

## Horizon 2020 funding: research and innovation for pandemic diseases

### Headlines

- This brief provides an overview of health-related capabilities across the EU27 Member States and the UK in the immediate pre-COVID-19 period, in order to potentially inform future funding and policy priorities in relation to health and pandemics.
- An analysis of health spending under Horizon 2020 prior to the outbreak of COVID-19 shows that funding has been directed almost overwhelmingly towards curative care, diagnosis and therapy, rather than disease prevention and vaccination.
- The concentration of H2020 pandemic-related funds is slightly greater than that of the overall spatial distribution of H2020 funding allocation. Regions in central and northern Europe are the strongest in both cases. However, a Mediterranean belt of contiguous regions displaying strong relative specialisation in disease-related R&I and running from Southern Spain to North Central Italy can also be determined.
- Research organisations and higher education establishments are the most numerous participants in pandemic-related research collaborations. Private sector partner collaborations are comparatively few in number.
- About 1 in 4 H2020 pandemic-related projects incorporate non-EU partner organisations. Extra-EU collaboration is dominated by organisations from Switzerland, Israel, the USA and Norway.

### COVID-19: a global disease, a EU challenge

On 11th March 2020 the WHO declared COVID-19 a global health emergency. The potential for a global pandemic for which the world was unprepared had been prophesied, and it is acknowledged that relevant research had been previously under-funded. While the pandemic has immediately triggered a race to develop a vaccine, it has also drawn attention to the longer-term need to strengthen and integrate research systems in areas related to health and pandemic diseases. Cooperation between Member States and cross-sectorial collaboration is of crucial importance to tackle the threat of emerging pandemics and ensure the sustainability and resilience of health systems.

Horizon 2020, the EU's programme for research and innovation, has invested more than 10 billion (out of its total

80 billion EUR available) in health-related research and innovation in the 2014-2020 period across a total of 15 different funding channels. The programme is *Open to the World* and prioritises cooperating internationally to ensure the best talent, knowledge and resources wherever they are located, and to tackle global societal challenges in the most effective way in a partnership approach.

Within that context, this brief showcases the distribution of 2014-2020 Horizon 2020 funding prior to the advent of COVID, developing an overview of the spatial distribution of research capabilities across the EU and partner countries in the area of disease and health. The mapping of knowledge capabilities related to pandemics firstly looks to identify and categorise the nature of the funded research projects and secondly to identify key regional critical mass or specialisations and actors and knowledge hubs at an EU level. An oversight of EU collaboration with partner countries and actors and hence a wider global perspective of EU funding in this area is followed by some conclusions and reflections of potential relevance to scientists and policy-makers.

### Mapping the EU pandemic related research - methodology

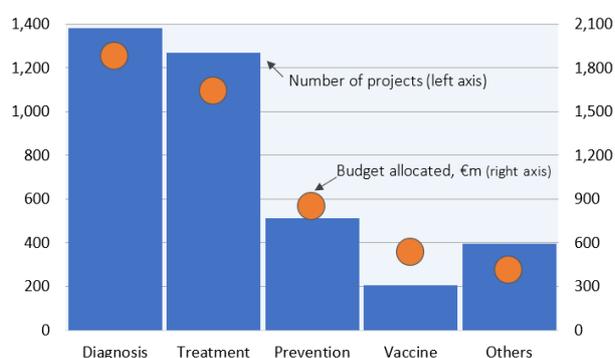
The analysis was undertaken on the basis of a text based search of the titles and abstracts of projects supported by the EU Horizon 2020 programme between January 2014 and August 2019. The search aimed to identify and map funding allocations that could be of relevance in relation to the COVID-19 crisis and provide an overview of research capabilities at a particular point in time to potentially inform future funding and policy priorities.

The keyword search allowed all relevant research activities, knowledge and capabilities in relation to diseases as well as health emergencies linked to virus and pandemics to be captured. It was based on a broader set of words than those related solely to the actual crisis, as the creation of the dataset preceded the pandemic (see table in appendix). The share of Horizon 2020 projects flagged as relevant was therefore significant and so the projects containing keywords were manually checked to improve the precision of the sample selected. The broad nature of the search also reflects the fact that other pathologies and patient characteristics may be closely correlated with COVID-19 and recognizes the potential for health-related capabilities to converge or be transformed into relevant solutions in sometimes seemingly unrelated areas. This textual search strategy (with control

check) identified 2,338 relevant projects funded under H2020 to the value of about 3.8 billion EUR, about 8% of the whole H2020 2014-2020 budget.

### Diagnosis and Treatment received more funds than Prevention and Vaccine

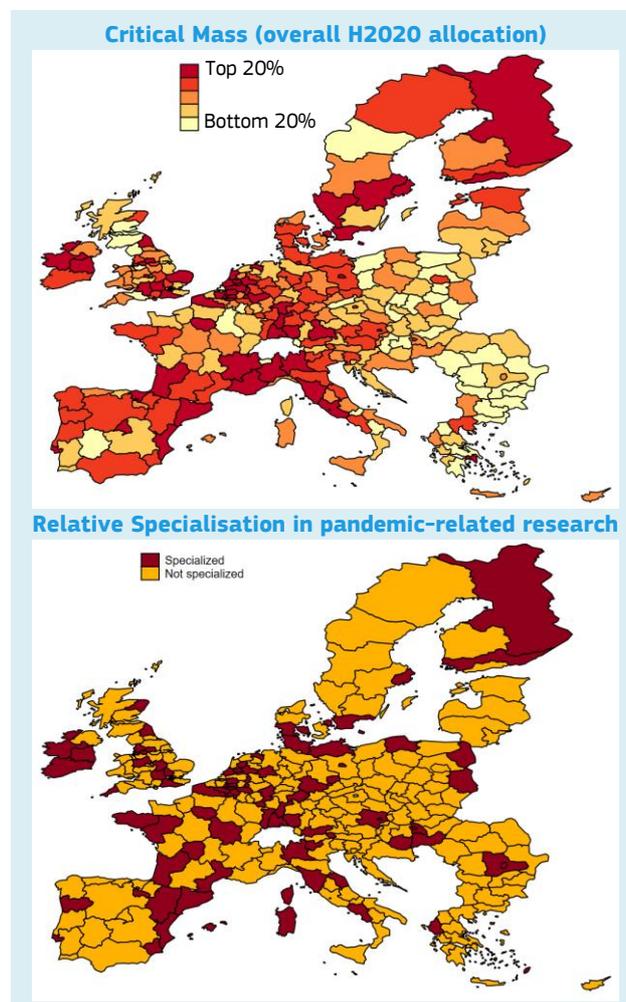
The identified projects were automatically classified (see appendix : the keyword search strategy) according to the following medical phases: *Diagnosis, Therapy, Prevention, Vaccine*; a category *Others* was used to group projects not classifiable in the chosen medical phases. Projects may be associated with more than one phase and can therefore be included in more than a single category. In general, the figures show that health spending has been directed almost overwhelmingly towards Diagnosis and Treatment (Therapeutic) rather than Prevention (including vaccination) and research on vaccines. In fact, the analysis highlights that more than half of the projects identified are related with these two medical phases, and about 1/3 are related to *both* diagnosis and treatment phases. Projects linked to prevention and vaccines are far fewer both in terms of numbers and budget allocated.



### The EU geography of Horizon 2020 projects

This section presents evidence about EU regional capabilities in performing research and producing knowledge and innovation that may be relevant to addressing pandemics. The aim is to determine whether the allocation of Horizon 2020 funding related to pandemic diseases and viruses was more concentrated across EU regions than that of other scientific domains. To estimate the “degree of specialisation” of EU regions, the used approach is based on the “location quotient” (LQ) methodology introduced by Sargent Florence (1939) in his “Theory of Location” and developed by Billing and Johnson (2012) as an estimator of “industrial concentration”. LQ offers a way to quantify how concentrated a particular industry is in a region as compared to a larger geographical area. In the context of this study, it allows an analysis of differences in the distribution of Horizon 2020 funding and hence the identification of any concentration of health-related research relative to the EU average. The maps (included below) illustrate the regional distribution of pandemic-related H2020 funds that were allocated pre-COVID-19 across the EU27 Member States and the UK. The “Critical Mass” map shows regions classified in one of 5 equally populated groups, which were defined according to the overall amount of H2020 pandemic-related funds allocated. The “Relative Specialisation” map shows the result of the use of LQ. It gives an indication of the level of

concentration of H2020 funding in pandemic-related knowledge production: regions with a higher share or relative concentration of total pandemic related funding than the EU average could be defined as “specialised” in pandemic-related areas of research.



Most of the regions with a strong knowledge base are located in the EU-14 countries and the UK; the same holds true with respect to demonstrating relative specialization. A “Mediterranean-belt” running from the south of Spain (Comunidad Valenciana) passing through the south of France and across to North-Central Italy demonstrates a particularly strong concentration and specialisation. However, some pockets of relative specialization are also apparent in the EU-13 countries, particularly in Romania, Poland and Hungary.

Overall, the concentration of funds is slightly higher for pandemic related themes, with the top 10 regions receiving about 32% of funds compared to 26% for other types of projects. This may be partly due to the fact that medical related innovation is in general more costly than innovation related to other technologies (Gkotsis and Vezzani, 2020).

### Horizon 2020 key players

The table below reports the top 10 EU-based organisations collaborating with the highest number of partners in H2020 pandemic-related projects. The majority are research organizations and universities, with the highest ranked private

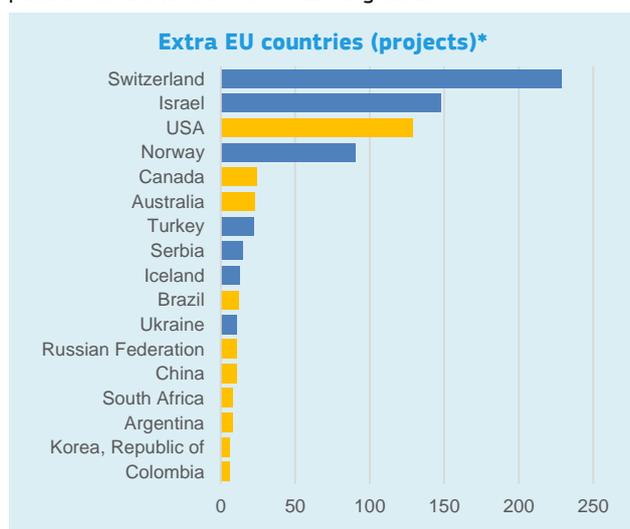
sector organisation coming in at 19th (Janssen Pharmaceutica Nv, a Belgian company that forms part of the Johnson & Johnson group).

| Organization  | Number of collaborating organizations |
|---|---------------------------------------|
| Institut National de la Sante et de la Recherche Medicale (INSERM) (FR)   | 655                                   |
| Centre National de la Recherche Scientifique (CNRS) (FR)                  | 544                                   |
| Fraunhofer Gesellschaft zur Förderung der Angewandten Forschung E.V. (DE) | 498                                   |
| Karolinska Institutet (SE)  | 497                                   |
| The Chancellor, Masters And Scholars Of The University Of Oxford (UK)     | 478                                   |
| Katholieke Universiteit Leuven (NL)                                       | 458                                   |
| Imperial College Of Science Technology And Medicine (UK)                  | 448                                   |
| Academisch Ziekenhuis Groningen (NL)                                      | 441                                   |
| Academisch Ziekenhuis Leiden (NL)   | 413                                   |
| Agencia Estatal Consejo Superior De investigaciones Cientificas (ES)      | 408                                   |

Other private companies with collaborations in H2020 pandemic-related projects tend to be pharmaceuticals companies included in the [EU Industrial R&D Investment Scoreboard](#), and among the top R&D investors worldwide.

### Switzerland, Israel, USA and Norway are the most significant extra-EU partners

In terms of collaborations in projects from organisations based outside of the EU, the countries with the highest number of participants in H2020 projects related to pandemics are listed in the following table.



\*Horizon 2020 associated countries are in blue

The countries with the highest involvement in terms of number of projects with at least one organization involved are Switzerland, Israel, the USA and Norway. About 1 out of 4 of the pandemic-related projects funded under H2020 includes at least one extra-EU partner (and almost 10% involving an

organization located in Switzerland). The table below lists non-EU organizations that are involved in of the highest number of projects.

| Institution                                      | Number of participations |
|--|--------------------------|
| Weizmann Institute of Science (IL)               | 31                       |
| University of Zurich (CH)                        | 26                       |
| Ecole Polytechnique Federale De Lausanne (CH)    | 22                       |
| Eidgenössische Technische Hochschule Zurich (CH) | 20                       |
| Université de Genève (CH)                        | 18                       |
| Technion - Israel Institute of Technology (CH)   | 18                       |
| Université de Lausanne (CH)                      | 15                       |
| University of Oslo (NO)                          | 14                       |
| Novartis Pharma AG (CH)                          | 13                       |
| University of Basel (CH)                         | 13                       |

Most of the organizations are universities, with the top private company in the ranking being Novartis Pharma AG. In terms of levels of "connectedness", i.e. participation not only in the highest number of projects but also in projects with the highest number of different partners, University of Zurich and Novartis Pharma AG are the most connected extra EU organizations.

### Conclusions and reflections

This brief presented an analysis of 2014-2020 Horizon 2020 research projects funded up until 28 August 2019, which whilst pre-dating the COVID-19 pandemic, and could be of potential relevance in relation to the current emergency. It seeks to map the extent to which the EU was supporting knowledge development in the field prior to the COVID-19 pandemic, and where knowledge hubs and research networks either existed or were already emerging.

The analysis of Horizon 2020 projects and funding distribution has some limitations. The Horizon 2020 programme is, above all, excellence-based and offers opportunities for the best organizations to work together after a highly selective application process. From a geographical perspective, this tends to exclude de facto organisations based in less R&I intensive regions. The study highlights a geographical divide between EU14 (and the UK) and EU 13 countries albeit with some regional specialisation in Romania, Poland and Hungary. Another drawback is the fact that highly competitive 'big pharma' companies are often reluctant to collaborate with peers when intellectual property rights and markets are at stake.

The research results demonstrate a non-negligible number of projects related to digital health or the digital dimension and this could be an area for future focus, as technologies related to Industry 4.0 can help in reducing over-crowding of patients, detection rates and hence the halt the spread of the disease. Digital platforms and applications are increasingly relevant in terms of research connections and networking in the current time of COVID-19 related restrictions where the mobility of

researchers and collaboration among different institutions may be hampered.

It should be noted that the EU has planned significant investment in health-related research funds as a response to COVID-19. The addition of an extra billion euros for health-related research and innovation under the Horizon 2020 work programme is only one area of funding that helps tackle the coronavirus outbreak. Alternative sources of funding have also been made rapidly available in response to the health crisis, however caution is needed. Whilst short term responses to an emergency should not ignore long-term considerations on how to address a lack of research in less profitable areas, excessive public support to vaccine development in times of crisis may lead to a non-effective use of funds (e.g. Veugelers and Zachmann, 2020). Further work could seek to map these sources and the geography of funding allocated in order to aid research cross-fertilisation, funding synergies and cross-agency coordination and ensure the most efficient and effective management of the additional funding.

## Further readings

Abi Younes, George, Charles Ayoubi, Omar Ballester, Gabriele Cristelli, Gaétan de Rassenfosse, Dominique Foray, Patrick Gaulé et al. (2020). [COVID-19: Insights from innovation economists](#). Science and Public Policy, 1-13.

Billing, S. and Johnson, E (2012). The location quotient as an estimator of industrial concentration, Regional Science and Urban Economics, Volume 42, Issue 4, July 2012, Pages 642-647

European Union (2020a). [EU's next long-term budget & nextGenerationEU: Key facts and figures](#), November 2020.

European Union (2020). [EUR 1 Billion mobilised under Horizon 2020](#). Coronavirus Global Response, May 2020.

Gkotsis P. & Vezzani A. (2020). [The price tag of technologies and the "unobserved" R&D capabilities of firms](#). Economics of Innovation and New Technology, 1-23.

Hollanders H., Es-Sadki N. & Merkelba I. (2019). [Regional Innovation Scoreboard 2019](#). Luxembourg: Publications Office of the European Union.

Jones, B. F., Wuchty, S., & Uzzi, B. (2008). [Multi-university research teams: Shifting impact, geography, and stratification in science](#). Science, 322(5905):1259-1262.

Sargent Florence (1939), Theory of Location: Definition, Factors and Criticism

Veugelers R. & Zachmann G. (2020). [Racing against COVID-19: a vaccines strategy for Europe](#). Policy Contribution 07/2020, Bruegel.

Vezzani A., Pugliese E. & Gkotsis P. (2018). [EU regions and the upgrading for the digital age. Socio-economic regional microscope series](#), Publications Office of the European Union.

## Appendix: the keyword search strategy

**Single keyword:** Angiot\* (angiotensin) -- antib\* (e.g. antibody/ies or antibiotics) -- biomarker\* -- coronav\* -- covs -- cytokin\* (e.g. cytokine/es) -- emergency/ies (excluding co-occurrence with flood, light, refugee, quake) -- epidem\* (e.g. epidemic, epidemiology) -- hcov -- hiv -- influenza -- immomb\*, immunog\*, immunol\*, immunoth\* (e.g. immunoglobulin, immunology/ical, immunogenics, immunobiology, immunotherapy) -- measles (this is a zinka detection related project) -- pandem\* (e.g. pandemic or pandemia) -- pneumo\* (e.g. pneumonia) -- pulmonar\* -- respirat\* (e.g. respiratory) -- vaccin\* -- virus

**Combination of keywords:** Chain + reaction + (antigen or polymerase) -- device + (medical, vitro, or health) -- Immune + (auto\* or system\* or respons\*) -- infect\* + (bacter\*, transm\* or diffus\*) -- nucleic\* + acid\* -- resist\* + (patho\* or antimicro\*) -- rna + amplific\* -- test\* or diagn\* or detect\* or ident\* + (medical or igm or igg or iga or igi --> specific types of immunoglobulins) -- viral\* + (anti\* or diagn\*) -- Glove + (surgic\* or medic\* or silicon or latex or rubber) -- Gown + (surgic\* or isolat\*) -- Mask (Surgic\* or face or medical or respirator\*) -- Medic\* + clot\* (clothes or clothing) -- Respirat + (artificial or safety or reusable) -- Ventil\* + (assist\* or mechanic\* or breath\* or respirat\*)

**Exclusion rules used both for title and abstracts:** all the entries containing the words bovine, plant, animal, agricult\*, farm\*, livestock, water, climate, environment\*, pollut\*, sustainabl\*, cyber\* + all the co-occurrences of emergency/ies with flood\*, light\*, refugee\*, \*quake\*

**Exclusion rules used only for abstracts:** all the co-occurrences of "virus" with computer, informatic and security + all the entries including the words aircraft, turbo, hydrogen, collision, and attack

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