Nutrition Surveillance and Fortified-Food Monitoring: Population Biomarkers and On-Site Quality Control

Accurate, timely subnational biomarker data are essential to target nutrition interventions, evaluate program impact, and guide policy decisions that increasingly intersect with infectious disease control and vaccine strategy. Yet many countries rely on infrequent, stand-alone household surveys conducted every 5-10 years, with samples often shipped to external laboratories. This approach limits geographic granularity, delays decision-making, constrains country ownership, and prevents timely adjustment of programs as micronutrient status changes.[1-3]

A growing body of global guidance and implementation experience supports shifting from episodic surveys toward routine nutrition surveillance embedded within existing health platforms. Leveraging remnant biological specimens collected through infectious-disease surveillance and other routine systems can substantially reduce cost while increasing data frequency and subnational resolution. Operationalizing this shift requires assays compatible with commonly available specimen types, particularly dried blood spots (DBS), and platforms capable of high-throughput, multiplex biomarker measurement. A central technical challenge remains reliable detection of low-concentration analytes such as vitamin B9 (folate) and vitamin B12, where assay sensitivity and analytical precision remain limiting factors in many current workflows.

Micronutrient biomarker surveillance (MNBi) solutions must also address biologic confounders, particularly inflammation, which can distort interpretation of iron and other micronutrient biomarkers. The BRINDA initiative has established adjustment frameworks that underscore the importance of pairing laboratory measurement with appropriate inflammation correction algorithms.[4-7] MNBi systems should integrate inflammation markers, validated correction algorithms, and alignment with existing national laboratory networks to support routine, policy-relevant subnational mapping and strengthen country capacity.

Fortified food monitoring represents a complementary and equally critical priority. Food fortification programs depend on regular quality control to ensure that micronutrient content meets standards and achieves intended public-health impact. Conventional laboratory confirmation can be slow and logistically complex, limiting the ability of mills and regulators to identify non-compliance and take timely corrective action. World Health Organization (WHO) and Food and Agriculture Organization (FAO) guidance emphasize the need for field-friendly, rapid testing approaches that enable quantitative or semi-quantitative assessment of micronutrient content directly within production and inspection workflows.[8] Rapid testing kits capable of delivering actionable on-site results for nutrients such as zinc, folic acid, or vitamin A can strengthen compliance and sustain program scale.

Across both surveillance and fortified-food monitoring, cost-disruptive innovation is central. Replacing infrequent national surveys with routine, surveillance-integrated biomarker measurement has the potential to improve timeliness and geographic resolution while reducing long-term system costs. Deployable, multiplex platforms and production-site rapid testing kits must be compatible with low-resource environments, require minimal cold-chain infrastructure, and support straightforward data capture for geospatial program targeting and regulatory decision making. Beyond incremental improvements to immunoassays and DBS-compatible workflows, transformative approaches may include integrated device architectures, computational inference models, or cross-sector sensing technologies, provided they meet defined performance, cost, and operational requirements for large-scale program use.

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