Pandemic Fund Risk-Need Metric and Methodology

A methodology for identifying High Risk and High Need Countries where outbreaks could escalate into Pandemics

2026

The Pandemic Fund
FOR A RESILIENT WORLD

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Foreword

Pandemic threats do not respect borders. Outbreaks that are not contained quickly can cascade into regional and global crises, with devastating consequences for lives, livelihoods, and economies. The world is only as resilient as its most vulnerable health systems.

The Pandemic Fund is the first multilateral financing mechanism dedicated exclusively to strengthening critical pandemic prevention, preparedness, and response (PPR) capabilities in low- and middle-income countries. Central to our mission is a commitment to prioritize support for countries facing the highest pandemic risks alongside the most acute gaps in essential PPR capacities and capabilities. Many of these countries are in contexts affected by fragility, conflict, or limited institutional capacity, where access to financing is often most constrained.

To guide this prioritization, the Pandemic Fund Governing Board asked for the development of a dedicated, fit-for-purpose High Risk–High Need Metric and Methodology. Developed over nearly a year with contributions from a wide range of partners, this scientifically grounded instrument systematically identifies countries where pandemic risks are greatest and PPR needs are most pronounced, and where targeted investments can deliver the greatest impact. The metric provides a transparent and evidence-based foundation for directing resources to those most in need.

Building on this analytical framework, the Fund is introducing a dedicated High-Risk, High-Need funding window, designed with several distinctive features, including: pre-allocated ceilings for eligible countries that have not previously received Pandemic Fund financing—providing greater predictability; a one-year rolling application period—allowing sufficient time for country-led preparation and partnership building; and tailored support that meets countries where they are, helping translate identified needs into actionable investment plans.

This effort illustrates the Pandemic Fund's commitment to agile and responsive financing. By using robust evidence to channel resources to settings with the highest risks and greatest unmet needs we can help prevent localized outbreaks from escalating into pandemics, protecting lives, and strengthening collective health security for all.

Priya Basu
Executive Head, The Pandemic Fund
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Special thanks are also extended to the members of the Pandemic Fund's Technical Advisory Panel for their strategic oversight and advice, to the Pandemic Fund's Strategy Committee for their valuable inputs, and to the Pandemic Fund's Governing Board for its overall guidance.

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Finally, the Pandemic Fund expresses its sincere appreciation to all participants in the country consultations, including representatives of the 18 constituencies of the Pandemic Fund that represents the 28 contributing donors and the 147 eligible countries, whose engagement and recommendations greatly strengthened the development of the Metric.

1 Context

The Pandemic Fund is a multilateral financing mechanism designed to enhance pandemic prevention, preparedness, response (PPR) capacities, and overall resilience against future epidemics and pandemics in low- and middle-income countries. As the Fund continues to expand its existing portfolio through its three Calls for Proposals, it recognizes that significant gaps in PPR capacity, pandemic risk, and socioeconomic vulnerability persist across countries, leaving some communities disproportionately exposed to epidemics and pandemics.

The Pandemic Fund's medium-term Strategic Plan[i], adopted by the Governing Board on May 21, 2024, outlines three allocation modalities emphasizing support for (1) targeted allocation of funds to countries with the largest gaps in pandemic PPR capacity, highest pandemic risks, including burden of disease, and taking into account socioeconomic context, (2) countries that are eligible to receive resources from the International Development Association or International Bank for Reconstruction and Development; and (3) regional and sub-regional entities.

To determine the eligibility of countries for a targeted Allocation Modality 1 call, the Pandemic Fund Governing Board decided to develop a custom Metric and with a robust methodology with the aim of identifying countries at highest risk and highest need of pandemic PPR support. A Technical Working Group (TWG), coordinated by the World Health Organization (WHO) with other Implementing Entities and specialized agencies was formed under the leadership of the Pandemic Fund Governing Board and the Strategy Committee and with technical guidance and oversight from the Pandemic Fund Technical Advisory Panel.

2 Objective

The Pandemic Fund Risk-Need Metric and methodology is an evidence-based instrument intended identify high-risk and high need countries where outbreaks could escalate into Pandemics based on gaps in PPR capacity; pandemic risks, including burden of disease; and the socioeconomic contexts of middle- and low-income countries eligible to receive support. This document describes the Metric and explains the underpinning methodology.

3 Definitions

Pandemic risk in the context of the Pandemic Fund Risk-Need Metric refers to the likelihood of a disease outbreak with pandemic potential to emerge and escalate, as well as the potential impacts of such an outbreak. Metric also comprehensively considers interactions between hazards, vulnerability, and capacity[ii]:

- ***Hazards:*** The presence, severity and likelihood of pandemic-prone threats, such as zoonotic spillover, geographic hotspots of emerging pathogens, and pre-existing burdens of epidemic-prone diseases.

- ***Vulnerability:*** Socioeconomic and demographic factors and environmental conditions that increase susceptibility to occurrence and impact of pandemics.
- ***PPR Capacity:*** The systems and institutional capabilities to prevent, prepare for, and respond to outbreaks/pandemics, including public health infrastructure, health workforces, resilient health systems, and strong governance.

Needs in the context of the Pandemic Fund Risk-Need Metric refer to critical gaps in capacities to prevent, prepare for, and respond to pandemic threats. This reflects both the absence or weakness of essential systems and services, as well as underlying conditions that amplify the impact of pandemics. Relevant examples include:

- ***Infrastructural and institutional capacities:*** Shortcomings in infrastructure, systems, policies, and institutional arrangements necessary for effective surveillance, functional early warning systems, robust laboratory capacity, strong health workforces, effective emergency response coordination, effective risk communication, and robust health systems.
- ***Socioeconomic and contextual vulnerabilities:*** Factors such as poverty, inequality, conflict, weak governance, and limited access to health services that exacerbate the impact of outbreaks and constrain countries' ability to rapidly detect and respond effectively to emerging threats.
- ***Unmet investment requirements****:* The lack of requisite financial and technical resources needed to build or strengthen core capacities aligned with the International Health Regulations (2005) (IHR), as well as with international standards for protecting animal and environmental health.

Enabling Environment in the context of the Pandemic Fund Risk-Need Metric refers to the broader set of conditions that influence the effectiveness and sustainability of PPR interventions within a country. It captures both external and internal contextual factors that can either facilitate or hinder progress. On one hand, it considers fragile and conflict-affected environments. On the other hand, it assesses enabling national policies, governance mechanisms, and legal frameworks, including institutional quality, multisectoral coordination, human capital, and financial absorption capacity. Together, these elements provide insight into how well a country's policy, governance, and institutional contexts support impactful and resilient PPR efforts.

4 Development process

The development process of the Pandemic Fund Risk-Need Metric leveraged existing Pandemic Fund mechanisms and bodies to ensure a scientifically rigorous and politically neutral instrument with the appropriate technical and governance oversight at numerous stages.

The Metric was primarily developed by a Technical Working Group, composed of Implementing Entities and other key partners, including African Development Bank, Asian Development Bank, Food and Agriculture Organization (FAO) of the United Nations, Inter-American

Development Bank, the Coalition for Epidemic Preparedness Innovations (CEPI), UNICEF, the World Bank, and the World Organisation for Animal Health (WOAH); and coordinated by the WHO. The TWG provided technical expertise and input to the development of the methodology underpinning the Pandemic Fund Risk-Need Metric.

In addition to its regular meetings, the TWG also received input from the Pandemic Fund Technical Advisory Panel, a group of 28 high-level experts, on the metric and methodology at key development phases. The TAP provided technical oversight and validation and made independent recommendations to the Board.

Finally, with support of the Pandemic Fund Secretariat, an expert consultation and country information sessions to gain buy-in from co-investor countries were conducted. For more information on the development of Pandemic Fund Risk-Need Metric, see Annex 1.

5 Methodological approach

The Pandemic Fund Risk-Need Metric framework builds on the WHO's Dynamic Preparedness Metric (DPM) [iii], which draws from existing frameworks and metrics to evaluate hazards, vulnerabilities, and capacities, and classifies countries according to their pandemic risk profiles and preparedness needs. All relevant existing indices and metrics were reviewed in the development of the Metric. While there are multiple classifications that capture countries' socioeconomic context, gaps in pandemic PPR capacity, pandemic risks, and enabling environment factors, there is no single fit-for-purpose index that incorporates all these aspects for Low- and Middle-income countries (LMICs).

The Pandemic Fund Risk-Need Metric leverages evidence-based assessments conducted by other stakeholders, data sources, frameworks for capacities monitoring, and methodologies for constructing and validating composite measures. Adopting a One Health approach, the Metric integrates critical, evidence-based elements of risks to which countries are exposed, as well as factors contributing to these risks. It also integrates country capacities, capabilities, and needs for mitigating pandemic risks. Finally, it categorizes countries based on their hazard, vulnerability, and capacity levels with a focus on identifying countries reporting high levels of both risk and need. The Metric gives special consideration to Small Island Developing States (SIDS), applying population-based weighted indicators that account for their relatively small populations.

The Pandemic Fund Risk-Need Metric focuses on quantifiable elements of pandemic risks and needs in middle- and low-income countries. Additionally, enabling environment factors including fragile settings, conflicts, governance, policy, legislative are considered in the categorization of countries as a complementary step.

6 Analytical framework

The Pandemic Fund Risk-Need Metric is informed by a variety of established indicators, and integrates four main conceptual dimensions as detailed below: Hazards, Vulnerability, PPR Capacity, and the Enabling Environment:

- **Hazard** dimension**:**
  - This dimension combines the severity of hazards (i.e., the magnitude of effects from exposure to hazards or events, including the burden of epidemic-prone diseases) with the probability of hazards (i.e., the likelihood of exposure to those hazards). This dimension accounts for zoonotic disease hotspot mapping; water, sanitation, and hygiene (WASH) indicators; and factors associated with demography and human habitats (e.g., population density, population living in slums).
- **Vulnerability** dimension**:**
  - This dimension incorporates a One Health approach and encompasses vulnerabilities related to socioeconomics, integrating, *inter alia*, the indicators of the Framework to Evaluate Pandemic Vulnerability and Risks to appropriately capture country-level economic vulnerabilities, inequality, population structure, and climate and ecosystem factors.
- **PPR Capacity** dimension**:**
  - This dimension captures infrastructural and institutional capacities and capabilities needed for PPR, drawing from the IHR, the IHR Monitoring and Evaluation Framework (IHRMEF), health security and health systems resilience, animal health systems, and non-health sector interdependencies.
- **Enabling Environment** dimension:
  - This dimension considers factors affecting the impact and success of interventions, focusing on a country's elements of fragility, crisis severity, governance, institutional quality, and development constraints.

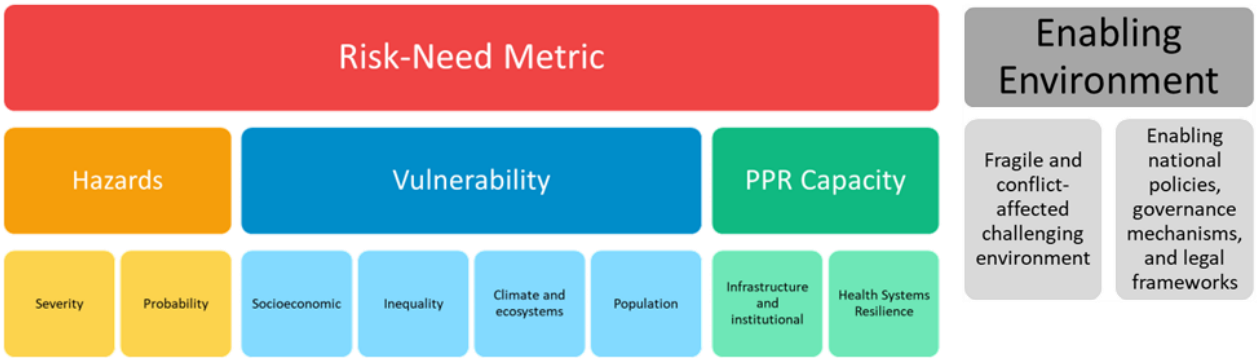

Figure 1. Pandemic Fund Risk-Need Metric analytical framework

6.1 Data sources

The Pandemic Fund Risk-Need Metric leverages evidence-based baseline assessments conducted by other stakeholders, data sources, frameworks for monitoring health system capacities, and methodologies of composite measure development, as shown in Table 1.

Tools/Frameworks	**Usage**
International Health Regulations Monitoring and Evaluation Framework[iv]	Provides IHR-related capacity information
Dynamic Preparedness Metric[v]	Provides guidance on composite measures and selection of relevant indicators for pandemic risk and PPR gaps
World Bank Open Data[vi]	Provides economic and governance indicators
WHO Global Health Estimates[vii]	Provides estimates on the burden of disease
G20 Framework to Evaluate Pandemic Vulnerability and Risks[viii]	Provides information on social and macroeconomic vulnerabilities and risks related to pandemics
FAO-STAT[ix]	Provides information on livestock and food insecurity
World Animal Health Information System (WAHIS) of the World Organisation for Animal Health (WOAH)[x]	Provides information on animal disease outbreaks
Performance of Veterinary Services Pathway[xi]	Provides information on veterinary services capacities and performance, in reference to internationally adopted standards
The Universal Health Coverage index[xii]	Provides information on health system capacities
INFORM Risk Index[xiii]	Provides information on risks related to disasters
Triple Billion Target (part of WHO's Thirteenth General Programme of Work, GPW13)[xiv]	Includes composite measures to incorporate as risk measures, particularly on PPR capacity related to health emergencies
Sustainable Development Goals (SDG)[xv]	Provides information on health, socioeconomic, and ecosystem vulnerabilities

Table 1. Existing tools and frameworks consulted and included in the Pandemic Fund Risk-Need Metric development

The indicators that comprise the Pandemic Fund Risk-Need Metric are derived from a range of established and reliable international data sources, and selected according to the principles of relevance, authoritative sources, measurability, open access, completeness, and timeliness Data for each dimension will be collected and updated quarterly. A breakdown of included indicators is presented in Annex 2: Pandemic Fund Risk-Need Metric indicators.

6.2 Dimensions and components

Each dimension, described above, includes several underlying components organized in a hierarchical structure, and each component is underpinned by a group of indicators and indices.

6.2.1 Hazards dimension

The Hazards dimension assesses the likelihood and impact of pandemic-prone threats. It refers only to infectious diseases, while other hazards like earthquakes, floods and conflict (which can increase exposure to infectious hazards) are included in the vulnerability dimension. This dimension is divided into:

- **Severity** component:
  - *Current Epidemics*: Epidemiological data of ongoing and recent outbreaks (i.e., number of cases and case fatality rate)
  - *Epidemic Burden*: Measures the burden of infectious disease in Disability-Adjusted Life Years (DALYs)
- **Probability** component:
  - *Zoonotic disease spillover risk*: This risk estimate is derived from global composite evaluations of spillover risk from 17 pathogen-specific assessments, accounting for animal reservoirs, vector species and their ranges, environmental suitability, and human case occurrence.
  - *Habitat*: This considers population density and the size of populations living in slums, and livestock density.
  - *WASH*: This covers water, sanitation, and hygiene conditions.

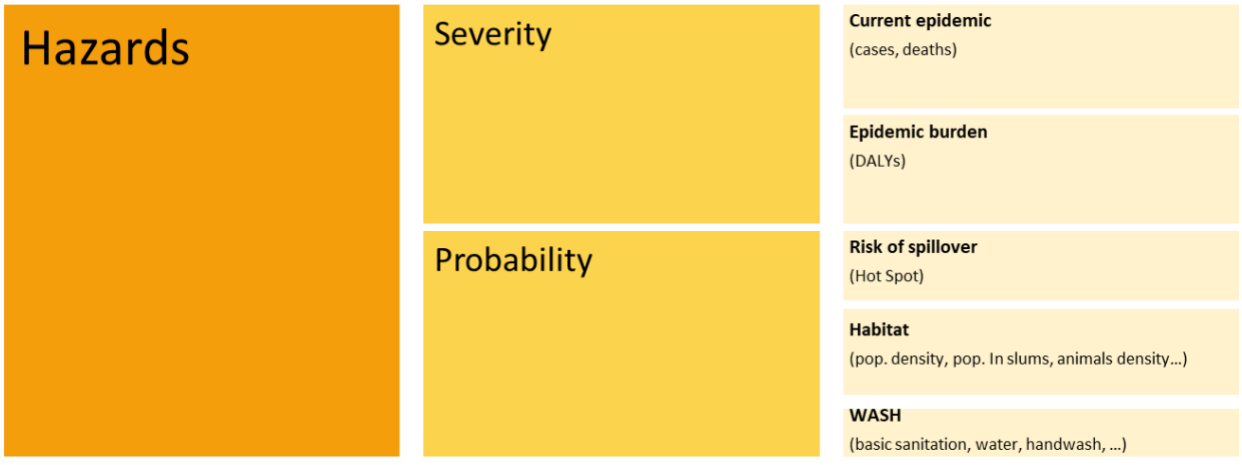

Figure 2: Hazards analytical framework.

6.3 Vulnerability dimension

This dimension measures the susceptibility of populations to pandemics, influenced by:

- **Socioeconomic** component:
  - *Social determinants*: Measures ability to respond and protect social and economic livelihoods through proxies such as access to education and social protection benefits, informal employment, and food insecurity.
  - *Domestic Economy*: Measures ability to effectively manage pandemic events through proxies such as level of development, multi-dimensional vulnerability, poverty gap, and aid for health dependency.
- **Inequality** component:
  - *Gender:* Gender Inequality Index
  - *Income:* Gini Index
  - *Education:* Ratio of girls to boys enrolled at the primary level in public and private schools
- **Climate and ecosystem** component:
  - *Climate Change*: Projected climatological variables (i.e., surface temperature, humidity)
  - *Land Use*: Forest covers, land degradation
  - *Other hazards*: Natural or man-made disasters (i.e., floods, earthquakes, conflicts) that can cause or exacerbate health emergencies
- **Population characteristics** component:
  - *Movement*: International movements of people and animals
  - *Demography*: Age structure of most vulnerable age groups
  - *Health Conditions*: Pre-existing health burdens
  - *Uprooted People*: Refugee and internal displaced populations

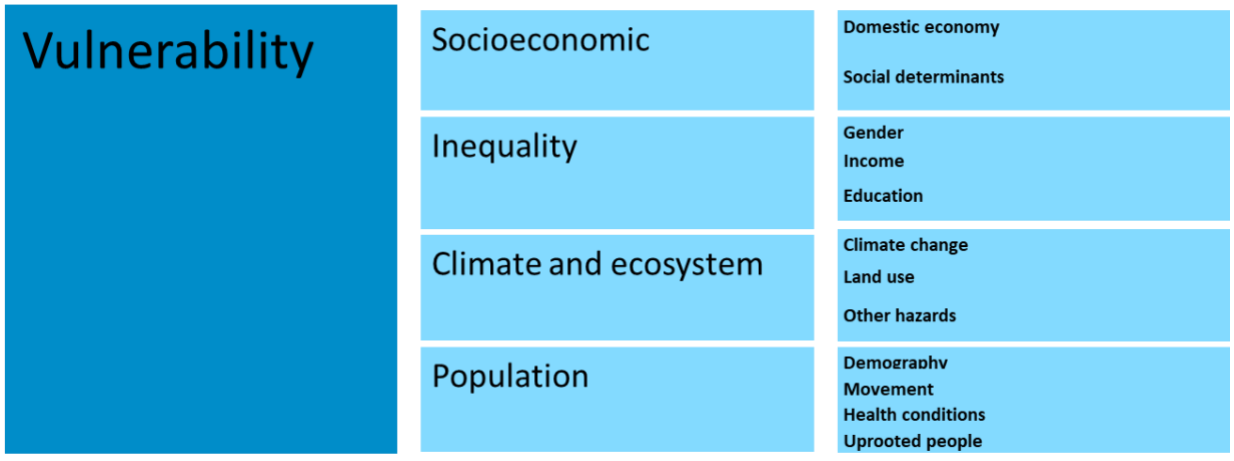

Figure 3. Vulnerability analytical framework.

6.4 PPR Capacity dimension

This dimension assesses the ability to prevent, prepare for, detect, and respond to pandemics, divided into:

- **Infrastructure and Institutional** component:
  - *Governance*: This component includes six domains of governance covered in the Worldwide Governance Indicators, including Voice and Accountability, Political Stability and Absence of Violence/Terrorism, Government Effectiveness, Regulatory Quality, Rule of Law, and Control of Corruption.
  - *Physical Infrastructure*: Captures all infrastructures that are interdependencies of preparedness, but not from the health sector, such as improved sanitation and water supply, access to electricity, accessibility to healthcare in terms of connectivity to facilities and quality of trade and transport-related infrastructure.
  - *Communication*: Information-sharing and risk communication
- **Health Systems Resilience** component:
  - *Health System Capacity (HS Capacity)*: This relates to specific foundational aspects of the health system, such as density of doctors, nurses and midwives; beds-to-population ratios; implementation of antimicrobial resistance (AMR) action plans; and health information systems.
  - *Universal Health Coverage (UHC)*: People receiving quality health services without incurring financial hardship
  - *Health Emergency Preparedness, Prevention, and Response (PPR)*: Frameworks for managing health crises, IHR Monitoring and Evaluation Framework assessments
  - *Animal Health System Capacity*: Achievements, performances, improvements, and maintenance of veterinary services

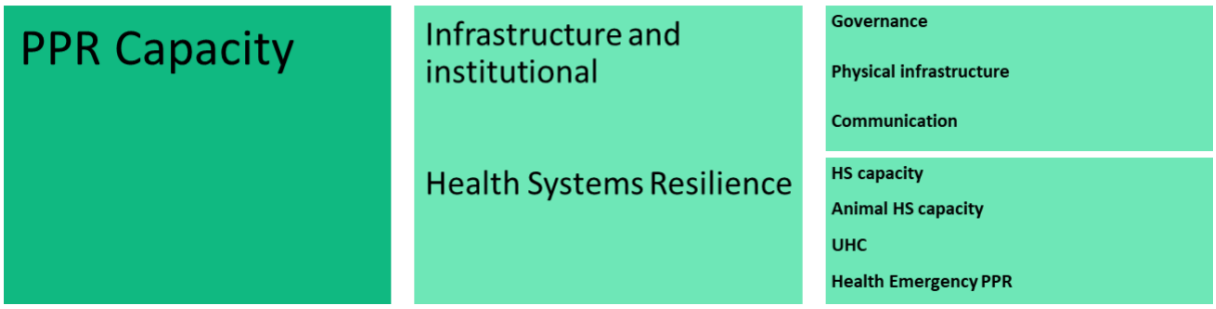

Figure 4. PPR Capacity analytical framework

6.5 Enabling Environment dimension

The Enabling Environment dimension considers factors affecting the impact and success of PPR interventions, focusing on a country's enabling policy and legislative environment. The indicators in this dimension are divided in two components:

- **Fragile and conflict-affected environments:** This component includes classifications of fragile and conflict-affected situations, as provided by the Humanitarian Response Plan, and the severity of humanitarian crises and disasters, as measured by the INFORM Severity Index.
- **Enabling national policies, governance mechanisms, and legal frameworks:** This component covers governance and institutional indices (e.g., CPIA, Worldwide Governance Indicators) and enabling factors such as the degree of multisectoral coordination around PPR (i.e., as measured by the IHR State Party Self-Assessment Annual Reporting (SPAR)), the presence of relevant legal frameworks, human capital to address PPR challenges, and the in-country funding absorption.

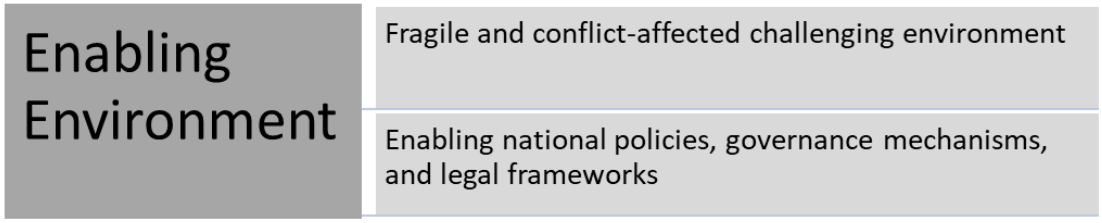

Figure 5. Enabling Environment analytical framework

6.6 Data Analysis/Process

The Pandemic Fund Risk-Need Metric is a composite measure that compiles individual indicators within a hierarchical framework to produce an aggregated index. To develop the Metric, we followed the steps below:

1) **Conceptual framework design:** The Metric's framework leverages the DPM, which similarly considers existing frameworks and metrics to assess and monitor hazards, vulnerabilities, and capacities, and categorizes countries based on their pandemic risk profiles and needs. This initial categorization was then refined by considering the Enabling Environment dimension.

2) **Indicator selection**: Indicators were selected using several key criteria, including relevance, authoritativeness of data sources, measurability, open access, completeness, and timeliness. The indicators originated largely from the DPM, and were integrated with other relevant data covering socioeconomic dimensions of PPR (i.e., Framework to Evaluate Pandemic Vulnerability and Risks) to align with the scope of the Pandemic

Fund Risk-Need Metric. The TWG reviewed the initial set of proposed indicators and provided suggestions and advice to finalize the list. A modified Delphi approach was used to prioritize the indicators, and a correlation analysis helped refine the indicators further. The finalized indicators are collected in a database using automatic or semi-automatic methods.

3) **Imputation of missing data**: Missing data values have been imputed by aggregation with the other indicators comprising the same component (i.e., implicit imputation). However, data for some countries was not available in certain years for a subset of structural indicators. In these cases, a systematic imputation of missing values was performed, using the most recent available data from within the previous five years.

4) **Identification and treatment of outliers:** Potentially problematic indicators that could bias the overall index results were identified based on two distributional characteristics: skewness and kurtosis. According to a rule proposed by the European Commission's Competence Centre on Composite Indicators and Scoreboards (CC-COIN), an indicator should be considered for treatment if it has an absolute skewness greater than 2.0 and a kurtosis greater than 3.5. Skewness and kurtosis were assessed for all variables to detect potential outliers. If outliers were identified, the data were reviewed to determine whether corrective measures—such as winsorisation—were necessary. Following this, the minimum and maximum values for each indicator were established in order to rescale the data to a standardised metric. Log transformations were applied to reduce positive skewness in the raw data. This method is particularly useful when the range of values is very wide. For example, if the animal population in Country X is in the thousands, while Country Y reports animal numbers in the millions, log transformation can be used to compress the numeric scale. This transformation assigns relatively more weight to differences among countries with lower values and less weight to differences at the higher end. Log transformation is optional and applied only when necessary, based on the distributional properties of specific indicators.

5) **Normalisation**: All indicator values were normalised using the min-max normalisation method on a scale of 1 to 10, using the pre-set bounds as minimum and maximum values. The rescaling equation ensured that all rescaled variables are expressed as ascending variables (i.e., higher values denote better performance).

6) **Weighting and aggregation**: The geometric average aggregation method with equal weights was used at all levels to build the Pandemic Fund Risk-Need Metric. In the sensitivity analysis, we tested alternate weighting schemes. The results show that the weighting schemes do not have a significant influence on the final scores, demonstrating the robustness of the aggregation methodology and validity of the default equal weighting scheme.

7) **Analysis of results**: As final result of the previous processes, countries are scored on a scale of 1 to 10 for their Hazard, Vulnerability, PPR Capacity level, and Enabling Environment. Low scores represent a negative performance (i.e., high risk), while high scores represent a positive performance (i.e., low risk). The notion that lower values are indicate worse performance is also applied consistently at the dimension, component and sub-component levels.

8) **Statistical validation:** Correlation and sensitivity analyses have been undertaken to assess the robustness of the Pandemic Fund Risk-Need Metric in terms of collinearity, the normalisation scheme, imputation of missing data, choice of weights, and method of aggregation.

7 Identifying countries with high risk & high need

In development of the Pandemic Fund Risk-Need Metric, several scenarios were tested and discussed for categorizing countries based on different methodological choices.

The country categorization methodology is influenced by two main decision points:

1. **Selection of the categorization metric**: Two alternative metrics were considered for country classification: (i) a matrix approach focused on PPR gaps; and (ii) a comprehensive, risk-based index that incorporates multiple dimensions of risk and vulnerability.
2. **Threshold determination methodology**: This variable addresses how thresholds for categorization are established. Two methods were evaluated: (i) the use of tertiles for equal distribution across categories; and (ii) cluster analysis to identify natural groupings within the data.

Each scenario reflected a different methodological pathway with implications for analysis, interpretation, and operational utility.

To identify countries with high PPR gaps, the Pandemic Fund Risk-Need Metric dimensions can be interpreted as the interaction of **Hazards & Vulnerability** with **PPR Capacity** (Figure 6). Conceptually, PPR capacity should be high enough to compensate for the hazards and vulnerability faced by a country. The combined **Hazards & Vulnerability** dimension is calculated by the geometric average of the two dimensions. This approach gives more weight to PPR Capacity (i.e., 25% Hazards, 25% Vulnerability, 50% PPR Capacity).

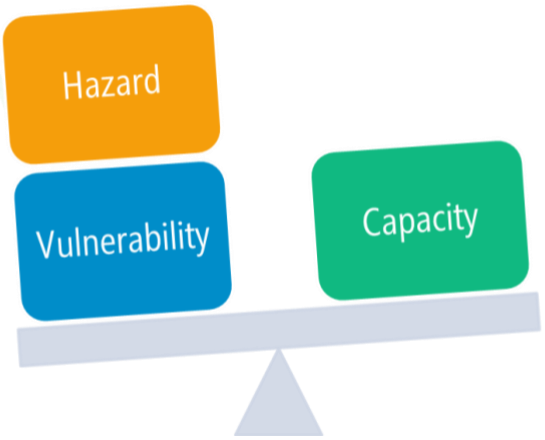

Figure 6. PPR Gaps are defined by a country's PPR Capacity relative to its Hazards & Vulnerability dimension

Hazards & Vulnerability and **PPR Capacity** are categorized into three levels based on the distribution of composite scores, using a hierarchical cluster analysis [xvi] to determine the thresholds for high Hazards & Vulnerability scores and low PPR Capacity scores:

Hazards & Vulnerability:

- **High:** Countries with scores below the lower threshold
- **Medium:** Countries with scores between lower and the higher threshold
- **Low:** Countries with scores above higher threshold

PPR Capacity:

- **Low:** Countries with scores below the lower threshold
- **Medium:** Countries with scores between the lower and higher thresholds
- **High:** Countries with scores above the higher threshold

The hierarchical cluster approach is statistically sound and based on actual score patterns, but less transparent and harder to interpret intuitively.

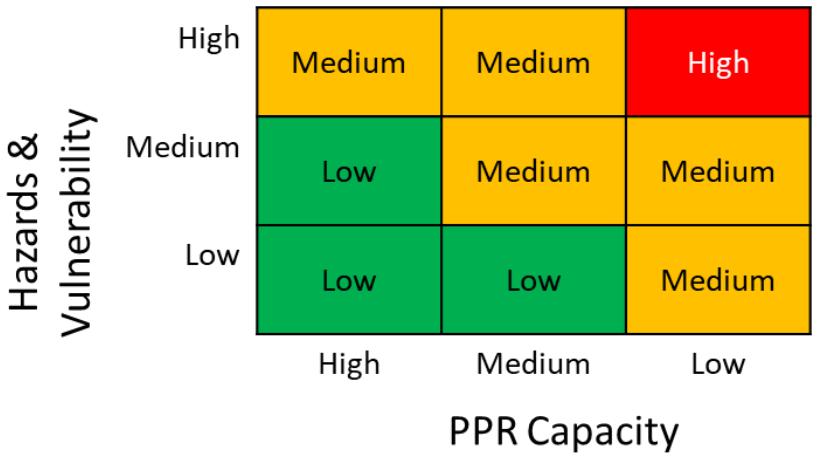

Figure 7. PPR Gaps defined by Hazards & Vulnerabilities compared to PPR Capacity

A risk matrix (Figure 7) is then used to categorize countries based on the PPR Capacity relative to their level of Hazards & Vulnerability. This comparison highlights areas with the most significant PPR Gaps, indicating priority needs for resource allocation and intervention.

- Countries with high Hazards & Vulnerability and low PPR Capacity scores have **high risk and needs**.
- Countries with high Hazards & Vulnerability and either medium or high PPR Capacity scores, or with medium Hazards & Vulnerability and either low or medium PPR Capacity scores, or with low Hazards & Vulnerability and low PPR Capacity scores have **medium risk and needs**.
- Countries with medium Hazards & Vulnerability and high PPR Capacity scores, or with low Hazards & Vulnerability and either high or medium PPR Capacity scores have **low risk and needs**.

7.1 Enabling Environment

After organizing countries into categories, those with challenging environments were subsequently be identified. Countries are categorized as being “challenging environments” based on their scores in the Enabling Environment dimension. Determination of this threshold was made by applying a hierarchical cluster analysis to the Enabling Environment composite scores. All countries with scores falling below this threshold were considered to have “challenging environments.”

8 Validation plan

The methodology incorporates multiple validation approaches: statistical validation through correlation and sensitivity analyses; expert consultation gathering technical stakeholder input; country consultation sessions for local validation and stakeholder buy-in; and continuous methodology refinement through dynamic updates and real-world application experience.

This comprehensive validation framework ensures the tool's evolution beyond initial deployment while maintaining scientific integrity and operational utility for pandemic preparedness resource allocation.

9 Limitations of the methodology

The limitations of this methodology relate primarily to data availability and dynamic factors. Data coverage and recentness are limitations for quantitative global models such as the Pandemic Fund Risk-Need Metric, and will likely make it difficult to obtain timely, up-to-date estimates for each country. In some cases, a country’s risk profile may also reflect limited data availability rather than limited capacity or high vulnerability. Particular caution should be

exercised when interpreting the results for Kosovo and the West Bank and Gaza, due to the large number of missing values. The temporal misalignment is addressed by using the most recent available data and applying tailored update frequencies for different indicator types. This approach maintains statistical coherence while also enhancing the methodology's operational flexibility, particularly for potential intra-annual or annual updates and decision-making.

Furthermore, a key limitation of relying solely on open-source data is that it may not capture the full complexity of a country's operating environment. Proprietary, confidential, or qualitative information—such as internal government assessments, after-action reviews, or in-country expert judgments—could reveal critical insights into operational realities, political dynamics, or systemic weaknesses that are not captured by quantitative indicators alone.

However, open-source, quantitative data is essential for the intended use of the Pandemic Fund Risk-Need Metric. The use of such data ensures transparency, consistency, and comparability across countries and regions, which are difficult to achieve with confidential or non-standardized sources. Standardized data sources make it possible to benchmark country performance, track trends over time, and inform country prioritization in a fair and objective way.

To incorporate animal-sector workforce capacity, an exception to using only open-source data is the inclusion of PVS-related indicators — specifically *Animal Health System Capacity* indicators: (1) PVS Achievement, (2) PVS Improvement, and (3) PVS Maintenance. These PVS data have been made available for the Pandemic Fund Risk Need Metric under a data-sharing agreement between WOAH and the Pandemic Fund Secretariat.

Furthermore, key drivers of pandemic risk such as equity, community engagement, behaviour, societal trust, government cohesion and institutional strength, and prevalence of misinformation have been excluded at present due to a lack of publicly available and consistent data. We will further review and explore the availability of reliable indicators for these areas with the TWG.

The Pandemic Fund Risk-Need Metric provides a national-level risk profile. Such a broad, national-level analysis may be effective for small- to medium-sized countries, but for larger, more heterogeneous countries, this approach may not produce an accurate estimation of pandemic risk.

There is a general challenge of validation related to composite indicators in that the lack of a gold standard and a specific use case for this index creates inherent issues for validation. Composite indicators aggregate diverse information into a single score, potentially obscuring important nuances or context-specific details. Translating the complex realities of pandemic risk into a broad classification or score could present important methodological challenges. Furthermore, the dynamic nature of the data on hazards, vulnerabilities, and capacities means that risk assessments, and thus resource allocation priorities, may shift over time.

Finally, composite indicators do not sufficiently account for interactive effects between dimensions and/or duplication or mischaracterization of relative impact. While the current

model does not explicitly calculate interactions between risk dimensions, it does incorporate some interaction logic through the application of the composite risk formula. In this formulation, risk increases when either hazard or vulnerability rises, or when PPR capacity declines. This structure reflects a basic multiplicative relationship that already captures interdependencies to a degree—for instance, a country with high hazard exposure and low capacity will register a much higher risk score than one where only one of those conditions is present.

Additionally, compounded risks are indirectly integrated through the inclusion of factors that link dimensions. For example, natural disasters—reflected in the vulnerability dimension—can increase the risk of disease outbreaks, which are captured under hazards. This approach recognizes how certain conditions may simultaneously affect multiple aspects of pandemic risk, even without explicit interaction terms.

Looking ahead, future refinements may include a review of the methodological approach to better account for complex interactions. This could involve interaction terms, non-linear modelling, and scenario-based stress testing to capture potential synergies, trade-offs, or tipping points in countries' risk profiles. However, implementing these enhancements would require additional analytical work and resources, and their feasibility will need to be assessed based on cost and value added.

10 Main outputs

- *Country Classification*: a list of countries that are at the intersection of high hazards, high vulnerability, and low capacity, considering enabling environment factors. The lists will be updated regularly using the most recent data.
- *Methodology Documentation*: A comprehensive document outlining the methods used for the Pandemic Fund Risk-Need Metric, the analytical plan, and a monitoring strategy, including the analytical component.
- *Indicator Database*: A database of all indicators used in the Pandemic Fund Risk-Need Metric, with automated data updates.

11 Other potential applications of the Pandemic Fund Risk-Need Metric

While the Pandemic Fund Risk-Need Metric is primarily designed for identifying eligibility for the Allocation Modality 1, a targeted modality to support high-risk and high-countries, there are other potential applications of the metric, pending modifications and further discussions. Such applications could potentially include the following:

Gap identification and proposed actions for strengthening preparedness

- Based on resultant scores, the Metric could identify the main drivers of pandemic risk in different countries.
- Countries could use the metric to inform their preparedness status and support prioritization and implementation of specific actions to improve capacities.

Risk management

- The metric could support countries in health emergency risk management.
- By tracking evolving hazards, vulnerabilities, and capacities, countries could assess and contextualize planning for preparedness and readiness over time. For example, risks for cholera follow a seasonal pattern, reflecting some root causes of the disease (e.g., floods, droughts and climate conditions).

Monitoring & Evaluation of Pandemic Preparedness and Response (PPR) Capacity

- The Metric could help track country progress over time by assessing improvements or gaps in pandemic preparedness efforts.

Dynamism for operational readiness

- The Metric could support operational readiness by allowing decision-makers to monitor risk trends to inform readiness actions.
- Countries could develop, enhance, and sustain dynamic operational readiness capabilities, investments, and actions prioritized in line with recurring health risk assessments.

Enhancing Governance, Policy, and Multi-Sectoral Collaboration

- The Metric could stimulate and promote cross-sector engagement for holistic public health strategies.
- The metric could also be used to strengthen institutional frameworks to support emergency preparedness.

Early Warning and Risk Prediction

- If integrated with real-time data, the metric could potentially provide early signals of emerging threats, thereby enabling rapid response.

Annex 1: Pandemic Fund Risk-Need Metric development process and timeline

WHO Project Management Team

The WHO Project Management Team, in coordination with the Pandemic Fund Secretariat, coordinated the day-to-day execution of the technical work, including, but not limited to methodology development, data analysis, testing and validating the methodology (with members of the TWG), reporting, classification of countries, and documentation. The WHO Project Management Team convened and led regular consultations with the TWG, consulted with external experts, organised consultations, and incorporated consultation feedback.

Technical Working Group (TWG)

The TWG provided expert advice and inputs on the development and implementation of the Pandemic Fund Risk-Need Metric and its methodology. The TWG comprised of Implementing Entities and other key partners, including African Development Bank, Asian Development Bank, Food and Agriculture Organization of the United Nations, Inter-American Development Bank, the Coalition for Epidemic Preparedness Innovations, UNICEF, the World Bank, and the World Organisation for Animal Health. The TWG's role was to:

- Provide technical expertise and input on the methodology underpinning the Pandemic Fund Risk-Need Metric.
- Review and provide technical feedback on the draft methodology and preliminary results.
- Consult external experts as needed for any specialised or additional inputs.
- Participate in country consultations to help build consensus on the Pandemic Fund Risk-Need Metric and methodology.

Pandemic Fund Technical Advisory Panel

The Pandemic Fund TAP provided strategic oversight and guidance for the development of the methodology, leveraging its members' existing roles and expertise. The TAP conducted two intermedial reviews and a final review.

Expert consultation

The primary objective of the expert consultation was to gather input from technical experts and stakeholders on the Pandemic Fund Risk-Need Metric, with a focus on reviewing the selected indicators and their rationale, critically assessing the methodology and analytical framework, evaluating the results of country categorization, and advising on its wider application as a

public good. The consultation aimed to produce targeted feedback and recommendations on these areas. Participants included experts from all WHO regions, relevant institutions, public health organizations, and academia, with attention to gender and geographic balance.

Country information sessions

The purpose of the country consultations was to engage countries on the ongoing development of the Pandemic Fund Risk-Need Metric and its methodology.

The specific objectives were to:

- Validate the Pandemic Fund Risk-Need Metric and its methodology.
- Solicit technical and contextual inputs to refine and enhance the methodology.
- Build consensus before it is finalized and applied to guide targeted allocations.

Implementation Timeline

The implementation plan aligned with the Pandemic Fund Board-approved workplan and timeline for Modality (1):

- Concept note and draft of analytical plan development (January-February 2025)
- Establishment of TWG (February 2025)
- Methodology development, consultation with external experts, and first TAP review and validation (March-April 2025)
- Pandemic Fund Secretariat to update the Governing Board Strategy Committee (March-April 2025)
- Expert consultation (May 2025)
- Incorporate feedback and undertake countries information sessions (July 2025)
- Finalize methodology and commence second TAP review (August 2025)
- Prepare final submission for the TAP (August 2025)
- TAP to update the Governing Board Strategy Committee on progress and recommendations (September 2025)
- TAP validation and submission of recommendations to Pandemic Fund Board for endorsement (end of September 2025)
- Endorsement of the Pandemic Fund Risk-Need Metric and methodology by the Governing Board (November 2025)

Annex 2: Pandemic Fund Risk-Need Metric indicators

Dimension	Component	Sub-component	Indicator Name
Hazard	Severity	Current epidemics	Total number of cases of ongoing/recent outbreaks
			Case fatality rate (CFR) of ongoing/recent outbreaks
		Epidemic burden	DALYs attributable to communicable diseases (pandemic-prone diseases only)
			Average number of zoonosis outbreaks in animals in the last 5 years
	Probability	Risk of spillover	Spillover of zoonotic pathogens
		Habitat	Population density
			Population living in slums (% of urban population)
			Density of livestock
		WASH	Proportion of population with basic handwashing facilities on premises (% of population)
			People using at least basic sanitation services (% of population)
			People using at least basic drinking water services (% of population)
			People practicing open defecation (% of population)

Dimension	Component	Sub-component	Indicator Name
Vulnerability	Inequality	Gender	Gender Inequality Index (GII)
		Education	School enrolment, primary (% gross), gender parity index (GPI)
		Income	GINI coefficient
	Socioeconomics	Domestic Economy	Human Development Index
			Multidimensional Vulnerability Index
			Poverty Gap
			Development Assistance for Health (DAH) as a Percentage of Total Health Expenditure
		Social determinants	Net enrolment rate in primary education
			Access to social protection benefits - Proportion of population covered by at least one social protection benefit (%)
			Prevalence of moderate or severe food insecurity in the population
			Informal employment
	Population	Movement	Air transport, passengers carried
			IHR core capacity: point of entry
			Annual Volume of Live Livestock Traded (imported) per 1,000 People
		Health status	DALYs attributable to cardiovascular disease, cancer, diabetes or chronic respiratory disease
			Mortality rate among children under 5 (per 1,000 live births)
			Prevalence of stunting, height for age (modelled estimate, % of children under 5)
		Demographics	Under-5 population
			Population over 65
		Uprooted people	Hosted refugees
			Internal Displaced People (IDPs)
	Climate and ecosystem	Climate change	Average Surface Temperature (projected)
			Average relative humidity (projected)
		Land use	Proportion of land that is degraded over total land area
			Evergreen broadleaf trees
		Other hazards	Percentage of the total population affected by natural disasters
			INFORM Severity Index
			Population exposed to seasonal floods, droughts, earthquakes, and tropical cyclones.

Dimension	Component	Sub-component	Indicator Name
PPR Capacity	Health Systems Resilience	Health emergency PPR	Prepare indicator (Health Emergencies Preparedness Index, HEPI)
			Prevent indicator (HEPI)
			Detect, Notify and Respond indicators (HEPI)
		UHC	Coverage of essential health services
			Proportion of population with large household health expenditures as a share of total household expenditure or income
			Out-of-pocket expenditure (% of current health expenditure)
		Health system capacity	Physician density
			Density of nurses and midwives
			Number of beds per 1,000 people
			Survey, Count, Optimize, Review, Enable (SCORE)
			Tracking AMR Country Self-assessment Survey
			One Health collaborative efforts across sectors on activities to address zoonoses (SPAR C12.1)
			Laboratory (SPAR C4)
			Continuity of essential services (SPAR C8.3)
		Animal health system capacity	Achievement and Performance of the Veterinary Service (PVS)s
			Improvement of the PVSs
			Maintenance of the Veterinary Services
	Infrastructure and institutional capacity	Governance	Worldwide Governance Indicators
		Physical infrastructure	Safely managed sanitation
			Safely managed water
			Access to electricity
			Logistics performance index
			Connectivity to HCF
		Communication	Internet users
			Mobile cellular subscriptions
			Risk communication and community engagement (SPAR C10)

Dimension	Component	Indicator name
Enabling Environment	Fragile and conflict-affected challenging environment	HRP (Humanitarian Response Plan)
		INFORM Severity Index [NB: also included in the Vulnerability dimension]
	Enabling national policies, governance, and legal frameworks	Policy, legal and normative instruments (SPAR C1.1)
		Multisectoral coordination mechanisms (SPAR C2.2)
		CPIA: IDA resource allocation index
		CPIA: transparency, accountability, and corruption in the public sector
		Worldwide Governance Indicators [NB: also included in the PPR Capacity dimension]
		Human Capital Index (HCI)
		In-countries absorption (Global Fund)

[i] Pandemic Fund. 2024. "Pandemic Fund Strategic Plan." June 2024. https://www.thepandemicfund.org/sites/default/files/2024-06/Pandemic%20Fund%20Strategic%20Plan.pdf.

[ii] United Nations Office for Disaster Risk Reduction (UNDRR). 2017. "The Sendai Framework Terminology on Disaster Risk Reduction." Accessed May 13, 2025. https://www.undrr.org/terminology/disaster-risk.

[iii]World Health Organization. Dynamic Preparedness Metric (DPM) https://extranet.who.int/sph/dpm

[iv] World Health Organization. "International Health Regulations Monitoring and Evaluation Framework." https://www.who.int/emergencies/operations/international-health-regulations-monitoring-evaluation-framework.

[v] World Health Organization. 2024. "Dynamic Preparedness Metric: Methodology Report." https://iris.who.int/handle/10665/377099.

[vi] World Bank. https://data.worldbank.org/

[vii] World Health Organization. "Global Health Estimates." https://www.who.int/data/global-health-estimates.

[viii] G20. 2023. "Report on Economic Vulnerabilities and Risks to Pandemics and Potential Policy Measures." August 2023. https://g20.in/content/dam/gtwenty/gtwenty_new/document/aug_docs/2_new_G20_Report_FEVR_Paper2Report.pdf.

[ix] FAO. 2025. FAO-STAT. https://www.fao.org/faostat/en/#data Licence: CC-BY-4.0.

[x] WOAH. WAHIS: World Animal Health Information System. https://wahis.woah.org/#/home

[xi] World Organisation for Animal Health (WOAH). "PVS Pathway." https://www.woah.org/en/what-we-offer/improving-veterinary-services/pvs-pathway/.

[xii] World Health Organization. "Health Emergency Preparedness and Response Indicator." https://data.who.int/indicators/i/9A706FD.

[xiii] European Commission Joint Research Centre. "INFORM Index for Risk Management." Disaster Risk Management Knowledge Centre. https://drmkc.jrc.ec.europa.eu/inform-index.

[xiv] World Health Organization. "Global Progress on Triple Billion Dashboard." https://data.who.int/dashboards/global-progress/triple-billion?n=o.

[xv] United Nations Statistics Division. "SDG Global Database." https://unstats.un.org/sdgs/dataportal/database.

[xvi] UC Business Analytics R Programming Guide. "Hierarchical Cluster Analysis." https://uc-r.github.io/hc_clustering.

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