Technology and digital health innovation
In collaboration with Sabin Vaccine Institute

GIS in microplanning

Geographic Information Systems (GIS) tools enhance immunisation programme delivery by improving data collection, management, analysis and visualisation. Digital maps reveal patterns in resource distribution, population density and immunisation coverage, enabling programme managers to optimise resource allocation for targeted and equitable vaccination efforts. Using GIS for microplanning increases the efficiency of identifying and reaching zero- dose children and underserved communities compared to traditional methods. Key advantages are listed below.

Using GIS in microplanning to reach zero-dose children

- Identify unreached areas
- Optimise campaign planning
- Track immunisation rates


Gavi/2020/Bangladesh polio campaign

Advantages of GIS in microplanning

Data visualisation

GIS visually represents geographic data and population density, enabling programme managers to understand immunisation coverage patterns and efficiently allocate vaccines and resources to areas in greatest need.

Spatial analysis

GIS analyses spatial patterns and socio-economic factors influencing vaccination rates, helping programme managers enhance immunisation planning and optimise service delivery strategies.

Monitoring and evaluation

GIS enables real-time tracking of vaccination efforts, allowing programme managers to quickly adjust strategies and respond to emerging challenges.

Country spotlights

In the Democratic Republic of the Congo, the Mashako Plan utilised GIS to increase immunisation coverage among zero-dose children during the post-COVID recovery. By integrating spatial and demographic data, teams used GIS to identify underserved communities and develop targeted outreach strategies. For example, the GRID3 Mapping for Health project utilised GIS technologies to create detailed catchment area maps of health facilities, population settlements and access routes, which directly informed vaccination logistics.

In Nigeria, a digital microplanning initiative used GIS to enhance immunisation services by collecting demographic and vaccination data, which was integrated into GIS platforms displaying health facilities, population clusters, transportation routes and geographic barriers. Health officials analysed vaccination gaps and logistical challenges to create tailored microplans for specific communities, ensuring strategic resource allocation. Engaging local leaders strengthened community buy-in for the plans, while real-time GIS monitoring enabled dynamic adjustments to campaigns.

When to use or not use GIS in microplanning

Do

- ✓ **Complex Regions** GIS is particularly beneficial in densely or sparsely populated and/or complex regions where traditional mapping techniques may fall short.
- ✓ **Strategic Planning** Use GIS when there is a need for in-depth spatial analysis for strategic planning and resource allocation.
- ✓ **Health Interventions** It's advantageous in planning, especially in emergency situations or outbreaks where time-sensitive data is crucial.

Don't

- ✕ **Limited Resources** In areas where there's a lack of technical capacity or reliable infrastructure to maintain and update GIS systems, traditional methods may be more feasible.
- ✕ **Simplistic Needs** If the microplanning objectives are straightforward and do not require geographic analysis, traditional methods might suffice.

Ask yourself

- [ ] What gaps do you aim to address, and can GIS help identify them?
- [ ] Can GIS integrate with existing health information systems?
- [ ] Which GIS tools best fit your needs?
- [ ] What cultural or logistical challenges may arise?
- [ ] What partnerships can you leverage?
- [ ] Are staff adequately trained to use GIS tools?

Types of GIS mapping applications for immunisation microplanning[1]

Implementation studies presented the use of a variety of GIS mapping approaches. Examples highlighting the diversity of GIS mapping use cases are described in the table below with a specific emphasis on geographic level and equity reference group settings.

GIS mapping intervention type	Examples	ERG setting
Vaccination coverage and population modelling	Data from Demographic and Health Surveys were aggregated to map spatial patterns of measles vaccination across ten African countries. Some highlighted cold spots were transnational: authors recommend collaboration to address coverage gaps.[2]	Regional
	DHS data were used to map coverage at a 1 km x 1 km resolution in Nigeria, Ethiopia, the Democratic Republic of Congo, Cambodia and Mozambique. The coverage of DTP3 and Meningococcal Conjugate Vaccine were compared as proxies for routine immunisation and supplementary immunisation activities, respectively.[3]	Regional
Identification of priority areas/barriers to vaccination	Geospatial analysis was used in India's National Family Health Surveys to map patterns in prevalence, distribution and drivers of zero-dose children over 24 years. Malnutrition, low socioeconomic status and urban or rural settings were strong predictors of zero-dose.[4]	National
	An ecological study in Ecuador combined data from a measles immunisation survey with recent census data and performed multiple spatial regression to assess a correlation between socioeconomic status and vaccination status.[5]	National
	Data from post-campaign coverage surveys produced maps comparing the effectiveness of specific immunisation campaigns and identified persistent cold spots in Nigeria. Authors recommend methodology as readily scalable for implementation in other low- and middle-income countries.[6]	National
	Using satellite imagery and vegetation growth as a proxy for habitation, researchers developed more accurate estimates of polio zero-dose children in Nigeria. Villages in Borno state were previously inaccessible due to conflict with Boko Haram.[7]	Sub-national (conflict-affected)
Session/vaccinator tracking	During polio SIAs in northern Nigeria, field teams carried GPS trackers overlaid on satellite imagery to identify commonly missed areas and allow for real-time monitoring. Aerial views of dense urban areas in Kano district improved the efficiency of vaccination teams.[8]	Sub-national (urban poor)
	For a polio vaccination campaign in Nigeria, GIS-based maps provided accurate and specific locations for hard-to-reach settlements and vaccination teams were monitored in real-time using GPS to ensure coverage.[9]	Subnational (remote rural)
Microplanning	Nomadic groups are often "invisible" to traditional DHS survey coverage. Geospatial sampling methods allowed researchers in Ethiopia to locate and survey the Nyangatom pastoralist community on core maternal and child health indicators, including vaccination status.[10]	Subnational (remote rural)
Geographic accessibility	A model was created to measure spatial access to COVID-19 vaccination centres in urban Mashhad, Iran. The mapping identified the periphery and poorer areas of the city as the most isolated from vaccination services.[11]	Sub-national (urban poor)

[1] https://zdlh.gavi.org/sites/default/files/2023-09/2_GIS%20Mapping_Evidence%20Brief.pdf
[2] https://www.nature.com/articles/ncomms15585
[3] https://www.nature.com/articles/s41467-019-09611-1
[4] https://www.thelancet.com/journals/langlo/article/PIIS2214-109X(21)00349-1/fulltext
[5] https://www.sciencedirect.com/science/article/pii/S0264410X183103
[6] https://pubmed.ncbi.nlm.nih.gov/32122718/
[7] https://pubmed.ncbi.nlm.nih.gov/31096971/
[8] https://pubmed.ncbi.nlm.nih.gov/25316882/
[9] https://pubmed.ncbi.nlm.nih.gov/25316823/
[10] doi: 10.4269/ajtmh.18-1009
[11] https://pubmed.ncbi.nlm.nih.gov/34530923/

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