DETECTION AND WARNING SYSTEMS

KEY CHALLENGES FACING THE EMERGENCE OF EPIDEMICS AND THE RISK OF RESURGENCE OF CASES AT THE END OF THE CRISIS PHASE
**PREAMBLE**

As it has done regularly in the past, in connection with complex, multi-factor and potentially long-lasting crises, the Groupe URD has begun to:

- Establish a ‘real-time evaluation observatory’ in order to produce synthesis reports, analysis and recommendations about the crisis.

This briefing note is the sixth output of the COVID-19 Observatory. It will regularly be updated and supplemented by various contributions on specific topics:

- Health;
- Food and economic security;
- Social cohesion;
- Mobility and migration;
- Disaster management.

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*The Groupe URD produces strategic documents in connection with a convention with the French Ministry for Europe and Foreign Affairs (Crisis and Support Centre and the General Directorate for Globalisation) and the French Development Agency (AFD). These focus on topical issues in the aid sector, and help to improve the quality of operations before, during and after crises. The content of these documents is solely the responsibility of its authors.*
Summary

Alerts successfully warned the world about the outbreak of COVID-19, but the world, despite its hyper-connectivity, its powerful intelligence agencies and its overinformation, has not been able to react quickly or consistently enough. In some countries, especially in Asia and Africa, decisions were made reasonably quickly, notably concerning the closing of borders and imposing public health barrier measures. In others, there have been significant delays in responding to the warning, or even denial of the risk that the virus posed. The problem is thus found not to be in the warning itself but rather in the systems that manage it, and which must generate a response to be effective. Both internationally and within nations, authorities and institutions alike have been overly confident about the ability of humans and health-care systems to control a new virus.

In today's world, as deconfinement is implemented in many countries, and our knowledge grows surrounding both the behaviour of SARS-CoV-2 and of the gaps in our understanding, alert systems have returned to the spotlight as a key way to ensure that response to the virus is effective and efficient (cost / effectiveness). Being able to identify the existence of a new threat as quickly as possible is key in simultaneously triggering an operational response and launching information gathering processes, essential in the gradual construction of countermeasures against this biomedical threat.

This note addresses several challenges and opportunities for improving the early warning systems presently in use, notably by providing them with innovative mechanisms and tools.
INTRODUCTION

As a gradual deconfinement is put in place in many countries and our understanding of the virus' behaviour increases, the tools used in detection and in warning systems returns to the center of the political and response agendas, both nationally and internationally. With the potentially few symptoms of infected persons and the oft-unexpected nature of outbreaks, a quick and agile case detection system is more important than ever, especially in countries in which economic resources may be lacking.

Warning systems generally have two parts:

- **Upward flows**: this is what allows us to know what is happening in the field and to relay information on health phenomena to the central, national or international levels where the findings can be analyzed, making it possible to make decisions on possible responses that can be rolled out.

- **Downward flows**: this is the alert given to populations, institutions and operational levels of the health pyramid, to trigger or adjust the various components of a response.

The warning systems activated for COVID-19, as with all communicable diseases, vary greatly depending on the capacity of the health system and the national response of countries. The capacity to verify rumors, to reliably collect and process information, and to raise it to the levels where analysis is conducted; and finally the strength of conviction of the “forewarners”, decision-makers and politicians, are all variables which will affect the alert itself and the probability that it will trigger the necessary actions. Systematic disease reporting requires a significant amount of administrative work and time. A rougher but more rapid (and parsimonious) detection, in the spirit of a sentinel observing the plain from the top of its watchtower, is therefore also needed at the core of epidemic management, and needs to be present in informing national and international decisions. As the warning systems are highly complex and vary across countries and regions, this note aims to study only some of the challenges that concern these systems in the context of the COVID-19 crisis.

« THERE ARE NONE SO DEAF AS THOSE WHO WILL NOT HEAR »

The central challenge of the first warning is to be correctly perceived by the system, which always presents difficulties for a new disease. At the start of the COVID-19 crisis, even the name of the disease was not assigned. The warnings were given by journalists, security officials, national disease control centers and other national/international sources. Each institution, whether in the health sector or not, has its own interpretation and responses to the warnings. Depending on its interests, its objectives and its capacity, an institution will listen to and relay warnings differently. The appearance of a new and potentially dangerous disease should be able to alarm authorities at least through one of these institutions, but for warnings to be useful, decision-makers must be ready to hear them.

The warnings that have echoed for over thirty years based on various scenarios, mathematical models, simulation exercises and other methods have not prevented countries, even wealthy ones, from going so far as to abandon their elaborate pandemic plans, or from interrupting the renewal stocks of equipment sometimes as inexpensive as simple masks.
## Chronology of the WHO alert processes in the case of COVID-19

<table>
<thead>
<tr>
<th>Date</th>
<th>Alert</th>
<th>Description</th>
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<tbody>
<tr>
<td>December 31st, 2019</td>
<td>Alert in China</td>
<td>Wuhan’s municipal sanitary commission, located in the Hubei province, informs the WHO China office about a group of cases of pneumonia linked to a new coronavirus.</td>
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<td>January 1st, 2020</td>
<td>First internal mobilization at the WHO level</td>
<td>The WHO sets up a team to assist in the management and the tracking of the situation, working across regional, national and internal levels, putting itself in a state of emergency to better respond to the new threat.</td>
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<td>January 4th, 2020</td>
<td>1st warning issued</td>
<td>The WHO publishes a first statement on social media concerning the existence of a cluster of pneumonia cases linked to a new virus in Wuhan.</td>
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<tr>
<td>January 5th, 2020</td>
<td>Publication of the 1st report on the COVID-19 epidemic</td>
<td>The WHO publishes its first report on the outbreak of a new epidemic linked to the new virus. It includes a risk assessment and advice, echoing China’s indications as to the health of patients affected, as well as the public health precautions implemented to face off against this cluster of cases of pneumonia in Wuhan.</td>
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<tr>
<td>January 10th, 2020</td>
<td>Publication of first set of guidelines to respond to COVID-19</td>
<td>The WHO publishes a complete set of technical procedures online, including recommendations for countries on how to detect, track and respond to potential cases, based on the knowledge of the virus as it stands.</td>
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<tr>
<td>January 13th, 2020</td>
<td>Warning that SRAS-CoV-2 has left China</td>
<td>Authorities confirm a case of COVID-19 in Thailand, the first case reported outside of China.</td>
</tr>
<tr>
<td>January 14th, 2020</td>
<td>WHO issues a warning of a potential large-scale epidemic</td>
<td>During a press briefing, the WHO's technical officer tasked with the response to the virus indicates there may be human-to-human transmission and that a risk exists of a widespread epidemic of large proportions.</td>
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<tr>
<td>January 22nd, 2020</td>
<td>Warning that human-to-human transmission is possible</td>
<td>The WHO China office publishes a declaration outlining evidence proving the possibility of human-to-human transmission found in Wuhan.</td>
</tr>
<tr>
<td>January 23rd, 2020</td>
<td>Pre-alert</td>
<td>The WHO Director General convenes an emergency committee under the International Health Regulations (IHR 2005) to determine if the outbreak is a public health emergency of international concern (PHEIC) but does not reach consensus. A new committee meeting is scheduled within 10 days.</td>
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<tr>
<td>January 30th, 2020</td>
<td>The WHO declares that the outbreak of the coronavirus constitutes a public health emergency of international concern (PHEIC)</td>
<td>The WHO emergency committee is reconvened just two days after the first reports of human-to-human transmission outside of China. The emergency committee transmits to the Director-General a notice indicating that the outbreak constitutes a PHEIC.</td>
</tr>
<tr>
<td>February 3rd, 2020</td>
<td>Announcement of the response plan</td>
<td>The WHO disseminates the international community's Strategic Preparedness and Response Plan to help protect states with fragile health systems.</td>
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<tr>
<td>March 11th, 2020</td>
<td>The WHO issues a pandemic alert</td>
<td>Faced with the alarming levels of propagation and the severity of the disease, the WHO makes the assessment that COVID-19 can be characterized as a pandemic.</td>
</tr>
</tbody>
</table>

The first alerts were downplayed by all of the first countries affected by the initial wave of the epidemic. National security systems awaiting a biological attack did not perceive this “flu” as a real threat and economists did not see it as posing a serious threat going forward. It is still too early to know the reasons for this, but many have put forward the idea of an inflated belief in their own technological capabilities and knowledge.
ALERT SYSTEMS MUST BE ADAPTED

Very quickly, the alert’s role was no longer to notify when the first case of the disease arrived in a country, but rather to provide information which would allow response committees to determine how alert they should be. COVID-19 has therefore been recognized as not being very dangerous at the individual level but very dangerous for a population. SARS-CoV-2’s real threat lies in its rapid and often asymptomatic mode of propagation. The number of sick or dead may be but a small percentage of the population, nonetheless it can rapidly exceed the capacity of a country or a zone, leading, for example to the mass graves which had to be dug in New York. COVID-19 also has the particularity of potentially leaving large swathes of a country virtually untouched, while others rapidly become “foci” (areas with very many cases in a short time). In such a context, effective alert systems are key in detecting the very first cases of a possible new outbreak.

HOW CAN WE IDENTIFY & MEASURE THE PRESENCE OF SARS-COV-2?

Alert systems determine the nature of the alert based in particular on two types of test:

The molecular test: This is the most widespread test available to date. It detects the genetic material or antigens specific to the virus by using a standard RT-PCR methodology. Highly specific and sensitive, it is done by collecting samples from the nose / throat. Sample collection equipment must be widely available and laboratories well equipped with reagents for this method to be deployed on a large scale. This method is known to all health systems globally and is broadly accessible, though there have been some shortages of tests due to the large demand. However, even where tests are available in appropriate quantities, they have limitations: in the case of the PCR test, results take several days to be known, and when practiced on a large population the logistical complexity of transportation and costs incurred rapidly become significant.

The serological test: This approach is well known but still being developed due to the peculiarities of each person’s immune response. This test measures the presence of antibodies in the plasma of a person who has had SARS-CoV-2. The specificity and sensitivity are not very clear over time and the test does not indicate a result only one to three weeks after the disease (but also longer after).

Currently, there are many challenges in implementing tests: the ability to develop and produce these tests; to have them approved by national authorities; to distribute them nationwide; to reinforce the health personnel’s capacity to conduct them both with quality and in large amount... These all parameters which must be taken into account simultaneously. Some wealthy countries like South Korea and Germany were quickly able to test (PCR) on a large scale. Inversely, though some reagents have been present in the global South, they are often only available in very limited quantities, and in systems which have a lower absorption capacity to conduct them effectively.

ALTERNATE TRACKING AND WARNING METHODS

In light of the many asymptomatic people who contract COVID-19, and in the absence of widely available tests, alternatives for tracking the virus had to be found. Currently, the most common practice is to estimate the course of the epidemic using extrapolation from the number of people hospitalized for COVID-19 in sentinel hospitals. This method faces many critical points: defining what constitutes a case of COVID-19 in a clinical setting; the reliability of collected data to identify anomalies through comparisons with established infection curves; the proper training of health personnel to identify anomalies; the effectiveness of information transfer to ad-hoc analytical levels; the frequency of these transfers; the analysis of anomalies and finally the triggering of alerts, are all limitations of even the most prepared health systems. However, there are many other ways to alert health or national response systems.
**Contact tracing:** An alert system which allows people to be warned but also to alert others – this genre of tracking systems seeks to find people who have been in contact with an infected individual, in order to indicate to them that they should quarantine themselves. The cost is very high and therefore only applicable if there are relatively few cases of COVID-19 in a given city/region/country, as it is necessary to contact more than 70% of the people an infected person comes into contact with to successfully « flatten the curve ». Many countries base their contact tracing on community health workers. Though these health workers may be less effective than a team recruited specifically to implement contact tracing, these workers are still very beneficial in alerting the population, especially as a result of their knowledge of the communities they work in.

**IMPROVING THE SENSITIVITY OF ALERT SYSTEMS**

Beyond these “classic” methods used in alert systems, in light of the general interest in overcoming the problems faced by society in this pandemic context, several other tools must be mobilized to quickly detect the emergence and development of epidemics like that of COVID-19. These additional tools can help to increase the sensitivity of the system by detecting many more cases at a low cost:

- **Monitoring of cemeteries and cremation sites:** Health statistics are often seen as weak and/or unreliable due to possible errors in the data collection, processing and transmission processes. On the other hand, even in the complete absence of data collection, as is the case in remote areas or in areas heavily controlled by authorities, large and sudden increases in mortality can be seen quite easily.

- **Use of trained dogs:** One track being explored is the use of trained dogs, because it was hypothesized that dogs, capable of detecting explosives, drugs and certain cancers, could be able to detect the coronavirus. Tests have been taking place for a week at the National Veterinary School of Alfort in Val-de-Marne. Initial results seem encouraging and, in several countries, civil protection and anti-drug canine units have mobilized to test the skills of dogs to identify patients infected by SARS-CoV-2.

- **Citizen systems:** The emergence of “User generated content” and citizen mapping systems (Ushaidi, Sawana, crisis groups, etc.) has enabled the generation and mapping of information. Used in Kenya during the post-electoral violence of 2006, then following various natural hazards (earthquake in Haiti, etc.), these systems can be used to identify and map trajectories of patients and potentially-affected areas, and to trigger alerts and rapid response teams. They are currently being adapted to the context of the COVID-19 pandemic, and as such it will be interesting to take stock of their progression in a few weeks. Other approaches are also emerging, based on indicators to be taken in the environment of populations at risk:

  - **In the wastewater treatment systems:** The continued monitoring of wastewater could provide additional information on the circulation of SARS-CoV-2 and thus serve as early warning systems for the detection of new outbreaks. Several researchers are currently arguing that analyzing untreated wastewater to potentially find viral genomes would have several benefits. First, this would make it possible to detect outbreaks more precisely than the analysis of cases declared in health centers, as this analysis would make it possible to see precisely where carriers of the virus are located, but also whether they are strongly or only slightly affected, or even asymptomatic. This analysis would allow health authorities to have tangible sources of data to anticipate new waves of contamination even before hospitals are full. These analyses could make it possible to gauge the effectiveness of strategies used to combat the virus, notably when it comes to lockdown. Many researchers also put forward the idea of creating sentinel networks around the world, in order to follow the transmission and evolution of the virus over long periods of time. While the implementation of these analyses has begun in Europe, they are still very rarely used in developing countries where, due to weak wastewater management systems, this kind of analysis could be very complex to implement.
- **In the air:** It has been thought that it might be possible to spot the virus in the air, in particular by using a laser. Though this method is still very experimental, it has enormous potential, especially in hospitals and places with air conditioning. Such a system would in particular make it possible to detect virus in a group of asymptomatic COVID-19 patients without testing everyone. At the same time, it could allow air treatment with UV light. Given the general desire to deconfinе citizens globally, such a measure should be implemented, especially in airplanes, restaurant toilets, hospital storage rooms, etc.

**ALERT SYSTEMS, BUT FOR WHOM?**

**FOR AUTHORITIES:**

The various sources of data previously outlined allows authorities to determine the reproduction number (also commonly called the R value) and determine what level of alert to issue and what measures to take accordingly. However, communicating the constantly changing alerts to the population has been found to be difficult. At regional and global levels, many different sources for alerts and data sources have emerged via different response and development organizations.

The issue remains surrounding the transparency of alerts. All citizens of the world would like to be informed of the first case linked to a transmissible and dangerous virus. However, no national authority is ready to give up its sovereignty. All the member countries of the International Health Regulations have therefore given permission to the WHO to investigate such a situation in any and all countries it presents itself in.

Nonetheless, these missions additionally depend on each country's further approval. Without this procedure, the world could have saved weeks and who knows, perhaps even been able to control the epidemic at its place of origin. However, the gap between local and global alerts is not specific to China. From keeping military secrets and protecting research, to a nation's political authority and economic interests, many barriers are present throughout the world which can only be overcome by perspicacious authorities capable of admitting that a small trade-off for generalized global interests will be the best way it can benefit its population.

**FOR INDIVIDUALS:**

Google and Apple are in the process of making an application available to the public which would let users know if they have been in contact with COVID-19 carriers in a 14-day window. Health authorities in more than 20 countries have also already started developing software based on information that consenting individuals would share. These proposals have created a lot of enthusiasm, but due to privacy concerns these apps can not allow authorities to automatically obtain the contact details and data of those alerted.

Several countries have also made self-alert systems available to the general public, in the form of guides which allow users to be alerted if there are reported cases of COVID-19 in their communities, and whether they may be potentially infected or not (and what to do if they deem they are at risk of having contracted the virus).

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1 https://africacdc.org/#
https://reliefweb.int/topics/covid-19-global; https://coronavirus.jhu.edu/
3 https://ourworldindata.org/
F O R  C O M M U N I T I E S:

Alerts around new cases and associated protective measures have also been given by community associations, NGOs, public and private companies, and other informal systems. Particular challenges have risen based on communities' understanding of these alerts: for example, in the DRC people full of suspicion have not hesitated to accuse those issuing the alerts of various things.

HEALTH ALERTS: CHALLENGES OF MULTILATERALISM

At all times, WHO monitors the evolution of infectious diseases, issues alerts if necessary, offers its expertise and takes the necessary measures to protect populations from the consequences of epidemics, wherever it may originate.

International Health Regulations (IHR) - operational aspects

The International Health Regulations (2005), or IHR (2005), came into force on June 15, 2007. Its purpose and mission is to prevent, protect, control and respond to the international spread of diseases through proportionate public health actions, limiting the risks it poses to overall public health, while also avoiding creating unnecessary obstacles to international traffic and commerce. The IHR (2005) provides a framework for WHO's early warning and rapid response systems in case of an epidemic, allowing it to work in collaboration with countries to contain international outbreaks and strengthen international health security.

The IHR (2005) defines new operational concepts:

- Specific procedures for countries' monitoring and reporting of events and risks concerning public health to the WHO.
- WHO requests for verification of public health events occurring in countries.
- Rapid risk assessment in collaboration with countries.
- Determines the criteria for a public health emergency of international concern.
- Coordination of international action.

Global management of events pertaining to the alerts and actions taken in the event of an international outbreak

Epidemiological data and operational information around outbreaks change constantly. WHO has consequently developed a comprehensive management system to process crucial information on outbreaks, and to ensure its rapid and reliable communication with the main stakeholders in the field of international public health (regional offices, WHO country offices and associated centers, and its partners in the Global Outbreak Alert and Response Network).

This event management system has the following characteristics:

- Comprehensive database on epidemiological monitoring, verification status, laboratory investigations and operational information.
- Monitoring and history of outbreaks, critical decisions and important actions taken by WHO and its partners, essential documents.
- Management of logistical support, as well as specific equipment and supplies necessary for response.
- Integrated database outlining the skills, experience and availability of international experts who are part of WHO action teams.
- Overview of the technical establishments part of the global epidemic alert and action network.
- Standardized information material for member states, public health officials, the media and the general public.
- A communication system with the global epidemic alert network to improve preparedness.

WHO's event management system provides continuous monitoring of alerts and response operations and provides information for corresponding action to be taken, enabling the WHO and its global alert and action network to better prepare, quickly react and efficiently manage resources in an epidemic context. This system is currently being updated to integrate the operational aspects of alert and action of the revised International Health Regulations.
THE EMERGING ROLE OF E-TECHNOLOGIES

Warning systems are all the more crucial as countries start to relax their confinement regulations, during which a thorough understanding of the virus’ behaviour becomes vital to avoid a second or even a third wave. These systems must therefore be reinforced to improve their capacity to detect the very first cases of outbreaks (and identify hot spots) of this disease. They also need to be flexible enough to quickly verify all rumors of virus transmission, wherever they come from.

Simple technologies and an ever-increasing connectivity must accelerate the integration of innovative methods to issue and receive alerts, not only in the countries of the global North, but also in the countries of the global South. Rapidly developing, adapting and improving new, but also existing applications used in other contexts will also allow for rapid progress. Though conventional alert systems remain the most commonly used ways of issuing warnings to authorities, communities and individuals, new contact-tracing systems from Google and Apple present a new way of creating alerts by giving individuals the ability to know their specific level of exposure. The power they give to web giants, however, remains a large concern for many, challenging citizens’ rights to privacy, a critical point best summarized by the phrase « free or at risk ».

The development of national alert systems based on social networks and individual applications is something to follow, not only from a medical point of view, but also from an ethical one. Other innovative technologies could also help detect the virus in air and water: they are promising for populations that are more difficult to reach, but also for those refusing the cooperation of health workers, or even for populations that cannot be monitored individually due to lacking resources, such as in refugee camps or shantytowns.
CONCLUSION: EFFECTIVE ALERTS FOR QUICK RESPONSES

Alerts are critical during the emergence of a new disease. The international health system as a whole has shown many dysfunctions during the COVID-19 epidemic. However, to simply point out these failures is not enough; it is essential for both national and international systems to rapidly change the way they operate, to ensure that health alerts - wherever they may come from - will be considered fully by other sectors and in particular by national response and security systems.

At the international level of health regulations, the information provided by China as early as the end of December and the subsequent alerts issued by the Director General of the WHO were not enough to alert and generate immediate action, for example by the United Nations Security Council. In order to improve the international alert system, we must therefore move beyond solely discussing ad-nominem attacks and accusations about the functioning of institutions such as the WHO. This process will take time, but it is essential in order to better manage any future epidemics. To be successful, a rigorous evaluation must be conducted, making it possible to reflect beyond the conditions which led to creation of this virus itself (as we've seen surrounding the particularities of the Wuhan market, of the consumption of pangolin and the accusations surrounding a P4 laboratory), to instead focus on the weaknesses, but also the strengths of the current system.

Boosting preparedness for large-scale epidemics and pandemics has been identified as being essential for alerts and warnings to be effective. As soon as a public health emergency of international concern was declared on January 30, WHO called on countries to review their response plans and ensure their capacity to identify, isolate and manage patients and prevent transmission. Unfortunately, as is all too often the case, there has been a gap between this recommendation and national responses. Thus, in France and in Europe, there has been much debate on the health risk and the preparatory measures to be taken, with few actions to follow them up. Foreshadowing this unpreparedness, was the September 2019 report published by the Global Crisis Preparedness Monitoring Board, which brought together the WHO, the World Organisation for Animal Health and the World Bank, which even then indicated that the world was not ready for a highly infectious disease. A few weeks later, the SARS-CoV-2 pandemic began.

Will the response to the pandemic following this global contamination by SARS-CoV-2 lead to new approaches to epidemic warning and response? COVID-19 provides us with a new opportunity to revisit our systemic response. Let us not waste it.
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