**COVID-19 health crisis**

**The CNRS response:
an overview of the main actions**

21 April, 2020

**FOREWORD**

For virtually all of its laboratories, the CNRS shares supervisory authority with other entities (research organisations, universities, schools, etc.). For ease of reference, this report sometimes uses the expression “our laboratories” even though it would be more accurate to say “the joint laboratories of the CNRS and its partners”.

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***All of the CNRS institutes, with their associated laboratories and their personnel, have undertaken operations in response to the COVID-19 health crisis, including research, social and communication actions.***

***However, for reasons that are obvious under the circumstances, the Institute of Biological Sciences (INSB) is at the forefront, coordinating a great many scientific initiatives with the INSERM, in particular through the Aviesan alliance. The Institute for Humanities and Social Sciences (INSHS) is also heavily involved, the human and social aspects of the crisis being of key importance.***

***The Institute of Chemistry (INC), Institute for Engineering and Systems Sciences (INSIS), National Institute for Mathematical Sciences (INSMI), Institute for Information Sciences and their Interactions (INS2I) and National Institute of Nuclear and Particle Physics (IN2P3) are also mobilised to address challenges in engineering, information technology and computation raised by the crisis.***

***The Institute of Physics (INP), National Institute for Earth Sciences and Astronomy (INSU) and Institute of Ecology and Environment (INEE) have taken part, along with the other institutes, in social and communication actions.***

1. **SCIENTIFIC AND TECHNOLOGICAL ACTIONS**
	1. **Research projects**

The laboratories of the CNRS and its partners are strongly committed to the effort to provide scientific responses that will help slow, and eventually halt, the pandemic as quickly as possible. As part of this struggle, all of the sciences and their related skills are called into action: biologists to understand the virus and its pathophysiology, as well as to devise treatments; chemists to discover molecules of pharmaceutical interest and new materials; specialists in the humanities and social sciences to evaluate, among other things, the short- and long-term consequences of confinement; mathematicians to develop new predictive models; computer scientists to analyse the available data using methods like artificial intelligence, etc.

The number of projects developed probably runs into the hundreds, making it difficult to draw an exhaustive list. The CNRS has mobilised financial resources to meet the most urgent needs. Some of these research projects are already leading to industrial applications, such as the EasyCov test, a non-invasive colorimetric saliva test to screen for SARS-COV-2 that requires no analytical device and produces a qualitative (infected or uninfected) result in about 30 minutes. Developed by an academic and industrial consortium comprising Sys2Diag (a joint laboratory of the CNRS and ALCEN Group company Alcediag) and SkillCell, a French biotechnology company (also a member of the ALCEN Group) that specialises in the development of field diagnostic tests, EasyCov has produced very good results in its preliminary phase. A clinical study is underway at the Montpellier university hospital to verify its performance in the field.

Through more conventional channels, several projects have been submitted in response to French and European calls for proposals. Examples include:

* [REACTing](https://www.inserm.fr/connaitre-inserm/programmes-recherche/reacting-research-and-action-targeting-emerging-infectious-diseases) (REsearch and ACTion targeting emerging infectious diseases), a consortium in charge of preparing and coordinating research to contend with health crises linked to emerging infectious diseases, has financed six teams in response to the COVID-19 crisis.
* Through its [Flash COVID-19](https://anr.fr/fr/actualites-de-lanr/details/news/flash-anr-COVID-19-86-projets-finances-pour-un-budget-de-145-meur-et-poursuite-dun-appel-ouvert-en/) programme, the French National Research Agency (ANR) is backing 36 projects involving units from six CNRS institutes, many specialising in biology or the humanities and social sciences (INSB: 20, INSHS: 10, INEE: 2, INSIS: 2, INSMI: 1 and INC: 1).
* At the European level, the [LifeTime](http://www.cnrs.fr/sites/default/files/press_info/2019-01/LifeTime_FR.pdf) flagship project has set out to combine research in single-cell analysis and viral infections.

In addition to these submissions, various teams have set up French and international networks to speed up the development of:

* Proteins for serological tests (IBS in Grenoble, in cooperation with the CEA IDMIT laboratory as well as the Grenoble university hospital, ESRF and ILL).
* Tests to detect the presence of the virus (Sys2Diag in Montpellier).
* Tests of active molecules to combat the virus (CEMIPAI and IRIM in Montpellier, CIRI in Lyon, CIIL in Lille).
* The formation of a patient cohort to study the immune response (CIMI in Paris).
* The COVID-ARA2 study on the role of antihypertensive drugs in combating lung inflammation (MITOVASC in Angers).
* Questionnaires and surveys such as [I-CARE](https://mbmc-cmcm.ca/fr/COVID19/), supervised by Canada and relayed in France by the INCC in Paris.
* Studies on [the senses of taste and smell during infection](https://join.slack.com/t/gccr-mql6351/shared_invite/zt-d0awmu92-bDwjAh_mr_gzvsHcHK5uOQ) (ICN in Nice) and on the perception of the epidemic in various countries (CSG in Dijon).
* [An online survey on confinement](https://ufrpsycho.eu.qualtrics.com/jfe/form/SV_9KQQbFDKEYs4YAt) (LAPSCO in Clermont-Ferrand).

Lastly, many of the projects being developed are interdisciplinary in nature, making the CNRS’s broad scientific scope a tremendous advantage in areas such as:

* Predictive models concerning the pandemic (biology, mathematics and computer science).
* Media analyses (the humanities and social sciences, computer science).
* The development of innovative solutions for the diagnosis and prevention of disorders linked to confinement (the humanities and social sciences, the biological sciences and computer science).
* The role of companion robots during the confinement period (robotics, the humanities and social sciences).
	1. **The reuse of FFP2 and surgical masks**

In a project initiated by Philippe Cinquin (a professor at Université Grenoble Alpes, director of the TIMC laboratory and a hospital practitioner), some 30 laboratories associated with the CNRS, CEA, INSERM, ANSES, INRS, the DGA and their university and engineering school partners, in cooperation with personnel from several French university hospitals and six industrial companies, along with a number of teams in other countries, are striving to find reliable methods for sterilising masks contaminated with the COVID-19 virus, while preserving their filtration capacities and thus their protective properties. Some of the work has been carried out in collaboration with industry, including Air Liquide.

For the CNRS and CEA, this research is coordinated by a joint task force in connection with an inter-ministerial group headed by Roger Genet, director general of the ANSES.

Multiple possibilities are being explored and tested for each type of mask. The resulting processes could be implemented on an individual or collective scale, directly at hospitals or outsourced to industrial service providers.

Several treatments have been identified, using ethylene oxide, supercritical CO2, ozone or pressurised hydrogen, as well as thermal treatments with dry or moist heat, gamma, beta or UVC radiation, plasmas or microwaves, and some have proven very promising. The next step is to have them approved and overcome any regulatory obstacles to their deployment. For some methods this will require the creation of logistics chains, which are also under study.

* 1. **Data flow control and analysis**

The emergence of COVID-19 and the speed of its propagation have exposed a key problem in the collection and sharing of data. Many types of data are needed for analysing and understanding the evolution and impact of the virus, whether they concern testing programmes, clinical studies, established scientific knowledge on comparable viruses, or social and economic information related to confinement. Four additional areas have been identified as essential to the efforts of the medical research teams: data management, data mining and visualisation, the extraction of information from documents, and AI techniques for data analysis.

The CNRS/INS2I has launched a call for volunteers among the personnel of the laboratories managed jointly by the CNRS and its partners. Nearly 250 researchers, academics, engineers and management and data processing specialists have come forward to offer their help.

The proposed concept has been successfully tested as part of a collaboration with a team headed by professor Philippe Ravaud (Hôtel-Dieu, Epidemiology and Statistics Research Centre), who created a [website](https://covid-nma.com/) compiling information on all COVID-19 clinical trials throughout the world, with data from 17 international sources (WHO, the EU, the US, China, Iran, etc.).

* 1. **Computational resources**

The CNRS has made its two national computing centres available to French and international projects on COVID-19. In addition to launching a call for proposals among the scientific community, the IDRIS, in collaboration with GENCI, immediately made the Jean Zay supercomputer operational for various molecular modelling projects and diagnostic tools. The CC-IN2P3 has also been dedicated to projects that require grid computing, as have other infrastructures (France Grille, computing clusters).

1. **COORDINATION ACTIONS**
	1. **CNRS-CRACOV**

On 27 March we launched a national cell to support the many social initiatives undertaken by the laboratories and their personnel, and to prepare for the continuity of research operations at the end of the confinement period. Called CNRS-CRACOV (for CNRS – Comité Recherche Action COVID, or COVID Action Research Committee), this cell backs up the efforts of the CARE (Comité Analyse Recherche et Expertise) Research and Expertise Analysis Committee, formed on 24 March by President Emmanuel Macron’s office, whose role includes analysing what is technically feasible and what has already been achieved by the laboratories.

The CNRS-CRACOV cell is kept informed of all proposals, projects and actions implemented at the local level. These cover a wide range of fields: the production or decontamination of masks, the use of 3D printing to make protective face shields, proposed tests for detecting the presence of the virus or its antibodies, data analysis, as well as various offers of volunteer work, including staff members donating their days off.

The cell studies the proposals and steers the most promising ones to the appropriate channel depending on the topic. To mention only two examples, we were able to respond in just a few hours to the Ministry of Higher Education, Research and Innovation, which had asked us to quantify swab production capacity using 3D printers. Also, thanks to the Business Relations Department, a researcher was put in contact with a manufacturer in less than 48 hours for the production of closed-system tracheal valves.

* 1. **HS3P-CriSE**

The CNRS and INSERM have created [Coordination HS3P-CriSE](file:///C%3A%5CUsers%5Claurencewinter%5CDownloads%5C%282%29%09https%3A%5Cwww.inshs.cnrs.fr%5Cfr%5Ccrises-sanitaires-et-environnementales-humanites-sciences-sociales-sante-publique) (for Humanités, Sciences Sociales, Santé Publique – Crises Sanitaires et Environnementales, or Humanities, Social Sciences, Public Health – Health and Environmental Crises) under the aegis of the Athena and Aviesan alliances. The goal is to foster structural initiatives in public health and the humanities and social sciences (HSS) based on research on COVID-19, and more generally on infectious diseases and major health and environmental crises. The group’s first three goals are:

* To launch an operation to map HSS initiatives concerning the COVID-19 epidemic and health crises in general, partly in coordination with the Maisons des Sciences de l’Homme (humanities centres) network.
* To form and host a coordinating committee tasked with defining and proposing a short list of directions for structural research on the epidemiological aspects of the current health crisis, on the healthcare and social protection system, and on the political and economic trends that are likely to ensue from the present situation, with a special focus on the transition to “deconfining”. The issues to be explored include: what happens in science when society faces a crisis and what science can contribute; the ethics of public decision-making and communication, in particular concerning the maintenance of public trust; reconsidering the conventional distinction between normal and pathological; the figure of the “healthy carrier” as a factor in public health; the patient’s role as a partner in healthcare and research.
* To identify tools to assist public decision-making based on research in the HSS and public health, in particular by contributing to the formation of ad hoc groups to provide the social science expertise needed for making crucial public policy decisions, such as the tracking of individuals via smartphone.

* 1. **MODCOV19**

Upon the initiative of the CNRS/INSMI, in association with the CEA, INRAe, INRIA and INSERM, a survey was conducted to find members of the scientific community with expertise in modelling. Some 250 researchers from our institutions, the IRD and universities proposed their services.

Based on this survey, the [MODCOV19 platform](file:///C%3A%5CUsers%5Claurencewinter%5CDownloads%5C%283%29%09https%3A%5Cmodcov19.math.cnrs.fr) was created with the aim of: clearly identifying the actions already undertaken in modelling, as well as the expertise potential, in order to respond quickly to concrete questions; enabling and coordinating exchanges among researchers so as to gather information rapidly, avoid duplication and promote pluridisciplinary cooperation; being an access portal for modelling expertise, with sufficient visibility to be recognised (by physicians, etc.) as an authority on these problems; responding swiftly to requests for expert analysis and interpretation, e.g. for international publications concerning COVID-19.

* 1. **Open Science**

The CNRS has launched an open-access library on the [“science-ouverte”](https://www.science-ouverte.cnrs.fr/ressources-covid-19/) website in order to facilitate the sharing of articles validated by our departments and laboratories, making it of use to the entire scientific community. We have received, for example, requests to that effect from African colleagues.

1. **SOCIAL ACTIONS**
	1. **Sharing academic laboratory resources**

The CNRS/INSB laboratories were among the first to take action to develop tests that could be used in local university hospitals (for example at the IPMC and EGID in Lille) and to offer their services as well as RNA and RT Q-PCR preparation equipment, making them available to the regional health agencies (ARS). Some 20 INSB laboratories are involved (see Appendix for a complete list). The EGID in Lille has already been requisitioned to carry out tests for the university hospital, and the IRCAN in Nice is participating in “Crowdfight COVID-19”, an international platform for PCR tests.

The CRBS in Strasbourg has been asked to perform pharmacokinetic analyses of blood samples from patients in intensive care being treated with a new anti-COVID-19 drug.

* 1. **Supplying hand sanitiser gel**

The CNRS has signed an agreement with the FACS, a national federation for healthcare coordination, to respond to the needs of private healthcare professionals (doctors, nurses, etc.) and home carers.

To this end, a large-scale operation has been initiated for the production of hand sanitiser gel. Many laboratories run by the CNRS and its university partners (in Gif-sur-Yvette, Lyon, Orléans-Poitiers, Toulouse, Bordeaux and Nice) have been mobilised, and so far 6,000 litres of hydroalcoholic solution have been produced.

Once this initial batch is delivered, our laboratories’ stock of basic ingredients will be depleted. To meet the strong and continuous demand, the CNRS is launching a new, more extensive purchasing and manufacturing operation covering all of France. Large quantities of the basic chemicals (≈ 20,000 litres of ethanol) are being purchased and shipped to sites across the country that are already producing sanitiser gel, as well as newly-identified facilities to be dedicated to solution preparation (in Strasbourg, Mulhouse, Nancy, Reims, Lille, Caen, Rennes, Montpellier, Marseille, Grenoble and Dijon). We hope to be able to start production at the new sites from the week of 20 April.

* 1. **Supplying masks**

A pluridisciplinary team comprising researchers, engineers, “makers”, physicians and manufacturers has joined forces to adapt the EasyBreath *Subea* full-face snorkelling mask by the Decathlon brand as a personal protective equipment (PPE) mask to shield against COVID-19. This open-source solution was initiated by Professor Prakash’s team at Stanford University.

An authorisation application was submitted on 10 April, and industrial production of the adapter was launched that same day. Some 22,000 kits including masks, adapters and instruction leaflets will be sent within days to the hospitals, according to their needs as identified by the Ministry for Solidarity and Health.

* 1. **Production of protective face shields**

Protective face shields can be produced by 3D-printing a ring attached to a transparent protective screen. Depending on the size of the printer, the ring can take several hours to complete, which limits the output of small printers to a few items per day.

Many laboratories have volunteered to manufacture face shields, with coordination provided by the CNRS’s networks of mechanics experts and electrical engineers.

To boost efficiency, local coordination of production and distribution operations has been implemented with the sites that have remained open, mainly Fablabs.

Thanks to the involvement of its personnel and to its technical resources, the CNRS’s contribution to production initiatives supervised by multiple organisations and often coordinated by a local Fablab, can be estimated at 5,000 face shields for the first two weeks (29 March to 14 April) using 3D printing and laser cutting.

The major coordination centres – Saclay, Marseille, Bordeaux, Toulouse, Lille and Nice – deliver face shields directly to large hospitals, while the smaller sites supply retirement homes, general practitioners and local police forces.

* 1. **Supplying minor equipment**

From the beginning of the crisis, many laboratories have responded by sharing their supplies of gloves, masks, gowns, hair nets and shoe covers, and have produced from a few litres to a few dozen litres of hand sanitiser gel for local needs, in particular for retirement homes.

* 1. **Volunteer work**

Hundreds of CNRS personnel have volunteered their time and expertise, in particular for the benefit of France’s clinical research centres. Many of those with medical training have also offered to help in hospitals, especially in eastern France and the Paris region.

In addition, a number of staff members in eastern France who have had COVID-19 have donated serum for use in the therapeutic trials on the effectiveness of serum transfer.

1. **COMMUNICATION INITIATIVES**

Convinced that it is more important than ever to offer our fellow citizens reliable scientific information in this difficult period, the CNRS is making a special effort to continue communicating through all of its channels, considerably increasing the quantity of content posted online.

Our news site is attracting an unprecedented number of readers: [CNRSlejournal.fr](https://lejournal.cnrs.fr/) recorded 390,000 visits on 15 April, equalling the figure for all of March, which was already a record-breaking month. Nearly 200,000 people have accessed our series of special [podcasts](https://soundcloud.com/cnrs_officiel/sets/covid19-parole-a-la-science) on the epidemic. And since the public’s interest in science is not limited to COVID-19, the offer of free access to our *Carnets de Science* collection has been a resounding success.

For the benefit of the media we have released a list of experts on COVID-19, now comprising more than 60 names.

Two pages dedicated to the epidemic, updated daily, have been created on the intranet and on [cnrs.fr](http://cnrs.fr/): [Coronavirus COVID-19 : consignes et conseils](https://intranet.cnrs.fr/Cnrs_pratique/partir_mission/Pages/Coronavirus--consignes-et-conseils.aspx) and [Coronavirus COVID-19 : sur le front scientifique](https://intranet.cnrs.fr/Vie_interne/actualites/Pages/Coronavirus--sur-le-front-scientifique.aspx). The CNRS strives to be a positive force in daily life during the period of confinement, and in a context of remote working, by relaying information on the [intranet](https://intranet.cnrs.fr/Cnrs_pratique/communiquer/ress/Pages/Plaquettes-institutionnelles-et-strat%C3%A9giques.aspx) and on [cnrs.fr](http://www.cnrs.fr/fr/ressources).