

Integrating Nutrition Diagnostics into Preventive Healthcare: A Framework for Holistic Patient Management in Developing and Developed Economies

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Abstract

Nutrition diagnostics is emerging as a key component of preventive care, enabling the early detection of nutritional risks and guiding targeted interventions that stem the burden of non-communicable disease (NCDs). In this article, an overall strategy for the integration of nutrition diagnostics as part of comprehensive patient care in developed and emerging economies is discussed. Drawing parallels with established models such as GLIM, NCP, and ESPEN guidelines, the paper suggests a tiered approach that includes community-based screening, confirmatory diagnostic testing, and integrated patient care. In high-income countries, nutrition diagnostics are assured by robust policies, insurance-covered reimbursement, and advanced laboratory technologies. Conversely, developing nations are facing challenges of constrained infrastructure, dearth of human resources, and limited funding but are progressing with scalable technologies such as point-of-care testing, key lists of diagnostics, and community health models. Comparative assessment recognizes convergences in the recognition of the international malnutrition burden and divergences in diagnostic capability, policy backing, and development of the workforce. The stated future directions outlined the roles to be played by artificial intelligence, precision medicine and mobile health in achieving enhanced access and global equity. The findings of this work once again underscore the non-negotiable nature of integrating nutrition diagnostics within preventive healthcare to achieve a holistic, cost-effective, and patient-focused care in diverse health systems.

I. INTRODUCTION

Nutrition plays a primary role in the prevention and management of non-communicable diseases, which have emerged as the major cause of morbidity and mortality worldwide. Unhealthy diet like low intake of fruits and vegetables, and high consumption of sodium, and processed food is the main contributor to death and disability-adjusted life among populations (Afshin et al., 2019).

Historically, healthcare systems have focused more on curing apparent disease and less on the early detection of nutritional risk. However, emerging evidence suggests the need for moving nutrition assessment to the realm of prevention. Malnutrition in both its under-nutrition and over-nutrition manifestations is a risk for infection, hospital-acquired complications, and the development of non-communicable disease (NCDs) (Jensen et al., 2013).

Through the inclusion of nutrition diagnostics in preventive care, systems are able to capture risks at an early stage, guide personalized interventions, and enable

extensive patient management. This goes a long way to close the loop between population monitoring of nutrition and individualized care so that interventions, which reduce healthcare costs and improve long-term health outcomes, become a reality.

II. NUTRITION DIAGNOSTICS

Nutrition diagnostics can be defined as the systematic identification of nutritional problems and risks by using a mix of screening instruments, biochemical and anthropometric measurements, and standardized diagnostic criteria. Unlike nutrition screening, which identifies individuals at risk, diagnostics confirm the presence and degree of malnutrition or imbalances of nutrients (Cederholm et al., 2019).

➤ *Frameworks That Guides Clinical Practice:*

- *GLIM (Global Leadership Initiative on Malnutrition):*
Provides consensus diagnostic criteria for malnutrition by combining phenotypic measures (weight loss, BMI,

muscle mass) with etiologic components (disease burden, inflammation, low intake) (Cederholm et al., 2019).

- *Nutrition Care Process (NCP):*

This was developed by the Academy of Nutrition and Dietetics, NCP applies a formal diagnostic language (the PES statement: Problem, Etiology, Symptoms) to standardize care workflow nutrition diagnosis (Academy of Nutrition and Dietetics, 2019).

- *ESPEN Terminology and Guidelines:*

ESPEN provides definitions and field-tested advice to harmonize clinical nutrition terminology and facilitate harmonization across healthcare environments (Cederholm et al., 2017).

Biochemical testing further refines this discipline, employing markers such as ferritin (to measure iron status) and vitamin D, B12, or folate levels to enhance diagnosis (World Health Organization, 2020). Such quantitative tests are in line with clinical nutrition pathways and are a key tool of both developing and developed economies.

Thus, nutrition diagnostics is the bridge from risk screening to treatment intervention, guaranteeing not only patients early detection but also into targeted, evidence-supported care plans.

III. INTEGRATING NUTRITION DIAGNOSTICS INTO PREVENTIVE HEALTHCARE SYSTEMS

The integration of nutrition diagnosis into prevention care includes the integration of diagnostic processes at all levels of the health system, ranging from population-based screening to the tertiary level of care. In practice, this includes linking the identification of nutritional risk with therapies aimed at addressing the underlying dietary and metabolic causes before disease onset.

In clinical treatment protocols, nutrition diagnosis could be seated alongside vital signs and routine laboratory tests. For example, the NRS-2002 screening tool is recommended to be utilized in hospitals to screen at-risk patients, which in turn triggers subsequent diagnostic confirmation using GLIM criteria or biochemical markers (Kondrup et al., 2003). Similarly, the Subjective Global Assessment (SGA) and Patient-Generated SGA offer evidence-based instruments to extend beyond screening and obtain a comprehensive picture of patient nutrition status (Ottery F. D., 1996).

Integration is also interdisciplinary. Dietitians and nutritionists interpret anthropometric and dietary data, physicians order and interpret laboratory-based diagnostics, and laboratory scientists track test quality. Policymakers construct guidelines and reimbursement systems, such as those in NICE CG32 within the UK, mandating routine screening and support for patients at risk (NICE, 2006).

Thus nutrition diagnostics serve as the gateway to preventive care: helping to identify risks early, confirming them with standardized measures, and engaging patients in nutrition-sensitive interventions.

IV. FRAMEWORK FOR HOLISTIC PATIENT CARE

Holistic patient care involves a framework that integrates diagnostics as part of an interconnected system of care addressing screening, confirmatory testing, intervention, and follow-up. This ensures that nutrition is not marginalized but as a central determinant of health. The model can be described in three tiers:

- *Screening Tier (Primary Prevention):*

Inexpensive tools such as BMI, MUAC (mid-upper arm circumference), and NRS-2002 are used at initial contact (e.g., primary care or community clinics) to designate risk (Kondrup et al., 2003).

- *Diagnostic Level (Secondary Prevention):*

Confirmatory assessments are performed following positive screenings. Examples include GLIM criteria, SGA/PG-SGA, and biochemical assessments such as ferritin, hemoglobin, vitamin D, and B12 tests (World Health Organization, 2020).

- *Integrated Management Level (Tertiary Prevention):*

Diagnostic results guide tailored interventions here. For instance, ESPEN and ASPEN hospital guidelines ensure that malnutrition diagnosis is promptly converted into customized care plans that reduce hospital complications and stay (McClave et al., 2016; Weimann et al., 2017).

The model introduces a new axis of digital health integration. Electronic health records, mobile health apps, and AI-supported decision-support systems can integrate screening and diagnostics, with patient information informing tailored nutrition advice (Jensen et al., 2013).

By connecting diagnostics and prevention to treatment, this model repositions nutrition from ancillary service to primary clinical determinant of patient outcomes, thereby achieving comprehensive care.

V. APPLICATIONS IN DEVELOPED ECONOMIES

In the developed world, nutrition diagnosis has become part of both hospital-based practice and primary care systems. Hospitals use standardized diagnostic systems like GLIM criteria and SGA so that early identification and management of malnutrition are possible, particularly in the elderly and those with chronic conditions (Cederholm et al., 2019).

For example, in the UK, the NICE CG32 guideline demands admission nutrition screening for all hospitalized patients and requires nutrition support plans for patients

found at risk of under-nutrition or overfeeding (NICE, 2006). In the US and parts of Europe, professional societies like ASPEN and ESPEN provide comprehensive disease-specific guidelines, which link diagnostics to intervention routes (McClave et al., 2016).

Advanced diagnostic tools are also evidenced through the availability of biochemical markers. Blood tests for ferritin, vitamin D, and B12 are common, often insured and part of prevention packages (Volkert et al., 2022). Moreover, electronic health records in Denmark and the US increasingly reflect nutrition screening results with patient data, allowing for predictive analysis and tailored nutrition (Jensen et al., 2013).

Thus, in high-income economies, nutrition diagnostics become standard-of-care tools that support evidence-based interventions, reduce healthcare costs by preventing complications, and fit into broader preventive healthcare paradigms.

VI. APPLICATIONS IN DEVELOPING ECONOMIES

In contrast to the developed economies, the majority of developing economies or third world countries suffer from shortages of infrastructure, cost, and man-power, and cannot deploy these advanced diagnostics widely. Malnutrition, particularly micronutrient deficiencies and protein-energy under-nutrition is highly prevalent, while diagnostic coverage is uneven favoring the higher class.

In response to this, the WHO Model List of Essential in Vitro Diagnostics (MEDEVIS) provides guidance on the prioritization of low-cost, high-impact nutrition tests such as hemoglobin, ferritin, vitamin D, and folate at different levels of the health system (World Health Organization, 2023). Similarly, India's National Essential Diagnostics List (NEDL) makes this principle a reality by assigning some nutrition-related diagnostic tests to village clinics, district hospitals, and tertiary centers (Ministry of Health & Family Welfare, India, 2019).

In the majority of Low-and-Middle Income Countries (LMIC) environments, point-of-care (POC) testing is emerging as an economies-of-scale response. Handheld hemoglobinometers, rapid ferritin tests, and anthropometric measurements in the community (BMI, MUAC) offer a cost-effective diagnostic route that can be integrated into preventive healthcare campaigns. All these advances complement WHO's global plan to facilitate equity of access to diagnostics (World Health Organization, 2020).

Nevertheless, there are challenges: low capacity in the laboratory, poor knowledge among health workers, and ineffective financing channels hinder uptake. Differently from developed economies, where reimbursement policy facilitates utilization of tests, LMICs work from donor-funded programs, which could be unstable.

Despite these challenges, integration of nutrition diagnostics within primary care is a prime possibility. The availability of low-cost diagnostics not only offers a solution for malnutrition but also defies the rising burden of diet-related non-communicable diseases, which are rising rapidly in emerging economies (GBD 2019 Risk Factors Collaborators, 2020).

VII. COMPARATIVE ANALYSIS: DEVELOPED VS. DEVELOPING ECONOMIES

While comparing the incorporation of nutrition diagnostics in developing and emerging nations, a pattern of converging priorities yet diverging realities is revealed.

➤ *Convergences:*

They both recognize diet-related non-communicable disease and malnutrition as important health priorities. Unsatisfactory diets are equally high in their effect by region, the Global Burden of Disease (GBD) research putting nutrition-related risk at the forefront of the list of major causes of global morbidity and mortality (GBD 2019 Risk Factors Collaborators, 2020). Also, clinical models such as GLIM are globally accepted as enabling consistency of malnutrition diagnosis no matter the location (Cederholm et al., 2019).

➤ *Divergences:*

• *Diagnostic Infrastructure:*

Advanced economies apply high-tech laboratory tests (ferritin, vitamin D, B12, DEXA muscle mass) as routine practice (Volkert et al., 2022), while developing economies apply anthropometry and point-of-care hemoglobin testing due to a lack of resources (World Health Organization, 2023).

• *Policy Support:*

The first world countries have effective policy formulation and implementation mechanisms to ensure effective nutrition diagnosis in preventive medicine. The third world countries on the other hand, conversely depend more on international and national essential lists of diagnostics to determine cost-effective testing.

• *Human Resources:*

Developed economies generally have an organized pool of dietitians and clinical nutritionists, while most LMICs have acute shortages, which results in underutilization even of simple diagnostic equipment.

➤ *Lessons & Cross-Learning:*

LMICs can leverage scalable Health Information Communication (HIC) solutions, such as digital health platforms to conduct remote screening, whereas high-income economies can learn from LMIC community-based diagnostic systems that focus on cost savings and access. The cross-exchange testimony bears the stamp of the universality of nutrition diagnostics in preventive healthcare.

VIII. POLICY AND IMPLEMENTATION PATHWAYS

In order for nutrition diagnostics to be meaningfully integrated into preventive healthcare, robust policy frameworks and implementation strategies will have to be put in place.

➤ *National Guidelines and Mandations:*

Guidelines like the UK NICE CG32 show how guidelines mandated by the government can integrate nutrition diagnostics into normal healthcare delivery (NICE, 2006). Such policies in LMICs would make nutrition screening and diagnostics obligatory on the primary healthcare level, with provisions for referral in more complicated cases.

➤ *Indispensable Diagnostics Lists:*

The use of such tools as WHO's MEDEVIS and national adaptations such as India's NEDL promotes equity by instituting minimal diagnostic standards for all levels of the health system (World Health Organization, 2023; Ministry of Health & Family Welfare, India, 2019).

➤ *Establishing Capacities:*

Implementation entails the capacity building of health care professionals with regard to utilizing standard diagnostic tools such as NRS-2002, SGA, and GLIM (Kondrup et al., 2003). Integrating nutrition-focused training into medical and nursing school curricula can enhance this capacity.

➤ *Reimbursement and Financing:*

In affluent economies, diagnostic testing is typically covered under insurance schemes, which creates a financial incentive to make them part of the services. For LMICs, government subsidies, donor partnerships, and covering primary care nutrition tests under universal health coverage packages may be required.

➤ *Public-Private Partnerships:*

Public-private partnerships among governments, NGOs, and diagnostic companies can reduce the price of test kits, expand access to point-of-care testing, and stimulate innovations in portable devices.

➤ *Monitoring and Evaluation:*

Normalized data collection through electronic health platforms can track uptake of diagnostics, monitor population-level malnutrition, and guide preventive healthcare programs (Jensen et al., 2013).

In total, policy intervention needs to place nutrition diagnostics as a not-an-add-on but as a core preventive healthcare service that informs and enhances comprehensive patient management.

IX. FUTURE DIRECTIONS AND INNOVATIONS

The future of nutrition diagnosis is where technology, personalized care, and global equity converge. A number of innovations are transforming how nutrition is measured and controlled:

➤ *Artificial Intelligence (AI) and Predictive Diagnostics:*

AI-driven tools are being developed to analyze diet intake information, laboratory tests, and anthropometric parameters, developing predictive models of nutritional risk. These systems may be integrated with electronic health records to warn patients before developing malnutrition or diet-associated illness (Jensen et al., 2013).

➤ *The Personalized Nutrition and Precision Medicine:*

Genomics and metabolomics enable highly personalized nutrition diagnostics, which can be used to intervene in metabolic disease, obesity, and micronutrient deficiency. This is presently centered in developed economies, but simplified versions may eventually reach LMICs.

➤ *Digital Health Integration:*

mHealth platforms which leverage on mobile technology to improve healthcare delivery, allows patients to test themselves using simplified tools (symptom questionnaires, BMI measurement calculators) and can link directly with healthcare providers. This bridges primary care gaps, especially in resource-scarce settings.

➤ *Portable and Point-of-Care Devices:*

Technical advancements in non-invasive hemoglobin meters, point-of-care ferritin tests, and portable body composition scanners are decreasing costs and enhancing access for nutrition diagnosis in hospitals and community health centers (World Health Organization, 2023).

➤ *Global Health Equity Lens:*

Growth in the future will depend on ensuring these innovations are equitably distributed and not add to the gap between developing and developed economies. Rolling out innovations in WHO's Essential Diagnostics pathway will be critical in making it scale and sustainable (World Health Organization, 2023).

Together, these innovations signal a shift from reactive diagnosis of malnutrition towards preventive, proactive nutrition diagnostics that can be used everywhere.

X. CONCLUSION

Nutrition diagnosis is a groundbreaking option for care consolidation of preventive healthcare and patient wholistic management. By separating from mere screening to systematic diagnostic systems, healthcare systems can identify nutritional risk earlier, confirm it using valid measures, and develop evidence-based interventions to reduce disease burden and costs.

In the advanced economies, integration is already far advanced, supported by strong policy imperatives (e.g., NICE, ASPEN, ESPEN), sophisticated diagnostic infrastructures, and digital health technology. In the developing economies, there are resource and infrastructure limitations but moving along required diagnostics lists (WHO MEDEVIS, India's NEDL) and scalable point-of-care solutions.

Since malnutrition and diet-related illness are still top causes of global health loss (GBD 2019 Risk Factors Collaborators, 2020), nutrition diagnostics are no longer a choice but a must. Their integration across contexts will allow healthcare systems to provide holistic, preventive, and patient-centered care, filling the gap between nutrition and medicine for both developing and developed economies.

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