COVID-19 RESEARCH

# RECOMMENDATIONS & CONSIDERATIONS FOR GLOPID-R

2021–2023

GLOPID-R

Global Research Collaboration for Infectious Disease Preparedness

GloPID-R Scientific Advisory Group – June 18, 2021

*On behalf of GloPID-R, I am pleased to share the On behalf of GloPID-R, I am pleased to share the GloPID-R Scientific Advisory Group's findings about COVID-19 research priorities for the next 12 to 18 months.*

*In February 2021, as the COVID-19 pandemic entered its second year and with multiple highly effective vaccines on the horizon, the GloPID-R Co-Chairs assessed a need to review the landscape and priorities for GloPID-R funders over the short to medium term. With that goal in mind, a SAG was formed and mandated to provide advice to GloPID-R.*

*This report presents the work that the **SAG members*** completed in early May 2021, under the guidance of experts from the Oxford Saïd Business School using a highly innovative method based on scenario planning. Together they developed and explored three plausible scenarios of what may unfold in the context of a COVID-19 pandemic and its aftermath. Although challenging at times, this approach was extremely thought-provoking and produced very interesting and useful results.*

*A great deal of work by many dedicated individuals has gone into this project. Particular thanks go to the Oxford Saïd Business School scenario-planning team (Rafael Ramirez, Ciaran McGinley, and Shirin Elahi), who generously donated their expertise and their time, including on weekends, to lead three intense workshops.*

*The GloPID-R Scientific Secretariat, under the leadership of Dr. Gail Carson, worked tirelessly to facilitate the work of the SAG and to produce this report.*

***Thank you Giuseppe Paparella, Alice Norton, Romans Matulevics, Nina Jamieson, Melina Michelen, and Gail Carson.***

*None of this would have been possible without the support of the European Union's Horizon 2020 Research and Innovation Programme, which provides the funding for the GloPID-R Secretariat[1].*

*It is my hope that these findings, which are aligned with the WHO Blueprint Revised Research Agenda, will provide rich food for thought and a sound basis for coordinated action among all stakeholders in infectious disease research funding. The GloPID-R Co-Chairs have spent significant time considering and deliberating to come up with a set of recommendations for their members, based on this report.*

*In its conclusions, the report underlines a clear need for greater coordination and efficiency to address the current pandemic as well as future pandemics. In that spirit, we are releasing the entire report so others can use it as a valuable tool to inform decisions and address the challenges ahead as the world continues to face the effects of the COVID-19 pandemic.*

*The authors dedicate this work to the memory of Ciaran McGinley.*

***With best regards,***

***Charu Kaushic***

*Chair of GloPID-R*
*Scientific Director of the Institute of Infection and Immunity at the Canadian Institutes of Health Research (CIHR)*

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[1] The GloPID-R Secretariat is a project which receives funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 874667.

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# EXECUTIVE SUMMARY

The COVID-19 pandemic has posed the challenge of a century and has catapulted the critical importance of emerging diseases research onto the front page. Building from earlier research investments, and with over $3.8 billion in new research funding invested in response to the events of the pandemic, the importance of preparedness research needs no further justification[1]. There have been some key successes in the pandemic-related research: the rapid coordination of research needs through the WHO R&D Blueprint mechanism and the ensuing funding calls offered through the research funders coalition Global Research Collaboration for Infectious Disease Preparedness (GloPID-R), the Coalition for Epidemic Preparedness Innovations (CEPI), and others have greatly enhanced our knowledge of the new pathogen and its impact. Essential knowledge gaps were filled through a range of basic, translational, and clinical research studies, and the findings of these studies have found their way into the evidence-based guidance that WHO and other public health and clinical partners developed. New mechanisms of pathogenesis were identified that helped inform the choice of potential therapeutic approaches, which were then trialled in clinical trial networks, allowing the rapid evaluation of their utility. Against all expectations, within a year of the release of the first genomic information by Chinese scientists, the first clinical trials of vaccines were completed, showing the first promise of a way out. Nonetheless, the pandemic is far from over, and is stretching the capacity of the world to deal with this health crisis. Challenges such as the emergence of new variants, vaccine acceptance, and the glaring global inequity in access have arisen as major concerns.

As the world faces the uncertainty of the second year of the COVID-19 pandemic, the leadership of the GloPID-R asked their Scientific Advisory Group[2] (SAG) to recommend an approach to research funding for COVID-19 over the coming 12–18 months. For this purpose, the SAG members reviewed existing research agendas and documents, and applied their expertise to undertake a scenario-planning approach to produce possible future scenarios for the COVID-19 and related research landscape. These scenarios were used to navigate and help frame the uncertainty around COVID-19 and infectious diseases, and to provide research recommendations.

[1] Norton, A., Bucher, A., Antonio, E., Advani, N., Grund, H., Mburu, S., Clegg, E., Gollish, M., Jabin, N., Scott, L., Boily-Larouche, G., Lay, A. M., Carson, G., & Tufet Bayona, M. (2021). A living mapping review for COVID-19 funded research projects: Six-month update. *Wellcome Open Research*, 5, 209. https://doi.org/10.12688/wellcomeopenres.16259.3

[2] The authors of the report request that the contribution of the GloPID-R Scientific Advisory Group is acknowledged where the report is used to inform publicly disclosed policies or decisions.

## Looking to 2030: Three Plausible Scenarios for COVID-19 Research

The SAG used a scenario-planning approach to formulate its recommendations. First, it examined the contextual environment in which GloPID-R exists. The contextual environment is the set of diverse factors, such as geopolitical, demographic, technological, and other changes, that are beyond the influence of GloPID-R. The nature of international cooperation and the impact of climate change were selected by the SAG members as key factors impacting the development and spread of infectious diseases in the years and decades ahead. Finally, they examined which actors GloPID-R would interact with in its transactional environment. Based on these dimensions, the SAG members developed three plausible scenarios, which they used to frame their deliberations. These scenarios were not designed to predict the future; rather, they served as tools to challenge assumptions and prompt strategic conversations, and can be used as such by the GLOPID-R members as well. The scenarios were named **Back to 'Normal'**, Infectious Nationalism, and GAFA Google/Amazon/Facebook/Apple) rule, and differ in the level of attention paid to infectious disease threats, priorities for research investments (national versus international), and the size of investments. In the Back to 'Normal' scenario, research attention has shifted from pandemic control to non-infectious disease priorities; the funding available for research is substantially less than what was available in 2020; international research collaboration is back to what it used to be pre-pandemic; and the impact of climate change is acknowledged, but not considered a priority. In the **Infectious Nationalism** scenario, there is continued impact of the pandemic and other infectious diseases, but international research collaboration is low; there is a nationalistic approach to infectious disease research, and the research budget less than what was available in 2020, but more than the pre-pandemic period. In **GAFA Rule**, international research collaboration is less than the pre-pandemic level, but climate change and its impact on other infectious diseases are acknowledged. Major digital tech companies with significant funds and an international reach might play a key role in infectious disease research in this scenario.

## Strategic Observations for GloPID-R in 2022-23

### Key observations: a strong need for research coordination and better efficiency

- Two of the three scenarios (Back to 'Normal' and Infectious Nationalism) are likely associated with greatly reduced levels of research funding from that made available for the pandemic research response in 2020, which points to a need for GloPID-R to help streamline and improve the efficiency of the research response.
- When the outcomes of the three scenarios were examined, the result was increased fragmentation of research, which points to a need for GloPID-R to play a coordinating role. The scenarios are challenging for global research cooperation, with the emergence of geopolitical blocs and nationalism resulting in fragmentation but for differing reasons depending on the scenario.

- New large-scale mechanisms have developed to coordinate aspects of the pandemic response; some of them involve research, but they do not in and of themselves coordinate research although they will develop their own research agendas. Going forward, GloPID-R needs a clear strategy to interact with and improve coordination across these initiatives (Access to COVID-19 Tools Accelerator therapeutics, diagnostics, and global surveillance, CEPI, and other initiatives) that are emerging after this unprecedented crisis.
- While preparedness research can be funded on a schedule, COVID-19 has shown us the perils and missed opportunities of not having funds that are readily releasable when a crisis occurs. Although GLOPID-R funding has been substantial, the fact that each country must independently execute a research funding process (e.g., calls for proposals, reviews, negotiations, and management of research outputs) on different timelines results in a funding landscape that is extremely fragmented. This in turn leads to fragmentation of research outcomes and missed opportunities to promote data comparability and data sharing. The end result is that the return on investment for this funding is not as high as it could be.

## Considerations for GloPID-R

What do these observations mean for GloPID-R's role as a meta-organisation?

To have an impact as joint funders, GLOPID-R needs to have strong leadership and governance to ensure it can fulfil a difficult but important role in the future. To enable this, GloPID-R needs to define a clear strategy for what role it wishes to play (e.g., improving coordination and filling research and capacity gaps). The SAG urges GloPID-R to consider the following ways to better align funding.

**1. Coordination of funding and funding initiatives** continues to be a key priority given:

- **How to fund** was identified as the biggest challenge as opposed to what to fund. There are numerous points to take into consideration, such as the inequity in national research funding pots, as many of the GloPID-R members are linked to national governments. One possibility would be to further explore common funding mechanisms as highlighted below.
- GloPID-R could use its global partnership to **drive greater efficiency of research funding** in other ways (through reducing superfluous duplication and raising standards of research planning, coordination, and data sharing). Mapping of research as early as pre-award as well as monitoring outputs was seen as key to this[3].
- The SAG urges GloPID-R to consider renewed scoping for **common funding mechanisms** between GloPID-R and other stakeholders (including WHO and other big funders) to enable a rapid response to an outbreak or to target specific underfunded areas

[3] One recommendation was that this could be further facilitated through funding the UKCDR & GloPID-R COVID-19 Project Tracker to capture outputs and impacts.

in real-time. These mechanisms could, for example, include adopting common themes, a shared timetable, and a shared review process. Or, as has been proposed in the past, countries could contribute to a 'common pot' to be allocated by GloPID-R.

2. A key focus for GloPID-R needs to be **research preparedness and response** in particular relating to the following:

- As there may be a smaller budget going forward, a more focused budget might be an appropriate approach. A key recommendation is to fund priorities research that has potential applications beyond COVID-19.
- A potential strategy is filling the gaps and ensuring that areas beyond diagnostics, therapeutics, and vaccines are prioritised. This may link to coordinating funding on research recommendations that have no commercial market but could have an immediate impact on the current crisis and/or be important for preparedness for future outbreaks. These areas include operational and implementation research, which have the potential for an immediate improvement of the COVID-19 response. The SAG has listed some specific topics for consideration below.
- The GloPID-R regional hubs strategy could facilitate preparedness, including relevant research infrastructure, which bridges into research capacity building. Thus, the ongoing renewal of GloPID-R members from low- and middle-income countries (LMICs) and the consideration of a global network of hubs and spokes are pertinent here. Animal health and environment/One Health was one thematic area recommended for increased GloPID-R funding across all three scenarios. The regional hubs with a One Health working group, in conjunction with relevant stakeholders, could drive this for research preparedness.
- IP and data will be critical factors going forward. Therefore, the SAG urges GloPID-R to engage in the discussions on this in the other initiatives (CEPI, WHO, ACT) and to rethink IP and data rights conditionalities and data-sharing infrastructures in its approach to funding. GloPID-R might go as far as ensuring as a minimum there is transparency from GloPID-R members regarding their stance/policy on such matters.

3. In order to increase equity in preparedness and outbreak response research, GloPID-R has a role to support improved preparedness through **research capacity strengthening**.

- GloPID-R could consider supporting research capacity strengthening through regional preparedness platforms. This could be done in consultation with stakeholders, including (but not limited to) national authorities, to ensure a comprehensive approach.
- GloPID-R could specifically target capacity strengthening for a One Health approach.
- Given the global disparity in funding for COVID-19 (as shown by a review of GLOPID-R response funding), an important consideration should be how GLOPID-R members can

help address this inequity. GloPID-R might want to consider expanding its membership into those regions with an emerging, youthful STEM population, e.g., India, China, and Africa, but particularly by working in partnership with funders who can work in global partnership via GloPID-R.

- The SAG listed a number of policy and economy-related aspects for GLOPID-R to consider.

## Scenario-Independent Areas for Research Recommendations in 2022-23

While the SAG found the scenario approach useful for considering future directions for GloPID-R overall, it also felt it important to identify topical areas for research investment over the next 12–18 months. These are cross-cutting research areas with potential middle- and long-term impacts, but also include more specific research topics, as listed below.

**Topics not currently covered by the 2020 WHO R&D Blueprint: Emerging themes**

- Operational research to improve the effectiveness and adaptability of response activities.
- Implementation research to determine the best application of medical countermeasures, particularly with vulnerable or hard-to-reach populations.
- Research focusing on policy and economy related to the pandemic response and recovery, including preparedness for future pandemics.
- Research addressing the environmental impact of COVID-19.
- Research into the mental health impacts of the pandemic and lessons for future preparedness planning.
- Research focusing on long COVID.

Where pre-existing agendas exist, efforts should be made to align with them and support them, e.g., the UN Research Recovery Roadmap and the African CDC, African Union, African Academy of Sciences, and WHO agenda for Africa.

**Topics aligning with the WHO R&D Blueprint Roadmap 2020 that may need specific attention due to their importance <u>across all</u> scenarios (depending on the outcome of the May 13th and 14th, 2021 meetings)**

- Research in support of assessment of variants in relation to clinical and public health decision-making:
    a. Develop tools and conduct studies to monitor phenotypic change (transmissibility, virulence, antigenicity, tropism, and treatability) and potential adaptation of virus variants to align with the genomic surveillance signals.
    b. Develop standardised approaches to the assessment of correlates of protection (naturally acquired, population- and vaccine-induced, including mucosal immunity).

- Research on the animal–environment interface was a consistent recommendation across the scenarios. The SAG noted that this topic has been on the WHO R&D Blueprint agenda since early 2020, but mapping of the funding landscape against the WHO R&D priorities showed that this topic was underfunded. To increase research on this topic, it was suggested that One Health-focused studies addressing the following areas be funded:
    a. Animal origin(s) and route(s) of transmission
    b. Socioeconomic and behavioural risk factors for spill over
    c. Risk-reduction strategies and the human–animal–environment interface (including SARS-CoV-2 as an anthroponosis)
- Research aimed at improving access to vaccines and truly novel concepts prior to being picked up as part of the CEPI R&D pipeline. Additionally, research on areas not covered by market forces.
- Social science research
    a. Approaches to promote acceptance, uptake, and adherence to public health measures for COVID-19 prevention and control.
    b. What are the relevant, feasible, and effective approaches for rapid engagement and good participatory practice that includes communities in the public health response?
    c. Clinical care and health systems: What are the relevant, feasible, and effective approaches for supporting the physical health and psychosocial needs of those providing care for COVID-19 patients?

**Table A: COVID-19 funding against WHO Roadmap (all funders and GloPID-R members)**

Source: UKCDR GloPID-R Project Tracker, May 2021

## Heatmap: Funded COVID-19 Research Projects vs. WHO Research Priorities

UKCDR

GLOPID-R

World Health Organisation: A Coordinated Global Research Roadmap: 2019 Novel Coronavirus, March 2020

Each project has been designated with one or more primary priority areas and, where appropriate, secondary priority areas. The *Focus* dropdown menu below can be used to filter on these.

**Notes on data**

CREDIT: UKCDR and GloPID-R COVID-19 Research Project Tracker, 2020

Funder(s): (All) | Focus: (All) | Search Title/Abstract:

### All funding captured: 10,610 projects

Funder(s): All | Focus: All | Search Title/Abstract:

Click on a research area or coloured tile to view the list of projects

| WHO priority research area | WHO priority sub-area a | b | c | d | e | f | N/A | Total Funding Amount ($) |
|---|---|---|---|---|---|---|---|---|
| 1. Virus: natural history, transmission an.. | 898 | 671 | 192 | 684 | 127 | 87 | 52 | 883.7M |
| 2. Animal and environmental research | 78 | 6 | 9 | | | | 3 | 18.3M |
| 3. Epidemiological studies | 659 | 272 | 72 | 275 | | | 153 | 402.9M |
| 4. Clinical characterization and managem.. | 511 | 904 | 11 | 782 | 27 | 7 | 194 | 1,240.9M |
| 5. Infection prevention and control | 196 | 327 | 475 | 323 | | | 199 | 296.6M |
| 6. Candidate therapeutics R&D | 852 | 97 | 18 | 253 | 49 | | 87 | 658.7M |
| 7. Candidate vaccines R&D | 240 | 43 | 37 | 2 | 17 | | 88 | 1,636.0M |
| 8. Ethics considerations for research | 40 | 16 | 30 | 50 | 16 | | 29 | 40.4M |
| 9. Social sciences in the outbreak response | 1,001 | 204 | 526 | 176 | 22 | 38 | 1,856 | 792.7M |
| Unallocated | | | | | | | 779 | 0.0M |

### GloPID-R members funding only: 4,819 projects

Funder(s): Multiple values | Focus: All | Search Title/Abstract:

Click on a research area or coloured tile to view the list of projects

| WHO priority research area | WHO priority sub-area a | b | c | d | e | f | N/A | Total Funding Amount ($) |
|---|---|---|---|---|---|---|---|---|
| 1. Virus: natural history, transmission an.. | 347 | 355 | 84 | 406 | 73 | 30 | 35 | 720.1M |
| 2. Animal and environmental research | 41 | 4 | 6 | | | | 1 | 12.1M |
| 3. Epidemiological studies | 280 | 157 | 49 | 97 | | | 62 | 327.8M |
| 4. Clinical characterization and managem.. | 294 | 536 | 5 | 302 | 10 | 3 | 117 | 1,126.4M |
| 5. Infection prevention and control | 55 | 85 | 158 | 117 | | | 143 | 203.2M |
| 6. Candidate therapeutics R&D | 457 | 57 | 6 | 142 | 28 | | 43 | 542.2M |
| 7. Candidate vaccines R&D | 149 | 28 | 25 | 1 | 9 | | 50 | 1,602.0M |
| 8. Ethics considerations for research | 24 | 2 | 13 | 13 | 8 | | 11 | 30.3M |
| 9. Social sciences in the outbreak response | 538 | 77 | 177 | 98 | 10 | 20 | 777 | 572.2M |
| Unallocated | | | | | | | 465 | 0.0M |

## Moonshots: Big Projects for GloPID-R to Consider

In addition to the scenario-planning exercises and consensus discussions, the SAG members were asked to suggest 'moonshot' projects, which were defined as big, ambitious projects that they felt would need consideration.

**Cross-cutting all scenarios**

- Create an ambitious worldwide surveillance system to map the spread of known diseases and anticipate the emergence of related agents (biological surveillance) and new emerging agents (syndromic surveillance).
- Do for antivirals in the 21st century what has been done for antibiotics in the 20th century (taxonomic approach, not only based on the last disease) in order to be able to face any new emerging viral pathogen.

**Back to 'Normal' and GAFA Rule**

- Global network of centres of excellence for pandemic preparedness research. One or two multidisciplinary One Health teams, with good geographic coverage, working on a joint collaborative preparedness research agenda, including risk-targeted surveillance, discovery, and embedded outbreak research. Partnership with clinical networks and public health networks.
- Preparing for regional or global crises resulting from infectious disease outbreaks in the changing world, with an emphasis on hot spots for disease emergence and spread. Develop novel approaches for forecasting, early detection, risk mitigation, and citizen education for preparedness and response plans.
- One Health approaches to preventing the next pandemic by reducing risk factors for zoonosis and antimicrobial resistance.

**Infectious Nationalism and GAFA Rule**

- Implementation of existing COVID tools and interventions feeding existing surveillance data and social/political/economic context to effective localized response with effectiveness measured in terms of reduced SARS-CoV-2 transmission and improved livelihoods. Transfer and adaptation of best practices to LMICs.

**GAFA Rule only**

- Rapid mechanism to develop broad-spectrum antivirals, to protect the economy (develop library of antivirals for high-threat pathogens and possibly stockpile these drugs).

- Global surveillance network (including surveillance for variants) with embedded capacity strengthening.
- Social/non-pharma interventions for pandemic preparedness and response.
- Creation of global public goods for global equity.
- Innovative business models for doing well by doing good.

**Not assigned to any scenario**

- Infrastructure for data and sample sharing (including capacity strengthening for data analytics and sharing).
- New conceptions of IP, technology transfer, and data sovereignty that better produce social goods than the current patent/trademark/copyright/trade-secrets system.
- How to achieve global cooperation on health in a hyperpolarized world?
- Strengthening regional research to policy uptake.

## Scenario-Dependent Areas for Research Recommendations in 2022-23

**Table B** presents recommendations for specific research themes that align with the WHO R&D Blueprint Roadmap 2020 and were formulated by the SAG during the validation scenario workshop held on 18th April 2021 (Exercise F) and a validation survey run between 7th and 13th May 2021.

In colour are the areas prioritised for funding in each scenario.

| WHO BLUEPRINT | | | | |
|---|---|---|---|---|
| CATEGORIES | SPECIFIC THEMES | BACK TO 'NORMAL' $0.7bn/annum | INFECTIOUS NATIONALISM $1.35bn/annum | GAFA RULE $2.7bn/annum |
| VACCINE R&D* | | | | |
| CLINICAL CHARACTERISATION & MANAGEMENT | Pathophysiology of infection | ■ | | ■ |
| | Processes of care | | ■ | ■ |
| | Core clinical outcomes | | ■ | |
| | Adjuvant therapies | | | ■ |
| VIRUS: DIAGNOSTICS, NATURAL HISTORY, TRANSMISSION...* | Phenotypic change and adaptation | ■ | ■ | ■ |
| | Characterise immunity | ■ | ■ | ■ |
| | Virus stability in the environment | | | ■ |
| SOCIAL SCIENCES* | Uptake of public health measures | ■ | ■ | ■ |
| | Clinical care and health systems | ■ | ■ | ■ |
| | Engagement and participation | ■ | ■ | ■ |
| | Media and communications | ■ | | |
| | International cooperation | | | ■ |
| THERAPEUTICS R&D* | Combination therapies | ■ | | |
| EPIDEMIOLOGICAL | Transmission dynamics | ■ | | ■ |
| | Control & mitigation measures | | | ■ |
| INFECTION PREVENTION & CONTROL | Compliance with IPC interventions | | ■ | ■ |
| ETHICS CONSIDERATIONS | Adapting existing ethical standards | | | ■ |
| | Ethical governance of research | | | ■ |
| ANIMAL & ENVIRONMENT | Animal source and transmission routes | ■ | ■ | ■ |
| | Spill-over risk factors | ■ | ■ | ■ |
| | Human-animal risk reduction | ■ | ■ | ■ |

| Notes |
|---|
| ***Vaccines R&D** |
| Funded by e.g. CEPI and other entities in all scenarios.<br>Vaccine standardisation and independent evaluation across scenarios.<br>Funding for vaccine equity and new strains (potentially covered by market forces). |
| ***Virus: diagnostics, natural history, transmission…** |
| Emphasis on the need for assays to assess phenotypic properties for global comparisons in support of global surveillance network development. |
| ***Social Sciences** |
| Explanation with reference to Back to Normal; there is a reduced budget in this scenario hence, the overall recommendation in a decrease in funding for GloPID-R. However, 4 subcategories have been identified for consideration of funding. |
| ***Therapeutics R&D** |
| Funded by ACT-A and other entities across all scenarios. |

**Table B: Research recommendations aligning with the WHO R&D Blueprint Roadmap 2020**

**Table C** presents recommendations on **emergent** research themes that align with other major research agendas, such as the UN Research Recovery Roadmap and other policy documents, and were formulated by the SAG during the validation scenario workshop held on 18th April 2021 (Exercise G) and a validation survey run between 10th and 13th May 2021.

In colour are the areas prioritised for funding in each scenario.

| EMERGENT PRIORITIES | | | | |
|---|---|---|---|---|
| CATEGORIES | SPECIFIC THEMES | BACK TO 'NORMAL' $0.7bn/annum | INFECTIOUS NATIONALISM $1.35bn/annum | GAFA RULE $2.7bn/annum |
| IMPLEMENTATION | Tools: vaccines, therapeutics, diagnostics, PPE | | | |
| | Research: Capacity to transform research results into implementable action | | | |
| | Implementation & localisation | | | |
| | Flexible micro-factory production tools | | | |
| POLICY & ECONOMY* | How research funders can best collaborate and optimise their investisments for impact (e.g.: science for global cooperation, and science of science funding) | | | |
| | Establishment of insurance mechanism (modelling, forecasting, foresight) | | | |
| | Establishment of joint rapid funding mechanismsv | | | |
| | Nature of public-private research collaboration and its ethical dimension | | | |
| | Collaboration and technology transfer across nations | | | |
| | Domestic security and capacity for vaccines, drugs, diagnostics | | | |
| | Capacity to build preparedness networks ready to pivot against Diseases X | | | |
| | Policy-making to attain individual level outcomes and impact | | | |
| ENVIRONMENTAL IMPACT | Climate change and impact on infectious diseases | | | |
| LONG COVID | | | | |
| MENTAL HEALTH | | | | |

**Table C: Research recommendations on emergent themes**

*NB1. The specific research themes identified by the SAG under the Policy & Economy category were not all research priorities; rather, in some instances, they were research system needs. These are included, as they are important for GloPID-R funders to consider for their activities beyond solely research funding.

*NB2: In Table B, the overall level of funding across the three scenarios is based on an estimation, made by the SAG, of the level of COVID research funding available for 2022-23 in comparison to what was available in 2020-21. The GAFA Rule scenario has 100% of the funding available in 2020; the Infectious Nationalism scenario has 50% of the funding in 2020; and the Back to 'Normal' scenario has 25% of the funding in 2020.

# SECTION A: INTRODUCTION AND APPROACH

## Purpose and Scope

As the world faces the uncertainty of the second year of the COVID-19 pandemic, the leadership of the Global Research Collaboration for Infectious Disease Preparedness (GloPID-R), a consortium of research funding organisations, chose to form a Scientific Advisory Group (SAG). This SAG was formed in February 2021 (its members are listed in Section C), and it had 3 months to undertake the present work.

The specific purpose of the SAG was to review existing research agendas and documents, and utilise the expertise of their members to apply a scenario-planning approach to produce possible and plausible future scenarios for COVID-19 and the related research landscape. These scenarios will be used to inform GloPID-R's approach to funding research on COVID-19 over the coming 12–18 months.

The scope of this report is to present a high-level synthesis of the SAG's scenario-planning work and to provide the resulting recommendations to the GloPID-R chair and co-chairs (in the first instance) on which research areas related to COVID-19 and infectious diseases in general could be the focus of funding in the coming 12–18 months. This report may also then be shared (in part) with GloPID-R members, depending on what the GloPID-R co-chairs deem relevant.

Given the short time period available for this work and the resulting inability to engage experts beyond the SAG members, this report could serve as the first step in a broader piece of scenario-planning work for GloPID-R, which would benefit from looking at priorities beyond both the next 12–18 months and beyond COVID-19. Some initial broader recommendations/considerations in this wider remit are given here. The report will also be considered in the light of the revised WHO COVID-19 research agenda, May 2021.

## Aim

The aim of the work by the SAG was to promptly provide GloPID-R with COVID-19 research funding recommendations and considerations for the next 12–18 months.

## Background and Approach

When COVID-19 first emerged, GloPID-R and the WHO R&D Blueprint rapidly convened a global forum on research and innovation for COVID-19 on the 11th and 12th of February, 2020. This two-day meeting resulted in the production of the 'Coordinated Global Research Roadmap: 2019 Novel Coronavirus', which identified nine categories of research priorities and was adopted by GloPID-R

to guide its members' funding[4]. The UK Collaborative on Development Research (UKCDR) and GloPID-R jointly established a COVID-19 Project Tracker soon afterwards to give visibility to the COVID-19 research funding response and its alignment to the nine research priorities[5]. Moreover, a living review has been established (and is updated 3 monthly) to identify gaps and areas for further collaboration. The latest analyses continue to show unmet needs in funding research around the 'Animal–Human Interface', 'Ethics Considerations for Research', and the emerging 'Long COVID' categories, and although many further areas have now received funding, this still has not resulted in all the research questions being answered. The analyses also show that most of the research is still being undertaken in high-income countries, and that the context-specific research needs in low- and middle-income countries (LMICs) remain to be met due to limited domestic funding. The WHO is currently reviewing this research roadmap and will be producing an updated version shortly, to which GloPID-R again intends to align.

Since the development of the original COVID-19 research roadmap, GloPID-R, WHO, and others have continued to undertake COVID-19 research review and prioritisation exercises to keep up with the emerging research needs in a fast-moving pandemic. Focus has been given to research needs in LMICs, through the joint collaborative work of the UKCDR, Global Health Network, and African Academy of Sciences (AAS) in May–June 2020 and through a more recent Synergies meeting held between GloPID-R, UKCDR, and the COVID-19 Clinical Research Coalition[6]. These collaborations have identified a range of research needs that largely align with the global agenda but also show the need for region-specific priority setting in the case of priorities such as low-cost interventions, technology-based interventions, health-care system research, capacity strengthening, and a One Health approach to the prevention and prediction of outbreaks and new variants. A regional research agenda has also been developed for Africa, through a collaboration between the AAS, African CDC, and WHO Afro, which highlights similar priorities and system

[4] World Health Organization. (2020, March 12). A Coordinated Global Research Roadmap. https://www.who.int/publications/m/item/a-coordinated-global-research-roadmap

[5] Norton, A., Bucher, A., Antonio, E., Advani, N., Grund, H., Mburu, S., Clegg, E., Gollish, M., Jabin, N., Scott, L., Boily-Larouche, G., Lay, A. M., Carson, G., & Tufet Bayona, M. (2020). A living mapping review for COVID-19 funded research projects: six-month update. *Wellcome Open Research*, 5, 209. https://doi.org/10.12688/wellcomeopenres.16259.3

[6] Norton, A., De La Horra Gozalo, A., Feune de Colombi, N., Alobo, M., Mutheu Asego, J., Al-Rawni, Z., Antonio, E., Parker, J., Mwangi, W., Adhiambo Wesonga, C., Marsh, K., Tufet, M., Piot, P., & Lang, T. (2020). The remaining unknowns: a mixed methods study of the current and global health research priorities for COVID-19. *BMJ Global Health*, 5(7), e003306. https://doi.org/10.1136/bmjgh-2020-003306. Norton, A. J., Wiysonge, C. S., Habarugira, J.-M. V., White, N. J., Tufet Bayona, M., Hagen, H.-E., Archer, J. E., Alobo, M. S., Carson, G. L., Garcia, P. J., Maciel, R. M. B., Ramakrishnan, U., Ryu, C.-M., Rees, H., Ntoumi, F., Tshangela, A. N., Faiz, M. A., Snewin, V. A., Mburu, S. W., … Kaushic, C. (2021). Priorities for COVID-19 research response and preparedness in low-resource settings. *The Lancet*, S0140673621009806. https://doi.org/10.1016/S0140-6736(21)00980-6

needs[7]. Fast-moving areas of research and emerging needs have also been identified through GloPID-R Synergies meetings (on therapeutics, vaccines, transmission, social sciences, and the emergent area of long COVID)[8].

Whilst the pandemic is still accelerating, and many research gaps remain, the immediate emergency research funding response has, in some cases, now shifted to longer-term measures. The UN has already supported these efforts through the UN Research Roadmap for the COVID-19 Recovery[9]. Given that the WHO is currently revising its original research roadmap, the GloPID-R leadership were keen for this review to be informed by all the aforementioned research prioritisation exercises, but to take a longer-term view, 'scenario planning' was chosen to facilitate this review and build in resilience and adaptability.

The Oxford scenario-planning approach was chosen to navigate and help frame the uncertainty around the COVID-19 pandemic, and to re-perceive research recommendations for the next 12–18 months. The use of this approach to develop multiple plausible scenarios helped to render implicit assumptions explicit, inform research recommendations, and hopefully build in more resilience than would be the case if the SAG worked only on one possible 'future'.

The Oxford scenario-planning approach has been previously deployed as a scholarly method of inquiry, and has been used widely for scenario development for complex organisations[10]. Through an iterative deductive process, the GloPID-R SAG members, aided by facilitators, defined three scenarios of what worlds GloPID-R member-funded research might inhabit up to 2030. This approach has provided the opportunity to iterate the scenarios as needed, for example, when

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[7] Policy Paper: Research and Development Priorities for COVID-19 in Africa. (2021, February 17). https://africacdc.org/download/policy-paper-research-and-development-priorities-for-covid-19-in-africa/

[8] Boily-Larouche, G., Carson, G., Golding, J., Depoortere, E., Rangel de Almeida, J., Vaux, R., Paparella, G., Vitali, D., Khursigara, D., Madelaine, C., Lay, A. M., Kerstiëns, B., Yazdanpanah, Y., Kaushic, C., Zaidi, A., Saville, M., Yeskey, D., Gray, G., Veloso, V., … Meeting Co-chairs. (2020). Ending COVID-19: Progress and gaps in research—Highlights of the July 2020 GloPID-R COVID-19 Research Synergies Meetings. *BMC Medicine*, 18(1), 342. https://doi.org/10.1186/s12916-020-01807-3. Long Covid Forum Group, & Carson, G. (2021). Research priorities for Long Covid: Refined through an international multi-stakeholder forum. *BMC Medicine*, 19(1), 84. https://doi.org/10.1186/s12916-021-01947-0. Norton, A., Olliaro, P., Sigfrid, L., Carson, G., Paparella, G., Hastie, C., Kaushic, C., Boily-Larouche, G., Suett, J. C., & O'Hara, M. (2021). Long COVID: Tackling a multifaceted condition requires a multidisciplinary approach. *The Lancet Infectious Diseases*, S1473309921000438. https://doi.org/10.1016/S1473-3099(21)00043-8

[9] UN Research Roadmap for the COVID-19 Recovery. (2020, November 17). https://www.un.org/en/coronavirus/communication-resources/un-research-roadmap-covid-19-recovery

[10] Ramirez, R., Mukherjee, M., Vezzoli, S., & Kramer, A. M. (2015). Scenarios as a scholarly methodology to produce "interesting research". *Futures*, 71, 70–87. https://doi.org/10.1016/j.futures.2015.06.006

additional questions and/or inputs have arisen about the future context that would be helpfully explored through scenarios[11].

Importantly, key policy documents and research agendas (described above) along with the most recent analyses from the COVID-19 Project Tracker were discussed and visited during three SAG meetings that were held in February and March 2021 and pre-dated the scenario planning.

[11] Ramírez, R., & Wilkinson, A. (2016). *Strategic reframing: The Oxford scenario planning approach*. Oxford University Press. https://doi.org/10.1093/acprof:oso/9780198745693.001.0001. Ramirez, R., McGinley, C., & Rissanen, J. (2020). Scenario planning in science-centric organizations. *Futures & Foresight Science*, 2(2). https://doi.org/10.1002/ffo2.30

# SECTION B: METHODS

The three scenarios developed by the SAG were located in a grid formed by two axes, which were selected by the SAG members. One axis considers whether international research collaboration will be high or low, and the other axis assesses how strong or weak the link between climate change and infectious diseases (not only SARS-CoV-2) might become[12]. In response to the ongoing emergency, this exercise was carried out over a period of only 6 weeks, and all work was done online via Zoom and Miro templates, including three 3-hour workshops. All materials used were digitally recorded to aid further examination of the findings in the future. Full details of the steps in the scenario-planning exercise are given in Annex 2 (Section E). Following the scenario exercise and after reviewing its outputs, the SAG held additional online meetings to discuss and agree on the recommendations.

**The Three Scenarios:**

Each scenario was given a name to try to capture the essence of the future it describes.

## I. Back to 'Normal'

COVID and other infectious diseases are back to being manageable, and pragmatic international cooperation has re-emerged. However, funding is anaemic ($0.7 billion per annum or yearly around 25% of what was made available in 2020) and full of conditionalities. COVID fatigue and a disputed link with climate change lead to a society that is reluctant to see what science is, or could be, showing.

## II. Infectious Nationalism

Rigorous border health checks and self-centred behaviour have helped developed nations bring COVID under control. Climate change sits in the infectious disease background as new variants emerge elsewhere, forcing constant adaptation. National infectious disease funding ($1.35 billion per annum or yearly around 50% of that in 2020) prioritises national economic interests with no inclination to listen to scientific pleas for a broader approach.

## III. GAFA Rule

Climate change has had a major impact on the development and spread of infectious diseases. Private-sector actors drive a post-pandemic market-based health agenda protected by a web of IP and data rights, leading to the de facto silencing of non-commercial science. A few states with good GAFA (which stands for Google/Amazon/Facebook/Apple) relations reap benefits from the considerable private research funding ($2.7 billion per annum, or the same level as in 2020) mobilised by these corporations. An anti-exclusivity backlash emerges from dissenting countries with youthful populations and development priorities (most of the LMICs).

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[12] Ramirez, R., & Wilkinson, A. (2014). Rethinking the 2×2 scenario method: Grid or frames? *Technological Forecasting and Social Change*, 86, 254–264. https://doi.org/10.1016/j.techfore.2013.10.020


FIGURE 1: SCENARIO SET IN THE MATRIX [13]

13

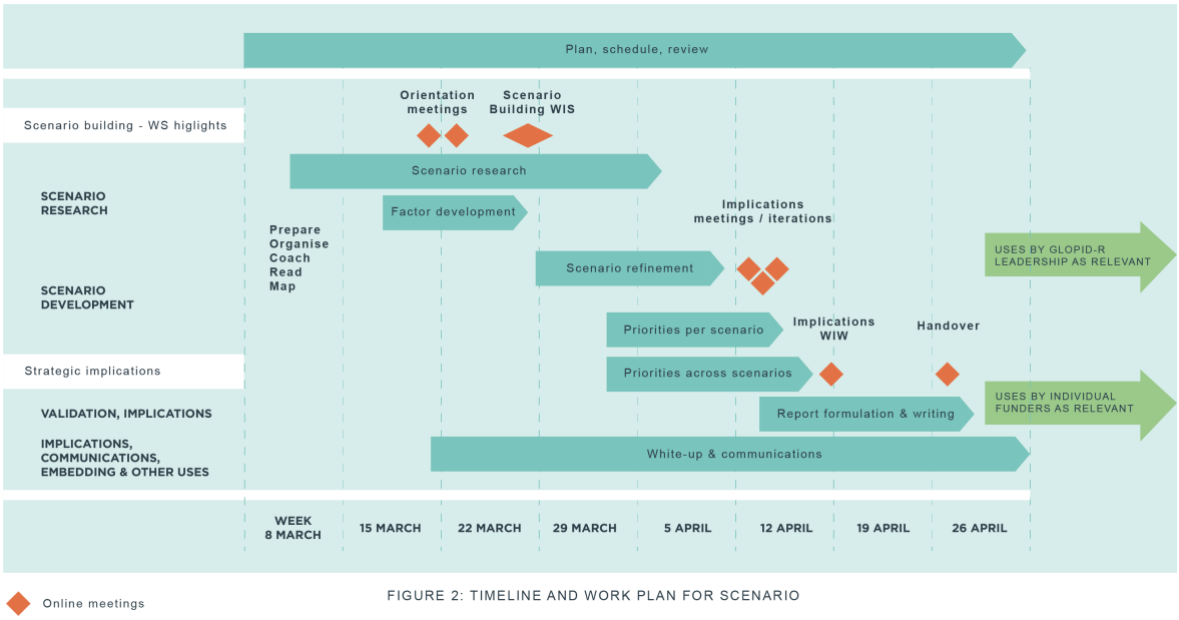


FIGURE 2: TIMELINE AND WORK PLAN FOR SCENARIO

[13] The scenario set in Figure 1 was developed to explore and define the research recommendations to be made by the GloPID-R SAG regarding funding for COVID-19 for the next 12–18 months (i.e., 2021–2023). The scenario set is focused on GloPID-R, the meta organisation, and one critical caveat is that members of GloPID-R may choose to further adapt the GloPID-R scenario set to inform their own recommendations, through a process of facilitation to be defined later with the dissemination plan. However, some of the research recommendations and considerations are scenario independent.

## Identifying the Factors that Shaped the Scenario Building: The Contextual Environment

The scenarios were developed by first looking at the broader contextual environmental factors beyond the influence of GloPID-R, and then, at which actors GloPID-R would interact with in its more immediate transactional environment. The contextual environment is the set of diverse factors, such as geopolitical, demographic, technological, and other changes, that are beyond the influence of GloPID-R. Each scenario is based on a unique combination of contextual factors. As described above, the SAG members identified as relevant contextual factors the nature of international cooperation and the impact of climate change on the development and spread of infectious diseases. Each step underpinning the development of the scenario set is available as a separate document (Miro snapshots).

## SAG Interviews and Scenario-Building Workshops

Factors relevant to scenario building were identified through semi-structured interviews with each SAG member. The interviews were collected and anonymised in a separate document entitled 'Chorus of Voices'. These insights were then complemented by comprehensive research and analysis, and after the two scenario-building workshops held by Professor Ramirez and his team with the SAG on March 27th and 28th, 2021, each scenario was further refined by three SAG 'scenario champions'.

Work to 'back-cast' from these 2030 worlds to the 2021–2023 period was the core focus of the third workshop, which was held on April 18th, 2021. During this workshop, the SAG members were invited to reflect on what GloPID-R should fund in each scenario, by utilising the nine WHO-defined categories of research priorities and their subcategories, to allow for a flexible funding response. As part of this workshop and process, a majority of the SAG members attended and took part in a series of exercises (Annex, Section E). In these exercises, SAG members were invited to debate and suggest criteria to determine what, how, and with whom to fund as well as to explain which research recommendations would be most impacted across the scenarios. Each scenario was allocated a distinct budget, which was estimated based on what was spent on COVID-19 research in 2020. In the Back to 'Normal' and Infectious Nationalism scenarios, the allocated research budgets are lower than the 2020 budget, whereas in GAFA Rule, it is the same as the 2020 budget.

Following the two scenario-building workshops conducted in March, the research funding recommendations proposed in the April 18th workshop were further validated via three surveys: one about the research funding recommendations against the WHO 2020 research criteria and relevant subcategories; the second on the emergent themes not captured in the February 2020 research agenda and discussed during the SAG meetings in March and April, 2021; and a final one

about ambitious and larger projects that the SAG deemed advisable in each scenario. A final consensus-building call was held where further refinements were made.

Surveys were used after the workshops as a form of validation and to facilitate discussion during SAG meetings prior to the issuing of the final report.

### Limitations

There is an acknowledgement amongst the SAG that they are a small group, and that these scenarios and the recommendations identified may differ if the SAG were larger and had more time to do this work.

The three scenarios presented in this report are not designed to predict the future, make a case for a preferred outcome, or offer an exhaustive list of possibilities. Rather, they are tools to challenge assumptions and prompt strategic conversations about the future. The aim of planning for the future is to navigate the uncertain environment that may evolve. Understanding how existing trends may develop and interact can help GloPID-R members plan for the future. The thinking before, during, and after the scenario planning included presentations on various pre-existing research agendas, outbreak research experience, and funded projects data from the UKCDR GloPID-R Project Tracker. A description of the detailed outcomes of the steps in the scenario exercises is given in Annex 2 (Section E).

## SECTION C: SAG MEMBERS, REFERENCES, AND LIST OF DOCUMENTS

### SAG Members

- Marion Koopmans (SAG Chair, GloPID-R Scientific Advisor)
- Lina Moses (GOARN Research, Tulane University)
- Moses Alobo (AAS)
- Nahoko Shindo (WHO)
- Nicole Lurie (CEPI)
- Steven Hoffman (CIHR)
- Xavier de Lamballerie (University of Marseilles; was unable to sign off on the document due to time constraints)
- Yazdan Yazdanpanah (INSERM/ANRS, GloPID-R Vice-Chair)

## Key References

### Journal articles and chapters


- Ahrne, G., & Brunsson, N. (2005). Organizations and meta-organizations. *Scandinavian Journal of Management*, 21(4), 429–449. https://doi.org/10.1016/j.scaman.2005.09.005.
- Bedford, J., Berglof, E., Buckee, C., Farrar, J., Grenfell, B., Holmes, E. C., Metcalf, C. J. E., Sridhar, D., & Thompson, B. (2020). COVID-19 Futures: A Framework for Exploring Medium and Long-Term Impacts. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.3678593
- Beyrer, C., Allotey, P., Amon, J. J., Baral, S. D., Bassett, M. T., Deacon, H., Dean, L. T., Fan, L., Giacaman, R., Gomes, C., Gruskin, S., Jabbour, S., Kazatchkine, M., Stackpool-Moore, L., Maleche, A., McKee, M., Mon, S. H. H., Paiva, V., Peryskina, A., … Corey, L. (2021). Human rights and fair access to COVID-19 vaccines: The International AIDS Society–Lancet Commission on Health and Human Rights. *The Lancet*, S014067362100708X. https://doi.org/10.1016/S0140-6736(21)00708-X
- Boily-Larouche, G., Carson, G., Golding, J., Depoortere, E., Rangel de Almeida, J., Vaux, R., Paparella, G., Vitali, D., Khursigara, D., Madelaine, C., Lay, A. M., Kerstiëns, B., Yazdanpanah, Y., Kaushic, C., Zaidi, A., Saville, M., Yeskey, D., Gray, G., Veloso, V., … Meeting Co-chairs. (2020). Ending COVID-19: Progress and gaps in research—Highlights of the July 2020 GloPID-R COVID-19 Research Synergies Meetings. *BMC Medicine*, 18(1), 342. https://doi.org/10.1186/s12916-020-01807-3.
- Hardin, G. (1968). The Tragedy of the Commons. *Science*, vol. 162, No. 3859, 1243-1248.
- Kawai, T. (2019). A Tentative Framework of Dynamic Platform Strategy─For the Era of GAFA and 5G─. *The International Academy of Strategic Management.* https://doi.org/10.24760/iasme.11.1_19.
- Lang, T. & Ramirez, R. (2021). Getting the Most From Publicly Available Scenarios: 5 Ways to Avoid Costly Mistakes. *California Management Review*. Available at: https://cmr.berkeley.edu/2021/04/getting-the-most-from-publicly-available-scenarios/
- Lindh, M., & Nolin, J. M. (2017). GAFA speaks: Metaphors in the promotion of cloud technology. *Journal of Documentation*, 73(1), 160–180. https://doi.org/10.1108/JD-03-2016-0039.
- Long Covid Forum Group, & Carson, G. (2021). Research priorities for Long Covid: Refined through an international multi-stakeholder forum. *BMC Medicine*, 19(1), 84. https://doi.org/10.1186/s12916-021-01947-0
- Lurie, N., Keusch, G. T., & Dzau, V. J. (2021). Urgent lessons from COVID 19: Why the world needs a standing, coordinated system and sustainable financing for global research and development. *The Lancet*, 397(10280), 1229–1236. https://doi.org/10.1016/S0140-6736(21)00503-1
- Miller, B. L. (2020). Science Denial and COVID Conspiracy Theories: Potential Neurological Mechanisms and Possible Responses. *JAMA*, 324(22), 2255. https://doi.org/10.1001/jama.2020.21332
- Norton, A., De La Horra Gozalo, A., Feune de Colombi, N., Alobo, M., Mutheu Asego, J., Al-Rawni, Z., Antonio, E., Parker, J., Mwangi, W., Adhiambo Wesonga, C., Marsh, K., Tufet, M., Piot, P., & Lang, T. (2020). The remaining unknowns: A mixed methods study

of the current and global health research priorities for COVID-19. *BMJ Global Health*, 5(7), e003306. https://doi.org/10.1136/bmjgh-2020-003306

- Norton, A. J., Wiysonge, C. S., Habarugira, J.-M. V., White, N. J., Tufet Bayona, M., Hagen, H.-E., Archer, J. E., Alobo, M. S., Carson, G. L., Garcia, P. J., Maciel, R. M. B., Ramakrishnan, U., Ryu, C.-M., Rees, H., Ntoumi, F., Tshangela, A. N., Faiz, M. A., Snewin, V. A., Mburu, S. W., … Kaushic, C. (2021). Priorities for COVID-19 research response and preparedness in low-resource settings. *The Lancet*, S0140673621009806. https://doi.org/10.1016/S0140-6736(21)00980-6
- Norton, A., Bucher, A., Antonio, E., Advani, N., Grund, H., Mburu, S., Clegg, E., Gollish, M., Jabin, N., Scott, L., Boily-Larouche, G., Lay, A. M., Carson, G., & Tufet Bayona, M. (2021). A living mapping review for COVID-19 funded research projects: Six-month update. *Wellcome Open Research*, *5*, 209. https://doi.org/10.12688/wellcomeopenres.16259.3
- Norton, A., Olliaro, P., Sigfrid, L., Carson, G., Paparella, G., Hastie, C., Kaushic, C., Boily-Larouche, G., Suett, J. C., & O'Hara, M. (2021). Long COVID: Tackling a multifaceted condition requires a multidisciplinary approach. *The Lancet Infectious Diseases*, S1473309921000438. https://doi.org/10.1016/S1473-3099(21)00043-8
- Ramirez, R., & Wilkinson, A. (2014). Rethinking the 2×2 scenario method: Grid or frames? *Technological Forecasting and Social Change*, 86, 254–264. https://doi.org/10.1016/j.techfore.2013.10.020
- Ramírez, R., & Wilkinson, A. (2016). *Strategic Reframing: The Oxford Scenario Planning Approach*. Oxford University Press. https://doi.org/10.1093/acprof:oso/9780198745693.001.0001.
- Ramirez, R., Lang, T., Peterson, G. (2021, April 1). Seven Sure-fire Ways to Do Scenario Planning Badly: A Guide to Poor Practice. *Long Range Planning*. Available at: https://www.journals.elsevier.com/long-range-planning/announcements/seven-sure-fire-ways-to-do-scenario
- Ramirez, R., McGinley, C., & Rissanen, J. (2020). Scenario planning in science-centric organizations. *FUTURES & FORESIGHT SCIENCE*, 2(2). https://doi.org/10.1002/ffo2.30
- Ramirez, R., Mukherjee, M., Vezzoli, S., & Kramer, A. M. (2015). Scenarios as a scholarly methodology to produce "interesting research". *Futures*, 71, 70–87. https://doi.org/10.1016/j.futures.2015.06.006
- Reyes, R., Ahn, R., Thurber, K., & Burke, T. F. (2013). Urbanization and Infectious Diseases: General Principles, Historical Perspectives, and Contemporary Challenges. In I. W. Fong (Ed.), *Challenges in Infectious Diseases* (pp. 123–146). Springer New York. https://doi.org/10.1007/978-1-4614-4496-1_4
- Soto, S. M. (2009). Human migration and infectious diseases. *Clinical Microbiology and Infection*, 15, 26–28. https://doi.org/10.1111/j.1469-0691.2008.02694.x
- Tang, Q., Zhang, K., & Li, Y. (2020). The Important Role of Social Media During the COVID-19 Epidemic. *Disaster Medicine and Public Health Preparedness*, 1–2. https://doi.org/10.1017/dmp.2020.330
- The COVID-19 Research GloPID-R Synergies Meeting Working Group & Meeting Co-chairs. (2020). Ending COVID-19: Progress and gaps in research—highlights of the July 2020 GloPID-R COVID-19 Research Synergies Meetings. *BMC Medicine*, 18(1), 342. https://doi.org/10.1186/s12916-020-01807-3

- van Laerhoven, F., & Ostrom, E. (2007). Traditions and Trends in the Study of the Commons. *International Journal of the Commons*, 1(1), 3–28. http://doi.org/10.18352/ijc.76


**Policy documents**


- Policy Paper: Research and Development Priorities for COVID-19 in Africa. 17 February 2021. https://africacdc.org/download/policy-paper-research-and-development-priorities-for-covid-19-in-africa/
- UN Research Roadmap for the COVID-19 Recovery. 17 November 2020. https://www.un.org/en/coronavirus/communication-resources/un-research-roadmap-covid-19-recovery
- UNAIDS. AIDS in Africa: Three Scenarios to 2025. https://www.unaids.org/sites/default/files/media_asset/jc1068-scenarios-execsumm_en_0.pdf
- World Health Organization. A Coordinated Global Research Roadmap. 12 March 2020. https://www.who.int/publications/m/item/a-coordinated-global-research-roadmap


**News articles, commentaries, and press releases**


- BBC. Covid-19: Debunking the latest wave of medical misinformation. 11 April 2021. https://www.bbc.com/news/56680399
- BBC. Covid: The inside story of the government's battle against the virus. 15 March 2021. https://www.bbc.com/news/uk-politics-56361599
- Brookings. Emergency rulemaking in response to COVID-19. 20 August 2020. https://www.brookings.edu/research/emergency-rulemaking-in-response-to-covid-19/
- El Pais. Five enigmas for the coronavirus (in Spanish). 13 March 2021. https://elpais.com/ciencia/2021-03-13/cinco-grandes-enigmas-del-coronavirus-aun-por-resolver.html
- El Pais. Las mafias acechan la llegada a África de las vacunas contra el coronavirus (in Spanish). 18 March 2021. https://elpais.com/planeta-futuro/2021-03-18/las-grandes-organizaciones-criminales-acechan-la-llegada-de-las-vacunas-contra-el-coronavirus-a-africa.html
- Facebook. Mark Zuckerberg Announces Facebook's Plans to Help Get People Vaccinated Against COVID-19. 15 March 2021. https://about.fb.com/news/2021/03/mark-zuckerberg-announces-facebooks-plans-to-help-get-people-vaccinated-against-covid-19/
- Forbes. Google Launches $3 Million Fund To Tackle Covid-19 Vaccine Misinformation. 12 January 2021. https://www.forbes.com/sites/roberthart/2021/01/12/google-launches-3-million-fund-to-tackle-covid-19-vaccine-misinformation/?sh=40d1c8ea614f
- Forbes. Amazon Offers To Help Biden With Covid-19 Vaccine Rollout. 20 January 2021. https://www.forbes.com/sites/alisondurkee/2021/01/20/amazon-offers-to-help-biden-with-covid-19-vaccine-rollout/?sh=c61bb4378a53
- GloPID-R Newsletter. GloPID-R observer CEPI launches funding call to develop broadly protective coronavirus vaccines. 9 April 2021. https://www.glopid-r.org/newsletters/news-flash-april-9-2021.html

- Google CEO. How we're helping get vaccines to more people. 25 January 2021. https://blog.google/technology/health/vaccines-how-were-helping/
- Harvard Business Review. Why Investing in Procurement Makes Organizations More Resilient. 17 June 2020. https://hbr.org/2020/06/why-investing-in-procurement-makes-organizations-more-resilient
- Healthcare IT News. AI has advantages for COVID-19 vaccine rollout, but potential dangers too. 11 February 2021. https://www.healthcareitnews.com/news/ai-has-advantages-covid-19-vaccine-rollout-potential-dangers-too
- Milken Institute. COVID-19 Africa Watch. https://covid19africawatch.org
- MSNBC. Chris Hayes: Tucker Carlson's Not Stupid, He Just Thinks His Audience Is. 17 March 2021. https://youtu.be/Avv_lVee4JM
- Nature News. The coronavirus is here to stay — here's what that means. 16 February 2021. https://www.nature.com/articles/d41586-021-00396-2
- Nature News. Why did the world's pandemic warning system fail when COVID hit? 23 January 2021. https://www.nature.com/articles/d41586-021-00162-4
- The Financial Times. A new Washington consensus is born. 11 April 2021. https://www.ft.com/content/3d8d2270-1533-4c88-a6e3-cf14456b353b?shareType=nongift
- The Financial Times. UK vaccine supremo Kate Bingham: 'The bickering needs to stop'. 3 April 2021. https://www.ft.com/content/8d9edc58-7922-496a-942f-5360bfe84876?shareType=nongift
- The Guardian. Tech giants' shares soar as companies benefit from Covid-19 pandemic. 30 July 2020. https://www.theguardian.com/business/2020/jul/30/amazon-apple-facebook-google-profits-earnings
- The New York Times. Kati Kariko Helped Shield the World From the Coronavirus. 8 April 2021. https://www.nytimes.com/2021/04/08/health/coronavirus-mrna-kariko.html
- The New York Times. One Year Later, We Still Have No Plan to Prevent the Next Pandemic. 16 March 2021. https://www.nytimes.com/2021/03/16/opinion/covid-pandemic.html
- The New York Times. Rich Countries Signed Away a Chance to Vaccinate the World. 21 March 2021. https://www.nytimes.com/2021/03/21/world/vaccine-patents-us-eu.html
- The New York Times. Some Nations Could Wait Years for Covid Shots. That's Bad for Everyone. 22 March 2021. https://www.nytimes.com/2021/03/22/world/africa/africa-vaccine-inequality-covid.html
- The New York Times. The Mysterious Aftermath of Infections. 6 April 2021. https://www.nytimes.com/2021/04/06/opinion/covid-infections.html
- The New York Times. The Pandemic and the Limits of Science. 16 March 2021. https://www.nytimes.com/2021/03/16/health/coronavirus-pandemic-lessons.html
- The Telegraph. A crisis even bigger than Covid: the new war on antibiotic resistance. 4 April 2021. https://www.telegraph.co.uk/health-fitness/body/crisis-even-bigger-covid-new-war-antibiotic-resistance/
- The Times Literary Supplement. Captain Blindsight By Jonathan Bak. April 2, 2021. https://www.the-tls.co.uk/articles/failures-of-state-jonathan-calvert-george-arbuthnott-review-jonathan-bak/

- The Washington Post. Tech giants are profiting — and getting more powerful — even as the global economy tanks. 27 April 2020. https://www.washingtonpost.com/technology/2020/04/27/big-tech-coronavirus-winners/
- University of Kent. People's compliance to Covid-19 guidelines is driven by what their friends and family do. 21 January 2021. https://www.kent.ac.uk/news/covid19/27685/peoples-compliance-to-covid-19-guidelines-is-driven-by-what-their-friends-and-family-do
- Wired. These scientists are already on the hunt for the next pandemic. 17 March 2021. https://www.wired.co.uk/article/africa-pandemic-early-detection


## Key Documents

- Chorus of voices (separate document, available on request).
- MIRO snapshots (separate document, available on request)
- Surveys (Validation of Exercises F, G, and H; separate documents, available on request).

## Acknowledgements

**GloPID-R Scientific Secretariat:** Giuseppe Paparella, Alice Norton, Romans Matulevics, Nina Jamieson, Melina Michelen, Gail Carson

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# SECTION D (Annex1): RESEARCH RECOMMENDATIONS FROM THE APRIL 18th, 2021 WORKSHOP

The recommendations from the April 18th workshop were further refined via surveys and are presented below.

## Prioritised Recommendations

The table below is based on the WHO 2020 COVID-19 research priority areas. The arrows indicate where GloPID-R is recommended to decrease, maintain, or increase funding compared to the 2020 level. The columns represent the budget that was spent in 2020-21 and the budgets allocated to each scenario. The SAG deliberated on these research priority areas in the context of the setting of the scenarios.

**CONSENSUS SUMMARY ON RESEARCH PRIORITIES FOR GLOPID-R IN 2022-23**

| CATEGORIES | 2020-2021 $2.7bn/annum | BACK TO 'NORMAL' $0.7bn/annum | INFECTIOUS NATIONALISM $1.35bn/annum | GAFA RULE $2.7bn/annum |
|---|---|---|---|---|
| VACCINE R&D | 800m | ↓ | ↓ | ↓ |
| CLINICAL CHARACTERISATION & MANAGEMENT | 553m | ↓ | ↔ | ↑ |
| VIRUS: DIAGNOSTICS, NATURAL HISTORY, TRANSMISSION... | 384m | ↓ | ↔ | ↑ |
| SOCIAL SCIENCE | 334m | ↓ | ↔ | ↑ |
| THERAPEUTICS R&D | 308m | ↓ | ↓ | ↓ |
| EPIDEMIOLOGICAL | 154m | ↓ | ↑ | ↑ ↔ |
| INFECTION PREVENTION & CONTROL | 131m | ↓ | ↔ | ↑ ↔ |
| ETHICS CONSIDERATIONS | 16m | ↓ | ↓ | ↑ |
| ANIMAL & ENVIRONMENT | 8m | ↑ | ↑ | ↑ |

NOTE: THE OVERALL GLOPID-R FUNDING RECOMMENDATION FOR A WHO 2020 PRIORITY AREA MIGHT BE TO DECREASE FUNDING, BUT A FOCUSED FUNDING RESPONSE MAY BE ADVOCATED FOR IN THE SUBCATEGORIES.

**Recommendations Split by Research Priority Categories and Subcategories**

## Virus: natural history, transmission, and diagnostics

Overall, the recommendation to GloPID-R is as follows:

| | 2020-2021<br>$2.7bn/annum | BACK TO 'NORMAL'<br>$0.7bn/annum | INFECTIOUS NATIONALISM<br>$1.35bn/annum | GAFA RULE<br>$2.7bn/annum |
|---|---|---|---|---|
| VIRUS: DIAGNOSTICS, NATURAL HISTORY, TRANSMISSION... | 384m | ↓ | ↔ | ↑ |

Not to prioritise funding in Back to 'Normal', to maintain funding in Infectious Nationalism, and to prioritise funding in GAFA Rule.

The **focused recommendations** based on the WHO 2020 subcategories are as follows:

Across all three scenarios

- Develop tools and conduct studies to monitor phenotypic change and potential adaptation
- Characterise immunity (naturally acquired, population- and vaccine-induced, including mucosal immunity)

For GAFA Rule

- Virus stability in the environment

For virus diagnostics, the SAG suggested that GloPID-R should focus on low-cost (cost reduction) and/or socially innovative (e.g., citizen science) solutions to infectious diseases challenges that can be used by all.

## Animal & environmental research: virus origin and management measures at the human–animal interface

Overall, the recommendation to GloPID-R is as follows:

| | 2020-2021<br>$2.7bn/annum | BACK TO 'NORMAL'<br>$0.7bn/annum | INFECTIOUS NATIONALISM<br>$1.35bn/annum | GAFA RULE<br>$2.7bn/annum |
|---|---|---|---|---|
| ANIMAL & ENVIRONMENT | 8m | ↑ | ↑ | ↑ |

Prioritise funding across all three scenarios.

The **focused recommendations** based on the WHO 2020 subcategories are as follows:

Across all three scenarios

- Investigation of animal source(s) and route(s) of transmission
- Socioeconomic and behavioural risk factors for spill over
- Risk-reduction strategies and the human–animal–environment interface

## Epidemiological studies

Overall, the recommendation to GloPID-R is as follows:

| | 2020-2021<br>$2.7bn/annum | BACK TO 'NORMAL'<br>$0.7bn/annum | INFECTIOUS NATIONALISM<br>$1.35bn/annum | GAFA RULE<br>$2.7bn/annum |
|---|---|---|---|---|
| EPIDEMIOLOGICAL | 154m | ↓ | ↑ | ↑ ↔ |

Prioritise funding in Infectious Nationalism, maintain or prioritise funding in GAFA Rule, and not to prioritise funding in Back to 'Normal'.

The **focused recommendations** based on the WHO 2020 subcategories are as follows:

For Back to 'Normal' and GAFA Rule

- Fund studies of transmission dynamics to clarify the relative importance of pre-symptomatic/asymptomatic transmissions (including the distinction between virus shedding and infectious transmission)

For GAFA Rule alone

- Fund studies of control-and-mitigate measures to predict the most effective measures to reduce the peak burden on healthcare providers and other societal functions, and estimate the effects of social distancing measures

## Clinical characterisation and management

Overall, the recommendation to GloPID-R is as follows:

| | 2020-2021<br>$2.7bn/annum | BACK TO 'NORMAL'<br>$0.7bn/annum | INFECTIOUS NATIONALISM<br>$1.35bn/annum | GAFA RULE<br>$2.7bn/annum |
|---|---|---|---|---|
| CLINICAL CHARACTERISATION & MANAGEMENT | 553m | ↓ | ↔ | ↑ |

Prioritise funding in GAFA Rule and maintain funding in Infectious Nationalism.

The **focused recommendations** based on the WHO 2020 subcategories are as follows:

For Back to 'Normal' and GAFA Rule

- Understand the pathophysiology of COVID-19 infection, including the pathophysiology of mild diseases and the role of co-infections/infection, transmissibility, and viral shedding

For Infectious Nationalism and GAFA Rule

- Improve processes of care, including early diagnosis and discharge criteria, and identify interventions that improve the clinical outcomes of infected patients (e.g., steroids and high-flow oxygen therapy)

For Infectious Nationalism alone

- Develop core clinical outcomes to maximise the usability of data across a range of trials

For GAFA Rule alone

- Optimal adjuvant therapies for patients (and contacts)

More broadly, the SAG considered that efforts to keep funding clinical characterisation and management research projects should be made by GloPID-R.

### Infection prevention and control, including healthcare worker protection

Overall, the recommendation to GloPID-R is as follows:

| | 2020-2021<br>$2.7bn/annum | BACK TO 'NORMAL'<br>$0.7bn/annum | INFECTIOUS NATIONALISM<br>$1.35bn/annum | GAFA RULE<br>$2.7bn/annum |
|---|---|---|---|---|
| INFECTION PREVENTION & CONTROL | 131m | ↓ | ↔ | ↑ ↔ |

Maintain funding in Infectious Nationalism and GAFA Rule, or possibly increase funding in GAFA Rule.

The **focused recommendations** based on the WHO 2020 subcategories are as follows:

For Infectious Nationalism and GAFA Rule

- Factors and methods influencing compliance with evidence-based infection prevention and control interventions during outbreak response

### Candidate Therapeutics R&D

Overall, the recommendation to GloPID-R is as follows:

| | 2020-2021<br>$2.7bn/annum | BACK TO 'NORMAL'<br>$0.7bn/annum | INFECTIOUS NATIONALISM<br>$1.35bn/annum | GAFA RULE<br>$2.7bn/annum |
|---|---|---|---|---|
| THERAPEUTICS R&D | 308m | ↓ | ↓ | ↓ |

Not to prioritise funding separately, as this category is funded by Access to COVID-19 Tools Accelerator and other entities in all three scenarios. However, there is one subcategory which is an exception.

The **focused recommendation** based on the WHO 2020 subcategories is as follows:

For Back to 'Normal' alone

- Investigate combination therapies

## Candidate Vaccines R&D

Overall, the recommendation to GloPID-R is as follows:

| | 2020-2021<br>$2.7bn/annum | BACK TO 'NORMAL'<br>$0.7bn/annum | INFECTIOUS NATIONALISM<br>$1.35bn/annum | GAFA RULE<br>$2.7bn/annum |
|---|---|---|---|---|
| VACCINE R&D | 800m | ↓ | ↓ | ↓ |

Not to prioritise funding separately, as this category is funded by the Coalition for Epidemic Preparedness Innovations (CEPI) and other entities in the three scenarios. However, there are exceptions.

The **focused recommendations** based on the WHO 2020 subcategories are as follows:

Scenario independent

- Across all scenarios, vaccine standardisation and independent evaluation should remain a priority.
- In addition, funding would still be required to enhance vaccine equity and to deal with new strains. At the same time, the SAG suggested that this area might be covered by market forces, and so, the focus was enlarged to include emerging diseases and was not limited to COVID.

## Ethics considerations for research

Overall, the recommendation to GloPID-R is as follows:

| | 2020-2021<br>$2.7bn/annum | BACK TO 'NORMAL'<br>$0.7bn/annum | INFECTIOUS NATIONALISM<br>$1.35bn/annum | GAFA RULE<br>$2.7bn/annum |
|---|---|---|---|---|
| ETHICS CONSIDERATIONS | 16m | ↓ | ↓ | ↑ |

To prioritise funding in GAFA Rule.

The **focused recommendations** based on the WHO 2020 subcategories are as follows:

For GAFA Rule alone

- Articulate and translate existing ethical standards to salient issues in COVID-19
- Ethical governance of global epidemic research

## Social science in outbreak response

Overall, the recommendation to GloPID-R is as follows:

| | 2020-2021<br>$2.7bn/annum | BACK TO 'NORMAL'<br>$0.7bn/annum | INFECTIOUS NATIONALISM<br>$1.35bn/annum | GAFA RULE<br>$2.7bn/annum |
|---|---|---|---|---|
| SOCIAL SCIENCE | 334m | ↓ | ↔ | ↑ |

Maintain funding in Infectious Nationalism and prioritise funding in GAFA Rule.

The **focused recommendations** based on the WHO 2020 subcategories are as follows:

Across all three scenarios

- Public health: what are the relevant, feasible, and effective approaches to promote acceptance, uptake, and adherence to public health measures for COVID-19 prevention and control?
- Clinical care and health systems: what are the relevant, feasible, and effective approaches to support the physical health and psychosocial needs of those providing care for COVID-19 patients?
- Engagement: what are the relevant, feasible, and effective approaches for rapid engagement and good participatory practice that includes communities in the public health response?

In Back to 'Normal', there is a reduced budget, and hence, the overall recommendation is a decrease in funding for GloPID-R. However, four subcategories are identified for consideration for increased funding.

For Back to 'Normal' alone

- Media and communications: How are individuals and communities communicating and making sense of COVID-19? What are the most effective ways to address the underlying drivers of fear, anxieties, rumours, and stigma related to COVID-19, and to improve public knowledge, awareness, and trust during the response?

For GAFA Rule alone

- International cooperation: What international coordination mechanisms can optimise international collaboration?

# SECTION E (Annex2): WORKSHOPS

## Scenario-Building and Refinement Workshops, March 27th and 28th, 2021

Each scenario was given a name to try to capture the essence of the future it describes (Figure 1, p. 16):

### I. Back to 'Normal'

COVID-19 and other infectious diseases are back to being manageable, and pragmatic international cooperation has re-emerged. However, funding is anaemic ($0.7 billion per annum or yearly around 25% of what was made available in 2020) and full of conditionalities. COVID fatigue and a disputed link with climate change lead to a society that is reluctant to see what science is, or could be, showing.

### II. Infectious Nationalism

Rigorous border health checks and self-centred behaviour have helped developed nations bring COVID-19 under control. Climate change sits in the infectious disease background as new variants emerge elsewhere, forcing constant adaptation. National infectious disease funding ($1.35 billion per annum or yearly around 50% of what was available in 2020) prioritises economic interests with no inclination to listen to scientific pleas for a broader approach.

### III. GAFA Rule

Climate change has had a major impact on the development and spread of infectious diseases. Private-sector actors drive a post-pandemic market-based health agenda protected by a web of IP and data rights, leading to the de facto silencing of non-commercial science. A few states with good GAFA (which stands for Google/Amazon/Facebook/Apple)[14] relations reap benefits from the considerable private research funding ($2.7 billion per annum, or the same level as in 2020) mobilised by these corporations. An anti-exclusivity backlash emerges from dissenting countries with youthful populations and development priorities (most of the LMICs).

[14] Lindh, M., & Nolin, J. M. (2017). GAFA speaks: Metaphors in the promotion of cloud technology. *Journal of Documentation*, 73(1), 160–180. https://doi.org/10.1108/JD-03-2016-0039. Kawai, T. (2019). A Tentative Framework of Dynamic Platform Strategy—For the Era of GAFA and 5G—. *Journal of Strategic Management Studies, 11(1), 19–36.* https://doi.org/10.24760/iasme.11.1_19.

## I. The Back to 'Normal' Scenario in 2030

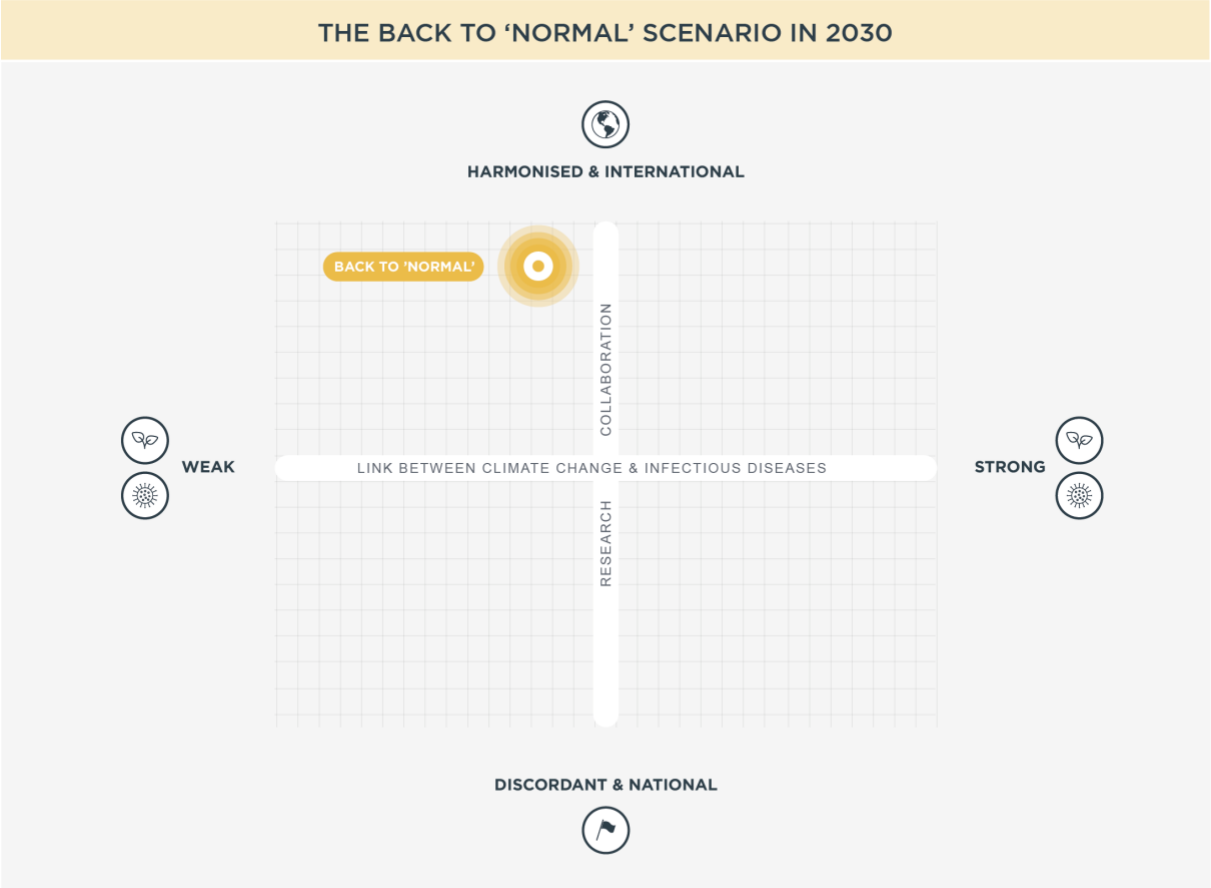


FIGURE 3: BACK TO 'NORMAL' SCENARIO IN THE MATRIX [13]

### The contextual world in 2030 in this scenario

Identifying the factors that shaped the scenario building: the contextual environment

The scenarios were developed by first looking at the broader contextual environment factors beyond the influence of GloPID-R, and then, at which actors GloPID-R would interact with in its more immediate transactional environment. The contextual environment is the set of diverse factors, such as geopolitical, demographic, technological, and other changes, that are beyond the influence of GloPID-R. Each scenario is based on a unique combination of contextual factors. As described above, SAG members identified as relevant contextual factors the nature of international cooperation and the impact of climate change on the development and spread of infectious diseases. The SAG members then decided where the three scenarios might plausibly sit on the two axes.

Nature of international cooperation in Back to 'Normal'

International relations are very good, but decision-making processes are slow, ineffective, and bureaucratic. Hidden 'me first' national agendas dominate. Cooperation is encouraged by nation-states, and duplication is reduced; however, genuine inter-nation collaboration is not so common.

Impact of climate change on the development and spread of infectious diseases

The perceived impact of climate change on infectious diseases is contested. Any link is less visible and seemingly manageable. COVID fatigue leads to a society that is reluctant to see what science is, or could be, showing.

How the matrix axes have unfolded in this scenario

COVID-19 and other infectious diseases are back to being manageable with a fast-recovering economy. COVID fatigue leads to a society that is reluctant to see what science is, or could be, showing. So, the link between climate change and infectious diseases is somebody else's problem. Global warming does remain a major issue, but the real focus is on energy transition, severe weather events, and sustainable food supplies. International cooperation has re-emerged as governments and NGOs engage in slow and ineffective decision-making processes. Crises are regional, and research recommendations are discussable – endlessly. The world is comfortably blinded, and research funding has returned to its former 'normal' level or less, as a consequence of the economic backlash of the pandemic.

System diagram depicting how key factors relate to each other and shape this scenario in 2030

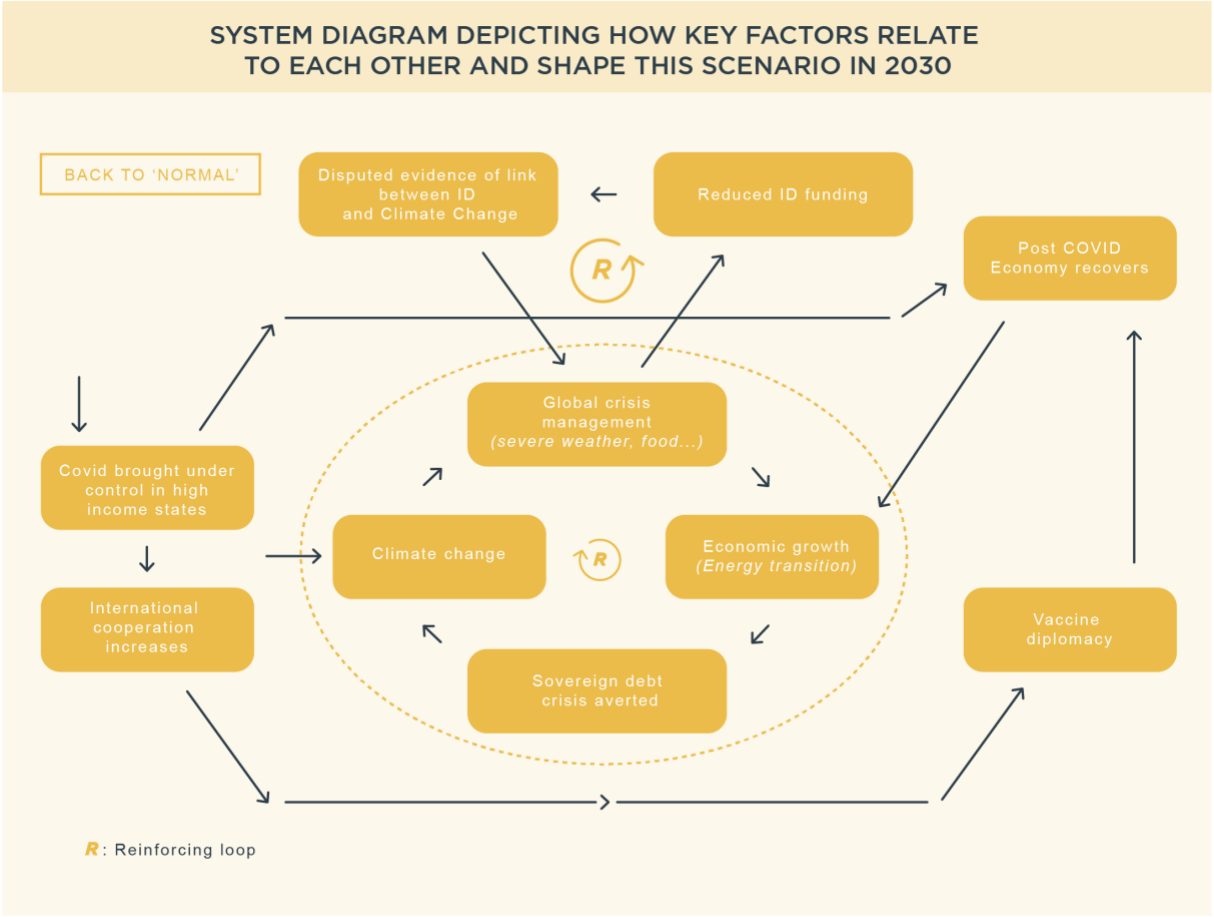


FIGURE 4: SYSTEM DIAGRAM FOR BACK TO 'NORMAL'

Description of the system diagram

This is a world in 2030 where although the level of international cooperation increases, the lack of change in better balancing proactive and reactive research recommendations as well as the lack of improvements in governance and decision-making make this cooperation less effective. In this context, international cooperation only follows when infectious disease outbreaks become unmanageable and spread around the world. As a result, the ability to manage epidemics and pandemics varies greatly across different regions and individual countries. In addition, this new world seems more conducive to the development of new infectious diseases due to accelerating urbanisation that makes human–animal interactions more frequent.

Other important factors shaping this scenario

- International cooperation remains at current levels or decreases. Effectiveness of international cooperation is not improved.
- Climate change impacts the development and spread of infectious diseases.
- Climate change impacts human movements and habitats, but the impact remains manageable.
- Decision-making has improved as a result of lessons learned from the COVID-19 pandemic.

**The transactional world in 2030 in this scenario**

- Overall infectious disease funding in 2030 compared to 2020-21: anaemic; reduced to 25% (yearly) of the COVID-19 period. Geopolitical vaccine diplomacy abounds.
- Winning actors: WHO, niche corporates, and high-income geopolitical powers.
- Possible losing actors: low-income countries and GLOPID-R.
- Dominant actors and new entrants: geopolitical powers and niche corporates.

Challenges and opportunities for infection disease research in this scenario

- Challenges for COVID-19/infectious disease research in 2030: breaking through the blindness of disease fatigue and the shortcomings of international cooperation.
- Opportunities for infectious disease research: willingness to reduce research duplication and develop rigorous projects, and willingness to develop global pandemic preparedness.

## II. The Infectious Nationalism Scenario in 2030

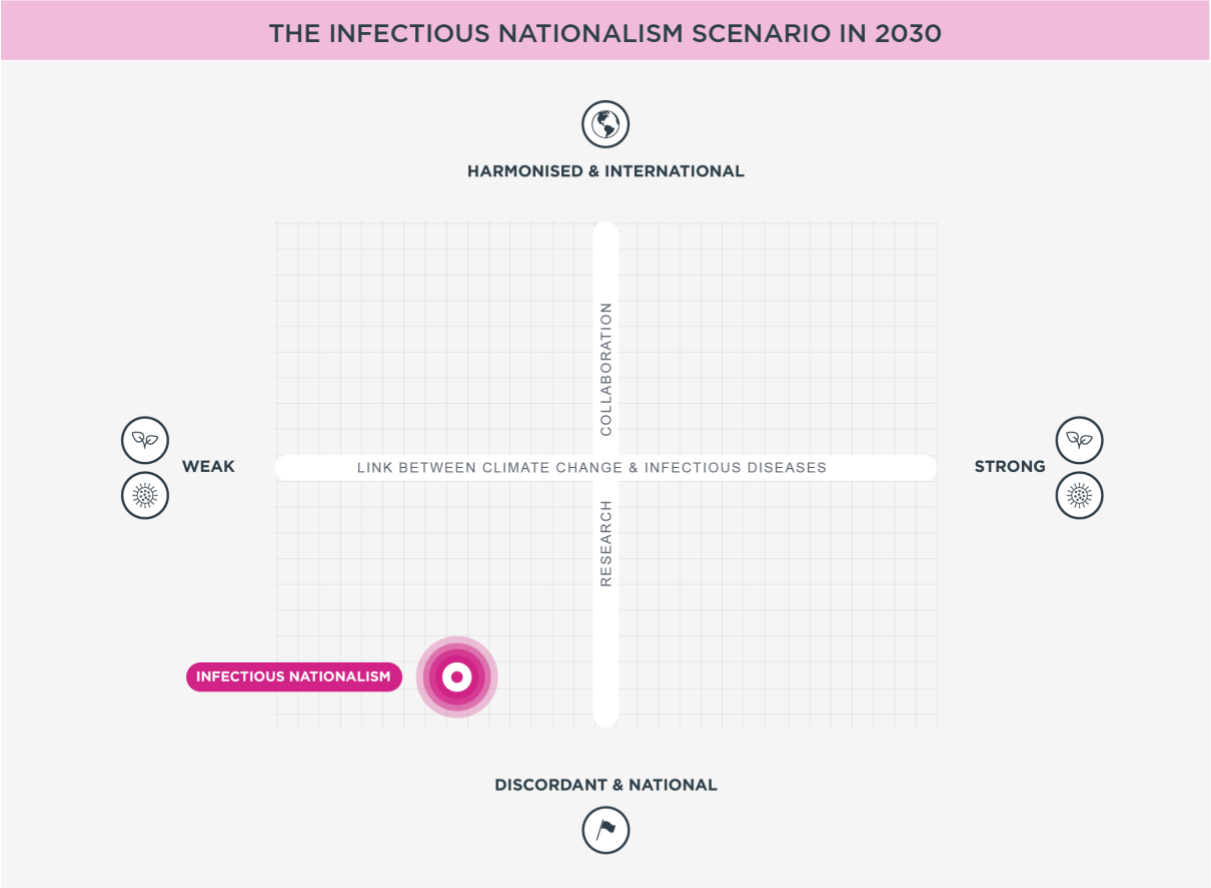


FIGURE 5: INFECTIOUS NATIONALISM SCENARIO IN THE MATRIX [13]

### The contextual world in 2030 in this scenario

Nature of international cooperation

International relations are very poor, and fast, effective decision-making is present at the national level only where there is economic alignment. 'Me first' thinking dominates decision-making.

Impact of climate change on the development and spread of infectious diseases

The visible impact of climate change on infectious diseases is seemingly small. National infectious disease funding is not inclined to listen to scientific pleas for a broader, cross-border approach.

Description of how the matrix axes have unfolded in this scenario

This is a world that has learnt hard lessons from the COVID-19 pandemic. Nation-states, acting in a self-centred but swift, forceful, and decisive way, have successfully protected their own citizens. Rigorous border checks and ongoing limitations on movement are the new normal. Climate change sits in the background as new variants emerge elsewhere, forcing constant adaptation. Constrained, national infectious disease funding prioritises science with profitable potential with no inclination to listen to scientific pleas for a broader approach. Society is broadly content with a populist, accountable, political class. International cooperation stagnates. Friction rises between

nations as a global 'tragedy of the commons' (everyone for themselves, end of common goods) plays out[15].

System diagram depicting how key factors relate to each other and shape this scenario in 2030

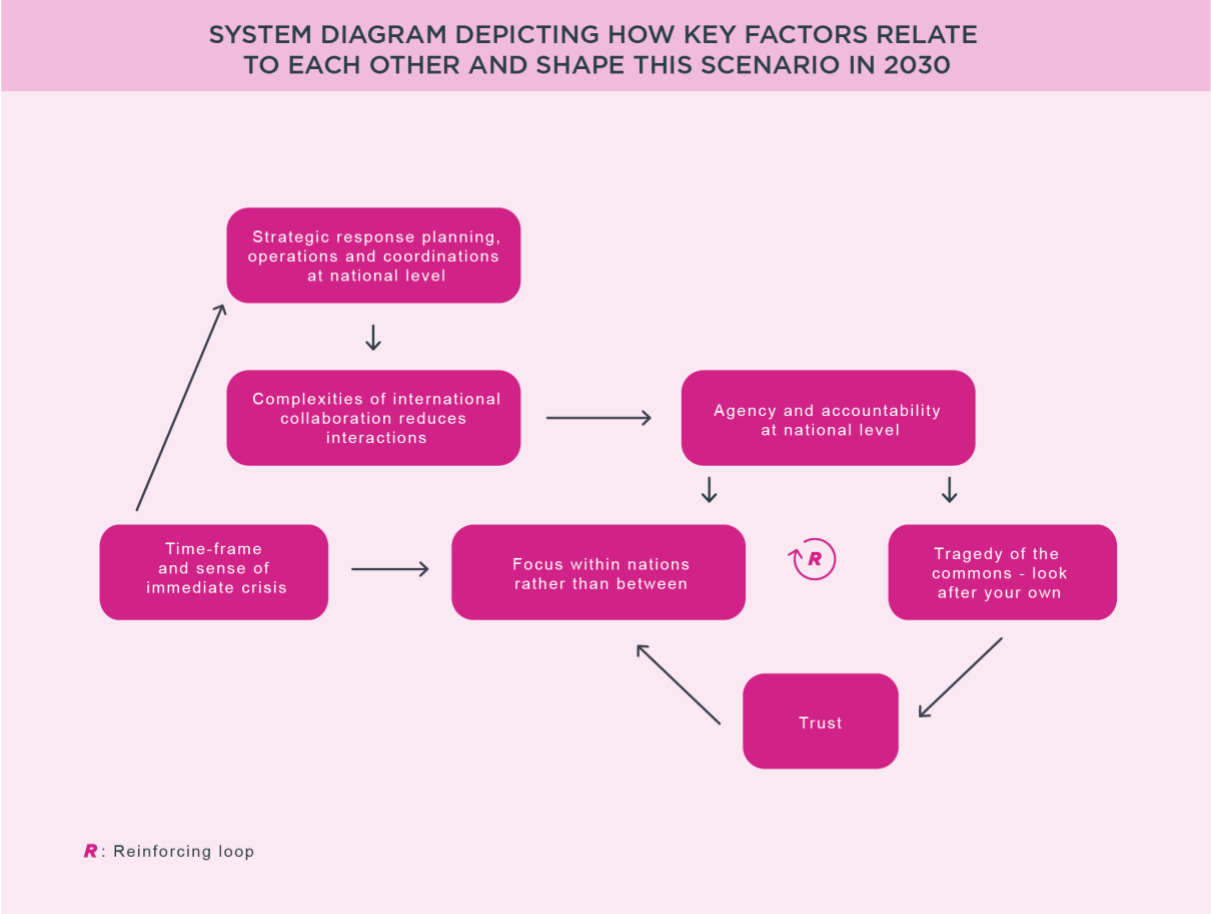


FIGURE 6: SYSTEM DIAGRAM FOR INFECTIOUS NATIONALISM

Description of the system diagram

This is a world in 2030 where the focus of control has moved to the national level where agency and accountability can be achieved, in part due to loss of confidence in international agencies and the complexities of global collaboration. Nations focus on their own local priorities with regard to challenging issues such as infectious diseases and economic benefit of biomedical research, responding to the specific needs of their vulnerable populations and their social and political priorities.

Other important factors shaping this scenario

- The economic biomedical model is efficient for the global context.

[15] Hardin, G. (1968). The Tragedy of the Commons. *Science*, vol. 162, No. 3859, 1243-1248. van Laerhoven, F., & Ostrom, E. (2007). Traditions and Trends in the Study of the Commons. *International Journal of the Commons*, 1(1), 3–28. DOI: http://doi.org/10.18352/ijc.76.

- International collaboration is complex and slow, with clashing cultures, rules, interests, and priorities to balance. During new crises, such collaboration is underutilised.
- The social and political consequences of crises lead to each country wanting to 'put their own face mask on' before helping others.
- Trust moves to the national level.

**The transactional world in 2030 in this scenario**

- Overall infectious disease funding in 2030 compared to 2020-21: (yearly) 50% of the intensive COVID-19 period. Strong bias towards certain (national) research recommendations.
- Winning actors: high-income countries with robust funding and pharma infrastructures, 'bad faith' media, and conspiracies.
- Possible losing actors: highly indebted countries with a limited R&D infrastructure and poor efficiency of regulatory bodies.
- Dominant actors and new entrants: nation-states and national champions.

Challenges and opportunities for infectious disease research in this scenario

- Challenges for COVID-19/infectious disease research in 2030: 'me first' nationalism, rampant duplication in overpopulated research areas, and limited capacity to deal with complex (wicked) issues.
- Opportunities for infectious disease research in this scenario: national inequity is easier to address, building infectious disease preparedness at national level, and resilience is taken more seriously.

## III. The GAFA Rule Scenario in 2030

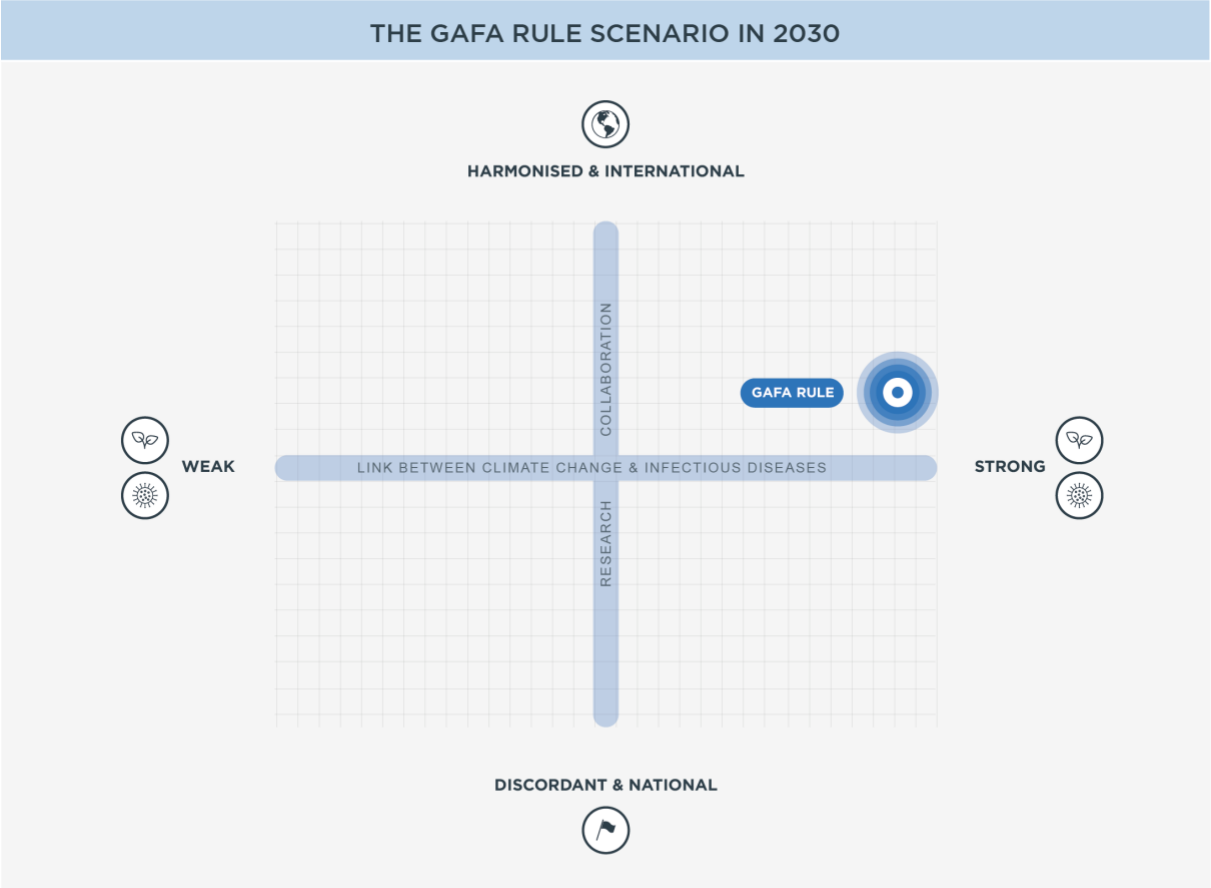


FIGURE 7: GAFA SCENARIO IN THE MATRIX [13]

### The contextual world in this scenario in 2030

Nature of international cooperation

International cooperation in health is market-based and driven by private actors, who are protected by a web of IP and data rights. A few states with good relations with these large international firms reap benefits. An anti-exclusivity backlash emerges from dissenting countries with youthful populations and development priorities (the LMICs).

Impact of climate change on the development and spread of infectious diseases

The impact of climate change on infectious diseases is very significant and visible. Corporate funders, anxious to protect their IP rights, align with partner nations who have given them privileged access to public data. The voice of researchers is weakened.

Description of how the matrix axes have unfolded in this scenario

This is a world in 2030 where ongoing climate change has had a major impact on the development and spread of infectious diseases. The obvious need for effective international collaboration conflicts with economic stress and high levels of debt. The environmental, social, and corporate governance stakeholder economy encourages private-sector actors to drive a market-based health agenda protected by a web of IP and data rights, leading to the de facto silencing of non-commercial

science. A few states with good GAFA relations reap benefits. Priority is given by funders to their core digital business models and the national interests of their main government partners. An anti-exclusivity backlash emerges from dissenting countries with youthful populations and development priorities (e.g., LMICs).

System diagram depicting how key factors relate to each other and shape this scenario in 2030

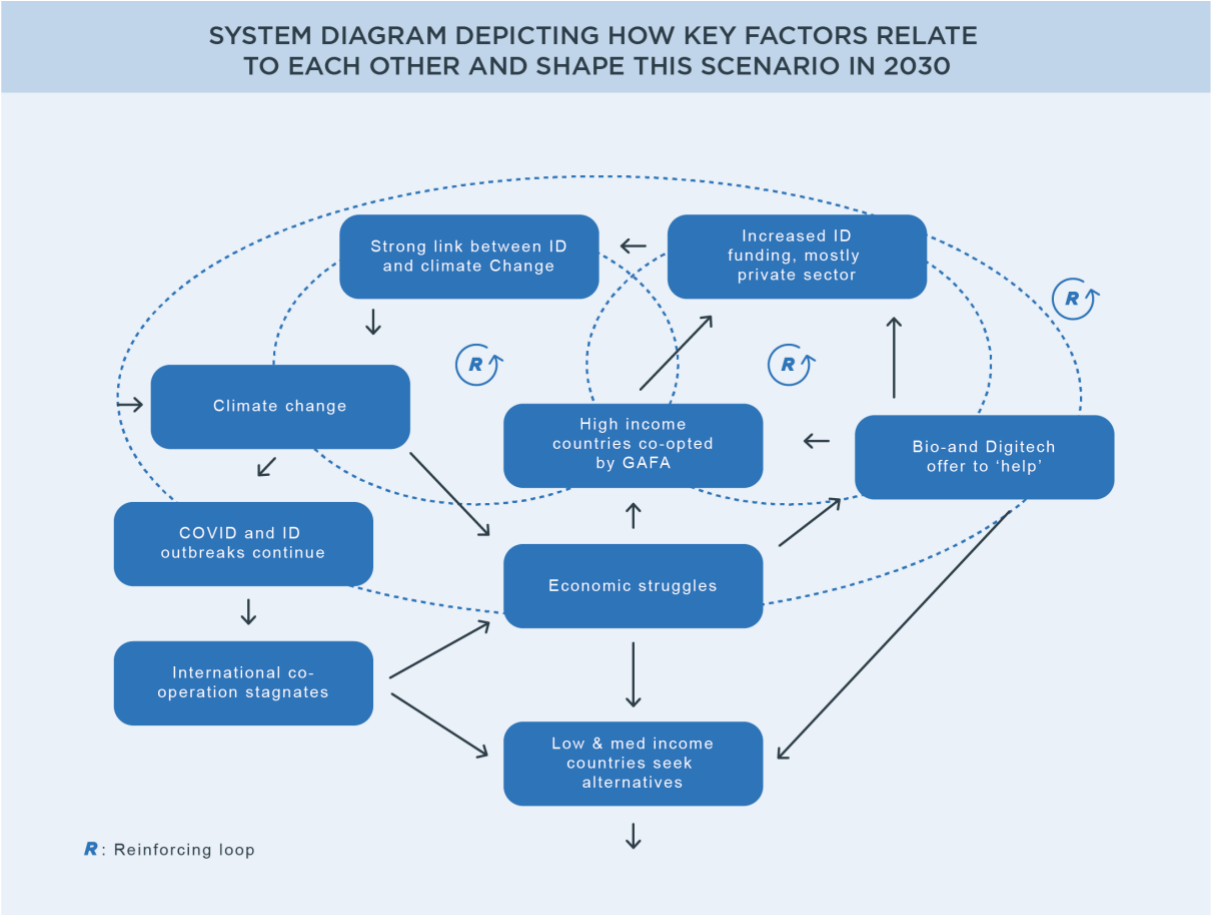


FIGURE 8: SYSTEM DIAGRAM FOR GAFA RULE

Description of the system diagram

In this world in 2030, the rebuilding of national vaccine institutions will be a dominant voice in setting research recommendations. Although the IP situation will be unchanged, discussions in 2021 about the breaking of vaccine patents have led to a new governance model in IP. The WHO will be reformed and decision-making improved, but the balance of academic partnerships will shift to industry partnership. Nationalism remains a major force, and regional differences in IP positions continue to create disputes across regions. As a result, due to decreased international cooperation, it is difficult to perform randomised clinical trials.

Other important factors shaping this scenario

- National approach is widespread.
- Vaccine passports are accepted and widespread.

- ‘Community’ is understood as only local, not global.
- Big countries now intervene and shape poor countries’ readiness.
- WHO is not stronger than it was in 2021 and has been forced to partner with the private sector.
- We continue to see many tech developments.
- Continued political fight between China and other superpowers.
- Evaluations of collaboration find it does not meet requirements, so collaboration is scarce.
- Nationalistic countries fare well.

**The transactional world in this scenario in 2030**

- Overall infectious disease funding in 2030 compared to 2020-21: high levels of funding are maintained, but with strong dependencies on global corporates and their values.
- Winning actors: GAFA and low-income countries with a demographic dividend can shape a better future.
- Possible losing actors: WHO, (public) social sciences, basic and translational science, and low-income countries without a demographic dividend.
- Dominant actors and new entrants: digi-biotech, global corporations, and mega-philanthropy.

Challenges and opportunities for infectious disease research in this scenario

- Challenges for COVID-19/infectious disease research in 2030: silence imposed by confidentiality in research, greater levels of inequality between and within nations, and funding/delivering non-IP research.
- Dominant agendas with massive budgets, little free space.
- Opportunities for infectious disease research in this scenario: finding novel ways to frame return on investment as a way of better leveraging environmental, social, and corporate governance; investment in education; and allying with low-income countries.

## Analysis of Differences Across the Three Scenarios

We analysed the common themes that emerged across the scenarios.

**Main differences across the three scenarios**[16]

For the scenarios to work as potential futures, they have to differ from each other.

[16]These and the following differences are the outcomes of a process, which was run by SAG members, to identify which common themes run across the three scenarios, and then, to understand how these themes differ across the scenarios. This is an important step, as it allows us to better understand how the scenarios differ from one other.

Evolution of COVID-19 and other infectious diseases in 2030

- Back to 'Normal': SARS-CoV-2 has become manageable. Outbreaks of infectious diseases continue to unfold, but they remain contained and are treated as 'somebody else's problem'.
- Infectious Nationalism: COVID-19 has become strictly controlled in most nation-states. Its lineage emerges in less disciplined countries; therefore, countries adapt locally to contain COVID. Long COVID is a major national health issue.
- GAFA Rule: Ongoing climate change is having major impacts on both the development and spread of all infectious diseases, and is a high priority for the new stakeholder economy.

How research value is captured and shared in 2030

- Back to 'Normal': Major national funders impose important conditionalities on the allocation of funds, and IP and data transfer. Limited fund availability imposes the development of niches.
- Infectious Nationalism: Research is funded only if it contributes directly to national well-being. This can be economically based, e.g., IP, data, and local production, but it can also be socially motivated, such as for securing freedom of movement and citizens' health.
- GAFA Rule: Research is oriented towards supporting bio- and digital business models and the economic interests of major geo-powers. Low-income countries reject this market paradigm.

The state of public health preparedness in 2030

- Back to 'Normal': There is very little development in terms of global public health preparedness compared to 2020. Promises of help are rarely accompanied by funds. Preparedness is considered a task for the public sector and is not taken up in clinical settings.
- Infectious Nationalism: Public health preparedness is strong in developed nations, and weak elsewhere due to ongoing sovereign debt crises, the collapse of health systems and education, etc.
- GAFA Rule: Responsibility for public health preparedness is blurred by the significantly increased role of the corporate sector in global health care. There is increased dependency on AI.

The nature of the relationship between society and science in 2030

- Back to 'Normal': COVID and climate change fatigue have led to a society that is reluctant to see what science is, or could be, offering.
- Infectious Nationalism: National interests trump scientific assessments. Misinformation as a business model actively prevents science from being heard.

- GAFA Rule: Private-sector research conditions such as IP and access to confidential personal data prevent corporate (as well as many non-corporate) researchers from speaking out.

**Other differences across the three scenarios**

The roles of state and private sectors in 2030

- Back to 'Normal': Public-private niche research areas have emerged, in which, access to public data and IP rights is exchanged for commercial funding.
- Infectious Nationalism: Highly indebted national champions emerge, and have a close, privileged, and symbiotic relationship with their patron high-income nation-states.
- GAFA Rule: High-income countries go through a growing privatisation of healthcare in the wake of economic difficulties. Younger, low-income countries and big philanthropy prioritise education and development.

Governmental decision-making in relation to pandemics and infectious diseases in 2030

- Back to 'Normal': Lessons have been learnt, and new international protocols and improved crisis-management processes have been established. There are too many conflicting priorities for infectious disease preparedness to rise to the top of the policy agenda.
- Infectious Nationalism: This scenario is protectionist and isolationist. A lesson learned from the pandemic is that the individual nation-state was more successful than those who collaborated. So, the locus of control and priority setting have moved to the national level.
- GAFA Rule: In high-income countries, decision-making is jointly done by nation-states and global corporates. In low-income countries, state decision-making is heavily influenced by NGOs and philanthropy.

Political appetite for global governance and cooperation in 2030

- Back to 'Normal': Climate change has sharply increased the appetite for international cooperation. Real power remains with high-income nations, whose number may decrease in 2030, and some niche corporates. There is pragmatic avoidance of research duplication.
- Infectious Nationalism: The decline of international cooperation has accelerated since 2020. A strong 'me first' political culture has emerged globally.
- GAFA Rule: In high-income countries, a global stakeholder economy with very close relations between the state and corporates has emerged. An anti-exclusivity backlash from LMICs forms a dissenting alliance.

## SCENARIO IMPLICATIONS WORKSHOP, APRIL 18th, 2021

The core focus of the third workshop, held on April 18th, 2021 via the MIRO platform, was to work to 'back-cast' from the 2030 worlds to the 2021–2023 period. During this final scenario workshop, the SAG members engaged in eight different exercises, in which they were invited to reflect on the strategic implications for GloPID-R's research agenda in each scenario: Back to 'Normal', Infectious Nationalism, and GAFA Rule.

In particular, the SAG members reflected on funding efficiency today and how funding recommendations might unfold by 2030, and on how the GLOPID-R 2022-23 recommendations might unfold across the scenarios. As part of this workshop, the SAG members were also invited to debate and suggest criteria to determine what, how, and with whom to fund as well as to explain which research recommendations would be most impacted across the scenarios.

This workshop was followed by a series of validation exercises conducted via online surveys and Zoom discussions.

### Exercise A: Exploring the Scenario Set

As a first step, participating SAG members were invited to review the scenario set individually, and to re-familiarise themselves with the contents and main differences between the scenarios. During this review exercise, specific emphasis was put on the main and other differences around seven key common themes that emerged across the scenarios:

- Evolution of COVID-19 & other infectious diseases in 2030
- How research value is captured and shared in 2030
- The state of public health preparedness in 2030
- The nature of the relationship between society and science in 2030
- The roles of state and private sectors in 2030
- Governmental decision-making in relation to pandemics and infectious diseases in 2030
- Political appetite for global governance and cooperation in 2030

This was an important step, as it allowed us to better understand how the scenarios differ from one other.

### Exercise B: Exploring the Scenario Set – Assumptions and Priorities

Secondly, participating SAG members were called, individually at first and then in a group, to further explore the scenario set by reflecting on which scenario questioned GloPID-R's thinking the most. The members first took into consideration the transactional environment of GloPID-R that had emerged during the previous workshops and which characterised, for each scenario, the following six main dimensions: overall infectious disease funding in 2030 compared to 2020-21, challenges for COVID/infectious disease research in 2030, opportunities for infectious diseases research,

winning actors, possible losing actors, and dominant actors and new entrants. Then, the participating SAG members were asked to reflect on which assumptions each scenario challenged the most and which research priority each scenario impacted the most.

To do so, SAG members were invited to use one virtual post-it for each assumption and for each research priority identified, and then, to discuss and share their thinking at the end of the exercise with other participants. The final result of this exercise is shown below:

**Which assumption held by GloPID-R is most challenged in this scenario**

- Back to 'Normal': That there will be increasing numbers of emerging infectious diseases, that funding for preparedness will be prioritised, and that policy will be data and evidence driven.
- Infectious Nationalism: That it will be possible to develop a coordinated preparedness and response agenda for emerging infectious diseases through GloPID-R, that a global approach can be taken to issues such as data sharing, that national research funders can fund globally or in partnership, and that collaboration/cooperation is beneficial to individual organisations/actors.
- GAFA Rule: That public research funders will be important players, that the current funding landscape will set agendas, that products will be developed without a financial market, that consensus and stakeholder engagement will be diminished, and that it will be difficult to maintain interest in emerging infectious diseases other than infectious diseases with pandemic potential.

**Which research priority is most impacted in this scenario**

- Back to 'Normal': Preparedness, negative impact on the study of re-emerging diseases, future threats, disease/preparedness and research, and implementation and localisation.
- Infectious Nationalism: Data sharing, global equity, pandemic prevention, and future global threats, as the focus is more on regional problems and priorities.
- GAFA Rule: Data sharing, ethics, pragmatic implementation suffers while technological innovation dominates, blue skies research, and translational research that does not fit a value proposition.

## Exercise C: Exploring the Implications for Research Priorities

During the third exercise, SAG members were invited to explore the implications for research priorities that emerged from the previous two exercises. By collectively reviewing these outcomes, they provided, for each scenario, inputs on three main decision-making dimensions:

- Top criteria for determining what to fund;
- Top 2–3 criteria to determine how research is undertaken;
- With whom and/or which consortia and partnerships to fund.

- The results of this exercise are shown below and help to contribute to the iterative process of understanding the possible implications of each scenario.

**Top criteria for determining what to fund**

- Back to 'Normal': Direct impact on transmission and livelihoods, funding gaps because of limited budget, basic research, and therapeutics (broad-spectrum, designed drugs). Is the disease relevant for the country/region covered by the funding? Does it contribute to global preparedness?
- Infectious Nationalism: Under this scenario, research will be driven by national interests, creating gaps in knowledge relevant to nation-states without research resources. As such, research knowledge that can be transferred to underserved nation-states or can be scaled to encompass regional contexts should be prioritised. Research that includes dissemination that is transnational and/or open access should be prioritised. Is the disease relevant for the country/region covered by the funding? Does it contribute to global preparedness?
- GAFA Rule: Commercialisation potential, potential impact commensurate with risk of success/failure, and direct impact on transmission and livelihoods. Is it a political priority in the G7? Is it interesting business wise?

**Top 2–3 criteria for determining how research is undertaken**

- Back to 'Normal': As research may not be mandatorily linked with action, there is a need to promote basic research AND research-for-action. Preparedness, including emergence and re-emergence, could be considered. Excellence. Value for region/local setting.
- Infectious Nationalism: Coupling several institutions, e.g., China and European institutions. Collaboration across nations. Capacity to transform research results into implementable action. Excellence. Value for region/local setting.
- GAFA Rule: No spontaneous appetite for consensus approaches and "improve candle rather than discover electricity" approach. Through global companies and their relationships. Substantial political involvement. Capacity to partner with state- and community-based implementors.

**With whom to fund? Which consortia and partnerships should be sought?**

- Back to 'Normal': Collaboration between high- and low-income countries. Researchers collaborating with implementing partners. International agencies. Research will remain quite fragmented. In order to contribute to global preparedness, partnering internationally should be a condition.
- Infectious Nationalism: Partners within the funder's country. Researchers collaborating with implementing partners. Military. Research will remain quite fragmented. In order to contribute to global preparedness, partnering internationally should be a condition.

- GAFA Rule: Partnerships with private sector. Billionaires. Innovators with state- and community-based implementors. Private-sector research teams or academically affiliated groups. Public health sector-focused research is limited and disconnected. International partnerships of LMICs with philanthropists.

At the end of this exercise, SAG members were split into two main groups to undertake the fourth exercise.

## Exercise D: Exploring the Research Priorities in 2030

Building on the outcomes of the previous steps, SAG members were split into two groups in order to provide inputs on research priorities in 2030. Each group focused on a set of two scenarios, one of which – GAFA Rule – was common across the two groups. Group A considered the Back to 'Normal' and GAFA Rule scenarios, while Group B focused on the Infectious Nationalism and GAFA Rule scenarios. GAFA Rule was placed in both groups primarily because of the funding levels (25% vs. 100% funding in Group A and 50% vs. 100% in Group B). This meant that both groups were obliged to consider a scenario with reduced funding and a scenario with sustained funding.

Then, each group analysed the current level of funding and priorities (Table 1), while studying the storyline template for their scenarios and how they unfolded in time between 2021 and 2030 (Figures 9 and 10) in order to provide a response to the following strategic questions:

- Which research area has received the most funding in this scenario in 2022–2030?
- Which research area is underattended to over the past 9 years, in terms of funding, in this scenario?
- Which new research area would need to be prioritised for 2022–23 if this scenario were to unfold in 2030?

## CURRENT FUNDING AND PRIORITIES - STATUS 8 APRIL 2021

| CATEGORIES | VALUE $ $5.4bn | PROJECTS ($/project) | PRIORITY funding vs.#Projects |
|---|---|---|---|
| VACCINE R&D | 1.600.1m | 373 (4.29m/project) | 1st vs.7th |
| CLINICAL CHARACTERISATION & MANAGEMENT | 1.106.4m | 1963 (0.56/project) | 2nd vs.3rd |
| VIRUS: DIAGNOSTICS, NATURAL HISTORY, TRANSMISSION... | 767.0m | 2290 (0.33/project) | 3rd vs.2nd |
| SOCIAL SCIENCE | 668.7m | 3274 (0.20/project) | 4th vs.1st |
| THERAPEUTICS R&D | 615.0m | 1201 (0.51/project) | 5th vs.6th |
| EPIDEMIOLOGICAL | 307.2 m | 1256 (0.24/project) | 6th vs.5th |
| INFECTION PREVENTION & CONTROL | 262.8m | 1383 (0.19/project) | 7th vs.4th |
| ETHICS CONSIDERATIONS | 32.2 m | 162 (0.20/project) | 8th vs.8th |
| ANIMAL & ENVIRONMENT | 16.7 m | 81 (0.21/project) | 9th vs.9th |

Source: UKCDR and GloPID-R COVID-19 Project Tracker

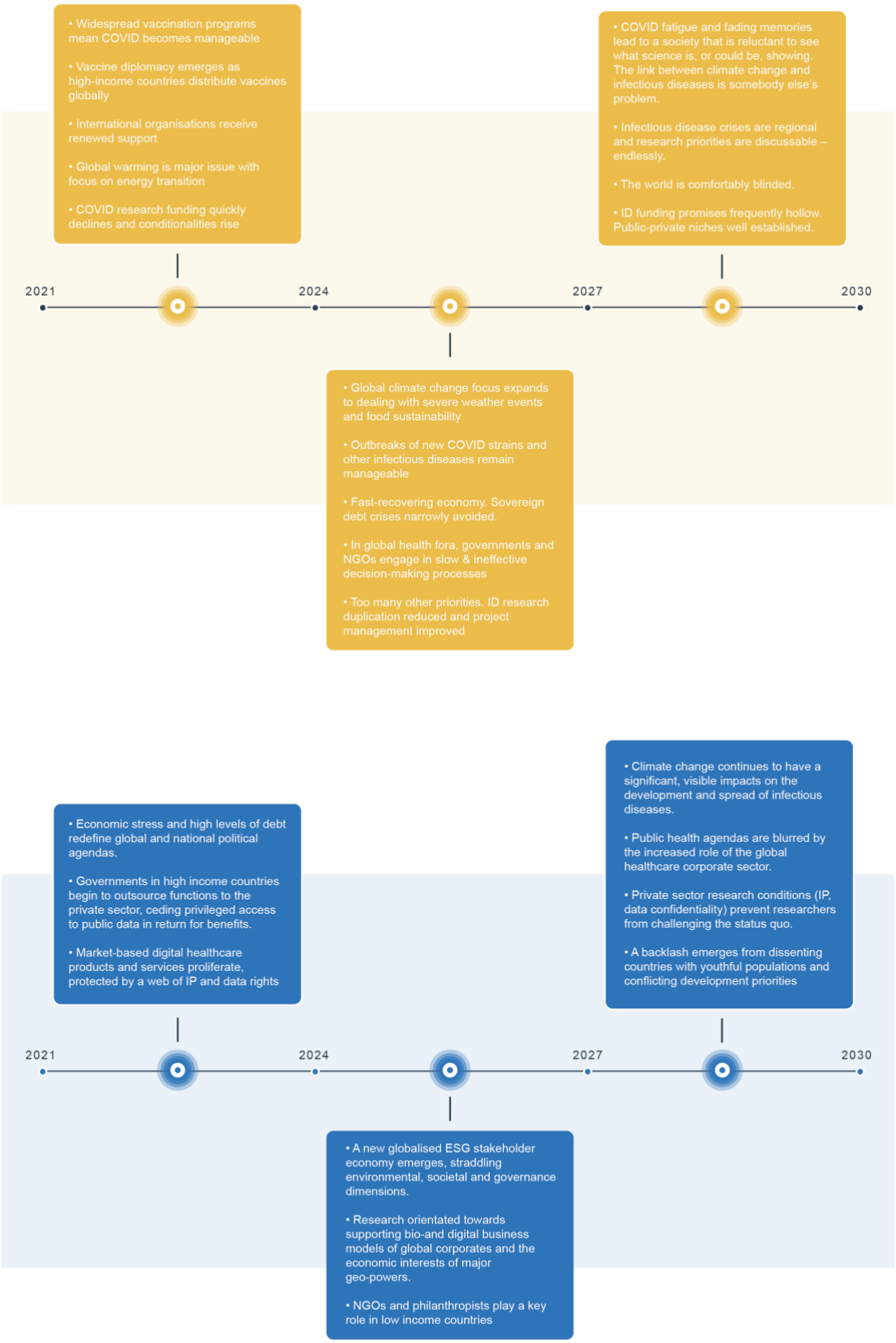


FIGURE 9: STORY LINE TEMPLATE IN GROUP A ( BACK TO NORMAL AND GAFA RULE )

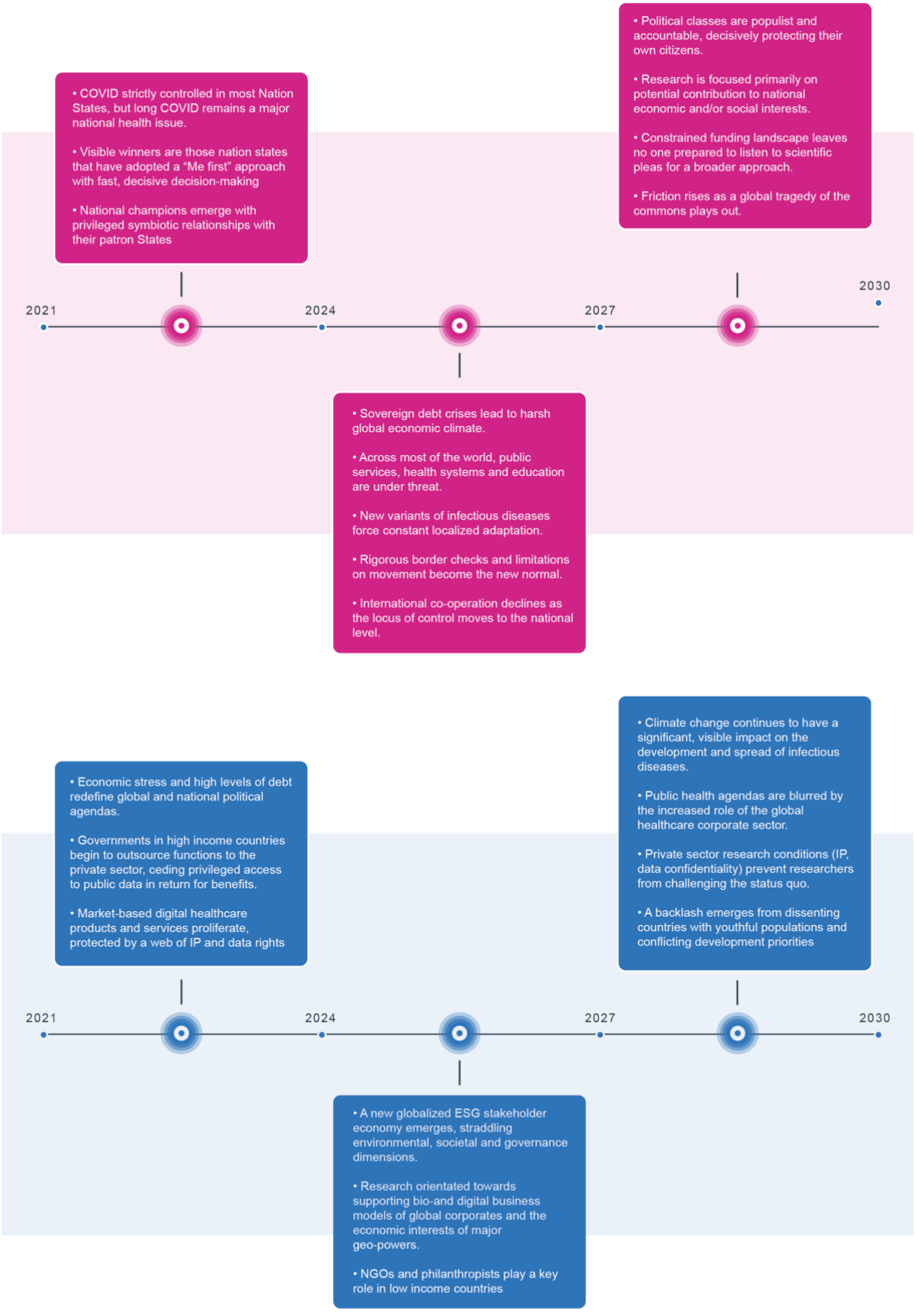


FIGURE 10: STORYLINE TEMPLATE IN GROUP B (INFECTIOUS NATIONALISM AND GAFA RULE)

The results of Exercise D are shown below.

**Group A**

Which research area has received the most funding in this scenario in 2022–2030?

- Back to 'Normal': Vaccine efficacy studies, vaccines R&D variants, vaccines and clinical research, longitudinal immunity studies, and Solidarity trials. SAG members highlighted that in this scenario, innovation continues for vaccines in the private sector, but public and international infectious diseases funding is redirected elsewhere. In addition, vaccine preparedness is linked to settings that cannot afford them.
- GAFA Rule: Vaccines and clinical (trial) research, AI, diagnostics R&D, therapeutics R&D, and tech-based infection prevention and control. SAG members highlighted that in this scenario, a lot of value is captured in vaccines, and that the tech world increases its hold on hospital data.
- Which research area is underattended to over the past 9 years in terms of funding in this scenario?
- Back to 'Normal': Human–animal interface, infection prevention, and basic epidemiological studies (transmission dynamics).
- GAFA Rule: Animal and environment, surveillance, epidemiology, ethics, social sciences, novel antivirals, and human–animal interface. SAG members noted that while vaccines remain a self-perpetuating business given their constant need, anti-viral drugs are not.

Which new research area would need to be prioritised for 2022-23 if this scenario were to unfold in 2030?

- Back to 'Normal': Animal and environment, animal and environment combined with climate, and social sciences.
- GAFA Rule: Social sciences, public health and social measures research, ethical considerations, and animal and environment combined with climate.

**Group B**

Which research area has received the most funding in this scenario in 2022–2030?

- Infectious Nationalism: Private tech and pharma with nationalist focus on deliverables and IP, reinforcement of national production capacity (vaccines, drugs, and diagnostics), diagnostics and tools to help with surveillance to mitigate transmission from tourists and business, detection at borders, and any measure to enhance national security.

- GAFA Rule: Therapeutics, vaccines, and other 'products', information technology for surveillance, and digital tech, e.g., help with surveillance and clinical tools.

Which research area is underattended to over the past 9 years in terms of funding in this scenario?

- Infectious Nationalism: Animal and environment, global surveillance and epidemiology, ethics, and social sciences. All factors relevant for security-driven considerations. LMICs.
- GAFA Rule: Animal and environment, global surveillance and epidemiology, ethics, social sciences. All in favour of the above for security-driven considerations. Individual-level outcomes and impact.

Which new research area would need to be prioritised for 2022-23 if this scenario were to unfold in 2030?

- Infectious Nationalism: Impact of border closure, diagnostics and surveillance, collaboration and technology transfer across nations, and flexible micro-factory production tools (molecular-based platforms for vaccines, diagnostics, and even therapeutics, where a device could be developed simply based on genomic information).
- GAFA Rule: Open IP sharing, ethics, digital tools for all aspects of prevention and response, and climate change and its impact on infectious diseases.

At the end of this exercise, SAG members reconvened in plenary, and each group reported back to all members, sharing their insights and participating in the subsequent exercise.

## Exercise E: Exploring the Efficiency of Current Funding

During the fifth exercise, the reconvened SAG members engaged in exploring the efficiency of the current levels of COVID funding against the research priority areas outlined in the 2020 WHO R&D Roadmap. The members were first invited to look at the estimate for today's funding efficiency (pre-filled based on comparative estimates to provide a reference point), and then, to move and place a red dot for each research area where they thought it was more relevant (Table 2). Funding efficiency represented the proportion of funded studies producing novel and translatable results. As an indication, the percentage is lower if there is superfluous duplication, or if studies are statistically underpowered and/or poorly designed. SAG's indications were then used for the final exercises.

**EXERCISE E: EFFICIENCY OF COVID FUNDING**

| CATEGORIES | VALUE $ | LOWER | ESTIMATED EFFICIENCY | HIGHER |
|---|---|---|---|---|
| VACCINE R&D | 1.600.1m | | 40% | |
| CLINICAL CHARACTERISATION & MANAGEMENT | 1.106.4m | | 50% | |
| VIRUS: DIAGNOSTICS, NATURAL HISTORY, TRANSMISSION… | 767.0m | | 60% | |
| SOCIAL SCIENCE | 668.7m | | 50% | |
| THERAPEUTICS R&D | 615.0m | | 30% | |
| EPIDEMIOLOGICAL | 307.2 m | | 60% | |
| INFECTION PREVENTION & CONTROL | 262.8m | | 50% | |
| ETHICS CONSIDERATIONS | 32.2 m | | 90% | |
| ANIMAL & ENVIRONEMENT | 16.7 m | | 90% | |

TABLE 2: ESTIMATION OF 2021 COVID FUNDING EFFICIENCY

A future piece of work on funding efficiency, which would be more exact, could be to see which parts of the WHO 2020 R&D Agenda are repeated in the 2021 revision.

## Exercise F: GloPID-R Research Priorities in 2022-23

For this exercise and the two subsequent back-casting exercises, SAG members were again split into the same two groups, each comprised of the two scenarios previously identified (Group A and Group B).

Within each group, SAG members reviewed the research priorities that emerged in the two scenarios by 2030. Then, for each research area, they discussed and agreed on what should be the GloPID-R research priorities in 2022-23 if this scenario were to unfold (Tables 3 and 4). As an indication, upward arrows mean that GloPID-R will seek to increase spending in this area above the 2020-21 level. Downward arrows mean a reduction in funding, and a double arrow means trying

to keep the spending at roughly the same level. Through this exercise, Group A and Group B came up with the following results.

### Group A: Back to 'Normal' and GAFA Rule

**GROUP A: BACK TO 'NORMAL' AND GAFA RULE**

| CATEGORIES | 2020-2021 $2.7bn/annum | 2030 BACK TO 'NORMAL' $0.7bn/annum | 2022/23 BACK TO 'NORMAL' GLOPID-R | 2030 GAFA RULE $2.7bn/annum | 2022/23 GAFA RULE GLOPID-R |
|---|---|---|---|---|---|
| VACCINE R&D | 800m | ↓ | ↓↓ | ↑ | ↓ |
| CLINICAL CHARACTERISATION & MANAGEMENT | 553m | ↓ | | ↓ | ↑ |
| VIRUS: DIAGNOSTICS, NATURAL HISTORY, TRANSMISSION... | 384m | ↓ | ↓ | ↑ | ↑ |
| SOCIAL SCIENCE | 334m | ↓ | ↓ | ↔ | ↑ |
| THERAPEUTICS R&D | 308m | ↔ | ↓ | ↑ | ↑↓ |
| EPIDEMIOLOGICAL | 154m | ↓ | ↓ | ↔ | ↑ |
| INFECTION PREVENTION & CONTROL | 131m | ↓ | ↓ | ↑ | ↑ |
| ETHICS CONSIDERATIONS | 16m | ↑ | ↑ | ↑ | ↑ |
| ANIMAL & ENVIRONMENT | 8m | ↔ | ↑ | ↑↑ | ↑ |

TABLE 3: GLOPID-R RESEARCH PRIORITIES IN 2022-23 ACCORDING TO GROUP A

Back to 'Normal'

According to Group A, funding levels for almost all research priorities would decrease in 2022-23 in the Back to 'Normal' scenario. The only exceptions to these trends would be Ethical considerations and Animal and Environment, whose levels of GloPID-R funding would instead increase (in part because the current low levels mean that an increase in funding for these categories may have a proportionally greater impact than increases for other priorities). However, it is worth noting that in such a scenario, vaccine standardisation and independent evaluation should remain a priority. There was also a recognition that funding levels for both Vaccines R&D and Clinical characterisation and management would go down given the limited overall budget. However, given their centrality, efforts to keep funding Vaccines R&D and Clinical characterisation and management research projects should be made by GloPID-R.

GAFA Rule

Group A indicated that funding levels for nearly all research priorities would go up in a 2022-23 in the GAFA Rule scenario. In such a case, the only exceptions would be for Vaccines R&D and Therapeutics R&D. However, caveats and additional details apply as well. For Vaccines R&D, the SAG members indicated that standardisation and independent evaluation should remain funded as well as research on strain surveillance and characterisation. For Virus diagnostics, the SAG suggested that GloPID-R should focus on low-cost (cost reduction) and/or socially innovative (e.g., citizen science) solutions to infectious diseases challenges that can be used by all. Regarding Epidemiological research, the SAG highlighted the equality issue as a high priority for GloPID-R. Finally, regarding Animal and Environment, the members recommended that more emphasis be put on independent non-commercial funding.

Overall, in a GAFA Rule scenario, GloPID-R should pursue a common non-commercial good as a strategic priority in 2022-23. Notably, the SAG highlighted that preparedness and diseases X would remain cross-cutting priorities across the nine research priority areas.

### Group B: Infectious Nationalism and GAFA Rule

**GROUP B: INFECTIOUS NATIONALISM AND GAFA RULE**

| CATEGORIES | 2020-2021 $2.7bn/annum | 2030 INFECTIOUS NATIONALISM $1.35bn/annum | 2022/23 INFECTIOUS NATIONALISM GLOPID-R | 2030 GAFA RULE $2.7bn/annum | 2022/23 GAFA RULE GLOPID-R |
|---|---|---|---|---|---|
| VACCINE R&D | 800m | ↑ | ↓ | ↑ | ↓ |
| CLINICAL CHARACTERISATION & MANAGEMENT | 553m | ↓↑ | ↔ | ↓↑ | ↔ |
| VIRUS: DIAGNOSTICS, NATURAL HISTORY, TRANSMISSION... | 384m | ↓↑ | ↔ | ↑ | ↔ |
| SOCIAL SCIENCE | 334m | ↓ | ↔ | ↔↓ | ↑ |
| THERAPEUTICS R&D | 308m | ↑ | ↓ | ↑ | ↓ |
| EPIDEMIOLOGICAL | 154m | ↓ | ↑ | ↔↓ | ↔ |
| INFECTION PREVENTION & CONTROL | 131m | ↓ | ↔ | ↑ | ↔ |
| ETHICS CONSIDERATIONS | 16m | ↓ | ↑ | ↑↓ | ↑ |
| ANIMAL & ENVIRONMENT | 8m | ↓ | ↑ | ↑↑↓ | ↑ |

TABLE 4: GLOPID-R RESEARCH PRIORITIES IN 2022-23 ACCORDING TO GROUP B

Infectious Nationalism

According to Group B, three research priority areas would see their funding levels increased in 2022-23 in the Infectious Nationalism scenario. These areas are Epidemiological research (funding in relation to implementation and information-sharing systems), Ethical considerations, and Animal and Environment. On the other hand, two areas would see decreased levels of funding: Therapeutics R&D and Vaccines R&D. For Vaccines R&D, the SAG stressed that some level of funding would still be required to enhance vaccine equity and to deal with new strains. At the same time, the SAG suggested that this area might be covered by market forces, and so, the focus enlarged to emerging diseases and was not uniquely on COVID.

Overall, in this scenario, research on impact, implementation, and knowledge transfer is missing for all themes. The aim is to develop tools (through market forces), so research would need to focus on implementation in vulnerable populations within states and between states.

GAFA Rule

A common feature shared with the 2022-23 Infectious Nationalism scenario is that research on implementation is missing throughout all research priority areas. In terms of variations in research funding levels, there is almost no difference between a 2022-23 GAFA Rule scenario and a 2022-23 Infectious Nationalism scenario. The only differences are in the level of social sciences funding, which is set to increase in a 2022-23 GAFA Rule scenario, and the level of Epidemiological research funding, which will not increase or decrease in a 2022-23 GAFA Rule scenario. In terms of implementation, tools will be developed through market demand, but funding needs to focus on getting tools on the ground.

## Exercise G: Emergent Research Priorities for 2022-23

In this exercise, Group A and Group B were invited to discuss and review the emergent research priorities of 2020-21[17]. Individually, and for each research area, they allocated up to three dots to each column in a given template, which provided the overall level of funding for these areas. This exercise was undertaken to identify what would be the GloPID-R emergent research priorities for 2022-23 if a specific scenario were to unfold. In addition, SAG members were invited to highlight

[17] These are the priorities that emerged from the UKCDR Tracker. They represent categorisation of projects where there is significant funding for COVID-19, but they map outside the WHO/GloPID-R priorities. Norton, A., Bucher, A., Antonio, E., Advani, N., Grund, H., Mburu, S., Clegg, E., Gollish, M., Jabin, N., Scott, L., Boily-Larouche, G., Lay, A. M., Carson, G., & Tufet Bayona, M. (2021). A living mapping review for COVID-19 funded research projects: Six-month update. *Wellcome Open Research*, 5, 209. https://doi.org/10.12688/wellcomeopenres.16259.3

any concern or missing area. See Table 5 for Group A's emergent priorities and Table 6 for Group B's emergent priorities.

**Group A**

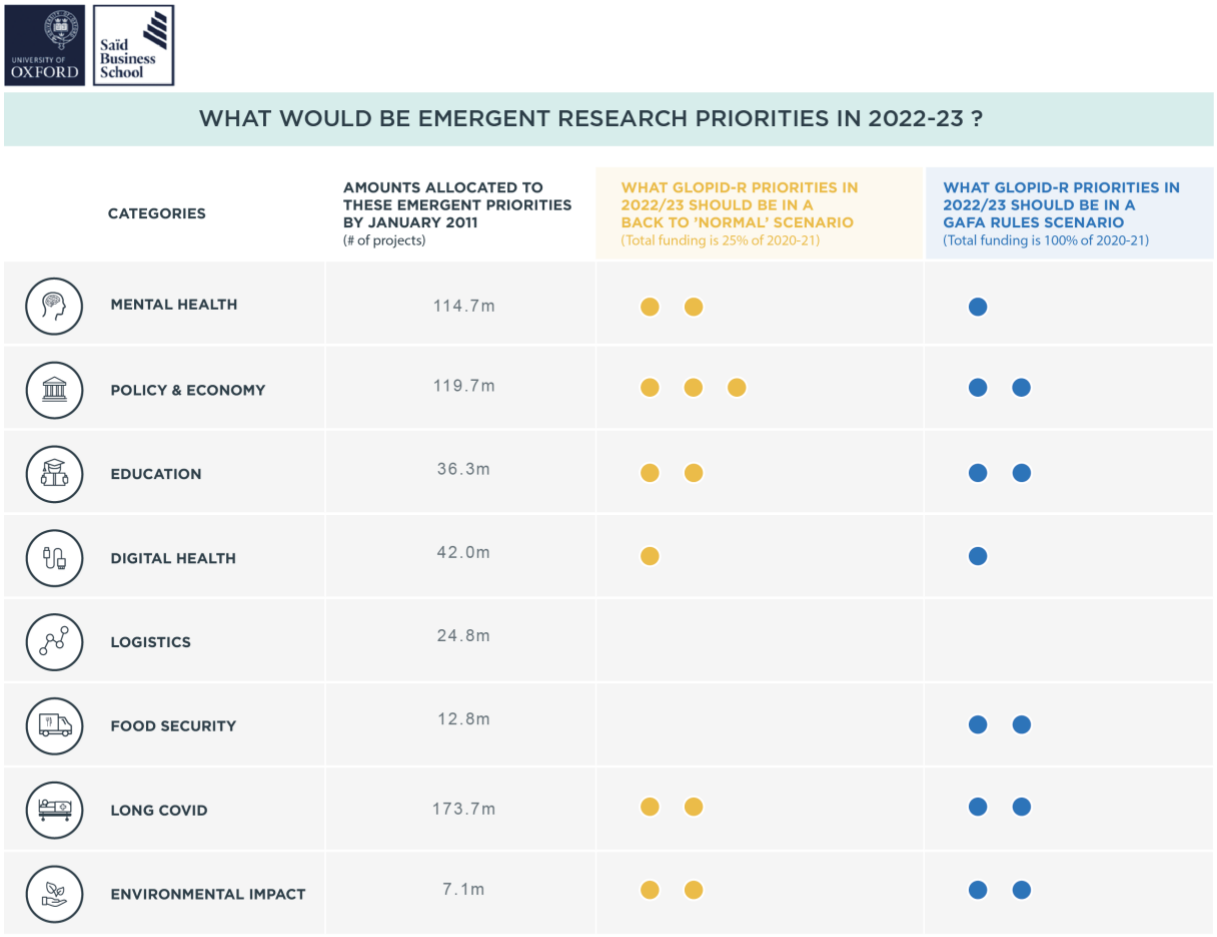


Table 5: Emergent research priorities for 2022-23 in the Back to 'Normal' and GAFA Rule scenarios according to group A

Back to 'Normal'

For the Back to 'Normal' scenario, the most important emergent research priorities were Policy and Economy (three dots), Education, Long COVID, Environmental Impact, and Mental Health (two dots each), and Digital Health (one dot).

GAFA Rule

For the GAFA Rule scenario, five emergent research priorities were assigned the same weight (two dots each): Policy and Economy, Education, Food Security, Long COVID, and Environmental Impact. Digital health and Mental Health were assigned one dot each.

**Several missing areas were highlighted**: how research funders can best collaborate and optimise their investments for impact (e.g., science for global cooperation and science of science funding), joint rapid funding mechanism, human genomics, capacity to build preparedness networks ready to pivot against diseases X, and the ability to come up with a visionary preparedness agenda for the future (moonshot ideas for emerging infectious diseases preparedness).

**Group B**

WHAT WOULD BE EMERGENT RESEARCH PRIORITIES IN 2022-23 ?

| CATEGORIES | AMOUNTS ALLOCATED TO THESE EMERGENT PRIORITIES BY JANUARY 2011 (# of projects) | WHAT GLOPID-R PRIORITIES IN 2022/23 SHOULD BE IN A INFECTIOUS NATIONALISM SCENARIO (Total funding is 50% of 2020-21) | WHAT GLOPID-R PRIORITIES IN 2022/23 SHOULD BE IN A GAFA RULES SCENARIO (Total funding is 100% of 2020-21) |
|---|---|---|---|
| MENTAL HEALTH | 114.7m | | |
| POLICY & ECONOMY | 119.7m | | ● ● |
| EDUCATION | 36.3m | | |
| DIGITAL HEALTH | 42.0m | ● | ● |
| LOGISTICS | 24.8m | ● ● | ● |
| FOOD SECURITY | 12.8m | | |
| LONG COVID | 173.7m | | |
| ENVIRONMENTAL IMPACT | 7.1m | ● | |
| IMPLEMENTATION OF INTERVENTIONS AND TOOLS ( vaccines, therapeutics, diagnostics, PPE ) | - | ● ● | ● ● |

TABLE 6: EMERGENT RESEARCH PRIORITIES FOR 2022-23 IN THE INFECTIOUS NATIONALISM AND GAFA RULES SCENARIOS ACCORDING TO GROUP B

Source: Glopid-R database

Infectious Nationalism

For the Infectious Nationalism scenario, two emergent research priorities were assigned the same weight: Logistics and Implementation of Interventions and Tools (vaccines, therapeutics, diagnostics, and PPE), with two dots each. Other less-urgent priorities were Digital Health and Environmental Impact (with one dot each).

GAFA Rule

For the GAFA Rule scenario, two emergent research priorities were assigned the same weight: Policy and Economy, and Implementation of Interventions and Tools (vaccines, therapeutics, diagnostics, and PPE), with two dots each. Digital Health and Logistics were assigned one dot each.

**Implementation of Interventions and Tools** was a missing area of research, and nonetheless, it figured consistently across the two scenarios as one of the most urgent research priorities for GloPID-R to address. In particular for GAFA Rule, it was suggested that Implementation of Interventions and Tools would be granted a large amount of funding. Digital Health was seen as an area in which GloPID-R might lead. Political considerations remain preeminent in the Infectious Nationalism scenario, while the nature of public-private research collaboration, including its ethical dimension, were predominant in the GAFA Rule scenario.

Taken together, Group A and Group B both suggested that the top three emergent research priority areas or groups for GloPID-R in 2022-23 will be:

- Policy & Economy (7 dots);
- Environmental Impact (5 dots);
- Education, Digital Health, Implementation, and Long COVID (4 dots each).

## Exercise H: Moonshot Ideas

In the final and concluding exercise, each group was asked to quickly suggest or advance ideas for projects for each scenario.

Cross-cutting all scenarios

- Create an ambitious worldwide surveillance system to map the spread of known diseases and anticipate the emergence of related agents (biological surveillance) and new emerging agents (syndromic surveillance).
- Do for antivirals in the 21$^{st}$ century what has been done for antibiotics in the 20$^{th}$ century (taxonomic approach, not only based on the last disease) in order to be able to face any new emerging viral pathogen.

Back to 'Normal' and GAFA Rule

- Global network of centres of excellence for pandemic preparedness research; one or two multidisciplinary One Health teams with good geographic coverage working on a joint collaborative preparedness research agenda, including risk-targeted surveillance, discovery, and embedded outbreak research; and partnership with clinical networks and public health networks.

- Prepare for regional or global crises resulting from infectious disease outbreaks in the changing world, with emphasis on hot spots for disease emergence and spread, and develop novel approaches for forecasting, early detection, risk mitigation, and citizen education for preparedness and response plans.
- One Health approaches to preventing the next pandemic by reducing risk factors for zoonosis and antimicrobial resistance.

Infectious Nationalism and GAFA Rule

- Implementation of existing COVID tools and interventions to utilise existing surveillance data and social/political/economic context to achieve an effective localized response, with the effectiveness of the response being measured in terms of reduced SARS-CoV-2 transmission and improved livelihoods, and transfer and adaptation of best practices to LMICs.

GAFA Rule only

- RAPID mechanism to develop broad-spectrum antivirals, protect the economy (develop a library of antivirals for high-threat pathogens and possibly stockpile these drugs).
- Global surveillance network (including surveillance for variants) with embedded capacity strengthening.
- Social/non-pharma interventions for pandemic preparedness and response.
- Creating global public goods for global equity.
- Innovative business models for doing well by doing good.

Not assigned to any scenario

- Infrastructure for data and sample sharing (including capacity strengthening for data analytics and sharing).
- New conceptions of IP, technology transfer, and data sovereignty that better produce social goods than the current patent/trademark/copyright/trade-secrets system.
- How to achieve global cooperation on health in a hyperpolarized world?
- Strengthening regional research to policy uptake.

**FINAL NOTE**

There is an acknowledgement amongst the SAG that they are a small group and that these scenarios and the recommendations identified may differ if the SAG were larger and if they had more time to undertake this work.

These scenarios are not the end of this process, but **instead the beginning of a learning process and a strategic conversation** with and within the global health funders community. Therefore, these scenarios would need to be updated regularly and reframed to reflect new developments.