

P A N D E M I C

Supermind Activation

**FIRST  
FINDINGS**

**Millipore  
SIGMA**

 **MIT** CENTER FOR  
COLLECTIVE  
INTELLIGENCE

**community<sup>21</sup>  
biotechnology**

The life science business of Merck KGaA, Darmstadt, Germany  
operates as MilliporeSigma in the U.S. and Canada.

The MIT Center for Collective Intelligence, MIT Media Lab's Community Biotechnology Initiative, and MilliporeSigma—the life science business of Merck KGaA, Darmstadt, Germany—convened more than 180 experts and global leaders in science, healthcare, public policy, and other sectors for a three-week exercise to address the following challenge:

*How can we develop pandemic resilience—the ability for society to recover quickly from global disease outbreaks—both in resolving the current COVID-19 pandemic and in building the public health and other infrastructure to prepare for future pandemics?*

We activated our expert group—or 'Supermind', "a powerful combination of many individual minds" (Laubacher et al., 2020)—to share their ideas on how to address this challenge in five domain areas: (1) diagnostics and monitoring; (2) viral transmission control; (3) therapies and vaccines; (4) validating, sharing, and communicating scientific insights; and (5) pandemic preparedness.

Our experts submitted more than 200 contributions—ideas that covered a wide spectrum of topics, from identifying emerging, disruptive technologies to suggesting new modes of global, cross-sector collaboration that could strengthen healthcare systems. Using facilitated dialogue and natural language processing, and with an emphasis on impact and feasibility, we clustered these contributions into emergent, actionable themes, several of which we have highlighted within the document:

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## **Early warning signs of disease spread can be found in sewers, genomes, voices, internet searches, and other digital health breadcrumbs.**

Robust and reliable monitoring of infectious disease can provide the advance warning necessary to control and prevent outbreaks. The Supermind identified several surveillance methodologies that can provide the timely information needed to save lives. Analyzing the genomic content from our sewer systems can provide as much as a seven-day leading indicator of disease spread. Studying sewage from planes, trains, and other transportation could signal the need for passenger testing and tracing. A widespread sewage monitoring program could help establish a critically needed population baseline to help us identify new pathogen threats. Genomic epidemiology can help detect the emergence of viral variants that may be evading population herd immunity to motivate the development of new treatments and vaccines. Phylogenetic network analysis of viral genomes could help identify unreported cases in a population. Voice acoustics change when disease impacts respiratory function, so smartphones could be potential COVID-19 respiratory monitoring tools. A host of digital breadcrumbs—from internet searches to networked digital thermometers and device data from wearables—could be integrated into systemic "disease forecasting" approaches to detect community spread days or even weeks early.

## **Digital contact tracing with privacy protections could suppress the pandemic.**

Our mobile phones could contain the data necessary to trace and rapidly identify the contacts of infected individuals so they can isolate themselves from the population, halting spread of the disease. If every adult carried a device with digital contact tracing enabled, such an approach, combined with cutting edge privacy protections, could single-handedly control the pandemic without mass lockdowns or masks. The Supermind proposed several ways to enhance the impact and adoption of digital contact tracing. Data standards could be implemented to create interoperable, privacy focused contact tracing applications that share community data and update in real time. Tracing could be done "bi-directionally"—notifying both people who were recently exposed, along with the infected individuals—which, when done with digital exposure notification, could triple the probability of controlling outbreaks relative to current practice. Giving phones to every adult could not only increase the efficacy of digital contact tracing, but would also help bridge the digital divide for low income communities.

### **Accelerate therapy and vaccine clinical trials.**

The COVID-19 pandemic will ultimately be controlled with effective therapies and vaccines. Research suggests that only 10% of drugs make it to market after an arduous trial process which often takes decades (Bio, Biomedtracker, and Amplion, 2016). The experts proposed ways to accelerate clinical trials through global, harmonized protocols. Competitive barriers can be removed when possible to encourage the broad sharing of antiviral and vaccine candidate clinical trial data. Data standards should be unified to facilitate cross-institutional agreements. New safety testing methods could be conducted, for example using proteomics to detect warning signs of adverse immune responses, potentially markedly reducing the duration of clinical trials.

### **Create resilient supply chains.**

Manufacturing and supply chains matter. From personal protective equipment (PPE) to diagnostic tests, therapies, and vaccines, our ability to stockpile and rapidly produce the necessary materials, ingredients, and reagents is essential for resilience. Our experts emphasized employing decentralized manufacturing modalities and creating regional and local production hubs for stockpiling and emergency production. Critical materials should have manufacturing redundancy with multiple factories. In the event of emergency, flexible manufacturing is necessary: plans and standards should be in place to pivot production lines or re-purpose existing factories.

### **Include and empower marginalized and vulnerable communities.**

Marginalized communities—including ethnic minorities like African Americans, Latinx, American Indians, immigrant workers, and other indigenous groups—are not only disproportionately impacted by the pandemic, but have also historically been under-represented in pharmaceutical clinical trials and benefited least from translational research. These systemic problems require systemic solutions. The Supermind proposed building equity considerations into all pandemic research funding and implementation and ensuring representation from these communities in randomized clinical trials (RCTs). Community mobilization and education should be participatory at the grass-roots level and involve engagement with trusted local leaders. Effective implementation of policies and programs, like contact tracing, should be done collaboratively and with respect to cultural perspectives and communal needs and priorities. Communication strategies need to be community specific and foster equitable discussions amongst healthcare, governmental, and other stakeholders, taking into account language and accessibility needs.

### **Build better behaviors.**

Non-pharmaceutical interventions can save lives and can, in lieu of an effective therapy or vaccine, control the pandemic. Our experts proposed ideas to change public behavior, like encouraging mask adoption by partnering with fashion forward designers and influencers to make mask-wearing culturally normative. Education programs could be deployed to teach the public basic sterile techniques regarding PPE like masks and gloves. Campaigns to address major risk factors for COVID-19, like obesity, should be launched. Technologies should be developed to encourage good hygiene, like preventing face-touching and avoiding contact with commonly shared surfaces. Social scientists, psychologists, and cultural anthropologists should be mobilized to help shape messages and interventions in ways that people will hear, trust, and follow.

### **Build trust and dispel fear.**

Controlling outbreaks requires trust at multiple levels—among the public, government, public health experts, scientists, and other stakeholders. Successfully empowering the public with trustworthy, accurate, and scientifically validated information can help dispel fear and promote the social cohesion and actions necessary to control the pandemic. Our experts proposed myriad strategies for building trust amongst stakeholders. Participatory research methods could be used to incorporate the perspectives, needs, and concerns of community members. Multi-generational engagement could be fostered by empowering communal youth networks for outreach and distribution of information and services. Concerted efforts should be made to develop reliable, continuous communication methods with vulnerable communities that may, for example, have accessibility issues like poor access to internet or smartphones. National and global institutions that can communicate scientific facts, guidance, and advice should be established or reformed. Scholarly articles could include plain language summaries for the public. Visual designers could collaborate closely with researchers to help demystify scientific findings. Public health officials should have platforms to regularly engage with the public and help manage expectations.

We will expand upon and explore these themes in greater depth, in the context of a series of upcoming reports we will release that correspond to the domain areas listed at the opening of the brief.

## References:

Bio, Biomedtracker, and Amplion. (2016). *Clinical Development Success Rates 2006-2015*. <https://www.bio.org/press-release/bio-releases-largest-study-ever-clinical-development-success-rates>.

Malone, T. (2018) *Superminds: The Surprising Power of People and Computers Thinking Together*. Little, Brown and Company.

Laubacher, R., Giacomelli, G. Kennedy, K., Kong, D.S., Bachmann, A., Kramer, K....Malone, T. (2020). *Using a supermind to design a supermind: A case study of university researchers and corporate executives co-designing an innovative healthcare concept*. <https://cci.mit.edu/wp-content/uploads/2020/04/Using-a-supermind-to-design-a-supermind-A-case-study-of-university-researchers-and-corporate-executives-co-designing-an-innovative-healthcare-concept.pdf>.

## Appendix 1: Methodology

The Pandemic Supermind was activated as a crowdsourcing platform for collective thinking, created as an enabler to help identify critical, unmet needs to address COVID-19 and future pandemics. The platform engaged participants online over a three-week period, allowing a diverse and geographically separated group to work together conveniently, cost-effectively, efficiently, and rapidly.

By bridging specialties, disciplines, industries, and geographic boundaries with technology, the Pandemic Supermind Activation aimed to deliver deeper insights and more useful and trusted information to contribute to the current and future role of life sciences in pandemic resilience.

The process used natural language processing (NLP), in addition to facilitated dialogue, to identify themes in experts' contributions. These themes informed questions and prompts throughout the process, ensuring there were not any gaps during the three-week discussion and discovery period.

**Week 1:** Experts were asked to submit contributions in their domain areas, i.e., areas in which they were most comfortable. Even if a participant brought a perspective that was outside of the life sciences (say for example they were a tech writer), they were asked to weigh in on areas that they might know more about from the news, life experiences, or how their field could intersect or inform the domain.

**Week 2:** Members of the Supermind were then asked to submit contributions outside of their domain areas. They were prompted to think creatively, and suggest ideas that were outside of the box. The hope was that this would expand the breadth of ideas and push the boundaries of domain bias.

Throughout the process, participants were asked to like and comment on others' contributions to highlight areas of opportunity or signify their support.

**Week 3:** Participants had the ability to vote on groups of contributions created by clustering the ideas generated in weeks 1 and 2. Prior to the start of week 3, the contributions created during weeks 1 and 2 were clustered into groups. This was done by first using natural language process (NLP). The results of the NLP analysis were then reviewed by members of the CBI/CCI staff and a scientific advisory committee from MilliporeSigma, and 15 meta topics or categorizations were parsed out using two NLP methodologies: 1) topic modeling, and 2) word to vector (word-2-vec). Topic modeling looks at the frequency of words and phrases used, and clusters according to semantic patterns. Word-2-vec takes a large corpus of text, and by noting which words occur close together, is able to represent each word as multi-dimensional vectors. It can take new strings of text and assign them a position in the multi-dimensional space. Text strings can then be clustered with like groups based on their proximity. By doing an initial pass with topic modeling and then comparing this result with word-2-vec, we were able to get our final 15 groups of contributions. The advisory committee then created a description and title for each of these clusters.

The Supermind participants voted on which clusters they believe would have the most impact in building pandemic resilience, both in resolving the current COVID-19 pandemic and in building public health and other infrastructure to prepare for future pandemics.

Throughout the process, we also created social network graphs, which looked at participants by their sector and analyzed what contributions they were commenting on and liking. An interesting insight from this analysis was that participants were liking and commenting on not only contributions within their sector, but also contributions outside their own. Thus, there was significant cross-pollination between sectors.

**Appendix 2: Pandemic Supermind  
Activation by the numbers**

**Total Contributions:** 243  
**Total Supports (Likes):** 413  
**Total Comments:** 152  
**Total Votes:** 1,267

**Participants by sector**

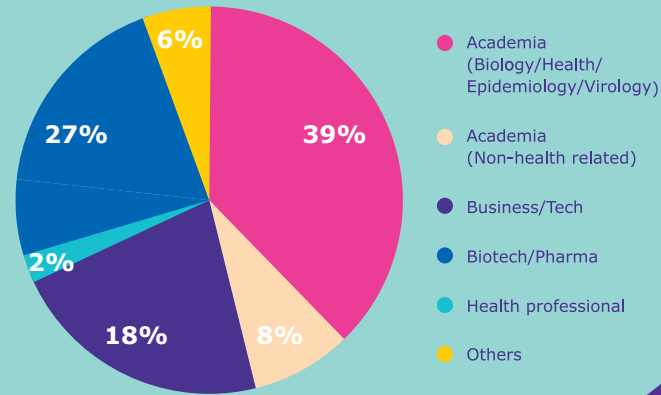


Figure 1: Participants by sector

**Most interacted with contributions**

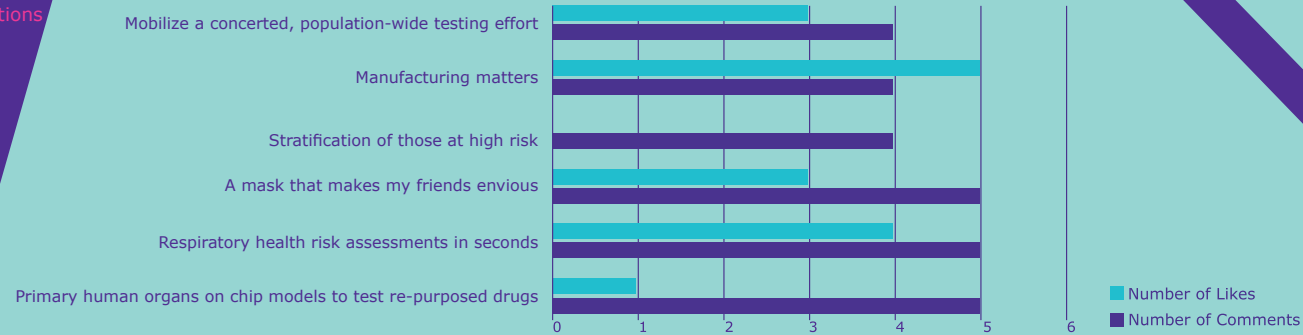


Figure 2: Most interacted with contributions

**Most impactful & feasible groups of contributions for present pandemic**

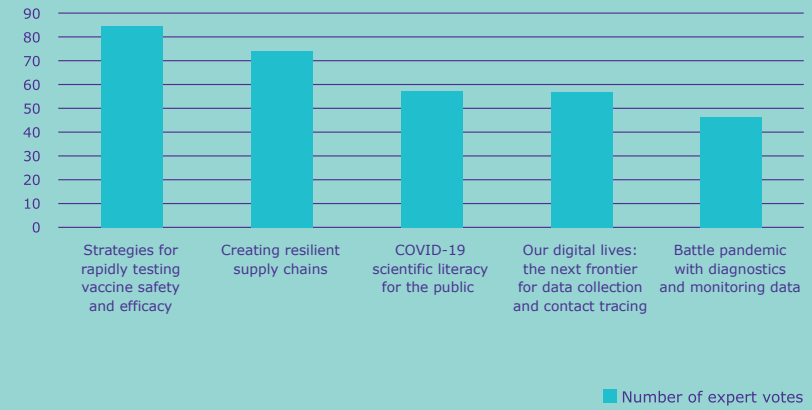


Figure 3: Most impactful & feasible groups of contributions for the present pandemic

**Most impactful & feasible groups of contributions for future pandemic resilience**

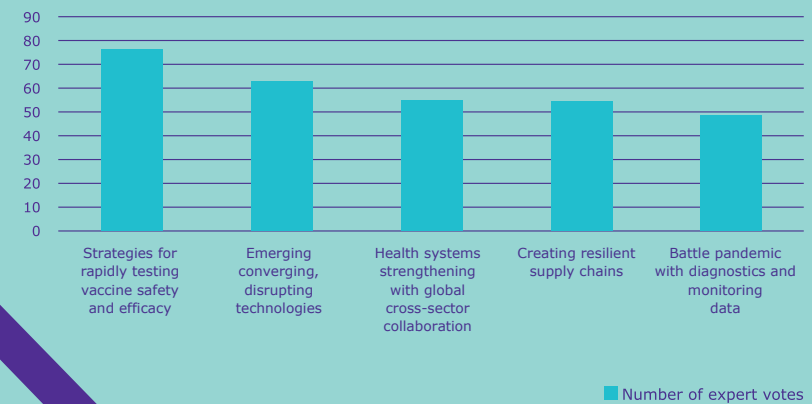
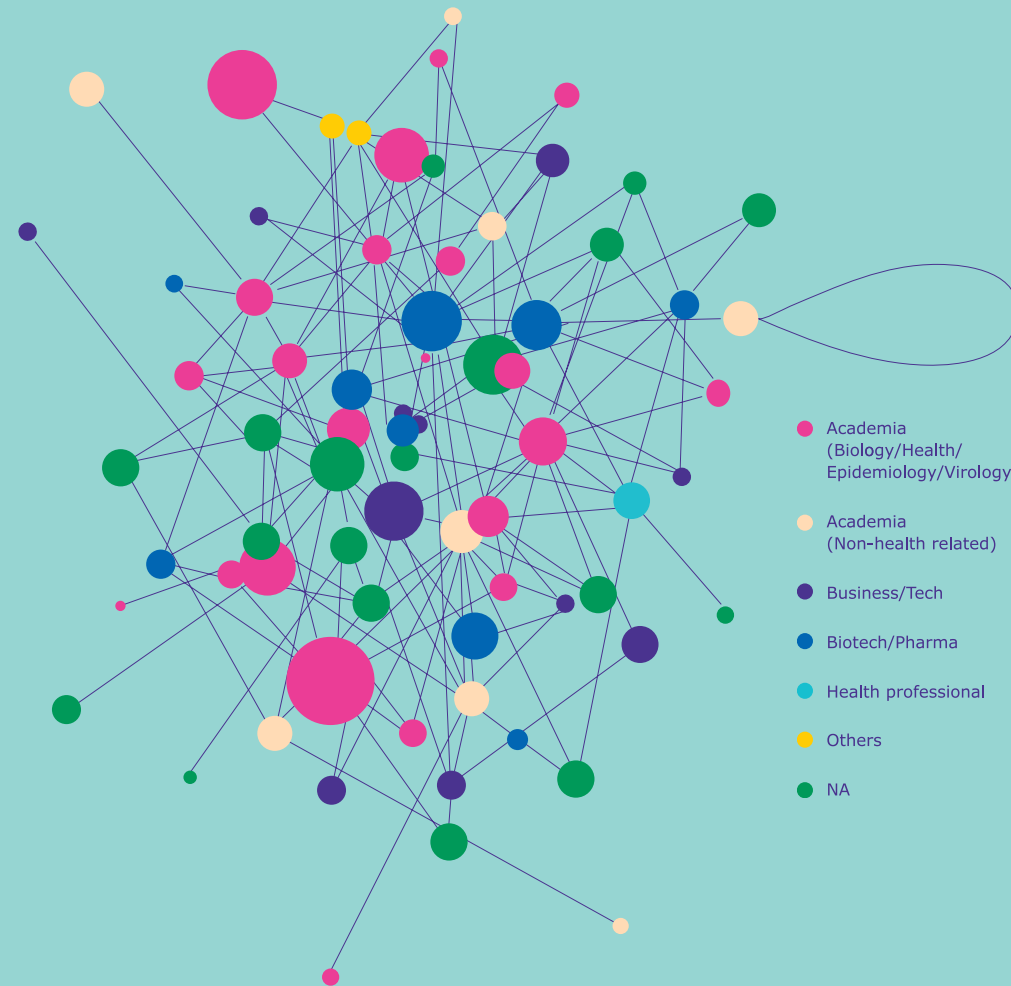


Figure 4: Most impactful & feasible groups of contributions for future pandemic resilience

## Social network graph of likes by participants by sector



## Appendix 3: Short list of Institutions of the Participants

- BI Lahey Health
- Boston Medical Center
- Stanford
- Brandeis University
- Institute of Natural Material Technology, TU
- Lysogene
- Wyss Institute
- University of Ghana
- MIT
- University of Iowa
- Longview Analytics
- University of Cambridge
- Takeda
- Deloitte
- Columbia University
- GenPact
- Boston Children's Hospital
- University of California San Diego
- Tel Aviv University
- University of Melbourne
- AAFOA
- Sonde Health
- MilliporeSigma



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