MANUAL

Framework for COVID-19 Risk Index

COVID-19 GLOBAL RESPONSE

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With support of

AN INITIATIVE OF THE NETHERLANDS RED CROSS

Rode Kruis

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For more information regarding the use of this product, please contact the 510 Data Team by sending an email to support@510.global

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Introduction

Since March 2020, the 510 Data Team of the Netherlands Red Cross (NLRC) has aided various National Societies (NS) in the calculation of a crisis risk index. This is called the "Index for Risk Management (INFORM) COVID-19 Risk Index" and includes information on the SARS-CoV-2 virus. This manual provides the necessary information for the calculation of the index.

Product in a nutshell

The framework presented in this manual consists of a spreadsheet, an example Python programming script and a web-based dashboard. These support data collection and organization and allow the user to calculate and visualize the COVID-19 Risk Index.

What is the COVID-19 Risk Index and what can you do with it?

The Index for Risk Management (INFORM) COVID-19 Risk Index[1,2], translates information about crisis risk of a geographical region, into indicators that together build up to a composite indicator showing the risk for each area. This indicator includes information about the SARS-CoV-2 virus and can easily be used for decision-making. For ease of reading, we will refer to the "INFORM COVID-19 Risk Index" as "COVID-19 Risk Index" from this point onwards.

The model which calculates the COVID-19 Risk Index takes different components into account such as population density, international tourism, health system capacity etc. All the components can be categorized into 3 dimensions of risk:

1. Hazards (events that could occur) & exposure to them
2. Vulnerability (the susceptibility of communities to those hazards)
3. Lack of coping capacity (lack of resources available that can alleviate the impact)

Who is the COVID-19 Risk Index for?

The COVID-19 Risk Index can be used by any organisation looking to incorporate the index in internal decision-making processes such as governments or non-governmental organisations. Examples of Red Cross or Red Crescent NS that have used this framework until now are:

- The Syrian Arab Red Crescent
- The Uganda Red Cross Society

[1] Poljansek, K., Vernaccini, L. and Marin Ferrer, M., INFORM Covid-19 Risk Index, EUR 30240 EN, Publications Office of the European Union, Luxembourg, 2020, ISBN 978-92-76-19203-9, doi:10.2760/596184, JRC120799.

[2] Marin-Ferrer, M., Vernaccini, L. and Poljansek, K., Index for Risk Management INFORM Concept and Methodology Report — Version 2017, EUR 28655 EN, doi:10.2760/094023

- The Mali Red Cross

Why use the COVID-19 Risk Index?

The COVID-19 Risk Index indicates which regions, at a national or subnational level, are at risk from health and humanitarian impacts of COVID-19 that would overwhelm national response capacity. The COVID-19 Risk Index can help the user determine the major driving factors of risk and is therefore a valuable tool for support planning or resource allocation processes. A few questions the COVID-19 Risk Index can help address are:

- What regions at national and subnational level are at risk from health and humanitarian impacts of COVID-19?
- Could these regions overwhelm current response capacity?
- Do these regions need additional international assistance?

What is achieved with the framework for the COVID-19 Risk Index?

The framework presented in this manual allows the user to methodically choose relevant indicators, organise data, and calculate the COVID-19 Risk Index for a country or country region as well as for each of the dimensions, categories, and components of risk.

Case study

The COVID-19 Risk Index provides an overview of what underlying factors can lead to certain humanitarian risks by looking at several components classified under the mentioned dimensions: hazards and exposure, vulnerability, and lack of coping capacity. The COVID-19 Risk Index mainly utilizes data that fall under structural risk factors; risk factors that existed before the occurrence of the outbreak.

To date, the 510 Data Team has supported the following Red Cross and Red Crescent NS in the development and implementation of the COVID-19 Risk Index:

- The Syrian Arab Red Crescent
- The Uganda Red Cross Society
- The Mali Red Cross
- The Palestine Red Crescent Society
- The Malawi Red Cross Society
- The Zimbabwe Red Cross Society
- The Ivory Coast Red Cross Society
- The Iraqi Red Crescent Society
- The Yemen Red Crescent
- The Central African Red Cross Society

The dimensions, categories, and components of the index remained the same for most of the NS. The sub-components used to calculate the COVID-19 Risk Index however, are adaptable. Adaptability is an important criterion, since it is crucial for the sub-components to fit the specific context of the country to achieve a conclusive and accurate end result. Thus, the sub-components were changed from country to country to fit better with their specific context (**Figure 1**). What's more, the choice of sub-components depended largely on the availability of the related data. This was the case for Syria, seen in **Figure 1**, where little to no data was available.

Zimbabwe				
Dimension	**Category**	**Component**	**Sub-component**	**Sub-Component**
Vulnerability	COVID-19 Vulnerability	Movement	International movement	Air transport
				International tourism
				Point of entry
			Internal movement	Access to citites
				Road density
		Behaviour	Awareness	Adult literacy rate
				Mobile cellular subscriptions
				Internet users
			Trust	
		Demographic and comorbidities	Proportion of the population at more severe risk of getting Covid-19	1+ underlying conditions plus 0 conditions (65+ yrs)
	INFORM Vulnerability	Socio-economic vulnerabilities	Development and deprivation	Human development index
				Multidimensional poverty index
			Inequality	Gender inequality index
				GINI index
			Economic Dependency Index	Public aid per capita
				Net ODA received
				Volume of remittances
		Vulnerable groups	Uprooted people	
			Gender based violence	
			Health conditions	HIV
				TBC
				Malaria
				People requiring interventions against neglected tropical diseases
			Food security	Food availability score
				Food utilization score

SYRIA				
Dimension	**Category**	**Component**	**Sub-component**	**Sub-Component**
Vulnerability	COVID-19 Vulnerability	Behaviour	Practices	Proportion of the population that reportedly undertook actions to avoid getting Covid-19
		Demographic and comorbidities	Proportion of the population at more severe risk of getting Covid-19	1+ underlying conditions plus 0 conditions (65+ yrs)
	INFORM Vulnerability	Socio-economic vulnerabilities	Development and deprivation	Humanitarian Severity
		Vulnerable groups	Uprooted people	

Figure 1 • The components and subcomponents used for the Vulnerability dimension differed between Zimbabwe (upper panel) and Syria (lower panel). This example showcases the adaptability of the index when used for two different countries.

Data responsibility

Datasets

The COVID-19 Risk Index takes different components into account. These include (but are not limited to): population density, household size, Water, Sanitation and Hygiene (WASH) needs, persons with disabilities, humanitarian needs overview, international tourism, health system capacity, Internally Displaced Persons registration data, food security, public aid, as well as other components depending on the country context. The data is mostly gathered from national open-source data sites, but could also include information from governmental and non-governmental sources.

Data processing

After downloading the spreadsheet that contains the components, the relevant components are determined for calculating the risk index based on the country context. The data gathered from the different open-sources will be inserted under its relevant component and the processing of the data into the desired format (e.g., normalization) will be done in order for the component values to be comparable. Once that is complete, the risk index is calculated. This can all be done while using the spreadsheet or by using a programming script.

Non-discrimination

That data availability for the COVID-19 Risk Index, might play an indirect discriminatory role in the use of the final product. The lack of data for certain components or country regions might affect the final result of the index and in turn the decision making for support and resource allocation. Moreover, data collected at a national level and not at a governorate level might also affect the assessment of response capacity and resource allocation.

Human oversight

The COVID-19 Risk Index guides the user to analyse and compare risk and its components across countries or within the same country. The user will be imputing the data that was gathered from the different sources and will either be calculating the index rate through the spreadsheet provided or by using a programming script.

Risks

The output of the framework represents a static situation and is not updated automatically. The user will have to re-calculate the risk index at different time points if they wish to re-assess the situation. Moreover, some data might not be readily available for certain components or even at a governorate level, which may cause a misrepresentation of the final index.

Requirements

User knowledge

In this section we describe the skills that someone would need to use the COVID-19 Risk Index framework presented in this manual. In addition to the skills mentioned below, it is crucial the user has the following skills:

- Analytical thought
- Problem-solving attitude
- Data responsibility (see also section “Data responsibility” of this manual)

To collect data and calculate the index, the user will need the following skills:

- **Internet browser:** beginner-intermediate level
- **Excel (or other spreadsheet-based program:** beginner to intermediate level:
- **Programming skills (Optional):** intermediate level Python or other programming language
- **PowerBI/Google Data Studio (Optional):** intermediate to advanced level to visualize the index. For more information on how to visualize the COVID-19 Risk Index (and other data), see manual “Dashboards”.

Hardware

Below you can find the hardware requirements for the COVID-19 Risk Index framework explained in this manual.

- **Mozilla Firefox** (or other internet browser):
    - Processor: Windows OS: Pentium 4 or newer processor that supports SSE2 / MacOS: Intel x86 processor
    - RAM: Windows OS: 512 MB; 2 GB (64-bit) / macOS: 512 MB
    - Disk space: 200 MB of available disk space
- **Microsoft Excel** (2019):
    - Processor: Windows OS: 1.6 GHz, 2-core / macOS: Intel processor
    - RAM: Windows OS: 4 GB; 2 GB (32-bit) / macOS: 4 GB
    - Disk space: Windows OS: 4 GB / macOS: 10 GB of available disk space

  - Screen resolution Windows OS: 1280 x 768 (32-bit requires hardware acceleration for 4K and higher) / macOS: 1280 x 800
  - Graphics Windows OS: DirectX 9 or later, with WDDM 2.0 or higher for Windows 10 (or WDDM 1.3 or higher for Windows 10 Fall Creators Update) / macOS: No graphics requirements
- **Python** (versions: 2.7.X, 3.6.X):
  - Processor: Intel Atom® processor or Intel® Core™ i3 processor
  - Disk space: 1 GB
  - Operating system: Windows* 7 or later, macOS, or Linux

Software

Below we list the software required for the COVID-19 Risk Index framework explained in this manual.

- Mozilla Firefox or another internet browser
  www.mozilla.org/en-US/firefox/new/
- Excel (Microsoft Office) or other spreadsheet-based program
  www.microsoft.com/en-us/microsoft-365/excel
- Installed Python (optional)
  www.python.org/downloads/

Time

Here we indicate which parameters influence the total duration of using the presented framework and calculating the COVID-19 Risk Index, and state a real-life example of usage by a NS.

The duration of setting up and using the framework for the COVID-19 Risk Index is the total duration of the following steps: adjusting the spreadsheet template to country-specific context, collection of the data, shaping the data (with spreadsheet or programming script), calculating the COVID-19 Risk Index (with spreadsheet or programming script), visualizing the COVID-19 Risk Index (optional).

As a real-life example of calculation of the COVID-19 Risk Index we use the COVID-19 Risk Index for Syria. It should be noted that the Syrian Arab Red Crescent was the first NS to

request support for a COVID-19 Risk Index, therefore the time indicated below is indicative of the initial setup. Following calculations for other countries took significantly less time to calculate. The 510 Data Team of the NLRC needed 80 hrs, including meetings with the NS and internal meetings to discuss the most suitable methodology for calculating the COVID-19 Risk Index. An additional 8,5 hours were spent on the development of the ArcGIS dashboard.

The product

What does the COVID-19 Risk Index framework consist of?

The COVID-19 Risk Index can be calculated by using the following:

- A spreadsheet with the components

OR

- A spreadsheet with the components and
- A programming script (e.g., Python)

Locations to download the product

Here we provide the links and locations to find the tools needed to set up the framework and calculate the COVID-19 Risk Index.

- The spreadsheet template COVID-19 Risk Index containing the COVID-19 Risk Index components is available upon request
- The Python script `CovidRiskIndex.py` used to reshape data and calculate the COVID-19 Risk is available through an internal link upon request

Advantages & Limitations

There are several advantages and limitations linked to using the COVID-19 Risk Index framework. Here we briefly discuss these.

- The user is dependent on the availability of data. Often data is not openly available. It is especially challenging to access data at the subnational level (e.g., governorates), which limits the granularity of the COVID-19 Risk Index.
- The COVID-19 Risk Index is a static metric and does not automatically update, which means that if the country situation changes, it will need to be re-calculated.
- The pipeline described in this manual can be executed by someone with Excel knowledge, as expertise in Python or R (or other programming language) is optional.

Calculating the COVID-19 Risk Index: a step-by-step guide

1. Determine the relevant components for calculating the COVID-19 Risk Index

For this step, the spreadsheet template COVID-19 Risk Index (see section "The product") is needed. The COVID-19 Risk Index can be calculated for a specific administrative level (admin level). For example, the user might be interested in calculating the COVID-19 Risk Index for the admin level 1 of a country, corresponding to provinces or governorates. The chosen administrative level depends heavily on the availability of data. For example, the user might calculate the COVID-19 Risk Index for administrative (admin) level 1 because the only data available are for that admin level, even though they are more interested in calculating the COVID-19 Risk Index for admin level 3.

a. Depending on the country's situation, the necessary components for the index calculation might need to be adjusted, as shown in **Figure 1** (page 4).

b. Collect the data for each component.

c. Insert the data for each component into the spreadsheet, as shown in **Figure 2** for the "Population" component as well as the "People in acute WASH need" component (part of the Combined Hazard & Exposure dimension).

Admin 1 (Governorate)	Population	People in acute WASH need
Aleppo	3.933.177	990494
Al-Hasakeh	1.060.347	249907
Ar-Raqqa	690.801	154350
As-Sweida	379.174	71954
Damascus	1.835.380	624613
Dar'a	1.015.275	362881
Deir-ez-Zor	741.253	146876
Hama	1.342.195	263096
Homs	1.451.059	327963
Idleb	2.588.456	1125234
Lattakia	1.186.495	451908
Quneitra	103.269	48963
Rural Damascus	3.160.455	1227369
Tartous	906.369	138313
Syria	**20.393.705**	**6183921**

Figure 2 • As a first step to calculating the COVID-19 Risk Index, data relevant for the components "Population" and "People in acute WASH need" are inserted into the spreadsheet. The example shown is for the calculation of the COVID-19 Risk Index of Syria. Data have been added for Admin level 1, which corresponds to Governorates in the specific country.

2. Normalize the data

For this step, the user can continue to use Excel (or other preferred spreadsheet-based program) or a programming script such as the `CovidRiskIndex.py` Python script. The data for the components might need to be normalized so data between components are comparable.

a. Remove any outliers that might represent faulty data.

b. Normalize the data (**Figure 3**). This can be done by rescaling, for which we recommend following the "feature scaling normalization", also known as "min max normalization", shown in the equation:

$$x_{normalized} = \frac{x - x_{min}}{x_{max} - x_{min}}$$

Note: in some cases, the available data might not correspond to the chosen administrative level. To be able to use the data, they would require "translating" from the available admin level to the chosen admin level. For example, population data might only be available for cities, but not for the province level.

Admin 1 (Governorate)	Population	People in acute WASH need	% in acute WASH need	NORM people in acute WASH need
Aleppo	3.933.177	990494	0,25	0,31
Al-Hasakeh	1.060.347	249907	0,24	0,26
Ar-Raqqa	690.801	154350	0,22	0,22
As-Sweida	379.174	71954	0,19	0,11
Damascus	1.835.380	624613	0,34	0,58
Dar'a	1.015.275	362881	0,36	0,63
Deir-ez-Zor	741.253	146876	0,20	0,14
Hama	1.342.195	263096	0,20	0,13
Homs	1.451.059	327963	0,23	0,23
Idleb	2.588.456	1125234	0,44	0,87
Lattakia	1.186.495	451908	0,38	0,71
Quneitra	103.269	48963	0,47	0,99
Rural Damascus	3.160.455	1227369	0,39	0,73
Tartous	906.369	138313	0,15	0
Syria	**20.393.705**	**6183921**	**0,30**	**0,47**

Figure 3 • Data normalization by rescaling for the different governorates of Syria for the component "People in acute WASH need". First, the "Percentage of the people in acute WASH need" for each governorate is calculated. After that, the "min max normalization" is applied, and shown in column "NORM people in acute WASH need" (NORM stands for Normalized).

3. Calculate the Index of each individual dimension

For this step, the user can continue to use Excel (or other preferred spreadsheet-based program) or a programming script such as the `CovidRiskIndex.py` Python script.

a. Determine the weight of each normalized component. This depends on the country-specific context. For example, a country might have a very high percentage of people >65 years old, which are a risk group for COVID-19. In this case, the user might choose to add a weight to this component.

b. Calculate the value for each of the three dimensions individually:

1. Hazard & Exposure
2. Vulnerability
3. Lack of Coping Capacity

Each dimension's value is equal to the mean value of all its' normalized components (**Figure 4**). To calculate the dimension's value, follow the equation, where "*norm component*" indicates the value of the normalized component:

$$Value_{dimension} = \frac{norm\ component_1 + norm\ component_2 + \cdots + norm\ component_n}{n}$$

Admin 1 (Governorate)	NORM Population density	NORM Household size	NORM people in acute WASH need	Combined hazard and exposure risk
Aleppo	0,01	0,36	0,31	0,23
Al-Hasakeh	0	0,91	0,26	0,39
Ar-Raqqa	0	0,58	0,22	0,11
As-Sweida	0	0	0,11	0,04
Damascus	1	0,45	0,58	0,68
Dar'a	0,01	1	0,63	0,55
Deir-ez-Zor	0	0,58	0,14	0,07
Hama	0,01	0,73	0,13	0,29
Homs	0	0,73	0,23	0,32
Idleb	0,01	0,58	0,87	0,44
Lattakia	0,03	0,18	0,71	0,31
Quneitra	0	0,73	0,99	0,57
Rural Damascus	0,01	0,91	0,73	0,55
Tartous	0,02	0,36	0	0,13
Syria	**0,079**	**0,58**	**0,47**	**0,37**

Figure 4 • Calculation of the value for the Hazard & Exposure risk for each governorate of Syria. For this, the mean is calculated for the normalized population density, the normalized household size and the normalized number of people in acute WASH need.

4. Calculate the COVID-19 Risk Index

For this step, the user can continue to use Excel (or other preferred spreadsheet-based program) or a programming script such as the `CovidRiskIndex.py` Python script. Determine the COVID-19 Risk Index based on the equation:

$$COVID-19\ Risk\ Index = \frac{Hazard\&Exposure + Vulnerability + Lack\ of\ coping\ capacity}{3}$$

The calculated COVID-19 Risk Index can be used to evaluate a certain admin district is under risk from the effects of COVID-19 and if this would overwhelm national response capacity.

Note: Some users opt for rescaling the calculated COVID-19 Risk Index by using the abovementioned min-max normalization when they wish to compare admin levels and the COVID-19 Risk Indices for the admin districts are similar. However, we recommend caution to the interpretation of the results, as the rescaling could lead to exaggerated values which do not indicate a true high risk.

5. Visualize the COVID-19 Risk Index (optional)

To make the interpretation of the COVID-19 Risk Index more user-friendly, the user can opt to visualize the COVID-19 Risk Index on the studied geographical area, with the help of a geo-based dashboard (**Figure 5**). We recommend using a geographic Information System (GIS) based program such as ArcGIS or QGIS. For more information on data visualization, see manual "Dashboards".

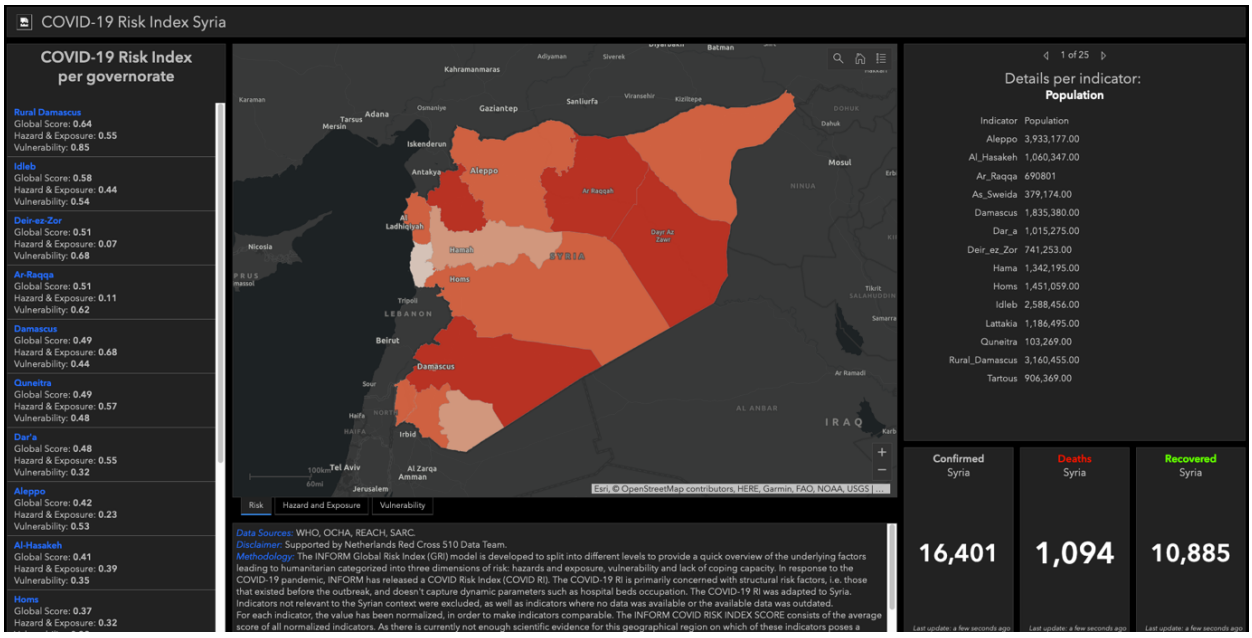

Figure 5 • Example of visualization of the COVID-19 Risk Index. The shown dashboard shows the COVID-19 Risk Index for the different governorates in Syria and is created using ArcGIS.

Table of abbreviations

NLRC	Netherlands Red Cross
NS	National Society/Societies
SARS-CoV-2	Severe Acute Respiratory Syndrome coronavirus 2
COVID-19	The disease caused by the SARS-CoV-2 virus
INFORM	Index for Risk Assessment
WASH	Water, Sanitation and Hygiene
GIS	Geographical Information System

Resources

- The INFORM Risk Index platform
  https://drmkc.jrc.ec.europa.eu/inform-index/INFORM-Risk
- The INFORM Risk Index methodology
  https://tinyurl.com/yxc94vqz
- The INFORM COVID Risk Index methodology
  https://publications.jrc.ec.europa.eu/repository/bitstream/JRC120799/jrc120799_pdf.pdf
- QGIS (open source)
  https://www.qgis.org/en/site