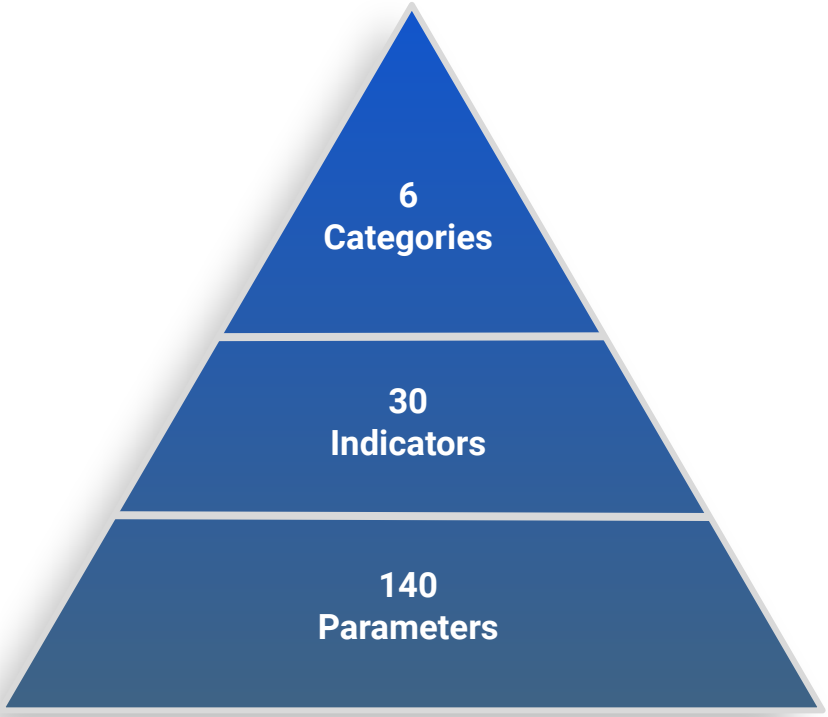
Analytical Framework and Methodology

COVID-19 Regional Safety Index: Introduction

The framework comprises 6 top-level categories (Quarantine Efficiency, Government Efficiency of Risk Management, Monitoring and Detection, Health Readiness, Regional Resilience and Emergency Preparedness).

Each category consists of a matrix of sub-parameters (referred to here as Indicators), which relate to specific factors of importance impacting the stability of current regional circumstances, of the effectiveness of various regions' emergency response efforts, and these variables will also address post-pandemic planning measures in future studies.

Finally, each indicator itself consists of a matrix of 2-10 quantitative or qualitative sub-parameters, relating to the specific topic, analytical focus and end-point of their parent indicator. Quantitative parameters are numeric, and are obtained from a variety of reputable, publicly available sources of data. Qualitative parameters are binary, and regions are assigned either a 1 or a 0, which represent an answer to a specific yes/no question.



COVID-19 Regional Safety Index: Data Sources

Data collection is an essential stage of the research. Accurate data collection is essential to maintaining the integrity of research. To answer relevant questions of the working paper and evaluate outcomes, data used for this analysis was collected from credible sources.

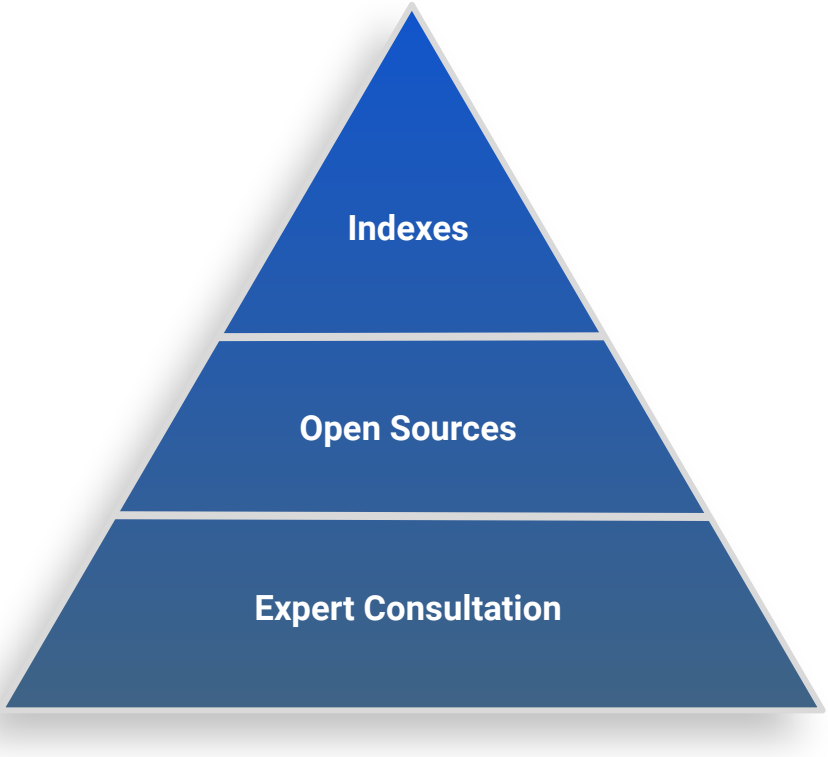
- World Health Organization
- World Bank Open Data
- Peer-Reviewed Scientific Publications
- E-Government Development Index
- UNdata
- IndexMundi
- World Population Review
- EuropePMC
- GHS Index
- WCRF International
- OECD Data
- Government Reports
- Worldometers
- Human Development Index
- Corruption Perceptions Index
- Our World in Data
- TheGlobalEconomy.com
- The Lancet
- WORLD LIFE EXPECTANCY
- ProCon.org

COVID-19 Regional Safety Index: Data Accuracy Review

The index utilizes a combination of publicly available databases (including but not limited to indexes and region statistics), as well as manually-curated and researched quantitative and qualitative data obtained by manual searches using search engines, media and governmental reports, and the use of expert opinions and consultations in cases where data was not available.

In utilizing three qualitatively distinct sources of data, Deep Knowledge Group analysts have attempted to overcome barriers in conducting a robust and comprehensive, yet reliable and methodologically-rigorous analysis by utilizing the largest and most reputable databases (usually constructed by an unbiased international group or foundation) where possible, by consulting region-specific resources in cases when open-source international databases are not possible, and finally by utilizing expert opinion in all cases where publicly-accessible regional and/or international sources of data are unavailable.

By utilizing this approach, the present analysis attempts to find an optimal balance between using maximally transparent and reliable sources of data, and including data which are only obtainable from expert consultation.



COVID-19 Regional Safety Index: Data Modeling and Calculations

Each parameter in all three layers of the framework (categories, indicators and parameters) is assigned a specific weight, or importance factor, designed to approximate the relative importance of each parameter or parameter-matrix on the effectiveness of a region's current situation, emergency response efforts or post-pandemic preventive measures as it relates to the specific analytical focus and endpoint of its parent group (indicator or category).

While the index takes into account both positive and negative factors impacting a given region's current or future (post-pandemic) stability, each binary question is constructed in such a way that a higher value is associated with more favorable conditions. Thus, for example, a higher score in an indicator or parameter within top-level categories focused on risk (such as region vulnerability) indicates less vulnerability, rather than higher vulnerability, than a lower score within the same category, indicator or parameter.

Deep Knowledge Group analysts first worked to formulate the specific list of parameters (categories, indicators and parameters), and to assign relevant parameter weights (importance factors) and then gathered data from government and academic publications; and websites of government authorities, international organizations, non-governmental organizations, and local and international news and media reports in order to compute the score for each parameter.

The research process proved challenging, both because of the difficulty in sourcing data and official information related each quantitative and qualitative parameter and, in some cases, because of a lack of publicly available information.

COVID-19 Regional Safety Index: Data Modeling and Calculations

Modeling the parameters, indicators, and categories in the COVID-19 Regional Safety Index results in overall scores of 0–100 for each region, in which 100 represents the most favorable conditions possible and 0 the least favorable (with respect to the topical focus of each parameter).

A score of 100 in the Index does not indicate that a region has perfect regional stability conditions, and a score of 0 does not mean that a region has no regional stability at all. Instead, scores of 100 and 0 represent the highest or lowest possible scores, respectively, as measured by the Index criteria.

1. The values of each parameter are averaged to determine the value of their parent indicator: ***indicator score = average of weighted individual parameters***
2. Then, the indicator score is multiplied by the weight of the indicator, and is normalized (multiplied by 100) in order to allow for a final category value to be made by summing the individual values of all normalized indicators in each category.
3. Finally, the aggregate value of each category (consisting of the sum of indicators) is multiplied by the weight of the category. The final cumulative index score for each region is the obtained by summing the individual category weights. Thus, the category values consist of a weighted total of the indicator values within each category: ***category score = ∑ weighted individual indicators***

The category values have been normalized on the basis of the following equation: $x = (x - Min(x))/(Max(x) - Min(x))$, where Min(x) and Max(x) are the lowest and highest values, respectively, in the COVID-19 Regional Safety Index (of the 20 regions) for any given indicator. The normalized value (i.e., a score of 0–100) makes it directly comparable with other normalized indicator scores.

COVID-19 Regional Safety Index: Principal Component Analysis

Principal components analysis (PCA) is a data science technique used to quantitatively define the way that indicator weights are assigned in order to create a “composite index” (a ranking based on a weighted sum of specific indicators). PCA allows us to remove redundant information that are shared among two or more indicators by creating a weighting that accounts for the greatest amount of variance in the data.

The PCA weights that have been used to create Deep Knowledge Group’s COVID-19 Regional Stability Ranking are provided in order to provide further depth into the model’s construction. However, they should be considered as complementary tools, and not as supplemental weights to override the default weights assigned to indicators, parameters and categories, or as a direct means of understanding the regional index scores themselves, because they do not take into account the “impact factor” or significance-based weights used in the model.

PCA gives a weight to each component in an the index which takes into account covariance between indicators, and the degree with which a particular component (parameter, indicator or category) maximizes the variation among scores in the index. In essence, it is a method used to minimize redundancy between variables and maximize variation as it pertains to the actual final index scores.

In simplified terms, it minimizes the importance or impact of redundant factors shared among variables and maximizes the importance of impact of non-redundant factors that contribute significantly to the final output of the index (the regional scores).

Principal Component Analysis

Each PCA weight is calculated by taking the principal component (known as the eigenvector) associated with the highest explained variance (known as the eigenvalue), which constitutes a method of decomposing data into independent components ordered by informational content. Valid PCA makes several important assumptions. These include (1) the assumption that variance is meaningful and not the result of significant measurement errors in the data itself, and (2) that the assumption that that the dynamic in question are along the direction with the largest variance.

Single-stage PCA analysis solves for the weights maximize variance across all variables, irrespective of which top-level category they belong to. The following steps are followed:

- Perform PCA analysis on all indicators, ignoring the category they belong to.
- Use the principal component associated with the highest eigenvalue.
- Set negative components to zero.
- Normalize indicator weights (such that the sum of weights is equal to 1).
- Normalize the category weights (such that the sum of categories is equal to 1).
- Use the sum of the non-normalized parameter weights and assign this as the indicator weight for that category.
- Renormalize top-level indicator weights across indicators so that those also sum to 1.

Variation within indicator weights is a sign that redundancy is occurring in the elements or that some elements are not as relevant in explaining the variation in the overall index once all the other variables are considered. Finding equal weights across indicators is a sign of very little redundancy across subgroups and similar relevance in explaining variation in the COVID-19 Regional Safety Index, which suggests that the Index has been divided into subgroups appropriately.

COVID-19 Regional Safety Assessment Analytical Framework

DEEP KNOWLEDGE GROUP

Quarantine Efficiency

- Scale of Quarantine
- Quarantine Timeline
- Criminal Penalties for Violating Quarantine
- Economic Support for Quarantined Citizens
- Economic Supply Chain Freezing
- Travel Restrictions

Government Efficiency of Risk Management

- Level of Security and Defense Advancement
- Rapid Emergency Mobilization
- Efficiency of Government Structure
- Economic Sustainability
- Pandemic Readiness
- Legislative Efficiency

Monitoring and Detection

- Monitoring Systems & Disaster Management
- Scope of Diagnostic Methods
- Testing Efficiency
- AI for Diagnostics and Prognostics
- Government Surveillance Technology for Monitoring
- Reliability and Transparency of Data

Healthcare Readiness

- COVID-19 Equipment Availability
- Mobilization of New Healthcare Resources
- Quantity and Quality of Medical Staff
- Level of Healthcare Progressiveness
- Level of Technological Advancement
- Epidemiology System Level of Development

Regional Resiliency

- Infection Spread Risk
- Culture Specifics and Societal Discipline
- Level of Modern Sanitization Methods
- Demography
- Chronic Diseases
- Geopolitical Vulnerability

Emergency Preparedness

- Societal Emergency Resilience
- Emergency Military Mobilization Experience
- Surveillance Capabilities
- Previous National Emergency Experience

COVID-19 Quarantine Efficiency

Scale of Quarantine

This indicator quantifies the current scale of a region's quarantine measures, including both the total size and the geographical distribution of quarantine efforts. Different weightings are given for full-scale quarantine vs. mandatory social distancing measures.

Quarantine Timeline

This indicator qualifies how early (with respect to the overall timeline of infection spread) that a region implements quarantine and social distancing measures, with respect to the total number of cases present and the geographical distribution of infection at the time of implementing quarantine and social distancing measures.

Criminal Penalties for Violating Quarantine

This indicator quantifies and qualifies the presence and severity of a region's criminal penalties for violating imposed quarantine and social distancing measures. regions that police such violations are generally better equipped to limit infection spread.

Economic Support for Quarantined Citizens

This indicator qualifies and quantifies the level of economic support provided by governments to citizens under stay-at-home or lockdown orders. Economic support provides citizens with the capacity to stay at home in practice.

Economic Supply Chain Freezing

This indicator quantifies the extent of governments' efforts to "freeze" economic and supply-chain activity, which allows for nationwide lockdowns to occur in practice, and in a way that is believed to minimize eventual negative economic repercussions of the pandemic.

Travel Restrictions

This indicator quantifies the scale of regions' travel restrictions on both citizens and tourists in order to minimize infection spread. Different weightings are given for domestic and international travel restrictions.

COVID-19 Government Efficiency of Risk Management

Level of Security and Defense Advancement

This indicator quantifies the current scale of a region's military security and defense capabilities (taking into account both national security and reserve capacities for neutralizing potential external geopolitical threats).

Rapid Emergency Mobilization

This indicator serves qualifies the robustness of a region's capacity to mobilize emergency response measures in the face of national emergencies, including pandemics.

Efficiency of Government Structure

This indicator measures various nations' capacity for rapid and effective governance to provide insight on which regions have the greatest risk of dealing with the COVID-19 pandemic (and its potential economic, societal and geopolitical consequences) in a non-optimal manner.

Economic Sustainability

This indicator qualifies and quantifies the overall level of the region's economic stability and sustainability (taking into account not just the current state of economy, but also the growth rate of its debt and its capacity to remain economically sustainable in a post-pandemic era).

Pandemic Readiness

This indicator quantifies a region's level of preparedness in rapidly mobilizing nation-wide emergency response measures in response to pandemics across legal, economic and social efforts to minimize a pandemic's negative effects on their citizens health and their economy.

Legislative Efficiency

This indicator quantifies the flexibility and comprehensiveness of the region's legislative infrastructure and resources for rapidly deploying emergency response legislation on a nation-wide scale.

COVID-19 Monitoring and Detection

Monitoring Systems and Disaster Management

This indicator quantifies how advanced and sophisticated a region's surveillance and monitoring technologies are, including both the depth and breadth of technologies (the diversity of surveillance and monitoring technologies, and their general level of sophistication).

Testing Efficiency

The indicator quantifies regions' average testing efficiency, considering both the average time to get results from an administered test, and the average test backlog based on available lab analysis personnel.

Government Surveillance Technology for Monitoring

This indicator quantifies how advanced and widespread a region's surveillance and monitoring activities are. Widespread monitoring gives governments greater capacity to track infection rates and compliance with quarantine and social distancing measures.

Scope of Diagnostic Methods

This indicator qualifies the scope, breadth and diversity of the specific diagnostic techniques in standard use in a region, assuming a relationship between the diversity and effectiveness of diagnostic techniques.

AI for Diagnostics and Prognostics

The indicator qualifies whether the use of AI and data-driven techniques for diagnostic analysis are in widespread use in a region. Such techniques lower the burden on resources and personnel dedicated to analyzing the results of COVID tests and patient prognosis.

Reliability and Transparency of Data

This indicator qualifies the reliability and transparency of a region's reported infection, hospitalization and mortality statistics. Many regions appear to be manipulating their data to obscure the true level of infection, hospitalization and mortality.

COVID-19 Healthcare Readiness

COVID-19 Equipment Availability

This indicator quantifies the size (total and per capita) of emergency equipment stockpiles (i.e., medical supplies and emergency treatment supplies used to treat COVID-19 patients in hospital.

Mobilization of New Healthcare Resources

This indicator takes into account a region's preparedness for mobilizing additional healthcare resources (supplies, equipment, treatments and personnel) beyond their current capacity, taking into account existing guidelines and policies for emergency healthcare mobilization.

Quantity and Quality of Medical Staff

This indicator takes into account the quantity of medical staff and healthcare workers (doctors, nurses, administrative staff, etc.) in the region and the average level of medical doctors' education and expertise.

Level of Healthcare Progressiveness

This indicator provides a measure of the general level of a technological advancement and progressiveness of a region's medical science and healthcare infrastructure, and serves as an approximation of the overall quality of medical treatment in that region.

Level of Technological Advancement

This indicator ranks regions according to their healthcare system's level of technological sophistication, modernization and effectiveness in comparison to other regions.

Epidemiology System Level of Development

This indicator ranks the epidemiology system of a region (including both epidemiologists and epidemiological resources, companies, etc), in terms both of quantity and regional distribution, as well as in terms of technological sophistication.

COVID-19 Regional Resiliency

Infection Spread Risk

This indicator quantifies nations' overall spread infection risk, and is used in order to provide information on which citizens of which regions have the highest and lowest overall risk of getting infected with COVID-19.

Level of Modern Sanitation Methods

This indicator ranks regions according to the presence (or absence) and degree of modernization of their sanitization systems. regions with poor sanitation systems, or those who lack them entirely, are at a much higher risk of infection spread.

Chronic Diseases

This indicator quantifies regions' level of geographic risk in terms of several variables including proximity to regions with a high level of infection, number of border crossings with neighboring regions, number of infection hot-spots, and number and distribution of population-dense areas.

Culture Specifics and Societal Discipline

This indicator qualifies regions according to their culture-specific practices and traditions, as it relates to health, wellness and sanitization, as well as general societal discipline. Populations which give less care and attention to health and sanitization are at greater risk of infection.

Demography

This indicator quantifies the population size and demographics (age, sex, and proportion of populations with specific diseases) of a given region with respect to demographics most vulnerable to infection and negative patient outcomes.

Geopolitical Vulnerability

This indicator qualifies the current state of the region's geopolitical stability, taking into account the economic and military strength of the region's allies and rivals, assuming an association between high geopolitical stability and lower risk of attack by military rivals and resulting socioeconomic instability.

COVID-19 Emergency Preparedness

Societal Emergency Resilience

This indicator approximates the overall level of societal resilience, preparedness and experience with national emergencies, incorporating practical historical experience, psychological, cultural and religious practices and attitudes, etc.

Emergency Military Mobilization Experience

This indicator approximates the region's practical historical experience with mobilizing their military in order to help deal with national emergencies (both geopolitical and non-geopolitical emergencies), as well as the overall domestic military resources available.

Surveillance Capabilities (Scale, Scope and Technological Sophistication)

This indicator approximates the scale, scope and technological sophistication of the region's government surveillance capabilities.

Previous National Emergency Experience

This indicator approximates the region's practical historical experience with national emergencies, accounting for both geopolitical and non-geopolitical emergencies, with a focus on preparation policies and government-led emergency relief efforts.

COVID-19 Regional Safety Index: Parameters

1	COVID-19 Quarantine Efficiency	
1.1	Scale of Quarantine	
1.1.1	Population Density	People per km^2
1.1.2	Does the region have dedicated military chemical and biological warfare divisions and forces?	yes=0, no=1
1.1.3	Does the region have “hotspots” (high density of cases in one specific area)?	yes=0, no=1
1.1.4	Number of cases.	per million individuals
1.1.5	Number of deaths.	per million individuals
1.1.6	Number of recovered.	per million individuals
1.1.7	Fatal cases ratio, %	(Total Deaths/Total Cases)*100
1.1.8	Scale and scope of region-wide lockdown	full = 1, partial = 0.5 non-existing = 0
1.1.9	Does the region’s federal government have legislative authority over the entire territory?	yes=0, no=1
1.1.10	Does the region possess culture and religion-specific behaviours that preclude enforcement of mandatory quarantine measures?	yes=0, no=1
1.2	Quarantine Timeline	
1.2.1	What is the length of quarantine?	14 days = 0.5, more than 14 = 1, no quarantine length = 0
1.2.2	Did the region impose quarantine measures early in the timeline of viral spread?	yes=0, no=1
1.2.3	Was quarantine easing officially declared?	yes=0, no=1
1.2.4	Did the population exert public pressure to ease quarantine measures?	yes=0, no=1
1.3	Criminal Penalties for Violating Quarantine	
1.3.1	Quantity of law enforcement officers.	number per capita

COVID-19 Regional Safety Index: Parameters

1.3.2	Did the region use volunteers to monitor quarantine compliance?	yes=1, no=0
1.3.3	Criminal penalties for violating quarantine.	Number of months in incarceration.
1.3.4	Fines	In USD
1.3.5	Did the region use military personnel to assist law-enforcement officers?	yes=1, no=0
1.4	Economic Support for Quarantined Citizens	
1.4.1	Economic support to citizens	in USD
1.4.2	Economic support to SMEs	in USD
1.4.3	Tax reliefs	in USD
1.4.4	Economic rescue package	% of GDP
1.5	Economic and Supply Chain Freezing	
1.5.1	Export-oriented region?	yes=0, no=1
1.5.2	Does the region have an absence of large supply shortages?	yes=0, no=1
1.5.3	Are the region's border-crossing routes open?	yes=0, no=1
1.5.4	Does the region have a high availability of food?	yes=0, no=1
1.5.5	Are there any shortages in protective equipment?	yes=0, no=1
1.6	Travel Restrictions	
1.6.1	Quantity of automotive vehicles.	number per 1000 people
1.6.2	Did the region allow for direct flights to Italy or China in February - March 2020?	yes=0, no=1
1.6.3	Average level of touristic flow.	number of tourists per year

COVID-19 Regional Safety Index: Parameters

2	COVID-19 Government Efficiency of Risk Management	
2.1	Level of Security and Defense Advancement	
2.1.1	Does the region's military have dedicated laboratories for protection against chemical and biological warfare?	yes=0, no=1
2.1.2	Does the region's military have pre-existing plans and policies in place in the event of a biological or chemical attack?	yes=0, no=1
2.2	Level of GovTech Development	
2.2.1	Does the region have COVID-specific training courses for doctors and nurses?	yes=0, no=1
2.2.2	Rural population	% of total population
2.2.3	Local vaccine development (attempts).	yes=0, no=1
2.3	The Efficiency of Government Structure	
2.3.1	Did the region's government develop a specific emergency response mechanism for engagement with the private sector?	yes=0, no=1
2.3.2	Are there government-startups cooperation?	yes=0, no=1
2.3.3	Government effectiveness (EIU score).	EIU Score
2.3.4	EGDI.	EGDI score
2.3.5	Number of internet users per 1000 individuals.	number per 1000 people
2.3.6	Smartphone penetration.	% of population
2.3.7	Does the region utilize Electronic Health Records?	yes=0, no=1

COVID-19 Regional Safety Index: Parameters

2.3.8	Regional Corruption Index Score.	Index
2.4	Economic Sustainability	
2.4.1	Regional economic debt (number).	% of GDP
2.4.3	GDP index.	GDP index score
2.4.4	GNI index.	GNI index score
2.4.5	Minimum wages.	in USD
2.4.6	Unemployment rate due to COVID19.	% of population
2.4.7	Economic Problems related to COVID-19	yes=0, no=1
2.4.8	Exit strategy plan.	yes=0, no=1
2.5	Legislative Efficiency	
2.5.1	Does the region's government have a pre-existing Action Plan for rapid resource mobilization in the event of a national emergency?	yes=0, no=1
2.5.2	Legislations and regulations for the cross-border screening of pathogens, toxic, pandemic potential pathogens.	yes=0, no=1
2.5.3	Legislative availability for disaster mobilization.	yes=0, no=1
2.5.4	State capability to adopt new surveillance laws.	yes=0, no=1
2.6	Political Stability	
2.6.1	Does the region's government have a pre-existing Action Plan for rapid resource mobilization in the event of a national emergency?	yes=0, no=1
2.6.2	Legislations and regulations for the cross-border screening of pathogens, toxic, pandemic potential pathogens.	yes=0, no=1
2.6.3	Legislative availability for disaster mobilization.	yes=0, no=1

COVID-19 Regional Safety Index: Parameters

3	COVID-19 Monitoring and Detection	
3.1	Monitoring Systems & Disaster Management	
3.1.1	Does the region's government use event-based surveillance for infection disease?	yes=0, no=1
3.1.2	Does the region's government share its surveillance data with the neighboring regions?	yes=0, no=1
3.1.3	Does the region's government have an existing Action Plan in place for the surveillance and detection of viral outbreaks and disease?	yes=0, no=1
3.2	Scope of Diagnostic Methods	
3.2.1	Does the region have validated laboratory testing methods available?	yes=0, no=1
3.2.2	Does the region have laboratories with molecular diagnostic capacity available?	yes=0, no=1
3.2.3	Does the region use online diagnostic tools?	yes=0, no=1
3.3	Testing Efficiency	
3.3.1	Number of COVID-19 tests conducted per day.	Numeric
3.3.2	Are mobile diagnostic stations available for use in the region?	yes=0, no=1
3.3.3	Does the region have a significant shortage of COVID-19 tests?	yes=0, no=1
3.3.4	Does the region use local production of COVID-19 tests?	yes=0, no=1
3.3.5	Does the region have national laboratories available for COVID-19 testing?	yes=0, no=1
3.4	AI for Diagnostics and Prognostics	
3.4.1	Are there AI/ML healthcare initiatives related to COVID-19?	yes=1, no=0

COVID-19 Regional Safety Index: Parameters

3.4.2	Are there AI startups that create solutions to fight Covid-19?	yes=1, no=0
3.4.3	Does the region employ AI technologies and techniques in hospitals?	yes=1, no=0
3.5	Government Surveillance Technology for Monitoring	
3.5.1	Per capita quantity of surveillance cameras.	per 1000 people / approximate
3.5.2	Does the region's government routinely use face-recognition technology for surveillance?	yes=0, no=1
3.5.3	Does the region's government use mobile tracking (tracking of population's mobile phones) in its surveillance practices?	yes=0, no=1
3.5.4	Does the region's government utilize other AI-based surveillance methods?	yes=0, no=1
3.6	Reliability and Transparency of Data	
3.6.1	Does the region have a publically-available National Plan for COVID-19?	yes=0, no=1
3.6.2	Does the region's governments conduct daily briefings on the current status of the pandemic?	yes=0, no=1
3.6.3	Does the region have an established agency or Action Group responsible for COVID-19 prevention and treatment?	yes=0, no=1
3.6.4	Does the region conduct centralized collection of COVID-19 data?	yes=0, no=1
3.6.5	Does the Ministry of Health provide data on confirmed COVID-19 cases among healthcare workers?	yes=0, no=1
3.6.6	Does the Ministry of Health provide data on confirmed COVID-19 cases, critical cases and deaths on a daily basis?	yes=0, no=1

COVID-19 Regional Safety Index: Parameters

4	COVID-19 Healthcare Readiness	
4.1	COVID 19 Equipment Availability	
4.1.1	Quantity of Ventilator Stockpile.	Numeric
4.1.2	Number of hospital beds	per 1000 people
4.1.3	Does the region have sufficient availability of PPE (masks and gloves)?	yes=0, no=1
4.1.4	Does the region have sufficient availability of face shields?	yes=0, no=1
4.2	Mobilization of New Healthcare Resources	
4.2.1	Did the government request that medical students assist in COVID-19 patient treatment?	yes=0, no=1
4.2.2	Does the region have the necessity and ability to build additional hospitals for COVID-19 treatment?	yes=0, no=1
4.2.3	Did the region use military mobile stations for chemical and bacteriological cleaning?	yes=0, no=1
4.2.4	Does the region have the necessary infrastructure for surplus ventilator production?	yes=0, no=1
4.2.5	Does the region have the necessary infrastructure for surplus mask production?	yes=0, no=1
4.2.6	Does the region have the necessary infrastructure for the production of other surplus PPE?	yes=0, no=1
4.3	Quantity and Quality of Medical Staff	
4.3.1	Number of doctors.	per 1000 people

COVID-19 Regional Safety Index: Parameters

4.3.2	Number of nurses.	per 1000 people
4.3.3	Does the region have epidemiology faculty at the majority of their medical universities?	yes=0, no=1
4.3.4	Are epidemiology classes available for medical students not specializing in epidemiology?	yes=0, no=1
4.4	Level of Healthcare Progressiveness	
4.4.1	Does the region have evidence of recent healthcare advancements and optimizations?	yes=0, no=1
4.4.2	Healthcare Development Index score.	Index
4.4.3	Current health expenditure per capita.	in USD
4.4.4	Current health expenditure.	as % of GDP
4.4.5	HAQ (The Healthcare Access and Quality Index) - 2016.	Index
4.4.6	Pharmaceuticals spending per capita.	in USD
4.5	Level of Technological Advancement	
4.5.1	MRI number.	per million people
4.5.2	Quantity of ICU-CCB beds.	per 100,000 people
4.6	Epidemiology System Level of Development	
4.6.1	Global Health Security Index	GHS index score

COVID-19 Regional Safety Index: Parameters

5	COVID-19 Region Vulnerability	
5.1	Infection Spread Risk	
5.1.1	**Container port traffic.**	**TEU: 20 foot equivalent units**
5.1.2	**Average number of international arrivals (incoming tourists) per year.**	**Number per year**
5.1.3	**Total transportation network size.**	**km**
5.1.4	**Does the region have a significant risk of power shortages?**	**yes=0, no=1**
5.1.5	**Does the region have a significant risk of medication shortages?**	**yes=0, no=1**
5.2	Culture Specifics and Societal Discipline	
5.2.1	**Literacy rate.**	**%**
5.2.2	**Proportion of population with tertiary education.**	**number per capita**
5.2.3	**Poverty rate.**	**Population living below national poverty line (%)**
5.2.4	**Does the region have religious or cultural practices that increase chances of infection risk or quarantine non-compliance?**	**yes=0, no=1**
5.2.5	**Human Development Index 2016.**	**Index**
5.3	Level of Modern Sanitization Methods	
5.3.1	**Does the region have access to basic sanitation facilities?**	**yes=1, no=0**
5.4	Diseases	
5.4.1	**Prevalence of diabetes.**	**% of population ages 20 to 79**

COVID-19 Regional Safety Index: Parameters

5.4.2	**Death rate due to endocrine disorder.**	**per 100,000 people**
5.4.3	**Prevalence of mental health and substance use disorders as a share of total disease burden, 2017.**	**Percent of total disease burden, 2017.**
5.4.4	**Incidence of tuberculosis.**	**per 100,000 people**
5.4.5	**Incidence of cancer.**	**per 100,000 people**
5.5	Demography	
5.5.1	**Size of Elderly Population.**	**% of total population**
5.6	Societal Risks	
5.6.1	**Is the region currently experiencing a political or election-based crisis?**	**yes=0, no=1**
5.6.2	**Is there a majoritively positive public sentiment regarding government COVID-19 strategy?**	**yes=0, no=1**
5.6.3	**Does the majority of the region's population support the current government?**	**yes=0, no=1**
5.6.4	**Does the region's government take into account diaspora as a factor in formulating its COVID-19 strategy?**	**yes=0, no=1**
5.6.5	**Does the region's government experience significant foreign pressure affecting its COVID-19 strategic decision making?**	**yes=0, no=1**

COVID-19 Regional Safety Index: Proprietary Parameters

6	COVID-19 Emergency Preparedness	
6.1	Societal Emergency Resilience	
6.1.1	**Proprietary metric #1**	**Not publicly disclosed.**
6.1.2	**Proprietary metric #2**	**Not publicly disclosed.**
6.1.3	**Proprietary metric #3**	**Not publicly disclosed.**
6.1.4	**Proprietary metric #4**	**Not publicly disclosed.**
6.2	Emergency Military Mobilization Experience	
6.2.1	**Proprietary metric #1**	**Not publicly disclosed.**
6.2.2	**Proprietary metric #2**	**Not publicly disclosed.**
6.2.3	**Proprietary metric #3**	**Not publicly disclosed.**
6.3	Surveillance Capabilities (Scale, Scope and Technological Sophistication)	
6.3.1	**Proprietary metric #1**	**Not publicly disclosed.**
6.3.2	**Proprietary metric #2**	**Not publicly disclosed.**
6.3.3	**Proprietary metric #3**	**Not publicly disclosed.**
6.4	Previous National Emergency Experience	
6.4.1	**Proprietary metric #1**	**Not publicly disclosed.**
6.4.1	**Proprietary metric #2**	**Not publicly disclosed.**
6.4.1	**Proprietary metric #3**	**Not publicly disclosed.**

COVID-19 Regional Safety Index: Indicator Weighting Rationale

Each index category is assigned a weighting, representative of an “importance factor”, which is applied to each aggregate category score when the final, cumulative regional score is computed. Generally speaking, greater weights are given to indicators that have a greater effect on overall regional safety and stability as it is defined in the present assessment. Similarly, the composite indicators within each index categories are also given individual weights, in accordance with their perceived importance and effect on the specific topic being measured by the indicator' parent category. While indicator weights are represented as a percentage, category weights are represented by integers for the purpose of obtaining round numbers that are more easily understandable.

The index's first two categories (COVID-19 Quarantine Efficiency and COVID-19 Government Efficiency of Risk Management) are given the highest weightings, of 2.2, respectively, because they measure the effectiveness of government responses made early in the overall timeline of COVID spread, which has a much greater (and, indeed, multiplative) effect on COVID-19 risk and safety than reactionary responses and management later on on the course of the pandemic. Meanwhile, COVID-19 Monitoring and Detection and COVID-19 Emergency Preparedness are given a weighting of 1.5, respectively, because they most closely measure the efficiency of ongoing responses, emergency relief efforts and real-time pandemic neutralization tactics, as well as the innate preventive infrastructure in place for rapid mobilization and coordination of crisis management efforts. Finally, COVID-19 Healthcare Readiness and COVID-19 Regional Resilience are given a weighting of 1.3, respectively, because while they are important to consider in the assessment of regional safety, they have comparatively less impact than the other categories. The high death rates in the USA and UK, for example, indicate that the tangible risk of infection and mortality in regions with a high degree of healthcare-related technological sophistication can still be high, despite the high level of medical modernization.

In future iterations of Deep Knowledge Group’s COVID-19 Regional Safety Assessment, the relative weightings of categories that reflect the efficiency of early crisis neutralization and mitigation efforts will be decreased in accordance with the growing timeline of the pandemic, and the weighting assigned to categories that reflect the efficiency of ongoing crisis management efforts will be increased proportionately.

COVID-19 Index Indicator Weight

1.	COVID-19 Quarantine Efficiency	Weighting of Index Indicator
1.1	Scale of Quarantine	18%
1.2	Quarantine Timeline	17%
1.3	Criminal Penalties for Violating Quarantine	14%
1.4	Economic Support for Quarantined Citizens	18%
1.5	Economic and Supply Chain Freezing	15.50%
1.6	Travel Restrictions	17.50%

2.	COVID-19 Government Efficiency of Risk Management	Weighting of Index Indicator
2.1	Level of Security and Defense Advancement	17%
2.2	Rapid Emergency Mobilization	16%
2.3	Efficiency of Government Structure	18%
2.4	Economic Sustainability	17%
2.5	Legislative Efficiency	16%
2.6	Political Stability	16%

COVID-19 Index Indicator Weight

3.	COVID-19 Monitoring and Detection	Weighting of Index Indicator
3.1	Monitoring Systems and Disaster Management	18%
3.2	Scope of Diagnostic Methods	15%
3.3	Testing Efficiency	18%
3.4	AI for Diagnostics and Prognostics	15%
3.5	Government Surveillance Technology for Monitoring	17%
3.6	Reliability and Transparency of Data	17%

4.	COVID-19 Healthcare Readiness	Weighting of Index Indicator
4.1	COVID-19 Equipment Availability	18%
4.2	Mobilization of New Healthcare Resources	17.50%
4.3	Quantity and Quality of Medical Staff	16%
4.4	Level of Healthcare Progressiveness	15%
4.5	Level of Technological Advancement	17%
4.6	Epidemiology System Level of Development	16.50%

COVID-19 Index Indicator Weight

5.	COVID-19 Regional Resiliency	Weighting of Index Indicator
5.1	Infection Spread Risk	16.50%
5.2	Culture Specifics and Societal Discipline	18%
5.3	Level of Modern Sanitization Methods	15%
5.4	Demography	15.50%
5.5	Chronic Diseases	18%
5.6	Societal Risks	17%

6.	COVID-19 Emergency Preparedness	Weighting of Index Indicator
6.1	Societal Emergency Resilience	27%
6.2	Emergency Military Mobilization Experience	23%
6.3	Surveillance Capabilities (Scale, Scope and Technological Sophistication)	27%
6.4	Previous National Emergency Experience	23%

Index Category Weight

COVID-19 Quarantine Efficiency

2.2 WEIGHT

	Weighting factor
Scale of Quarantine	18%
Quarantine Timeline	17%
Criminal Penalties for Violating Quarantine	14%
Economic Support for Quarantined Citizens	18%
Economic and Supply Chain Freezing	15.50%
Travel Restrictions	17.50%

COVID-19 Emergency Preparedness

1.5 WEIGHT

	Weighting factor
Societal Emergency Resilience	27%
Emergency Military Mobilization Experience	23%
Surveillance Capabilities (Scale, Scope and Technological Sophistication)	27%
Previous National Emergency Experience	23%

COVID-19 Government Efficiency of Risk Management

2.2 WEIGHT

	Weighting factor
Level of Security and Defense Advancement	17%
Rapid Emergency Mobilization	16%
Efficiency of Government Structure	18%
Economic Sustainability	17%
Legislative Efficiency	16%
Political Stability	16%

COVID-19 Healthcare Readiness

1.3 WEIGHT

	Weighting factor
COVID-19 Equipment Availability	18%
Mobilization of New Healthcare Resources	17.50%
Quantity and Quality of Medical Staff	16%
Level of Healthcare Progressiveness	15%
Level of Technological Advancement	17%
Epidemiology System Level of Development	16.50%

COVID-19 Monitoring and Detection

1.5 WEIGHT

	Weighting factor
Monitoring Systems and Disaster Management	18%
Scope of Diagnostic Methods	15%
Testing Efficiency	18%
AI for Diagnostics and Prognostics	15%
Government Surveillance Technology for Monitoring	17%
Reliability and Transparency of Data	17%

COVID-19 Regional Resiliency

1.3 WEIGHT

	Weighting factor
Infection Spread Risk	6.50%
Culture Specifics and Societal Discipline	18%
Level of Modern Sanitization Methods	15%
Demography	15.50%
Chronic Diseases	18%
Societal Risks	17%

COVID-19 Regional Safety Index: Proprietary Data Overview

Five of the six top-level categories that comprise the index have been made publicly available in an open-source manner, all the way from the top level categories, down through their component indicators and parameters. However, Deep Knowledge group has only disclosed the component indicators of the sixth top-level index category (Emergency Preparedness), and not it's bottom-level parameters, because they employ proprietary techniques that are the group's intellectual property and are intended only for internal use.

The Emergency Preparedness index category consists of four component indicators: Societal Emergency Resilience (whose parameters measure the regions' overall level of societal resilience, preparedness and experience with national emergencies), Emergency Military Mobilization Experience (whose parameters measure region's practical historical experience with mobilizing their military in order to help deal with national emergencies), Surveillance Capabilities (which measure regions' the scale, scope and technological sophistication of the region's government surveillance capabilities), and Previous National Emergency Experience (which measures region's practical historical experience with national emergencies).

It has always been Deep Knowledge Group's long-term mission to pursue its strategic agenda in a dual non-profit and for-profit manner, aiming to achieve positive impact in the support of progressive technologies for the benefit of humanity. It is for this reason that the decision was made to conduct the majority of the group's COVID-19 analytics in an open-source manner, free of charge, to provide the public in general and authorized organizations in particular with fact-based and unbiased information. However, the group also remains open to disclosing its proprietary metrics and analytical techniques to relevant organizations, and to conducting region-specific and topic-specific analytics and forecasting for responsible governmental bodies and departments.

COVID-19 Regional Safety Index: Conclusion and Future Methodology Development

Deep Knowledge Group's COVID-19 analytics generally, as well as the methodological underpinning of the present special case study, are in a continuous state of refinement, expansion and enhancement, and future COVID-19 rankings and special case studies will strive to incorporate a larger number of regions in its analysis, a broader scope of specific parameters, a wider array of topics and categories of analysis, and a greater scope of data-science techniques.

Continuously-Updated Sources of Data	New Analytical Frameworks
Deep Knowledge Group is constantly incorporating the latest findings from existing and new, reputable sources of public data as they become available, and regularly consulting with specific experts on the matter of advanced and qualitative aspects of the current COVID-19 pandemic, to remain on the forefront of shifting trends.	Deep Knowledge Group is developing and releasing entirely new ranking frameworks on additional topics relating to COVID-19 on a continual basis. In the coming weeks the group will reveal frameworks relating to such topics as regions' prospects for economic vulnerability and geopolitical instability as a result of the pandemic.
Enhancing of Analytical Techniques	**Customized Consultancy**
Deep Knowledge Group is continually refining and expanding both the breadth and depth the analytical techniques applied to its ranking frameworks, and periodically enhancing their capacity to handle and quantitatively assess highly complex and multidimensional data, as the complexity of the pandemic increases.	Deep Knowledge Group is open to disclosing its proprietary metrics and analytical techniques to select counterparties, and to conducting customized region-specific and topic-specific analytics and forecasting for interested governmental bodies and departments in order to derive as much humanitarian benefit from its activities as possible.

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DISCLAIMER

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Deep Knowledge Group is using its best efforts to continuously update its COVID-19 analytics based on dynamic, publicly available metrics deemed reliable, such as World Health Organization, Worldometers, CDC, Johns Hopkins University, and other publicly available sources.

Certain metrics used for advanced and qualitative assessment were formulated by Deep Knowledge Group analysts in coordination with specific experts and consultants using proprietary sources and techniques. Therefore, such rankings may be adjusted over time depending on the corresponding underlying information and in coordination with ongoing enhancements to our underlying analytical methodologies.

Information provided herein is intended for indicative and informational purposes only. Opinions, estimates and analysis represented constitute the current judgment and opinion of the author.

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