INNOVATION IN FLANDERS TO COMBAT THE SARS-COV-2 VIRUS OR ITS DERIVED EFFECTS

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Introduction

In the last months we have seen in Flanders numerous initiatives to respond to the COVID-19 crisis, many of them arising bottom-up, often in collaboration with European partnerships that received funding from the European Union's Horizon 2020 research and innovation programme. Everywhere in the region, research groups, as well as companies, have reallocated budgets to address different issues related to the COVID-19 pandemic.

The Flemish universities and their experts play a crucial role in the guidance and decision-making of this unseen crisis. This is particularly challenging, as the virus is new and its pathophysiology, the epidemiology and social impact need to be better understood to develop better diagnostics, vaccines, treatments and interventions.

Industry is also committed to developing solutions for various aspects related to COVID-19; from the hackathon[1] organised by the Belgian start-up community, to the unprecedented collaboration[2] between several life science companies to help address this global health emergency.

In dealing with the COVID-19 crisis, the research has been broadly addressed and covers epidemiology, diagnosis, treatment and social impact. Below you can find an overview of the ongoing initiatives that we know of. If you would like to add an initiative, don't hesitate to contact us.

An overview of research on COVID-19 done in Wallonia and Brussels and at the federal level can be found on their dedicated webpages.[3,4]

1. Diagnostic approaches and epidemiological research

Academic research

Prof. Herman Goossens (UZA, UAntwerpen) is coordinating the **PREPARE**[5] project, a network financed by the EU, for harmonised large-scale clinical studies on infectious diseases, to prepare for infectious disease outbreaks, and to provide real-time information on clinical management of patients and to guide public health interventions. PREPARE aims to establish a common European clinical research infrastructure with 600 primary care sites and more than 600 hospital sites in 27 EU Member States. It was started after the previous pandemics in order to be prepared and to quickly start the necessary clinical studies. Now it is also being used to tackle the SARS-CoV-2 pandemic.

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[1] https://www.hackthecrisis.be/nl/
[2] https://www.gatesfoundation.org/Media-Center/Press-Releases/2020/03/Life-Science-Companies-Commit-to-the-Fight-Against-COVID-19-Pandemic-alongside-Gates-Foundation
[3] https://www.covid19-wb.be/
[4] https://www.belspo.be/belspo/covid19/index_nl.stm
[5] https://www.prepare-europe.eu/

The **COntAGIouS trial**[6] (COvid-19 Advanced Genetic and Immunologic Sampling), led by Prof. Joost Wauters (UZLeuven, KULeuven) and Rega Institute, wants to deliver an in-depth characterisation of the dynamic host immune response to coronavirus SARS-CoV-2. It will study the host immune response in severe and extreme severely affected COVID-19 patients as compared to healthy controls.

The CONDITIONAL study (prof. Haerynck, UGent) aims to gain insights into genetic defects, immunological pathways, and expression shifts that may render some individuals more prone to severe COVID-19.

The European ORCHESTRA project, in which UAntwerpen participates, provides an innovative approach to learn from the SARS-CoV-2 health crisis and derive recommendations for increasing preparedness for future outbreaks. The main outcome of the project is the creation of a new pan-European cohort built on existing and new large-scale population cohorts in European and non-European countries. Data analysis through a federated learning technique supported by advanced modelling capabilities will allow the integration of epidemiological, clinical, microbiological and genotypic aspects of population-based cohorts with environment and socio-economic features. The ORCHESTRA cohort will include SARS-CoV-2 infected and non-infected individuals of all ages and conditions and thereby enabling a retrospective evaluation of risk factors for the disease acquisition and progression of the disease and prospective follow-up aimed at exploring long-term consequences and analysis of vaccination response when vaccines will be available.

The Jessa Hospital in Hasselt, together with Sciensano en Mensura, will start, after the approval of the ethics committee, with a pilot study to determine to what extent antibodies in the blood actually **protect against a new COVID-19 infection**.[7]

Researchers from the Institute of Tropical Medicine (ITM), the University of Antwerp and Sciensano aim to reveal whether healthcare workers who were already infected with COVID-19 are **protected against the virus afterwards**. Antibody tests against COVID-19 are essential to find out what percentage of the population was infected. However, these antibody tests reveal nothing about the amount of protection given by antibodies during a second exposure to the virus. The scientists will investigate this by applying a new antibody detection test using a virus neutralisation test. By doing so, not only will they measure whether and how long antibodies are present, they will also investigate to what extent the antibodies are capable of neutralising the virus. The research is supported through an accelerated procedure by Fonds Wetenschappelijk Onderzoek - Vlaanderen (FWO).

The Neuro-Aging and Viro-Immunotherapy (NAVI) research group at the Vrije Universiteit Brussel (VUB) will analyse blood samples from COVID-19 patients to see how their **immune system** reacted during and after their illness. The results can be of important value for diagnosis, treatment and prevention of the virus.

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[6] https://clinicaltrials.gov/ct2/show/NCT04327570
[7] https://www.knack.be/nieuws/belgie/coronavirus-jessa-ziekenhuis-start-met-pilootstudie-rond-antistoffen-in-bloed/article-belga-1591577.html?cookie_check=1587730692

A large study led by Prof. Pierre Van Damme (UAntwerpen) and Prof. Heide Theeten (UAntwerpen) maps the proportion of the Belgian population that was infectedby the SARS-CoV-2 virus.[8] **Blood from commercial labs** are being analysed for this purpose.

Prof. Bossuyt (KU Leuven) leads a study that uses a validated unbiased **mass spectrometry** based work-flow to identify disease-related Complementarity Determining Region (CDR) signatures that can be used for prognosis and outcome prediction.

At KU Leuven, the Laboratory of Therapeutic and Diagnostic Antibodies (Prof Paul Declerck) and PharmAbs initiated the development of high affinity mouse monoclonal **antibodies** for use in the development of reliable diagnostic solutions.

The MeBioS Biosensors group of KU Leuven (Prof. Lammertyn) is (1) developing and validating highly sensitive multiplex (IgM, IgG and IgA) **diagnostic tests for measuring immune responses** of patients infected with SARS-CoV-2 virus, and (2) finalizing the development of an innovative **self-sampling cartridge technology** for dried blood spot sampling capable of precisely metering and storing a droplet of blood from a patient's finger prick. Recently a longitudinal study was initiated in collaboration with UAntwerpen, UGent and KU Leuven to validate both technologies (1 + 2) in a primary care setting.

The research group of Prof. Du Laing (UGent) investigates the effect of **selenium shortage** on the severity of COVID-19.[9]

Sciensano and the Institute of Tropical Medicine (ITM) are investigating the **number of COVID-19 infections among healthcare workers** in Belgian hospitals. The study examines to what extent healthcare workers in hospitals come into contact with COVID-19. To this end the scientists will monitor 850 health workers who are representative of the health corps involved over a five-month period.[10] At the beginning of May, 8.4% of healthcare workers in the Belgian hospitals had antibodies against SARS-CoV-2.

Labs are reducing their research activities to **increase capacity for COVID-19 testing**. An example is the case of the specialised physicians of the Institute of Tropical Medicine in Antwerp who recently strengthened the Antwerp University Hospital in the screening and treatment of COVID-19 patients as they are experienced in working with infectious diseases. Also at the U(Z)Gent campus large-scale logistics is being set to process corona test samples. In the same effort to increase testing capacity, VIB has established a task force to realise a testing capacity of 20-30.000 samples per day. This is done in collaboration with the National reference centre in the Rega Institute, industrial partners and the university hospital Gent. VIB personnel is engaged in the effort on a voluntary base and this further enforced by volunteers of the biotech industry. A thorough selection of the workforce is ensured to

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[8]https://www.standaard.be/cnt/dmf20200331_04908683?articlehash=C232C064C77DC246E3CDDA247CB0F17015D13D174D00F849DD003F703C647AB50943D2B9226AA4228FC1342842951DE9E9A863D8BAF1DB859F2419154B3ADC8A

[9] https://edit.ugent.be/nl/actueel/selenium-tekort-corona-covid-onderzoek.htm

[10] https://www.itg.be/E/Article/study-of-the-number-of-covid-19-infections-among-healthcare-workers-in-belgian-hospitals

guarantee the quality testing. VIB made a video to explain how the testing is done.[11] The VIB-VUB center for Structural Biology makes its KingFisher robot available. The robot makes it possible to rapidly test large quantities of samples for the presence of the SARS-CoV2 virus, providing 1000 additional tests per day.

VIB together with LifeTime partners, a transnational and interdisciplinary initiative of leading European researchers jointly coordinated by the Max Delbrück Center in Berlin and the Institut Curie in Paris, is developing an **EU-wide standardised protocol** to test COVID-19 patient samples and to enable exchange of data across borders, using single cell and other technologies.

At the request of the academic Jessa and ZOL hospitals, UHasselt will **validate an alternative diagnostic method** so that general practitioners can perform tests themselves. They will purchase test kits and start validation as soon as possible.

The COVIDAM study (ITG) will compare laboratory diagnostic accuracy and pre-analytical stability of novel **diagnostic methods** (some selected for potential use in low- and middle-income countries) on different sample types in the entire study population, incl. nasopharyngeal swabs / self-taken nasal swabs / saliva.

The CORONAIR study (UAntwerpen/UZA) will test the diagnostic accuracy of **breathomics**, or exhaled breath analysis, for COVID-19.

Prof. Morrens and his colleagues (UAntwerpen/UZA) will track the cumulative frequency of COVID-19 seropositivity (as a marker of past Covid-19 exposure) in newly admitted patients with **serious mental illness** over time. They furthermore will compare the COVID-19 seropositivity rate in patients at each timepoint to the rate in newly admitted patients without serious mental illness and the regional background prevalence in the general population. Prof. Coenen will investigate the effectiveness of the preventive measures in primary care and immune response against SARS-CoV-2 using validated serological test.

Prof. Boon and colleagues (UZ-KULeuven-Rega Institute) will study proteases and inhibitors as potential disease targets and as biomarkers for COVID-19. Prof. Proost and colleagues (UZ-KULeuven-Rega Institute) will search for **diagnostic markers for disease severity** by understanding the role of the most abundant leukocytes in COVID-19 patients and their role during the disease course. They furthermore try to discover the main immune signalling molecules, and their regulation by posttranslational modification in COVID-19 patients during different stages of the disease. Prof. Matthys (UZ-KULeuven-Rega Institute) investigates the role of NK cells in Covid-19 patients. NK cells are crucial for antiviral defence and preliminary data point towards atypical characteristics.

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[11] http://www.vib.be/nl/nieuws/Pages/VIB-zet-zich-in-voor-COVID-19-tests.aspx

Prof. Van Rompaey and Dr. Vroegop (UAntwerpen/UZA) investigates the prevalence, onset, evolution, recuperation and long-term effects of self-reported **olfactory dysfunction** in health workers during the COVID-19 pandemic.

Prof. Dieter Deforce (UGent) started research to see if it is possible to diagnose COVID-19 using **proteomics** technology.

Imec is developing **fast micro-qPCR chips** for the development of specific assays to diagnose the presence of SARS-CoV-2 virus.[12] They have received requests to set up collaborations from various European countries and China.

Researchers from Flanders Make@UAntwerp developed a device that allows for **remotely listening to the lungs** of patients with COVID-19.[13] The device will become available open-source.

Prof. Movahedi (VUB) uses **single-cell immune profiling** of COVID-19 patients to identify the immune parameters that correlate with disease severity. The VUB lab for Molecular and Cellular Therapy will test the vaccination potential of immunogenic epitopes.

Researchers from the Institute of Tropical Medicine in Antwerp (ITM), the Antwerp University Hospital (UZA) and the University of Antwerp (UAntwerp) are collaborating in a study on the immune response in COVID-19 patients. Using samples from infected COVID-19 patients, they will **analyse white blood cells** and cast them into high-end computer models. With this detailed information, the researchers want to better understand the levels of disease severity and, in case of a new outbreak in the future, to find the 'right' immune response for a vaccine more quickly.

The EC **MOOD project** aims to identify, monitor and analyse outbreaks of new and existing diseases at an early stage. The Outbreak Research Team of the Institute of Tropical Medicine (ITM) is participating in the project, establishing a bridge between scientists and national and international public health and animal health institutions. The MOOD project started in January and examines a variety of model diseases, including the recent breakout of COVID-19.[14]

Prof. Pieter Libin of the Artificial Intelligence Lab (VUB) studies epidemiological applications of "**reinforcement learning**" in his research, in collaboration with Prof. dr. Phillippe Lemey of the Rega Institute (KU Leuven) and Prof. dr. Niel Hens (UHasselt and UAntwerp). The research was funded by FWO and the Research program Artificial Intelligence (AI) Flanders. In this form of AI, well-studied mathematical techniques and concepts, derived from the field of psychology, are used to make optimal decisions based on interaction with an environment. The research shows that AI offers promising opportunities to support policy makers in their

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[12] https://www.imec-int.com/en/expertise/lifesciences/pcr-on-chip
[13] https://www.flandersmake.be/nl/nieuws/onderzoekers-van-flandersmakeuantwerpen-ontwikkelen-nieuw-toestel-voor-longonderzoek-op
[14] https://www.itg.be/E/covid-19

decision-making and can have a significant impact on the outcome of health crises such as the current one. They nevertheless strongly advocate that AI innovation respects our democratic values, taking into account ethical considerations and the privacy of our citizens.

Research is ongoing on **possible transfers of SARS-CoV-2 to pets** and the circulation within animal populations. Researchers, led by prof. Hans Nauwynck together with prof. Bruno Verhasselt and prof. Linos Vandekerckhove (all UGent), are currently preparing a serological test to see to what extent this transfer is happening. This serological test can be used not only for animals but also for humans.

The immune system plays an important role both in the development and course of cancer and to respond to a viral infection. However, if a patient has both cancer and a virus infection, it is not possible fully estimate the effect of both together, especially with a new infection such as COVID-19. The CAN-COVID19 study (KULeuven) maps the disease progression of patients with **COVID-19 and cancer** and how they react to anti-cancer treatments.[15] The MOCOR study (UAntwerpen, UZA, AZ Maria Middelares) documents the prevalence of symptomatic COVID-19 infection and the seroprevalence of SARS-CoV-2 infection in cancer patients and non-cancer subjects. In a second objective immune system responses will be mapped using immunoassays, flow cytometry, immunomethylomics, proteomics and glycomics. This can unravel adverse immune cell deficiencies and/or dysregulated immune responses as risk factors for severe COVID-19. A multicenter international survey, partially organised by UZA, furthermore maps the characteristics and outcome of COVID-19 infection in patients with lung cancer and mesothelioma. The COREO study (UAntwerpen, UZA) investigates whether patients having home monitored oncologic treatment (cohort A) have a lower risk to the develop (severe) clinical COVID-19 compared to patients having classic in hospital oncologic treatment (cohort B). Additionally, this project will prove that cancer patients that undergo and perform blood sampling and therapy monitoring at home during the SARS-CoV-2 pandemic can have oncologic treatment safely. At UHasselt, the group of prof. Mebis will evaluate the impact of a COVID-19 infection on the severity of the cancer therapy-related complications and the quality of life of patients with cancer undergoing chemotherapy.

The DERMCovid e-registry, a collaboration between UZ Gent, Clin. Univ. St. Luc Brussels and UZ Antwerpen, is a Belgian nationwide e-registry to document cutaneous manifestations associated with COVID-19.[16] The PHO COVID-19 registry (UAntwerpen, UZA) is a retrospective and prospective registry that will collect data of patients that were/are being treated in one of the 8 recognized paediatric haemato oncology centers in Belgium and who tested positive for SARS-CoV-2. The aim is to gain more insights in the disease course, risk profile and morbidity/mortality in this specific patient population.

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[15] https://www.uzleuven.be/nl/ethische-commissie-onderzoek/covid-19-studies-goedgekeurd-door-ec-onderzoek/observationele-studies and www.facebook.com/immunovar

[16] https://www.belgiandermatology.be/nl/announcements/dermcovid-e-registry

The MUCOV study (UAntwerp/UZA) investigates the crosstalk between the respiratory barrier, aquaporines and the **microbiome** shaping the course of SARS-CoV-2 infection, the pathological alterations in the lungs and subsequent disease severity of COVID-19 patients.

Hasselt University and KU Leuven, together with AZ Nikolaas in Sint-Niklaas and UZ Antwerp, will conduct a study into the relationship between air pollution and the course of disease in COVID-19 patients.

Industry

Several companies are assisting as well to **increase the capacity of COVID-19 diagnostic testing**: Janssen Pharmaceutical (J&J), GSK, UCB and Biogazelle are installing diagnostic labs on their Belgian sites.[17]

Biocartis announced the development of a SARS-CoV-2 test on their fully automated, rapid and easy to use molecular diagnostics platform Idylla™. It will detect SARS-CoV-2 from respiratory samples such as nasopharyngeal swabs.[18]

FluidA has developed a screening method to detect pulmonary diseases at an early stage. The Broncholab platform was developed with the aim of making parameters of functional respiratory imaging available to medical professionals on an online platform. The platform can be used for multiple pulmonary diseases.[19]

The software company **icometrix** developed, together with more than 40 Belgian and even more foreign partners, the software package icolung, with which it can better predict the chances of survival of very ill COVID-19 patients and also assign patients more precisely to a specific hospital department. By releasing **artificial intelligence (AI) on CT scans** from COVID-19 patients, one can find out whether the lung tissue is strong enough to send the patient home for further home isolation. At the Radiology department of the UZ in Brussels, people quickly started using AI in medical imaging. This makes the hospital one of the top in the field. Meanwhile, the software has been rolled out in 30 Belgian hospitals.[20]

AntelopeDx is developing a prototype test for Flu A/B based on a nasal/nasopharyngeal swab. It wants to establish a diagnostic solution for home and other decentralised settings that brings lab quality analysis with the ease-of-use of a pregnancy test at a consumer price tag.

Bingli has developed a COVID-19 triage module. With the help of 10 simple questions, the test can determine whether you should contact a doctor or not.[21]

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[17] https://www.tijd.be/ondernemen/farma-biotech/gents-biotechbedrijf-start-grootschalige-coronatesten/10218507.html

[18] https://flanders.bio/en/news/biocartis-announces-development-of-idylla-covid-19-test

[19] https://www.linkedin.com/posts/jan-de-backer-6537645_fda-clears-fluiddas-broncholab-platform-activity-6642818289737314304-oIGm

[20] https://flanders.bio/en/news/icometrix-lanceert-de-eerste-ce-gemarkeerde-ai-oplossing-voor-ct-beelden-van-de-longen-bij-covid-19 and https://icovid.ai/

[21] https://www.mybingli.com/covid19/

UgenTec supports the diagnostic community in managing the Corona virus crisis. Laboratories that apply today will get access to a free and AI-powered data analysis tool for the CDC's Corona virus assay.[22]

2. Development of therapies, medicines and vaccines

Academic research

The lab of prof. Xavier Saelens (VIB-UGent), in collaboration with prof. Nico Callewaert (VIB-UGent) and two research laboratories in the US, has refocused its research to a potential COVID-19 therapy based on VHH **nanobodies**. Following the publication of the SARS-CoV-2 genome in early January 2020, the genome of the new virus was compared to the SARS-CoV-1 on which the research group had been active in recent years. The scientists identified a single-domain antibody with high binding affinity to a unique, conserved conformational epitope present on the receptor-binding domain of SARS-CoV and SARS-CoV-2. New results provide the first evidence that the antibody could prevent the new coronavirus from infecting human cells. Importantly, the antibody can also be produced at large-scale using production processes that are common in the biopharmaceutical industry.[23]

At KU Leuven, PharmAbs (Prof. Paul Declerck) and MeBioS (Prof. Jeroen Lammertyn) are using their in-house developed microfluidic single B cell screening platform "MabMine" as a tool for (1) selection, cloning and detailed characterization of a SARS-CoV-2 specific human mAbs from patients that will provide insights in the biochemical and functional properties of neutralizing vs. non-neutralizing antibodies and (2) for identification of neutralizing antibodies with drug-like properties.

Prof. Bart Lambrecht (VIB-UGent) and Partner Therapeutics started a clinical study (SARPAC trial) on the use of **Leukine®** (granulocyte macrophage-colony stimulating factor or GM-CSF) to reduce the impact of the corona virus on lungs. Initial results indicate that with this treatment we can prevent the patient from developing a cytokine storm.[24] He is furthermore preparing for a study to compare the impact of treating severe cases of COVID-19 patients on intensive care with anti-IL6 antibodies as compared to anti-IL6-receptor antibodies.[25] The COV-AID study, also led by prof. Lambrecht and funded and coordinated by the Federal Knowledge Center for Healthcare (KCE), investigates the effect of existing treatments of rheumatism that target interleukine-1 and -6 in COVID-19 patients with acute respiratory distress. The study examines the efficacy, safety and mode of action of these medicines.[26]

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[22] https://www.ugentec.com/managing-coronavirus-ncov
[23] http://www.vib.be/en/news/Pages/Towards-antibodies-against-COVID-19.aspx
[24] http://www.vib.be/en/news/Pages/University-hospital-Ghent-and-VIB-are-testing-medication-to-treat-COVID-19-associated-respiratory-illness.aspx and https://www.partnertx.com/11508-2/
[25] https://clinicaltrials.gov/ct2/show/NCT04330638?term=NCT04330638&draw=2&rank=1
[26] https://www.kce.fgov.be/nl/cov201002-een-prospectieve-gerandomiseerde-open-label-interventionele-studie-om-de-werkzaamheid-van

The team of Prof. Johan Neyts (Rega Institute, KULeuven) works on the development of a **vaccine** and on **antiviral therapy**. In the past weeks, two EU-projects[27] were submitted and selected for funding (SCORE[28] and EXSCALATE4CoV[29]). The lab also received funding from the Bill and Melinda Gates Foundation to test candidate drugs against SARS-COV2.[30] It received 15000 medicinal molecules from Scripps Institute in California and will test them in the Rega high-biosecurity lab at high throughput. The lab can safely test thousands of candidate molecules for their potential activity against the new coronavirus. The lab is custom designed and runs fully automatically, day and night, seven days a week and is unique in the world. Several molecules were already identified that slow down the SARS-CoV-2 virus in laboratory settings. Clinical studies (Direct Antivirals Working Against nCoV, DAWN) must show whether patients who receive such a drug recover faster and are less likely to end up in intensive care. The study is a collaboration between UZ Leuven, Belgian university and peripheral hospitals and VIB.[31]

The Switch lab from the KU Leuven-VIB (prof Rousseau and prof Schymkowitz) has applied their Pept-In technology platform to develop antivirals against SARS-CoV-2. This project is in collaboration with Prof. Johan Neyts (Rega Institute for Medical Research, KU Leuven) and builds on earlier work on antivirals for influenza and Zika. They also contributed to computational studies on nanobodies against COVID-19, in collaboration with VIB Discovery Sciences.

The Centre for the Evaluation of Vaccination (Prof. Pierre Van Damme, UAntwerp) will conduct several **phase 1 SARS-CoV2 vaccine trials** in healthy adults. The centre is being prepared to be able to perform such phase 1 trial in social distancing and semi-quarantine conditions, based on previous experience with polio vaccine trials. The team of prof. Kris Laukens (UAntwerpen) will use machine learning models for recognition of patterns associated with viral infection status and symptoms, which will be used to test the immune response of candidate vaccines. Several research groups across the Flemish universities are working on vaccine development. **Flanders Vaccine** is a non-profit, strategy-driven platform for academic, industrial and public stakeholders that serves as a one-stop-shop for vaccine trials.[32] It aims to brings together universities, public and private hospitals, research centres, SMEs, pharma, competence providers, patient organisations, and government bodies to develop novel immunological health solutions and the vaccines of the future.

UAntwerpen, together with ULB, is building infrastructure to allow for a **Controlled Human Infection Model** study. A separate quarantine facility with thirty beds is being constructed. The aim is to accommodate thirty healthy test subjects. Fifteen of them receive a vaccine, the other not. They are then exposed to a weakened version of a virus, or the virus itself if effective

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[27] The other two SC1-CORONAVIRUS projects with Belgian participants are RECoVER (UA) and EpiPose (UA and UHasselt), for more information see:
https://www.ncpflanders.be/sites/default/files/ec_rtd_corona%20virus%20-projects-1.pdf
[28] https://www.lumc.nl/over-het-lumc/nieuws/2020/Maart/lumc-doet-onderzoek-naar-coranavirus-remmers/?setlanguage=English&setcountry=en
[29] https://www.exscalate.eu/en/projects.html
[30] https://www.theguardian.com/world/2020/mar/04/bill-and-melinda-gates-fund-study-into-finding-coronavirus-cure
[31] https://www.knack.be/nieuws/wetenschap/uz-leuven-test-geneesmiddelen-op-covid-patienten/article-news-1584621.html?cookie_check=1586425221
[32] https://flandersvaccine.be/

therapy is available. The research team will then analyze their immune response to both the vaccine and the virus. They received 20 million euros from the federal government to realize the project.

The Institute of Tropical Medicine (ITM) will start a study to investigate the effect of **hydroxychloroquine**, an existing medicine to treat malaria, on the duration of infectivity of COVID-19. The ITM team conducts the study primarily with health professionals infected with the virus, but showing only mild symptoms.[33]

The team of Prof. Herregodts (UGent, UZGent, VIB) is working on a prototype[34] that can be used for the **ventilation of COVID-19 patients**. The prototype has already been tested on a breathing machine in the hospital of Aalst. Industrial Research Fund is being released for the further development of this equipment. Also other ventilation initiatives are emerging.[35]

The Research Group of Organic Chemistry (ORGC), headed by Prof. Steven Ballet (VUB), intends to lead efforts to design and develop new **peptide-based therapeutics**. Using data gained from high-level molecular modelling studies, the group wants to develop a number of peptide-based therapeutics against COVID-19. These will then be tested in biological systems that are most closely related to COVID-19 to see which are the most effective and which show promise for further development, and, ultimately, use in clinical (i.e. human) settings.

Prof. Bogaert (VUB) is adapting existing technologies to predict immunogenic epitopes of cancer neo-antigens to predict immunogenic epitopes of new viral strains based on genomic similarity to other known viruses.

The Institute of Tropical Medicine (ITM) in Antwerp, thirteen African countries and an international network of research institutions, join forces for the largest clinical COVID-19 study in Africa. The ANTICOV study targets patients with mild to moderate symptoms and addresses the need to identify treatments that can be used to treat these people in a timely manner. In this way, spikes in hospital admissions can be avoided that can overwhelm Africa's health systems.

Industry

Mid-June already 18 clinical trials on therapies and vaccines for COVID-19 were approved by the medicines agency FAGG. They often involve joining forces between universities, pharmaceutical companies and hospitals.

The Pfizer site in Puurs will become one of the future production sites of the candidate COVID-19 vaccine BNT162.

For the candidate vaccine developed by Janssen Pharmaceutica (part of Johnson & Johnson), clinical studies on humans will start in the second half of July. The studies will be conducted in the US and Belgium. A total of 1,045 healthy adults between the ages of 18 and 55 and persons over 65 years old are tested. The European Commission has approved a contract with

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[33] https://www.itg.be/N/Artikel/itg-start-onderzoek-naar-hydroxychloroquine-in-strijd-tegen-covid-19
[34] https://www.coronaventilator.be/
[35] https://no2covid.com/

Janssen Pharmaceutica to purchase the vaccine for 200 million people, with the option to purchase an additional 200 million doses. In January 2021, the Institute of Tropical Medicine (ITM) in Antwerp will start a phase 3 vaccine study into the COVID-19 vaccine that is being developed by Johnson & Johnson. ITM is one of six test centers in Belgium where participants can join the study. In this final phase of the vaccine study, the researchers want to test the degree of protection of the vaccine.

Italian ReiThera Srl. (Rome), German LEUKOCARE AG (Munich), and Belgian Univercells S.A. (Brussels), today announced a strategic pan-European collaboration for the development and large-scale manufacturing of a novel **adenoviral vector-based vaccine** against COVID-19. The vaccine candidate is expected to enter clinical trials during summer 2020 with large-scale vaccine production planned to start soon after.[36]

GSK made their **vaccine adjuvant technology** available to scientists and organisations working on promising vaccine candidates and technology platforms. Furthermore, GSK is participating in the new collaborative research effort, the **COVID-19 Therapeutics Accelerator**. The aim of the Accelerator is to bring pharmaceutical companies and expert academic institutions into coordinated research programs, with the aim of bringing the most promising molecules forward that could be used to treat patients with COVID-19.[37]

eTheRNA (VUB spin-off) will develop a novel mRNA vaccine against SARS-CoV-2, for which preclinical development has started.[38] Also **Ziphius Therapeutics** announced the acceleration of the development of a mRNA-based vaccine for COVID-19, in collaboration with Prof. Niek Sanders (UGent).

Audi Brussels is producing ventilators. The ventilator has been developed and tested by a group of **FabLab Brussels** (VUB)[39] and in the University Hospital Brussels in recent weeks. The engineers, doctorandi and students of the VUB immediately received support: Flanders Make provided financial support to purchase essential components, DAF Trucks and Volvo Trucks provided the wiper motors that form the heart of the unit and Audi Brussels offered a production line.[40]

A Belgian consortium of seven medical and technological companies (Byteflies, Melexis, Quad Industries, Televic, Z-Plus and the Belgian departments of Henkel and Nitto) has developed an innovative chest patch that can monitor the respiration, heart rate and soon temperature of corona patients wirelessly, continuously and remotely. The **'COVID-19 smart patch'** will digitally transmit the values to the treating doctor or specialist and also has an alarm function

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[36] https://www.univercells.com/newsroom/reithera-leukocare-and-univercells-announce-fast-track-development-of-a-covid-19-vaccine/

[37] https://www.gsk.com/en-gb/media/resource-centre/our-contribution-to-the-fight-against-2019-ncov/

[38] https://flanders.bio/en/news/etherna-launches-an-international-consortium-and-starts-development-of-cross-strain-protective-cov-2-mrna-vaccine-for-high-risk-populations

[39] https://breathney.vub.be/electronics/

[40] https://press.vub.ac.be/eerste-vub-fablab-beademingstoestellen-geproduceerd-door-audi-brussels-ism-flanders-make

similar to the red button in the hospital. The Hospital Oost-Limburg (ZOL) is the first to start clinical tests with about 20 patients.

3. Prevention

Academic research

The city of Leuven and KULeuven started a pilot project to detect COVID-19 using sewage water. The aim is to detect local outbreaks of COVID-19 even before there is an increase in the number of patients. Some of the infected people have virus particles in the digestive system. Those particles are excreted and end up in the sewage water. Leuven will take samples of the sewage water several times a week in several places. The intention is to take measurements at densely populated housing blocks or, for example, residential care centres where the risk of a rapid spread of the virus is greater.

The University of Antwerp has launched Rapid European COVID-19 Emergency Research response (**RECOVER**), in collaboration with 9 international partners and led by prof. Herman Goossens. This project was selected for funding by the European Union under the Horizon 2020 research framework and builds on many years of investment by the European Commission in clinical research preparedness for epidemic response. RECOVER will address the most urgent questions for patient and public health by conducting medical research to address key knowledge gaps, such as those about best approaches to prevent further spread of the disease and about the virus interactions with the human host. In this way, RECOVER will provide scientific evidence that can be used by clinical, public health and policy decision-makers about how best to protect health and save lives.

Together with industrial partners, product developers of the Antwerp Design Factory (UAntwerpen) started an emergency production for **protective equipment for health workers**. For now, they can produce 1000 FFP2 face masks per day. The face mask will be produced on an industrial scale within a few months by Medimundi, a spin-off in collaboration with playing card manufacturer Cartamundi and machine builder Cloostermans.[41]

Also diaper manufacturer Ontex starts with the production of surgical mouth masks.

Northern-Limburg searched locally for a solution to create protective face masks for home nurses, physiotherapists etc. Eurofilters, a company specialised in creating vacuum cleaner bags, created filters and distributed free 'DIY packages'. Together with 'Welzijnsregio' and the 'Eerstelijnszone Noord-Limburg' a survey was launched to get an overview of the needs in the healthcare sector in Northern Limburg. Since the masks were FFP2 certified, they are also used in hospital settings.

VITO obtained European accreditation for testing FFP2 / FFP3 mouth masks. VITO can now test mouth masks against the strictest European quality standards (EN149-norm).

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[41] http://www.medimundi.be/

The Robotics team of VUB has a research line where they want to convert commercially available **snorkel masks** to a suitable protective mask (with extra filter). In collaboration with Ethias and Decathlon, they will produce the adapter. All Belgian hospitals can order the masks for staff who come into contact with COVID-19 patients.[42]

VITO produced disinfectant gel, made their mouth masks and protective clothing available for hospitals and ordered 30 000 additional masks.

UAntwerpen and UZA developed the CORELSA **remote stethoscope system**. With this system it is possible to conduct remote auscultations of a large number of patients without getting in direct contact to them. The system is available as an open-source project.[43]

The Institute of Tropical Medicine (Antwerp) coordinated the development of the Belgian **treatment guidelines** for COVID-19, and prof. Wim Van Damme (ITM) is adviser to the Congolese government in regards to the COVID-19 pandemic.

Ghent University is participating in a large-scale international study that investigates the impact of physical activity on immunity to COVID-19. The results can contribute to opening up the forests and parks.

At the University Hospital Antwerp (UZA), a test is started with a robot that will support staff in access control to the hospital. Zorabot and Digitopia's' Cruzr Health 'will scan admission tickets, measure visitors' fever, and can also detect whether everyone is wearing the mandatory mask.

The University of Antwerp, Robovision and Securitas will use artificial intelligence to map out how much distance people keep from each other on the Meir in Antwerp. It is a scientific pilot project and is in no way intended for law enforcement.

The Flemish government is investing 2 million euros in the development of a groundbreaking SARS-COV-2 test. This test is being developed by imec and will be tested in close collaboration with Brussels Airport. Unlike current testing methods based on blood, saliva or a sample from the nose / pharynx, this test will use exhaled air. According to researchers, this can reliably give the test a definite answer about a person's infectivity within 5 minutes.

The H2020 COVINFORM project, in which UAntwerpen participates, will conduct research on the disproportionate impacts of COVID-19 on vulnerable persons. The project will culminate in the development of an online portal and visual toolkit for stakeholders in government, public health, and civil society integrating data streams, indices and indicators, maps, models, primary research and case study findings, empirically grounded policy guidance, and creative assessment tools.

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[42] Hospitals that are in need for masks can mail to MaskForBelgium@gmail.com. The masks are free of charge for healthcare institutions.

[43] https://www.corelsa.info/

Flemish and Dutch engineers from Holst Centre and Forcit Benelux are working on a "smart" face mask that can be used to remotely monitor rehabilitating COVID-19 patients. The aim is to develop a face mask that registers several parameters, such as oxygen saturation and respiratory rate.

Van Heurck and **ECA**, two Belgian companies, are starting up the production of surgical and FFP2 mouth masks The machines can produce 190 million surgical masks per year.[44] The packing group **Ducaiu** will produce comfort mouth masks, disposable masks that approach the efficiency of surgical masks. They aim for 50 milion masks per year.

Sioen and Deltrian will produce 6 million filters that will be distributed among the population to be used in fabric mouth masks.

Pharmaceutical company Janssen Pharmaceutica and gin distillery Filliers are making **disinfectant hand gel**, which is distributed among the Belgian hospitals.[45]

Laboratory ECCA, Jansen Cleanrooms and GreenX jointly developed a 'Clean Mask Decontamination Room': a **mobile disinfection container** that disinfects FFP2 and FFP3 masks on a large scale, using hydrogen peroxide.[46]

SpectronX, the Wetterse manufacturer of disinfection devices based on UVC light, introduces three new devices that are used to combat viruses, such as SARS-CoV-2: one for face masks, one for shopping carts and an automatic disinfection robot.

Anthleron is ready to make its **biomedical 3D printing** resources and expertise available to relieve acute needs of various medical parts (e.g. venture valves, respiratory system parts, etc.).

Perseus supports their customers in **biosafety management**. They have compiled a biosafety guidance document specifically targeting organisations that are implementing SARS-CoV-2 diagnostic methods.[47]

NBD offer **standards for masks and other personal protective equipment** for medical professionals free of charge.[48]

Seaters – who normally helps to distribute sponsoring tickets for sports and cultural events – has transformed its product into a **Virtual Queuing System**. It allows us to request an appointment voucher for authorised locations. Each voucher mentions an hour of visit, that

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[44] https://www.tijd.be/dossiers/coronavirus/van-heurck-en-eca-gaan-belgische-mondmaskers-produceren/10220551.html
[45] https://biovox.eu/janssen-pharmaceutica-and-filliers-distillery-make-disinfectant-hand-gel/
[46] http://www.biotox.be/en/news/decontamination-of-mouth-masks-ecca-your-partner
[47] https://www.perseus.be/
[48] https://www.nbn.be/nl/nieuwsberichten/gratis-normen-voor-mondmaskers?utm_source=newsletter&utm_medium=email&utm_campaign=Newslettermaart2020nl

takes into account the social distancing rules (max. 1 person per 10 m2) and the necessary time per person (max. 30 min. for groceries, for example). The demo version[49] of the platform can be activated nationally in 24 hours.

A grassroots initiative (maakjemondmasker.be) was launched and gives guidelines on how to make your own face masks.[50]

4. e-health and app development

Academic research

Several track and tracing apps are being developed. To select the best app, a taskforce was founded by minister De Backer. They concluded that a track & tracing app must have the following characteristics: (1) decentralized, (2) privacy guarantee, (3) minimal information collection, (4) Bluetooth technology and (5) interoperable at European level.

A European consortium in which prof. Preneel (KULeuven) takes part, made a proposal for a secure and decentralized privacy-preserving proximity tracing system according to these principles: **DP-3T**. Their code is open-source available.[51] This protocol is the basis for the coronalert.be app[52] that was launched in Belgium on September 30th. The app works with a green and a red screen. If you've had a high-risk contact, the app will show a red screen. If you get tested for COVID-19, you can receive the result in your app and inform your risk contacts. The app works via Bluetooth and only keeps a list of codes. No information about your location is stored or passed on.

A multidisciplinary consortium consisting of academic researchers, privacy experts and app developers (UGent, VIB) has joined to develop a platform to map the further spread of the virus and to contain the epidemic better. The platform combines: a **mobile app** for citizens; a web app for medical personnel; a back-end for data aggregation and an AI system to train models. All these components work together to map potential infected clusters, hotspots and super spreading. Contact tracing can furthermore be done more efficiently. Privacy experts have been involved from day one. Also KULeuven and UZLeuven are developing a mobile app, Corona Compass.

The AI lab (VUB) is building an AI application that will support doctors in two ways: (i) a COVID-19 dashboard with data analysis for better insight into the disease and (ii) logistical support, such as for predicting the number of beds required on Intensive Care.

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[49] https://demo.seaters.com/westandstrong/
[50] https://maakjemondmasker.be/
[51] https://github.com/DP-3T/documents
[52] https://coronalert.be

Belgium will participate in the EUvsVirus **hackathon** (24-26 April 2020).[53] The hackathon resulted in 117 possible innovative solutions. Belgium is represented in eight of the 117 winning projects: Covid-19 Alert[54], Instant SARS-CoV-2 breathalyzer[55], HomeNurse[56], BorderX.eu[57], MAGGY[58], #WeStudyTogether[59], Integrated Fast Financial Aid (IFFA)[60] and Corazones against Covid19[61].

Rombit launches a **digital bracelet** to prevent Covid-19 contamination in the workplace. The solution allows employees in industry, construction and logistics to resume work safely. If employees come too close to each other, their bracelet gives a warning signal. Port of Antwerp will be the first to test these bracelets.[62] Also ProDongle launched a Proximity Alert wearable. The appliance warns carriers with a sound and vibration signal when the distance is less than 1,5 m. No data is stored so that privacy is maximally respected.[63]

The company Lopos (imec and UGent spin-off) has developed a **wearable** as well: SafeDistance. The wearable will alert, with an audible signal, vibration and optionally also a burning LED light, if the social distance of 1,5 meters to another device is not respected. The device is a tool for safe collaboration in the workplace or for shopping. SafeDistance uses ultra-wideband (UWB) instead of Bluetooth and is therefore much more accurate and faster.[64]

VIL tested five social distancing alarms, as described above, in 230 different companies. Social Distancing Alarms can help employees in a logistics environment to work at a safe distance from each other. The findings show that with the social distancing trackers, employees are able to monitor the required safety distance. The main influence on the operation of the devices is the mutual position of the employees.

Belgian technology company **Devside** has been commissioned to develop the Belgian COVID-19 app to warn people if they may have been in contact with a corona case by September. The app must use Bluetooth technology DP-3T and must be a Belgian variant of the existing German Corona Warn app. In addition, the company Enviso was appointed in a second tender to test whether the Devside app complies with all safety rules.

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[53] https://euvsvirus.org/
[54] https://devpost.com/software/covid19-alert
[55] https://devpost.com/software/instant-sars-cov-2-breathalyzer
[56] https://devpost.com/software/voicebot-for-ongoing-assistance-to-covid-19-patients
[57] https://devpost.com/software/borderx
[58] https://devpost.com/software/maggy-ovyepd
[59] https://devpost.com/software/westudytogether
[60] https://devpost.com/software/eurocovidbusters
[61] https://devpost.com/software/corazones-against-covid19-tech-to-increase-impact-of-money
[62] https://rombit.be/slimme-armband-om-coronabesmettingen-op-de-werkvloer-te-voorkomen/
[63] http://www.prodongle.com/nl/oplossing/social-distancing and
https://www.prodongle.com/media/20200526_NOS_Journaal.mp4
[64] https://www.lopos.be/

The **COVID-19 Alert** app, developed by a group of tech developers, can delay the spread of COVID-19 by registering bluetooth contacts of mobile telephones. The app informs users in case they have been at risk of getting infected, when they have been near an infected person.[65]

Vinçotte, Esoptra, Mensura, Attentia and Vias are collaborating in a project called Savitas (Scoped Anonymous Viral Infection Tracing At Scale). This project developed a **QR-code system** that can be used directly by any employee with a simple scan of their phone, without any registration or link with personal data and without privacy risk. When an employee turns out to be COVID-19 positive, that person reports to Savitas that he is ill. Colleagues who have scanned the same QR code at the same time are then informed that they may also be infected, place themselves in isolation and consult a doctor to prevent further spread. They will receive this notification the next time they voluntarily scan one of our QR codes or go to the website.[66]

The city of Antwerp launched a call for start-ups to develop innovative digital solutions for problems related to the COVID-19 crisis. 8 projects were selected: Artists Unlimited vzw, Bingli, Greygin, Health Endeavour, Helpper, Robovision, Spikes en UZA-FibriCheck.[67] **Bingli** helps to fight overcrowded doctor's offices and hospitals. The company developed a multilingual, scientifically supported COVID-19 triage module to determine whether a patient should be seen by a physician. The goal is to help doctors identify the people who need more medical attention. **Greygin** developed the online game based learning platform Play it Safe (see also chapter 6. Dissemination of information and debunking fake news). **Health Endeavour** developed a social prescription platform that provides patients who contact their doctor with a "social prescription" to support their psychosocial needs. It creates a link between welfare and primary care. **Helpper** has set up a telephone line for healthcare staff, which can relieve them of tasks such as shopping or walking the dog. **Robovision** offers AI technology to analyse CT scans of lungs and provide reliable evidence of COVID-19 infection. This allows radiologists to work faster. **Spikes** developed a tool that provides accurate management information about the contamination situation of residents and staff in healthcare institutions. It furthermore allows for safely re-deploying volunteers in healthcare institutions. **UZA and FibriCheck** are developing a digital care program for patients with cardiac arrhythmias. In addition to the consultations that are already taking place, FibriCheck adds an app that can monitor cardiac arrhythmias. **Artists Unlimited vzw** develops an online streaming platform for artists and their fans. Online festivals, concerts and live streams will be programmed via the platform in collaboration with Antwerp concert halls, festivals and artists.

5. Behavioural changes and mental health

Academic research
A team with Prof. Philippe Beutels (UAntwerpen) and Prof. Niel Hens (UHasselt, UAntwerpen) will study our behaviour, and hence improve the modelling of the protective measurements

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[65] https://covid19-alert.eu/
[66] https://www.savitas.life/
[67] https://www.ondernemeninantwerpen.be/nieuws/antwerpse-start-ups-en-bedrijven-bestrijden-mee-coronacrisis-met-innovatieve-digitale

taken. They are issuing **weekly online polls**. The first poll issued Tuesday 17 March was answered by no less than 563.796 respondents![68]

A survey by KULeuven and UGent tries to find out if recently infected persons have something in common and want to identify targeted measures to bring down the transmission.[69]

Researchers from three universities - KU Leuven, UHasselt and UGent - and health institute Sciensano, with funding from FWO, will investigate how compliance with the corona rules can be improved. More specifically, there will be more focus on the role of social psychology. It will not only look at how people experience themselves to follow the measures, but also what they think about how other people follow the measures. The ultimate aim of the study is to provide advice for communication about the measures.

A number of surveys were launched at the UGent to get a better picture of the impact of the COVID-19 pandemic on **mental and social well-being**. They are also monitoring the motivation of the population to comply with the COVID-19 measures.[70] The research department of IDEWE, in collaboration with KU Leuven, will conduct a study into the **mental well-being of Belgian employees** during the corona crisis.[71] A survey by IndiVille and Bpact focussed on our **emotions** related to the COVID-19 pandemic and its related measurements.[72] VUB and UGent investigate the impact of the pandemic on our existential life experiences.[73] KULeuven started a longitudinal study where participants keep a **diary** about their experiences, for two months. Prof. Van Hal (UAntwerpen) collects corona diaries of health care workers. At the VUB, Prof. Ignace Glorieux, together with spin-off hbits, investigates how the new coronavirus impacts our daily life[74]. Together with an international consortium of sleep scientists, VUB is conducting a worldwide survey on **insomnia** during and before the lockdown period.[75] Other surveys investigate lockdown behaviour concerning mobility, sports, values, compulsive buying, well-being, impact on pharmacists and on pregnant women. At the UAntwerpen, they investigate the well-being of students and academics. Researchers from the Flanders Marine Institute (VLIZ), UGent and KULeuven want to map out how, where and how much we visit outdoor areas, and how these visits affect our health and emotions.[76]
Prof. Elke Van Hoof (VUB) launched the free online intervention tool '**Iedereen ok?**' to help handle loneliness and stressors more easily.[77]

Prof. Kris Van den Broeck (UAntwerpen) in collaboration with UCLouvain started the Covidenik study, a large-scale international survey of mental well-being in relation to quarantine and social isolation. Initial results indicate young people as an extra vulnerable group. The following analyses will look at the health of other vulnerable groups, such as people with a

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[68] https://www.uantwerpen.be/nl/projecten/corona-studie/
[69] https://coronasurvey.eu/
[70] https://www.ugent.be/epg/nl/onderzoek/coronastudie and https://www.knack.be/nieuws/belgie/maatregelen-blijven-volgen-wordt-een-marathoninspanning-hoe-motiveren-we-de-bevolking-om-vol-te-houden/article-opinion-1587391.html
[71] https://www.idewe.be/-/wat-doet-coronacrisis-met-u
[72] https://indiville.be/resultaten-onderzoek-coronacrisis/
[73] https://vub.fra1.qualtrics.com/jfe/form/SV_9AAcpZNnSNKpAup
[74] https://today.vub.be/en/article/survey-how-does-the-coronavirus-affect-daily-life
[75] https://vub.fra1.qualtrics.com/jfe/form/SV_8HcuItBNoj8c9Hn.
[76] https://tpsurvey.ugent.be/limesurvey315/index.php/726526?lang=nl
[77] https://www.iedereenok.be/

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mental frailty, chronic condition or socio-economic vulnerability. In collaboration with the city of Antwerp, the mental health of the Antwerp citizens was assessed in a second study, questioning two waves of 3000 participants per wave. Furthermore, in a third study in collaboration with the Dezorgsamen.be consortium, ZorgnetIcuro, Red Cross Flanders, Domus Medica, the Flemish Society for Clinical Psychology, the Flemish Society for Psychiatry, Doctors4Doctors, ArtsInNood, and professors of different Flemish universities, measures the wellbeing of the healthcare staff. There are significantly more acute stress symptoms among healthcare providers in the first COVID-19 period, and exhaustion is starting to take its toll.[78]

Antwerp Management School, together with VBO - FEB and HRPro.be, questioned > 1200 business leaders and HR professionals, on topics related to work organization and well-being at work. Major dismissals for current staff are not foreseen. Main concerns are about keeping teleworkers connected and the risk of stress-related dropout at crucial organizations.[79]

The Institute for the Future (Rega institute, KULeuven) launched a transdisciplinary approach on pandemic preparedness to **map the societal impact** and advise on potential unintended consequences of pandemic preparedness measures.[80] A first outcome of this team is a manuscript on the usefulness of contact tracing tools for pandemics.[81]

UAntwerpen investigates to what extent people seek out **nature** (more) during corona time and what effect this has on their general health and well-being. The survey is part of a larger university study on the relationship between care and natural living environment that is financed by the province of Antwerp.[82]

Prof. Van Meerbeeck (UZA) studies the quality of life after hospitalization for COVID 19. Furthermore, at UAntwerpen, they investigate the impact of COVID-19 on populations in low and Middle income countries, on persons living with HIV, on persons with epilepsy, on pregnant women and neonates, on persons with cerebral venous thrombosis (CVT) and on healthcare workers in humanitarian settings. They also investigate how best to assist Rwandese families in coping with COVID-19 and the knowledge, attitudes and practices towards COVID-19 among adult Ugandans. At UHasselt, they investigate the impact of COVID-19 on patients with Multiple Sclerosis.

Thomas Moore investigates the effect the COVID-19 pandemic has on our **travel** plans.[83] Odisee Hogeschool investigates the effect of the COVID-19 measures on families.[84]

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[78] https://www.dezorgsamen.be/barometer/
[79] https://www.youtube.com/watch?v=kNM7hso-r6k&feature=youtu.be&utm_campaign=2020+Human+impact&utm_source=hs_email&utm_medium=email&utm_content=2&_hsenc=p2ANqtz-9izC13rtdT7wZ8a6uvO7Fr75fvYr8PUHocbXfsSMUydq_2Z6XO1_cb7-2ZblT3IjcETz34pS9CPens-CtWtBvdBpejEA&_hsmi=2
[80] https://rega.kuleuven.be/if/coronavirus_challenge
[81] https://rega.kuleuven.be/if/tracing-tools-for-pandemics
[82] https://www.uantwerpen.be/nl/leerstoelen/zorg-en-natuurlijke-leefomgeving/het-corona-natuuronderzoek/
[83] https://thomasmore.qualtrics.com/jfe/form/SV_dokQYY8pEF42s7P
[84] https://www.kcgezinswetenschappen.be/nl/E-studiedag-in-verband-met-gezinnen

To help leaders in all sectors to overcome this difficult period, the Vlerick business school bundled all their online learning courses.[85]

The Joint Research Centre (JRC) launched a survey that aims to increase the understanding of citizen experiences throughout the COVID-19 crisis and thus foster the development of effective strategies to mitigate the impact of the crisis on the people and the economies in the European Union.[86]

Prof. Hannes (KULeuven) is part of the ABR global research project which studies in-depth lived experiences of the global community during the COVID-19 pandemic by collecting arts-based and narrative responses from global arts-based research scholars. They are looking for co-researchers to create arts-based and narrative responses to one of their research questions.[87]

Scientists from the Institute of Tropical Medicine (ITM) in Antwerp are investigating in a new study why people doubt whether or not to get vaccinated against COVID-19. By engaging in open dialogue with the population and public health authorities on the one hand, and by analyzing social media posts on the other, the researchers proactively map out vaccination doubts in Belgium. The results of the study can help to roll out an effective and targeted COVID-19 vaccination campaign in our country. This study is coordinated by ITM, in close collaboration with researchers from KU Leuven, the London School of Hygiene and Tropical Medicine (LSHTM) and l'Institut Pasteur in Paris. This research was made possible thanks to the support of the Fund for Scientific Research (FWO).

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Industry

To motivate both the beginner and the more experienced **meditator** to pay attention to mental well-being during this difficult period, Moonbird organises free live webinars from March 23rd onwards. Each weekday at 6pm a Flemish expert will share insights and methods that can really make the difference.[88]

Textgain, a spin-off from the UAntwerp, wrote an AI computer program to better understand health using social media. The program can recognize statements that refer to physical and

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85 https://www.vlerick.com/en/research-and-faculty/knowledge-items/how-to-cope-with-turbulant-times
86 https://ec.europa.eu/eusurvey/runner/JRC-Covid19-Survey
87 https://www.abrglobalconsotium.org/research
88 https://www.moonbird.life/livestream/

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86 https://ec.europa.eu/eusurvey/runner/JRC-Covid19-Survey
87 https://www.abrglobalconsotium.org/research
88 https://www.moonbird.life/livestream/

mental complaints and depressed feelings, such as "I have a headache" or "I feel lonely". In the period from January 2019 to May 2020, the program analysed approximately 20 000 messages on Twitter. This shows that we seem to be most elated during the summer months and least in November and January, but this trend did not apply in March and April this year. Where we should normally feel almost as elated as in the summer, our posts were more like November or January. In March, the researchers saw a spike in posts referring to physical complaints, almost three times as much as in any other month. In April there was a spike in mental complaints.[89]

6. Dissemination of information and debunking fake news

The Flemish government organised a taskforce to map, align and promote all public and private **digital initiatives** to make the world go further during the pandemic.[90]

Several information channels have been set up to inform citizens about the pandemic and the measurements taken. The Flemish agency of Care and Health (Agentschap Zorg en Gezondheid) created a dedicated fact check webpage on the 'health and science' website to help **debunking the fake news** on COVID-19.[91] Also EOS Science, a magazine partially funded by the Flemish government, has a website on COVID-19 with news and questions[92] and the Young Academy, an interdisciplinary and interuniversity meeting place for young top researchers and artists, has some initiatives that strive to combine forces within the scientific community [93]. They furthermore created an overview of **all Belgian initiatives on ventilators**, because shortage of ventilators was a crucial bottleneck in Italy.[94]

Health House developed a "COVID-19" storyline, which combines the most important findings at the medical, scientific, ethical, social, psychological and political level of the pandemic. The goal of this storyline is to provide objective, scientifically validated information to a wide, international audience about the impact of the virus and how we can control similar situations in the future even better. Furthermore, they pay attention to how the current outbreak leads to new (technological) opportunities.

Flanders Marine Institute (VLIZ), in collaboration with UGent and the province of West Flanders, gives a fact check on the risks of contamination from SARS-CoV-2 when we return to the beach this summer.[95]

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[89] https://www.textgain.com/
[90] https://www.vlaanderen.be/vlaanderen-helemaal-digitaal
[91] https://www.gezondheidenwetenschap.be/dossiers/coronavirus
[92] https://www.eoswetenschap.eu/tag/coronavirus
[93] https://jongeacademie.be/covid/
[94] https://docs.google.com/document/d/1lWZg_hImGW_xlDLAtB6wptzKT6Hg1fHMGsYPbO8dEp8/edit#
[95] http://www.vliz.be/nl/news?p=show&id=8348

The Institute of the Future (Rega institute, KULeuven) published a living paper about COVID-19.[96] It is a **structured compilation of scientific data** about the virus, the disease and its control. The aim is to help scientists identify the most relevant publications on COVID-19 in the mass of information that appears every day. The paper is updated weekly. ID-Lab Ghent (UGent) creates knowledge graphs to facilitate the search of 45,000 scientific articles on COVID-19.

Biostatistics and mathematical models play an important role to predict the evolution of corona infections and the influence on our healthcare sector. A consortium with top researchers from the universities of Hasselt, Antwerp, Ghent and Brussels was founded to support the Scientific Committee and the government in taking the necessary measures.
The team of prof. Yvan Saeys (VIB-UGent) applies machine learning techniques to develop descriptive and predictive models for COVID patients. The BIOMATH and KERMIT groups (UGent) provide model-based decision support tools for further controlling the COVID-19 outbreak and optimizing possible exit strategies.[97]

Imec has an **webpage** where they list several initiatives of companies directly or indirectly linked to the new corona virus.[98] Various research institutions have an overview webpage as well about their ongoing research related to COVID-19.[99,100,101,102,103,104,105]

Furthermore, information and communication are also part of the missions of universities and in Flanders we have seen many specialists taking part in **radio and TV** programmes. They play a key role in explaining what is happening and in helping the citizens to understand the need for the measures taken by the Belgian government.

At the European level, the European Bioinformatics Institute (EBI) of the European Molecular Biology Laboratory (EMBL) and the European Commission, together with other partners[106] have recognised the urgency to develop and deploy a **pan European COVID-19 research data platform**[107] connected to the European Open Science Cloud (EOSC). The objective is to speed up and improve the sharing, storage, processing of and access to research data and metadata on SARS-CoV-2 and COVID-19.

Relevant datasets include:

- Omics data for the characterisation and quantification of biological molecules (including sequence data on both virus genomes and human genomes) and other high-dimensional data such as microbiome data;

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[96] https://rega.kuleuven.be/if/corona_covid-19

[97] https://biomath.ugent.be/covid-19-outbreak-modelling-and-control

[98] www.imec-int.com/en/istart/startup-initiatives-covid-19

[99] https://www.ugent.be/nl/onderzoek/ugent/covid-19-onderzoek.htm

[100] https://www.uzleuven.be/nl/ethische-commissie-onderzoek/covid-19-studies-goedgekeurd-door-ec-onderzoek

[101] https://www.itg.be/E/covid-19

[102] https://www.vub.be/coronavirus/onderzoek#lopend-onderzoek

[103] https://blog.uantwerpen.be/corona/

[104] https://www.uhasselt.be/coronavirus-en

[105] https://ghum.kuleuven.be/NL2018/corona#research

[106] Including ELIXIR, Instruct-ERIC, RDA and H2020 projects such as EOSC-Life, CORBEL, RECODID, VEO, EXSCALATE4CoV.

[107] https://www.covid19dataportal.org/

- Data from pre-clinical research to test drug candidates, vaccine interventions, or other treatments, for efficacy, toxicity and pharmacokinetic information;
- Research data from clinical trials and from observational studies;
- Epidemiological data, models, codes and algorithms.

The Anticancer fund made an overview of **all interventional clinical trials** ongoing in COVID-19, in an easy to use open-access online database. This will help to reduce the chance of duplicated trials and ideally this should result in more collaborations around the world.[108]

#DATA4COVID19 gives an overview of global initiatives to build a responsible infrastructure for data-driven pandemic response[109] and the OECD, together with the GovLab, collects open data sets that are used in response to the COVID-19 outbreak.[110]

The GOVTRUST partners wrote a research paper on confidence in the government during the COVID-19 crisis. The results provide insight into the risk perception of Flemish people, confidence in the government to properly tackle the COVID-19 crisis, the reliability of various sources of information about COVID-19 and the extent to which government measures are perceived as restrictive and / or effective.

Industry

EisphorIA now allows researchers to **navigate in thousands of COVID-19 related scientific papers**, being assisted by artificial intelligence. It helps them to find insights, identify trends and apprehend quickly critical contents while working in a collaborative environment.[111]

Knowledge on the Corona virus can save lives. It is therefore crucial that communication on the virus and its prevention should be comprehensible to all of us. To spread the right information in a fun, accessible way, Play it Safe developed the **Corona Prevention Game**.[112]

Using **artificial intelligence and linked data**, the platform of Ontoforce allows the life sciences industry to extract, integrate and analyse their data. To support the industry in the challenges they face now, Ontoforce made a COVID-19 edition of their platform freely available.[113]

7. Funding

The European Commission has approved a €21 million Belgian scheme to support the production of coronavirus-relevant medical products, equipment, technologies and raw materials in the Flemish region. The public support will take the form of direct grants and will be open to all companies active in the Flemish region, except for financial institutions. The aim of the scheme is to incentivise companies to direct their activities to the production of certain

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[108] https://www.anticancerfund.org/en/more-200-trials-fight-covid-19-worldwide
[109] https://docs.google.com/document/d/1JWeD1AaIGKMPry_EN8GjIqwX4J4KLQIAqP09exZ-ENI/edit
[110] https://docs.google.com/document/d/1BdSnXzCZ1Z7ovOrPue3O0osRUpiqTKlu8pwG9U4DwWw/edit
[111] https://covid.eisphoria.com/
[112] https://playitsafe.eu/speel-het-corona-preventie-game/
[113] https://ontoforce.lpages.co/disqovercovid19/

products that are crucial to tackle the current health crisis, including vaccines and treatments, medical equipment and devices, disinfectants, data collection and processing instruments.

Several projects were submitted from the various universities and ranked for funding by the **H2020 SC1-PHE-CORONAVIRUS 2020 call**. This is a call published under Horizon 2020 on January 30, 2020 with deadline for submission on February 12, 2020, for which 47.5 million euro was made available. [114] Seventeen projects were short-listed for funding.[115] Four projects have a Flemish partner (SCORE[116], EXSCALATE4CoV[117]) of which two are coordinated by a Flemish partner (RECoVER[118] and EpiPose). An overview of all projects supported by the European Commission related to the COVID-19 pandemic is given as well.[119] The European Commission is developing a ERAvsCorona action plan, to facilitate coordinated research and innovation actions.[120]

Regionally, budget has been made available to combat the COVID-19 pandemic. **VIB** will reallocate about 1 million euro of the budgets from its Grand Challenges Programme to COVID-19 projects to test novel interventions in patients after preclinical evidence; to test immune status during infection; and to test the potential of suppressing inflammation response. A fast track evaluation procedure was started for ad hoc co-funding of these COVID-19 projects under the thematic domain 'epidemic control', and an ad hoc evaluation panel was installed. **VLAIO** may also provide a budget.

Flanders Make has released 1 million euro to participate in the development of several projects[121]: (1) ventilator prototypes and their scaling-up, (2) infrared fever detection, (3) auscultation, or the medical listening to sounds in the body, at a distance, and (4) the production of mouth masks. They additionally support companies, for example to consider how they can apply social distancing in their processes. Several innovative solutions were demonstrated and can be watched online.[122]

A new council of nine leading scientists should prepare us for the next peak of the virus. The **Flemish government** and **FWO** will provide 2,5 million euros to fund research on the efficacy of a vaccine, the local production of mouth masks and an analysis of the impact of the lockdown.[123] 9 projects were selected for funding.[124] A second special call provides an

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[114]https://ec.europa.eu/info/sites/info/files/research_and_innovation/research_by_area/documents/ec_rtd_coronavirus-factsheet.pdf

[115] For an overview of all projects see:
https://www.ncpflanders.be/sites/default/files/ec_rtd_corona%20virus%20-projects-1.pdf

[116] https://www.lumc.nl/over-het-lumc/nieuws/2020/Maart/lumc-doet-onderzoek-naar-coranavirus-remmers/?setlanguage=English&setcountry=en

[117] https://www.exscalate.eu/en/projects.html#Covid-19

[118] https://www.prepare-europe.eu/News/News-items/ID/1215

[119] https://ec.europa.eu/info/research-and-innovation/research-area/health-research-and-innovation/coronavirus-research-and-innovation_nl

[120] https://ec.europa.eu/info/files/first-eravscorona-action-plan-short-term-coordinated-research-and-innovation-actions_nl

[121] https://www.flandersmake.be/nl/covid-19

[122] https://www.youtube.com/embed/QMQ1mwD9U8A?wmode=transparent

[123] https://www.fwo.be/nl/mandaten-financiering/onderzoeksprojecten/projecten-covid-19/

[124] https://www.ewi-vlaanderen.be/nieuws/covid-19-vlaanderen-investeert-25-miljoen-euro-negen-onderzoeksprojecten

additional 2,5 million euros to fund research into personal and social well-being.[125] 11 projects were selected for funding.[126]

An extra 1,25 million euro will be released in the short term to invest in the **research of VIB** to (1) focus on the effect of medication on lung recovery in patients with COVID-19, and (2) the first phase of a start-up that VIB wants to establish about an antiviral agent.

UAntwerp launched a **twin-call** to the FWO call for COVID-19 research projects of 50,000 to 75,000 euro per project, for a total budget of 500,000 euro. The UAntwerp call largely copies the goals, deadline, template and evaluation criteria of the FWO call to offer synergy and reduce workload.

The Flemish agency for innovation and entrepreneurship (VLAIO) launched an extra COOCK program (collective research and innovation and collective knowledge dissemination) focusing on the challenges related to the COVID-19 crisis. The COOCK program bridges the gap between the knowledge world and the business world. The call aims to accelerate knowledge and technology transfer from our research organizations to companies and organizations that are suffering from the corona crisis.[127]

VLAIO furthermore launches strategic transformation support for Flemish SMEs and larger companies that, since 1 June 2020, invest extra in the production of COVID-19 relevant products or services in the context of COVID-19. The European Commission has given permission for the relaxation of state aid rules, which allows Flanders to provide more support to certain Flemish companies. This measure is temporary: you can submit until 1 November 2020 at the latest.[128]

8. Other actions

The **Flemish Supercomputer Centre (VSC)** provides computing time for research on COVID-19 both for academics and companies.[129] So far, fifteen research teams within universities, strategic research centres and companies could scale up their work and use large computing capacity, including a project on simulating the spread of the virus in a virtual population and making predictions about the usefulness of measures such as social distancing. These studies can obtain faster and more accurate results thanks to the use of supercomputers.

Biobanks are crucial in the run towards a COVID-19 vaccine and/or treatment. The **BBMRI-ERIC biobank network[130]** of 600+ biobanks can provide key services to researchers, such as (1) efficient and high-quality storage of samples in clinical and research settings; (2) samples from healthy individuals, to be used as control (collected 2-3 months before outbreak in each

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[125] https://www.fwo.be/en/fellowships-funding/research-projects/second-call-projects-covid-19/
[126] https://www.fwo.be/en/news/results/research-projects-and-research-grants/results-second-special-call-covid-19-research-projects/
[127] https://www.vlaio.be/nl/andere-doelgroepen/coock-collectief-oo-en-collectieve-kennisverspreiding/wat/coock-corona-oproep
[128] https://www.vlaio.be/nl/subsidies-financiering/subsidiedatabank/strategische-transformatiesteun-covid-19
[129] www.vscentrum.be/covid19
[130] https://www.bbmri-eric.eu/covid-19

country), and (3) guidance and standards for targeted identification, collection and conservation of important samples. The online search catalogue of BBMRI-ERIC has furthermore been adapted with a COVID-19 filter so researchers can find biobanks that have COVID-19 samples available.[131]

VIB and Elixir Belgium contributed to the **open source tools and public cyberinfrastructure** for transparent, reproducible analyses of viral datasets. The goal is to provide publicly accessible infrastructure and workflows for SARS-CoV-2 data analyses.[132]

Due to the COVID-19 crisis, a number of companies and organisations, medical and other, experience supply chain problems. 3DP PAN EU is an EU-wide, web-based matchmaking tool connecting supply and demand in the field of **3D-printing**. Existing initiatives are free to register their offer on the 3DP PAN EU website. Companies and organisations can extend their outreach for a solution to their needs.[133] The 3DP Pan EU project is a project developed by Vanguard Initiative's 3D Printing pilot, enabled by funding from the European Parliament.

The Flanders Marine Institute (VLIZ) runs observation infrastructure, both in the sea and on the beach, including in the context of the ESFRI projects LifeWatch and ICOS, and Seawatch-B. Observations during this exceptional period may provide a picture of the changed human pressures on the marine environment. Data is openly available, and is used by scientists who cannot access the sea because of the COVID-19 measures.[134]

At the Architecture Department of the KU Leuven, the Research [x] Design group (Prof. Heylighen) is working on a study that will map out how hospitals in Flanders have adapted their infrastructure under the influence of Covid-19.[135] Various strategies for spatial interventions are identified and insights are gained into how those interventions are planned and designed. The research is part of the enable² project.

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[131] https://directory.bbmri-eric.eu/menu/main/app-molgenis-app-biobank-explorer/biobankexplorer?covid19=covid19
[132] https://covid19.galaxyproject.org/
[133] www.3dppan.eu
[134] www.lifewatch.be, www.icos-belgium.be, www.seawatch-b.be
[135] https://rxd.architectuur.kuleuven.be/