MCSP Mozambique Program Brief

Addressing the Denominator Conundrum for Maternal and Child Health Programs: a New Methodology

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Context

Immunization coverage rates (the percentage of people who receive one or more vaccines in relation to the eligible population[i]) are important indicators of immunization program performance in the fight against vaccine-preventable diseases. Coverage rates provide insight into how well a health care system is functioning and can guide national immunization program decisions about service delivery strategy, supply chain management, program monitoring, and planning.[ii] Immunization coverage rates can be determined at various administrative levels (e.g., national, sub-national) and calculated using routine data reported by health facilities (i.e., administrative data) and from population-based surveys.[iii]

Decision-makers need accurate coverage rates to improve immunization program performance. When using administrative reports and national population estimates to calculate immunization coverage, the quality of data is a recognized concern. Both inaccurate numerators (errors in the numbers of women and children vaccinated) because of over- and under-reporting, and inaccurate denominators (estimated on the basis of outdated or incorrect population data) can produce inaccurate results, including coverage rates over 100 percent.[iv] Inaccurate coverage rates mislead program managers and health workers and cause them to make poor management decisions. The topic of this briefer—the "denominator conundrum" facing immunization program experts--is how to make sure that the population estimations used to calculate immunization coverage rates are as correct as possible.

Strengthened administrative data systems, as well as the use of periodic surveys or alternative data sources, can help with more accurate coverage rate estimation.[v,vi,vii,viii] The World Health Organization (WHO) guidelines for improving denominator accuracy recommend using the number of annual births from a national census or from newer sources such as civil registration.[ix] In the absence of accurate national census data, independent data sources and proxy indicators have been used to evaluate health program performance – most commonly at national level.[x,xi] More emphasis is needed on improving the accuracy of denominators (target population estimation) at *subnational* levels. Improved subnational denominator estimation would lead to more accurate coverage rates, which in turn would facilitate more targeted and effective program planning, implementation, and monitoring by those who manage and deliver immunization services.

In Mozambique, the Ministry of Health (MOH) has used one methodology since 1979 to estimate the size of target populations for all health programs, including immunization. Each year the MOH multiplies National Institute of Statistics (INE) population estimates (projected from the most recent census findings) by a uniform conversion factor across all provinces and districts to determine subnational-level denominators. Use of a single conversion factor assumes that annualized growth rates, in- and out-migration rates, and mortality rates are uniform within and among the provinces and districts. While this approach produces somewhat accurate population estimates at national level (i.e., aggregation at national level smooths out subnational differences), it fails to produce reliable estimates at subnational level because it overlooks the considerable variations in demographic change (e.g., births, deaths, migration) that affect provinces, districts, and

communities. This has implications at subnational level from a program planning perspective, since program managers may be basing subnational planning decisions on potentially too-high or too-low estimates of target populations. From an implementation perspective, supply chain challenges (e.g., forecasting vaccine needs and managing vaccine distribution at district level) may result in vaccine stock outs in some health facilities and over-supply in others. From a program monitoring perspective, data reporting and analysis challenges may arise, making the accurate assessment of program performance difficult. In all of these cases, "the denominator conundrum" (see box 1) negatively affects stakeholders' ability to forecast, understand, and address program needs.

Box 1. The current "denominator conundrum" in Mozambique

Case 1	$\frac{\text{\# children given measles vaccine}}{\text{inaccurately low target population size, estimated annually based on applying national conversion factor to INE census data}} \times 100\%$	At subnational levels, potential for under-planning, vaccine and other supply stock-outs, and reported coverage rates that are misleadingly high (possibly over 100%).
Case 2	$\frac{\text{\# children given measles vaccine}}{\text{inaccurately } \textit{high} \text{ target population size, estimated annually based on applying national conversion factor to INE census data}} \times 100\%$	At subnational levels, potential for over-planning, over-supply of vaccine and other supplies, and reported coverage rates that are misleadingly low.

In 2011, Mozambique's National Immunization Technical Advisory Group (NITAG) recommended that the MOH revise the method it was using to estimate subnational-level target populations. Although it took some time to gain traction, in 2016, the Maternal and Child Survival Program (MCSP) worked closely with the MOH Public Health Directorate (DNSP) and the INE to implement the NITAG's recommendation.

Program Approach

Getting the buy-in and approval of the MOH and its programs was an important first step in changing how the MOH estimates target populations at subnational level. In 2016, MCSP approached the DNSP to restart the conversation that the NITAG had started five years earlier. Having developed a clear roadmap for the initiative, the MOH appointed MCSP to lead the revision process, together with the INE and a focal person from the national immunization technical working group. Subsequent steps in the revision process were to:

- **Identify problems with the traditional method of estimating denominators and target populations**. Two key issues were identified: (1) uniformly applying one growth/migration/mortality rate (i.e., "change coefficient") based on 2007 census data across all provinces and districts, despite the knowledge that provinces/districts were not growing uniformly; and, (2) using the same change coefficient to estimate the population of children under one year of age and the populations over one year of age[1]. Since 2007, the MOH had used 3.9% as the annual population change coefficient for the under-one population, applying it uniformly at national and subnational levels. By default, this coefficient also was applied to estimate children over one year of age, because there was no specific coefficient for older age groups.
- **Develop a matrix for calculating province/district-appropriate coefficient estimates for all key target populations**. Rather than using the standard 3.9% change coefficient, the team used 2016/2017 population projections generated from 2007 census findings, disaggregated down to provincial and district levels (and in single age groups when needed using Beers procedures[xii]) to calculate more accurate change coefficients. A key assumption was that certain population dynamics (e.g., migration) had remained stable within provinces and districts since the time of the census. Revised change coefficients were calculated for each district by dividing the estimated target population (based on INE projections) by the total estimated population for the district (see table 1). New coefficients were then ready for use by district-level program managers and health workers to calculate more accurate target population estimates.
- **Test the validity of the new coefficients over time.** The final step involved comparing provincial- and district-level population projections for the period 2016 to 2020 (based on the 2007 census findings), and then calculating coefficients for each year using the corresponding numbers of live births. Results of the

[1] This second issue had the potential to further exacerbate inaccuracies in calculating target population size since children receive vaccination after age one and into adolescence. Change coefficients therefore should be calculated by age group as well as by province/district for the most accurate targeting.

test indicated that annual coefficients for each district/province varied little over the five-year period.[2] This means that district/provincial coefficients calculated using 2016/2017 data should be valid until new census data becomes available in 2018[3].

Results

- Table 1 shows the results when the new coefficients by district, instead of the 3.9% standard coefficient, were used to estimate target populations for immunization. For district A, the traditional 3.9% coefficient resulted in a target population of 8,135 children 0-11 months old, while the new district growth coefficient (2.6%) resulted in a more accurate target population of 5,354 children, or 2,781 fewer children. In district A's case, using the new method for calculating target population size would facilitate more accurate planning and forecasting to avoid potential oversupply of vaccines, vaccine stock and supply management, data interpretation, and program evaluation. In addition, the service delivery performance of health workers in district A would be more fairly judged using the new method. For example, vaccinating 5,000 eligible children would result in 93% coverage using the new district coefficients, whereas the coverage rate using the old method would be only 61%. Clearly, this would not only improve the accuracy of coverage estimates, but also help to improve staff morale and incentivize their continued performance as well as allocating appropriate staff across districts.

Table 1: Illustrative district-level 2017 target population estimates using new and old methodologies, 0-11 months of age group

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7
District	Total district population, 2016 (INE projection)	Estimated live birth population, 2017 (0-11 months, INE)	Change coefficient to be used in 2017, based on ***new*** methodology *(column 3/column 2)*	Change coefficient to be used in 2017, based on ***old*** methodology	Estimated population target in 2017 based on ***old*** methodology *(column 2 * column 5)*	Difference in 2017 target pop estimate using new method versus old method *(col 3-col 6)*
A	208,594	5,354	2.6%	3.9%	8,135	-2,781
B	122,269	4,701	3.8%	3.9%	4,768	-67
C	144,415	5,952	4.1%	3.9%	5,632	320
D	110,310	1,458	1.3%	3.9%	4,302	-2,844
E	214,522	8,821	4.1%	3.9%	8,366	455

- In May 2017, the national immunization technical working group presented the new methodology for estimating target populations to and it was endorsed by the NITAG. In early 2018, the methodology was presented to additional technical working groups at the DNSP's weekly meeting, where it was also endorsed for use by all reproductive, maternal and child health programs. Coefficients were then updated for all target groups. The next steps will be for the DNSP and the MOH Planning and Cooperation Directorate to agree to the new methodology and to present it for approval to the Minister of Health. If approved by the Minister, a national circular will be issued mandating that all health programs adopt the approach for use at subnational levels. After the 2017 census results become available, the methodology will be revalidated by the MOH with updated numbers from the census, but we expect the approach to remain the same.
- In 2018, after the DNSP endorsed the new methodology, the MOH asked MCSP to help in applying it during strategic planning for national human papillomavirus (HPV) vaccine introduction. MCSP calculated provincial-level coefficients for the 6-12 year-old age group and the target population sizes

[2] It is important to note that the test assumed stable population dynamics (including stable migratory patterns) within the provinces/districts between 2016 and 2020; coefficients would only be valid if these assumptions remained true.
[3] Mozambique conducted its most recent national census in 2017. Census results will be released at the end of 2018, after which new subnational-level coefficients will need to be calculated.

estimated with these coefficients were then used in program planning, including in costing the amount of HPV vaccine needed in each province.

- Based on the success achieved in Mozambique, in 2018, MCSP shared the new methodology with colleagues from Uganda, Tanzania, Kenya, Zimbabwe, Zambia, Ethiopia, and Madagascar. These teams took information about the new method to their government counterparts and began discussions about applying it to set immunization program targets in their own countries where the current methods may be inaccurate.

"Using the new coefficients improves planning of products, activities, program monitoring, and tracking immunization defaulters. It also decreases discrepancies between coverage rates calculated using routine data versus through surveys, for example, when the Demographic and Health Survey says the coverage rate of children completely vaccinated in Maputo City is 95% but the routine data says the coverage rate is 70%."
– Arlinda Ingomane, EPI Manager, Maputo City

Conclusions and Lessons Learned

- The denominator conundrum – particularly at subnational levels – is a recognized challenge for immunization (and other) programs around the world. Applying the methodology described here – across not only immunization but also other reproductive, maternal and child health and public health programs – is one way to achieve greater accuracy when estimating the size of a target population.
- Having MOH buy-in, support, and leadership for this process has been essential; it will continue to be critical in ensuring that the Minister of Health approves the new methodology for national adoption and regular updates of the estimates.
- The process related to changing any longstanding national methodology (especially when linked to government policy and census data) is a lengthy one that requires not only high-level advocacy and support, but also documented proof of effectiveness and persistence.
- Adoption of the revised methodology outlined in this brief is not a solution to all problems. A notable limitation is that subnational population estimates are often less reliable and more uncertain than national projections. This is due to the difficulties associated with projecting internal migration, an important component of subnational population change and other demographic characteristics that can vary by region.
- Nevertheless, this new methodology represents an important step toward improving the quality of Mozambique's subnational and national population estimates, its program targets, and the coverage indicators that are based on both. Improved population estimates should lead to more effective planning, forecasting, monitoring and evaluation, and to better health outcomes in the future.

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