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# Health System Maturity: A Narrative Review of Existing Maturity Models

Higenyi Emmanuel
*Department of Public Health and Nutrition, Faculty of Health Sciences, Victoria University, Kampala, Uganda*

***Abstract***

*Various health system maturity models have been elaborated in literature but none offers a unified and integrated perspective to facilitate comparison of maturity levels across different health systems. Such a unified and universal health system maturity model would enable various stakeholders-national governments, international agencies, scholars and researchers, and other interested parties to gain insight into maturity of individual health systems while also permitting quantitative and qualitative comparisons across systems. It would facilitate progress tracking and systematic improvement at global, national and sub-national levels. This article explored and examined the various models for health system maturity and proposes robust criteria and framework for health system maturity assessment. Basing on the purpose, functions and goal of the health system, ten (10) maturity dimensions were synthesized to form a benchmark for the critical review of the existing maturity models and constitute a bedrock for the unified and integrated maturity assessment framework. The dimensions are: Universal Health Coverage; Continuity of Care; Continuum of Care; Population Health Status; Quality Management; Responsiveness; Resilience; Partnerships and Collaborations; Global Participation and Integration; and Sustainability. A critical review of the existing maturity models indicated that none of the maturity models covers all the health system maturity dimensions thus confirming the need for the synthesis of a unified and integrated framework for health system maturity assessment. The information from the review was used to formulate metrics and performance indicators for each dimension, thereby giving rise to the proposed comprehensive assessment framework.*

***Keywords:*** *Assessment, Criteria, Health System, Maturity, Model, Performance.*

## Introduction

This narrative review focuses on health system maturity assessment with particular attention on methods used and aspects forming the basis for assessments. Understanding the methods and aspects used in the assessment was crucial to the review's objective. The objective was to identify existing health system maturity models, assess their applicability across the entire health system, and use the resulting knowledge to propose a robust, integrated health system maturity assessment framework.

Data for this review included primary literature in form of peer-reviewed original published journal articles, secondary literature in form of review articles, and grey literature. The sources were searched and retrieved using the phrases ‘‘health system purpose/mandate’’, ‘health system functions’’, ‘‘health system goal’’, ‘‘health system obligation’’, ‘“health system maturity models” via the google search engine and citation tracking. The identified articles and website content were checked for relevancy to the objective of the review. Sources were checked for mention of the relevant concepts. Sources that had a clear

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***Corresponding Author: emmanuelhigenyi@gmail.com***

description of health system purpose, functions, goal, obligations and the maturity were included in the review.

## Background

Health systems are a collection of interconnected mechanisms, institutions, resources, and tools through which citizens access health services, and governments and the political class deliver their health-related mandates and commitments to their electorates. These mandates include ensuring that their citizens receive the required healthcare services, are protected from public health threats, and are shielded from disease epidemics and climate-related disasters. [34] On this basis, health systems constitute an important functional element of modern societies, subserving political, economic and social purposes. Maturity of health systems is therefore of great importance socially, economically, and politically as it not only determines the quality and quantity of services delivered to the citizens but also the efficiency, effectiveness, resource mobilization capacity, and sustainability of the systems. This makes system maturity a key determinant of success and overall performance of health system. This article therefore explored and examined the various models for health system maturity and proposes robust criteria and framework for health system maturity assessment.

Like any other system, the health system must progressively move from design to maturity to function optimally [1]. Maturity of a health system is a function of the extent to which the system achieves positive health outcomes for the population; attains financial protection of users; nurtures positive user experience; is responsive to user needs and expectations; promotes equity, engenders sustainability; and demonstrates resilience to emergences [20]. By interpretation therefore success and maturity of a health system can be determined from the health status of the population it is designed to serve, the quality of services provided by the system, fairness of the system, sustainability of the system, adaptability of the system, and contribution of the system to global health [8].

## Health System Maturity Dimensions

Based on its purpose, functions, goal and obligations [32, 34] health system maturity can be construed as a composite of ten (10) dimensions reflecting the associated governance, managerial, design, and service delivery complexities (Figure 1).

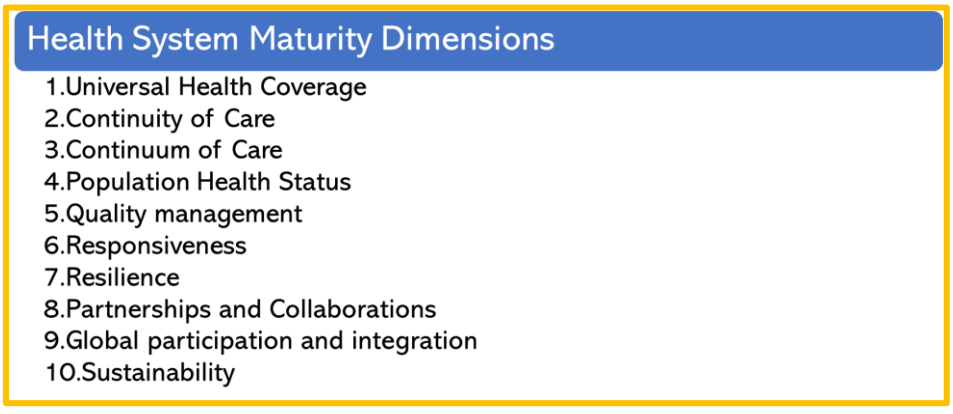


**Figure 1.** The Proposed Health System Maturity Dimension

*Source: Emmanuel Higenyi*

**Universal Health Coverage:** This is a health system maturity dimension that requires health systems to develop and provide services that meet the health needs and align with the social constraints of the population. This involves an interplay between finances, resources, and services [32] and digital health technologies including telemedicine [7]. This

dimension emphasizes financial protection, population coverage, and services. Financial protection is concerned with the ability of health consumers to mobilize and deploy financial resources for purposes of receiving health care services at the time and point of need without hardship. Population coverage is concerned with the proportion of the population that access the full range of services; health promotion, disease prevention, treatment, rehabilitation and palliative care while service coverage refers to the range of services. This dimension reflects access, affordability, and availability, with catastrophic expenditure related to consumption of healthcare being a key issue.

**Continuity of Care:** This health system maturity dimension is concerned with knowledge- and information-sharing transcending disciplinary and organizational boundaries [14, 15]. The dimension is closely linked to Universal Health Coverage and facilitates easy and complete movement of patients through the health system from initial contact to the next stages for services needed to address their health problems. This requires availability of interoperable digital platforms, use of digital tracking tools and standardized patient information forms, policies and protocols on referrals and counter-referrals, as well as appropriate transportation systems for patients.

**Continuum of Care**: This health system maturity dimension dictates how the population accesses a balanced mix of promotive, preventive, curative, and rehabilitative services [31]. This can be achieved through integrated care models and formulation of policies for integration of social determinants or social care into clinical practice [11, 12, 18, 30].

**Population Health Status:** This dimension entails the interaction between health system performance and population health outcomes [27]. This requires that health systems maintain population-level access to quality healthcare while ensuring equity and protection for vulnerable populations, and sustain engagement with communities and citizens through mechanisms such as outreach, open days, and population-based surveys.

**Quality Management**: This dimension considers the technical, humanity, delivery, procedural, environmental, and efficacy perspectives of health services as perceived by the consumer, and as dictated by technical and regulatory standards [10]. This dimension requires health systems to have robust quality improvement programs, consensus on country-specific service quality metrics and client satisfaction metrics, and consistent tracking of client satisfaction [5].

**Responsiveness:** This dimension focuses on the health system's ability to nurture, embrace and cater for non-medical aspects of dignity, autonomy, confidentiality, prompt attention, amenities, social support, and freedom of choice [4, 22, 24].

**Resilience** This dimension focuses on evolving health needs, public health emergencies, and disruptions [34]. The dimension requires health systems to develop contingency plans, medical counter-measures, as well as policies for modification and expansion of health services with the associated service delivery platforms to align with evolving health needs and population socio-demographics. It also requires anticipation, preparation, and budgeting for public health emergencies, and integration of animal, environmental and human health disciplines.

**Partnerships and Collaborations:** This dimension is anchored on policies and engagements that build partnerships and collaborations in pharmaceutical, clinical, financing, and managerial aspects of health systems. The dimension dictates the need for a clear policy and strategy on partnerships and collaborations including guidance on appropriate models for partnership and collaboration [2] such as infrastructure-based models, discrete clinical service models, and intergraded public partnership models [2].

**Global Participation and Integration:** This dimension focuses on strategies for participation in and integration into the global health agenda including adoption of global health policies and plans related to global health security [36]. The dimension dictates that health systems share disease-related information and data, integrate global health policies, participate in global initiatives such as joint evaluations and research programs, international forums, and global security agenda, as well as share data on persistent, emerging, and reemerging health problems. This dimension also dictates the need for multilateral and bilateral cooperation and collaboration, technology transfer and capacity building, and formation of specialized alliances.

**Sustainability**: This dimension comprises three sub-dimensions: environmental, financial, and social. Health system environmental sustainability is concerned with protection of the environment by decarbonizing service delivery, the supply chain, and infrastructure [29]. Decarbonizing service delivery entails reducing greenhouse gases through better care planning, promoting disease prevention and patient self-care, embracing re-usable products, investing in green infrastructure, and reducing the consumption of energy and water [29], Decarbonizing the supply chain requires procurement of environmentally safe products and services, promoting circularity of commodities, eliminating plastics, and proper disposal of pharmaceutical, medical, equipment, and electronic waste[28, 29]. Decarbonizing infrastracture requires transitioning to renewable energy sources and constructing green energy buildings [28, 29] Health system financial sustainability requires that health systems are financially viable, embrace operational efficiency, adopt resource optimsation strategies such as digitization, data management, medical technology, and governance. Health system social sustainability is concerned with ability of the health system to maintain its relevance to the population by enhancing quality of life and improving well-being of the population and promoting social equity [21].

## Review of the Existing Health System Maturity Models

Maturity models are applied ubiquitously as tools and frameworks for assessing progress, performance and capabilities of organizations and systems, and do provide a structured roadmap for understanding current performance, identifying areas for improvement, and driving sustained growth [3] Therefore a unified and universal health system maturity model would enable various stakeholders-national governments, international agencies, scholars and researchers, and other interested parties to evaluate maturity of individual health systems while also permitting quantitative and qualitative comparisons across systems; facilitate progress tracking and systematic improvement at global, national and sub-national levels.

The majority of health system maturity models (HSSMs) found in the literature are devoid of a global, let alone a national character, and focus on hospital services and supply chain operations [3, 13] as can be appreciated from the ensuing discourse.

**The Hospital cooperation maturity model** is premised on intrainstitutional and interinstitutional collaboration, and the enabling information management systems [3]. The model can be used to asses intra-facility and inter-facility cooperation. This model underscores the importance of continuity and continuum of care through: intra-facility integration of services such as primary care, preventive services, mental health support, emergency care, rehabilitation, home-based care, and hospice or palliative care; seamless transitions between types of care based on changing health needs; and coordination and communication among all care providers,

specialists, and family members. The model aligns with continuity and continuum of care dimensions.

**The Maturity model of hospital** is based on the balanced score card approach incorporating aspects related to clients, financing, internal processes, and learning and growth or organizational capacity [3]. The model highlights the importance of inputs, processes, and clinical and health outcomes and aligns with the financial sustainability and population health dimensions.

**The High Reliability Health Care Maturity Model** focuses on patient safety through leadership, safety culture, and process improvement [3]. The model underscores the importance of clinical governance in the health system. The hallmark of the model is patient safety including aspects of medication errors, surgical errors, diagnostic errors, and hospital acquired diseases. This maturity model emphasizes the quality management dimension.

**The Healthcare data quality maturity model** focuses on quality of patient data including precision, completeness, duplication, and uniqueness [3]. The model underscores the importance of data governance and data quality assurance and aligns with the quality management dimension.

**The Meaningful use (Forrester model)** focuses on aspects of medical records management such as structure, custody, protection, and content together with the technologies used for information management [3]. The model identifies three maturity levels based on technology adoption: paper-based, stand-alone databases such as electronic health records, and digitally integrated medical records management systems. The maturity model aligns with the continuity-of-care dimension.

**The Healthcare analytics adoption model** places emphasis on extensive data analyses to improve patient outcomes and reduce costs [3] threshing out nine maturity levels including enterprise data operation system, standardized vocabulary and patient registries, automated internal reporting, and automated external reporting, The model emphasizes data automation and utilization and aligns with the quality management and financial sustainability dimensions.

**The Business intelligence maturity model** assesses the business intelligence maturity at five levels [3]. At the ad hoc level there is no formal business intelligence (BI) processes or system within the institution, there is no central data center, and business intelligence is used erratically. At the initial level business intelligence systems are basic, not integrated, with manual work involved and decision-makers cannot access data easily. At the repeatable level business intelligence systems are partially integrated enabling better data access, however data quality and data analysis capabilities are low. At the managed level there is a well-defined business intelligence strategy with enterprise-wide integration characterized by robust data quality and the use of business intelligence to support decision-making at all levels of the organization. At the optimized level there is high level of innovation in use of business intelligence systems within the organization. The model underscores the importance of use of patient and other operational data for planning, and management of operations and aligns with the financial sustainability dimension.

**The Healthcare usability maturity model** focuses on usability of information and technology resources [3]. The model assesses maturity at five levels: the ad hoc level where health care organizations have not adopted information and technology; the managed level with partial adoption with no defined standards for information and technology use; the standardized level where there is a set of standards for the use of information and technology systems and the standards are applied consistently; the quantitatively managed level characterized by the use of measurement and monitoring systems; the

optimized level characterized by continual improvement of the information and technology practices. This maturity model aligns with financial sustainability and continuity of care dimension.

**The Hospital information system maturity model** assesses maturity of health information systems at six levels based on the aspects of data analysis, strategy, people, systems, and infrastructure [3]. This model considers the extent to which data is analyzed for actions, decision-making, and policy formulation and aligns with the financial sustainability dimension.

**The infrastructure maturity model** focuses on healthcare information technology infrastructure with five perspectives [3] involving alignment of information technology infrastructure with business strategy; deployment, acquisition, and maintenance of information technology infrastructure; daily operations of information technology infrastructure; security for the information technology systems against unauthorized access, use, disclosure, tampering, modification or destruction; and managerial aspects including governance and control of information technology systems. This maturity model aligns with the financial sustainability dimension.

**The Telemedicine service maturity model** is used for assessing the maturity of adoption and use of telemedicine and is characterized by six levels [3]. Level 0 (Initial) is where there is no use of telemedicine services. Level 1, the ad hoc level, is where there is some use of telemedicine but no clear telemedicine strategy or plan. Level 2 (managed) has a structured approach to telemedicine, including a strategy and procedures, but with inconsistencies in application. Level 3 (Defined) is characterized by a well-documented telemedicine strategy, procedures, controls, and clear goals and objectives. Level 4 (Quantitatively managed) is where data and metrics are used to measure and improve the performance of the telemedicine service. Level 5 (Optimization) is where there is active continual improvement of the telemedicine service.

The model has micro, meso, and macro perspectives with the micro-level focusing on individual components of telemedicine services such as processes, technology, and the people involved, the meso level focusing on interactions between different service components, and macro level focusing on the general context of telemedicine services, such as healthcare systems and regulatory environments. This maturity model aligns with the universal health coverage and continuity of care dimensions.

**The Project Management Maturity Model**. This is a family of models used to assess organizations' project management proficiency. The model grades project management maturity ranging from disorganized and inadequately controlled methods through structured and standardized practices in the middle tier, to consistently refined practices at the top tier. This model aligns with the financial sustainability dimension [3].

**The Informatics capability maturity model**. This is a five-level framework for assessing the maturity of informatics use in health care [3]. The model has the basic level, controlled level, standard level, optimized level, and innovative excellence level. This maturity model aligns with the quality management and financial sustainability dimensions.

**The Business Process Orientation Maturity Model** is a framework for assessing the maturity of business processes [3]. The model considers optimization of business processes and associated increase in efficiency, effectiveness, and customer satisfaction. The model is applied at five levels, namely the ad hoc stage with informal and ad hoc processes and little or no coordination between departments or functions, the define stage with documented and standardized processes, but

suboptimal coordination between departments or functions, the linked stage with interoperability but limited focus on customers and clients, the managed stage with a proper management strategy, the integrated stage where processes are fully integrated and optimized and characterized by continual improvement and innovation. This model aligns with the quality management and financial sustainability dimensions.

**The Health Industry Insights Mobility Maturity Model**. This model is applied as a framework for assessing maturity in adopting mobile solutions for the health information system) [3] and has five stages. Stage 1 (Ad hoc) is characterized by exploration of mobile solutions, no general strategy or governance structure for use of mobile devices; Stage 2 (Pilot) is where mobile solutions are under test in several areas of the entity but with limited users and limited integration with legacy systems; Stage 3 (Deployment stage) characterized by operational mobile solutions, large scale adoption and high level of integration with existing systems, but still with security and management issues; Stage 4 (Optimization stage), elaborating a well-defined strategy and governance structure, and full integration with the existing systems; Stage 5 (Transformation stage), characterized by full adoption of mobile solutions. This model aligns more with the financial sustainability and universal health coverage dimensions.

**The Electronic medical record adoption (EMR) model**. This is a five-stage model used to assess the adoption of EMR in patient care involving all key patient facing modules [3]. Stage 0: no EMR, Stage 1: Basic EMR., Stage 2: Computerized Provider Order Entry Stage 3: Clinical Decision Support (CDS), Stage 4: Integration, Stage 5: Advanced clinical applications, Stage 6: Population health management. Stage 7: Interoperability characterized by integration of data from multiple external sources, use of automated tools for notifications and reminders to patients and for measuring patient outcomes. This maturity model aligns with population health, continuity of care and quality management dimensions.

**The Continuity of care maturity model** is an eight-level model used to assess the maturity of the health system with respect to patient and industry perspectives [3], focusing on continuity of care where there is no interruption to care, and alignment of health care resources across care settings. This model emphasizes coordination of care over various care settings involving administrators, clinicians, and information technology personnel. Level 0 is characterized by limited to no electronic communication, Level 1 is characterized by peer-to-peer data exchange, Level 2 is characterized by patient-centered clinical data using essential system-to-system exchange, Level 3 is characterized by normalized patient records using structural interoperability, Level 4 is characterized by care coordination based on data, Level 5 is characterized by community-wide focus , Level 6 is characterized by closed loop care coordination among care team members, Level 7 is characterized by knowledge-based participation This model aligns with the continuity of care dimension.

**The Interoperability maturity model** is a five-level model that assesses maturity in the context of interoperability involving health information systems and devices that communicate, exchange, and use data efficiently and securely [3]. Ad hoc level is the lowest level of interoperability with no formal plan or process; Repeat level with basic plans for interoperability; Enhanced level with formal plans and processes and a focus on interoperability; Managed level with interoperability, regular reviews and assessments; and Optimized level with the highest level of interoperability. This model aligns with continuity of care and financial sustainability dimensions.

**The Capability maturity model** integration for services is applied to assess maturity of

business processes [3] where Initial stage portrays no defined processes for service delivery; Managed stage portrays presence of defined processes for service delivery, but no consistence; Defined stage portrays presence of defined processes for service delivery with consistence in application; Quantitatively Managed stage portrays consistent collection and analysis of data on service delivery for improvement; Optimizing stage portrays continuous improvement in service delivery processes. This model aligns with the quality management dimension.

**The Four Levels of Supply Chain Maturity model** assesses the maturity of the health system with respect to planning, integration, collaboration, and adaptation of the supply chain [9] and comprises the reactive level, internal integration level, extended collaboration level, and dynamic adaptation level. This model aligns with the financial sustainability dimension.

GHSC-PSM Supply Chain Information System Maturity Model focuses on processes, visibility, data integrity, decision making, and interoperability, with level 1 being reporting-based, level 2 transactional, level 3 advanced digitization, level 4 end-to-end visibility, and level 5 digital ecosystem [26]. This model aligns with the financial sustainability and global participation and integration dimensions.

**The UNICEF Supply Chain Maturity Model** is a participatory, qualitative and government-led supply chain model used to determine whether supply chain management is a barrier to access. It reviews the performance of 13 critical operational and technical supply chain functions linked to the five UNICEF supply chain rainbow levels [25]. This model aligns with financial sustainability, universal health coverage, resilience as well as global participation and integration dimensions.

**The Health Accounts (HA) Maturity Model** focuses on institutionalization of Health Accounts at country level considering aspects of demand, governance, institutional technical capacity, as well as dissemination and use of health accounts data [33, 37]According this model demand references the need and use of national health accounts data; governance and financing elaborates the required institutional framework that includes mandates, resources, and decision-making processes; institutional technical capacity considers the technical expertise and resources available for producing and analyzing health accounts data; and dissemination and use dimension examines how effectively the health accounts data is shared and utilized for decision-making and policy development. The model aligns with the financial protection aspect of the universal health coverage dimension.

**The Global Digital Health Index** is a multistakeholder initiative developed under the leadership of the Global Development Incubator and HealthEnabled [17] and considers aspects such as interoperability, strategy, and personalized care [6]. This model elaborates five levels of maturity and facilitates creation of baseline data, generation of a country scorecard and a benchmark against global averages, and learnings from other countries to inform and target investments in digital health at the country, regional, and global level. This model aligns with the continuity of care dimension and to a certain extent the dimension on international partnerships and collaborations as well as global participation and integration.

## Discussion

### Maturity Models versus Maturity Domains

A critical review of the above maturity models indicates that none of them covers all health system maturity dimensions, while very few provide broad coverage of the health system maturity domains (Table 1). Most of them are focused on financial sustainability, followed by a modest coverage of the continuity of care, quality management, universal health coverage, as well as global

participation and integration dimensions. Very few incorporate the dimensions on partnership and collaboration, population health status, resilience, and continuum of care. None of the models incorporates environmental and social sustainability, and responsiveness. The maturity models, however, provide a good premise for establishing a unified and integrated maturity assessment framework.

**Table 1.** Showing the Maturity Dimensions for the Health System Maturity Models

| **Model** | **UHC** | **Continuity of Care** | **Continuum of care** | **Population Health** | **Quality management** | **Responsiveness** | **Resilience** | **Partnerships and Collaborations** | **Global participation and integration** | **Sustainability** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | **Env** | **Fin** | **Soc** |
| The Hospital cooperation maturity model | | x | x | | | | | | | | | |
| The Maturity model of hospital | | | | x | | | | | | | x | |
| The High reliability health care maturity model | | | | | x | | | | | | | |
| The Healthcare data quality maturity model | | | | | x | | | | | | | |
| The Meaningful use (Forrester model) | | x | | | | | | | | | | |
| The Healthcare analytics adoption model | | | | | x | | | | | | x | |
| The Business intelligence maturity model | | | | | | | | | | | x | |
| The Healthcare usability maturity model | | x | | | | | | | | | x | |
| The Hospital information system maturity model | | | | | | | | | | | x | |
| The infrastructure maturity model | | | | | | | | | | | x | |
| The Telemedicine service maturity model | x | x | | | | | | | | | | |
| The Project management maturity model | | | | | | | | | | | x | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| The Informatics capability maturity model | | | | | x | | | | | | x | |
| The Business process orientation maturity model | | | | | x | | | | | | x | |
| The Health Industry Insights Mobility maturity model. | x | | | | | | | | | | x | |
| The Electronic medical record adoption model | | x | | x | x | | | | | | | |
| The Continuity of care maturity model | | x | | | | | | | | | | |
| The Interoperability maturity model | | x | | | | | | | | | x | |
| The Capability maturity model integration for services | | | | | x | x | | | | | | |
| The supply chain maturity models | | | | | | | | | | | x | |
| GHSC-PSM Supply Chain Information System Maturity Model | | | | | | | | | x | | x | |
| The UNICEF Supply Chain Maturity Model | x | | | | | | x | | x | | x | |
| The ASCM Global Health Supply Chain Maturity Model | | | | | | | | | x | | x | |
| The Health Accounts (HA) Maturity Model | x | | | | | | | | | | | |
| The Global Digital Health Index | | x | | | | | | x | x | | | |

## Proposed Maturity Assessment Framework

The ten health system maturity dimensions offer clear basis for the metrics and indicators to constitute a unified and integrated framework. Each dimension has been operationalized into metrics, and each metric decomposed into specific indicators. The number of metrics and indicators for each maturity dimension is summarized in figure 2 while the details of the metrics and indicators are presented in table 2.

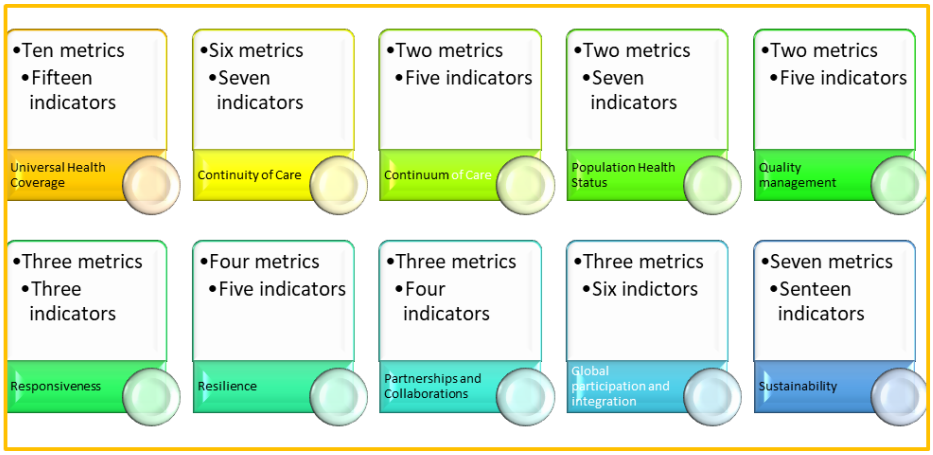


**Figure 2.** Summary of the Number of Metrics and Indicators for Each Maturity Dimension

**Table 2.** Showing the Metrics and Indicators for the Respective Maturity Dimension

| **Dimension** | **Metric** | **Indicator** |
|---|---|---|
| Universal Health Coverage (UHC) | Health facility coverage-distribution | Proportion of the population within 30-minute travel to the nearest primary care health facility |
| | Health infrastructure coverage-health facility density | Ratio of the number of health facilities to the population |
| | | Ratio of the number of hospitals to the population |
| | Health infrastructure coverage-medical equipment density | Selected priority medical equipment density per population |
| | | Existence of a list of priority medical equipment |
| | General or primary practitioner population coverage | Ratio of primary care practitioners to the population |
| | Specialist care population coverage: | Ratio of specialists to population (general surgeons, paediatricians, psychiatrists, physicians, gynaecologists, cardiologists, dental surgeons, ENT) |
| | Financial protection-equity | Existence of safety nets for vulnerable persons: Refugees and displaced persons, homeless persons, Substance Abusing Persons (SAPs), unemployed |
| | Financial protection-affordability | 25th percentile wage[1] vs 25$^{th}$ percentile cost of emergency procedures or cost of hospitalization |
| | | Existence of a system for tracking catastrophic expenditure on health care |
| | Financial protection-health insurance coverage | Proportion of the population with comprehensive health insurance |
| | | Proportion of people protected from health emergencies |
| | Governance | Health Accounts data is annually aggregated and shared |
| | | Existence of a policy on health financing, health infrastructure, human resources for health, and services |

| | | |
|---|---|---|
| | Telemedicine coverage | Proportion of licensed medical and pharmaceutical outlets with digital health technology[2] capabilities including telemedicine capabilities |
| Continuity of care | Governance | Existence of policy on digital system interoperability |
| | Digital system interoperability coverage | Proportion of medical and pharmaceutical providers on the national digital interoperable ecosystem system |
| | | Proportion of licensed medical and pharmaceutical providers within a group interoperable digital ecosystem |
| | Patient referrals | Existence of protocols for referral, counter-referral and emergency transfer |
| | Care pathways | Proportion of medical providers with care pathways for tracer conditions |
| | Standardized patient data exchange | Existence of nationally adopted Continuity of Care Document (CCD): Standardized electronic summary for health information exchange between systems. |
| | Standardized care approaches | Existence of standardized diagnostic, therapeutic, clinical, and patient care protocols |
| Continuum of care | Governance | Explicit policy on integration of services |
| | | Explicit policy on integration of social determinants or social care into clinical practice |
| | Promotive-Preventive-Curative-Rehabilitation mix | Proportion of medical care providers with full integration of services (sharing workflows, data, and treatment plans) |
| | | Proportion of medical providers with co-location of services (sharing space or working on same site) |
| | | Proportion of primary care providers with a defined actively engaged population beneficiaries |
| Population Health status | Governance | Existence of Policy on use of local, regional and national population health data for long-term and short-term planning at national, subnational, and provider levels |
| | | Existence of policy on citizen engagement in planning, service delivery, monitoring, and evaluation |
| | | Existence of policy on community extension services |
| | | System for tracking population health indices |
| | | DALYS per capita[3] |
| | Community linkages and engagement | System for tracking community engagements |
| | | Existence of a structured community outreach program |
| Quality management | Quality metrics | Existence of nationally agreed metrics for client satisfaction with health services |
| | | Client satisfaction levels and trends |
| | Quality improvement | Proportion of medical and pharmaceutical providers actively practicing quality improvement programs |

| | | |
|---|---|---|
| | | Existence of quality improvement guideline for medical and pharmaceutical providers |
| | | Existence of guideline and program on skills inventory/audit and skills appraisal |
| Responsiveness | Environment of care | Proportion of medical providers with fully functioning list of key amenities |
| | Process | Proportion medical providers with instruments for ensuring health service responsiveness |
| | Performance | Proportion of medical and pharmaceutical providers conducting regular surveys on the seven domains of responsiveness: prompt attention; respect for dignity; clear communication; respect for autonomy; access to social support; respect for confidentiality; quality of basic amenities |
| Resilience | Governance | Existence of a policy on expansion of health services and delivery platforms |
| | Accessibility | Proportion of the population reporting unmet need for health services[4] |
| | Emergency preparedness | Existence of protocols and contingency plan for public health emergencies |
| | | Dedicated budget for public health emergencies |
| | One Health orientation | Existence of an operational one-health framework[5], i.e with budget, leadership, annual plans, and activities |
| Partnerships and collaborations | Governance | Existence of policies for nurturing and legitimizing partnerships and collaborations in Pharmaceutical, Clinical, Financing, Management aspects of the health systems. |
| | | Existence of priority health issues targeted for partnerships and collaborations |
| | | Existence of collaboration framework between health and key sectors allied to health |
| | Operations | Existence of a centralized oversight coordination mechanism for partnerships and collaborations, i.e central registry of collaborations and partnerships within the entire health system |
| | Performance | Proportion of priority health issues managed through partnerships and collaboration: |
| Global participation and integration | Convener status | Proportion of key global and regional health agendas where the country is a convener |
| | Host status | Proportion of key global and regional health events hosted in the country |
| | | Proportion of key global and regional agencies with offices in the country |
| | Adoption of global health initiatives | Proportion of funding and administrative obligations to global and regional health agendas fulfilled |

| | | |
|---|---|---|
| | | Existence of a policy to participate in the global health agenda. |
| | | Proportion of global health initiatives ratified in the country |
| Sustainability-Environmental perspective | Governance | Existence of health system ecological sustainability policy |
| | Waste control | Medical waste per capita |
| | | Proportion of waste recycled, reused, |
| | Energy consumption | Total Energy use per capita (health facilities and Ministry of Health |
| | | Proportion of fossil-source energy supply |
| | Emissions | Health system greenhouse (GHG) scope 1,2,3 gas emissions[6] per capita (CO2 equivalents) |
| Sustainability-Financial perspective | Public spending | Percentage of health expenditure financed by public sources/health insurance |
| | | Projected public expenditure on health expressed as a percentage of the gross domestic product |
| | Operational efficiency | Mortality rate[7] per unit expenditure on health |
| Sustainability-Social perspective | Social equity | DALYS Gini coefficient[8] |
| | | Extent of integration of social care in health care delivery. |

[1]*25th percentile monthly wage: This refers to the pay level where 25% of workers earn less, and 75% earn more, representing lower-end compensation. For example, if the 25th percentile monthly wage is 1000 USD, it means a quarter of workers earn 1,000 USD or less, while three-quarters earn over that amount [39]*

[2]*Digital health technology: This refers to digital tools used by healthcare personnel to monitor and manage disease conditions and includes technologies such mHealth, Telehealth, Telemedicine, Health information technology, and Wearables [40]*

[3]*DALYS Per capita (Disability-Adjusted Life Years per person) This population health metric indicates the total disease burden in the population and is a measure of lost healthy years. It amalgamates years of life lost (YLL) from premature death and years lived with disability (YLD) [35]).*

[4]*Unmet need for health services: This characterizes a situation where a need for healthcare such as medicine, surgery, and diagnosis was not fulfilled regardless of cause [19].*

[5]*One-Health framework: This approach recognizes that human, animal, plant, and environmental health are intertwined thus the need for multisectoral efforts to tackle cross-cutting and multifaceted health problems including zoonotics, antimicrobial resistance, and climate change. This concept extends the purview of human health to de-silo the fields of human medicine, veterinary practice, environmental health, and public health thus facilitating prompt and effective prevention, detection, and response [38].*

[6]*Scope 1 emissions: these are direct emissions from operations of health facilities and the ministry of health**;** Scope 2 emissions: these are indirect emissions from consumption of electricity and other forms of energy purchased from external parties Scope 3 emissions: this includes the rest of the indirect emissions arising from supply chain, product use, and staff commuting [17].*

[7]*Higher values for mortality rate per unit expenditure on health indicate low efficiency.*

[8]*A rising Gini coefficient for DALYs means health disparities are increasing [23].*

## Conclusion

The review clearly shows that while the existing health system maturity models are explicit in their presentation, they exhibit different levels of shortcomings with respect to the key maturity domains. This has provided an opportunity to use the findings and synthesize a maturity assessment model that can be applied globally thus enabling inter system comparisons in addition to serving as a progress tracking tool at system level. Furthermore, global level comparison will facilitate and shape multilateral and bilateral engagements and guide the global health agenda.

## Ethical Approval

Exemption was granted by the School of Health Sciences Research and Ethics Committee, Makerere University.

## Conflict of Interest

There was no conflict of interest.

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## Author's Contribution

Emmanuel Higenyi undertook the design of the review, identification and screening of sources, extraction of data, and preparation of the manuscript.

## Data Availability

All data used in the preparation of this narrative review article, with the exception of the unpublished presentation, is available publicly and can be accessed from the sources indicated in the references. The unpublished presentation can be accessed by contacting the corresponding author using the contact details available.

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