AI and Pandemic Response Working Group

November 2021 - GPAI Paris Summit

GPAI | THE GLOBAL PARTNERSHIP ON ARTIFICIAL INTELLIGENCE

Please note that this report was developed by experts of the Global Partnership on Artificial Intelligence's Working Group on AI and Pandemic Response. The report reflects the personal opinions of GPAI experts and does not necessarily reflect the views of the experts' organizations, GPAI, the OECD or their respective members.

Co-Chairs Welcome

Alice Oh
Associate Professor of Computer Science, Korea Advanced Institute of Science and Technology

Paul Suetens
Professor Emeritus, Katholieke Universiteit (KU) Leuven

We are pleased to report on our mandate to foster and support the responsible development and use of AI-enabled solutions to fight COVID-19 and other future pandemics. With less than 1% vaccination in low-income countries[1], and G7 Leaders setting a target to develop diagnostics, therapeutics and vaccines within 100 days in a future crisis[2], we know that our mandate remains urgent and vital.

And yet, there is a growing acknowledgement that AI technologies have far from reached their potential in their contribution to pandemic response, with challenges identified at Summit 2020, such as poor quality data, remaining a significant barrier for the developer community.

We are pleased therefore to present work that offers a more granular view on these challenges, and practical steps towards addressing them. This more granular view includes evaluating the impact of specific AI-driven interventions, and investigating how partnerships could boost the most promising, and practical recommendations to ensure AI technologies can make a significant contribution to the ambition represented by the 100 Days Mission.

We are incredibly grateful for the hard work and commitment of our Working Group members, especially those that have volunteered to lead and contribute to our projects. We thank Yoshua Bengio and Michael Sullivan in particular for their great collaboration with us on co-leading our two lead projects, as well as the teams at Mila and The Future Society for their support in delivering them.

In its next phase of work, the Working Group wants to be an active partner with those who share the ambition of our mandate. This includes a strategic dialogue on AI-accelerated drug discovery to unlock that potential, and connecting more closely with teams working on immediate AI applications that show most promise and could benefit most from our partnership.

We look forward to that collaboration to come, and thank you for reading our report.

Alice Oh

Paul Suetens

[1] Nature, September 2021
[2] G7 Carbis Bay Declaration, June 2021

Working Group Overview

AI and Pandemic Response was formed as an ad hoc subgroup of the Responsible AI (RAI) Working Group at the request of GPAI's members in 2020, in light of the global health emergency. The subgroup has defined its mandate as fostering and supporting the responsible development and use of AI-enabled solutions to fight COVID-19 and other future pandemics.

The Working Group consists of 19 experts, including three observers, from 15 countries. The group includes insights from academia and industry, principally experts from technical backgrounds applying AI technologies to complex medical challenges.

Membership of GPAI's AI and Pandemic Sub Working Group

Working Group members

Alice Oh (Co-Chair) – Korea Advanced Institute of Science and Technology (South Korea)
Paul Suetens (Co-Chair) – KU Leuven (Belgium / European Union nominee)
Anurag Agrawal – Council of Scientific and Industrial Research (India)
Amrutur Bharadwaj – Indian Institute of Science (India)
Nozha Boujemaa – Median Technologies (France)
Dirk Brockmann – Humboldt University of Berlin (Germany)
Howie Choset – Carnegie Mellon University (United States)
Enrico Coiera – Macquarie University (Australia)
Marzyeh Ghassemi – University of Toronto (Canada)
Hiroaki Kitano – Sony Computer Science Laboratories Inc (Japan)
Seán Ó hÉigeartaigh – Centre for the Study of Existential Risk (UK / European Union nominee)
Michael Justin O'Sullivan – University of Auckland (New Zealand)
Michael Plank – University of Canterbury (New Zealand)
Mario Poljak – University of Ljubljana (Slovenia)
Daniele Pucci – Istituto Italiano di Tecnologia Research Labs Genova (Italy)
Margarita Sordo-Sanchez – Brigham and Women's Hospital at Harvard Medical School (Mexico)
Leong Tze Yun – National University of Singapore (Singapore)
Gaël Varoquaux – INRIA (France)
Blaž Zupan – University of Ljubljana (Slovenia)

Observer

Cyrus Hodes – AI Initiative
Kim McGrail – University of British Columbia
Alan Paic – OECD

Cross-Working Group collaboration has been a strong feature of the subgroup's approach in 2021 - building on the complementary mandates of the Responsible AI and Data Governance Working Groups. The subgroup's first report, published for the 2020 Montreal Summit, highlighted legal, ethical and data access issues as common challenges facing AI-enabled solutions. The subgroup has been pleased to collaborate with the Responsible AI on the AI for public domain drug discovery project, co-chaired by Alice Oh and Yoshua Bengio, and has been grateful for the expertise offered by several members of the Data Governance Working Group on this project.

Progress Report

Building on the recommendations from Summit 2020, the Subgroup agreed to advance two projects from 2021:

1. **AI for public-domain drug discovery:** this project responds to international demand from governments to find ways to accelerate drug discovery[3] more broadly, by providing a set of recommendations for GPAI member countries and the international community in general to create an enabling environment for open AI research towards the development of new drugs or the repurposing of existing ones to address public health challenges. The Project Committee (fully listed under Annex 1) is co-led by Alice Oh and Yoshua Bengio, with research support from Mila (Allison Cohen and Elliot Layne).
2. **AI-powered immediate response to pandemics:** this project reflects the ongoing global emergency presented by COVID-19 and the urgency with which the subgroup was established. Its overarching goal is to directly support impactful and practical AI initiatives to help in the fight against the COVID-19 pandemic. It has two outputs: (1) an update and upgrade of the catalogue of practical initiatives that the subgroup commissioned in 2020, transforming it into a living repository, and (2) an evaluation of initiatives to identify impactful and scalable initiatives that could benefit from partnership with GPAI. The insights from these activities will help establish research/technology for fighting against future epidemics/pandemics. The Project Committee (fully listed under Annex 1) is co-led by Michael Sullivan and Paul Suetens, with support from The Future Society.

1 - AI for public-domain drug discovery

For Summit 2021, the Project Committee has developed a 'roadmap' with actionable recommendations on ways to accelerate drug discovery through the use of AI technologies. The report has been produced in consultation with a wide range of expertise on technical AI, medical science, law (including intellectual property), and data governance.

The roadmap surveys the breadth of AI's potential. AI technologies are already starting to bear fruit in the arena of drug discovery, but should the field reach its full potential, it offers the ability to:

- Discover new categories of effective drugs,
- Enable intelligent, targeted design of novel therapies,
- Vastly improve the speed and cost of running clinical trials, and
- Further our understanding about the basic science underlying drug and disease mechanics.

However, the roadmap identifies barriers within the current drug discovery ecosystem to realising this opportunity, and considers these as areas where government support could make a significant difference. More specifically, the field needs financial investments in areas where insufficient R&D is taking place and requires a shift towards open-data and open-science in order to feed the most powerful, data-hungry AI algorithms. This shift will catalyze research in areas of high social impact, such as addressing neglected diseases and developing new antibiotic solutions to incoming drug-resistant threats. While open science and AI promise successes on producing new drugs, they cannot address the challenges associated with market-failure for certain drug categories. Government interventions must therefore target the entire drug development and deployment lifecycle to ensure that the benefits of AI technology, as applied to the pharmaceutical industry, result in improved healthcare outcomes for the public in areas where they are urgently needed and not currently addressed.

The roadmap makes recommendations targeting three outcomes:

- Research and development in fields of drug discovery that are valuable to society and necessary to public health, but are not being sufficiently addressed by stakeholders in industry.
- Uptake of AI throughout the entire drug discovery and development pipeline.

[3] See for example the "100 Days Mission" launched by the G7

- A shift in culture towards open-data among stakeholders in academia and industry when undertaking research on drug discovery and development.

The Roadmap presents recommendations to achieve these outcomes as follows:

1. Governments need to invest in multi-disciplinary academic research in the field of AI-driven drug discovery. Governments should especially fund research into applications of AI in public health concerns where there is currently insufficient commercial interest and investment. To benefit the R&D pipeline and society more broadly, government-funded academic research should be in an open-science, open-source and open-data legal framework. Additionally, some grants should be specifically targeted towards funding the construction of high quality open datasets, as well as cross-discipline collaborations that enable the development and testing of AI algorithms for tasks that are of particular interest to public health, such as that of novel antimicrobials.

2. In order to best facilitate (1), governments should incentivize AI-capacity building inside of the drug discovery and development ecosystem. This should include developing AI literacy across all aspects of the ecosystem, an emphasis on access to quality training programs, and the development of tools and resources to facilitate increased AI uptake.

3. Governments should set up novel innovation procurement programs for stimulating and incentivizing the efforts of biotech, pharma, healthcare or public research organizations, downstream from the academic research (1), to go from academic prototypes (software, biotech methodologies, candidate drugs) to industrial-strength development pipelines and optimized drugs.
   - That include a goal to substantially increase knowledge-sharing and data-sharing across organizations and disciplines compared to the current practice in industry (ideally as open as with the academic work in (1)) in order to reduce costs, accelerate the pace of innovation, and enable more successful application of AI.
   - Another goal of these programs (for example through particular forms of licensing) should be to avoid abusive drug prices resulting from patent-supported monopolies, as well as favour low-cost access of the resulting drugs and fabrication methodology in LMIC.

   Different contractual and licensing options for (a) and (b) are discussed below and should be expanded as per (6). An important characteristic of the proposed procurement approaches is that they combine partial funding of the R&D costs (like grants) along with outcome-driven rewards.

4. Governments should set up financial incentives (not necessarily regular patents, see below) to make sure that clinical trials are performed following successful outputs from these grants when the drugs being developed are sufficiently promising to address significant public health issues and when usual commercial incentives are not sufficient to motivate the pharmaceutical industry to fund the clinical trials themselves.

5. Governments should internationally coordinate (1,2,3,4) above to favour
   a. Research collaborations, knowledge sharing and transfer of know-how across countries and in particular from richer countries to LMICs;
   b. More uniform innovation policies (across countries) in their procurement and incentive mechanisms in (3) and (4) to make it easier for companies that are involved to comply with similar legal and operational frameworks across countries;
   c. Access to the resulting technologies and drugs at low prices in LMICs;
   d. Joint funding on efforts with international scope (see (6)).

6. Follow-up this roadmap with a deeper evaluation of and research on different procurement and incentive policies appropriate to reach the goals in (3) and (4), in particular regarding the objective of maximizing data sharing in a context where current regulatory instruments are not sufficient (patents do not apply, copyrights are insufficient, and trade secrets prevent sharing and lead to

inefficiencies). This analysis should be specifically motivated by the consideration of how to best make available data related to the results of pre-clinical assays and of clinical trials. The latter warrant additional attention as they will be far more likely to be obtained through industry partnerships rather than academic grants. Additionally, they will have considerable privacy concerns that may require the use of a Data Access Committee, or similar mechanism, to administer release. This body will ensure that there will be sufficient infrastructure to manage the regulatory considerations that come with incentivizing industrial organizations to share their data.

7. Either create a permanent international non-profit organization or leverage an existing one which will be responsible over the longer term to coordinate as recommended in (5) across countries, as well as manage internationally funded projects (from discovery to fabrication to deployment), and make sure to fund this organization to allow it to reach the desired goals. A discussion of the necessary criteria this organization should fulfill is included below.

The Project Committee looks forward to discussing these in further detail at GPAI's 2021 Summit.

2 – AI powered immediate response to pandemics

For the 2021 Summit, the subgroup has worked in collaboration with The Future Society to develop an updated and upgraded catalogue of AI initiatives with potential to fight COVID-19 and other future pandemics, and transform it into a Living Repository. The research builds upon last year's report, *Responsible AI in Pandemic Response*.

A detailed approach to impact assessment has been developed yielding a subset of initiatives that show promise in terms of their potential and ability to scale, in order to identify those that could benefit most from partnership to deliver on their promise.

The research begun in collaboration between The Future Society, the OECD and GPAI by applying the OECD Framework for the Classification of AI Systems to document AI initiatives. Shared as a public survey, the survey invited developers or those associated with the development of AI systems created or repurposed to aid in COVID-19 responses to complete the survey. This brought the total number of initiatives to 66.

The Immediate Response Committee then built upon the OECD Framework to provide a more technically focused set of criteria for classification and evaluation - this included the below (the full table of criteria is under Annex 2):

- Background of the initiative (name, sources, objective/purpose)
- Origin (including organization(s), locality)
- Categorisation (type of approach / AI method)
- Scope (domain, target users/operators and beneficiaries, geographic coverage)
- Data (description of the dataset in use including demographics, target population, size, collection timeframe, any public access links)

The 66 AI systems have been classified using this framework, to create the Living Repository. For Summit 2021, this is being shared in an open 'work in progress' format, in reflection of the immediate needs of the pandemic for those that may find it immediately useful as a resource.

Using these classifications, the Immediate Response Committee has conducted assessments of their intrinsic potential to mitigate this and future pandemics, and their scalability, to narrow the 66 identified initiatives into a shortlist of 26 of which 11 have initially been prioritised as candidates for potential partnerships with the AIPR Subgroup and GPAI more widely, as well as with other similar initiatives listed in the Living Repository.

Alongside the Living Repository, we will be sharing a summary of the initial prioritised 11 once finalised. They include AI systems that have been trained to:

- Predict the distances and angles between pairs of proteins' amino acid residues
- Determine the effectiveness of non-pharmaceutical interventions (NPIs) on COVID-19
- Identify individuals who are at the greatest risk of heightened vulnerability to COVID-19, based on individuals' pre-existing medical conditions
- Provide users with personalized daily COVID-19 "risk scores" associated with regular activities
- Organise both structured and unstructured COVID-19 data into a knowledge graph that can be navigated and queried to retrieve information
- Provide a country-level risk modeling framework intended to assist the government and individuals in making informed decisions
- Quickly and accurately detect the presence of COVID-19 in thoracic CT scans
- Model the spread of COVID-19 based on the prevalence of mask-wearing in a population
- Identify, track, and analyze events associated with COVID-19 via mentions on online news articles and social media posts
- Aggregate and clean various sources of US pandemic-related raw data to produce COVID-19 "indicators" for "nowcasting" (situational awareness) and short-term forecasting.
- Allows users to view current occupancy rates of hospitals across the US and recommendations for intra-state patient transfers based on current occupancy rates

We now look forward to the analysis being discussed at Summit 2021 and will publish the revised Living Repository with an additional 15 descriptive summaries with a further update to be shared early in the New Year.

Our intention is that the analysis will then be used to help inform the Immediate Response Committee's partnerships approach in 2022, but should also provide a useful tool and model for the critical evaluation of AI initiatives within the ongoing and future pandemics.

Forward Look

The Subgroup has agreed to continue its two projects into next year, with a focus on collaboration and partnership.

In the case of the project on AI for public domain and drug discovery, the Subgroup proposes to support international collaboration on the basis of the Roadmap's recommendations in active coordination with multilateral fora, governments (including national public R&D agencies), international health organisations, university and public/private research organisations, non-profits and biotechs / global drug discovery R&D companies.

In 2022, the Project Committee will develop and deliver:

- A structured, sustained and multistakeholder public engagement programme and strategic dialogue;
- An updated paper that identifies consensus positions amongst key decision makers, having developed its recommendations in response to the process above; and
- Alignment of this programme with an existing multilateral process and institutional effort to more broadly accelerate drug discovery

In the case of the project on AI-powered immediate response to the pandemic, the Project Committee intends to identify 1-3 initiatives from the Living Repository that can most benefit from partnership, through invitations to interviews to understand their needs. The Project Committee wants to understand the opportunities to scale these promising initiatives to more people and localities, and needs in relation to that aim. The Project Committee is testing for needs including resources, expertise, legal compliance (e.g Data Protection, Privacy and Intellectual Property), data, accessibility for vulnerable and minority groups, technical and infrastructure requirements, and user acceptance of the tool.

In H1 2022, the Working Group proposes:

- Reporting on the status of 1-3 AI initiatives to both GPAI Member States as well as other states in need in partnership with, for example, leading scientists, public health experts and policy makers from those states.
- Maintenance of a living document for fighting against COVID-19 and future epidemics/pandemics
- Report and recommendations for GPAI members on feasibility for a scaled mechanism for expert-led validation of promising AI interventions

The Subgroup would like to continue building upon its cross-Working Group collaboration as a Subgroup that provides an urgent, practical context for demonstrator and pilot initiatives, and looks forward to engaging with other Working Groups on these possibilities in the New Year.

Annex 1

Committee on AI for public-domain Drug Discovery

Co-Chairs

Yoshua Bengio, Founder and Scientific Director, Mila – Quebec Artificial Intelligence Institute & Professor of Computer Science, University of Montreal

Alice Oh, Associate Professor of Computer Science, Korea Advanced Institute of Science and Technology (KAIST)

Contributing Authors

Allison Cohen, Applied AI Projects Lead, AI for Humanity - Mila

Elliot Layne, PhD Candidate - McGill University, School of Computer Science

AIPR Subgroup Committee members

Anurag Agrawal, Director, Council of Scientific and Industrial Research

Daniele Pucci, Head, DIC-lab, IIT. Visiting Lecturer, University of Manchester

Enrico Coiera, Director of the Centre for Health Informatics, Australian Institute of Health Innovation

Gaël Varoquaux, Research Director, INRIA

Hiroaki Kitano, Director, The Systems Biology Institute. President & CEO, Sony Computer Science Laboratories

Leong Tze Yun, Professor of Computer Science, National University of Singapore

Margarita Sordo, Instructor of General Internal Medicine and Primary Care, Department of medicine, Bringham and Women's Hospital, Harvard Medical School

Alan Paic (Observer), Senior Policy Analyst, OECD

Kim McGrail (Observer), Professor, School of Population and Public Health, UBC. Director of Research, UBC Health

Invited Specialists

Alan Aspuru-Guzik, Professor of Chemistry and Computer Science, University of Toronto

Regina Barzilay, Distinguished Professor for AI and Health, MIT

Joanna Bryson, Professor of Ethics and Technology, Hertie School

Carlo Casonato, Professor of Comparative Constitutional Law, University of Trento

Raja Catila, Professor of Robotics and Ethics, Pierre and Marie Curie University

Payel Das, Research Staff Member and Manager, AI Science, IBM

Marc-Antoine de La Vega, Postdoctoral Fellow, Microbiology and Immunology, Galveston National Laboratory

Aled Edwards, Founder and Chief Executive of the Structural Genomics Consortium

Marc-André Gagnon, Professor of Political Economy, Carleton University

Yeong Zee Kin, Deputy Commissioner, Personal Data Protection Commission

Gary Kobinger, Director, Galveston National Laboratory

Pierre Larouche, Professor of Innovation and Law, University of Montreal

Dewey Murdick, Director, Center for Security and Emerging Technology, Georgetown

Richard Naiberg, Litigator, Intellectual Property Law, Goodmans

Ziad Obermeyer, Distinguished Associate Professor of Health Policy and Management, Berkeley

Alejandro Pisanty, Director General for Academic Computing Services, National University of Mexico

Mirjana Stankovich, Senior Digital Policy Specialist, Center for Digital Acceleration, DAI

Committee on AI-powered Immediate Response to Pandemics

Committee Co-Chairs

Paul Suetens, KU Leuven
Michael Justin O'Sullivan – University of Auckland (New Zealand)

AIPR Subgroup Committee members

Alice Oh (Co-Chair) – Korea Advanced Institute of Science and Technology (South Korea)
Howie Choset – Carnegie Mellon University (United States)
Enrico Coiera – Macquarie University (Australia)
Seán Ó hÉigeartaigh – Centre for the Study of Existential Risk (UK / European Union nominee)
Margarita Sordo-Sanchez – Brigham and Women's Hospital at Harvard Medical School (Mexico)
Cyrus Hodes (Observer) – AI Initiative
Alan Paic (Observer) – OECD
Kim McGrail (Observer) – University of British Columbia