



ALMA MATER STUDIORUM  
UNIVERSITÀ DI BOLOGNA

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**COVID-19  
RESEARCH AT  
THE UNIVERSITY  
OF BOLOGNA**



# CONTENTS

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UNIVERSITY OF BOLOGNA AT A GLANCE	5
RESEARCH DEVELOPMENT FOR COMPETITIVE FUNDING	5
PARTNERSHIP WITH INDUSTRY	6
RESEARCH AND INNOVATION TO FACE THE COVID-19 EMERGENCY	7
THE UNIVERSITY OF BOLOGNA'S RESEARCH	7
FUNDED PROJECTS ON COVID-19 @UNIVERSITY OF BOLOGNA	8
UNIVERSITY OF BOLOGNA PROPOSED SOLUTIONS FOR COVID-19 RELATED NEEDS	13
URGENT CLINICAL NEEDS	14
OTHER CLINICAL NEEDS	16
NEEDS OF RELEVANT INDUSTRIAL SECTORS	19
SOCIO-ECONOMIC NEEDS	21
RESEARCH AREAS	29
HEALTH RESEARCH @ UNIVERSITY OF BOLOGNA	29
ICT RESEARCH @ UNIVERSITY OF BOLOGNA	31
SOCIAL SCIENCES AND HUMANITIES @ UNIVERSITY OF BOLOGNA	32



# UNIVERSITY OF BOLOGNA AT A GLANCE

Founded in 1088, University of Bologna is recognized as the oldest university of the Western world. Nowadays, University of Bologna is the second largest university in Italy and one of the most important institutions of higher education across Europe.

5 operating sites and a permanent headquarter in Buenos Aires

637 M€ turnover

32 Departments

5 Schools

87.758 students (among which, 6.484 International students)

5.733 permanent staff

2nd Italian University in QS World University Ranking 2019 for Life Science & Medicine

30 research outputs per day, 11.000 research outputs per year (annual average)

as of September 2020, in Horizon 2020, University of Bologna is involved in 306 funded projects (81 as coordinator) with more than 128 M€ of funding

Among its assets, University of Bologna encompasses Bologna University Hospital Authority St. Orsola Polyclinic, which is home to the School of Medicine and Surgery. The University Hospital is an internationally acclaimed institution for the study and treatment of diseases, and each year organizes medical conferences and conventions attended by professionals of international fame.

## RESEARCH DEVELOPMENT FOR COMPETITIVE FUNDING

University of Bologna supports research development and access to funds through the Research Development Units within the Research Services Division: Physical and Engineering Sciences, Social Sciences & Humanities, Life Sciences & Bioeconomy. The Units promote the participation to European competitive funding, significant partnerships and access to strategic networks at local, regional, national and international level, the supervision of policies, the integration and enhancement of skills and infrastructures of excellence, and the development of new projects.

Life Sciences & Bioeconomy Research Development Unit: [lsb@unibo.it](mailto:lsb@unibo.it)

Physical and Engineering Sciences Research Development Unit: [pes@unibo.it](mailto:pes@unibo.it)

Social Sciences and Humanities Research Development Unit: [ssh@unibo.it](mailto:ssh@unibo.it)

**Research and Innovation** are a priority for University of Bologna, very active in all the research areas at National and European level. With over 10 years' experience and about 50 people assisting the research groups, the **Research Service Division** supports activities related to competitive funding programs along the whole project lifecycle and closely cooperating with the **Knowledge Transfer Office**, for the innovation management, the intellectual property protection and exploitation, and the take up and commercialization of project results.

## **PARTNERSHIP WITH INDUSTRY**

To respond to the COVID-19 emergency, University of Bologna has been **collaborating with regional, national and international businesses** from the very beginning.

This Brochure and the online Database are meant to be effective tools for industry to discover and scout University of Bologna on multidisciplinary COVID-19 related research activities. University of Bologna strongly supports the development of **collaborations** aimed at:

- providing companies with concrete and ready-to-use solutions to the challenges posed by COVID-19;
- responding to business science and technology research and validation needs;
- developing joint innovation.

The **University-Business Collaboration** unit facilitates relations between businesses and University, acting as main point of contact between University departments and entrepreneurial abilities and resources of industry.

For more information about University-business collaboration opportunities, please contact **University-Business Collaboration**: [industrial.partnerships@unibo.it](mailto:industrial.partnerships@unibo.it)

# RESEARCH AND INNOVATION TO FACE THE COVID-19 EMERGENCY

## THE UNIVERSITY OF BOLOGNA'S RESEARCH

In response to the global emergency caused by the COVID-19 pandemic, the University has promptly and actively taken part in national and international initiatives with research projects and innovative contributions involving the multi-disciplinary resources and skills within our community. **Promoting research that ranges from the medical to the economic and social sector, including key enabling technologies**, the University has provided a significant scientific contribution and, in just a few months, has taken part in **over 100 project proposals**, responding to funding calls for research from regional, national and European bodies.

The full list of COVID-19 projects and initiatives developed by University of Bologna researchers are **available, and continuously updated**, in the following University of Bologna sections:

- [Funded Projects](#)
- [Academic articles on the University of Bologna's Covid-19 Research](#)

Moreover, the University has set up a rich **database** of research **competences, infrastructures, services and projects** in order to **foster collaboration** with research partners.

For more information about University of Bologna COVID-19 research, please contact directly the **Research Development Office – Life Sciences and Bioeconomy Unit: [lsb@unibo.it](mailto:lsb@unibo.it)**

## FUNDED PROJECTS ON COVID-19 @UNIVERSITY OF BOLOGNA

### H2020-SC1-PHE-CORONAVIRUS-2020 Call – Advancing knowledge for the clinical and public health response to the 2019-nCoV epidemic (under GAP)

Call for applications funded under the H2020 FP, as second extraordinary call in response to COVID-19 pandemic crisis, in order to advance the knowledge on 2019-nCoV virus and its impact on infected persons, with the aim of contributing to an efficient patient management and/or public health preparedness and response.

#### ORCHESTRA

Connecting European Cohorts to Increase Common and Effective Response to SARS-CoV-2 Pandemic

#### INNO4COV-19

Boosting Innovation for COVID-19 Diagnostic, Prevention and Surveillance

### EIT FOOD - COVID-19 RAPID RESPONSE CALL - INNOVATION

Call for applications funded by [EIT Food](#), as part of [EIT's Crisis Response Initiative](#), to offer innovative solutions that can make a rapid and significant impact in relation to the COVID-19 emergency by the end of 2020.

#### PASS

#### Plasma Assisted Sanitation System

Several studies suggested that coronaviruses can survive on material surfaces such as metals, glass and plastic. This project will develop plasma-assisted sanitation systems for packaging materials, equipment and tools used in the processing and handling food products. In the first stage, PASS will identify and assess the specific plasma parameters able to induce the inactivation of COVID-19. This input will be used to realise a pre-industrial prototype, which eventually will be commercialised.

This is a project funded by EIT Food, which is a division of the European Institute of Innovation and Technology (EIT), a body of the European Union, under Horizon2020, the EU Framework Programme for Research and Innovation. As part of the EIT's Crisis Response Initiative, this project directly contributes to the European Union's response to the COVID-19 pandemic.



**SAFELIVERY****Safer Food Delivery and distribution service during and after the COVID-19 Pandemic**

The project will develop innovative food delivery services and protocols to reduce the risk of surface and packaging contamination of “Ready To Eat” foods by the COVID-19 virus and other agents. It will address safety gaps identified in the production and the delivery process of Ready To Eat foods by providing:

- Enhanced HACCP protocols to manage and control risks related to human factors and delivery conditions
- Anti-tampering boxes with smart locks, which can only be opened through a key code communicated to the final client
- Enhanced training for food handlers and deliverers.

Other possible impacts of this project include the improvement of consumers' confidence in food.

This is a project funded by EIT Food, which is a division of the European Institute of Innovation and Technology (EIT), a body of the European Union, under Horizon2020, the EU Framework Programme for Research and Innovation. As part of the EIT's Crisis Response Initiative, this project directly contributes to the European Union's response to the COVID-19 pandemic.

**SPIN****SPermidin and eugenol INtegrator for contrasting incidence of coronavirus in EU population**

The SPIN project is led by the University of Bologna and it involves public research institutes and private companies, with a strong multidisciplinary integration: the Autonomous University of Madrid (Spain), the Institute of Animal Reproduction and Food Research of PAS (Poland), the spinoff of the University of Bologna TGD, specialized in the production of food supplements obtained from natural ingredients, the company XEDA (France), manufacturer of natural formulations and Molino Naldoni, a company from Faenza specialized

in high quality flours for artisanal use and industrial. This project will develop a nutritional supplement rich in Spermidine, which plays a crucial role in favouring autophagy (diminished by SARS-CoV-2 infection) and Eugenol, which decreases the viral ability to infect cells. To date there are no available drugs, able to guarantee a level of safety, that can be taken without medical supervision. The continuing use of this supplement, which does not present any toxicological risk, may prevent infection, or greatly increase the minimum infectious load of SARS-CoV-2. This is a project funded by EIT Food, which is a division of the European Institute of Innovation and Technology (EIT), a body of the European Union, under Horizon2020, the EU Framework Programme for Research and Innovation. As part of the EIT's Crisis Response Initiative, this project directly contributes to the European Union's response to the COVID-19 pandemic.

#### ROP ERDF EMILIA-ROMAGNA 2014-2020

Implementing actions 1.1.4 and 1.2.2 of the ROP ERDF Emilia-Romagna 2014-2020, the Regional Government has issued a call for applications that aims to encourage the regional research and innovation system, and particularly companies and laboratories part of the High Technology Network, to study and test innovative solutions to fight the COVID-19 pandemic.

##### C-Voice Mask

Evolution from functional prototype to full face PPE certified product

##### LIVESTOCK-STOP-COVI

Advanced envirogenomic and analytical applications for a "One Health" strategy to fight the spread of the Coronavirus by monitoring livestock and animal species of zootechnic interest. The project develops eDNA and eRNA solutions to identify coronaviruses in livestock production systems, to identify livestock infected by coronavirus and to select animals to increase resistance to coronavirus infections.

##### MySIGN

Multiparametric physiological safe monitoring of patients with COVID

**PLASMA-  
DECON-FOOD**

Cold atmospheric plasma treatments for COVID-19 decontamination of food surfaces and food contact materials. The PLASMA-DECON-FOOD project is coordinated by the Interdepartmental Centre for Agri-Food Industrial Research (CIRI-AGRO) of University of Bologna, and involves also food SMEs and industries of the Emilia Romagna Region. Analysis of 23 studies reveals that human coronaviruses can persist on surfaces such as metal, glass or plastic up to nine days. However, specific studies on their persistency in food products and packaging surfaces is still lacking. The aim of the project is to verify the effectiveness of treatments with cold plasma carried out with a newly developed pilot prototype, for the inactivation of SARS-CoV-2 in not heat treated foods (fresh fruit and vegetables, fresh cheeses and fish tartare) and on the surfaces of the most used packaging materials in the food sector (polypropylene: PP; polyethylene terephthalate: PET; polyethylene: PE and cardboard). Considering the experimental demonstration and the development of strategies for industrialization, the areas of possible use of the resulting products are production plants and food packaging, distribution platforms and retailers, such as food stores and GDO.

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**Safety Mask**

Assessment of the effectiveness of surgical masks for the protection of healthcare workers and the general population (Safety Mask)

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**SANIFI-COV**

SARS-CoV-2 air and surface sanitizing with methods that have a low environmental impact

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**SWAPS**

Automatic Workflow Support for the Management of Healthcare Workers

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**Tech4Mask**

Innovative technology for the flexible production of FFP3 antiviral and antibacterial face masks

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**VIKI  
Virus Killer**

Sanitizing device against the transport of indoor bioaerosols

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## EOSC (2020-2021)

### VirAnimalOne

VirAnimalOne applies large scale mining of publicly deposited genomic and transcriptomic datasets and derived from pets, livestock and wild animal species 1) to identify unexpected coronavirus sequences, 2) to mine the host animal genomes for potential variants that might confer resistance or susceptibility to SARS-CoV-2 and other coronaviruses known to infect both humans and animals and 3) to phylogenetically and structurally evaluate host receptor conformations and infer potential animal susceptibility to coronavirus infection.

## THE EGI FEDERATION CALL FOR COVID-19 RESEARCH PROJECTS

EGI and Open Science Grid (OSG) in the USA are joining forces to commit specialized technical support, specialized simulation tools, and compute and storage resources, to accelerate progress on COVID-19 research.

### AnGen1H

Animal genomics for a “One Health” perspectives in the COVID-19 pandemic era

Bioinformatic analyses of animal genomes to identify variants conferring resistance to SARS-CoV-2,

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## THE EUROPEAN FEDERATION OF CORRUGATED BOARD MANUFACTURERS

Project funded by [FEFCO](#) together with the Consortium for corrugated cardboard and packaging ([BESTACK](#))

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Study of the persistence times of SARS-CoV-2 on different packaging materials. Industrial research project funded by FEFCO e BESTACK

# UNIVERSITY OF BOLOGNA PROPOSED SOLUTIONS FOR COVID-19 RELATED NEEDS

The following sections reports the overall output of the critical analysis performed within the University community, in order to identify the main COVID-19 related needs and the solutions that University of Bologna will be able to provide with dedicated research activities for each specific thematic domain: Health, Industrial and Socio-economic areas.

URGENT CLINICAL NEEDS

**URGENT CLINICAL NEEDS**

**PROPOSED SOLUTIONS**

<p>Means of disinfection of medical clinic rooms during routine clinical activity (e.g. use of automation)</p>	<ul style="list-style-type: none"> <li>• Development of devices employing photocatalysis, coupled with ozonation if needed, to abate bacteria and viruses constantly.</li> <li>• Development of robotic systems able to collaborate with human operators and support them in their activities in an intuitive manner. Physical interaction human-robot.</li> </ul>
<p>Architectural re- organization of clinical (e.g. installation of protective shields) and shared areas (e.g. defining paths to increase social distancing with diversified access and exit routes, one-way hallways, etc)</p>	<ul style="list-style-type: none"> <li>• Set-up of a wireless monitoring system, to help maintain “social distances”, connected to a Decision Support System capable of integrating additional information (even clinical-epidemiological-social ones) and suggesting virus containment measures through opening/closures/ regulation of activities. This will be a collaboration with the University of Bologna AI centre.</li> <li>• Implementation of systems to detect occupancy beyond capacity of common areas such as waiting rooms, cafes, hallways, etc.</li> <li>• Production of a prototype able to treat at high abatement rates volumes of air contaminated by bioaerosols before re-introducing them in the environment.</li> </ul>
<p>Management and usage of air conditioning systems in medical clinics</p>	<ul style="list-style-type: none"> <li>• Production of a device able to eliminate 99% of submicronic particles from the air</li> </ul>
<p>Reduction of contamination risk in dentistry</p>	<ul style="list-style-type: none"> <li>• Study of the reduction methods for contamination in the dental clinic and operating room through reduction of droplets and aerosols produced from equipment (drills, ultrasound, etc)</li> <li>• Analysis of the aspiration capacity of air pumps for FLOATING DROPLETS with viral load and their capture and disposal with nanopore filters.</li> </ul>

**URGENT CLINICAL NEEDS****PROPOSED SOLUTIONS**

Automated daily monitoring systems for COVID-19 symptoms on healthcare personnel	<ul style="list-style-type: none"> <li>Design and produce a compact and miniaturized analytical system connected to a smartphone to carry out a complete COVID-19 diagnosis determining in biological samples both virus-specific IgM and IgG, and K90 protein as a specific marker of disease progression. The system foresees the simultaneous determination of the three parameters using a LFIA system with parallel strip.</li> </ul>
Telemedicine platform in support of specialist clinical activity	<ul style="list-style-type: none"> <li>Impact evaluation on efficacy and safety outcomes of a phone management protocol in patients affected by chronic rheumatological diseases in sanitary emergency conditions (COVID-19 pandemic).</li> </ul>
COVID-19 persistence on environmental surfaces in hospital wards	<ul style="list-style-type: none"> <li>To verify the real immune response and the timing of antibody insurgence in the presence or absence of viral clearance.</li> <li>To optimise EN 14683 and ISO 10993 tests to assess the compliance of protective face masks and the production of composite materials to minimise bacterial contamination for the production of personal protective equipment for prolonged usage.</li> <li>Air quality monitoring systems integrated with a centralised database for data collection in order to trace a map of any micro-organisms, powders, viruses and bacteria present.</li> </ul>
Predictive model for in silico evaluation of the efficacy of new therapies for communicable diseases	<ul style="list-style-type: none"> <li>Evaluation of the predictive accuracy of the UISS-TB simulator in order to drastically decrease costs and duration of clinical trials to evaluate the efficacy of new therapies for communicable diseases.</li> </ul>

OTHER CLINICAL NEEDS

**OTHER CLINICAL NEEDS**

**PROPOSED SOLUTIONS**

<p>Implementation of Food Supply Chain Management practices (e.g. for hospital cafeterias)</p>	<ul style="list-style-type: none"> <li>• Optimization systems for supply chain management integrated with data management to define predictive models based on demand and access.</li> </ul>
<p>Case Management</p>	<ul style="list-style-type: none"> <li>• To identify predictive factors for respiratory failure which require admission to intensive care therapy through the construction of a prediction rule apt to guide therapeutic choices.</li> <li>• To test a monitoring system for respiratory function of COVID-19 patients limiting the proximity of healthcare personnel and other patients (telemonitoring) in order to guarantee patient safety while limiting the spread of contagion and allowing for an optimization of the ventilating support and pharmacological therapy.</li> <li>• To verify if chronic intake of RAS inhibitors modifies prevalence and severity of COVID-19 clinical signs.</li> <li>• Healthcare operative research and analytical methods for optimising the network of hospital stays for COVID-19 patients.</li> <li>• Development of a validated 3D numerical model of the human lung to predict Coronavirus tissue damage and degeneration</li> <li>• RAS-SARS: Investigating the association between drugs against the renin-angiotensin system and the clinical signs of COVID-19.</li> <li>• Support to an automated workflow for the management of healthcare personnel (SWAPS).</li> </ul>



OTHER CLINICAL  
NEEDS

## PROPOSED SOLUTIONS

Kits for detection of  
COVID- 19 in blood

- Point-of-care diagnostics based on fluorescence for rapid immunological or molecular analyses. Integrated analysis of fluorescent images for viral diagnostics.
- A Deep CNN for OLED based point of care immunofluorescent diagnostic system:
  - 1) Realization of a disposable and low-cost cartridge for the detection of antibodies against Coronavirus (immunodiagnostic test);
  - 2) Realization of a disposable geno-sensor cartridge for the detection of coronavirus in patient sera using DNA probes. Both disposable cartridges will use the same portable reader for the imaging of the fluorescent spots specifically related to the presence of the investigated analyte (antibody or virus). A portable incubator will also be used to process the samples and to reduce analysis duration. The A.I. algorithm will be optimized to allow extremely accurate diagnostic also in case of low contrast fluorescence images and analyte quantification in the reader device.

Prevention of  
coronavirus  
pulmonary fibrosis

- Phase 1: discovery of candidate pathways in the development of pulmonary fibrosis in the animal model (bleomycin mouse) with time-point study (activation of approximately 800 genes from candidate pathways in pulmonary tissue). Phase 2: crossing these data with FDA repository of drugs/molecules active on these pathways. Phase 3: in vitro validation of targets and drugs on human cells via high-throughput screening. Phase 4: in vivo validation on the animal model

**OTHER CLINICAL NEEDS**

**PROPOSED SOLUTIONS**

<p>Research on the genetic determinants associated with severity of clinical manifestations in COVID-19 patients</p>	<ul style="list-style-type: none"> <li>• Study of the allelic frequency of variants in candidate genes (ACEII, TMPRSS2) on previously collected genome data. Search of variants identified in the study population. Search of an association between specific gene variants and disease severity in different patients.</li> <li>• Evaluation of gene variants in the IL-6 and IL-6 receptor genes in the response to Tocilizumab.</li> </ul>
<p>Organization of data collection and automated reporting systems</p>	<ul style="list-style-type: none"> <li>• Mathematical models to describe epidemic spread, platforms for collection of crowd-sensing monitoring data and for stimulating citizen behaviours, sentiment characterization on the social network level, genetic analysis of viral and bacterial strains, characterization of climate and environmental conditions correlated with epidemic diffusion processes.</li> <li>• Big Data analysis platform capable of: (i) supporting complex analyses of massive volumes of data; (ii) integrating private and sensitive data from heterogeneous sources; (iii) maintaining privacy and sensitivity of such data through the use of privacy- preserving technologies such as anonymization and cryptography. Such platform would allow the development of intelligent digital tools to improve health surveillance and care services.</li> </ul>
<p>Trauma and resilience in healthcare workers during the COVID-19 pandemic</p>	<ul style="list-style-type: none"> <li>• Promoting psychological resilience, preventing the development of depression and anxiety disorders or post-traumatic stress disorder after the COVID-19 healthcare emergency.</li> </ul>

NEEDS OF RELEVANT INDUSTRIAL SECTORS

FOOD INDUSTRY APPLICATIONS

PROPOSED SOLUTIONS

<p>Monitoring healthiness of meat and fish in the production chain</p>	<ul style="list-style-type: none"> <li>• Air quality monitoring systems integrated with a centralized database for data collection, in order to trace a map of any micro-organisms, powders, viruses and bacteria present.</li> </ul>
<p>Efficient and sustainable sanitation systems for food packaging, processing and handling tools</p>	<ul style="list-style-type: none"> <li>• Production of a chemical-free and easy to use prototype system based on cold-gas plasma technology for food packaging and processing tools sanitation.</li> </ul>
<p>Disinfection of non-clinical workplaces (e.g. factories, offices, etc)</p>	<ul style="list-style-type: none"> <li>• Production of a prototype system able to treat at high abatement rates volumes of air contaminated by bioaerosols before re-introducing them in the environment</li> </ul>
<p>Urban logistics for the delivery of drugs and transport of people, planning on-call transport services inside and outside of the cities also applicable to personal services, care and transport of drugs and patients</p>	<ul style="list-style-type: none"> <li>• Effective calculation methods for planning vehicle trips. Development of algorithms that could be included in commercially available decision support systems (PRIN 2007 Engineering Department).</li> <li>• Mathematical models to describe epidemic diffusions, sentiment characterization on the social network level, genetic analysis of viral and bacterial strains, characterization of climate and environmental conditions correlated with epidemic diffusion processes.</li> </ul>

FOOD INDUSTRY APPLICATIONS

PROPOSED SOLUTIONS

Environmental analysis systems to detect the presence of SARS-CoV2 in the air particulate virome  
 Design and production of machines for the production of nanofibres functionalized for virus and bacteria filtration  
 Prevention, environment, environmental and healthcare risk assessment, community capacity assessment, territorial governance, health risk assessment 2.0 4.0

- Integrated physical-chemical and microbiological characterization of PM10 samples. Study of the correlation between these parameters for environmental diagnostics purposes.
- Set-up and optimization of a nanofibrous coating on a filtering substrate for the abatement of viruses and bacteria
- Experimental application of the digital platform q-City4.0 ([www.q-cumber.com](http://www.q-cumber.com)) multi-stakeholder 2.0/4.0, adopted by the Ministry of Environment, for the governance of the healthcare and economical risks determined by the COVID-19 emergency. The platform has been officially adopted by the Lombardy, Umbria, Liguria regions, ARPA Umbria, and by the Ministry of Environment in October 2019. The following results are expected: 1) Use of the platform by national, regional, provincial and city institutions for planning effective actions and interventions for the preventive containment of healthcare and environmental risk conditions related to the epidemics; 2) Use of the platform by national, regional, provincial and city institutions as an information and education tool in the territory; 3) Use of the platform by enterprises as an information and education system regarding the eligibility conditions for opening during the emergency status.
- Simulation tools and predictive models for the environmental, economical and social impact evaluation of virus containment measures. Definition of surrogate models based on these simulators and their integration in a decision support system for defining sustainability policies in post-pandemic scenarios.

## SOCIO-ECONOMIC NEEDS

## URGENT SOCIO-ECONOMIC NEEDS

## PROPOSED SOLUTIONS

Social impact of the emergency and community resilience factors for promoting compliant behaviours

1. **Analysis of the pandemic impact on the community psychosocial dynamics** - Analysis of the psychosocial resilience factors and predictive factors relative to participation, health-relevant behaviours (individual and collective) and to compliance with policy indications for risky behaviour prevention and promotion of precautionary behaviours. Experimentation of citizen involvement, prevention and health promotion interventions. Evaluation of efficacy and impact of institutional communication strategies and informational campaigns. Wellbeing and socio-economic factors of resilience and community preparedness. Promotion of a social responsibility culture for strengthening social cohesion rather than rage, hostility and social and spatial segregation. Short- and long-term consequences on daily life in a view of intersectionality of factors in order to build new and effective emergency preparation practices.
2. **Risk perception and the influence of media and social media** - Textual and sentiment analysis of posts published on the main social media following the emergency; role of the institutional and media discourse in the social perception of the crisis in different social groups; analysis of the discourse produced by different actors on social inequalities and risk perception configuration among social groups
3. **Resilience factors related to arts and culture** through visual, performing, literary representations and the study of resilient human behaviours

URGENT SOCIO-ECONOMIC NEEDS

PROPOSED SOLUTIONS

Mental health in vulnerable groups and social inequalities

1. **Prevention of stress and post-traumatic disorders in healthcare personnel, emergency workers and other first-responder associations**  
 Detection and evaluation of workers' stress management, activation of relaxation treatments aimed at training self-regulation capacity of psychophysiological indices; Evaluation and psychological tests for the prevention of depressive disorders, post-traumatic stress disorder and the increase of psychological resilience of healthcare workers, emergency workers and other first responder associations.
2. **Social inequalities and protection of vulnerable groups** (homeless, drug users, migrants, informal economy workers, prisoners and victims of domestic violence).
3. **Immigrant foreign population** Evaluate the impact of COVID-19 spread and the socio-economic consequences of the containment measures on the foreign population regarding work, fertility, poverty, subsequent migrations through methods of demographic and statistical methods.
4. **Consequences of COVID-19 on lifestyle and mental health** (fertility, use of drugs and alcohol, and mental health consequences); Risk perception and re-organisation of daily life practices, with special attention paid to damaging lifestyles (e.g. alcohol, drugs); Short- and long-term consequences on daily life in a view of intersectionality of factors in order to build new and effective emergency preparation practices; Social innovation and co-creation practices; impact on mental health of restrictions from the pandemic and domestic life.
5. **Gender disparity and domestic violence**

URGENT SOCIO-ECONOMIC NEEDS

PROPOSED SOLUTIONS

<p>Lifestyle transformation</p>	<ol style="list-style-type: none"> <li>1. <b>Student condition</b> Investigate how the student condition changes, including the aspects related to housing situation, lifestyle changes, student participation following the change in teaching mode.</li> <li>2. <b>Consumers</b> Consumer choices and behaviours: validation of specific consumer choice models in emergency situations, in order to understand how the current emergency situation modifies consumer behaviour due to risk perception with the aim of targeting possible interventions; Quantifying the effects of social distancing and information on food consumer choices in order to define appropriate policies.</li> <li>3. <b>Physical activity and exercise</b> Understanding people choices and the transformation of physical activity routines for health and wellbeing in emergency contexts</li> <li>4. Modification of <b>daily lifestyles of families</b>, particularly of families with relatives in assisted care facilities</li> </ol>
<p>Gender disparity, including gender violence</p>	<ol style="list-style-type: none"> <li>1. <b>Gender disparity</b> and domestic violence</li> <li>2. <b>Female independent work</b> Analyse the response (greater vulnerability or greater resilience) of independent work in a context of pandemic crisis, in particular for female work. Understand the influence of the gender variant and the socio-demographic context.</li> <li>3. <b>Spread of contagion by gender</b> Analysis of the differential COVID-19 contagion spread by gender &amp; age.</li> </ol>

URGENT SOCIO-ECONOMIC NEEDS

PROPOSED SOLUTIONS

<p>Organization and protection of work</p>	<ol style="list-style-type: none"> <li>1. <b>Work in sectors at risk of contagion</b> - a) Incentivation and remuneration for risk, selection of personnel in sectors at risk of contagion; b) Employee stress management: evaluation and detection, activation of relaxation treatments in order to train the self-regulation capability of psychophysiological indices; Evaluation and psychological tests for preventing depressive disorders, post-traumatic stress disorder and strengthening the psychological resilience of healthcare workers, emergency workers and other first responder associations. Psychology of work and organizations.</li> <li>2. <b>Female independent work</b> - Analyse the response (greater vulnerability or greater resilience) of independent work in a context of pandemic crisis, in particular for female work. Understand the influence of the gender variant and the socio-demographic context.</li> <li>3. <b>Emergency agile work (LAE)/smart working</b> Understanding LAE worker organization mode</li> </ol>
<p>Organizational changes, in particular for public healthcare</p>	<ol style="list-style-type: none"> <li>1. <b>Study of the organizational routines</b>, group decisional processes and individual behaviour.</li> <li>2. Analysis and mapping of the <b>rationalization tendencies</b> and conglomeration of organizational structures in the public sector. Hypotheses on the effects in terms of organization performance and ability to offer the services needed. Evaluation of the effects of organizational interventions on system capacity and minimum essential services.</li> <li>3. <b>Healthcare organization</b> and to guarantee essential services in healthcare and social matters from a legal profile</li> <li>4. <b>Local administration efficiency</b> in contexts of inequality deriving from economic crises</li> </ol>



URGENT SOCIO-  
ECONOMIC NEEDS

PROPOSED SOLUTIONS

<p>Short- and mid-term socio- economic impacts</p>	<ol style="list-style-type: none"> <li>1. <b>Macro economy policies</b> - Public finance and fiscal and monetary emergency measures. Prediction of socio-economical trends.</li> <li>2. <b>Public policy evaluation</b> - Data analytics and economics in the 20 country most affected by the epidemics in order to optimise post- emergency socio-economical strategies and measures. Determine the relationship of Italian citizens with the news and their trust in the sources, their opinion on the work of the subjects involved in the emergency and their perception of Coronavirus risks. Statistical methods for the evaluation of public policy impacts. Statistical measures of territorial socio-economical inequalities between regions on a European scale.</li> <li>3. <b>Microeconomical functioning of markets</b> - Job market, digitalization and innovation for enterprises, human capital accumulation, smart working and productivity.</li> <li>4. <b>International commerce and industrial production chains</b> - Consequences on the global supply chain, financial incentives.</li> <li>5. <b>Research and development</b> in the biomedical area, new drugs, competitiveness and intellectual property.</li> <li>6. <b>Environmental policies.</b></li> </ol>
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URGENT SOCIO-  
ECONOMIC NEEDS

PROPOSED SOLUTIONS

International  
coordination to  
face pandemics

1. **Optimisation of international standards** - Study of the international regulatory framework for identifying international standards and obligations, for optimising procedures, decisions and the involvement of citizens and other stakeholders involved and for identifying gaps in research, in all phases regarding a CBRN risk/event, including pandemics (prevention, preparedness, response and recovery). Analysis of the international regulatory framework assessing the shortages, the needs of institutional reforms and cooperation principles to face sanitary emergencies and pandemics.
2. **Training of the leadership** for international coordination on access to drugs and medical devices, and the mobility of medical personnel.
3. **International trading and industrial production chains** - Consequences on global supply chain, financial incentives

URGENT SOCIO-ECONOMIC NEEDS

PROPOSED SOLUTIONS

<p>Democratic governance in emergency and post-emergency</p>	<ol style="list-style-type: none"> <li>1. <b>Analysis of the macro social structures of decision-making</b> activated during the emergency in order to compare the push for integration in response to emergency, with the need for processes of decisional differentiation in different areas of society;</li> <li>2. <b>Optimisation of decisional processes in emergency situations</b> - Understand the main cognitive biases and limits in the understanding of risk and probabilities applied to big numbers in order to increase awareness of the most common judgment mistakes and the limits of intuitive thought, with particular application to emergencies in order to prevent potentially harmful decisions in the medical or political areas.</li> <li>3. <b>Fight against corruption</b> - Understand and explain how citizens use and create digital platforms to monitor corruption events in a moment of sanitary and political crisis in different world countries.</li> <li>4. <b>Influence of cultural and infrastructural variables</b> at regional level on social distancing measures.</li> <li>5. <b>Checking Compliance</b> - Comparative study of the democratic processes and policy tools</li> <li>6. <b>Analysis of the social control measures</b> in order to verify capacity of democratic governances in sanitary crises and to improve people control according to democratic standards</li> </ol>
<p>Digital Humanities to support a greater analytical understanding of the pandemic phenomenon</p>	<ol style="list-style-type: none"> <li>1. <b>Web semantic models</b> capable of finding the most appropriate text excerpts in the literature in order to answer medical/clinical questions regarding COVID- 19.</li> <li>2. <b>Legal knowledge modelling tools</b>, legal rule formalization, legal language mining/NLP/ML, Legal Data Analytics and Visualization, legal reasoning to support the correct application of legal production and the compliance of public administrations with the emergency.</li> </ol>

URGENT SOCIO-  
ECONOMIC NEEDS

PROPOSED SOLUTIONS

Artistic and social  
representations

1. Analysis of the graphical representations in social media, of contemporary myths and recurring models, criminalization of vulnerable groups and social exclusion.
2. Analysis of visual and performative representations of the sanitary crisis developed by citizens to face epidemics control measures.
3. Analysis of human resilient behaviours in contrast with natural, historical, collective and personal catastrophes on a large scale. To show how linguistic and cultural models have elaborated the effects of devastation, shaping symbolic forms able to overcome the traumatic phases.

# RESEARCH AREAS

In the following sections the main University of Bologna research competences actively involved within the COVID-19 related projects are summarized. Three main thematic areas are described Health, ICT and SSH, even if an intersectoral and multidisciplinary approach is strongly necessary to address the COVID-19 research fields, leading to a constant interaction of different thematic areas and expertise.

## HEALTH RESEARCH @ UNIVERSITY OF BOLOGNA [lsb@unibo.it](mailto:lsb@unibo.it)

University of Bologna ranks **3<sup>rd</sup> among Italian Universities and 120<sup>th</sup> at European level in Health** competitive research funded in Horizon 2020 programme Societal Challenge 1 and related funding frameworks, **participating in 30 projects (5 under IMI-2 JTI) with a total EU contribution of over 14 M€.**

University of Bologna is institutionally connected to three research hospitals:

- The **Istituto Ortopedico Rizzoli (IOR)** dedicated to the study and care of musculoskeletal conditions
- The **Istituto delle Scienze Neurologiche (ISNB)** dedicated to the study and care of neurological conditions
- The **St. Orsola-Malpighi University Hospital (AOSP)**, is the first hospital in Bologna, with more than 400 years of history, and today is the official venue of the School of Medicine and Surgery.

The main areas of expertise and competencies includes:

OMICS AND TECHNOLOGY PLATFORM FOR HEALTH AND BIOMEDICINE - The University of Bologna has a long-lasting experience in studying the **ageing** multi-factorial process and its associated non-infectious **co-morbidities**, as well as a number of **other clinical conditions**. The integration of preclinical and clinical research with therapeutics and care is a strong asset of the University of Bologna. Furthermore, several research group have exploited the use of **NGS approaches** to identify causative mutations in patients with a range of different rare Mendelian phenotypes.

PRE-CLINICAL AND BIOMEDICAL SCIENCES - Research expertise across different departments also includes the **harmonization of healthcare data collection**, the development of tools for population-level detection of cognitive impairment and the investigation of **animal models** of addiction, neuropathic pain, and brain- related diseases. **Pre-clinical research** is

developed within university laboratories and in collaboration with clinicians, in areas ranging from subcellular organelles of tumor cells (mitochondria, ribosomes), to cancer vaccines, to cancer predisposition genes, to the use of cancer genomics and transcriptomics to discover and target novel cancer genes, to studies of preventive components of the diet. Preclinical research develops **regenerative medicine approaches** based on the combination of polymeric and ceramic biomaterials, cells, physical energies, and bioactive drugs for in vivo applications (self-repair stimulation) and implantable devices (controlled release of drugs, cells and cell derivatives such as exosomes).

BIOINFORMATICS FOR SYSTEMS AND PERSONALISED MEDICINE - Researchers at the University of Bologna have advanced skills in complex networks, deterministic and stochastic modelling of physiological systems with multiscale approaches, advanced data-driven techniques based on machine and statistical learning methods. Other points of excellence are the **big data analytics methods**, including the integration of heterogeneous data sources leveraging on the computing resources and cloud environment owned by the University. This has led to improve and evaluate **preventive strategies** and to identify personalised and precision medicine approaches, with particular relevance for **early diagnosis** and prediction of outcomes such as falls, frailty, depression, and functional decline in older people. Furthermore, the University of Bologna has a long-lasting expertise in the **integration of -omics data with genomic characterisation** and with higher levels of complexity, including lifestyle and environmental data, in order to obtain a better understanding of clinical phenotypes.

E-HEALTH AND ROBOTICS - The University of Bologna has advanced skills in managing large amount of digital data. The interdisciplinary research focuses on healthy ageing, cognitive impairment and musculoskeletal conditions, among others. Research activities spans from the application of virtual/augmented reality and digital diagnostics and care, to the use of health informatics and mobile technologies. At the University of Bologna, researchers have a strong expertise in the **design, development and real-life testing of smart and adaptive environments**. Multidisciplinary teams are used to work together with a participatory design approach. Researchers have exploited the potential offered by **Internet of Things (IoT)** technology, wearable sensors, mobiles, biomedical signal processing and Artificial Intelligence for prototyping smart objects and environments capable of identifying, locating, and sensing.

NANOMEDICINE – The application of nanotechnology to health is an emerging field of multidisciplinary research that introduces innovative approaches in the **diagnosis and treatment of diseases**, with a huge impact on human wellbeing and society. The University of Bologna is actively involved in research and application of nanomedicine, **nano-biomaterials, nanotechnology-based devices and diagnostics**. The deep knowledge in chemistry, physics, biology, medicine and engineering, is exploited through an interdisciplinary collaborative effort to establish platforms for both knowledge-based research and application of imaging, diagnosis and therapy of a number of difficult-to-treat pathologies. University of Bologna is an active partner of the European Technology Platform on Nanomedicine.

**ICT RESEARCH @ UNIVERSITY OF BOLOGNA**  
[pes@unibo.it](mailto:pes@unibo.it)

In the framework of H2020 – LEIT ICT, University of Bologna is involved in **28 projects** with a total EU contribution of **about 10 M €**. Research at the University of Bologna is at the forefront of research in many ICT enabling technologies:

- **Micro and nano electronics**: embedded systems featuring innovative microelectronics components based on next-generation devices.
- **Internet of things, cyber physical systems and smart system integration** in different application domains
- **Automation and Robotics**
- Advanced communication and networking technologies
- **Software engineering, programming languages and formal methods** in many different application areas including manufacturing, mobility, social platforms, software platforms and IoT
- **Big data**: Methods, approaches and engineering paradigms in analytics and data management
- **Cloud computing systems**: Infrastructures and ecosystems for advanced cloud computing, including optimizations for cloud continuum (fog), big data management, and latency-sensitive Industry 4.0
- **Operation research**: innovative models and algorithms for the optimization of hard decision planning problems in several application domains
- **HPC**
- **Artificial Intelligence**

### ALMA-AI: ALMA MATER RESEARCH INSTITUTE FOR HUMAN-CENTERED ARTIFICIAL INTELLIGENCE

AI is a very strong and wide field of research at University of Bologna. It covers both theoretical and technological aspects but also legal, social and economic aspects of AI. The interdisciplinary hub, the "[Alma Mater Research Centre for Human-Centered Artificial Intelligence](https://centri.unibo.it/alma-ai/it)" (Alma Human-AI - <https://centri.unibo.it/alma-ai/it>) has been created by the University of Bologna, to aggregate and facilitate cross-discipline AI research and AI driven applications. The joint effort of more than 300 researchers working in 26 Departments of the University reinforces the position of the Alma Mater in the international debate about artificial intelligence in terms of research, education, innovation and societal impact.

University of Bologna is member of the most important EU associations bridging research, innovation, infrastructure, capacity building and policies such as BDVA (Big Data Value Association), euRobotics, 5G Infrastructure Association, AENEAS (Association for European NanoElectronics Activities), ARTEMISIA (Advanced Research & Technology for EMbedded Intelligence and Systems Industrial Association), ETP4HPC and ECSO (European CyberSecurity Organization).

### SOCIAL SCIENCES AND HUMANITIES @UNIVERSITY OF BOLOGNA [ssh@unibo.it](mailto:ssh@unibo.it)

University of Bologna ranks 1° among Italian HES and 6° among European HES for competitive research funded in Horizon 2020 programme - Societal Challenge 6, being involved in 22 projects (of which 7 as coordinator) with a total EU contribution of over € 7 Million.

Projects areas include: political and civil participation of youth; social innovation and public services innovation; European heritage and identity; international relations; migrants' integration; social and economic transformations; platform economy's impact on work, welfare and social protection; work, poverty and social rights; social cohesion, participation, and inclusion through cultural engagement; creativity, digital humanities.



### SSH-STEM KNOWLEDGE CO-CREATION

University of Bologna is committed to **facing societal challenges** through a rich and dynamic variety of social and human (SSH) research expertise with the aim to enhance existing knowledge through the co-creation of impactful interdisciplinary research.

As a comprehensive university, University of Bologna has made the most of all its disciplinary fields by mobilizing researchers across disciplinary areas in order to create a friendly environment for a genuine **interdisciplinary** and foster the **co-creation of challenge-oriented knowledge between SSH and STEM**. SSH are fully integrated in Horizon 2020 funded projects, addressing human factor, user-centered approach, behavior change, socio-economic impacts of climate change, end users, socio-technical readiness of innovations, socio-economic aspects, social/cultural acceptance, human-centered design. Moreover, the internal promotion of interdisciplinary has facilitated the meaningful integration of RRI principles (public engagement; open science; gender; science education; ethics) in collaborative proposals under all Horizon 2020 pillars.

University of Bologna **SSH expertise** includes research activities across the psychological, ethical, social, legal, political, cultural and economic domains aiming to understand and change behavior patterns and influence public policies to provide solutions to public health challenges.

More in detail, SSH research investigates and **addresses a wide range of thematic issues related to the public health priorities**: psychological, behavioral and cultural factors; social determinants of health; ethical aspects; health inequalities; Indicators for wellbeing; healthcare policies; demographic factors; mental health; health care markets; legal issues; health economics and management; health policies and politics.







ALMA MATER STUDIORUM  
UNIVERSITÀ DI BOLOGNA

ARIC - Research Services Division  
For information:  
[lsb@unibo.it](mailto:lsb@unibo.it)