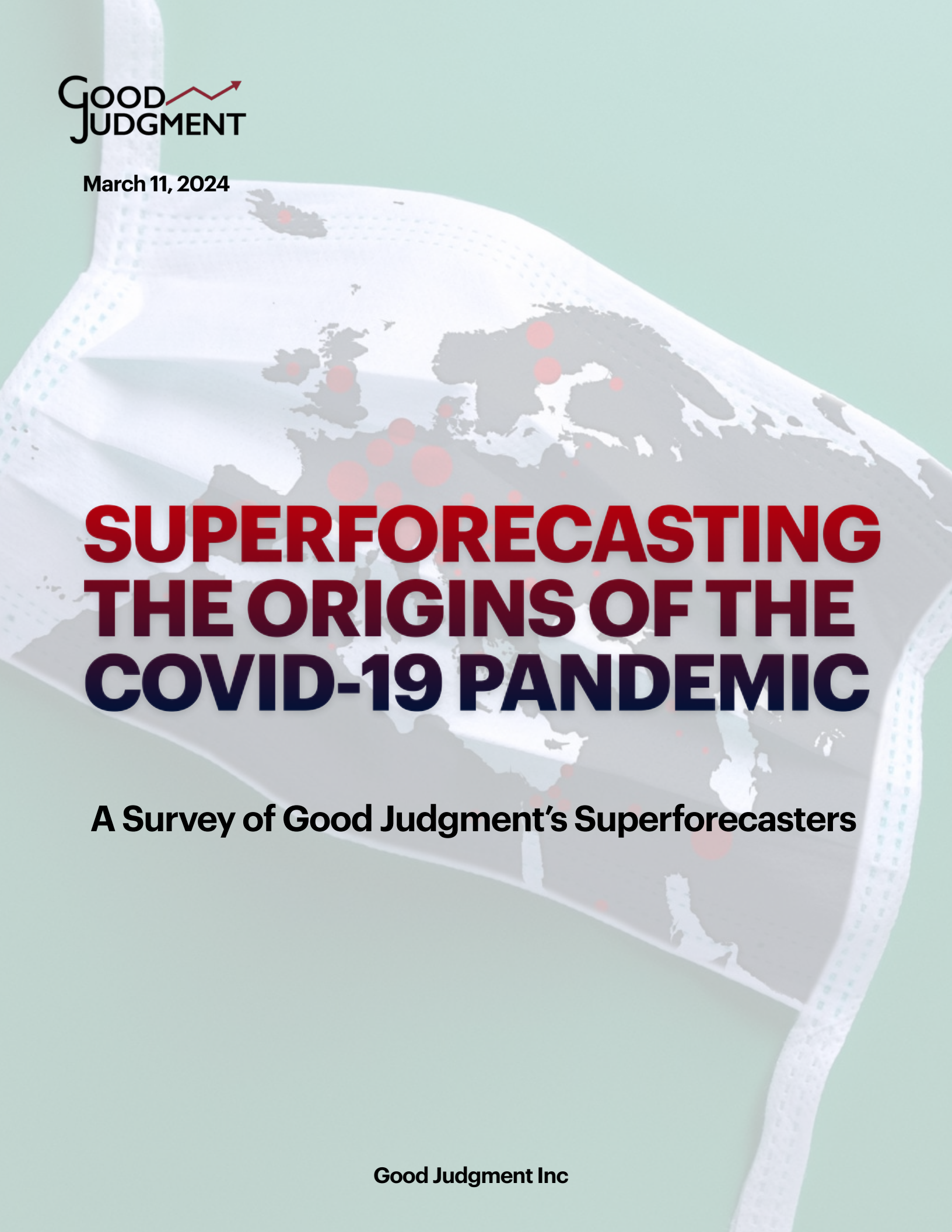

March 11, 2024

SUPERFORECASTING THE ORIGINS OF THE COVID-19 PANDEMIC

A Survey of Good Judgment's Superforecasters

Good Judgment Inc

SUPERFORECASTING THE ORIGINS OF THE COVID-19 PANDEMIC

EXECUTIVE SUMMARY

Superforecasters assess that natural zoonosis is three times more likely to be the cause of the Covid-19 pandemic than either a biomedical research-related accident or some other process or mechanism. Asked to assign a probability to what caused the emergence of SARS-CoV-2 in human populations, more than 50 Superforecasters engaged in extensive online discussions starting on December 1, 2023.[1] In aggregate, they assessed that the pandemic was:

- **74% likely to have been caused by natural zoonosis** (meaning that SARS-CoV-2 emerged in human populations as the result of the infection of a person with coronavirus directly from a naturally infected non-human animal);
- **25% likely to have been caused by a biomedical research-related accident** (meaning that SARS-CoV-2 emerged in human populations as the result of the accidental infection of a laboratory worker with a natural coronavirus; or the accidental infection of researchers with a natural coronavirus during biomedical fieldwork; or the accidental infection of a laboratory worker with an engineered coronavirus; "research" includes civilian biomedical, biodefense, and bioweapons research);
- **1% likely to have been caused by some other process or mechanism** (to include possibilities like the deliberate release of the virus into human populations, irrespective of whether it was an act in accordance with state policy, or the development of the virus due to drug resistance in humans).

The Superforecasters made more than 750 comments when developing their assessments.

[1] The survey was commissioned by John Halstead, PhD.

INTRODUCTION

The debate surrounding the origins of the SARS-CoV-2 virus remains an important part of public discourse, informing both our understanding of the global Covid-19 pandemic and our ability to foresee such pandemics in the future. This survey was conducted in the period from December 2023 to February 2024 and was commissioned by John Halstead, PhD.

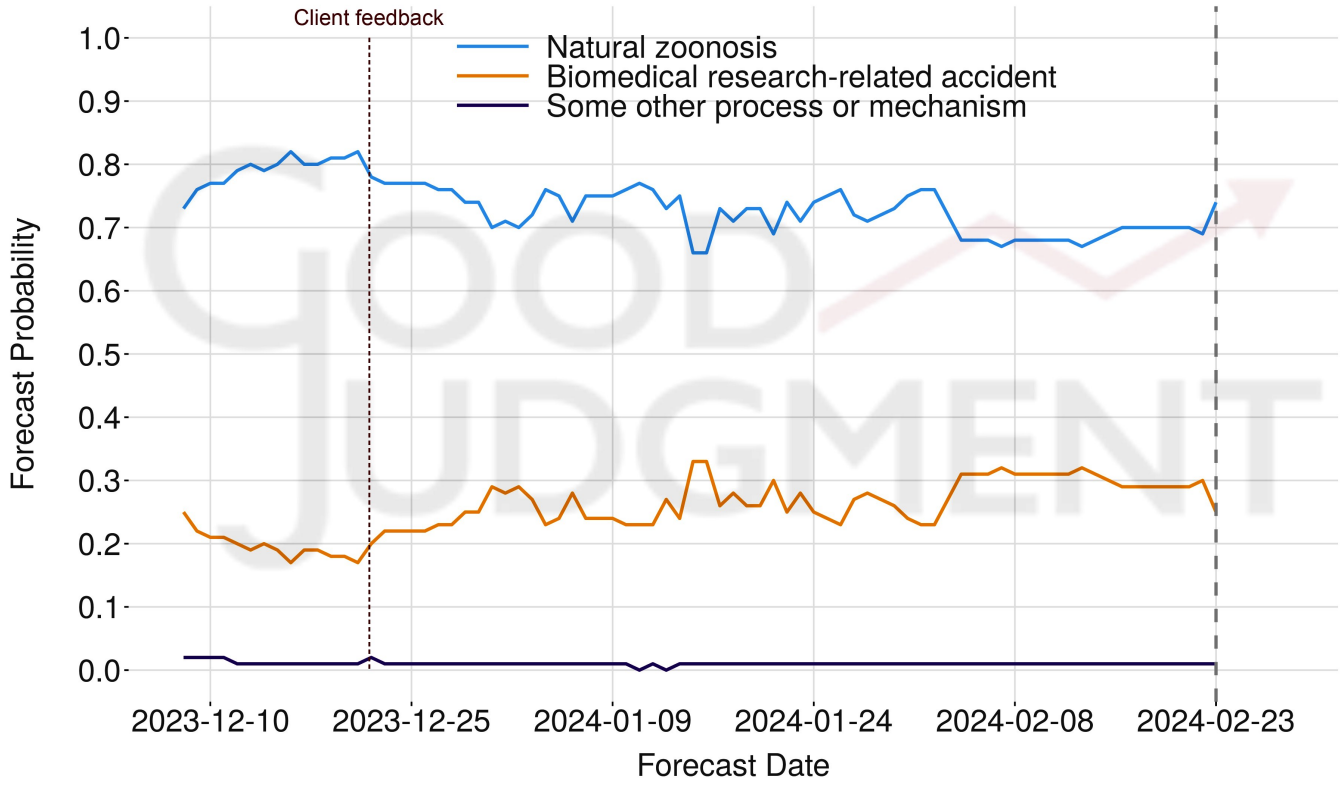

Fig. 1. The timeline of the forecast evolution shows that natural zoonosis is the most likely hypothesis (74% probability), in Superforecasters' assessment.

Good Judgment's professional Superforecasters—elite forecasters whose forecasting accuracy placed them in the top 1-2% of the more than 100,000 forecasters either in a US Government research project[2] or on the public forecasting platform Good Judgment

[2] Good Judgment Inc is the culmination of a four-year, $20 million research project run by the US Office of the Director of National Intelligence to see whether crowd-sourced forecasting approaches could deliver more accurate forecasts than existing approaches. The result was decisively positive, with Good Judgment's methodology generating up to an 85% increase in accuracy (https://journals.sagepub.com/doi/abs/10.1177/1745691615577794).

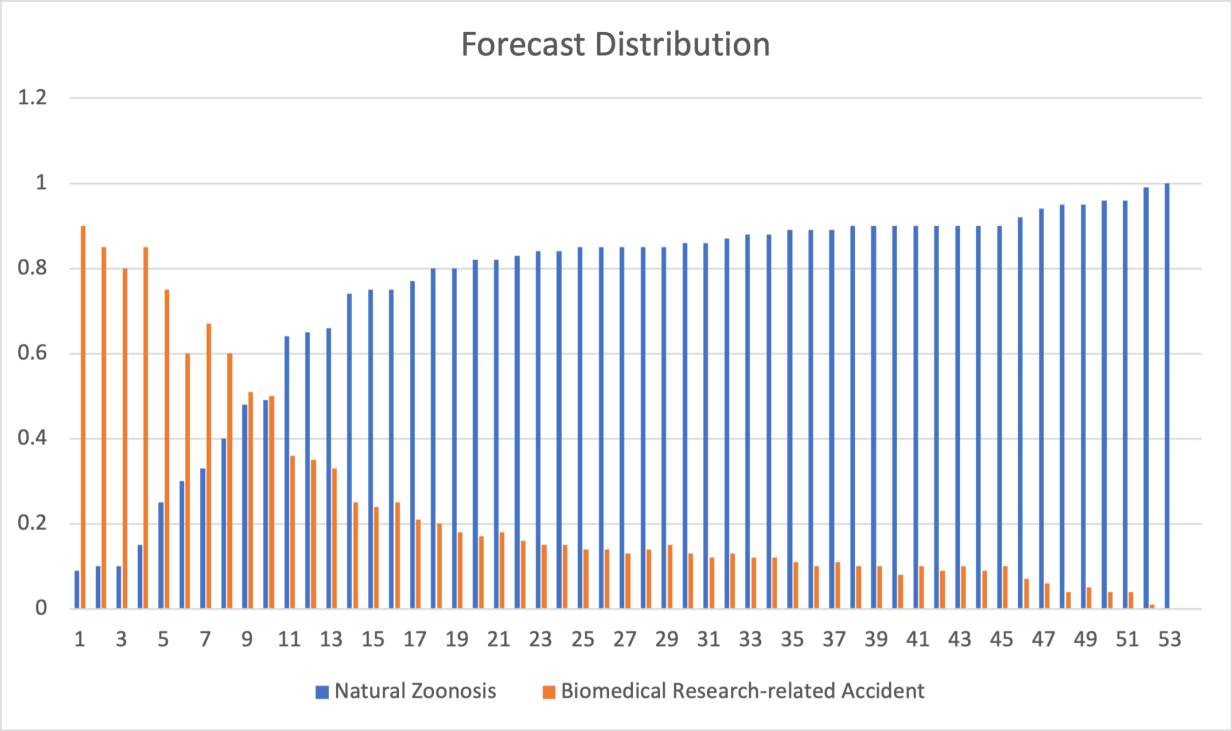

Fig. 2. Forecast distribution for each Superforecaster participating in the survey.

Open[3]—were asked to assess the likelihood of various mechanisms that may have caused SARS-CoV-2. In the aggregate, natural zoonosis was identified as the most likely cause of the pandemic (74% probability), with the likelihood of a biomedical research-related accident being seen as second most likely (25%). But even despite ten weeks of discussion, disagreement among the Superforecasters persisted and a bimodal distribution of assessments solidified (Fig. 2); of the 54 Superforecasters who made a probabilistic assessment on the origins of Covid-19, ten saw a biomedical research-related accident as the most likely cause (Fig. 4).

MAJOR THEMES ADDRESSED

In their extensive discussions[4], Good Judgment's Superforecasters assessed base rates and historical patterns, existing evidence and scientific analysis, geopolitical context and transparency concerns, trust in intelligence communities, and methodological constraints.

[3] https://www.gjopen.com/

[4] https://goodjudgment.io/docs/Superforecaster_Commentary_on_Covid_Origins.pdf

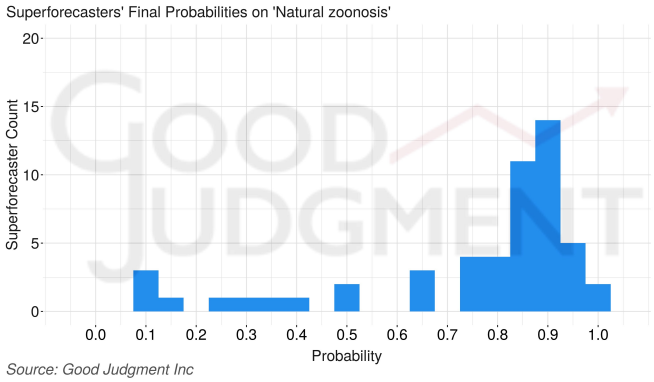

Fig. 3. Forecast histogram of each Superforecaster's probability of the natural zoonosis hypothesis.

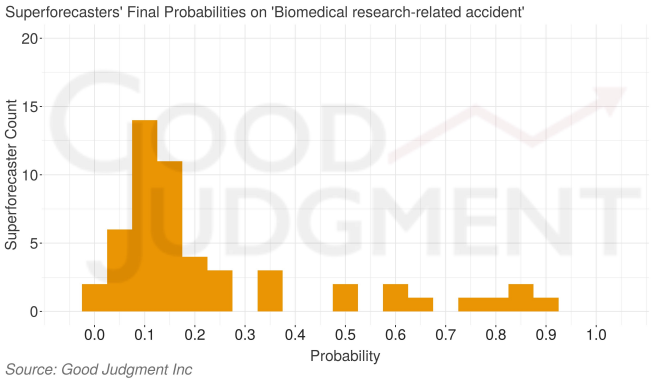

Fig. 4. Forecast histogram of each Superforecaster's probability of the biomedical research-related accident hypothesis.

1. Base Rates and Historical Patterns: The Superforecasters frequently referenced base rates, i.e., the history of pandemics emerging from natural zoonosis versus the history of laboratory leaks, to anchor their probabilities. For the former, they discussed how the base rates are changing as the climate warms and as expanding human populations push farther into natural environments that previously saw little human presence. For the latter, they acknowledged that it has only been 12 years since the advent of CRISPR gene-editing tools, and the base rate of lab leaks in the short synthetic biology era is not yet well established.

2. New Evidence and Scientific Analysis: Throughout the period, the Superforecasters adapted their forecasts in light of new scientific evidence, including genomic analyses of SARS-CoV-2 and its relation to bat viruses, and the debate over potential laboratory manipulation.

3. Geopolitical Context and Transparency Concerns: The geopolitical implications of the virus's origins, particularly in relation to China's transparency and the involvement of international research institutions, played a significant role in the analysis. Concerns over data veracity, and over the political ramifications of determining that the pandemic's origins were other than zoonosis, were extensively debated.

4. Trust in Intelligence: Commentary on trust in intelligence communities and discussions about the impact of geopolitical biases on the interpretation of evidence illustrated the complex interplay between science, politics, and human behavior in assessing the pandemic's origins.

5. Methodological Critiques and the Evaluation of Evidence: The Superforecasters engaged in methodological critiques of the evidence base, including the scrutiny of laboratory practices and biocontainment levels.

EVOLUTION OF THINKING

Initially, on December 8, 2023, the Superforecasters' probability estimates leaned toward natural zoonosis (73%) over a biomedical research-related accident (25%), with minimal consideration for other mechanisms (2%). This early stage reflected a cautious approach, balancing between the dominant scientific consensus favoring natural origins while acknowledging the plausibility of a lab-related incident.

Client feedback was provided to the Superforecasters on December 21. The client posed questions to the Superforecasters about their assessments up to that date and asked for their reactions to several studies and articles.[5] In the days following the client engagement, the Superforecasters lowered their confidence in the natural zoonosis

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[5] The client offered a list of readings for Superforecasters' consideration on both sides of the natural zoonosis/lab leak debate.
On the *natural zoonosis hypothesis*, the main arguments are presented in the following papers:
1. Worobey et al, 'The Huanan Seafood Wholesale Market in Wuhan was the early epicenter of the COVID-19 pandemic', *Science* 2022 [https://www.science.org/doi/full/10.1126/science.abp8715];
2. Holmes et al, 'The origins of SARS-CoV-2: A critical review', *Cell* 2021 [https://www.cell.com/cell/pdf/S0092-8674(21)00991-0.pdf];
3. Andersen et al, 'The proximal origin of SARS-CoV-2', *Nature Medicine* 2020 [https://www.nature.com/articles/s41591-020-0820-9];
4. Pekar et al, 'The molecular epidemiology of multiple zoonotic origins of SARS-CoV-2', *Science* 2022 (though important to note the recent erratum) [https://www.science.org/doi/full/10.1126/science.abp8337].

On the *biomedical research-related accident hypothesis*, the main arguments are in the following resources:
1. Michael Weissman, 'Robust Bayesian analysis of Covid origins, now using better corrections for uncertainties', Substack, November 12, 2023 [https://michaelweissman.substack.com/p/an-inconvenient-probability-v40];
2. Demaneuf, 'Limitations of the official 2019 Wuhan cases based on Primary Sources', WHO SAGO presentation, 2023 [https://www.researchgate.net/publication/373301830_SAGO_Presentation_Limitations_of_the_official_2019_Wuhan_cases_based_on_Primary_Sources];
3. Demaneuf and De Maistre, 'Outlines of a probabilistic evaluation of possible SARS-CoV-2 origins', 2020, pre-print [https://zenodo.org/records/4067919];
4. Stoyan and Chiu, 'Statistics did not prove that the Huanan Seafood Wholesale Market was the early epicenter of the COVID-19 pandemic', forthcoming in *Journal of Royal Statistical Society A* [https://arxiv.org/abs/2208.10106].

The Superforecasters also considered:
1. Shellenberger et al, 'First People Sickened By COVID-19 Were Chinese Scientists At Wuhan Institute Of Virology, Say US Government Sources,' Substack, June 13, 2023 [https://public.substack.com/p/first-people-sickened-by-covid-19];
2. 'Rootclaim's COVID-19 Origins debate results,' *Rootclaim*, February 18, 2024 [https://blog.rootclaim.com/rootclaims-covid-19-origins-debate-results/].

hypothesis from 73% to 67%, although zoonosis remained the most likely potential cause in their assessment. But following an active engagement with recent genomic studies and historical base rates of zoonotic spillovers, those numbers began to return to earlier levels. January also saw increased attention to the geopolitical context and transparency issues, particularly related to research activities in Wuhan.

By February 23, 2024, the Superforecasters settled on a slightly adjusted forecast, in the aggregate assessing natural zoonosis as the most probable origin at 74% likelihood, compared to biomedical research-related accident at 25%. However, a substantial minority of Superforecasters—ten out of 54—continued to see the possibility of a lab accident as the most likely cause of the pandemic.

RED-TEAMING: FACTORS THAT WOULD MAKE THE SUPERFORECASTERS CHANGE THEIR ASSESSMENT

Good Judgment's Superforecasters stated they would be willing to change their minds in the event that new evidence emerged, such as identification of an ancestor virus or definitive animal host. Alternatively, new evidence suggesting a lab leak, such as records showing that Chinese researchers were ordering DNA sequences that unequivocally corresponded to SARS-CoV-2 from commercial suppliers, would cause the Superforecasters to update their projections that a laboratory leak was the origin of Covid-19.

Of note is that among this group of Superforecasters were multiple scientists and medical professionals with expert knowledge of epidemiology and virology. Their interpretations of published studies helped the crowd reach a better common understanding of the complex scientific issues being discussed. In the end, most Superforecasters were in rough agreement on issues like the base rates of zoonotic spillover. Where they most often disagreed was on the interpretation of actions by Chinese officials and whether their actions reflected how an authoritarian government would react in any crisis over which it did not have full control, or whether those actions were indicative of attempts to cover up a biomedical research-related accident that allowed the SARS-CoV-2 virus to enter circulation in China and, ultimately, the entire globe.

GOOD JUDGMENT

From groundbreaking theory to powerhouse practice

In 2011, IARPA—the US intelligence community's equivalent to DARPA—launched a massive competition to identify cutting-edge methods to forecast geopolitical events. Four years, 500 questions, and over a million forecasts later, the Good Judgment Project (GJP)—led by Philip Tetlock and Barbara Mellers at the University of Pennsylvania—emerged as the undisputed victor in the tournament. GJP's forecasts were so accurate that they even outperformed intelligence analysts with access to classified data.

Good Judgment Inc is now making this winning approach to harnessing the wisdom of the crowd available for commercial use. Our clients benefit from the externally validated forecasting methodology that made the Good Judgment Project so successful.

Today, Good Judgment's professional Superforecasters deliver unparalleled accuracy on forecasting questions across the political, economic and social spectrum. And, we train others to apply this evidence-based methodology within their own teams.

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