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USING COLLECTIVE INTELLIGENCE TO ASSESS THE FUTURE WITH THE PANDEMIC SUPERMIND

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The story

In early 2020, the COVID-19 pandemic threw the world into turmoil. Many grew ill, many lost lives and loved ones, and many others found themselves turning to virtual tools to meet everyday needs. As governments struggled to respond, we began to recognize how the policies in place were insufficient to uncover the most critical unmet needs – from vaccine manufacture and storage to contact tracing and Personal Protective Equipment supply. And as this public health crisis unfolded, our vulnerability to future such crises became painfully clear.

In May 2020, the MIT Center for Collective Intelligence (CCI), MIT Media Lab's Community Biotechnology Initiative (CBI), and MilliporeSigma (the life science business of Merck KGaA based in Germany) convened more than 180 experts and global leaders in science, healthcare, public policy, and other sectors to address this challenge: "How can we develop pandemic resilience—the ability for society to recover quickly from global disease outbreaks—both in resolving the Covid-19 pandemic and in building public health infrastructure to prepare for future pandemics?"

The use of information and communication technologies (ICTs) can be, as the COVID-19 crisis reaffirmed, a critical way to facilitate collaboration through virtual mediums. Collaborative tasks that once needed days of in-person meetings, workshops, interviews, and other physical interactions are now regularly accomplished asynchronously online through crowdsourcing. The MIT CCI aimed to harness the power of expert-based crowdsourcing, leveraged to develop scenarios for the future, as well as to spur critical conversations about unmet needs. Could these virtual collaborations imposed on so many by the COVID-19 crisis also help uncover policies to address the next crisis before it arrived?

To answer this question, the MIT CCI leveraged an open-source platform called xCoLab to combine the practice of expert-based crowdsourcing with problem solving and scenario planning. Scenario planning is a planification method based on identifying key drivers

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shaping the future and developing different plausible development scenarios based on those. We effectively used two approaches:

(1) Assessing critical unmet needs resulting from the Coronavirus pandemic (called the "Pandemic Supermind Activation" initiative), and
(2) Sourcing scenarios for the future concerning public trust in healthcare and medicine ("Trust CoLab").

Through two applications, namely the Pandemic Supermind Activation and the Trust CoLab, collective intelligence emerged in ways previously unseen.

To realize this collaboration, the consortium activated an expert network or "Supermind" – "a powerful combination of many individual minds" (Laubacher et al., 2020; Malone, 2018). This "Supermind" conceived ideas on how to address this public health challenge across five domains:

(1) Diagnostics and monitoring
(2) Viral transmission control
(3) Therapies and vaccines
(4) Validating, sharing, and communicating scientific insights, and
(5) Pandemic preparedness.

Assessing Strategies with the Pandemic Supermind

Using software-enabled discussions, the Pandemic Supermind was activated as a crowdsourcing platform for collective thinking. The platform engaged participants online over a three-week period. During the first two weeks, experts were asked to submit contributions to the platform that outlined important research, ideas, or themes within the pandemic. A Natural Language Processing (NLP) algorithm then clustered all contributions into 15 "meta-topics," subsequently reviewed by the organizing team.[1] In the final week, participants were asked to vote on the most important contributions from the previous two weeks, now clustered into thematic areas.

Over the duration of the exercise, experts submitted more than 200 contributions within the five domain areas. They also voiced their virtual support ("liking" numerous contributions submitted by others), suggested improvements in comment threads, and cast over a thousand votes on what contributions they found to be most impactful and feasible.

Examining comments and likes, it appeared that participants tended to like and comment on contributions outside their own specialty. Thus, we found significant cross-pollination between sectors, a result often difficult to achieve in traditional meeting formats.

The most impactful and feasible contribution, in the opinion of the network as a whole, concerned strategies for rapidly testing vaccine safety and efficiency. In essence, the experts agreed that the effective global distribution of safe vaccines would be the most important policy step in mitigating the COVID-19 crisis. Some experts suggested that using population-level statistics for clinical trials could be one approach to achieving this goal (Kong & Bachmann, 2020). In addition to this insight, the program team was able to report on a variety of further important critical unmet needs and approaches to creating pandemic resilience that could eventually be delivered to decision-makers to help inform approaches to the pandemic (Kong & Bachmann, 2020). This report was released online,[2] and was featured prominently in a series of public events with policymakers, scientists, researchers, industry

leaders, and members of the community to discuss how we can implement these findings at scale.

Anticipating challenges with the Trust CoLab

Preparing his community against the threat of fires, Benjamin Franklin once advised his fellow Philadelphians that "an ounce of prevention is worth a pound of cure."[3] Similarly, it may prove far less costly to anticipate public health challenges before they mushroom into a global crisis (Wimmer et al., 2012). Our hypothesis was that policymakers in the public health sector could benefit from forward-thinking analysis that considers external variables and trends in order to produce insights that can help make our systems more resilient against future threats (Laubacher et al., 2020). And as we observed during the COVID-19 crisis, the level of trust between citizens and public actors can have a dramatic impact on the effectiveness of public health measures, for good or for ill.

To begin to reflect on the future of trust in healthcare, U.S. Pharmacopeia (USP) and MIT CCI jointly launched Trust CoLab. This online platform engaged more than 100 global experts from a broad range of disciplines to collectively develop scenarios for potential futures and address the following questions: "What developments will shape people's health between now and 2040, and how will trust be critical in making sure these developments help people everywhere live longer and healthier?"

USP and MIT CCI guided the expert participants through a four-week exercise between October and November 2019, which was structured according to the four steps of scenario planning: (i) select the issues; (ii) analyze the areas of concern; (iii) organize the scenario around a logical concept; and (iv) focus the scenario (Schoemaker et al., 1992).

During the initial phase, the expert network was asked to identify drivers of change that could shape people's health and the future of trust in medicine and healthcare between now and 2040. Two hundred seventy-eight individual contributions were then clustered using a similar NLP process as the Pandemic Supermind Activation, employing a word-2-vec method,[4] and was done by the Trust CoLab organizing team with oversight from issue experts. Following this, participants were presented with 29 groups of drivers that had been organized into four overarching categories – external forces; non-healthcare technologies; healthcare trends; and new therapies – and asked to give their feedback and vote for the areas of greatest potential impact on public health by 2040. In total, 18 highest-priority items were selected by the network.

In step 3 of the scenario planning process, the future scenarios were developed. Participants' voting and comments on the groups of drivers served as a basis for 14 different scenario axes. All participants commented on the uncertainties described by the axes and indicated their support for the actions they thought could produce the most valuable scenarios. Based on that input, organizers chose two axes that had attracted the greatest attention from participants and also showed potential to serve as the basis for an interesting set of scenarios. They arrayed those two uncertainties onto orthogonal axes, thereby outlining four potential future worlds that could emerge by 2040. The first axis/uncertainty concerned big data and artificial intelligence (AI), and how these technologies could facilitate radical medical advances in personalized medicine, gene-based prevention, diagnostics, and treatment. At one extreme, these anticipated innovations would deliver on their promise; at the other, the future would bring disappointments and slower-than-expected advances.

The second axis/uncertainty related to how broadly distributed new medical advances and access to care will be in the future. At one end of the spectrum, the future would

bring widened health disparities, with the most advanced treatments available only to the privileged; at the other extreme, the future would bring widespread, relatively equal access.

The other scenarios sketched out three potential futures:

1. Dangerous uncertainty: Problems with big data and AI lead to devastating healthcare failures, and the unequal distribution of access leads to a fragmentation of trust.
2. A world of difference: Successful application of big data and AI leads to rapid medical advances informed by genetic information, but disparities in access perpetuate a "haves" vs. "have nots" dynamic.
3. Solving tomorrow's problems: Advances in big data and AI help create effective, inexpensive genetic diagnostic tools and treatments that are broadly distributed (please see Figure 39.1 Scenarios developed in the Trust CoLab exercise below).

Ultimately, these scenarios highlighted potential future outcomes that, according to this diverse crowd of 100 experts, could enable strategic planning in a new way. The results were shared at TEDMED, a large conference held in Boston, MA for healthcare professionals, in 2020 with hopes that they would spur further conversations about the future of healthcare and medicine. Utilizing this type of expert-based crowdsourcing before global health crises arise would enable communities to anticipate and build policy mechanisms to respond before it is too late. While the Pandemic Supermind Activation showed us how to bring together a community to formulate a crisis response, Trust CoLab exhibits a forward-thinking approach to anticipate potential problems before they devastate the globe.

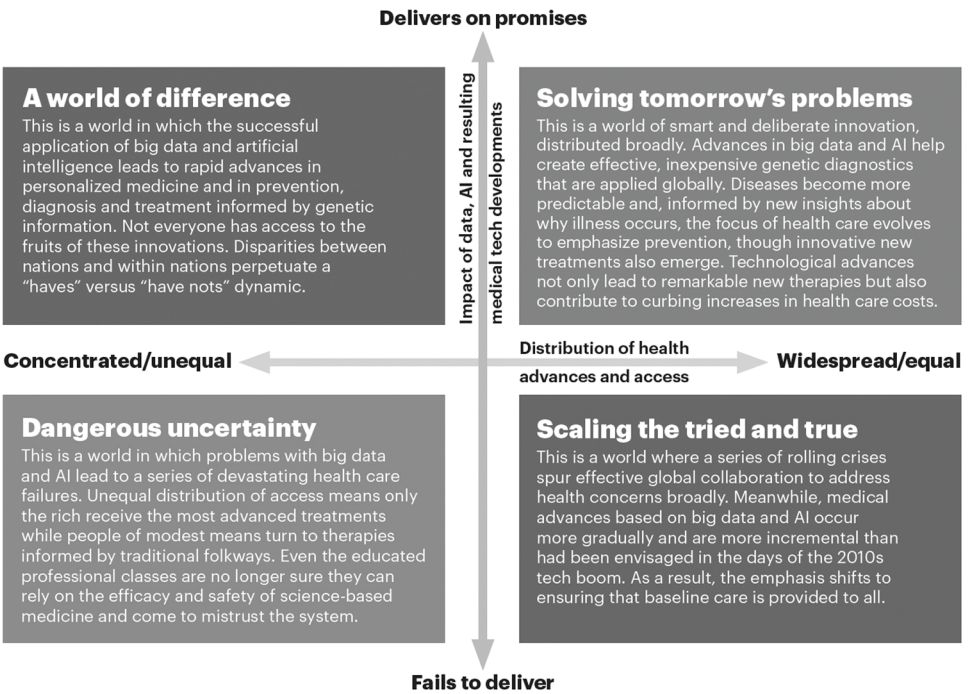

Figure 39.1 Scenarios developed in the Trust CoLab exercise.

What science tells us

Supermind – A Supermind is a group acting together in a way that is intelligent (Malone, 2018). Examples of Superminds can be found around the world within companies, governments, and markets. In essence, a Supermind is a collectively intelligent system (Malone, 2018).

Expert-based crowdsourcing – While many tasks can be solved by the knowledge of a broad and diverse crowd, some real-world problems require more technical or specialized knowledge (Retelny et al., 2014). One way to solve this type of problem is expert-based crowdsourcing. This particular form of crowdsourcing has already found its way into healthcare, and will continue to play a pivotal role in the future of healthcare advancement. For example, experts have been engaged to determine the relevance of genetic variants for different diseases (Griffith et al., 2017; Martin et al., 2019) or to design a system which supports the diagnosis and development of recommended actions for people (prone to) suffering from depression and their personal support network (Laubacher et al., 2020).

Scenario planning – In some cases, engaging experts can help to achieve insights about what might happen in the future. Scenario planning is a structured process to crowdsource the wisdom of experts in order to generate potential scenarios for the future. Scenarios are not exact predictions. Rather, they provide narratives about what *could* happen, recounted in detailed, alternative versions of the future (Laubacher & Star, 2020; Schwartz, 1991). This approach intends to open up people's minds and expand their thinking about the possibilities on the horizon. The underlying purpose of the exercise is that envisioning future possibilities more clearly can improve decision-making in the present (Laubacher & Star, 2020). In this sense, scenarios combine facts with the perceptions of potential decision-makers to produce insight (Wack, 1985b).

Natural Language Processing (NLP) – NLP is a type of AI that enables computers to analyze and summarize patterns found in spoken or written word (IBM, 2020). NLP is used to understand patterns in a variety of different fields, but it can serve an integral role within collective intelligence methodologies by allowing a quicker analysis of contributions. In instances of asynchronous collective intelligence activities before the widespread use of NLP, analysis of contributions was often done manually by organizers. With the help of the NLP methods described in the aforementioned exercises, organizers were able to visualize patterns of contributions quickly. This allows them to dig deeper into themes that could have been missed or would have taken far longer to find and analyze. NLP does not replace the need for all manual analysis in these activities, but rather, complements the organizers and provides process efficiency.

Do's and don'ts

Maximize diversity and accessibility – The fact that The "Pandemic Supermind Activation" Initiative and "Trust CoLab" were able to assemble over 100 experts from around the world is an unusual success. Organizers of similar activities should include experts from a variety of areas to increase the diversity of ideas and facilitate cross-pollination across disciplines. Additionally, the asynchronous nature of conversation allowed for experts across many time zones to participate when it suited their schedule. The platforms were very active, which shows the accessibility of these processes even when they involve professionals in demanding,

senior-level positions. Additional features such as liking or commenting on contributions can further increase engagement by lowering the time required of each individual.

Organizers need to ensure this flexible use of the platform through a low-touch process with intuitive features. Such features could include the following: making voting simple through a one-step button click, having a simplified comment or chat feature that doesn't require participants to log into the platform frequently to monitor responses, and creating templates for the contributions that are 200 words or less. The most important user design element is to ensure that participants can log on quickly and seamlessly from whatever location and device is convenient for them. In both use cases, experts were added to the platform by program management through a customized link sent to their inbox rather than going through the process of creating an account for themselves. The participants would stay logged into the platform throughout the duration of the exercise, as long as they were on the same device. The goal should be to make it as easy as possible for participants to log on and contribute in a couple of minutes.

Plan ahead for impact – In both exercises, The "Pandemic Supermind Activation" Initiative and "Trust CoLab", policymakers took part in the conversation at the conclusion of the process. These exchanges are only helpful, however, if they can be transformed into tangible action items for decision-makers. The potential to develop new strategies and highlight unforeseen areas of risk through scenario planning could enable us to foresee healthcare-based challenges before they wreak havoc on our societies. This future-oriented thinking could have positive downstream impacts on populations because it allows for a full risk analysis rather than rushed, reactive legislation. Nevertheless, these processes are only useful to the degree that policymakers are engaged at an early stage and manifest their commitment to take the resulting recommendations into account.

Expand to global systems – An underexplored area of opportunity for global policy lies at the systemic level: thinking about how the interdependencies of the health sector, the economy and society interact to enable new policy responses to global challenges. With the emergence of COVID-19, we witnessed the inability of current political institutions to create such a holistic plan of action. Collective intelligence methods such as platform-enabled expert crowdsourcing can provide the basis for more holistic and effective responses that, by operating on the level of complex systems, could better serve public needs.

Notes

1 The clustering was done by using natural language processing (NLP), producing 15 meta topics and using two NLP methodologies: (1) topic modeling which looks at the frequency of words and phrases used and clusters them according to semantic patterns; (2) word to vector ("word-2-vec"), that takes a large corpus of text, and by noting which words occur close together, represents 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. The NLP analysis was subsequently reviewed by individuals.
2 cci.mit.edu/pandemic-response-programs.
3 www.cam.ac.uk/research/news/ounce-of-prevention-pound-of-cure#.
4 According to Wikipedia (accessed April 22, 2022):

> Word2vec is a technique for natural language processing published in 2013. The word2vec algorithm uses a neural network model to learn word associations from a large corpus of text. Once trained, such a model can detect synonymous words or suggest additional words for a partial sentence. As the name implies, word2vec represents each distinct word with

a particular list of numbers called a vector. The vectors are chosen carefully such that a simple mathematical function (the cosine similarity between the vectors) indicates the level of semantic similarity between the words represented by those vectors.

References

Brabham, D. C. (2013). *Crowdsourcing*. MIT Press.

Evangelista, L., Steinhubl, S. R., & Topol, E. J. (2019). 'Digital health care for older adults'. *The Lancet, 393*(10180), 1493.

Griffith, M., Spies, N. C., Krysiak, K., McMichael, J. F., Coffman, A. C., Danos, A. M., ... & Barnell, E. K. (2017). 'CIViC is a community knowledgebase for expert crowdsourcing the clinical interpretation of variants in cancer'. *Nature Genetics, 49*(2), 170–174.

Howe, J. (2008). *Crowdsourcing: How the power of the crowd is driving the future of business*. Random House.

IBM. (2020). 'What is Natural Language Processing?' *IBM Cloud Education*. Retrieved from www.ibm.com/cloud/learn/natural-language-processing,

Kong, D.S. & Bachmann, A. (2020). 'Pandemic supermind activation first findings'. *MIT Center for Collective Intelligence, MIT Media Lab Community Biotechnology Initiative, and MilliporeSigma*.

Laubacher, R., Giacomelli, G., Kennedy, K., Kong, D. S., Bachmann, A., Kramer, K., … & Malone, T. W. (2020). 'Using a supermind to design a supermind: A case study of university researchers and corporate executives co-designing an innovative healthcare concept'. *MIT Center for Collective Intelligence, Massachusetts Institute of Technology*.

Laubacher, R. & Star, J. (2020). 'Trust or Consequences 2040: Will innovations in health and medicine deliver?' *US Pharmacopeia*.

Malone, T.W., Nickerson, J.V., Laubacher, R.J., Hesse Fisher, L., de Boer, P., Han, Y. & Towne, W.B. (2017). 'Putting the pieces back together again: Contest webs for large-scale problem solving'. MIT Center for Collective Intelligence Working Paper, 2017–001.

Malone, T. W. (2018). *Superminds: The surprising power of people and computers thinking together*. Little Brown and Company.

Malone, T. W., & Bernstein, M. S. (Eds.). (2015). *Handbook of collective intelligence*. MIT Press.

Malone, T. W., Laubacher, R., & Dellarocas, C. N. (2009). 'Harnessing crowds: Mapping the genome of collective intelligence'. MIT Center for Collective Intelligence Working Paper, Cambridge, MA, February 3, 2009. *MIT Sloan School of Management Research Paper* No. 4732–09.

Martin, A. R., Williams, E., Foulger, R. E., Leigh, S., Daugherty, L. C., Niblock, O., ... & Thomas, E. (2019). 'PanelApp crowdsources expert knowledge to establish consensus diagnostic gene panels'. *Nature Genetics, 51*(11), 1560–1565.

Nagendran, M., Chen, Y., Lovejoy, C. A., Gordon, A. C., Komorowski, M., Harvey, H., ... & Maruthappu, M. (2020). 'Artificial intelligence versus clinicians: systematic review of design, reporting standards, and claims of deep learning studies'. *BMJ*, *368*.

Retelny, D., Robaszkiewicz, S., To, A., Lasecki, W. S., Patel, J., Rahmati, N., ... & Bernstein, M. S. (2014, October). 'Expert crowdsourcing with flash teams'. *Proceedings of the 27th annual ACM symposium on User interface software and technology* (pp. 75–85).

Schoemaker, P.J. & van der Heijden, C.A. (1992). 'Integrating scenarios into strategic planning at Royal Dutch/Shell'. *Strategy & Leadership, 20*(3), 41–46.

Schwartz, P. (1991). *The art of the long view: Planning for the Future in an Uncertain World*. New York: Doubleday Currency.

Shell International (2008). *Scenarios: An explorer's guide*.

Wack, P. (1985a). 'Scenarios: Uncharted waters ahead'. *Harvard Business Review, 63*(5), 72–89.

Wack, P. (1985b). 'Scenarios: Shooting the rapids'. *Harvard Business Review, 63*(6), 139–150.

Wimmer, M.A., Furdik, K., Bicking, M., Mach, M., Sabol, T., & Butka, P. (2012). 'Open Collaboration in Policy Development: Concept and Architecture to Integrate Scenario Development and Formal Policy Modeling'. *Empowering Open and Collaborative Governance*, 199–219.

World Health Organization (2019). *WHO guideline: Recommendations on digital interventions for health system strengthening*. Available at: http://apps.who.int/iris/bitstream/handle/10665/311941/9789241550505-eng.pdf?ua=1.