Data and models:
Technopolitics
of the health crisis

36   **Building a dynamic, multisource surveillance**
for an emerging infections disease:
The French experience with Covid-19
Julie Figoni for Santé publique France.

All countries in the world, confronted with the new emerging threat, Covid-19, have faced numerous challenges on the health, economic, societal, or political level. One of them was the fast structuration and implementation of a surveillance system that had to be multisource, responsive, and flexible over time to be able to provide relevant epidemiological markers for decision makers and outbreak management. This article describes how in France, the national public health agency in collaboration with all its partners has built such a system to monitor the trends of Covid-19 from January 2020 and its course throughout the pandemic. The rapid progress of knowledge on Sars-CoV-2, particularly on its transmission, its clinical presentation, the most affected populations, and its numerous risk factors for severity, hospitalization, or death has made it an even greater challenge requiring a constant evolution of the surveillance methods and tools, and of the preventive measures to avoid the rapid spread of the virus.

51   **Participatory epidemiology: When the public participates**
in the surveillance and understanding of Covid-19
Sophie Pène & Maurice Ronai.

From March-April 2020, faced with the limitations of the data collected by emergency services and hospitals, the idea of relying on the public to complete the knowledge of the epidemic became commonplace. In a few weeks, a flourishing of online questionnaires and surveys was created to identify symptoms and enrich the clinical picture, count cases, map the spread, and understand the transmission mechanisms. These surveys and calls for contributions have been initiated by public health agencies, statistical offices, hospitals, universities and research centers, NGOs, companies and digital health start-ups, often in partnership. While the voluntary contribution of the public is the common factor in all these schemes, there is great diversity in the methods of recruitment. Some panels are random, based on calls for participation *via* social networks, with press coverage. Others mobilize polling institutes or pre-existing cohorts made up of specific populations (age, chronic patients at risk).

60   **The making of the follow-up of the Covid-19 crisis**
at *Le Monde*
Les Décodeurs du *Monde*.

In a few weeks, an "atypical pneumonia" that appeared in China became a global pandemic, disrupting our lives. How can we account for the scope, effects and spread of this disease that was to become Covid-19? Since the beginning of the pandemic, *Le Monde*'s Les Décodeurs service has tried to follow the extent of this global public health emergency on a daily basis.
To tell the story of how we have tried to report on the extent of the health emergency since the first cases – indentified in an *ad hoc* manner – is to tell a story of the epidemic and of the unpreparedness of health agencies in terms of open data. In fact, the latter were of capital interest to our readers, since it is on the basis of various indicators – contaminations, R0, hospitalizations, deaths, etc. – that health policies were decided that would have a major impact on our lives.

69 **How to popularize Covid data?**
Nicolas Berrod.

Since the beginning of the Covid-19 pandemic, in early 2020, data have been essential to follow the evolution of the epidemic and to try to anticipate what will happen next. Incidence rate, number of hospitalized patients, share of each Sars-CoV-2 variant among new positive cases, vaccination coverage... These indicators are provided on a daily, weekly, or monthly basis by several official organizations. As journalists, our mission is to use and popularize them in our articles and comments published on social networks. And when we work at *Le Parisien*, a newspaper for a very large audience, we also have to make this data accessible to everyone. Here is how we did it.

77 **Mathematical modeling**
of the Covid-19 epidemic in France,
and international comparison
Samuel Alizon & Mircea T. Sofonea.

The Sars-CoV-2 pandemic has brought to the forefront a scientific discipline that was previously discreet: Mathematical modeling of infectious diseases. A divinatory practice for some, a trivial application for others: It is above all little known in France. After explaining the foundations of this field and the different approaches to modeling, we return to the role of mathematical modeling during the epidemic in France. In order to highlight the variations of this role, we compare the different periods with marked policies implemented in other countries. In conclusion, we suggest ways of using epidemiological modelling in public decision-making.

86 **Institutionalization of models**
during the Covid-19 crisis
Mathieu Corteel.

The Covid-19 crisis brought models to the political forefront. How did this shift occur? What were the organizational dynamics that carried it forward? How did models shape health strategies during the Covid-19 crisis? To answer these questions, this article analyzes the process of institutionalization of the models, *i.e.* the emergence of a cognitive and operational framework that was built around them. It thus defends the thesis of an intermittent institutionalization of models, leading the government to mobilize models from both public scientific organizations and private consulting firms. From then on, this study allows us to consider a new form of institutional entrepreneurship characterizing the government's thinking and action during the crisis.

91 **Modelers of the Covid-19 epidemic**
Fabrizio Li Vigni.
The emergence of "computational epidemiology" in the early 2000s has renewed the activity of modeling infectious diseases using numerical tools. During the Covid-19 crisis, the governments of some countries made their decisions based on the modeling of these researchers from the natural and engineering sciences. However, they were not the only modelers who were called upon by the authorities to anticipate the spread of the disease, and to autonomously engage in pedagogic activities to explain its causes to the general public. Outsiders – from the natural and social sciences – contributed to the research on Covid-19 even though they had never been involved in epidemics before. This article looks at these communities and why they have made themselves available in the last health crisis.

97   **Lessons learned from the contact tracing activities**
         carried out by the Assurance Maladie
         (French Medicare)
         Jean-Baptiste Calcoen.

In record time, the Assurance Maladie implemented a national contact-tracing system dedicated to Covid-19. In each department, a contact-tracing platform made outgoing calls to positive cases and identified contact cases. These platforms operated 7 days a week from May 12, 2020 to June 2022, and handled 30 million positive cases and 23 million contact cases.

Despite the dramatic increase in cases, the Assurance Maladie was able to contact more than 90% of cases and contacts within a quick 24-hour timeframe. In order to cope with the magnitude of the epidemic, the Assurance Maladie has continuously adapted the contact-tracing system, progressively dematerializing it, and then fully dematerializing it as of July 2022.

While the effectiveness of the contact-tracing system has been proven in terms of the overall dynamics of the epidemic, the level of hospitalizations and the detection of contact cases, it is very complicated at this stage to determine whether or not cases have complied with isolation and whether or not the census of contact cases has been exhaustive.

This unique experience for the Assurance Maladie, and for the other actors of the health world, requires a complete feedback that will allow to define the role that the Assurance Maladie can play in the management of future health crises.

106   **Interview with Professor Renaud Piarroux**
         (Head of department at the Pitié Salpêtrière Hospital,
         specialist in epidemics, member of the Pierre Louis Institute
         of Epidemiology and Public Health attached to INSERM)
         on the COVISAN project
         Maurice Ronai & Aymeril Hoang.

An epidemic is a population in a territory. The response is territorial. In the fight against epidemics, we try to find out in a very simple way where and when cases have occurred, with a geographical unit that allows us to organize the response.

The COVISAN project, deployed in April 2020, in the Paris region, was directly inspired by the experience of eliminating cholera in Haiti in the 2010s. To break the transmission chains, mobile teams offered systematic screening to patients potentially infected with Sars-CoV-2 as well as to their relatives, and accompanied them in their confinement. In total, more than 100,000 people will have been tested and accompanied by the COVISAN system. In the face of future epidemics, we must ask ourselves which organizations and leaders are capable of organizing a response that is both territorial and community-based.

112   **BreakingTheChain.org:**
         Dematerializing contact-case research
         for efficiency at scale
         Florian Gauthier.

A number of citizen initiatives have emerged during the health crisis, whether to visualize data (CovidTracker, Coronaboard.fr, Covinfo.fr or Vaccinator.fr) or to facilitate access to vaccination (Covidliste, ViteMaDose). BreakTheChain.org is one of them.

120 **Dr. Spreadsheet & Mr. Excel**
Tools for flexible data-structuring
in the health crisis
Godefroy Beauvallet & Maurice Ronai.

A real digital "broom wagon", Excel was used in a wide variety of ways during the health crisis, allowing the collection and progressive structuring of data, facilitating their transfer and exchange, and facilitating the modeling and exploration of the dynamics of the crisis. Spreadsheets and other flexible data-structuring tools proved to be usable where previous structured or *ad hoc* information systems could no longer manage the complexity of situations, the fluidity of events, and the variety of subjects. This review of the uses of Excel during the crisis traces the stages of the informational arrest of Covid: From the initial overflow of the official data processing systems to the regaining of control of the local interpretative autonomy zones once the ordeal was over.

128 **Seeing the important things clearly**
Zeynep Tufekci, a sociologist in action
Hervé Le Crosnier.

During the first phase of the pandemic, the scientific discourse was mainly occupied by physicians and epidemiologists. However, as early as January 2020, it was a sociologist in the United States who anticipated most of the inflections concerning the behaviors necessary to face the disease, and acceptable by society. Zeynep Tufekci, with her multidisciplinary approach and her fluid, accessible yet sharp and relevant writing skills, has been able to propose appropriate solutions in numerous forums and on Twitter. So much so that she was featured in a long article in the *New York Times* characterizing her as the sociologist who could see the important things clearly.

134 **Personal data protection in the face**
of the health crisis
Valérie Peugeot.

The Covid-19 pandemic tested the capacity of personal data law to deal with an unprecedented health emergency. The experience showed on the one hand the robustness and flexibility of these texts, and on the other hand the responsiveness of the institution in charge of ensuring their application. In extremely short timeframes, the government was able to be closely accompanied by the CNIL (National Commission for Information Technology and Civil Liberties) in the implementation of unprecedented measures, ensuring that the derogations granted were minimal, transitional and controlled, while researchers obtained authorisations to process health data in record time.

139 **How the Scientific Council addressed**
the issue of digital tools
Daniel Benamouzig & Aymeril Hoang.

From the very beginning of the epidemic, the digital health sector has been the object of striking innovations, without their place having been anticipated or imagined in an epidemic context. While these innovations have posed real challenges, they have also raised numerous difficulties, never purely technical in the case of health uses. By looking back at the experience of the Covid-19 Scientific Council, of which the authors were members between spring 2020 and July 2022, this article describes how this committee of experts, created to advise the highest authorities of the State, took part in the reflections on the place of digital technology in the fight

against the epidemic. It looks back at some of the key episodes and the gradual implementation of a collective vigilance approach, before evoking key dimensions that go beyond the framework of the epidemic.

145   **Wastewater-based epidemiology:**
Current status and future of an alternative
epidemiological method for detecting
and monitoring epidemics
Vincent Maréchal *et al.*

Wastewater-based epidemiology has been successfully used – and for the first time on a global scale – to monitor the Covid-19 epidemic. The OBservatoire ÉPIdémiologique daNs les Eaux usées (OBEPINE) brings together researchers from different disciplinary fields (virology, hydrology, mathematics, environmental microbiology) with the common objective of developing and validating wastewater-based epidemiology to monitor microbial, and particularly viral, infections. Coupled with an innovative mathematical model, the strategy implemented by OBEPINE has made it possible to monitor the dynamics of the Covid-19 epidemic in nearly 200 wastewater treatment plants – *i.e.* nearly 40% of the French population – until April 2022. The success of this approach opens up major prospects for detecting and monitoring emerging infectious diseases to which we will inevitably be exposed in the near future, in France and elsewhere.