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Unified definition of integrated diagnostics: a position statement of the EFLM

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Abstract: Integrated diagnostics is an emerging multidisciplinary model of care that integrates traditionally siloed domains, including pathology, radiology, genomics, and laboratory medicine, into a coordinated framework designed to improve diagnostic accuracy, treatment selection, and clinical outcomes. In this position statement, the EFLM *Integrated Diagnostics Committee* proposes a concise and operational definition of integrated diagnostics and outlines the relevance for healthcare systems. Integrated diagnostics has the potential to advance precision medicine through improved data integration, more coordinated interpretation, and enhanced clinical decision-making. Drawing on multidisciplinary expert consensus, we recommend adoption of a

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standardized conceptual framework to support research, clinical implementation, interoperability, and policy development across healthcare systems with implementation adapted to local needs, scale, and digital maturity.

Keywords: biomarker; radiology; definition; integrated diagnostics

Introduction

Integrated diagnostics is increasingly recognized as a critical enabler of precision medicine [1]. By fostering collaboration between laboratory medicine specialists, radiologists, microbiologists and virologists, pathologists (including anatomic, surgical, clinical and cytopathology), human geneticists as well as bioinformaticians and other healthcare professionals, it enables the collaborative integration and interpretation of diverse diagnostic data, including imaging, molecular biomarkers, and clinical laboratory findings [2].

Despite its growing recognition [3], a universally accepted definition of integrated diagnostics remains lacking, thereby limiting efforts to standardize its implementation, evaluate its impact, and ensure consistent adoption across healthcare systems.

In this position statement, the *Integrated Diagnostics Committee* from the EFLM (European Federation for Laboratory Medicine) proposes a precise and operational definition of integrated diagnostics (and related terms), informed by multidisciplinary diagnostic expertise and grounded in practical considerations relevant to clinical implementation, research, and policy development. According to this definition, *integrated diagnostics* delineates the output of analytical results and interpretations communicated to the clinician as a combined diagnostic state or product in an interdisciplinary fashion. By contrast, *integrative diagnostics* denotes the process through which diagnostic disciplines, data sources, workflows, and expertise are coordinated and synthesized in response to a clinical question. Thus, *integrative diagnostics* describes the process, whereas *integrated diagnostics* describes the resulting state or output. This distinction may help clarify related terminology in the field (Table 1).

At a time of increasing data complexity, workforce constraints, and growing demand for value-based care, integrated diagnostics is becoming a strategic necessity rather than an optional innovation. Its historical evolution and the accelerating scientific attention to the field further underscore the timeliness of a unified definitional framework (Figure 1) [4–8].

Towards a definition

Integrated diagnostics is a patient-centered, multidisciplinary approach that combines and synthesizes data from imaging, laboratory medicine, microbiology, pathology, genomics and other relevant diagnostic domains. This coordinated integration transforms discipline-specific findings into a clinically meaningful multidisciplinary assessment that supports better stratification of the decision-making processes across the care pathway [9] by improving the precision, timeliness, and actionability of diagnostic information.

Conceptually, *integrated diagnostics* is defined by four interrelated features. First, it requires the integration of diverse diagnostic data into cohesive and clinically meaningful reports rather than isolated discipline-specific outputs. Second, it depends on structured and continuous communication among diagnostic specialists to enable comprehensive interpretation, harmonized recommendations, and the formulation of staged, integrated diagnostic algorithms designed to account for the findings and expertise of the various disciplines involved. Third, diagnostic findings should be aligned with patient management pathways, therapeutic planning, and longitudinal care decisions. Fourth, integrated diagnostics is supported by advanced informatics capabilities, including interoperable digital infrastructure, artificial intelligence, and data analytics, that enable complex datasets to be translated into actionable insights.

Together, these features distinguish integrated diagnostics from conventional models in which diagnostic disciplines operate sequentially or in parallel but remain only loosely integrated.

Rationale for a unified definition

A standardized definition of integrated diagnostics is necessary to address several persistent barriers to implementation. First, it establishes consistent terminology and shared conceptual boundaries across healthcare systems, thereby improving communication among stakeholders working within multidisciplinary care models, including across laboratory and imaging services spanning both centralized facilities and decentralized, near-patient modalities such as point-of-care testing (POCT) and point-of-care ultrasound (POCUS). In oncology, the value of harmonized reporting frameworks has already been demonstrated [10]. Second, a unified definition enables more rigorous evaluation of clinical utility, operational performance, and health-economic outcomes. Third, it provides an essential foundation for the development

Table 1: Definitions based on the integration perspective.

Integration perspective	Definition	Rationale
Logistics	Integration of various diagnostic services and processes to ensure efficient and coordinated diagnostic workflows	Efficient diagnostic workflows depend on the integration of services and processes to avoid delays and redundancies, ensuring streamlined patient care pathways
Operational	Coordination and harmonization of diagnostic tests, technologies, and resources across different departments or facilities within a healthcare system	Harmonizing diagnostic tests, technologies, and resources promotes consistency, reduces variability, increases the cost-effectiveness, and enhances the overall quality of diagnostics
Integrative vs. integrated	**Integrative diagnostics** refers to the dynamic process of combining data, expertise, methods, and workflows across diagnostic disciplines **Integrated diagnostics** refers to the resulting synthesized diagnostic output, recommendation, or achieved diagnostic state generated through that process	Distinguishing process from product can improve conceptual clarity, reduce inconsistent terminology, and support more precise communication in clinical, academic, and operational contexts
Radiological	Collaborative approach involving radiologists, pathologists, and other specialists to obtain a comprehensive diagnostic evaluation using imaging techniques	Collaborating with radiologists and integrating imaging techniques provide critical insights for comprehensive diagnostic evaluations
Pathological	Integration of clinical information, imaging data, and laboratory findings obtained from biological samples to provide accurate and comprehensive diagnoses	Incorporating clinical, imaging, and laboratory findings ensures a detailed understanding of disease mechanisms, leading to precise and actionable diagnoses
Physician	Collaborative use of patient history, clinical investigation, and multiple diagnostic modalities and expertise to guide patient management and treatment decisions	Collaborative decision-making using multiple diagnostic modalities helps tailor treatment plans to individual needs.
Lab medicine	Integration of laboratory testing, including molecular diagnostics, with clinical information to support patient care and disease management.	Laboratory integration aligns test results with clinical contexts, ensuring relevant and timely insights for disease management
Administrative	Coordinated planning, resource allocation, and workflow management across diagnostic departments to optimize efficiency and quality of care	Effective planning and resource allocation optimize efficiency and enable better quality care within resource constraints
Payor	Utilization of integrated diagnostic services to improve cost-effectiveness, reduce duplicate testing, and enhance patient outcomes	Integrated diagnostics reduces unnecessary tests and costs by promoting efficiency and aligning diagnostic efforts with clinical outcomes
Patient	Comprehensive diagnostic evaluation that incorporates interview, clinical investigation, multiple tests and specialties to obtain a timely and accurate diagnosis, leading to improved treatment decisions	A comprehensive approach incorporating multiple specialties and tests ensures timely and accurate diagnoses, contributing to improved treatment outcomes
Healthcare systems	Organizational integration of diagnostic services within a healthcare system, enabling seamless information sharing and coordinated patient care	Organizational integration enables seamless information sharing and coordinated care, reducing fragmentation and improving system-wide efficiency
Interdisciplinary	Synergistic collaboration and integration of knowledge, expertise, and technologies from various disciplines, such as radiology, pathology, laboratory medicine, and clinical specialties, to provide a holistic approach in diagnostics. This approach aims to leverage the strengths of each discipline and enhance the accuracy, efficiency, and patient-centeredness of the diagnostic process	Collaborative integration of expertise across various disciplines enhances diagnostic accuracy, fosters innovation, and supports patient-centered models.
Data space	A secure federated ecosystems with semantically interoperable data with a clear governance framework	Integration of data from different disciplines and health institutions ensures optimal use of clinical and diagnostic data
Data science	Utilization of advanced analytics, machine learning, and data integration techniques to extract insights from diverse diagnostic datasets, enabling predictive modeling, precision medicine, and enhanced diagnostic decision support	Advanced data integration and analytics empower predictive modeling, precision medicine, and improved diagnostic decision-making and tailored treatment
Pharmacy	Integration of diagnostic information with pharmaceutical knowledge and patient-specific factors to optimize medication selection, dosing, and therapy monitoring, ensuring safe and effective pharmacotherapy	Integration of clinical and genetic information and diagnostic test results with pharmacological expertise ensures accurate medication selection, dosing, and monitoring, improving therapeutic safety and effectiveness
Billing and revenue cycle management	Integration of diagnostic coding, documentation, and reimbursement processes to ensure accurate and timely billing, claim submission, and revenue capture for diagnostic services rendered, while adhering to regulatory and compliance requirements	Integrated billing processes ensure accurate documentation, reduce delays, and align financial processes with diagnostic services, supporting regulatory compliance

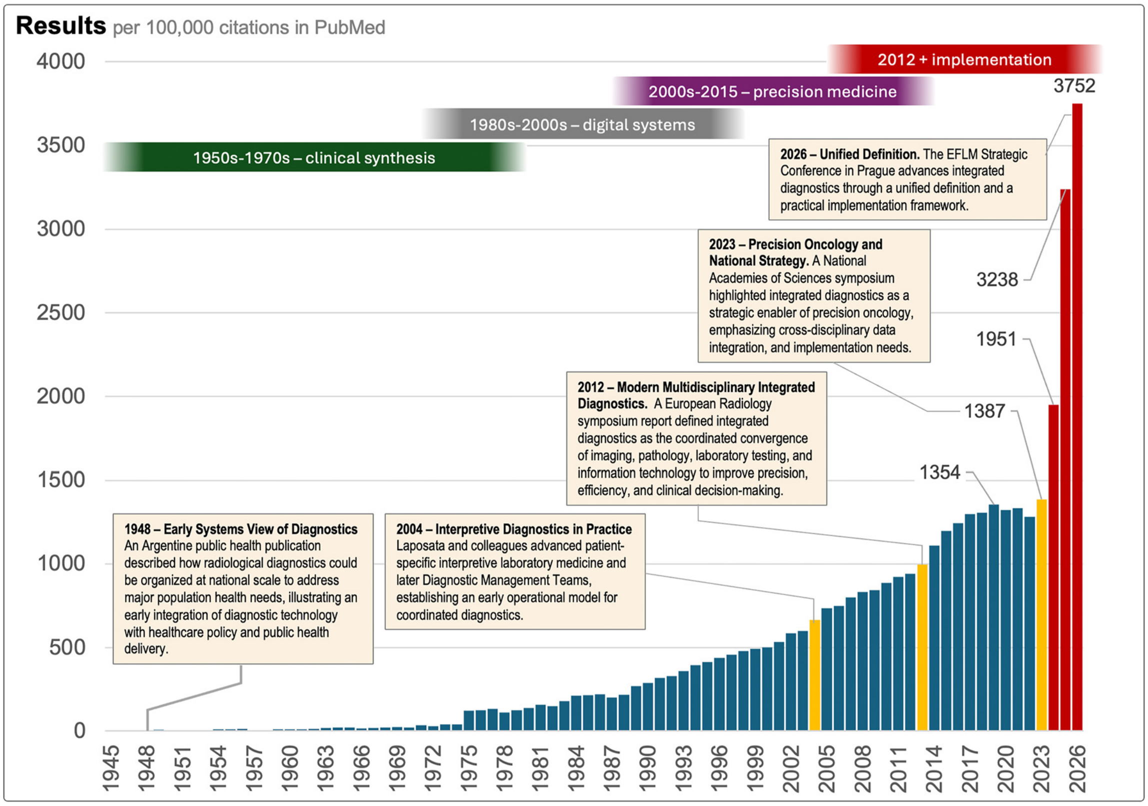

Figure 1: Historical evolution and growing scientific attention to integrated diagnostics. Annual PubMed search results illustrate the marked rise in publications related to integrated diagnostics and associated concepts over time, with rapid growth in recent years. The timeline highlights selected milestones in the evolution of the field, including early systems-based diagnostic thinking (1948) [4], interpretive laboratory medicine and Diagnostic Management Teams (2004) [6], formal multidisciplinary definitions integrating pathology, radiology, laboratory testing, and information technology (2012) [5, 8], strategic recognition in precision oncology (2023) [7], and the 2026 EFLM initiative to establish a unified definition and practical implementation framework (here). Together, these trends suggest growing scientific, clinical, and policy momentum toward integrated diagnostics.

of regulatory and reimbursement frameworks that appropriately recognize integrated diagnostic services. Value-based laboratory medicine frameworks have further emphasized the need for measurable performance indicators that extend beyond analytical quality to clinical impact, operational effectiveness, and stakeholder value [11, 12]. Similar principles are likely to become increasingly relevant for integrated diagnostics.

Modern disease classification systems also illustrate integrated diagnostics from a different vantage point. Frameworks such as contemporary *WHO Tumour Classifications* and aligned coding systems are often perceived simply as fixed standards for routine use; however, they are themselves created through the structured synthesis of pathology, molecular findings, imaging features, clinical behavior, epidemiology, and therapeutic relevance. In this sense, they serve not only as classification tools, but also as mature examples of how multidisciplinary evidence can be integrated into clinically actionable diagnostic frameworks [13, 14].

Importantly, integrated diagnostics does not imply *temporal synchrony* across modalities, which in practice remain sequential, but rather meaningful data integration across timepoints and sources to support clinical decision-making. This requires robust and scalable digital infrastructure capable of aggregating and harmonizing multimodal data across institutional boundaries, supported by substantial investment in information technology, computational capacity, and specialized human expertise. As such, data integration represents a foundational prerequisite for implementation, with implications for capital and operational expenditure, workforce development, and data governance, with the magnitude of these investments scaling directly with the scope, complexity, and degree of interoperability of the systems involved.

As value-based care becomes increasingly embedded within healthcare delivery and payer strategies, the ability to clearly define and measure integrated diagnostics becomes progressively more important. Clear terminology is required not only for scientific discourse, but also for commissioning, reimbursement, benchmarking, and accountability. More fundamentally, integrated diagnostics reflects a shift from procedure-centered to value-driven diagnostic paradigms, where the primary measure of success is not technical execution but demonstrable impact on patient outcomes and clinical decision-making. This conceptual transition, including the hierarchy of outcomes and the enabling role of digital infrastructure, is summarized in Figure 2.

From a policy perspective, multidisciplinary models of diagnostics require equally multidisciplinary governance frameworks. A precise and coherent definition is therefore a prerequisite for sustainable implementation at scale.

Dimensions of integrated diagnostics

Building on evidence from the published literature and multidisciplinary expert consensus, the EFLM Committee identifies several core dimensions of integrated diagnostics. These dimensions reflect the operational characteristics required for effective implementation across healthcare systems.

A first dimension is diagnostic modality integration, defined as the coordinated and, where feasible, real-time synthesis of information derived from multiple diagnostic domains [15, 16]. These may include *in vivo* diagnostic disciplines such as radiology and nuclear medicine, as well as *in vitro* diagnostics disciplines including pathology, laboratory medicine, clinical chemistry, hematology, microbiology/virology, immunology, and human genetics. Across these disciplines, advanced analytical and computational technologies – including genomics, proteomics, other -omics approaches, molecular diagnostics, and bioinformatics – increasingly contribute to the generation, interpretation, and integration of diagnostic information.

A second dimension is data interoperability, which enables the seamless exchange, aggregation, and interpretation of information across platforms and institutions. This

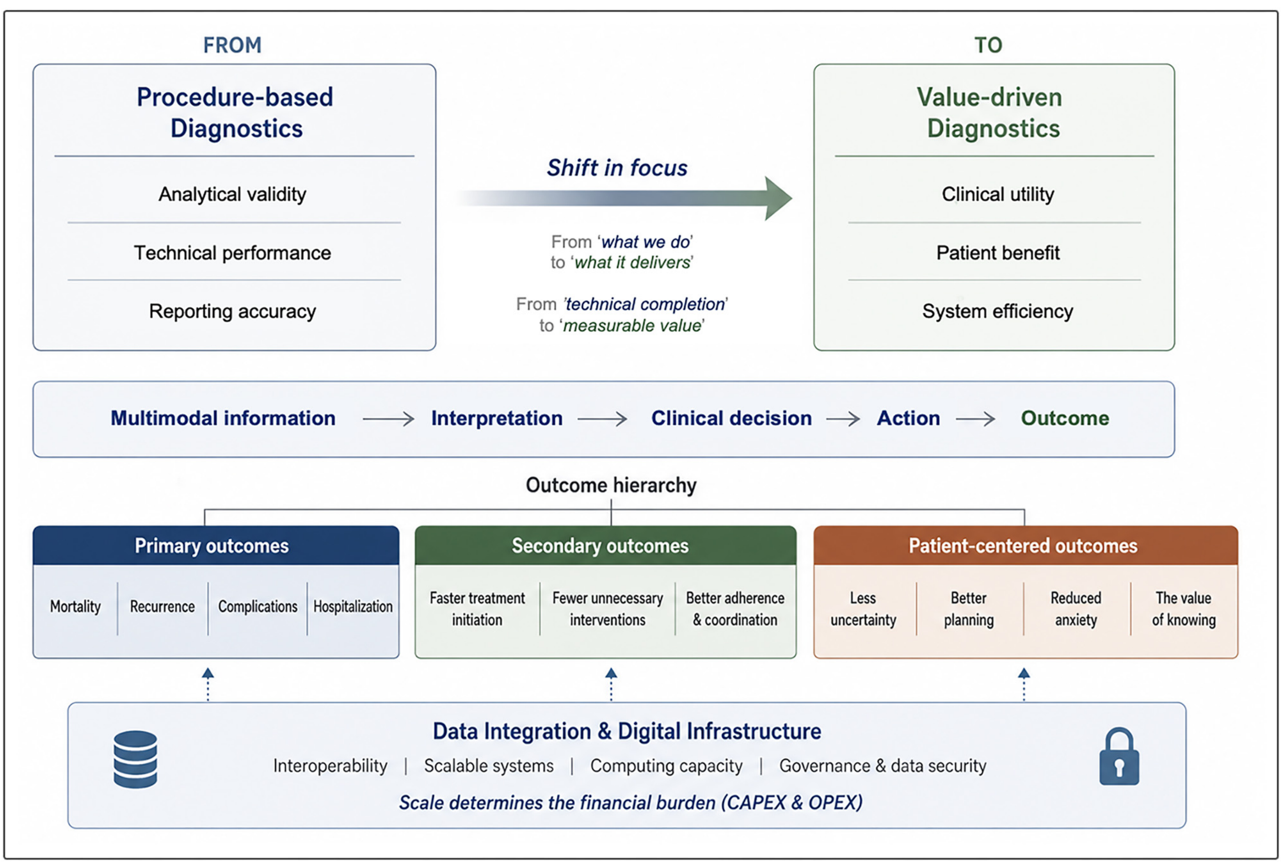

Figure 2: From procedure-based to value-driven diagnostics. Traditional diagnostic models primarily emphasize analytical validity, technical performance, and reporting accuracy. In contrast, integrated diagnostics focuses on the translation of multimodal information into clinical decisions and measurable value. This value may be measured across a hierarchy of outcomes, including primary clinical endpoints, secondary care-process outcomes, and patient-centered benefits. Effective implementation depends on scalable digital infrastructure and interoperable data integration, with associated capital expenditure (CAPEX) and operational expenditure (OPEX) increasing according to the scale, complexity, and degree of interoperability of deployment.

requires standardized data models, shared terminology [17], and interoperable informatics infrastructure.

A third dimension is multidisciplinary decision-making, supported through structured collaboration among diagnostic specialists and treating clinicians. Contemporary examples include integrated tumor boards, cross-disciplinary consultations, and coordinated review pathways embedded in routine clinical practice [18].

A fourth dimension is patient-centered reporting [19], which emphasizes unified diagnostic outputs that synthesize findings across disciplines and communicate clinically actionable insights in a clear, timely, and relevant format.

Together, these dimensions provide a practical foundation for the implementation of integrated diagnostics (Table 2). Because integrated diagnostics has both scientific and operational dimensions, the EFLM Committee proposes complementary conceptual and functional definitions. Together, these definitions capture both the purpose of integrated diagnostics and the mechanisms required for implementation.

Table 1 summarizes the diverse domains and viewpoints encompassed by the term integrated diagnostics.

The promise

Integrated diagnostics has the potential to reshape healthcare delivery by bridging traditionally siloed diagnostic disciplines and enabling more coordinated models of care [20]. By integrating and interpreting diverse data sources, it may improve diagnostic accuracy, reduce variability in clinical assessments, and support more consistent decision-making.

Integrated diagnostics may also strengthen precision medicine by enabling more refined patient stratification and supporting biomarker-informed therapeutic selection [21], and dynamic treatment adaptation in oncology [22] – particularly in oncology care pathways [23]. In parallel, streamlined workflows and coordinated diagnostic pathways may reduce unnecessary duplication, shorten time to diagnosis, and improve operational efficiency [20, 23]. In practice, integrated diagnostic pathways have also been associated with accelerated treatment initiation, fewer repeat visits, and downstream savings through earlier and more coordinated decision-making. This collaborative model also fosters cross-disciplinary interaction, encouraging a more holistic view of the patient beyond the perspective of any single specialty.

Ultimately, the principal promise of integrated diagnostics lies in its capacity to deliver timely, accurate, and clinically actionable information that improves therapeutic decision-making and patient outcomes (Figure 3).

Table 2: Proposed definitions.

Conceptual definition – Integrated diagnostics
Integrated diagnostics is a patient-centered, multidisciplinary diagnostic state or output that results from the synthesis of data, expertise, and findings across pathology, laboratory medicine, imaging, genomics, and clinical domains to improve the precision, timeliness, and actionability of diagnostic decision-making
Functional definition – Integrative diagnostics
Integrative diagnostics is the coordinated process through which relevant diagnostic information, together with the associated clinical, informatic, operational, and administrative components, are aligned along a patient journey to enable efficient, timely, and actionable care decisions. For clarity, the Committee uses "integrative diagnostics" when referring to the process of multidisciplinary coordination and "integrated diagnostics" when referring to the resulting diagnostic product, recommendation, or state

Outlook and recommendations for implementation

Successful implementation of integrated diagnostics will require coordinated action across professional, institutional, technical, and policy domains. Based on multidisciplinary expert consensus, the EFLM Committee identifies several priority areas for implementation.

(1) **Unified framework:** Healthcare institutions should align around a shared definition, common terminology, and core principles of integrated diagnostics to ensure consistency across disciplines, institutions, and care pathways.
(2) **Education and workforce development:** Targeted educational programs should prepare laboratory professionals, radiologists, pathologists, clinicians, and data scientists to work effectively within multidisciplinary diagnostic models, recognizing that implementation pathways and team structures differ across healthcare systems.
(3) **Digital infrastructure and interoperability:** Sustained investment is required in information systems that enable secure and structured data exchange, semantic interoperability, and deployment of advanced analytics, including clinical decision-support tools [24, 25].
(4) **Evidence generation and research priorities:** Future health economic studies should evaluate clinical utility, operational efficiency, patient outcomes, and cost-effectiveness to establish the measurable value of integrated diagnostics [26]. Existing diagnostic health-technology assessment models illustrate how pathway-level evidence and economic evaluation can inform implementation decisions [26]. Emerging value-based scorecards in laboratory medicine and related diagnostic

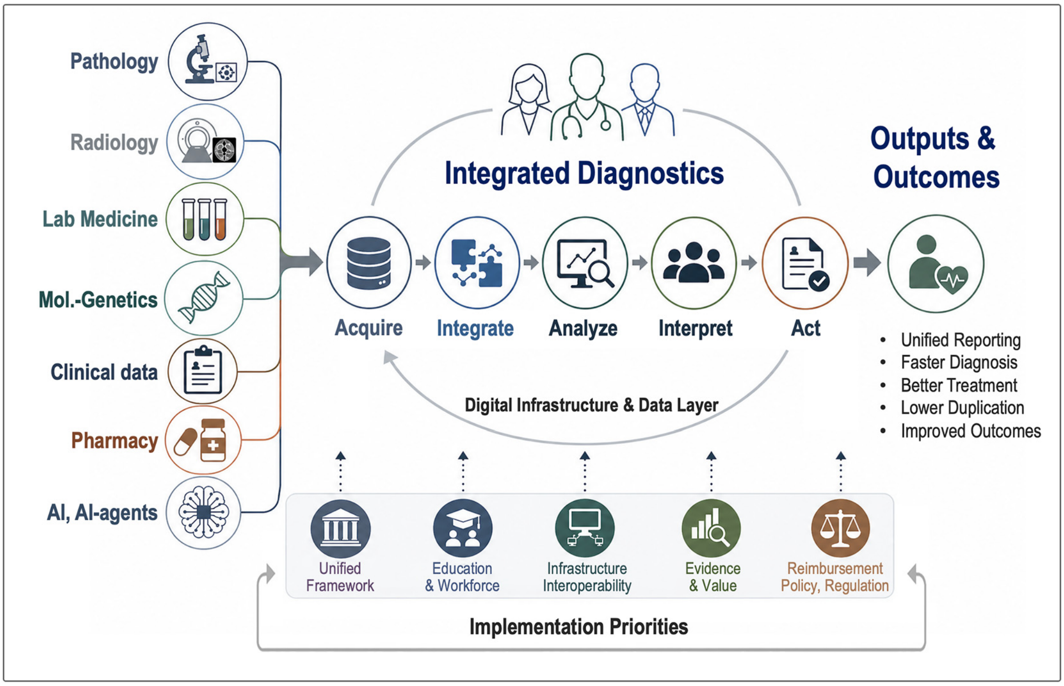

Figure 3: Conceptual framework and implementation priorities for integrated diagnostics. Integrated diagnostics is a patient-centered, multidisciplinary model that combines inputs from pathology, radiology, laboratory medicine, molecular genetics, clinical data, and artificial intelligence into a coordinated workflow of acquisition, integration, analysis, interpretation, and action. This process enables unified reporting, faster diagnosis, improved treatment selection, reduced duplication, and better clinical outcomes. Successful implementation requires five enabling priorities: a unified framework, education and workforce development, interoperable digital infrastructure and data storage, evidence generation with value assessment, and supportive policy, regulatory, and reimbursement pathways.

disciplines may provide useful conceptual models for future benchmarking approaches [27]. In parallel, rapidly evolving computational methods – including multimodal and agentic artificial intelligence systems – underscore the need for prospective validation frameworks that assess real-world utility, reproducibility, and impact before routine adoption [23, 28–30].

(5) **Policy, regulation, and reimbursement:** Engagement with policymakers, regulators, and payors is necessary to develop enabling governance models and reimbursement pathways that support implementation at scale [31].

Together, these priorities provide a practical roadmap for translating integrated diagnostics from conceptual aspiration into routine clinical practice. The relationship between diagnostic inputs, coordinated workflows, expected outputs, and enabling *implementation priorities* is summarized in Figure 3. Implementation should be proportionate to local clinical needs, institutional scale, and digital maturity. While integrated diagnostics may require upfront capital expenditure and ongoing operational investment (Figure 2), these requirements vary according to local scope and complexity. When appropriately tailored and deployed, integrated diagnostics can improve efficiency, reduce duplication, and generate value across patient pathways.

Conclusions

Integrated diagnostics provides a transformative framework to advance precision medicine through closer alignment of diagnostic disciplines, integration of diverse datasets, and a stronger focus on patient-centered care. Integrated diagnostics is not solely a future aspiration; many of its core elements already exist in established but often underrecognized forms, including disease classification systems, multidisciplinary team workflows, pathway-based economic models, same-day diagnostic clinics, and reflex testing strategies. By enabling more coordinated and data-informed decision-making, it has the potential to improve clinical practice and healthcare outcomes. The unified definition proposed by the EFLM Integrated Diagnostics Committee provides an important foundation for harmonizing terminology, guiding implementation, supporting research, and informing policy development. It may also enable future value-based assessment frameworks aligned with modern healthcare delivery. Its adoption may strengthen consistency, collaboration, and innovation across healthcare systems while helping translate diagnostic complexity into more effective patient care.

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