IRR Technical Note
ARGENTINA

BACKGROUND

Covid-19 is the crisis of our time. A deep shock to the world, the pandemic creates risk beyond that of the health crisis, affecting economies, social infrastructures and even the way we interact with each other; impacts that may have long lasting effects on societies. Making the right decisions is more important than ever, minimizing the health and socioeconomic damage as communities continues to contain the virus and begin to adapt to a new normality. Whilst challenging, tools that can help navigate through this complexity will not only reduce the immediate impact but better prepare society to recover from Covid-19.

INTRODUCTION

Demographics, economic structure, poverty, levels of inequality, as well as characteristics of public space, are some of the social and economic factors that influence people's exposure to infectious diseases, and consequently generate impact on a population's health. The World Health Organization (WHO) refers to these socioeconomic conditions as risk factors to public health. They affect the vulnerability of a population, the efficacy of preventative measures and the safety and effectiveness of reopening policies. In order to control this contagious disease, these conditions will need to be incorporated from local to community level through intersectoral strategies and interventions that complement health policies. This collective approach and holistic understanding of risk is essential if societies are to be fully protected. The United Nations has developed a dashboard[1] to visualize the vulnerability of countries and their ability to respond the pandemic. This is a good example of an international program that helps countries incorporate social and economic structures into risk management.

Following this same logic, the Social Progress Imperative has developed a statistical tool to help visualize the risk that the pandemic poses from a local or subnational perspective: the Covid Integrated Risk and Response Tool (The IRR Tool). The IRR Tool is the progression of an index developed in partnership with INCAE Business School and applied in Costa Rica[2]. The objective of the IRR tool is to facilitate the integration of socioeconomic characteristics of risk into local strategies, promote inter-institutional coordination in risk management and form a more inclusive approach to the Covid-19 response. The level and type of impact from Covid-19 is clearly not defined by income, as demonstrated by more affluent nations experiencing some of the most devastating effects. Across nations, it's vital that governance can effectively measure and identify areas in need, prioritize resources and ultimately guide the response. In the near future as vaccine development accelerates, the IRR Tool will

additionally support the formation of targeted strategies to reach those most in need first.

CONCEPUTALISING THE IRR TOOL

In context of applied research in social, economic and political fields, individual indicators or statistics are useful for identifying trends and drawing attention to specific issues. They can also be useful for setting political priorities and for benchmarking or monitoring performance. A composite indicator is formed when individual indicators are compiled into a single index based on a conceptual model. Ideally, the composite indicator should measure multidimensional concepts such as: competitiveness, sustainability, social progress and human development among others, some of which cannot be captured by a single specific indicator. They facilitate the analysis as well as the understanding and communication of complex topics. Understanding the subnational risks in response to Covid-19 is a complex multi-dimensional issue that requires taking into account various economic and social indicators. This is why the development of a composite index acts as a useful tool to more effectively identify areas in need and assist in formulating intervention strategies. In order to develop a composite indicator that measures the level of risk, a conceptual model must first be developed that defines the main risk factors and their key elements. Following the conceptual model, it is then necessary to identify the best possible indicators that most wholly capture each element. Finally, the design and implementation of a statistical methodology for the calculation of the composite indicator can take place.

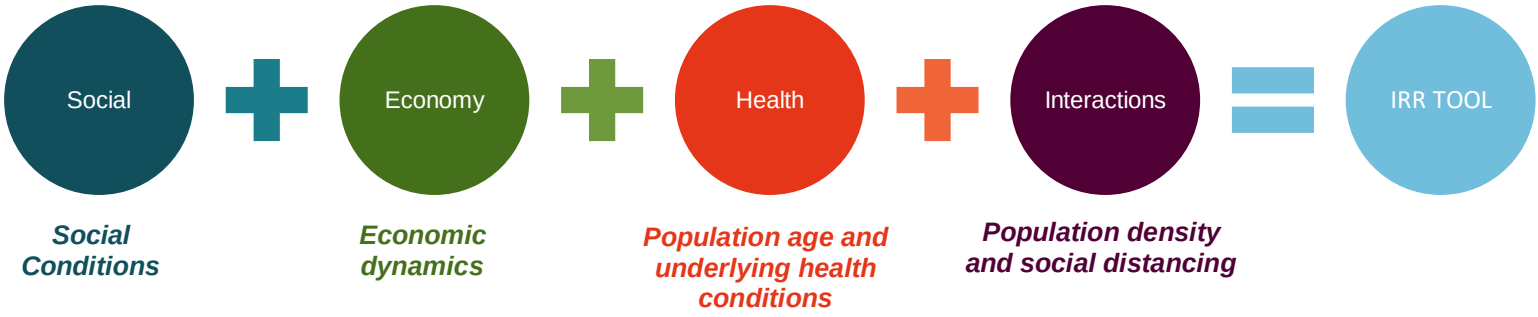
To understand the need of the IRR Tool, it's important to first further explore the connection between socioeconomic factors and Covid-19. The inclusion of socioeconomic structures within risk management models for the Covid-19 pandemic has been a widely documented topic; In fact, the World Bank (WB) refers to these structures at the local level as critical points to take into account when considering risk management[3]. The priority is focused on stopping the transmission of contagion whilst supporting the most vulnerable populations. This is most effectively accomplished by keeping the infrastructures working, continuing to provide public services, identifying areas of high transmissibility, implementing targeted communication strategies and highlighting the populations at the highest risk of being exposed to the virus. WHO has also reported the importance of socioeconomic dynamics and their impact on response capacity and efficiency in controlling the pandemic[4]. Housing conditions, poverty, educational level, economic activity, ability to telecommute and types of company, are all characteristics that not only have implications on the transmissibility of the virus, but also on the implementation of strategies focused on reducing the interaction of people, modification of hygiene habits and protection of vulnerable populations.

In this sense, the combination of socioeconomic structures, public spaces, and population characteristics not only determine the transmissibility of the virus, but also

the probability that the number of hospitalized patients will accelerate, threatening total capacity and increasing the risk of health care system collapse. These local factors including: the type of population, the living conditions and the characteristics of the area are core elements to consider when constructing a Covid-19 containment strategy.

In accordance with these local risk factors, the conceptual model of the IRR Tool incorporates four dimensions: social conditions, economic conditions, social conditions, health conditions and conditions of interactions (Figure 1). All of equal importance, each dimension seeks to answer a specific question that characterizes the level of risk within each geographic area. Together, these form dimensions form the composite index.

Figure 2: Conceptual model of the IRR Tool



Social

Within the social dimension, the IRR tool asks two main questions:

- What parts of the society are most vulnerable to the impacts of Covid-19?
- Do the social structures and resources allow for effective containment of Covid-19?

Social components that are vulnerable to Covid-19:

- *Population living in poverty:* People living in poverty are most vulnerable to Covid-19 as they cannot afford proper health care and may have insufficient resources to protect themselves from the virus.
- *Level of education in women:* Women are more likely than men to lose their jobs during the pandemic leading to an increase in gender-based inequality. Level of education in women is an indicator of the resources available for women in a society as it is predicted that areas with higher resource difference among genders are going to face an increase in gender inequality.

Social components that determine the efficiency of containment measures:

- *Access to information and communication:* A greater access to information and communication means that individuals can effectively quarantine or limit social interactions while staying connected to their immediate community. In addition, information regarding Covid-19 can be easily spread across the society to increase awareness and encourage good sanitary measures.
- *Overcrowding*: Overcrowding means that people cannot as effectively limit social interactions within a household. The lack of space may also increase the chance of individuals partaking in activities outside of their house, increasing their risk of contracting Covid-19.
- *Access to clean water:* Without access to clean water, individuals will have to leave their house more frequently to get clean water, reducing the effectiveness of quarantine. In addition, no access to clean water may indicate bad hygiene which thus increasing mortality risk from Covid-19.

Economy

Within the economy dimension, the IRR tool asks two main questions:

- What components of the economy are most vulnerable to the effects of Covid-19?
- What components of the economy align with an effective and safe reopening of the economy?

Components of the economy that are vulnerable to Covid-19:

- *Access to internet:* A greater access to internet creates a greater propensity for home office allowing individuals to reduce their interactions through travelling to work and limiting the spread of Covid-19.
- *Informal labor:* Lockdowns for Covid-19 containment have a drastic impact on the informal labor market. According to some ILO estimates, assuming a situation without any alternative income sources, lost labor income will result in an increase in relative poverty for informal workers and their families of more than 21 percentage points in upper-middle-income countries, almost 52 points in high-income countries and 56 points in lower- and low-income countries. Large proportions of informal labor in a locality indicates that strong lockdown measures can lead to an increase in poverty and social unrest in the area.
- *Small businesses:* Higher percentage of small businesses indicates higher risk as they are most expected to be negatively impacted by the pandemic.
- *Self-employed individuals:* Economic activity has been reduced as a result of lockdown measures. Self-employed individuals are more vulnerable and likely to struggle due to supply and demand disruptions.

Components of the economy that align with an effective and safe reopening:

- *Percentage of businesses that export:* businesses that export are more likely to adjust to the new normality and abide by international standards in order to stay competitive in the global market

Health

Within the health dimension, the IRR tool asks two main questions:

- What age groups have a higher risk of mortality from Covid-19?
- What underlying health conditions create a greater risk of mortality from Covid-19?

Age groups at higher risk:

- *Population that is 65+ years old:* Older aged population have higher mortality risk from Covid-19.

Population groups with underlying health conditions at higher risk:

- *Diabetes*
- *Cardiovascular diseases*
- *Obesity*
- *Cancer*

Interactions

Within the interactions dimension, the IRR Tool asked one main question:

- How does public space and the movement of people affect the transmissibility of the virus?

Two answer this, the following components are used:

- *Population density:* Higher population density indicates that a higher proportion of people are living in a certain area. A greater amount of people living in an area can limit the effectiveness of quarantine as social interactions are more likely.
- *Response to restrictions:* Mobility data is used to understand how a specific area will respond to restrictions. Areas with a greater reduction in the change in movement as a result of Covid-19 can better contain its spread than those that had a smaller reduction in the change in movement. It's assumed that areas with greater reduction in change in movement have better resources to quarantine and limit social interactions than those that faced a lesser change in movement.

The indicator selection process is guided by understanding these questions and the components needed to answer them. In addition, the IRR tool applies a set of unique design principles:

1. **It only considers indicators of results and not of efforts.**

There are two broad categories of conceptually coherent methodologies for index construction: input indices and outcome indices. Both can help countries to benchmark

their progress, but in very different ways. Input indices measure a country's policy choices or investments believed or known to lead to an important outcome. In competitiveness, for example, an input index might measure investments in human capital or basic research. Outcome indices directly measure the outcomes of investments. The IRR Tool has been designed as an outcome index. The tool measures the lived experience of real people, regardless of effort spent or the capacity to impart change. Given that there are multiple distinct aspects of Covid risk, each measurable in different ways, the IRR Tool has been designed to aggregate and synthesize multiple outcome measures in a conceptually consistent and transparent way.

2. **Indicators must be relevant to the context of the pandemic.**

As a risk management tool that is inclusive of indicators beyond that of the health crisis, the scope of potential metrics is wide. Indicators chosen within each dimension must be directly relatable to the pandemic and the risk it poses. Nevertheless, the specific indicators that help to capture risk are likely to change based upon the country's specific socioeconomic structures and available data. Importantly, the principles of the dimension remain the same whilst the indicator(s) is adapted.

3. **Indicators must be from official sources.**

Reliable, trustworthy data is fundamental for any effective tool. The IRR Tool must include indicators only from official sources.

4. **Indicators are only chosen if they can be transformed into risk management actions.**

The IRR Tool aims to be highly actionable with sufficient specificity to provide leaders and practitioners in government, business, and civil society with an integrated risk assessment. From this analysis of risk, decision-makers can more effectively identify and prioritize needs, ultimately guiding the response. Every dimension highlights an essential element of Covid-19 risk, and every indicator implies a potential "entry-point" and an "explicit target" for public policy. Building a subnational index with local networks will strengthen the actionability of the IRR Tool, provided that the process of disaggregating and customizing the tool is also supported by strong political buy-in around socially legitimate targets.

These four principles allow the generation of a tool to measure risk and vulnerability to Covid-19, and at the same time, support the construction of a practical agenda of priorities for Covid-19 risk management.

SELECTION OF INDICATORS ARGENTINA

The selection of the general set of indicators given above was completed by considering the questions discussed for each dimension in the conceptual model. However, due to a number of factors - primarily data availability and statistical

robustness - the individual indicators used to answer each question will vary from country to country. Therefore, when selecting indicators, it's vital the conceptual model and principles of design are followed. If an indicator from the conceptual model is not available at a subnational level, then a proxy variable for the same concept can be used as long as it effectively answers the question being asked. The investigation is carried out at the local level to select the indicators for the specific geographical level (granularity) with indicators prioritized statistical robustness, the source of the data and the period of time that the indicator measures. Fundamentally, the data must make sense in terms of actionability and thus the level of granularity must correlate to policy decisions and be communicable to a wider audience.

This approach was carried out in Argentina through partnership between CIPPEC and the Social Progress Imperative. Indicators were selected at the level of Province and Aglomerado the details of which can be found below.

Argentina Indicators

Dimensión	Indicador	Fuente
Social	% de hogares con hacinamiento crítico	Encuesta Permanente de Hogares, módulo Hogares, 2do Trimestre 2020. Instituto Nacional de Estadísticas y Censos (INDEC).
Social	% de hogares por debajo de la línea de pobreza	Encuesta Permanente de Hogares, módulo Individuos, 2do Trimestre 2020. Instituto Nacional de Estadísticas y Censos (INDEC).
Social	% de hogares con agua por red pública	Encuesta Permanente de Hogares, módulo Hogares, 2do Trimestre 2020. Instituto Nacional de Estadísticas y Censos (INDEC).
Social	% de mujeres sin instrucción	Encuesta Permanente de Hogares, módulo Individuos, 2do Trimestre 2020. Instituto Nacional de Estadísticas y Censos (INDEC).
Económico	% hogares con Acceso a internet	Módulo de Acceso y Uso de Tecnologías de la Información y la Comunicación (EPH, 4to Trimestre 2019) Instituto Nacional de Estadísticas y Censos (INDEC).
Económico	Tasa de empleo no registrado por provincia	Encuesta Permanente de Hogares, módulo Individuos, 2do Trimestre 2020. Instituto Nacional de Estadísticas y Censos (INDEC).
Económico	Trabajadores cuenta propia por provincia (porcentaje sobre total de ocupados)	Encuesta Permanente de Hogares, módulo Individuos, 2do Trimestre 2020. Instituto Nacional de Estadísticas y Censos (INDEC).
Salud	% de población 65 o más, por provincia.	Porcentaje de población mayor de 65 años
Salud	Tasa de mortalidad por causas, por provincia [cada 10.000 habitantes]	Pedido de Acceso a la Información a la Dirección de Estadísticas e Información en Salud (DEIS), 2018. Para enfermedades del sistema circulatorio, las categorías I00 a I99 de la CIE-10. * Clasificación Estadística Internacional de Enfermedades y Problemas Relacionados con la Salud (CIE-10)
Salud	Tasa de mortalidad por causas, por provincia. Prevalencia de diabetes [cada 10.000 habitantes]	Pedido de Acceso a la Información a la Dirección de Estadísticas e Información en Salud (DEIS), 2018. Para diabetes mellitus se consideraron las categorías E10 a E14 de la CIE-10. * Clasificación Estadística Internacional de Enfermedades y Problemas Relacionados con la Salud (CIE-10)
Salud	Tasa de mortalidad de personas que tienen como causa básica de defunción la categoría E66 Obesidad de la CIE-10 [cada 10.000 habitantes]	Pedido de Acceso a la Información a la Dirección de Estadísticas e Información en Salud (DEIS), 2018. Se incluyen fallecidos que tienen como causa básica de defunción la categoría E66 Obesidad de la CIE-10 * Clasificación Estadística Internacional de Enfermedades y Problemas Relacionados con la Salud (CIE-10)

Interacciones	Densidad por provincia	Proyecciones de población del Censo 2010 para 2020 y datos obtenidos de la http://biblioteca.municipios.unq.edu.ar/
Interacciones	Respuesta a las restricciones "movimiento en casa".	https://www.google.com/covid19/mobility/
Interacciones	Respuesta a las restricciones "movimiento en el trabajo"	https://www.google.com/covid19/mobility/

CALCULATING THE IRR TOOL

Once the conceptual model of the tool is established, the next step is to consolidate a database. This is accomplished in stages using the methodological document of the Organization for Economic Cooperation and Development (OECD) on the construction of composite indicators as a guide[5]. Following are the steps used for the calculation of the IRR Tool Argentina:

A. Identifying Directionality and Standardizing Data:

After consolidating the database, it must be ensured that each indicator obeys the same rules from a conceptual standpoint; increasing the value will increase risk within each dimension. For this, the corresponding indicators that had an inverse relation were multiplied by minus one.

B. Normalization.

After correctly setting the directionality, the database needs to be standardized to render them comparable. To do this, the mean and standard deviation are calculated in order to obtain the value of the "z-score" statistic of each indicator. This will enable all indicators in the dataset to have a mean of 0 and standard deviation of 1.

$$Z = \frac{X - \mu}{\sigma} \rightarrow N(0,1)$$

C. Identifying Utopias and Dystopias

For the calculation of the IRR Tool, the min and max within each indicator are used to identify utopias and dystopias. This step is essential for setting the limits of the relative risk within each geographic unit and will be used within the rescaling process (E). Max and min are appropriate as the IRR Tool is not calculating temporal changes but providing a snapshot of the reality of the local context in the specific area in relation to Covid-19 risk.

D. Cronbach Alpha Analysis

Once these monotonic transformations have been completed, Cronbach's Alpha analysis must be applied. Cronbach's Alpha assesses the "fit between" individual indicators within a component, making it a measure of internal consistency of the indicators. A general rule of thumb implemented by experts is that the value of alpha should be close to 0.7 for any set of variables[6].

E. Columnar aggregation and indicator weighting

Afterwards, an exploratory analysis has been performed to investigate the overall structure of the indicators, assess the suitability of the data set and explain the methodological choices in terms of weighting and aggregation. For this reason a columnar aggregation method is performed for each dimension. In this case, equal weighting is used to aggregate the indicators within each dimension.

F. Rescaling

Once the dimensions are aggregated, the result is scaled from 0 to 100 using the following formula:

$$\frac{(X_j - Worst\ Case)}{(Best\ Case - Worst\ Case)}$$

Here, 0 represents the utopian level of risk and 100 represents the dystopian level of risk. The lower the score the lower the risk in that specific dimension in relation to the other geographic units. Min and max define the best and worst cases (utopias and dystopias), therefore, for example, if a province had the min value within each indicator of the social dimension, the resulting aggregated score would be 0.

G. Final index aggregation

Finally, a geometric average of the aggregated dimensions is used to calculate the index. Geometric mean is used to tackle continuous data series which the arithmetic mean is often unable to accurately reflect. The geometric mean reduces the level of substitutability between dimensions and at the same time ensures that a 1 percent decline in the indicator of, for example, access to internet has the same impact on the IRR as a 1 percent decline in the morality from diabetes indicator. Thus, as a basis for comparisons of achievements, this method is also more respectful of the intrinsic differences across the dimensions than a simple average. The final IRR result represents a value ranging from 0 to 100 in which the higher the score, the higher the risk.

$$\bar{x} = \sqrt[n]{\prod_{i=1}^{n} x_i} = \sqrt[n]{x_1 \cdot x_2 \cdots x_n}$$

CONCLUSION

Conceptually, the risk posed by Covid-19 has been deconstructed beyond that of the health crisis, identifying the threat posed to the socioeconomic structures that underpin our societies. Further considered, is the way these socioeconomic factors impact the contagion of the virus itself, affecting the efficacy of preventative measures and the vulnerability of specific groups. Using innovative data that assess the ways communities interact, the understanding of the way Covid-19 is impactful and how it can be managed is further compounded. From this deep conceptual position, the IRR Tool is created that incorporates all of these elements into a single composite indicator, easily communicable and ready to create a positive impact on communities. The IRR Tool looks beyond income as the sole metric that defines resilience to Covid-19, helping to navigate through the multi-dimensional impacts Covid-19 presents.

An essential part of the IRR Tool is connecting sectors to drive inter-institutional policy able to generate far-reaching impacts. The current reality means that innovative solutions to reopening economies whilst maintaining saving lives as a core priority are needed. The IRR Tool guides interventions that complement health policy; it does not replace them. As vaccines become more available, a targeted strategy is needed that highlights which areas receive it first and why. The IRR Tool fundamentally supports the management of this pandemic through an inclusive approach, minimizing damage to health and socioeconomic structures and better preparing communities across the world to recover from Covid-19.

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