

Supplementary Appendix

Health capacity and vulnerability in context of COVID-19 outbreak - an analysis of 185 countries

Extraction of indicators

State Parties Annual Reporting (SPAR):¹ SPAR evaluates 13 capacities using 24 indicators (bracketed number shows indicators per capacity): IHR legislation and financing (3), IHR strategic coordination (2), Zoonotic events and human-animal interface (1), Food safety (1), Laboratory (3), Surveillance (2), Human resources (1), Emergency preparedness for response (3), Health service provision (3), Risk communication (1), Points of entry (2), Chemical events (1), and Radiation emergencies (1).

All capacities but 4 (zoonoses, food safety, chemical events, and radiation emergencies) were considered relevant to the context of COVID-19 based on current evidence. An indicator for health capacity was extracted by averaging 20 indicators covering all 9 relevant capacities.

Joint External Evaluation (JEE):^{2,3} The JEE data has 49 indicators grouped according to 19 technical areas: Legislation (2), Coordination (1), Antimicrobial resistance (4), Zoonoses (3), Food safety (1), Bio-safety and biosecurity (2), Immunization (2), Laboratory (4), Surveillance (4), Reporting (2), Human resources (3), Emergency preparedness (2), Emergency response operation (4), Linking public health and security (1), Medical countermeasures and personal deployment (2), Risk communication (6), Points of entry (2), Chemical events (2), and Radiation emergency (2).

All technical areas except 5 (antimicrobial resistance, zoonoses, food safety, chemical events, and radiation emergency) were considered relevant to COVID-19. A health capacity indicator based on JEE was calculated as average of 37 indicators covering the 14 relevant technical areas.

Indicators of overall vulnerability were extracted from Infectious Disease Vulnerability Index (IDVI) and INFORM Epidemic Risk Index (IERI) data.^{4,5}

All indicators were rescaled from 0-100 from lowest to highest health capacity and highest to lowest vulnerability.

Choosing the metrics for health capacity and vulnerability

4 potential pairs of metrics for health capacity and vulnerability were identified: SPAR-IDVI, SPAR-IERI, JEE-IDVI, and JEE-IERI.

A multivariate correlation analysis of the 4 extracted indicators (SPAR, JEE, IDVI, and IERI) was performed. Only countries with data available for all 4 indicators (n = 95) were included in the analysis. The analysis (Figure S1) showed high correlation between SPAR and JEE ($r = 0.886$), and between IDVI and IERI ($r = 0.665$). The lowest correlation was found between SPAR and IERI ($r = 0.481$). A lower correlation between

the metrics of health capacity and vulnerability was interpreted as lower redundancy and thus higher complementarity.

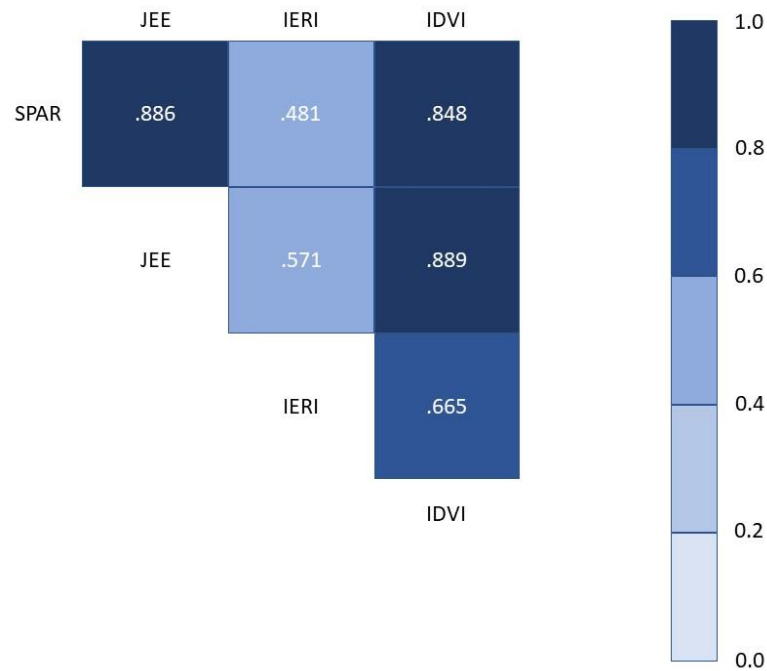


Figure S1. Correlogram showing correlation coefficients from the multivariate analysis

Availability of data was considered for each pair. SPAR-IDVI pair had highest data availability ($n = 187/194$), followed by SPAR-IERI pair ($n = 185/194$). JEE data was available for very limited number of countries ($n = 95/194$), so all JEE pairs were excluded. SPAR-IDVI pair was also excluded because of high correlation among the two metrics. Hence, we selected SPAR and IERI to capture health capacity and vulnerability of 185 countries in the context of COVID-19 after excluding 9 countries with missing SPAR or IERI data (Figure S2).

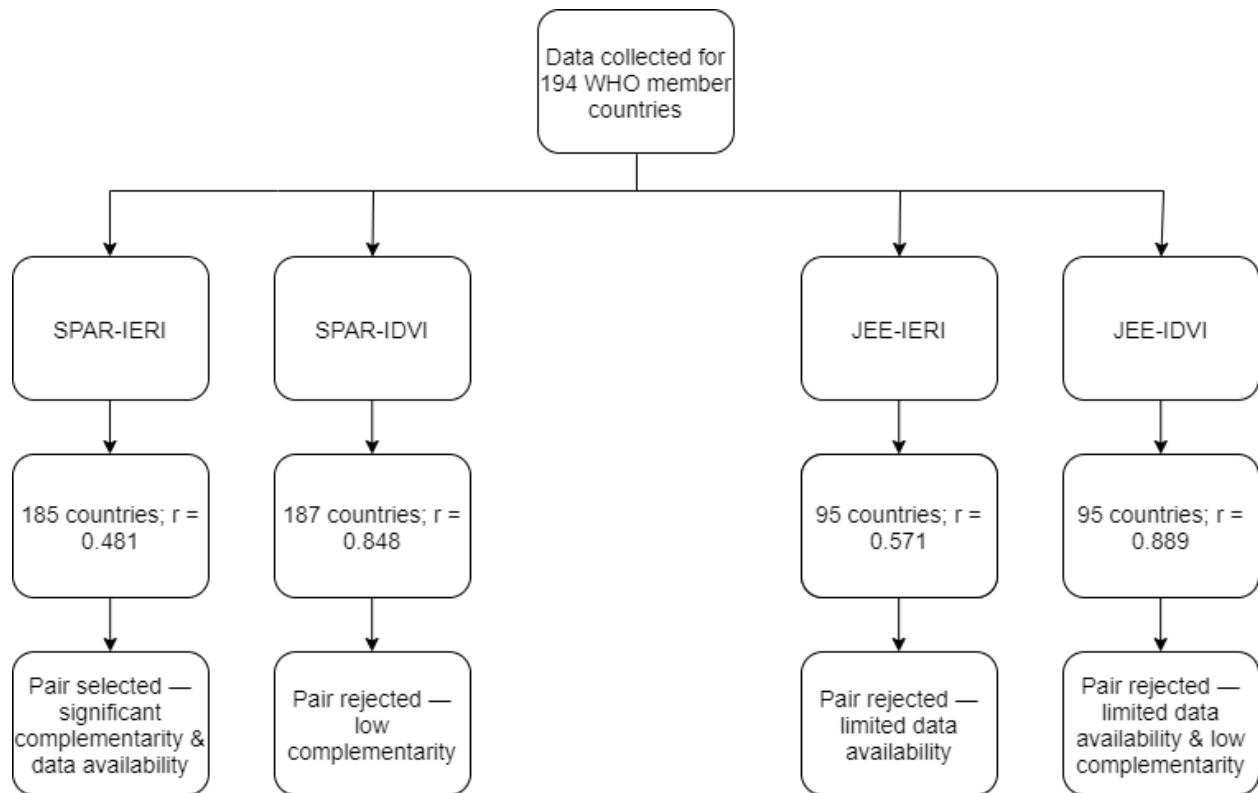


Figure S2. Flowchart illustrating metrics pair selection

Excluded countries

9 countries were excluded due to missing SPAR or IERI data: Andorra, Barbados, Bolivia, Brunei, Cook Islands, Grenada, Monaco, Niue, and San Marino. IERI indicators were missing for Andorra, Cook Islands, Monaco, Niue, and San Marino. SPAR scores were missing for rest of the countries.

References

1. 1. WHO. Electronic State Parties Self-Assessment Annual Reporting Tool. Available from: <https://extranet.who.int/e-spar>.
2. 2. WHO. Joint external evaluation tool: International Health Regulations (2005). Geneva: World Health Organization;; 2018.
3. 3. WHO. Joint External Evaluation (JEE) mission reports. Available from: <https://www.who.int/ihr/procedures/mission-reports/en/>.
4. 4. Moore M, Gelfeld B, Okunogbe AT, Paul C. Identifying Future Disease Hot Spots: Infectious Disease Vulnerability Index. Santa Monica, USA: RAND Corporation;; 2016.
5. 5. Karmen P, Montserrat MF, Luca V, Laura M. Incorporating epidemics risk in the INFORM Global Risk Index. Luxembourg: Publications Office of the European Union;; 2018.