Institute on Science for Global Policy (ISGP)

Foresight from the COVID-19 Pandemic
Science, Policy, and Communication (COVID-SPC)

A program and conference organized, facilitated, moderated and convened by the ISGP using an internet format
February 27 — March 1, 2023

Institute on Science for Global Policy (ISGP)

Foresight from the COVID-19 Pandemic: *Science, Policy, and Communication* (COVID-SPC)

A program and conference organized, facilitated, moderated,
and convened by the ISGP using an internet format
February 27 — March 1, 2023

An ongoing series of dialogues, critical debates, and extended caucuses examining the effective domestic and international policy decisions regarding the COVID-19 pandemic, especially in regard to the intersection of science, policy, and communication.

Institute on Science for Global Policy (ISGP)

Address
13630 E. Sahuaro Sunset Road
Tucson, AZ 85749

www.scienceforglobalpolicy.org

ISBN: 978-1-7334375-4-7

Table of Contents

Introduction

Preface

The contents of this book were taken from the material presented at the ISGP "Foresight from the COVID-19 Pandemic – Science, Policy, and Communication" (ISGP COVID-SPC) conference convened by the Institute on Science for Global Policy (ISGP) on February 27, 28, and March 1, 2023, Tucson, Arizona. The ISGP COVID-SPC conference, structured on a critical debate/plenary caucus format, was conducted using an internet-based platform and was attended by approximately 80 subject-matter experts, leaders, and stakeholders from governmental, private sector, and public advocacy communities representing both U.S. and international interlocutors.

As in all ISGP programs and conferences, the agenda and conference program were focused on learning how to significantly improve the communication of credible scientific and technological understanding for policymakers throughout society. Special attention was also given to improving the effective communication of accurate biomedical and policy information to the public *writ large* consistent with garnering broad societal confidence and promoting sustained support for practical, real-world decisions addressing infectious disease outbreaks.

Current realities

The COVID-19 pandemic taught the world, once again, that a lack of foresight and preparedness to address serious infectious disease outbreaks has tragic consequences. It is foreseeable, with unfortunate certainty, that new infectious disease outbreaks, and even pandemics will occur.

To critically examine the current, evidence-based scientific understanding and biomedical options needed to inform the practical policy decisions necessary to prepare for new infectious disease events, the Institute on Science for Global Policy (ISGP) organized the COVID-SPC program. Under the critical debate/plenary caucus format pioneered by the ISGP over more than 15 years, the ISGP gathered highly respected subject-matter experts, stakeholders, and policymakers to identify and debate the core scientific, policy, and communication (SPC) challenges experienced during the COVID-19 pandemic. An accurate understanding of these challenges provided the foundational understanding needed to shape **future** SPC decisions throughout society. It was emphasized that infectious disease outbreaks

of all kinds can be effectively combated only if credible scientific understanding is converted into real-world governmental, private-sector, and public advocacy policy decisions. The accurate communication to the public *writ large* regarding the often rapidly expanding evidence emerging from ongoing research directly influences the policies and implementing decisions made to establish societal confidence and sustained support required to effectively combat infectious disease events.

The ISGP COVID-SPC debate/plenary caucus model

The ISGP COVID-SPC conference was conducted using a modification of the "critical debate/plenary caucus" format to conform with an internet-based platform designed to include a broad range of participants from governmental, private sector, and public advocacy communities worldwide. The agenda and program included seven, 60-minute debates of concise (3-page) Position Papers focused on critically evaluating credible scientific, technological, economic, and policy options for practical decisions in real-world societal environments. Authors were provided with five minutes to summarize the major points presented in their respective Position Papers. Following each debate, a 60-minute plenary caucus involving all participants was convened to identify areas of consensus (AoC) and actionable next steps (ANS) that articulated aspirational goals and the decisions needed to pursue their fulfillment. All debates and plenary caucuses were moderated by ISGP and were conducted under the Chatham House Rule (no attribution). Since all participants were briefed on the Chatham House Rule and formally agreed to abide by its restrictions, the ISGP COVID-SPC debates and plenary caucuses encouraged the candid exchange of ideas and criticism focused on identifying real-world decisions shaped by evidence-based information.

The longstanding commitment of the ISGP to not express any opinions, nor lobby on any issue, provides the neutrality required to organize and convene conferences focused on effectively addressing major societal challenges using exceptionally the diverse, evidence-based positions and priorities now routinely encountered worldwide.

The organization of the ISGP COVID-SPC conference began with more than 150 confidential interviews by ISGP staff with subject-matter experts and stakeholders from governmental, private sector, and public advocacy communities worldwide. Numerous consultations were held with a Global Advisory Panel (GAP) to elucidate the major topics to be addressed in the conference and to identify the approximately 80 individuals to be invited by the ISGP to participate. The membership of the voluntary GAP for the COVID-SPC program is presented on the ISGP website (scienceforglobalpolicy.org). Seven distinguished subject-matter

experts and key stakeholders were invited to prepare and debate a concise (3-page), Position Paper. The debates and plenary caucuses were recorded and used as the basis for the ISGP staff to prepare not-for-attribution summaries of the debates and the statements of the areas of consensus (AoC) and actionable next steps (ANS) emerging from the plenary caucuses. The recordings were held in custody by the ISGP before being destroyed.

Concluding remarks

The specific goals for the ISGP COVID-SPC conference centered on the overlapping challenges that require (i) rapid evaluations of evolving scientific surveillance data and analysis of information characterizing infectious disease events, (ii) astute policy decisions reflecting legal constraints practical options, and real-world societal limitations, (iii) the impacts of often virulent public distrust and opposition to the perspectives and advice from those having expertise and experience in scientific and biomedical fields, and (iv) the increasingly distracting, counterproductive interventions from unfounded rumors, aggressive, misinformed voices, and even intentional distribution of disinformation. Since collectively, these challenges create new and significantly more difficult environments in which to combat infectious disease events, the gathering of participants with scientific, policy, and communication expertise and experience was fundamentally important to convening a successful COVID SPC program and conference. The simultaneous participation of individuals from across these fields was unusual and expressly appreciated. The overarching, candid exchanges of diverse views and priorities are reflected in the material published here.

ISGP COVID-SPC Areas of Consensus (AoC) and Actionable Next Steps (ANS)

AoC 1: Immediate, sustained programs to significantly strengthen scientific literacy among the public *writ large* need to be societal priorities, especially given the tragic consequences experienced during recent infectious disease outbreaks and the COVID pandemic. To combat infectious diseases, it is essential to improve public understanding of and respect for healthcare advisories and recommendations, precautionary activities, and therapeutic procedures emerging from (i) credible experimentation and analysis, (ii) critical peer reviews of research publications prior to public access, and (iii) ongoing regulatory evaluations and research informing public health strategies. Elevated scientific literacy throughout society is needed for effectively countering the negative impacts and often dramatic consequences of (i) widely distributed, unfounded rumors, (ii) unsubstantiated, misunderstood information, and (iii) campaigns to intentionally deceive, harm, and promote societal instability.

- **ANS 1.1:** Establish partnerships between scientific, private sector, and public advocacy communities to collectively design, implement, and sustain science literacy in educational entities as well as among diverse social groups representing meaningful cross sections of different economic, cultural, and ethnic groupings.
- **ANS 1.2:** Tailor science and health education through curricula and training protocols to address the interests and backgrounds of diverse communities.
- **ANS 1.3:** Emphasize strengthening science literacy for decision makers in government, the private sector, and public advocacy communities, especially for younger individuals aspiring to leadership positions within these sectors.
- **ANS 1.4:** Prioritize community-wide health assessments that reflect sensitivity to the diverse cultural, economic, ethnic, and respective priorities within modern societies, especially focused on optimizing the degree of support that can be reasonably obtained.
- **ANS 1.5:** Expand and strengthen educational programs designed to expose students at all levels to the principles underlying the scientific method and the continuous evolution of hypotheses and credible scientific understanding that is continuously updated by new research results and increasingly sophisticated analysis.

- **ANS 1.6:** Encourage open conversations and critical debates focused on the differences related to correlations among observations, information, and data versus causational relationships that identify a direct dependence between an action and an outcome.
- **ANS 1.7:** Renew efforts to gain public confidence in and commitment to understanding healthcare advice based on the probabilities of specific outcomes that assist in making rational decisions, but that do not guarantee a specific outcome with certainty.

AoC 2: The establishment of ongoing, collaborative relationships among political, economic, and cultural leaders and influencers is central to effectively fostering communication throughout diverse communities responding to public health emergencies, including infectious disease outbreaks. Early-stage strategies focused on eliciting candid exchanges of views and concerns about preventive and therapeutic options and potential public policies can prepare communities to respond appropriately to infectious disease outbreaks. The presence of widely endorsed, networked procedures for soliciting public input on concerns and priorities builds trust and facilitates access to the resources required to quickly address community-wide challenges during public health emergencies. Collaborative community environments can be anticipated to improve on the current fragmentary, and often dysfunctional, communication and funding mechanisms. Current communication models need to (i) utilize credible scientific interlocutors with trusted local and/or community messengers, (ii) convey messages in a manner that is tailored to respective communities, especially those that are underserved, (iii) emphasize the likelihood that routinely changing public health conditions require updated messaging, and (iv) ensure updated messaging accurately reflects a broad range of public health challenges beyond infectious diseases (e.g., heart disease, diabetes, asthma).

- **ANS 2.1:** Conduct qualitative interview-based surveys to identify the specific sources for trusted information and advice used within given communities as the basis for constructing communication models reflecting diverse perspectives and priorities with respect to infectious disease control responses.
- **ANS 2.2:** Promulgate major advertisement programs to promote messaging from trusted scientific organizations and societies (e.g., Infectious Diseases Society of America) as central sources of credible public health information and advice on infectious disease prevention, vaccines, and therapeutic treatments.

- **ANS 2.3:** Improve design and access, including interactive capabilities, of authoritative websites (e.g., Center for Disease Control and Prevention, CDC) to significantly increase public use to obtain quickly available, trusted information and advice on the prevention and treatment of infectious diseases.
- **ANS 2.4:** Establish user-friendly websites (e.g., governmental and professional associations) for practitioners, clinicians, and other public-facing healthcare officials to receive the up-to-date, authoritative scientific information and policy decisions on rapidly evolving infectious disease prevention and outbreaks.
- **ANS 2.5:** Develop publicly accessible internet "clearing houses" to engage well-informed, credible biomedical professionals and locally respected influencers to informally discuss questions, perspectives, and priorities with individuals using concise, broadly understandable language and an egalitarian description of the current understanding of scientific information on infectious diseases.
- **ANS 2.6:** Build sustainable (e.g., sustained funding, robust structures) communication mechanisms that encourage community involvement early in a public health crisis. Engage essential stakeholders (e.g., scientists, public health and communications experts) as part of the review process.
- **ANS 2.7:** Expand the resources, personnel, and funding for social science research focused on understanding audience fragmentation and delineating effective communication strategies for diverse communities addressing their specific views, perspectives, and priorities regarding infectious disease prevention, prophylaxis, and treatment.
- **ANS 2.8:** Develop, with adequate funding, community-wide public health outreach modeled on successful characteristics of agricultural extension programs in educational institutions to significantly increase public understanding and appreciation for ongoing research and communication programs addressing infectious disease challenges before outbreaks occur.
- **ANS 2.9**: Expand routine collaborations among academic research scientists, private sector technologists and manufacturers, and governmental public health officials to proactively facilitate exchanges of proprietary research data, information, and agreements on real-world economic benefits, regulatory requirements, and licensing needed to efficiently provide the vaccines, non-pharmaceutical supplies, and treatments required to combat infectious disease events.

- **ANS 2.10:** Ensure that the needs and priorities of the public *writ large* are continuously acknowledged in crafting messaging from multiple, trusted sources on infectious disease prevention and treatment in concise, widely understood language reflective of priorities in diverse economic, cultural, and ethnic communities.
- **ANS 2.11:** Develop mechanisms among governmental, private sector, and public advocacy communities to increase the density of evidence-based social media content (e.g., messages on infectious disease challenges and options of significance to the public *writ large*) from all sources (e.g., public health officials, trusted influencers) that accurately reflects credible scientific information by:

  (a) developing a fact-checking mechanism monitored by trusted, nonpartisan organizations to certify the accuracy of public health information within social media sites;

  (b) strengthening relationships between social media research centers, social media sites, and public health officials to connect understanding of the issues the public cares about and the facts that need to be incorporated into communications;

  (c) expanding and improving approaches that recognize and address the emotional aspects (e.g., potential fear responses) of public health information, particularly for risk communication.
- **ANS 2.12:** Require certified communication training for/within federal agencies responsible for conveying health information to the public.
- **ANS 2.13:** Ensure appropriate levels of transparency regarding the data collected by social media platforms and improve accessibility of critical social media data to infectious disease monitoring systems.
- **ANS 2.14:** Mobilize all-encompassing messaging campaigns for public health communications by:

  (a) understanding and utilizing pre-bunking techniques in public communication efforts to share accurate, digestible public health information to the public *writ large* in real time;

  (b) educating journalists to ensure their abilities to identify credible spokespersons, especially in scientific and medical fields;

  (c) using insights from highly effective past public health messaging campaigns (e.g., campaigns conveying the dangers of tobacco and nicotine) as a model.
- **ANS 2.15**: Codify appropriate policies that encourage the international sharing of disease and outbreak information when highly contagious transmissible disease is identified.

AoC 3: While regional, national, and global public health policies need to focus on the societal priorities within their respective regions, it is critical that these same policies are collectively effective in combating the broad geographical impacts of infectious disease outbreaks in general, and certainly those of global pandemics. It is recognized that without globally impactful policies, the success of geographically localized efforts are endangered. Public health authorities (e.g., local, regional, national, international) need to focus on developing effective communication strategies using impactful messages tailored for respective distribution over a broad range of media (e.g., social media, news, local radio). Early governmental, private sector, and public advocacy commitments to policies spanning local, regional, national, and global challenges require (i) sharing existing and emerging biomedical research and information (e.g., successes and failures), (ii) soliciting community-wide views and priorities, (iii) monitoring the degree of public acceptance of evidence-based information and advice, and (iv) establishing economic and licensing agreements consistent with the need to rapidly deploy vaccines, non-pharmaceutical options, and clinical trials.

- **ANS 3.1:** Organize efforts to regularly convene national, regional, and international discussions among senior-level governmental officials focused on identifying common priorities and practices to support a surveillance system spanning political boundaries to alert public health units world-wide to animal and human conditions conducive to infectious disease outbreaks.
- **ANS 3.2:** Prioritize communications throughout government highlighting the need for agencies and departments to provide personnel and funding support for public health emergencies based on credible scientific recommendations that may not have garnered broad political and/or public traction.
- **ANS 3.3**: Document and critically evaluate real-world experiences and policy consequences from governmental, private sector, and public advocacy efforts to address previous health emergencies (e.g., HIV AIDS, Ebola, SARS) as foresight and guidelines for implementing future policies during infectious disease outbreaks.
- **ANS 3.4:** Utilize ongoing "bench-top" exercises for subject-matter experts and leaders from government, the private sector, and public advocacy communities to simulate various scenarios designed to respond to future healthcare emergencies and to build partnerships.
- **ANS 3.5:** Increase funding for research on effective social media communication models designed to improve health outcomes in under-served communities disproportionately impacted by infectious diseases.

- **ANS 3.6:** Remove bureaucratic barriers impeding the capacity of public health officials to utilize social media and disseminate essential, evidence-based health information.
- **ANS 3.7:** Generate discussions with philanthropic communities to establish an organizational structure for optimizing a public advertising model (e.g., sports) to improve the framing and dissemination of evidence-based public health messages.
- **ANS 3.8:** Enhance public communication surrounding infectious disease events by

  (a) employing trained Public Information Officers having explicit duties within the public healthcare ecosystem;

  (b) defining publicly key messaging responsivities and limitations;

  (c) establishing strategic agreements with social media outlets concerning the formulation and dissemination models that preserve independent views while ensuring the distribution of evidence-based information.
- **ANS 3.9**: Expand certified training for scientists and subject-matter experts in the challenges and skills of communicating with a public not necessarily well-informed or experienced with scientific or technological information and its consequences on real-world behavior.

AoC 4: The continuing research and deployment of vaccines and other pharmaceutical interventions in response to existing and reasonably anticipated infectious disease outbreaks need to: (i) encompass the patient needs throughout the full spectrum of disease expression and (ii) consider the underlying differences across patient populations (e.g., children at various ages, long-COVID sufferers, immunocompromised patients). It is critical that strategic planning recognizes that the timing of the stages of disease progression manifest with different degrees of impact within the diverse patient population. Decisions concerning the use of research results and surveillance data to inform the application of specific vaccines and pharmaceutical interventions need to recognize the different stages of disease progression that may be observed in diverse local, national, regional, and certainly across global populations. The tailoring of all interventions needs to be based on scientifically credible, evidence-based information and not controlled only by economic constraints.

- **ANS 4.1:** Invest significant resources (e.g., personnel, funding) in preclinical studies (e.g., in *ex-vivo* systems) focused on identifying and characterizing

at the molecular biochemical level the broad spectra of human illnesses appearing outside those found in animal models.

- **ANS 4.2:** Develop new artificial intelligence (AI) systems as sophisticated tools to advance studies designed to assist the scope and accuracy of the predictive human response models on which pharmaceutical interventions are designed.
- **ANS 4.3:** Ensure results from preclinical and AI studies are consistent with and validated via clinical evaluations and experimentally supported testing required for implementing the application of conventional disease intervention mechanisms.
- **ANS 4.4:** Institute senior-level discussions among governmental, private sector, and public advocacy communities to ensure advanced disease intervention methods are incorporated into the predictive policies applied in strategic decisions employed at the local, national, and regional levels that underpin the effectiveness of global responses to infectious disease outbreaks.

AoC 5: Pathways for regulatory decisions controlling the permitting of research, development, testing, approval for public use, and marketing guidelines of pharmaceutical products and therapeutic treatments need to be clearly delineated and easily accessible to biomedical researchers, manufacturers of pharmaceuticals and medical devices, and the public *writ large*. Specific regulatory expectations and requirements for both Emergency Use Authorization (EUA) and non-emergency approval of pharmaceutical products and interventions (e.g., prescription and over-the-counter public use), require clarity with respect to development and manufacturing standards. Regulatory decisions also need to garner public confidence in the healthcare benefits distinct from private sector priorities.

- **ANS 5.1:** Structure and commit a public-private, not-for-profit panel comprised of subject-matter experts knowledgeable of the scientific, biomedical, and manufactured properties of current and emerging pharmaceuticals to continuously offer non-technical, easily understood information to the public *writ large* on the benefits and risks associated pharmaceutical products and interventions.
- **ANS 5.2**: Ensure that regulatory frameworks focused on infectious disease prevention and response work to establish sustained public acceptance through candid, egalitarian negotiations informed by presentations of transparent, legally consistent governmental goals, practical economic

options and constraints in the private sector, and the aspirational, but realistic priorities emerging from diverse populations.

- **ANS 5.3:** Engage physicians, biomedical interlocutors, hospital administrators, and nurses performing public-facing duties to provide early stage advice on public health options and regulatory principles that recognize the historical reluctance of the public to embrace preventive measures (e.g., vaccine acceptance, wearing of masks, social distancing).
- **ANS 5.4:** Conduct exploratory discussions with social and news media representatives concerning procedures to ensure the accurate description of regulatory goals and restrictions that clarify intent and avoid the extreme degree of misunderstanding permeating recent infectious disease events with unfounded rumors, misunderstood social media transmissions, and the potentially dramatic negative impacts from intentional efforts to spread disinformation.

AoC 6: Effective strategies intended to combat infectious disease outbreaks, and certainly pandemics, need to recognize fundamental global requirements: (i) earliest-stage detection of biomedically characterized viral infections to ascertain source(s), (ii) practical surveillance regimes monitoring disease spread and transmissibility, (iii) rapid testing and analysis technologies applicable across broad geographical areas and populations, (iv) access to accurately analyzed genomic data for monitoring viral evolution, especially for the protection of vulnerable populations, (v) infrastructure supporting vaccine development and distribution, and (vi) methodologies for administering vaccines, pharmaceutical treatments, and non-pharmaceutical supplies tailored to individual patient needs. Current levels of travel and trade across national, regional, and international boundaries ensure that targeting selected geographical areas and/or limited population groups for attention is unlikely to protect public health against widely circulating disease vectors. Efforts not effectively deployed across global landscapes and international populations risk limited success in protecting human health in any given area and population grouping and may facilitate increasingly serious, prolonged impacts with potential pandemic outcomes, especially in developing, underserved communities.

- **ANS 6.1:** Develop public-private partnerships to support and launch vaccine information platforms targeting engagement from the public *writ large* to improve public health outcomes by increasing understanding of the benefits and potential risks from vaccination.

- **ANS 6.2**: Examine critically the processes underlying patent protection and regulations used in the development and distribution of vaccines and pharmaceutical treatments designed to combat infectious disease outbreaks and potential pandemics.
- **ANS 6.3:** Launch public messaging campaigns emphasizing that ensuring private sector economic returns and creating stable research environments required to develop and evaluate pharmaceutical products and treatments (e.g., conducting clinical trials) do not supersede the public health benefits of vaccines and pharmaceutical treatments addressing infectious diseases.
- **ANS 6.4:** Remove impediments from existing patent portfolios and regulatory decisions protecting earlier vaccine development that discourage new governmental and private sector funding commitments to new vaccines based on emerging technologies and methodologies.
- **ANS 6.5**: Recognize the value of renewing commitments to proven vaccine development and production methods, even with lower effectiveness, when the need to rapidly provide vaccine protection to underserved communities arises.
- **ANS 6.6:** Convene stakeholders having public health responsibilities from government, private sector, and public advocacy entities to identify common goals and fundamental principles required to control the development and distribution of vaccines and pharmaceutical treatments against viral infections arising from myriad sources in increasingly vulnerable communities worldwide.
- **ANS 6.7:** Establish centralized sources for the public distribution of accurate information about the critical importance of vaccination against infectious diseases before and during outbreaks with attention given to underserved, local communities and vaccine-hesitant groups.

AoC 7: Gaps in proactive public health strategies and failures to effectively utilize existing pandemic preparedness systems underpinned by practical policy decisions during the COVID-19 pandemic severely impacted societal capacities to (i) protect lives and minimize suffering, (ii) limit the spread of contagion, (iii) ensure functional levels economic activity, and (iv) hasten control over the public health consequences of even the early stages of the infectious disease outbreak preceding pandemic conditions. Successful public health strategies need to proactively (i) acquire and maintain the large stockpiles of vaccines, medicines for therapeutic treatments, and medical supplies (e.g., diagnostic and testing kits, personal protection equipment, ventilators, etc.) and (ii) retain professional

and/or standby cadres of trained medical and hospital staff at levels adequate to meet the emergency conditions reasonably anticipated during and after major infectious disease outbreaks. Reliance solely upon reactive strategies can be expected to result in widespread challenges in public health responses.

- **ANS 7.1:** Conduct a community-wide review and critique of existing public health strategies and procedures (e.g., preparation and content of material stockpiles, deployment of medical personnel) focused on addressing gaps and inadequacies exposed by the COVID-19 pandemic.
- **ANS 7.2:** Develop realistic timelines to inform public health decisions and activate the:

  (a) institution of societal countermeasures (e.g., isolation and/or masking within population groupings);
  (b) distribution of public health equipment/materials;
  (c) deployment of emergency medical personnel, all initiated by evidence-based surveillance data and analysis of results from the monitoring of infectious disease events.
- **ANS 7.3:** Define an accelerated, strategic timeline for the development of safe vaccines based on substantiated research results and clinical trials subjected to critical peer review.
- **ANS 7.4:** Examine the regulatory, economic, and legal requirements used to obtain approval for public use of new vaccines, pharmaceutical products, and treatments in efforts to eliminate barriers encountered both before and during the COVID-19 pandemic.
- **ANS 7.5:** Inform the public of ongoing, interagency governmental/private sector efforts to optimize the evidence-based, regulatory approval of new vaccines, pharmaceutical products and treatments while confirming the validity of public trust in their efficiency, effectiveness, efficacy, and safety.
- **ANS 7.6:** Delineate and codify thresholds for interpreting surveillance data and analysis results from monitoring of infectious diseases (e.g., infection rates, mortality rates, hospitalization admissions) that require specific countermeasure actions to protect public health.
- **ANS 7.7:** Prioritize collaborative discussions with healthcare professionals and leadership from international governmental and private sector communities to identify gaps and challenges encountered in combating infectious disease outbreaks and how effectively different decisions, mechanisms, and vaccine/treatment protocols functioned before and during outbreaks.

- **ANS 7.8:** Create geographically diverse incident command center structures as platforms to address the immediacy of infectious disease decisions and deployments.
- **ANS 7.9:** Structure a broadly accessible warning system (e.g., DEFCON model), tasked to continuously monitor surveillance data and digest analysis results to determine the "level of threat" from infectious disease events by a range of vetted communities charged with public health and security responsibilities.

AoC 8: The establishment of sustained funding to support rapidly evolving monitoring and research needed to address the serious challenges presented by existing and emerging infectious diseases is foundational for all public health strategies. Without initiatives to coordinate, restructure, and monitor research efforts undertaken by academic, national laboratory, state and local, and private sector stakeholders, there cannot be a reasonable expectation of successfully combating the myriad forms of infectious pathogens and disease expressions currently recognized worldwide. While the focused pursuit of parochial goals (e.g., motivation for economic returns) is to be expected, funding strategies need to fully recognize and effectively support overarching goals consistent with sustained public health.

- **ANS 8.1:** Commit, across all sectors, to continually sustaining (e.g., funding, fixing, integrating, utilizing, and maintaining) a surveillance database of accurate and searchable information that will identify, characterize, and measure infection and disease globally and locally.
- **ANS 8.2:** Develop active collaborations among academic institutions and governmental health agencies and departments to facilitate the efficient exchange of the credible information that underpins the public distribution of advice.
- **ANS 8.3:** Establish national mechanisms in each country to integrate and enhance a simple, minimally burdensome, and transparent infectious disease surveillance system tailored to the needs of each respective country.
- **ANS 8.4:** Systematize continually benchmarked interoperability criteria and best practices for software platforms used to collect, store, organize, analyze, and/or report data associated with infectious disease surveillance to streamline the accurate identification of trends and outcomes (e.g., excess deaths).
- **ANS 8.5:** Establish stakeholder collaborations (e.g., public-private partnerships) focused on providing the funding and effort required to ensure

sustained interoperability of infectious disease surveillance platforms across sectors and stakeholder groups.

- **ANS 8.6:** Ensure interoperability of ongoing and reasonably anticipated metadata (e.g., traffic density, quantity of cold medicine purchases) collection by diverse entities (e.g., grocery stores, department stores, websites) by encouraging/incentivizing the utilization of a common platform/system with public health authorities.
- **ANS 8.7:** Establish a non-administrative global steering body to implement mechanisms for coordinating global funders and stakeholders while incorporating existing coordination efforts that are overlapping and/or redundant.
- **ANS 8.8:** Emphasize to possible funders that the need for increased and sustainable funding is essential for homeland security as well as economic viability.
- **ANS 8.9:** Develop new anticipatory capabilities systems that integrate further relevant data and information (e.g., animal health data) pertinent to One Health understandings of infectious diseases.
- **ANS 8.10:** Develop a business plan to identify what infrastructure is required for pursuing different R&D goals.
- **ANS 8.11:** Ensure that, in addition to domestic efforts, significant funding is allocated to global disease control and prevention efforts to address risks across the public health ecosystem.
- **ANS 8.12:** Ensure budget flexibility within federal, state, and local departments and organizations for redistributing money to necessary efforts.
- **ANS 8.13:** Foster alliances with the private sector for public health efforts while considering private and public models of public health systems.

AoC 9: Strategic improvements in existing infectious disease surveillance programs need to incorporate legally accessible data within electronic health records (e.g., age, sex assigned at birth, ethnicity, race, demographic information, major health interventions and outcomes) that may be linked to the evaluation of co-morbidities, mortality, and disease transmissibility factors. While appropriate patient privacy needs to be ensured (e.g., through formatting of health records), this type of information can provide the foundational understanding required for effectively tracking infections throughout populations and for recognizing disease clusters within large population groups. Strengthening the existing national laboratory system through integration with a broad range of academic and public health laboratories (e.g., Centers for Disease Prevention and Control

facilities), private sector stakeholders, and regulatory agencies is foundationally critical to establishing an effective diagnostic system commensurate with the challenges presented by infectious disease outbreaks.

- **ANS 9.1**: Integrate information from electronic health records into analyses used to evaluate co-morbidities, mortality, and disease transmission outcomes while protecting the privacy of patients.
- **ANS 9.2**: Articulate endorsed objectives for existing infectious disease surveillance programs by identifying the key scientific questions and types of data required for accurately informing societal decisions underpinning coordinated surveillance strategies.
- **ANS 9.3**: Consult community leadership in the formulation of surveillance goals, priorities and procedures (e.g., infrastructure, data management and access) and use the outcomes to establish a foundation for broad community endorsement and sustained support.
- **ANS 9.4**: Identify the realistic resources, personnel, and funding required to maintain a functioning surveillance system as integral parts of all proposals to governmental, private sector, and philanthropic entities, and link funding requests for the development and implementation of infectious disease surveillance systems to realistic expectations of "returns-on-investment," both for economic viability and societal public health protection.
- **ANS 9.5**: Ensure research data, clinical results, large reference laboratory conclusions, and analyses of raw surveillance data from both domestic and international sources are appropriately incorporated into public health decisions prior to public communication.
- **ANS 9.6**: Invest in language and communication programs to develop publicly accessible messaging accurately describing surveillance data and analyses and having meaningful impact on policy decisions.
- **ANS 9.7**: Use caution in efforts to integrate artificial intelligence (AI) methods and procedures with electronic health data records in shaping surveillance systems focused on monitoring viral diseases.
- **ANS 9.8**: Ensure surveillance monitoring and analysis recognizing the rapidity with which viruses mutate throughout the evolution of the disease outbreak with special attention to:

    (a) observing evolutionary convergences of different viral taxons that can significantly change the characterization of disease dynamics;

    (b) identifying commonalities across divergent viruses or pathogens that reveal common mechanisms of pathogenesis;

(c) elucidating broadly applicable interventions that provide countermeasures to disease progression.

- **ANS 9.9**: Avoid restrictive supply chains arising from the development of field-oriented diagnostic instruments and tools for use during disease outbreaks that rely on single-source components from manufacturers that cannot provide adequate inventories to all consumers (e.g., laboratories, state health departments, hospitals).
- **ANS 9.10**: Define return-on-investment associated with the coordination of a national, multi-sector diagnostic laboratory system to affirm potential benefits that may motivate funding and active participation by domestic and international governmental and private sector stakeholders.

Institute on Science for Global Policy (ISGP)

Program on

Foresight from the COVID-19 Pandemic: Science, Policy, and Communication (COVID-SPC)

ISGP COVID-SPC Debate/Plenary Caucus Conference

(Invitation-only)

Internet Format

February 27, 28, and March 1, 2023

Agenda

Conference Day One

Monday, February 27, 2023

Three 60-minute debates (moderated by ISGP staff), each immediately followed by a 60-minute plenary caucus (moderated and scribed by ISGP staff) All debates and plenary caucuses are held under Chatham House Rule (not-for-attribution)

07:15 - 07:30 EST	**Participant Check-in**
13:15 - 13:30 CET	*Please enter the Zoom waiting room to be admitted*
12:15 - 12:30 GMT	*by ISGP staff*
07:30 - 07:45 EST	**Introductory Remarks**
13:30 - 13:45 CET	**Dr. George Atkinson**, Founder and Executive
12:30 - 12:45 GMT	Director, ISGP
07:45 - 08:00 EST	**Program Overview and Online Participation Overview**
13:45 - 14:00 CET	*Conference attendees receive internet participation*
12:45 - 13:00 GMT	*instructions*
	ISGP Staff Provide Conference Attendees with Instructions for Internet Participation
08:00 - 09:00 EST	**Debate One: Prioritizing Ongoing and Emerging**
14:00 - 15:00 CET	**Scientific Research Pertaining to Infectious Diseases**
13:00 - 14:00 GMT	*Position Paper One: "Prioritizing Ongoing and Emerging Scientific Research Pertaining to Infectious Diseases"*
	Author: Col. Nelson Michael, M.D., Ph.D., Director, Center for Infectious Diseases Research, Walter Reed Army Institute of Research
	Moderated by Ciaran Fitzpatrick, ISGP Senior Fellow
	Under Chatham House Rule (not-for-attribution)
09:00 - 10:00 EST	**Caucus One: Prioritizing Ongoing and Emerging**
15:00 - 16:00 CET	**Scientific Research Pertaining to Infectious Diseases**

14:00 - 15:00 GMT	Participants identify areas of consensus (AoC) and actionable next steps (ANS) Moderated by Ciaran Fitzpatrick, ISGP Senior Fellow Scribed by ISGP Fellows Ian Shotts and Haile Tadesse *Under Chatham House Rule (not-for-attribution)*
10:00 - 11:00 EST 16:00 - 17:00 CET 15:00 - 16:00 GMT	**Debate Two: Optimizing the Effectiveness of Infectious Disease Surveillance Before, During, and Following Outbreaks** *Position Paper Two: "Optimizing the Effectiveness of Infectious Disease Surveillance Before, During, and Following Outbreaks"* **Author: Dr. Sunil Solomon**, Professor of Medicine and Epidemiology at Johns Hopkins University School of Medicine; Director, Center for Infectious Diseases in India, Johns Hopkins University Moderated by Camelia Bou, ISGP Senior Fellow *Under Chatham House Rule (not-for-attribution)*
11:00 - 12:00 EST 17:00 - 18:00 CET 16:00 - 17:00 GMT	**Caucus Two: Optimizing the Effectiveness of Infectious Disease Surveillance Before, During, and Following Outbreaks** Participants identify AoC and ANS Moderated by Camelia Bou, ISGP Senior Fellow Scribed by ISGP Fellows Rebecca Simison and Sophie Bartholomaus *Under Chatham House Rule (not-for-attribution)*
12:00 - 13:00 EST 18:00 - 19:00 CET 17:00 - 18:00 GMT	**Debate Three: Evaluating and Developing Therapeutic Options for Addressing Infectious Diseases** *Position Paper Three: "Medical Priorities: Therapeutic Options"* **Author: Dr. Michael Kurilla**, Director, Division of Clinical Innovation at National Center for Advancing Translational Sciences, National Institute of Health Moderated by Mattia Anfosso Lembo, ISGP Fellow *Under Chatham House Rule (not-for-attribution)*
13:00 - 14:00 EST 19:00 - 20:00 CET 18:00 - 19:00 GMT	**Caucus Three: Evaluating and Developing Therapeutic Options for Addressing Infectious Diseases** Participants identify AoC and ANS Moderated by Mattia Anfosso Lembo, ISGP Fellow Scribed by ISGP Fellows Haile Tadesse and Tory Brewster *Under Chatham House Rule (not-for-attribution)*

14:00 - 14:05 EST **Day One Adjournment**
20:00 - 20:05 CET
19:00 - 19:05 GMT

Conference Day Two
Tuesday, February 28, 2023
Three 60-minute debates (moderated by ISGP staff), each immediately followed by a 60-minute plenary caucus (moderated and scribed by ISGP staff) All debates and plenary caucuses are held under Chatham House Rule (not-for-attribution)

07:45 - 08:00 EST **Participant Check-in**
13:45 - 14:00 CET *Please enter the Zoom waiting room to be admitted by*
12:45 - 13:00 GMT *ISGP staff*

08:00 - 09:00 EST **Debate Four: Examining Vaccine Development,**
14:00 - 15:00 CET **Prioritization, and Use for Domestic and Global**
13:00 - 14:00 GMT **Prophylaxis**
Position Paper Four: "How Low Vaccination Rates Diminish the Triumph of COVID Vaccines"
Author: Dr. Stephen Thomas, Professor, Microbiology and Immunology, Upstate Medical University
Moderated by Rebecca Simison, ISGP Fellow
Under Chatham House Rule (not-for-attribution)

09:00 - 10:00 EST **Caucus Four: Examining Vaccine Development,**
15:00 - 16:00 CET **Prioritization, and Use for Domestic and Global**
14:00 - 15:00 GMT **Prophylaxis**
Participants identify AoC and ANS
Moderated by Rebecca Simison, ISGP Fellow
Scribed by ISGP Fellows Ian Shotts and Joe Khine
Under Chatham House Rule (not-for-attribution)

10:00 - 11:00 EST **Debate Five: Implementing Responsive Strategies**
16:00 - 17:00 CET **Based on Diagnostic Insights**
15:00 - 16:00 GMT *Position Paper Five: "What We Learned From SARS-CoV-2 Antigen Testing That Informs Further Novel Pandemic Planning"*
Author: Dr. Georges C. Benjamin, Executive Director, American Public Health Association
Moderated by Sophie Bartholomaus, ISGP Fellow
Under Chatham House Rule (not-for-attribution)

11:00 - 12:00 EST 17:00 - 18:00 CET 16:00 - 17:00 GMT	**Caucus Five: Implementing Responsive Strategies Based on Diagnostic Insights** Participants identify AoC and ANS Moderated by Sophie Bartholomaus, ISGP Fellow Scribed by ISGP Fellows Haile Tadesse and Rebecca Simison *Under Chatham House Rule (not-for-attribution)*
12:00 - 13:00 EST 18:00 - 19:00 CET 17:00 - 18:00 GMT	**Debate Six: Optimizing Diverse, Evidence-based Messages and Identifying Broadly Trusted Societal Interlocutors to Convey Critical Public Health Information** *Position Paper Six: "Issues and Actions to Share Accurate, Relevant Public Health Information With Diverse Audiences"* **Author: Dr. Cynthia Baur,** Director, the University of Maryland Horowitz Center for Health Literacy; former Plain Language and Health Literacy Lead, Centers for Disease Control and Prevention, U.S. Department of Health and Human Services Moderated by Tory Brewster, ISGP Fellow *Under Chatham House Rule (not-for-attribution)*
13:00 - 14:00 EST 19:00 - 20:00 CET 18:00 - 19:00 GMT	**Caucus Six: Optimizing Diverse, Evidence-based Messages and Identifying Broadly Trusted Societal Interlocutors to Convey Critical Public Health Information** Participants identify AoC and ANS Moderated by Tory Brewster, ISGP Fellow Scribed by ISGP Fellows Haile Tadesse and Sophie Bartholomaus *Under Chatham House Rule (not-for-attribution)*
14:00 - 14:05 EST 20:00 - 20:05 CET 19:00 - 19:05 GMT	**Day Two Adjournment**

<u>Conference Day Three</u>
Wednesday, March 1, 2023
One 60-minute Summary Caucus, one 60-minute debate (moderated by ISGP staff), immediately followed by a 60-minute plenary caucus (moderated and scribed by ISGP staff) All summary caucuses, debates, and plenary caucuses are held under Chatham House Rule (not-for-attribution)

08:45 - 09:00 EST 13:45 - 14:00 CET 12:45 - 13:00 GMT	**Participant Check-in** *Please enter the Zoom waiting room to be admitted by ISGP staff*
09:00 - 10:00 EST 14:00 - 16:00 CET 13:00 - 15:00 GMT	**Summary Caucus** *Comments and Discussion on the initial outcomes from Conference Days One and Two* Moderated by Ciaran Fitzpatrick, ISGP Senior Fellow *Under Chatham House Rule (not-for-attribution)*
10:00 - 11:00 EST 16:00 - 17:00 CET 15:00 - 16:00 GMT	**Debate Seven: Examining the Societal Impacts of Misinformation, Disinformation, and Malinformation and Developing Practical Approaches to Effectively Respond to the Consequences of Inaccurate Messaging on Infectious Diseases** *Position Paper Seven: "Rumors, Misinformation, and Responses"* **Author: Ms. Renée DiResta,** Technical Research Manager, Stanford Internet Observatory Moderated by Haile Tadesse, ISGP Fellow *Under Chatham House Rule (not-for-attribution)*
11:00 - 12:00 EST 17:00 - 18:00 CET 16:00 - 17:00 GMT	**Caucus Seven: Examining the Societal Impacts of Misinformation, Disinformation, and Malinformation and Developing Practical Approaches to Effectivel Respond to the Consequences of Inaccurate Messaging on Infectious Diseases** Participants identify AoC and ANS Moderated by Ian Shotts, ISGP Fellow Scribed by ISGP Fellows Tory Brewster and Mattia Anfonso Lembo *Under Chatham House Rule (not-for-attribution)*
12:00 - 12:05 EST 18:00 - 20:05 CET 17:00 - 19:05 GMT	**Day Three Adjournment**

Position Paper One
Prioritizing Ongoing and Emerging Scientific Research Pertaining to Infectious Diseases**

Nelson L. Michael, M.D., Ph.D.
Director, Center for Infectious Diseases Research, Walter Reed Army Institute of Research, Silver Spring, Maryland, U.S.

Summary

The recent SARS-CoV-2 pandemic provided valuable insights regarding approaches to infectious disease threats and how to most effectively counter them. While the initial U.S. response to the pandemic accomplished many successes in the research and development (R&D) of effective countermeasures to detect, prevent, and treat SARS-CoV-2, significant gaps in scientific approach and public health implementation were also identified. Attention to prospectively closing these gaps prior to the next pandemic will save lives, reduce suffering, and conserve resources.

Current realities

The scientific response to the SARS-CoV-2 pandemic was a perfect storm for vaccines, effective for diagnostics, and problematic for monoclonal antibodies and drugs. The response was powered by the early formation of public-private partnerships funded by the U.S. Government (USG) that provided direction, de-risked engagement by the private sector, and ensured coordination across Agencies of the USG (i.e., Inter-Agency, IA). For vaccine development, the USG funded efforts for six candidates, with two candidates representing each of three distinct vaccine platforms (i.e., technological approaches): mRNA, viral vector, and recombinant protein. Research for developing mRNA vaccine platforms was undertaken by Moderna and Pfizer, and both showed very early promise as they could be produced quickly and at scale. Pfizer funded its own R&D effort but had guarantees of USG purchase if authorized/approved by the U.S. FDA. The development of two viral vector-based vaccines by AstraZeneca and Janssen were slower to be tested and especially slower to enter large-scale efficacy trials in the U.S. due to production problems. Last, two more traditional recombinant protein vaccines were developed by Sanofi and Novavax, respectively. These vaccines were the last to be tested in

large-scale clinical trials due to inherent manufacturing challenges associated with this technological platform.

For all six vaccines, animal models predicted clinical success in reducing the transmission and, critically, reducing the severity of disease. The mRNA and viral vector vaccines were new to the public, and many expressed hesitancy stemming from personal concerns regarding long-term safety. While the mRNA vaccines proved to be safe, they suffered from relatively short periods of protection and required frequent booster shots to maintain high levels of protection. While a succession of new SARS-CoV-2 variants challenged the protective effect of these two mRNA vaccines, the mRNA platform enabled scientists to quickly retool the initial vaccines for improved protection against both early and later viral variants, especially in terms of protection against either death or the need for hospitalization. Initial logistical challenges caused by the low temperature required for the storage of these vaccines was overcome in the U.S. through the expertise of large, commercial pharmaceutical distribution chains. Thus, the mRNA vaccines gained considerable commercialization and were accepted by a large fraction of the public early in the pandemic. While initially authorized for adults, additional studies in children, adolescents, and immunocompromised people soon followed, ensuring that mRNA vaccines became generalized public health tools in the U.S. Both viral vector vaccines suffered from a number of factors. The AstraZeneca vaccine was emphasized for use outside of the U.S. and was never authorized for use in the U.S. The Janssen vaccine, while initially authorized for adults in the U.S., was noted to cause rare, but devastating, blood clots in a small number of people at a rate distinctly higher than the mRNA vaccines. This caused the U.S. Centers for Disease Control to recommend a de-prioritization of the Janssen vaccine. Ultimately, Janssen withdrew its vaccine, first in the U.S. and subsequently in the rest of the world, as the mRNA vaccines became the vaccines of choice in most of the world. The two protein vaccines both proved safe and effective, but their development took much longer than the other four vaccines. Despite the Novavax vaccine being authorized in the U.S., it gained no market share. The Sanofi vaccine has yet to be authorized in the U.S. Both protein vaccines have limited distribution as public health tools outside of the U.S. Their future is uncertain, as neither has been retooled to broaden their protective efficacy against modern circulating SARS-CoV-2 variants, which is far more difficult to do with recombinant protein vaccines, compared to mRNA vaccines. It is highly unlikely that they will ever be significant public health tools for SARS-CoV-2 in the U.S.

In retrospect, the USG approach to SARS-CoV-2 vaccine R&D was ultimately successful, because of the substantial funding allocated to six commercial companies

for developing six vaccines utilizing diverse technological platforms. The most successful technological platform for developing COVID-19 vaccines proved to be mRNA vaccine technology, despite not having advanced product development experience, experiencing significant storage challenges, and evoking initial hesitancy from the public. This could not have been predicted in early 2020 that the preferred choice for vaccines would be different from the tried and tested recombinant protein vaccines, which did not have a significant impact on public health in the U.S. When developing pharmaceutical therapeutics, the USG and its partners initially focused on monoclonal antibodies (Mabs), which could be quickly developed and distributed to provide rapid protection of the most vulnerable populations in the U.S., including those aged 75+ years, long-term care facility residents, and immunocompromised individuals. Additionally, Mabs could be used as treatment along with antivirals and immunomodulators. While Mabs were initially fielded for treatment as early as December 2020, they were: (i) difficult to administer in the outpatient setting, because most required intravenous infusion support, (ii) became challenged as single agents with the emergence of viral variants that were resistant to these agents, and (iii) have been supplanted as treatment modalities by the rapid development of two antiviral agents that can be taken orally and have broad effectiveness against a wide range of viral variants. Mabs were initially used as a protective measure against infection in a small number of individuals when vaccine use was challenged by hesitancy or poor effectiveness (e.g., for immunocompromised people), this market was quite small and increasingly diminished by the development of broader, population-based viral immunity. Antivirals were developed very rapidly and were shown to be both safe and effective when used within the first five days of symptomatic disease, especially a drug developed by Pfizer (trade name Paxlovid). Their uptake by primary care providers in the U.S. has not been particularly robust, which has limited the impact of these antivirals.

While the use of at-home testing using simple and specific approaches took more than a year to be realized, diagnostic modalities began to make a significant impact on early disease identification, the implementation of isolation and quarantine to control transmission, and the determination of individuals that could receive early treatment.

Scientifically credible approaches and challenges

We need to be prepared for the next pandemic. Several major challenges can be predicted today:

First, the USG will be challenged by the need to re-establish the "connective tissue" of IA and public-private partnerships backed by substantial resourcing in

terms of leadership, legal and contracting agreements, and industry incentives. The lessons of the SARS-CoV-2 pandemic must be codified as operational contingency plans, so that the USG can swiftly shift from reactive to proactive action. The initial IA response was the development of a collaboration between the Departments of Health and Human Services (DHHS) and Defense (DoD), termed "Operation Warp Speed." This gave way to the current DHHS-led framework known as the "HHS Coordination Operations and Response Element (HCORE)," which is led by the Assistant Secretary for Preparedness and Readiness. HCORE largely focuses on product development but not research or epidemiology, which are the responsibility of the NIH and the CDC, respectively. HCORE will need augmentation from these Agencies and others for a subsequent pandemic.

Second, while focus on biomedical countermeasures for SARS-CoV-2 was initially successful, the emergence of viral variants challenged the effectiveness of vaccines. This limited the ability of major pharmaceutical companies not originally using mRNA vaccine platforms to effectively engage in next- generation products, taking major executing partners out of the game.

Third, the use of Mabs was hampered both by the slow development of using cocktails of two or more Mabs to anticipate and circumvent viral resistance as well as the limited number of infusion centers to deliver them efficiently.

Fourth, a large fraction of primary care providers did not follow developing clinical practice guidelines for employing antiviral therapies in the first five days of symptomatic infection which, when done, greatly reduced suffering and saved lives among the most vulnerable individuals.

Fifth, while it took some time for at-home diagnostic kits to become widely available and used, this led to more effective use of nonpharmacologic containment approaches (e.g., isolation, quarantine) and facilitated the early use of antivirals and Mabs to reduce the burden of disease. Diagnostic laboratories lack approved tests that can efficiently differentiate between a resolving infection and a more transmissible case, despite the existing scientific capability to do so.

Sixth, despite an impressive array of prevention, treatment, and diagnostic tools available to the U.S. public early in the pandemic, the lack of attention to community engagement and research needed to guide deployment of these tools for public health benefit significantly blunted their effectiveness in the public health implementation phase of the U.S. pandemic response.

Evidence-based options (EBO) and actionable next steps (ANS)

The lessons learned from the SARS-CoV-2 pandemic need to be converted into prospective plans for the next pandemic. The following approaches are encouraged:

- Develop a better USG framework for the next pandemic based on HCORE model. HCORE needs to be augmented by other Federal Agencies, especially the NIH, CDC, and DoD.
- Emphasize the development of much more broadly effective vaccines for anticipated future pandemics. Instead of additional vaccines for SARS-CoV-2, develop vaccines that would cover all or most of the anticipated viruses of this class that have either been found in human disease already (e.g., SARS-CoV-1) or are only a few mutations away from transmissibility from animal reservoirs to humans.
- Develop cocktails of two or more Mabs to broaden protection and reduce the impact of resistance against single Mabs. Deliver these Mabs by means other than IV infusion.
- Write Clinical Practice Guidelines under the Infectious Disease Society of America or other professional groups to ensure the wider and earlier use of oral therapeutics and Mabs.
- Encourage the concomitant use of at-home diagnostic testing and sophisticated tests for predicting active infection by incentivizing developers of these assays.
- Expand awareness and use of community engagement frameworks and increase funding for implementation research by the CDC to ensure that a larger fraction of the public is enfranchised by medical science in a culturally effective fashion as a counterweight to prevalent medical countermeasure misinformation.

A position paper prepared for presentation at the ISGP Debate/Caucus Conference on "Foresight from the COVID-19 Pandemic: Science, Policy, and Communication" (COVID-SPC), organized and convened using an internet format on February 27 - March 1, 2023.

Debate One Summary

This not-for-attribution Debate Summary was prepared by the ISGP staff from an audio recording, and its transcription, of the debate of the position paper prepared by Dr. Nelson Michael (see position paper above and author biographical information in the Appendix). Dr. Michael initiated the debate with a 5-minute statement of his views and then actively engaged the conference participants, including other authors, throughout the remainder of the 55-minute debate period. This Debate Summary represents the best effort of the ISGP to

accurately capture the comments offered and questions posed by all participants, as well as those responses made by Dr. Michael and other participants. Given the not-for-attribution format of the debate, the views comprising this summary do not necessarily represent the views of Dr. Michael, as evidenced by his position paper. Rather, it is, and should be read as, an overview of the discussion and exchange of views and priorities, both in support of, and in opposition to, points expressed by all those participating in the debate.

It was almost universally agreed that continually ongoing biomedical research and development (R&D) of biomedical countermeasures is critical to societal preparedness for, and response to, infectious disease outbreaks and pandemics. Debaters discussed both the challenges and goals considered critical to identifying priority research areas and ensuring the rapid, effective research in response to the emergence of infectious disease outbreaks. It was widely asserted that U.S. government agencies need to continually maintain interagency pandemic preparedness and response structures and engage international communities (e.g., national regulatory authorities, multilateral organizations) in coordinating global response structures. Focusing on the development of "next-generation" technologies that can protect against a broad range of pathogens was identified as a key goal requiring policies and actions that incentivize rigorous, broadly supported decisions by stakeholders throughout society (e.g., private sector countermeasure developers, academic research). It was argued that scientific research needs to be paired with "implementation research" by government agencies to ensure that countermeasures can be effectively utilized when needed.

Establishing improved strategies and structures for interagency coordination and cooperation, both within the U.S. government and among international agencies, was broadly asserted to be critical for proactive and responsive R&D efforts. It was argued that governments in the Northern Hemisphere need to proactively cooperate with, and assist, agencies in other countries to ensure domestic preparedness based on international cooperation. Assisting other countries experiencing duress from infectious disease challenges was posited to be particularly important because epidemic and pandemic infectious diseases frequently originate in the Southern Hemisphere. Efforts by U.S. government agencies to engage the international community (e.g., CEPI, European regulatory agencies) were noted, and it was suggested that experiences from responses to the AIDS epidemic can serve as an example for future international cooperation, including the extensive U.S. engagement with the government of South Africa and the establishment of the COVID-19 Prevention Network (CoVPN) (i.e., through the partnership of the HIV

prevention Treatment Network, the AIDS Clinical Trials Group, the HIV vaccine trial network, and other leadership networks).

Establishing and clearly delineating transparent regulatory requirements and benchmarks was identified as a high priority for infectious disease research. It was noted that divergent approaches by regulatory bodies impact the efficiency of developing infectious disease countermeasures and impact public perceptions regarding the credibility of public health authorities. Several debaters suggested that normative bodies (e.g., WHO) have a responsibility to facilitate interaction and cooperation among national regulatory agencies to foster alignment in regulatory expectations. The involvement of normative bodies in fostering alignment was also posited to be a way of depoliticizing public health decisions and improving public trust.

Multiple debaters strongly asserted that ensuring global coordination for infectious disease preparedness and response was paramount to addressing future pandemics. It was acknowledged that individual countries may have different vulnerabilities (e.g., infrastructure, varying proportions of specific health risks observed in populations), and it was asserted that efforts for international cooperation needs to consider which public health strategies (e.g., community engagement, countermeasure distribution plans) are most effective in different national/regional contexts. Ensuring equitable implementation of infectious disease countermeasures (e.g., vaccine distribution) was noted to be a challenge for effective global coordination.

It was argued that government agencies and international normative bodies need to play a more active role in operational work to implement public health research, utilizing "boots on the ground" approaches. Multiple debaters identified insufficient funding allocation as a hurdle for expanding "boots-on-ground" operational activities by national agencies and international organizations currently engaged in regulatory, scientific, public health, and normative roles. In the case of multilateral normative bodies, multiple debaters reiterated that it is particularly challenging to align the priorities of member states to support funding for operational activities in a manner that meets member state expectations. It was noted that some multilateral institutions are setting examples by undergoing external assessments of their COVID responses and actively communicating with member states to understand their needs and expectations.

Improving the clarity and transparency of national and international regulatory requirements associated with developing and approving medical countermeasures was identified as a key goal by several debaters. It was posited that improved clarity from U.S. regulatory agencies can significantly improve the capacity of

countermeasure developers (e.g., private sector companies, academic laboratories, multisector research partnerships) to pursue R&D of new products and technologies. Understanding and alignment of regulatory benchmarks among national regulatory agencies from different countries was further suggested as an effective approach for increasing R&D capacities among stakeholders. Multiple debaters expressed support for fostering proactive discussions on international regulatory clarity and alignment through multilateral normative bodies.

Clearly delineating expectations associated with intellectual property rights for countermeasures developed through multisector partnerships was also suggested as an approach for fostering engagement in critical R&D areas. In addition to market-oriented considerations of how to effectively incentivize private sector companies and other research entities to engage in high-priority R&D areas, it was contended that policies and structures for multisector partnerships need to be informed by ethical considerations regarding the public ownership of products, tools, and technologies developed through government research or funding (i.e., taxpayer dollars).

It was broadly agreed that R&D efforts need to encompass a wide range of medical countermeasures, both in response to, and in anticipation of, infectious disease outbreaks and pandemics. Developing a broad range of countermeasures was suggested to be important for addressing a number of public health challenges, including: (i) the possibility that different forms of a countermeasure (e.g., vaccines utilizing different technological platforms) may vary in effectiveness, (ii) the possibility that different forms of countermeasure may not be preferred options under specific circumstances (e.g., in patients with certain immuno-deficiencies) or be best-suited to different situations; (iii) the development of resistance to specific countermeasures (e.g., specific monoclonal antibodies, antivirals, and vaccines) by infectious disease pathogens; and (iv) the possibility that some members of the public may be more personally receptive to different countermeasures. One stakeholder argued that investments for R&D of pharmaceutical therapeutics (e.g., antivirals, monoclonal antibodies), in particular, need to be significantly expanded. It was asserted that ensuring/maintaining political will for continuously advancing public health priorities and implementing substantive policies for de-risking private sector R&D investments are two critical factors for ensuring the development of a broad range of medical countermeasures for emerging and persistent infectious diseases.

It was frequently reiterated that scientific research prior to the emergence of SARS-CoV-2 was critical to rapidly developing and implementing countermeasures in response to the COVID-19 pandemic. Multiple debaters strongly conveyed that allowing R&D investments and institutional response structures to atrophy, as political will and public attention shifts away from COVID-19, would be critically

detrimental to U.S. preparedness and response. It was urged that developing "next-generation" pharmaceuticals utilizing continually advancing technologies is not only critical for preparedness but can also address many of the specific challenges experienced during the implementation of past and current countermeasures. It was argued that continually developing prophylactic and therapeutic pharmaceuticals that can provide effective protection against entire families of pathogens (e.g., pan-sarbecovirus vaccines, pan-betacoronavirus vaccines, universal flu vaccines, cocktails of 3+ therapeutics), rather than individual pathogens and/or variants, is a key priority. Developing approaches for rapidly adapting vaccines for mucosal and intranasal administration was asserted to be important for the implementation of effective medical countermeasures.

When conducting research on initial countermeasures for responding to the emergence of a specific infectious disease threat, multiple debaters argued that it is critical to simultaneously conduct forward-looking research and planning for the development and implementation of the "next stages" of those countermeasures. Examples offered included (i) proactive research for: adapting vaccines to protect against new disease variants, (ii) subsequent generations of monoclonal antibodies for utilization in anticipation of waning levels of protection provided those developed initially, and (iii) antivirals that can be implemented if diseases develop resistance. It was suggested that the potential need to utilize "multidrug" cocktails for ensuring the effectiveness of therapeutic pharmaceuticals emphasizes the importance of rapidly developing multiple countermeasures. It was also suggested that implementation of multidrug cocktails (e.g., of monovalent and bivalent cocktails of monoclonal antibodies and other biologics) is particularly impacted by production challenges related to chemistry, manufacturing, and controls (CMC). It was argued that efforts to develop such countermeasures need to be paired with approaches that facilitate the cost-effective production of those countermeasures (e.g., policies incentivizing private sector companies to overcome CMC issues).

It was repeatedly asserted that focused effort on infectious disease and public health research needs to be conducted proactively and continuously, not only in response to the emergence of any specific infectious threat or outbreak. Many stakeholders expressed agreement that U.S. government agencies need to actively maintain and utilize both internal and interagency structures for preparedness and response. Multiple debaters contended that the military is highly effective at maintaining preparedness for a broad range of potential crises and rapidly responding to urgent challenges, and its approaches can serve as an example for developing approaches within the public health system. It was vehemently argued that government agencies associated with public health systems need to establish

and maintain leadership positions and trained personnel whose specific mandate and responsibility is ensuring readiness and maintaining effective structures (e.g., internal protocol, interagency procedures, "playbooks" from past infectious disease outbreaks) for responding to public health challenges. The utilization of incident command structures for coordinated responses to infectious disease threats was also suggested as a key example for efficient crisis response. The operational capacities of the United Nations High Commissioner for Refugees (UNHCR) were also cited as an example of effective and efficient crisis response.

While many effective medical countermeasures were developed by the scientific community both before and during the COVID-19 pandemic, it was argued that suboptimal implementation of countermeasures can greatly reduce their potential impacts. Ensuring that public health authorities and personnel are trained to appropriately implement and utilize public health countermeasures was suggested to be critical. Various debaters suggested potential approaches that may contribute to improved countermeasure implementation. Multiple stakeholders discussed potential benefits of combining regulatory or scientific activities with implementation research and operational activities. It was posited that implementation research (e.g., utilizing social sciences, behavioral science, communication expertise) can help address major challenges impeding the effective implementation of medical countermeasures (e.g., public acceptance and trust, engagement of hard-to-reach and at-risk communities, broad accessibility to the public *writ large*).

Clearly delineating which government agencies and leadership positions bear which specific responsibilities for communicating developing public health understandings and/or public health decisions was argued to be more effective than channeling most government communications through one or two agencies or individuals. Effective community engagement was frequently emphasized as a crucial aspect of public health decision-making and policy implementation. It was suggested that government communicators need to avoid addressing the public in academic terms and focus on presenting clear answers to questions that are viewed as critical by members of the public. The lack of available or required communication and/or community engagement training for government scientists and public health officials was cited as a serious impediment to effective public communication. A significant gap was asserted to exist between the perception of risks held by public officials and that held by the public *writ large*. It was acknowledged that issuing scientifically credible statements is essential, but it was also posited that use of phrases such as, "we have no evidence of … (e.g., human-to-human transmission)," on issues with highly likely conclusions (e.g., based on population-level observations) can

be confusing to the public and can delay public health responses while waiting for verification of empirical evidence (e.g, multiple studies, completion of peer review).

It was emphasized that community engagement encompasses much more than effective communication by societal leaders in a top-down manner. It was asserted that community engagement strategies need to incorporate interlocutors who work closely with the individuals or community they serve (e.g., individual medical practitioners, local religious leaders). It was noted that communicating the nature of developing scientific understanding as more data become available remains a significant challenge. It was posited that communication by credentialed scientists (e.g., on local news stations) that does not fully align with broader public health messages contributes to the challenge of communicating the developing scientific understanding in a consistent manner. Politicization of scientific and public health messages and interventions by political leadership in public health processes were identified as significant barriers to accurate communication and community engagement.

Position Paper Two
Optimizing the Effectiveness of Infectious Disease Surveillance Before, During, and Following Outbreaks**

Sunil Suhas Solomon, M.B.B.S., Ph.D., M.P.H.
Professor of Medicine and Epidemiology; Director,
Center for Infectious Diseases in India,
Johns Hopkins School of Medicine, Baltimore, Maryland, U.S.

Summary

The SARS-CoV-2/COVID-19 pandemic claimed more American lives than the influenza pandemic of 1918 and challenged governments, public health systems, and society *writ large* revealing major gaps in disease surveillance systems and pandemic response capabilities. Improving these surveillance systems is imperative, in order to promptly identify and mitigate the threat of future pandemics. Surveillance in most countries, including the U.S., relied primarily on passive approaches including monitoring case counts, hospitalizations, and deaths. Yet, these approaches are inherently biased, because they require people to actively seek a test or care, and they do not necessarily accurately reflect all of the changes over time that might impact inferences about the deployment of countermeasures (e.g., testing availability and accessibility, therapeutics and vaccines). Active approaches that measure critical outcomes of incidence and prevalence in random population samples were far less common, and when they were implemented, efforts were not coordinated. While these approaches are more costly and logistically cumbersome, they proved to be a critical resource in countries where they were available (e.g., United Kingdom, Luxembourg). The pandemic also revealed gaps in our capacity for pathogen genomic surveillance as well as in our ability to coordinate efforts across stakeholders, sectors, and countries. At the same time, the pandemic revealed new approaches (e.g., wastewater surveillance), opening new avenues for continuous surveillance of ongoing and emerging pandemics. To ensure continuous monitoring of existing threats (e.g., SARS-CoV-2/COVID-19) even as public vigilance wanes, as well as to ensure that public health systems are better equipped to rapidly identify, respond to, and mitigate the impacts of future pandemics, it is critical to embrace OneHealth. OneHealth perspectives can best inform: (i) the early identification of threats, (ii) global capacity building, (iii) the development of a comprehensive network of surveillance sites integrating academia, government, industry, and the communities.

Current realities

From the beginning of the COVID-19 pandemic, countries faced a broad range of challenges in all aspects of response, including monitoring and predicting the trajectory of infections, understanding how infections were being transmitted, and identifying short and long-term consequences to individuals and society. Countries operated within silos and, even within countries, there was suboptimal collaboration and system integration across all relevant stakeholder groups (e.g., government, industry, academia, the public *writ large*). The long-term impacts of the COVID-19 pandemic on physical and mental health, social cohesion, and trust in government are not quantifiable at this point, but, in order to mitigate the impacts of future pandemics, it is crucial to advance the capabilities of U.S. and global disease surveillance systems to identify and respond to existing and emerging threats.

Since the first cases of SARS-CoV-2 emerged, surveillance in the vast majority of countries depended heavily on case counts, a form of passive disease surveillance which relies on hospitals, clinics, and other sources to report cases to health departments for tracking. These absolute case counts were used in many countries to drive decisions about shelter-in-place orders and the adoption of other preventive health measures, but case counts are inherently biased, because they rely on the willingness of individuals to visit a health or testing center to complete a test. During the COVID-19 pandemic, this bias changed dramatically over time. Testing uptake was and continues to be affected by availability, access, and personal motivations. For example, in the early months of the pandemic, limited testing capability caused a prioritization of certain individuals with indications qualified for testing, implying that many cases went undetected. Access further favored those with resources, whereas the pandemic was ravaging underserved populations. During the later days of the pandemic, when home testing became increasingly available and utilized, fewer and fewer individuals who tested positive reported their test results to surveillance systems. Currently, it is nearly impossible to accurately quantify the number of new COVID-19 cases diagnosed per day. Other passive surveillance systems tracked hospitalizations and mortality, which are clear indicators of disease severity and potentially less biased than case-count data. However, not all countries record vital statistics and maintain death registries, so assigning cause of death is fraught with challenges. It is well recognized that COVID-19 related deaths have been grossly underestimated, particularly in settings without formal registries. Moreover, hospitalization data also has to be interpreted in the context of changing vaccination rates and treatment advances, particularly when using these data to draw conclusions about the virulence or pathogenesis of new viral strains. While passive reporting of cases from testing data is a critical component of disease surveillance

that can be implemented quickly and with limited cost, it needs to be combined with data from active surveillance sources to be most effective and interpretable.

Active surveillance requires proactive efforts to sample and obtain information from multiple sources. Generally, active surveillance can provide more accurate estimates of disease burden and impact, but can also be more cumbersome and expensive. Ideal strategies would rely on repeated random samples of the population (i.e., another form of active surveillance). This would allow for the inclusion of individuals with and without a history of prior infection and estimation of prevalent and incident infections, immunity, and morbidity without the bias created by relying on passive reporting systems. Countries that had existing infrastructure for such studies were able to rapidly adapt these efforts to measure SARS-CoV-2/COVID-19. Studies that longitudinally followed these populations over time to characterize repeated infections, impacts of variants, changes in immunity over time, impact of interventions, and long-term complications (such as long COVID) would be even more effective. Many such longitudinal cohorts exist for other diseases, but such studies are expensive and logistically challenging. Regardless, they can be effective when combined with passive approaches. Additional efforts need to move even further upstream to identify potential risk before cases actually occur. For example, the COVID-19 pandemic highlighted the utility of wastewater surveillance for predicting spikes in cases/hospitalizations before they actually occurred. Similarly, monitoring mobility either through cell phone records or online surveys could provide insights into regions with potential risk of an outbreak.

Finally, the continued strengthening and maintenance of these systems, even in times when it appears a disease is transitioning from pandemic to endemic and the world no longer appears to be in a state of public health emergency, is a major challenge. With SARS-CoV-2/COVID-19, it is entirely possible that a new, more transmissible, and more pathogenic variant will appear once again, crippling healthcare systems. Further, it is almost certain that another respiratory or non-respiratory pathogen will arise in the coming decades and we need to have systems in place to identify them and respond quickly.

Scientifically credible approaches and challenges

Effective strategies need to balance logistical complexity and costs with scientific rigor and consider using a combination of approaches. Such approaches need to be maintained even in times when there is no visible threat. Strategies need to combine both active and passive surveillance approaches. Continued passive reporting of cases and deaths to health departments and ministries of health remains the most expedient way to attain accurate, actionable information. In settings

where electronic health records are available, such systems can provide additional information that is linked to other data on comorbidities and health outcomes. It is critically important to link these types of data with demographic information, so trends and clustering of infections or deaths can be tracked by factors such as age, sex assigned at birth, race, and ethnicity. Finally, having systems in place to rapidly sample from the community on a regular basis to monitor symptoms, behaviors, and collect blood and other biological specimens can provide perhaps the best early warning systems and ongoing monitoring, even when the most acute threat has subsided. Integrating rapid genomic testing and analysis will further allow for characterization of the evolution of existing pathogens and the identification of new pathogens. This may also potentially allow for predicting the impact of new and emerging variants. Stakeholders also need to build capacity to integrate advances in data science with big data from clinical centers globally to examine patterns of concern. However, such approaches may have to contend with privacy issues. All of these approaches will require ongoing collaboration between all relevant stakeholders (e.g., government, industry, public health, academics, technology) to ensure that systems are in place to rapidly recognize threats and respond.

The major challenges for establishing effective infectious disease surveillance systems are cost, complexity, and coordination. Moreover, it is difficult to obtain and maintain buy-in from all required stakeholders, particularly when an immediate threat appears to have waned, and a new threat is not yet in sight, but this is precisely when systems need to be strengthened. Unfortunately, our memories are often too short-lived, and, stakeholders tend to focus on the seemingly more immediate challenges, as opposed to being concerned about a nebulous potential infectious disease threat that could be years or decades away. Despite years of continued warnings from experts of an imminent pandemic, governments remained unprepared for COVID-19. COVID-19 has reinforced that this is exactly the time to remain vigilant, not just to prevent resurgence but also to build up capacity for the next threat. Scaling up and integrating global surveillance systems for respiratory and other pathogens through integrated passive and active surveillance with novel approaches (e.g., wastewater and genomic surveillance) is the optimal approach to prepare and protect against the next threat. Such efforts should be combined with state-of-the art analytics and assurances of data transparency, so that public health systems can respond to threats in a globally coordinated manner.

Evidence-based options (EBO) and actionable next steps (ANS)

Listed below are certain essential steps for ensuring that we are prepared to identify and contain an infectious disease threat as quickly as possible.

- Identify donors who will support a global surveillance program.
- Establish a network of global surveillance sites that span high-income and low-income settings and integrate effort across public and private sectors.
- Establish a network of academics, industry, public sector, and community partners who will inform and continue to evaluate the development and maintenance of surveillance programs.
- Promote a "OneHealth" approach and scale-up work at the interface of humans, animals, and environment as a key component of these surveillance sites.
- Assess ongoing disease surveillance data for emerging threats, while simultaneously monitoring existing and re-emerging threats.
- Develop specific frameworks for active surveillance for a variety of potential threats (e.g., airborne, bloodborne, vector-borne, etc.).
- Build local capacity for both clinical and molecular epidemiologic surveillance globally.
- Establish data sharing policies that ensure data transparency while protecting identifying information.

***A position paper prepared for presentation at the ISGP Debate/Caucus Conference on "Foresight from the COVID-19 Pandemic: Science, Policy, and Communication" (COVID-SPC), organized and convened using an internet format on February 27 - March 1, 2023.*

Debate Two Summary

This not-for-attribution Debate Summary was prepared by the ISGP staff from an audio recording, and its transcription, of the debate of the position paper prepared by Dr. Sunil Solomon (see position paper above and author biographical information in the Appendix). Dr. Solomon initiated the debate with a 5-minute statement of his views and then actively engaged the conference participants, including other authors, throughout the remainder of the 55-minute debate period. This Debate Summary represents the best effort of the ISGP to accurately capture the comments offered and questions posed by all participants, as well as those responses made by Dr. Solomon and other participants. Given the not-for-attribution format of the debate, the views comprising this summary do not necessarily represent the views of Dr. Solomon as evidenced by his position paper. Rather, it is, and should be read as, an overview of the discussion and exchange

of views and priorities, both in support and opposition, to points expressed by all those participating in the debate.

Active and passive surveillance systems were identified during the debate as the two main types of surveillance systems. It was broadly agreed that active surveillance systems are hard to maintain because they requires extensive resources, especially when interest and/or concern for the impact of the disease pandemic is waning. Analogously, passive surveillance systems were characterized as being more readily maintained, but have serious limitations with respect to early identification of the conditions leading to infectious disease outbreaks, and potential pandemics. Sustaining active and passive surveillance systems was broadly agreed to be a high priority, and ensuring the identification and allocation of continuous funding for such activity was identified as a critical challenge. It was expressed that the current need to develop robust surveillance systems for monitoring public health challenges provides an opportunity for developing ongoing systems in preparation for future infectious disease threats.

Many voiced the view that continuous surveillance efforts significantly improve responses to an ongoing infectious disease outbreak, and certainly a pandemic. A continuous surveillance system was viewed as critical for monitoring the appearance and progressions of diseases globally, as well as for the preparation to immediately address infectious disease outbreaks and to mitigate the development of pandemics. There was general agreement that the next infectious disease outbreak already is underway, and the establishment of effective surveillance systems is essential to maintaining public health and improving societal capacity and capabilities to respond to the next infectious disease outbreak, and certainly a pandemic. Immediate societal responses are essential once evidence-based information from disease surveillance indicates a significant risk of an infectious disease outbreak. Failing to employ early-stage measures designed to prevent and/or mitigate the broad impact of infectious diseases only enhances the potential seriousness of how emerging and/or reemerging infections spread throughout communities.

It was emphasized that any surveillance system needs to be global in scope. Significant resources and overarching policies are needed to immediately create an effective global surveillance system focused on infections and diseases *writ large*. While COVID-19 focused world attention on a specific series of viral infections, there is clear evidence that other infectious disease challenges lie ahead.

It was strongly contended that an understanding of the gaps and limitations of the existing surveillance systems need to be used to redesign and strengthen the usefulness of new approaches. Multiple debaters suggested that identifying gaps in existing surveillance systems and strengthening these existing structures is a feasible

initial approach, while the need for incorporating more universally applicable capabilities (e.g., global communication platforms that foster rapid, accurate transfer of data and commitments to collaborative analyses) was also strongly endorsed.

The public presentation of surveillance data by public health entities and surveillance groups, including consideration for what degree of detail is appropriate, was identified as a central issue in promoting understanding and garnering sustained community and individual support. Establishing ongoing collaborations among academic, private sector, and governmental communities in the evaluation of surveillance data before messages are prepared for public distribution was viewed as crucial. Ensuring citizens have a baseline understanding of normal health risks within a community before any significant threat increase or emergency occurs with respect to a specific pathogen was considered essential to build public confidence.

Many participants observed that the greatest challenges in supporting a proactive infectious disease surveillance system stemmed from the availability of sufficient funding. While less expensive passive/reactive surveillance approaches were viewed as important, they were recognized to have minimal impact on infectious disease preparedness. Concerns were voiced regarding the enhanced risks borne by public health systems if adequate resources are not invested to create and maintain proactive surveillance systems having global reach and oversight and focused on the myriad infectious diseases currently circulating and reasonably anticipated worldwide. Participants emphasized that participation in, and funding for, such a global surveillance system needs to be coordinated internationally. The motivation for international partnership on disease surveillance, accompanied by an obvious need to identify immediate investment returns, requires clear guidelines for decisions and strategies defining societally relevant benefits over time. Participants strongly endorsed the value of international partnerships in the development of active surveillance systems, while acknowledging that agreements need to be negotiated openly and communicated clearly to obtain sustained public support. It was also observed that disease surveillance is among those public services for which importance is not measured by their monetary return on investment. The proactive preparation to protect society *writ large* from catastrophic effects of infectious disease outbreaks and pandemics stands high on that list.

It was noted that, while surveillance data needs to be collected from multiple sources and correlated, the diversity of sources makes its analysis and interpretation challenging, particularly without standardized measurement parameters and guidelines for conclusions (e.g., triangulation methods for evaluating the significance of pathogen surveillance in wastewater requires correlation with clinical data from humans). Complementarily integrating different forms of data from myriad

sources was posited to reduce error limits, as different forms of data have different limitations (e.g., related to collection methods). It was agreed that transparent data management and sharing are critical in building a sustainable surveillance system.

It was suggested that establishing a centralized facility to organize and oversee surveillance data collection and analysis would significantly aid the overall process, especially if created under international supervision with numerous satellite facilities serving smaller geographical areas. It was emphasized that all such units need to ensure data transparency and protect personal information on human subjects. This systematic approach was endorsed as a model for increasing public confidence in the societal decisions emanating from the evaluation of these data.

Development and evaluation of tests for detecting and characterizing new pathogens at the outset of a disease outbreak or pandemic was identified as a serious issue for clinicians. The need to develop surveillance tests for use in the pre-pandemic stages was emphasized, especially as testing is crucial for populations with heavier disease burdens (e.g., nursing homes and prisons). Establishing a clinical case definition used in public health settings was suggested to ensure the prioritization of clinical tests used by public health entities. However, testing kits cannot all be distributed to public health entities since they will be critical in diagnosing patients in other settings. The difficulty in decision-making to balance these types of competing priorities for testing kits (e.g., death in ICUs versus public consumption) also was recognized.

Participants also identified the challenges associated with interpreting clinical tests and their applications in decisions. Clinical tests use IgG antibodies, which were built from specimens in a hospital and not only from symptomatic people, but they only have a distinction of a positive or negative result, which was noted to be imprecise when considering asymptomatic populations. It was recognized that tests used for surveillance studies for populations in which almost 90% of infections were asymptomatic cannot be interpreted using those clinical criteria. It was also noted that surveillance testing was not equally distributed over the population and therefore, the validity of the results in informing surveillance strategies was questionable. Answers to these questions need to be found including how to more accurately determine the geographical distribution of the virus.

Since it was acknowledged that genotyping of the virus was critical in effectively responding to the COVID-19 pandemic, it was agreed that focused attention needs to be given to the development of next-generation sequencing technologies that can significantly improve surveillance strategies. It was made clear, however, that these advanced capabilities require increased funding. Independently, it was emphasized that other surveillance techniques (e.g., wastewater monitoring and analysis) need

to be supported not only for disease outbreaks, but also for issues associated with antimicrobial resistance. Questions arose about the ownership and responsibility for wastewater surveillance data as part of a framework for public health decisions. Current CDC efforts to establish a wastewater surveillance program within the U.S. was noted positively, although most threats arise from outside the U.S., thus highlighting the value of a global wastewater surveillance data-sharing system. Due to the novelty of wastewater surveillance, questions were raised over the clarity associated with the interpretation of the data and the methods for communicating the results to the public. Addressing these issues requires the recognition of the impacts of diverse real-world conditions under which surveillance occurs and the degree to which modelers can interpret data obtained from populations with different levels of immunity that shifts among those who are vaccinated and those who are infected.

Communicating to citizens the significance of new types of data emerging from surveillance systems was suggested to present serious difficulties. As with all data, and the respective models used in their interpretation, some degree of uncertainty remains. Clearly, the public demands certainty while scientific understanding routinely provides probabilities with degrees of uncertainty. Since the COVID-19 experience elucidated the potential negative consequences of decisions presented without clear statements of uncertainty, the impact of new surveillance data on public decisions regarding infectious diseases (e.g., masks, vaccinations, mandates) was foreseen to be dramatic. It was noted that modeling used to analyze new data also depends directly on rapidly changing parameters (e.g., number of vaccinated people, degrees of transmissibility). The expectation that these collective degrees of uncertainty will present major barriers to developing effective communication strategies for any future infectious disease outbreaks motivated the debaters to strongly recommend significant investments in learning how to increase the impact of future communication efforts not only to the public *writ large*, but also to policymakers in government and the private sector. One debater suggested that scientists should even work to cultivate relationships with their policymakers.

The long-standing "One Health" approach to monitoring infectious disease was considered as an important, and perhaps, crucial aspect of improved surveillance strategies. The One Health emphasis on monitoring avian populations can be anticipated to have an increasingly significant contribution in defining global surveillance strategies and pandemic preparedness. It was acknowledged that monitoring avian and other animal disease patterns and occurrences in the environment has been demonstrated to be useful for predicting disease events in the human population. It was confirmed that humans, animals, and the environment are interconnected as disease vectors that affect each other via the transmission

of pathogens. It was urged by multiple debaters that surveillance systems need to simultaneously monitor diseases in humans, animals, and the environment if they are to be effective in protecting any one of these global components.

Position Paper Three
Medical Priorities: Therapeutic Options**

Michael G Kurilla, M.D., Ph.D., Director, Division of Clinical Innovation, National Center for Advancing Translational Sciences, National Institute of Health, Bethesda, Maryland, U.S.

Summary

Infectious disease therapeutics are critical for responding to emerging disease threats. While vaccines remain the most comprehensive solution, there will always remain a significant portion of the population that will not adequately respond with effective, durable immunity, necessitating therapeutic options. Two broad categories of interventions are possible: (i) directly acting anti-infectives (DAAs) and (ii) host-based targeting (HBT). While many DAA mechanisms of action are possible, the most successful include monoclonal antibodies (MAb) as well as inhibitors of pathogen-specific proteases and DNA/RNA polymerases. For certain pathogens, targeting mediators of disease or toxicity without directly impacting the organism's ability to grow and replicate may also be feasible. HBT can include inhibition of host cellular processes necessary for pathogen infection or replication as well as modulation of host responses such as coagulation, cytokine storm-like inflammation, or specific organ dysfunction.

Interventions will need to encompass the full disease spectrum (from pre-exposure prophylaxis to ICU patients). Each stage suggests specific interventions (e.g., MAbs for pre-/post-exposure prophylaxis). Most importantly, the regulatory pathways for each need to be clearly delineated such that developers understand what is required and regulators know what to expect. Expectations for Emergency Use Authorization (EUA) versus full approval need to be differentiated. Support for preclinical testing, including appropriate biocontainment facilities, suitable animal models, reference reagents, and prototype pathogen strains need to be made available to the research and development community. Dissemination of research findings requires a more effective communications strategy. Finally, surveillance efforts need to incorporate ongoing pathogen characterization to ensure continued effectiveness of deployed interventions.

Current realities

Unfortunately, our current COVID vaccine strategy results in a time-limited (i.e., one to three months) neutralizing antibody response conveying primarily infection protection. High-risk individuals (e.g., frail elderly, immunocompromised, obesity, diabetes, immunomodulator rx) who manifest defective or impaired cellular immune processes that preclude the generation of durable immune memory following either vaccination or natural infection will continue to suffer from transient protection with each new variant. More than 90% of COVID deaths currently occur in high-risk individuals. In the absence of a second/next-generation COVID vaccine (i.e., not a booster!), high-risk individuals will need to rely on prophylactic MAbs, whose authorization unfortunately has recently been pulled, or therapeutic treatment in the setting of COVID infection to mitigate severe disease progression.

Convalescent plasma (CP) offers a possible alternative. However, the initial rollout of CP, originally proposed as a pre-/post-prophylaxis intervention, was offered to everyone (and mostly hospitalized patients) under an Expanded Access Program in the absence of any clinical data. This resulted in a huge expenditure of time, money, and effort, which was abandoned following randomized clinical trial results. Importantly, CP did demonstrate efficacy as a post-exposure therapeutic. CP procurement requires federal-level coordination.

The proclivity of SARS-CoV-2 to rapidly evolve to evade neutralizing antisera is an attribute shared by coronaviruses, in general, that should have been anticipated given the past 60 years of endemic coronaviruses returning annually. This evolutionary proclivity reduces the likelihood of further development of MAbs, due to their limited 'shelf-life' for clinical utility. As such, DAAs will be crucial to mitigate severe disease progression in high-risk groups. The paucity of therapeutic options will become critical once drug resistance develops. Presently, the only obstacle to this future is the limited utilization of these available therapeutic options. Additional therapeutic options are desirable, even in the absence of resistance, given significant drug/drug interactions. Access by developers to biocontainment facilities and recognized, relevant animal models is needed.

The most prominent challenge concerns the uncertainty regarding continued investigational interventions once the public health emergency declaration is suspended. Typically, the FDA requires an 'E' in order to issue an EUA. In the absence of an 'E,' the standard regulatory pathway becomes crucial for developers to understand expectations. The FDA needs to be more forthcoming.

Scientifically credible approaches and challenges

In any emerging infectious disease outbreak, epidemic, or pandemic, there are certain

expectations, assuming there is a lack of any pre-existing vaccines or therapeutics. CP will always be an initial focus. At the same time, research labs will be announcing small molecules that demonstrate *in vitro* activity, and various MAbs will be rapidly generated. All of these will clamor for clinical testing while comprehensive master protocols are slowly (i.e., due to all the various 'cooks in the kitchen') being developed. At the same time, many smaller clinical trials that will never result in actionable regulatory data will be launched to be seen as 'doing something'. In addition, at least early in any outbreak, attention will be primarily focused toward the most severe forms of the disease. More transparency and communication, as opposed to waiting for the 'big splash', will aid the more comprehensive efforts.

Development of therapeutics will proceed within the two categories described previously. For DAAs, standardized *in vitro* assays with recognized reference or prototype strains will facilitate interlaboratory comparisons. It should also be recognized that science is not always the sole arbiter of further testing (e.g., recent testing of hydroxychloroquine or ivermectin). Generating negative data as quickly as possible can be nearly as valuable as positive data.

HBTs will be partly dependent on the specific pathology resulting from disease. While natural history studies will be crucial, HBTs are likely more clinically relevant than DAAs for the most severely ill, especially for situations such as coagulopathies, cytokine storm-like phenomena, or specific organ dysfunction.

Simple, templated clinical trial protocols make possible the ability to rapidly implement and execute trials across a wide variety of healthcare delivery settings. Emphasis needs to be given to the most unambiguous clinical endpoints (e.g., death or need for mechanical ventilation). Softer endpoints (e.g., composite patient reported outcomes) will require natural history studies and buy-in from regulators. These can be partly developed ahead of time to be 'shovel-ready.' At the same time, these protocols can be exercised with other relevant, but smaller disease outbreaks during interpandemic periods. CP trials need to be initiated, primarily for outpatient cases, as soon as CP is available to assess future resource allocation, and outpatient trials need to emphasize decentralized designs to maximize recruitment potential. Alternative statistical analyses also need to be pursued, such as Bayesian (i.e., as opposed to just frequentist), to inform clinical guidelines policy.

MAbs are likely to figure prominently in early therapeutic interventions, given their ease of isolation and production. If appropriate for inpatient situations, these can likely be impactful and could be quickly evaluated and authorized. For outpatient settings, the major challenge is the lack of outpatient infusion capacity. In addition, outpatient infusion works well in high-density centers, but low-density (rural settings) will suffer.

Natural history studies are also critical, but given the time required and inherent limitations (e.g., you only learn what was specifically studied), greater use of electronic health records to collect and analyze natural history is paramount to complement rigorous clinical studies.

Lastly, dissemination of pertinent and relevant clinically actionable interventions through the peer-reviewed literature is inefficient and largely ignored by the bulk of the practicing healthcare community. Furthermore, the peer-reviewed literature will already be 6-plus months behind emerging data, which is unacceptable during an emergency. Better means of dissemination of clinically actionable findings are needed.

Evidence-based options (EBO) and actionable next steps (ANS):

Ironically, possible options and next steps have been outlined in excruciating detail over the past several decades after nearly every real or imagined infectious disease outbreak. Lack of implementation and follow-through has mainly been due to lack of funding and continued interest from both the academic and private sectors.

- Facilitate coordinated and transparent sharing of major isolates and reference strains, especially sequence data.
- Standardize and harmonize *in vitro* assays specifically to support drug evaluation.
- Consider a comprehensive approach to infectious disease therapeutic development.
    - Create neutralizing MAbs candidates for all significant identified viral pathogens.
    - Develop drug candidates for all viral families' proteases and polymerases.
    - Increase effort for novel antibacterials.
    - Focus on emerging and expanding fungal pathogens.
- Develop simplified clinical protocol templates for inpatient and outpatient trials.
    - Standardize patient severity scores.
    - Employ alternative statistical approaches.
    - Exercise protocols with regional outbreak situations.
- Engage regulators to define critical parameters related to product development.
    - Articulate distinct requirements for EUA versus full approval.
    - Provide general guidance for generic categories such as MAbs.

- Aggregate electronic health records to support and augment:
    - Natural history studies.
    - Identification of early signals for therapeutic failure or resistance.
- Expand outpatient infusion capacity.
- Explore novel modes of dissemination including social media, podcasts, YouTube, etc.
- Convince funders and policymakers that public health preparedness matters.

***A position paper prepared for presentation at the ISGP Debate/Caucus Conference on "Foresight from the COVID-19 Pandemic: Science, Policy, and Communication" (COVID-SPC), organized and convened using an internet format on February 27 - March 1, 2023.*

Debate Three Summary

This not-for-attribution Debate Summary was prepared by the ISGP staff from an audio recording, and its transcription, of the debate of the position paper prepared by Dr. Michael Kurilla (see position paper above and author biographical information in the Appendix). Dr. Kurilla initiated the debate with a 5-minute statement of his views and then actively engaged the conference participants, including other authors, throughout the remainder of the 55-minute debate period. This Debate Summary represents the best effort of the ISGP to accurately capture the comments offered and questions posed by all participants, as well as those responses made by Dr. Kurilla and other participants. Given the not-for-attribution format of the debate, the views comprising this summary do not necessarily represent the views of Dr. Kurilla, as evidenced by his position paper. Rather, it is, and should be read as, an overview of the discussion and exchange of views and priorities, both in support of, and in opposition to, points expressed by all those participating in the debate.

During the debate, participants focused on a series of topics, including: (i) workforce training and availability, (ii) the development of clear, consistent guidelines for the development and implementation of therapeutics, (iii) information gaps before and during infectious disease outbreaks, (iv) clinical trials and health informatics, and (v) biosafety.

Maintaining sufficient, well-trained workforces for both the development and implementation of therapeutics was generally agreed to be a critical aspect of preparedness for future outbreaks. The importance of maintaining an available pool of qualified infectious disease specialists, particularly in rural communities, was

emphasized. It was contended that some medical and nursing schools may provide insufficient training on infectious diseases, specifically. Concern was expressed regarding the risk of knowledge gaps or lack of access to the most up-to-date outbreak information among primary care physicians and medical professionals when providing firsthand information to their patients. It was argued that gaps in knowledge and capacity present a serious challenge to maintaining an effective workforce (e.g., for infusion clinics). This was found to be particularly crucial when accessing the health needs of high-risk groups. It was suggested that treating high-risk patients in an outpatient setting may be preferable for minimizing exposure to pathogens. There was agreement on the need for increased numbers of clinical trials focused on vulnerable populations. While some population groups (e.g., children) are reportedly less likely to experience severe health outcomes from COVID, it was cautioned that future pathogens may not impact different populations in the same way. Concerning children's health, it was conveyed that the National Institutes of Health (NIH) has taken responsibility for the entire maternal vaccination program in an effort to instill public confidence and mitigate fears of adverse effects, particularly among parents of young children, a population in which vaccine uptake has been observed to increase. One debater posited that vaccination trials in young children were found to be unrelated to the confidence level of parents as it did not seem to increase vaccination rates.

Establishing consistent therapeutic implementation guidelines among stakeholders in government and the private sector prior to an infectious disease outbreak was proposed to be essential, especially among institutions responsible for the care of individuals in disproportionately impacted populations. Having a pre-existing infrastructure was asserted to be crucial in the development of treatment for vulnerable populations requiring early clinical trials. While developing new or updated infrastructure, it was argued that public trust needs to be broadly established before the infectious disease outbreak occurs. It was claimed that public trust in the spokespersons providing information on therapeutic approaches is key to the success of therapeutic implementation. Identifying community leaders in the pre-outbreak period is important to ensure information and advice from public health officials are appropriately trusted and implemented.

It was strongly asserted that, even among healthcare practitioners, there is a need to collectively identify cogent and easily discernible clinical practice guidelines for the use of therapeutic measures. Many participants agreed that well-defined, broadly deliberated methodologies for generating effective clinical guidelines need to be developed by professional societies that accurately reflect accepted healthcare standards. These guidelines need to be widely available, independent of any public

health emergency, and especially before an infectious disease outbreak. Addressing the impacts of infectious diseases throughout each potential stage of the "patient journey" (e.g., from pre-exposure prophylaxis, to treatment in Intensive Care Units) emerged as a key theme. It was widely emphasized that there is a need for significant improvements in the methods used for accurately assessing data (e.g., on-the-ground medical assessments used to characterize global health conditions). These data were identified as essential for both accurately informing global health decisions and for supporting healthcare practitioners who need to act expeditiously in the midst of public health emergencies.

While discussing the need to accurately inform the public of the benefits of well-designed and tested methods for preventing infectious disease outbreaks, the importance of communication regarding clinical trials was emphasized. It was argued that large clinical trials often lacked transparency to other hospitals, institutions, and practitioners during the COVID pandemic. This was asserted to have caused many entities to conduct their own, smaller clinical trials, unintentionally hindering the effectiveness and enrollment of the larger clinical trials. Establishing clear, consistent protocols for designing clinical trials was strongly endorsed.

There was general agreement on the need for public understanding on the importance of a well-established system for conducting and statistically analyzing clinical trials well before an infectious disease emergency occurs. Establishing the appropriate degree of public trust in the outcomes of clinical trials, especially in terms of informing individual actions prior to the progression of an infectious disease outbreak, was viewed by many participants as a critical component of building public trust during a public health emergency.

Establishing partnerships with institutions that care for communities that have been reported to be disproportionately affected by the pandemic (e.g., Black, Latino, Indigenous communities) was identified as an essential step to the crisis. It was posited that limited funding availability hindered clinical trials, including pivotal ones, and a lack of these partnerships reduced capacities for certain healthcare practitioners to conduct or engage with clinical trials. The significance of pre-crisis partnerships was highlighted as a means of fostering trust and increasing clinical participation from diverse communities. Identifying and understanding the role of community, religious, and political figures in building public trust was suggested to be important for maintaining effective societal partnerships as well.

One participant noted that understanding where clinicians obtain their information can help to identify any knowledge gaps and suggested conducting surveys to address any knowledge gaps within clinical communities. It was acknowledged that staying informed and building trust is difficult when information

is constantly being updated during an outbreak. It was conveyed that information and education regarding products/therapeutics (e.g., monoclonal antibodies) needs to be consistently disseminated to healthcare providers to inform them on when/how certain therapeutics need to be administered. Debaters also shared personal experiences of interfacing with family members and acquaintances who received inaccurate or unevidenced information from their physicians. It was broadly agreed that there is a significant opportunity for improving information sharing of accurate and up-to-date information in preparation for future pandemics.

Improving the dissemination of clinical guidelines for the use of monoclonal antibodies and antivirals, covering issues such as social pressure and the need for collaboration among healthcare practitioners, was highlighted in the debate. While methodologies for creating clinical guidelines within professional societies and healthcare providers often already exist, it was contended that the process is lengthy. It was posited that the FDA is currently facing challenges integrating real-world data, and it was argued that healthcare practitioners need to act quickly during public health emergencies to gather all available data rather than waiting for clinical trials to be completed.

Questions were raised concerning how to characterize future outbreaks regarding the specific strategies needed for antiviral treatments and/or host-based therapeutics to support practitioners. These inquiries on alternative therapeutic strategies for viruses resulted in monoclonal antibodies as a dominant topic of discussion. Although there are about 100 licensed monoclonal antibodies, including RSV and anthrax, it was asserted that they have not been extensively used in infectious diseases. COVID-19 has made monoclonal antibody treatment more challenging due to the virus' mutations, rendering the treatment ineffective. This led to a stronger focus on RNA polymers, which is a more conserved target across the coronavirus space. As a result, practitioners directed their attention to options already available that could be tested efficiently and quickly. It was noted that future infectious disease outbreaks could present different challenges for which monoclonal options would be effective, and therefore, it was strongly supported that monoclonal antibody research continues to be a high priority requiring vigorous support.

A participant inquired about monoclonal antibodies against conserved proteins and their level of protection. It was discussed that previous assumptions about monoclonal antibodies and vaccines for infectious diseases only generating neutralizing antibodies may have overlooked other functional capabilities, such as the FC portion of the molecule. There may be other effector functions of monoclonal antibodies that could be effective against the spike protein besides neutralization, but further research is necessary. A more creative approach to exploring the potential

functionalities of monoclonal antibodies beyond neutralization was recommended in the discussion.

The discussion on monoclonal antibodies also noted the need to consider the functional capabilities of the FCR portion of the molecule, rather than just its neutralizing antibodies. It was suggested that more research is needed to explore other effector functions of monoclonal antibodies against the spike protein. Concerns were raised about the lack of impact of clinical practice guidelines on general healthcare practitioners and primary care physicians. The importance of being realistic about the potential risks of using binding, non-neutralizing antibodies and the history of enhanced diseases caused by such antibodies in infectious diseases was also emphasized. Testing a non-neutralizing antibodies without a neutralization function is believed to be risky and likely to be perceived as a significant risk.

During the discussion, a question was introduced about the possibility of future clinical trials being different from current ones. Traditional statistical methods used in clinical trials have limitations, including the need for a certain enrollment level to ensure adequate power, making it challenging to conduct trials for rare diseases. It was suggested that alternative approaches, such as Bayesian analysis, can provide likelihood of efficacy that may be beneficial during public health emergencies where lives are at stake. It was posited that the traditional rigid approach may not be appropriate in acute situations where the risk-benefit analysis is different.

The need to explore a wider range of potential therapeutics beyond traditional treatments was discussed. Challenges associated with developing treatments for rapidly spreading diseases were highlighted, with an emphasis on the importance of preparing for future outbreaks by expanding the availability of potential treatments. Challenges identified by participants included: (i) a poor correlation between *in vitro* and *in vivo* activity in some infectious disease treatments, (ii) understanding species specificity before using relevant animal models to explore host-based targeting treatments, and (iii) clinical evaluation of promising broad-spectrum treatments. Some debaters cautioned against relying solely on *in vitro* results and suggested a middle ground between *in vitro* and clinical trials for evaluating potential treatments. Since host-based targeting drugs, such as hydroxychloroquine and ivermectin, have not shown promise for severe disease treatment during the COVID-19 pandemic, it was argued that emphasis needs to be placed on identifying the most relevant animal model for severe disease and focusing on *in-vitro* human tissue culture systems.

The lengthy process of disseminating information, implementing interventions, and developing drugs was also addressed in the discussion. It was argued that peer-reviewed publications alone do not suffice for informing healthcare providers with the necessary clinical information to make informed decisions. Artificial Intelligence

(AI) systems were suggested by one debater as a potential aid in addressing this issue, while it was conveyed that the healthcare community may initially struggle with trusting such systems. One debater requested the expansion of conversation on the topic of AI with an interest in the issue of forecasting and anticipation functions.

It was also stated that misinterpretations can occur when AI systems attempt to understand human language, using an example of a customer requesting a bag with cream cheese and receiving a response about cash only. Trust issues may arise in clinical-decision support due to misinterpretations. It was contended that AI has the potential to provide surprising conclusions by analyzing biological, sociological, and psychological data, highlighting examples of how AI has identified tanks by looking at trees and identified the sex and race of individuals from medical images.

The significance of biosafety level three and four (i.e., BSL-3, BSL-4) laboratories for non-human primate research, particularly in transmission variant testing, was discussed. The difficulty in sourcing these limited laboratory spaces and the importance of education and training on containment issues for emerging infections was underscored. The example of the Reeve antiviral treatment was used to illustrate the reliance on confirmatory testing in non-human primate models that necessitate B- and O-level laboratory space. More information on the cost and significance of these laboratories was requested. The challenges of operating BSL-3 and BSL-4 laboratories were discussed, including their high costs, security requirements, and training requirements. The critical importance of these labs for handling dangerous pathogens was highlighted, indicating that the people working in BSL-3 and BSL-4 laboratories need to be educated, trained, and certified in a manner exceeding the expectations of scientists in more routine laboratories. It was argued, however, that the issue of addressing the unique needs of these laboratories is currently being avoided by academic institutions and government agencies.

Position Paper Four
How Low Vaccination Rates Diminish the Triumph of COVID Vaccines**

Stephen J. Thomas, M.D.
Professor of Medicine and Microbiology and Immunology
Institute for Global Health and Translational Sciences,
State University of New York, Upstate Medical University,
Syracuse, New York, U.S.

Summary

Throughout the COVID pandemic, biomedical science and research and development (R&D) communities have repeatedly and efficiently delivered safe and effective vaccines. The speed with which vaccine technology platforms were leveraged to create diverse candidates, complete human testing and manufacture, and deploy large-scale supply was unprecedented. These successes have changed expectations of how to plan and execute future biomedical R&D initiatives. Despite clear causes for celebration, equally clear are the numerous opportunities for improving vaccination rates. Although there was, and remains, variance in global vaccine access, anti-vaccination views and hesitancy permeate even places with the least access. Unexpectedly low rates of eligible populations receiving the primary COVID vaccination series and even worse rates receiving additional, booster doses underscore the call-to-action for the scientific, medical, and public health communities to acknowledge that: (i) *carte blanche* vaccine acceptance among populations is dwindling significantly, (ii) both lay and medical community sophistication around vaccine development and accurate interpretation of vaccine performance is overestimated, (iii) effectively communicating complex medical and scientific concepts to diverse lay populations is difficult and requires specific expertise, and (iv) failure to properly manage population expectations of vaccine performance can have profound and lasting negative impacts on subsequent vaccination rates. If these lessons are not heeded, and plans for course correction are not established, we cannot reasonably expect to improve pandemic preparedness and response. The COVID experience exemplifies the adage, "*Vaccines do not save lives, it is vaccination which saves lives.*"

Current realities

The first COVID vaccines became available in the west under an Emergency Use Authorization (EUA) regulatory pathway approximately one year after the first cluster of pneumonia cases were reported in China. SARS-CoV-2 transmission dynamics, viral mutation potential, and how vaccine induced immunity would or would not translate into clinical benefit were incompletely understood when widespread vaccination was first implemented. This allowed for the hope that high-level population immunity was possible, and the pandemic could be short lived, at least regionally. However, as optimism around the potential game-changing effect of vaccine availability swelled, so did anti-vaccine, particularly anti-mRNA vaccine, sentiment.

COVID vaccination rates were quick out of the starting gate but eventually slowed and stuttered. Social initiatives for incentivizing people to be vaccinated were creative, at times bizarre, and did not substantially increase uptake. Disinformation and misinformation about vaccine ingredients and far-fetched conspiracy theories contributed to decreasing uptake, but so did important and rational questions about acute and long-term vaccine side effects (e.g., allergic type reactions, clot formation and stroke, heart inflammation, and in some cases, temporarily debilitating arm pain, headache, fatigue, and fever).

In addition to increasing attention to vaccine safety, observations that the rates of vaccine efficacy, initially exceeding expectations, were quickly declining and showing evidence of waning immunity and protection. The term 'breakthrough infection' became widely known, and often associated with great disappointment. Emerging data indicating the protective abilities of natural immunity or hybrid immunity imparted by a combination of natural infection and vaccination was another 'straw' grasped by the vaccine-reluctant. The emergence of virus variants was met with attempts to maintain immunity and protection by administering additional vaccine doses (i.e., boosters). Boosting was initially conducted with vaccines having the same components as the original formulations, but then variant-specific vaccines were tested and eventually a bivalent formulation targeting the original and more recent strains were used.

Surveys performed by entities (e.g., Kaiser Family Foundation) revealed that, when asked about their intentions to be vaccinated, responses often matched specific categories, including desire to be vaccinated immediately, desire to wait and see, and "hell no, never!" Studies have associated factors, including age, race, socioeconomic status, political affiliation, and educational background with what group a person fell into.

The most consistent early adopters of vaccines were older individuals, likely due to generational tendencies to trust the medical establishment and self-perceptions of increased risk from COVID. The thousands of older adults succumbing to infection daily and reports on the horrors occurring in group living facilities were difficult to ignore. Vaccine uptake decreased as recipients' age decreased. Just as perceptions of increased risk drove older adults to get vaccinated, perceptions of decreased risk caused parents and young adults to avoid vaccination. Their perception of decreased risk was not incorrect, but there was an underappreciation of the direct health risks COVID posed to children and concern about secondary risks imposed by an 'endless' pandemic' (e.g., associated with virtual learning, social isolation, and cancelation of extra-curricular programs). Quarantine, isolation, masking, and other policies considered less oppressive to the vaccinated, motivated some hesitant people to roll up their sleeves.

We know today that the benefit of COVID vaccination outweighs the risks, but the degree of benefit is not the same for everyone. Comparatively, those with low risk of a bad outcome from COVID benefit less. The vaccines, regardless of formulation, are highly successful in reducing the risk of severe disease, hospitalization, and death but less impactful in preventing infection or mild disease. Data indicates that vaccination reduces the risk of long COVID and is safe and beneficial in multiple special populations (e.g., pregnant women, people living with certain cancers). There is the potential that vaccination may reduce infectiousness or prevent infection in a small percentage of people, but these data are less compelling. The protective benefits of immunity from natural infection may be on par with those from vaccination, and hybrid immunity may or may not offer even greater protection. COVID vaccination recommendations are starting to mirror those of influenza, despite the current differences between the diseases. Unfortunately, there are clinicians and scientists who continue to raise concerns over the safety and effectiveness of COVID vaccines, despite being unable to support their claims with rigorous data.

Scientifically credible approaches and challenges

Technical challenges for optimizing COVID vaccines (e.g., vaccine component optimization, delivery method, dose and schedule, manufacturing, packaging, logistics and cold chain needs) are being, and will continue to be, addressed. Numerous large-scale efficacy trials of different vaccine platforms, high rates of infection in the population, and incredible amounts of real-world data from diverse environments and populations offer unique opportunities to rigorously explore scientific questions (e.g., immune responses associated with protection), which could lead to COVID vaccines with improved safety and effectiveness profiles.

However, a vaccine has no benefit if it is not administered and plans to improve vaccine uptake are less clear.

COVID vaccination campaigns have caused skeptics to not only question the risks and benefits of COVID vaccines, but all vaccines. Rates of vaccination across the board have declined during the pandemic and outbreaks of vaccine-preventable diseases (e.g., measles) are increasing. Clinicians and public health officials need to recognize that recommendations to vaccinate oneself or family members will likely be much longer conversations than in times past. With most people having never experienced an outbreak of a highly transmissible and highly morbid disease (e.g., polio), clinicians will need to make the case for vaccination by detailing what patients will gain by vaccinating, not with the case for avoiding hypothetical risks.

The impact of disinformation and misinformation on individual beliefs and behaviors during the pandemic revealed that, among the general population, the level of sophistication in these areas may have been overestimated. The same may also be said about pockets of professionals within the scientific and medical communities. Many people still do not know how vaccines are made, tested, and evaluated prior to approval, so reassuring the public about the safety of available vaccines is very difficult, while failure to do so impedes widespread uptake. Understanding how to accurately evaluate the credibility of information sources has also been a challenge for the public writ large, interjecting significant noise into important treatment and prevention discussions. Many clinicians have faced litigation or violence for refusing to prescribe ineffective medications (e.g., ivermectin), due to trends on social media. A shared understanding and agreement of what constitutes the 'known knowns' has been elusive.

During the pandemic, there has been a call for many scientists and clinicians to engage the public through various forms of media and the press. Whether through social media or local news segments, the public was receiving and consuming daily, detailed information about the pandemic from scientists and clinicians not used to communicating on this scale. It was quickly revealed that communicating public health information to educate the public and encourage certain behaviors (e.g., wear a mask, social distance, get vaccinated) is a highly specific skill requiring education, training, and experience that most scientific and medical professionals lack. Understanding how to engage the press is also a rare skill among these groups. Ineffective, poorly worded messaging can cause people to be informed by less credible information sources.

Perhaps one of the most significant opportunities for improvement is learning how to properly manage public expectations of vaccine safety and benefits. The goals of vaccination and how it addresses the public health burden of a specific disease

needs to be communicated. Unrealistic goals and expectations (e.g., prevention of infection, long-term immunity) also need to be addressed. Risk-benefit analyses for individuals and populations may be new and obscure concepts for many people. Failure to openly discuss knowledge gaps often erodes public trust. Finally, deepening public understanding that everyone may experience vaccine risks and benefits differently helps to frame rational discussions about vaccination.

Evidence-based options (EBO) and actionable next steps (ANS)

As efforts are under way to improve COVID vaccines, efforts should also be underway to improve how we communicate and discuss vaccines with the intended recipients. Specific actions include:

- Embrace the new normal of an increasingly vaccine-hesitant population and have clear and accessible talking points on individual vaccine risks and benefits.
- Accept there are individuals and groups attempting to dissuade people from being vaccinated and proactively leverage all available venues to communicate accurate information clearly.
- Develop multiple sources and access points of credible information derived from objective and accurate information sources.
- Recognize the increasing need for scientists and clinicians to communicate with the public on a large scale. Strongly encourage communication and media training.
- Assess the studies and surveys exploring why people did, or did not, get vaccinated to inform future vaccination and communication strategies..
- Identify when centralized (i.e., government) communication strategies are best executed using de-centralized and traditional (i.e., individual patient-physician relationship) methods.
- Develop governmental and non-governmental messaging on how vaccines, drugs, and other medical countermeasures are developed and the processes in place to ensure public safety.
- Actively manage public expectations of vaccine performance using the highest quality and most contemporary data and information and effective public health messaging techniques.

A position paper prepared for presentation at the ISGP Debate/Caucus Conference on "Foresight from the COVID-19 Pandemic: Science, Policy, and Communication" (COVID-SPC), organized and convened using an internet format on February 27 - March 1, 2023.

Debate Four Summary

This not-for-attribution Debate Summary was prepared by the ISGP staff from an audio recording, and its transcription, of the debate of the position paper prepared by Dr. Stephen Thomas (see position paper above and author biographical information in the Appendix). Dr. Thomas initiated the debate with a 5-minute statement of his views and then actively engaged the conference participants, including other authors, throughout the remainder of the 55-minute debate period. This Debate Summary represents the best effort of the ISGP to accurately capture the comments offered and questions posed by all participants, as well as those responses made by Dr. Thomas and participants. Given the not-for-attribution format of the debate, the views comprising this summary do not necessarily represent the views of Dr. Thomas, as evidenced by his position paper. Rather, it is, and should be read as, an overview of the discussion and exchange of views and priorities, both in support of, and in opposition to, points expressed by all those participating in the debate.

Participants agreed that the widespread vaccine hesitancy experienced during the COVID-19 pandemic needs to be seriously considered by the biomedical community and policymakers in government and the private sector as they develop more effective strategies designed to accurately communicate the importance of evidence-based scientific information and sound public health advice. Mitigating the impact of false information, often proliferated via social media, that minimized vaccination rates and denigrated safety measures (e.g., mask wearing) were identified as major barriers to promoting public health. Debaters uniformly endorsed the need for expanding science literacy among the public *writ large,* engaging community-level interlocutors to assist in communicating sound public health advice to their constituencies, and developing tailored science communication strategies for specific populations, both nationally and internationally.

Engendering science literacy throughout society was stressed as a necessary component in combating vaccine hesitancy by many participants during the discussion. The importance of ensuring that evidence-based scientific inquiry and the basic principles of the scientific method for experimentation and the repeated examination of hypotheses as an integral part of curricula in elementary, middle, and high schools was acknowledged. It was agreed that these principles need to be essential, core concepts throughout the entire modern educational program. It was further agreed that the inclusion of advanced scientific principles needs to be integral to collegiate and apprenticed education.

It was posited that current teaching methods in U.S. schools unfortunately

fail to properly incorporate scientific education, and as a result, large numbers of adults throughout the population are susceptible to believing misinformation and disinformation as well as accepting false rumors that fail to even appear rational. The need to immediately expand the adoption of sound scientific educational models was endorsed broadly by the debaters who emphasized the absence of sound science education and public scientific literacy as a direct danger to current societal stability. Experience from the COVID-19 Pandemic demonstrated the importance of public confidence in evidence-based information from credible scientific sources in preserving public health.

Improving scientific knowledge within the public *writ large* before the next anticipated infectious disease outbreak is needed to provide individuals with the evidenced-based knowledge required to make informed personal health decisions. For the public to decipher accurate information from misinformation and disinformation requires a baseline scientific understanding to properly assess many of the complex scientific concepts and approaches applied during an infectious outbreak. One participant argued that broadening educational curricula alone cannot address vaccine hesitancy, and that targeted efforts focused on educating communities that are statistically more likely to be vaccine hesitant need to be implemented.

The impacts of misinformation quickly emerged as a major focus in the debate. Misinformation, inaccurate or false information shared unknowingly, and disinformation, information that is known to be inaccurate but is shared with malicious intent, were identified by debaters as major causes of vaccine hesitancy and low rates of vaccine uptake. It was stated that during the COVID-19 pandemic, individuals and entities having longstanding public opposition to vaccinations were given a renewed, expanded platform with further reach. The effects of misinformation and antivaccination sentiments propagated by such groups and individuals were argued to extend beyond bolstering public hesitancy regarding COVID vaccines, but also to have caused a rise in several vaccine-preventable illnesses (i.e., measles, pertussis, etc.).

Debaters also contended that some credentialed experts and scientists, as well as public and political leaders, intentionally spread misinformation and disinformation about COVID-19 therapeutics, vaccines, and prophylaxis. When confusing or potentially incorrect information was communicated, whether intentionally or accidentally, by trusted public figures, highly educated individuals, and/or leaders in power, the impact was viewed by debaters as being even more harmful. One participant expressed their view that credentialed fact-checking systems need to be established for pandemic, healthcare, and science experts to

improve public confidence that they are a trusted source of information during an outbreak. Utilizing such credentialing/fact-check systems was suggested by one debater to be an effective method for curbing the spread of inaccurate and incorrect information to the public, and clarifying where to find the trusted, accurate information required to make informed decisions during a pandemic.

The debate focused heavily on the importance of communication as a means of curbing vaccine hesitancy and improving vaccine uptake. It was asserted that trained communication experts focusing on health and science communication are essential to advancing the acceptance of evidenced-based information. It was noted that communicating complex science and healthcare information requires specific education, training, and experience. When such communication expertise is not available or utilized, it was observed that public health messages are often confusing and overwhelming to the recipient. It was also suggested that when people are overwhelmed by conflicting information, they are likely to seek information from parochial views provided on television or social media, where the messaging is readily available and easier to accept without questioning its validity. It was argued that these circumstances can be an entryway into using and spreading misinformation and disinformation. It was asserted that existing groups of public health communicators were underutilized during many of the most challenging periods of the COVID-19 pandemic.

The importance of proactive, pre-pandemic preparation was stressed repeatedly during the debate by many participants. Regarding science and health communications specifically, multiple participants suggested that communication plans for addressing vaccines, prophylaxis, and educational information about diseases/viruses need to be established before the next infectious disease outbreak. It was posited that such a communication plan needs to include specific actions designed to train community leaders, thereby enabling them to share public health information with their own communities on the basis of trust. The urgent need for a cadre of societal interlocutors who are able to disseminate accurate and important health information to the public *writ large* was affirmed several times. It was repeatedly emphasized that community-level communicators are far more impactful when conducting outreach to specific communities than messaging from large organizations and agencies. Communicating what to expect from the emergence of a virus or disease, ways to prevent the spread, and the goals and potential impacts of a vaccine were viewed as key approaches for reducing public confusion and minimizing the consequences of misinformation and disinformation.

Many participants confirmed that community-level interlocutors were identified as essential elements in strategies for public health preparedness and

response. One participant shared an example in which a hospital had established a far-reaching program to develop relationships between hospital staff and local community leaders. The program enabled these trusted community members to serve as intermediaries among medical experts and communities. This program was viewed as a major success in the several states where it was implemented. Another participant discussed similar programs at another hospital, stating that the outcomes were widely viewed as positive. Many debaters agreed that grassroots efforts to spread accurate information are necessary during an outbreak and are critical for helping community members make informed decisions regarding the virus.

One participant noted that individual communities are unique, and that answers and information shared must be tailored to respective communities. Differences in race, ethnicity, socioeconomic status, gender, and age were all identified as factors impacting individual decision-making during the COVID pandemic since each group has different needs, concerns, and priorities that cannot be addressed broadly. It was widely agreed that community interlocutors are better positioned to answer specific questions about misinformation and disinformation. Ideally, these interlocutors would know their own communities well enough to effectively address specific concerns. Another participant shared their experience in parts of Northern Thailand where a public health infrastructure, reported to be highly effective, became the foundation on which community-based healthcare workers were able to help minimize the effects of COVID-19. These communities were characterized as having incredibly high rates of vaccination and uptake of what is considered foundational elements of health, and the participant credited this to efforts undertaken at the community level.

Participants with expertise in science communication emphasized the importance of the "production side" of communication involving more than simply teaching people science literacy. There are myriad reasons that members of the public were not interested in the information that experts shared about the safety of vaccines. It was strongly asserted that public receptivity is not only affected by those who present the information to communities, but that the quality of messaging (e.g., content, phrasing, format) is crucial as well. It was posited that communication experts need to play a role in developing messages by collaborating with community interlocutors to tailor the messages to their communities. Specifically, it was suggested that the goals and anticipated impacts of public health interventions (e.g., vaccines, therapeutics) need to be clearly explained to the public in understandable terms, noting that they had encountered individuals who believed they would not benefit from vaccination because they were already taking preventative measures against the vaccine.

It was also noted that public health authorities need to clearly delineate which official messengers (i.e., specific roles, leaders, agencies, organizations) are responsible for communicating specific types of information, as it was not always clear from which sources the public *writ large* needed to seek information. It was observed that, at the beginning of the U.S. response to the COVID-19 pandemic, most information and guidelines were originating from the Centers for Disease Control (CDC) and the White House, but as the pandemic progressed, more information sources emerged. It was also contended that government information sources sometimes shared conflicting information via social media, news outlets, and state and local governments. Concern was raised that this inconsistency further confused the messages being conveyed because it was not clear to whom the public needed to listen.

Political polarization was identified as a major disruptive aspect of how the COVID-19 pandemic was treated in the United States. Political motivations were observed to foster significant public distrust in credible scientific information and healthcare advice, becoming barrier to effective public health decisions throughout society. One participant, positing that polarization was exacerbated during the 2020 Presidential election, argued that both political parties did not fulfill their responsibilities to the public. It was suggested that some politically active individuals took antivaccination, antiface-covering positions to appeal to specific voters while others vocalized distrust in vaccine safety for vaccines developed during the administrations of their political opponents. It was generally agreed that political communities did not effectively engage with credible scientific and biomedical sources available to them to prepare accurate messaging concerning the benefits and potential risks of vaccination during the COVID-19 pandemic. It was also observed that currently most political communities do not view the threat of COVID-19 seriously and as a result, act as if the threat of any infectious disease has ceased. Debaters did not come to a consensus regarding the cause of politicization during the response to the COVID-19 pandemic or how to address the challenges of political polarization on a large scale.

It was posited that perceived risk was a major driving factor in individual decision-making process. Several participants considered that the political leanings of an individual became one indicator of whether an individual would get vaccinated. Educating people on the use/safety of vaccines was posited to be a beneficial and important option throughout society, but it was argued that vaccine hesitancy is statistically predictable. As a consequence, it was strongly suggested that there needs to be a focused outreach to groups prone to vaccine hesitancy (e.g., groups whose hesitancy stems from factors correlated with political affiliations, religious

beliefs, race, gender, socioeconomic factors). It was also asserted that the amount of resources allocated for outreach to these specific populations for vaccination efforts, as opposed to focusing on broad science education, needs to be increased.

The implementation of vaccine requirements or "mandates" (e.g., by employers, governments) was also cited as a source of political contention during the pandemic, independent of the appropriateness of imposing mandates. Several participants noted that vaccine mandates within their organizations were viewed by some employees as contentious, despite working in fields related to healthcare and science. Multiple different participants posited/reiterated that they had colleagues in these types of organizations who were opposed to vaccination mandates, exemplifying the challenges of vaccine mandates and the animosity that they can cause in those who do not want to get vaccinated. One participant shared that an organization was able to mitigate some concerns over vaccine mandates by having open conversations with employees who were opposed to receiving the vaccine. Overarching requirements for vaccines were argued to be less effective than providing incentives for individuals to be vaccinated. It was noted that perceived risk was a major driving factor for whether people choose to get vaccinated. It was asserted that the aging population, whose risk of death and complications from COVID-19 are much higher, got vaccinated at higher rates than the general population.

Position Paper Five
What We Learned From SARS-CoV-2 Antigen Testing That Informs Further Novel Pandemic Planning**

Georges C. Benjamin, M.D., MACP, FACEP(E), FRSPH, FFPH
Executive Director, American Public Health Association,
Washington, D.C., U.S.

Summary

Identifying when a new or re-emerging infectious threat appears in society is at the core of disease control and prevention. The capacity to create and utilize diagnostic tests to verify the presence of a specific disease is an essential step in this identification. This is especially important when the disease does not have pathognomonic characteristics (i.e., signs and symptoms that are diagnostic by themselves) and, therefore, the disease has to be differentiated from other diseases with similar symptoms. For SARS-CoV-2, the virus that causes COVID-19, a diagnostic test was essential for disease identification, contact tracing, isolation, quarantining decisions, and individual treatment. The development process for SARS-CoV-2 tests was problematic during much of the COVID-19 pandemic. This case study of COVID-19 needs to inform future efforts for diagnostic test development for emergency purposes since, unlike "Operation Warp Speed," the underlying research helped create the accelerated evaluation of mRNA vaccines. Diagnostic test development for emerging diseases with pandemic potential needs a whole-of-government approach and the early engagement of the private sector at every phase of test development and deployment. The need for better contingency planning for diagnostic test creation, manufacture, stockpiling, allocation, and distribution is essential.

Current realities

The COVID-19 pandemic from the SARS-CoV-2 virus in the United States, apparently related to its emergence from the People's Republic of China, demonstrated the strengths and weaknesses of a nation's ability to rapidly identify, contain, and treat an emerging infectious disease of pandemic potential.

The U.S. system for recognizing the emergence of a new health threat, or the resurgence of a known health threat, within the community is fragile. This

determination is currently facilitated through a range of disease surveillance systems hosted by the U.S. public health system. The U.S. public health system is a patchwork federation of federal, state, and local governmental agencies whose overall missions include promoting and protecting the public's health. The public health system is assisted by a range of public, private, nonprofit, and for-profit entities that provide a variety of enabling services. Validation of an infectious disease test is usually ascertained using a confirmatory diagnostic test, a procedure that is essential unless the disease has a unique symptom complex.

Identifying SARS-CoV-2 infection in patients required the development of a new diagnostic test. As SARS-CoV-2 is part of a family of coronaviruses that causes seasonal respiratory diseases, the diagnostic test for COVID-19 needed to be highly specific to accurately differentiate SARS-CoV-2 from other nonpandemic coronavirus strains. COVID-19 diagnostic tests also needed to be sufficiently sensitive to provide the early-stage detection essential to support immediate disease control activities.

Traditionally, new diagnostic tests for public health purposes are created by the scientists at the U.S. Centers for Disease Control and Prevention (CDC). These early tests are then evaluated and licensed by the Food and Drug Administration (FDA) for use. Other licensed clinical and research laboratories in the private sector can also create diagnostic tests, which can eventually be evaluated and licensed by the FDA. Private sector laboratories, however, can create their own *in vitro* diagnostic tests for use in their own facilities. These laboratory developed tests (LDTs) do not undergo FDA approval. While this regulatory gap has grown over the years, the extent of its impact remains unclear. When LDTs are developed in a laboratory certified under Clinical Laboratory Improvement Amendments regulations, development has theoretically been done in a manner that involved some regulatory oversight. However, when a public health emergency is declared, it triggers strict limits on lab diagnostic test development in government-certified clinical labs at hospitals, research centers and universities. This requires these laboratories to receive an Emergency Use Authorization from the FDA before use.

Two unsubstantiated assumptions emerged during the early stages of the COVID-19 pandemic:

- Assumption #1: The proliferation of the disease would be on a manageable scale, and private sector-developed tests would not be needed.
- Assumption #2: The test developed by the CDC would work.

Both assumptions were incorrect.

The CDC test had a flaw in its controls, due to a laboratory contamination during manufacturing, and the COVID-19 outbreak was much more extensive

than originally understood, despite the emerging experiences in China and other nations. Additionally, a decision was made to use the diagnostic tests developed by the CDC instead of other existing tests being used in other nations with support from the World Health Organization (WHO). At the time, it was argued that the CDC diagnostic tests were prioritized because they were believed to be more sensitive, although national pride and hubris may have played a role.

Challenges with maintaining reliable supply lines for diagnostic test reagents, both within the U.S. and globally, also became an obvious problem throughout the first year of the COVID-19 pandemic. These decisions were driven by the global demand for tests, difficulties forecasting demand, and manufacturing capacity limits for critical items (e.g., transport medium, testing reagents, and swabs). Early on, these supply challenges caused inefficient production, distribution, and deployment processes and subsequently, hampered capacities to scale up diagnostic test production when needed. As a nation, the use of incentives, including the Defense Production Act, to spur the private sector to produce pandemic-related materials often seemed haphazard to the outside observer.

During the early stages of the COVID-19 pandemic, supplies and access to diagnostic tests were quite limited, particularly for underserved populations. The accessibility of diagnostic tests was improved through the establishment of a government distribution system, which eventually flooded the market. However, as the government began to shift from its role as "test provider of first resort," to being the "test provider of last resort," there emerged the risk that obtaining diagnostic tests could again become difficult for some communities.

Boom-or-bust funding remains a reality for public health programs and has an impact throughout the life cycle of a disease outbreak like the COVID-19 pandemic. Resource allocators are already resisting the continuation of funding for research and development (R&D) of new diagnostic tools as well as vaccines and therapeutics. Dwindling R&D funding has major implications for the resilience of current and future public health systems and their capacity to manage emerging and re-emerging infectious disease outbreaks, epidemics, and pandemics.

Scientifically credible approaches and challenges

The U.S. has an essential need to define the acceptable timeline and critical timing required to develop diagnostic tests in a manner that will ensure effective test deployment and use that optimizes disease containment following outbreak of emerging, re-emerging, and diseases of pandemic potential. Such a timeline needs to include the timing, role, and methods of engagement for governmental agencies as well as the private sector.

Contingency planning needs to include best practices for ensuring an efficient supply line for critical reagents and materials. In addition, the development and production of pharmaceuticals (e.g., vaccines, therapeutics) needs to be integrated into ongoing outbreak response strategies and implementation plans with sequential pathways. Distribution schemes need to be informed by the experiences encountered during the COVID-19 pandemic and need to use a whole-of-nation approach to effectively memorialize lessons learned.

Recognizable shortcomings and strategic gaps in current diagnostic technologies demonstrate that the continual appearance of viral variants stresses the capacity of current tests to provide results with sufficient sensitivity and specificity. Widely used COVID-19 diagnostic tests have remained accurate and effective, despite the viral drift of SARS-CoV-2, but a major shift in the virus could result in a failure of testing accuracy. Continued research for improving test durability is essential to maintain the capacity of public health systems to track disease outbreaks.

The role of testing needs better definition within public health structures and strategies as the COVID-19 pandemic transitions to its endemic form. This requires better clinical and forensic diagnostic clarity. For example, questions about the role of a positive COVID-19 test with respect to eventual death of patients who contracted SARS-CoV-2 needs to be clarified. It is important to understand if a person died while infected by SARS-CoV-2, or as a direct result of COVID-19, specifically. The role of a positive test in a person that has recovered, but now has an apparent "breakthrough" infection also needs to be clarified. The politicization of the pandemic, and all of its aspects, continues to be a challenge. This is especially true in cases involving false-negative test results, which can undermine compliance in low-trust situations.

Evidence-based options (EBO) and actionable next steps (ANS)

The COVD-19 diagnostic test is in many ways a metaphor for the problems impacting the manufacture, allocation, distribution, and utilization of all of the elements of the response, including personal protective equipment (e.g. masks, gowns, and gloves) as well as the production and distribution of vaccines and therapeutics. All of these issues encountered similar challenges with understated demand, supply chain/production limitations, and allocation/distribution inequities.

- Establish a strategic approach to laboratory test development and implementation within new requirements for regulatory oversight during Emergency Use Authorizations. Regulatory flexibility within these strategies is an essential next step to ensure the ability to rapidly scale up testing, particularly when the private clinical and research laboratory network is

required to obtain desired capacity.

- Overhaul the currently outdated organization of the Federal Strategic National Stockpile (SNS) for use as a major national asset, while clarifying the options and priorities for utilizing it during emergencies. Emphasis needs to be placed on improving the flexibility and adaptability of the SNS mission to meet contemporaneous and reasonably anticipated emergency preparedness and response environments. Similar challenges involve the development of countermeasures and nano-pharmaceutical tools.
- Expand funding for improved behavioral science research focused on understanding the role that accurate testing can play in enhancing the use of myriad NPI countermeasures (e.g., masks, social distancing, hand hygiene). Improved behavioral approaches need to be part of the evolving medical guidelines for responding rapidly to infectious disease and pandemic outbreaks related to geopolitical conflicts. Accurate testing can play a role in developing trust.
- Examine how public confidence in the accuracy of diagnostic testing, and its effective communication to society *writ large*, can enhance trust throughout diverse communities.

*****A position paper prepared for presentation at the ISGP Debate/Caucus Conference on "Foresight from the COVID-19 Pandemic: Science, Policy, and Communication" (COVID-SPC), organized and convened using an internet format on February 27 - March 1, 2023.***

Debate Five Summary

This not-for-attribution Debate Summary was prepared by the ISGP staff from an audio recording, and its transcription, of the debate of the position paper prepared by Dr. Georges Benjamin (see position paper above and author biographical information in the Appendix). Dr. Benjamin initiated the debate with a 5-minute statement of his views and then actively engaged the conference participants, including other authors, throughout the remainder of the 55-minute debate period. This Debate Summary represents the best effort of the ISGP to accurately capture the comments offered and questions posed by all participants, as well as those responses made by Dr. Benjamin and other participants. Given the not-for-attribution format of the debate, the views comprising this summary do not necessarily represent the views of Dr. Benjamin, as evidenced by their position paper. Rather, it is, and should be read as, an overview of the discussion

and exchange of views and priorities, both in support of, and in opposition to, points expressed by all those participating in the debate.

Debate participants focused on a series of topics, including (i) the effectiveness of utilizing incident command structures for response to infectious disease outbreaks, (ii) the practical management of Emergency-Use Authorization (EUA) policies, (iii) the comparison of communication strategies in global responses to infectious disease events, (iv) the critical roles of partnerships throughout all societal sectors, (v) programs designed to address supply shortages, and (vi) the impact of diagnostic procedures and collected data.

Serious concerns were expressed regarding the need to establish effective logistical structures that quickly facilitate the effective, targeted responses and actions required during public health emergencies. Many participants identified ineffective response structures as a key challenge during discussion, particularly highlighting confusion surrounding which authorities had leadership responsibilities for different aspects of public action. Inefficient response structures were suggested to especially impact access to essential health services, resources, and information under emergency conditions. It was noted that existing communication strategies and distribution structures specifically designed for use under emergency conditions (e.g., disaster response for hurricanes or tornadoes) provide useful models for implementing appropriate crisis response structures for infectious disease outbreaks that can be implemented with minimal ambiguity. Minimal ambiguity in response procedures was asserted to be critical, especially regarding the designation of responsibilities and authority to different agencies, organizations, groups, or individuals as well as the delineation of standard operating procedures for response. It was noted that the appearance of biological emergencies often engenders significant public confusion given the unknown dimensions of such crises in terms of immediate impacts on human health and the nature of transmissibility throughout a given population.

Debaters broadly agreed that there is an urgent need to establish a national response framework in the U.S. for emergencies associated with infectious diseases. Several debaters asserted that a well-organized, adequately funded, and continuously maintained incident command structure is the most effective approach for coordinating infectious disease response. It was contended that public health incident command structures need to be utilized consistently, rather than simply "dusting them off" when a major public health event emerges. Some agreed that a leadership group consisting of specifically designated societal leaders (e.g., holding specific roles at government agencies and public health authorities) needs to be organized to meet regularly (e.g., quarterly) to ensure preparedness and response

structures (e.g., interagency, multisector) are well-equipped to rapidly respond to a specific public health emergency. Such an established incident command structure needs to focus on (i) identifying and evaluating creative new approaches that effectively address recognized and reasonably anticipated challenges from infectious disease outbreaks, (ii) identifying potential improvements; (iii) evaluating and improving metrologies used to rapidly identify and analyze the domestic and global public health data needed to more accurately alert societies to emerging infectious disease threats; (iv) developing increasingly effective diagnostic testing regimes with respect to detecting and characterizing variants underlying emerging infectious diseases; (v) improving the structures and management of commercial supply chains associated with infectious disease prevention, treatment, and recovery protocols; (vi) fostering national, regional, and global agreements on harmonizing the functionality of response mechanisms that optimize the distribution of resources required to combat the global impacts of infectious diseases; and (vii) supporting communication agreements to enhance public trust in the use of credible scientific, evidence-based messaging concerning infectious disease prevention and treatments.

The urgent need for cohesive public health leadership was broadly agreed to be essential. Identifying trustworthy leaders who can deliver public messaging and convey public health decisions was asserted to be essential for creating unity, ensuring public trust in health authorities, and engendering understanding of what members of the public need to do in pandemic situations. It was suggested that the establishment of effective leadership roles and incident command structures would have positive, overarching impacts on many aspects of pandemic preparedness and response.

It was broadly agreed that effective implementation of Emergency-Use Authorizations (EUA) by the Food and Drug Administration (FDA) needed to be categorized and expanded, and approaches were discussed by several debaters. It was posited that the proposal by the FDA of additional requirements for diagnostic test manufacturers seemed onerous to diagnostic developers, because there the regulation of diagnostic tests was not as extensive prior to the COVID-19 pandemic. Concerns were raised regarding the impact that EUAs have on public trust, and it was suggested that members of the public *writ large* often react poorly to interventions approved through the EUA process. It was questioned whether addressing this challenge requires a change in the regulatory structure for early approval of new public health countermeasures. A contrary view was expressed suggesting that misunderstandings are rooted in broader communication issues. Mindfulness regarding the choice of wording to avoid stoking public fear or uncertainty when discussing EUA products was suggested to be important, but it was also argued that many individuals will

continue to be opposed to a countermeasure if they have already decided they do not like it and/or mistrust expert advice on any issue.

Analyzing international differences in approaches to pandemic response during the COVID-19 Pandemic was posited to be important for drawing comparisons and identifying effective options for the future. It was noted that implementing responses in the European Union (EU) was especially challenging since effective communication required conveying nuanced language to the public throughout countries having 24 official languages. It was contended that this diversity required a meticulous approach for generating public health narratives. The organization of stakeholder meetings in Europe to engage the public in consulting and addressing concerns with decision-makers to improve how they would respond moving forward was posited as a necessary component to the communication of credible scientific information in all social settings. This was suggested to have helped in mediating concerns in the EU as the general public was given the opportunity to better understand what was happening and the decisions being made, enhancing trust in those making these decisions.

The importance of coherent narratives when combating the spread of misinformation was expounded by multiple debaters. It was also siggested that cohesive public messaging supports efforts to "pre-bunk" information during an infodemic. "Pre-bunking" is an emerging term in communications in which correct information is shared and taught before misinformation and disinformation, thus intending to mitigate the effects of inaccurate information.

It was also generally agreed that building and/or utilizing effective partnerships throughout all sectors, including universities and local community organizations, was a critical part of effective communication. Relationships between universities and their local communities often provide specific opportunities for effective partnerships, and several universities reportedly developed partnerships to support local efforts (e.g., distribution of testing materials to ensure the safety of the campus and the local community). On many university campuses, rapid systems were established for testing, diagnostic reporting, and isolation/quarantining of individuals who tested positive for COVID-19. It was recognized that not all universities had the same positive experience, but those having strong relationships with their local public health departments were characterized as having more effective responses.

Instances of partnerships between laboratories and their local health departments were offered as examples of successful partnerships, providing opportunities for laboratories to share information rapidly with health departments and for local authorities to subsequently create informed responses to protect community health. Questions arose regarding which stakeholders are responsible

for organizing partnerships in different instances. While it was contended that there may be no definitive answer that applies to the diversity of potential stakeholder partnerships, it was argued that adjusting national frameworks for the incident command system and identifying various conducive regulatory structures is an important first step. On the local community level, it was mentioned that there are public health extension systems in most states that help to provide connections between universities and their respective communities.

Supply shortages

Shortages of various essential supplies, even from the beginning of the COVID pandemic, were identified as a major issue. According to debaters, some of these shortages were driven by consumer panic-buying as a response to crisis, while many were caused and/or exacerbated by supply chain issues. It was suggested that supply chain issues were particularly widespread because most stakeholders (e.g., national/state/local government agencies, hospitals) use the same suppliers and back-up suppliers for essential products and materials, and increases in demand during crises exceeds available supply. To address these supply chain challenges, it was argued that the federal government needs to incentivize businesses carrying critical supplies to maintain sufficient stock in preparation for crises. It was argued that the Strategic National Stockpile needs to be a reservoir for hospitals and clinics to rotate materials in and out of the system to prevent shortages.

It was additionally posited that diagnostic capabilities and capacity (e.g., within laboratories, at-home testing) is another aspect of pandemic preparedness that needs to be improved. Limitations to the capacity at which individual diagnostic laboratories can effectively produce new diagnostic results and findings were suggested to be a significant challenge for effective diagnostic and surveillance systems. Questions arose around the potential effectiveness of utilizing a national lab system that included the CDC, public health labs, and some of the large reference/academic labs. Debaters conveyed that such collaboration is essential in cases of new pathogens. Multiple debaters expressed agreement that there can be several entities trying to develop effective diagnostic tests to prevent surges through the collaboration of a national lab system.

The development and normalization of at-home testing procedures was said to be a beneficial advancement during the COVID pandemic. Readily accessible at-home testing options were praised for enabling individuals to preemptively avoid transmitting the SARS-CoV-2 virus to others (e.g., self-testing before visiting elderly relatives, immunocompromised friends, public places). While the benefits of at-home testing were acknowledged, it was also noted that increased use of at-home

testing resulted in a gap in diagnostic data when results are not reported. Some debaters contended that at-home diagnostic results need to be recorded, but others noted that at-home testing can introduce significant factors affecting the accuracy of results. It was asserted by many that the overall benefits outweighed the reduction in available data, as making these tests accessible can inform the general public on their infectious status and make them aware of their need to self-isolate.

Vaccination was broadly agreed to be an important countermeasure for impeding the spread of a virus and limiting disease side effects. The necessity of administering booster doses for some of the COVID vaccines, as well as the need to develop updated vaccines for protection against new variants, was suggested to present some challenges pertaining to public perception. It was posited that some members of the public incorrectly perceived recommendations to receive multiple vaccine doses as an indication that the vaccines were not effective, despite overwhelming scientific evidence showing COVID vaccines to provide high levels of protection. The continued development of COVID vaccines was characterized by one debater as a race to identify mutant strains and fight against variants deemed to be the most threatening. While it was acknowledged that this may be a necessary approach under current circumstances, investing in "pan-vaccines" (e.g., pan-sarbecovirus, pan-betacoronavirus vaccines) could mitigate the need to respond reactively to the emergence of new variants in the future. While agreeing that implementing pan-vaccines would be an effective method for the next potential pandemic, one debater noted that engendering the public will and political will to commit large investments for research may be a significant challenge, particularly considering the lack of immediate or guaranteed payoff. Though significant investment and extensive scientific research are required for the development of effective pan-vaccines, it was contended that the utilization of pan-vaccines during future infectious disease outbreaks will reduce overall costs significantly, compared to the costs associated with administering several booster vaccines and developing updated vaccines for new variants. It was argued that robust, global partnerships would be essential to developing pan-vaccines.

Position Paper Six
Issues and Actions to Share Accurate, Relevant Public Health Information With Diverse Audiences**

Cynthia Baur, Ph.D.
Endowed Chair and Director, Horowitz Center for Health Literacy
University of Maryland School of Public Health,
College Park, Maryland, U.S.

Summary

A crisis of facts and trust is undermining the conditions for evidence-based public health messages. People are inundated with so much information they cannot verify sources and accuracy. Traditional information sources such as government agencies and media are not trusted, and few other organizations are well-equipped to step in as providers of accurate public health information. Best practices to produce evidence-based information exist but are not consistently used. Local information sources and scientists partnered with communicators may be some of the best options to counteract an unstable information environment. Policy discussions to reduce the flood of inaccurate information are essential.

Current realities

The current situation for trusted messengers and evidence-based messages for diverse audiences is unstable and undergoing a massive social transition. We are in a global crisis of facts and trust in core institutions and information sources. Facts establish a shared space for debate and dialogue, and trust is central to credibility. Perceptions that something sounds true enough but is not accurate and declines in trust have serious implications for public health communication.

Globally, the public's trust is low in government and media, traditionally two primary sources of public health messages. Across 25 countries, 46% of 2023 Edelman Trust Barometer respondents said governments are a source of false or misleading information. Scientists rate more highly than government or journalists. In the U.S., the director of the CDC, the country's premier public health agency, publicly admitted the agency botched the COVID-19 response and did not communicate clearly with the public. The WHO Director-General observed

the information environment was so chaotic that the world was experiencing an "infodemic" as part of the COVID-19 pandemic.

Trustworthy alternatives are few. Because of confirmation and other cognitive biases, partisan media sources have more credibility with their followers than "mainstream media" that claim objectivity practices. Local news sources in the U.S. are closing, with one-fifth of the U.S. population in a "news desert." Edelman respondents report more trust in nongovernmental organizations and the business sector, but the latter is not typically a source of evidence-based public health messages.

Although healthcare providers remain trusted and often preferred sources of personalized health information, they are often inaccessible or too expensive to serve as everyday sources for people's critical health questions. Moreover, few educational programs for health professionals require in-depth communication training, nor require that professionals refresh and improve their communication skills once in practice. Problems of explicit and implicit bias because of race, gender, education, or language differences can undermine effective communication between providers and patients.

Public health professionals, especially those at the most local levels, should be strong candidates to be trusted information sources because they work and often live in the communities they serve. They have access to scientific information to inform evidence-based messages and channels to reach community members. However, the COVID-19 pandemic put public health officials in the spotlight for many unpopular policies, such as shut-downs, masking, and vaccination requirements, and they have become less trusted by some audiences.

Not surprisingly, social media services, such as Facebook, Twitter, and TikTok, and private messaging services, such as WhatsApp, are popular information sources, even though they are heavily criticized as spreaders of misinformation and disinformation. They score high on diversity of audience and content and low on standards for evidence and accuracy. The reality is people may trust other people online for the wrong reasons. Unlike government, mass media, and academic sources, social media and messaging services offer many advantages: they are free, anonymous, fun, often easy-to-understand, available 24/7, allow users to create their own content and respond to others in many languages, and provide information, opinions, and feelings to meet any information need or question. Websites, blogs, and other digital formats available through the internet are sources of accurate and inaccurate public health messages, but they do not have all the advantages of social media and messaging services.

Scientifically credible approaches and challenges

Communication, risk, and health literacy sciences offer general principles to help understand diverse audiences and public health message design. Message accuracy is paramount. These principles include: (1) know the audience by conducting formative research; (2) have clear communication objectives and align messages with objectives; (3) have a main message and call to action; (4) be accurate, transparent, and honest about what you know and don't know; and (5) explain what's at stake in harm and exposure for the audience.

Best practice is to test all messages with the intended audiences and use their feedback to revise messages before they are publicly released. Testing can use different methods, such as one-on-one interviews, focus groups, online surveys or experiments with draft messages, and eye-tracking studies that observe people interact with materials displayed on a screen.

Public health communication has many guidelines and best practices based on these principles. Training, usually optional, is available and lacks evidence of effectiveness. In the 9/11 and anthrax attacks aftermath, the U.S. CDC created a Crisis and Emergency Risk Communication (CERC) framework and principles. CERC's motto is Be First, Be Right, Be Credible. Getting accurate, trustworthy information out quickly can save lives, according to CERC's creators. The Association of State and Territorial Health Officers has a website with resources, including a Crisis Communications Guide, for public health communicators.

Although not health specific, an international plain language movement provides plain language guidelines that can be applied to messages and materials about any health topic. Plain language makes information broadly accessible because an audience can understand the information the first time they read, hear, or see it. In the U.S., federal agencies, such as CDC, FDA, and NIH, must use plain language in all public communications (except regulations).

A health literacy approach, also developed at the U.S. CDC, is the CDC Clear Communication Index. The Index is an evidence-based tool to create public health messages using health literacy techniques. The Index aligns audiences and message content in easy-to-understand formats. Messages must provide clear explanations of public health risks.

Many traditional as well as new approaches exist to tackle misinformation. These include media literacy, which has roots in helping people counteract advertising and recognize deceptive claims. Information literacy includes tactics for searching for credible information and assessing information quality. Newer approaches to online misinformation include prebunking, debunking, and other methods to help people prepare for, recognize, and reject misinformation. Although

social media companies offer content moderation, they have been unable or unwilling to significantly slow the spread of misleading or false information.

Three main challenges exist for successful use of evidence-based public health messages for diverse audiences. First, tools for information accuracy and audience appropriateness are premised on having communicators whose purpose is to deliver accurate, useful information to diverse publics. Producing these messages takes time. This means public health communicators are typically slower to the marketplace of ideas, leaving space for the rapid spread and acceptance of sensational misinformation and disinformation. Many commenters have observed that credible sources with factual information were slow to recognize and respond to the COVID-19 infodemic.

Second, the public's information preferences may have shifted from fact to opinion. Researchers note clear ideological patterns in people's responses to questions about many current topics, which suggest they value personal experience and opinions over verifiable facts. References to people living in information bubbles or echo chambers indicate that people are paying attention to what they already believe rather than seeking out new information or ideas that might challenge what they think they know. New evidence-based messages are not likely to break through these hardened walls of beliefs, opinions, and personal experience.

Third, the evidence isn't strong yet for effective methods to prevent or counteract misinformation. Despite a PubMed search of "COVID-19 misinformation" yielding more than 15,000 results, we know very little about how to help people consistently resist the lure of misinformation, especially when it is anchored in some recognizably truthful information and delivered by an apparently credible source.

Evidence-based options (EBO) and actionable next steps (ANS)

The information environment is so complex and distributed that no single solution is sufficient. The suggested options can work together to support an environment for accuracy and diversity.

- Create local info hubs with accurate information and credible, trusted messengers. These hubs could aggregate libraries, social services agencies, healthcare providers, academic groups, or clubs. The Edelman results show that employees want their employers to stand up to misinformation, and employers are an underused resource. New digital non-profit news organizations are starting up. Organizations closest to people's everyday lives may be best positioned as trusted sources, and they need help to have the infrastructure, staff, knowledge, and resources to produce and distribute evidence-based public health messages.

- Fund communicator positions in health departments, and connect funding of government agencies and public healthcare organizations to verified use of communication, risk, and health literacy guidelines and best practices, such as the U.S. Federal Plain Language Guidelines. In the U.S., all COVID-19 information from federal agencies should have been in plain language because of the Plain Writing Act law. Public agencies need to experience consequences when they don't follow laws or communication best practices.
- Begin serious global policy conversations about social media companies and reducing online misinformation and disinformation. Given the volume and attractiveness of social media content, we can't expect people on their own to recognize all misinformation and disinformation. When information purveyors follow the motto to "flood the zone with sh*t," individuals need structural and policy help to find and focus on factual information.
- Support science literacy and science communication at all levels. Scientists themselves may not be the best messengers, and training them in communication may be too expensive and time-consuming. But, they can work in teams with communicators and local hubs to reach diverse publics. ISGP did a 2015 convening on science communication, and many of the recommendations are still valid. Evaluation studies can show what has been achieved and what remains undone.

A position paper prepared for presentation at the ISGP Debate/Caucus Conference on "Foresight from the COVID-19 Pandemic: Science, Policy, and Communication" (COVID-SPC), organized and convened using an internet format on February 27 - March 1, 2023.

Debate Six Summary

This not-for-attribution Debate Summary was prepared by the ISGP staff from an audio recording, and its transcription, of the debate of the position paper prepared by Dr. Cynthia Baur (see position paper above and author biographical information in the Appendix). Dr. Baur initiated the debate with a 5-minute statement of her views and then actively engaged the conference participants, including other authors, throughout the remainder of the 55-minute debate period. This Debate Summary represents the best effort of the ISGP to accurately capture the comments offered and questions posed by all participants, as well as those responses made by Dr. Baur and other participants. Given the not-for-attribution format of the debate, the views comprising this summary do not

necessarily represent the views of Dr. Baur, as evidenced by her position paper. Rather, it is, and should be read as, an overview of the discussion and exchange of views and priorities, both in support of, and in opposition to, points expressed by all those participating in the debate.

Participants centered this debate on specific issues related to communication, message accuracy, sources of public health information, and declining trust in the public health system. Attention was focused on the 10 Essential Services Model for Public Health, developed by the Public Health National Center for Innovations (PHNCI) and the de Beaumont Foundation. This model places health equity at the center and includes steps related to community engagement and public communication to frame the topics of discussion. Recurring topic areas discussed in the debate included (i) equitable public health messaging, (ii) building upon healthcare infrastructure, (iii) increased community engagement efforts, and (iv) post-pandemic policy implications.

Combating distrust in the public health system was a theme that permeated all topic areas. The position paper referred to a survey across 25 countries, in which 46% of respondents said that governments are a source of false or misleading information. Current challenges to building trust in the public health system include a shift in the widely-held public opinion concerning the trustworthiness of a given source of information and the accessibility of healthcare providers to answering questions relevant to public concerns. Participants identified as a critical issue the lack of access to healthcare providers for many people and therefore, the limited options to consult a healthcare professional during the pandemic. While obvious constraints arose from the overstretched work of healthcare providers and office closures during the pandemic, many individuals faced personal/financial healthcare accessibility problems independent of COVID. Participants posited that public health professionals were overwhelmed and not well trained in public health communication, particularly in small health ministries or health departments. Many professionals also held multiple jobs, and public communication was often added to other tasks.

Debaters expressed concern regarding significant levels of public hesitancy, both domestically and globally, associated with COVID vaccines. The need to build public trust in public health systems was a recurring theme throughout the debate. Ensuring the accessibility of important public health information to the public *writ large* was identified as a critical "best practice" for equitable communication among diverse ethnic, cultural, financial, and geographical populations. Accessibility to scientifically credible information was characterized as addressing three factors: (i) whether individuals can find the information, (ii) whether the information is

translated to all audiences, and (iii) whether public health messages speak to the specific questions or concerns of its recipients (e.g., specific communities, cultures, and language groups). A current gap in information accessibility factors arises from the reality that less than half of the Ministries of Health in the Americas have websites, which are a main conduit for broad public communication in a modern world and an obvious area requiring improvement. Debaters also emphasized the importance of translating public health messages into meaningful language within specific communities. Debaters posited that public health communicators need to understand and advocate for communities based on a detailed, sympathetic understanding of the actual living conditions and challenges being experienced by individuals. Rather than categorizing people or communities "hard-to-reach," it was argued that healthcare professionals need to learn and respect the sources of distrust, especially regarding vaccine hesitancy, in specific communities. This degree of understanding often requires an understanding of past community experiences (e.g., discrimination and limited access to effective resources historically).

Multiple debaters referred to the "information ecosystem" and noted that current political instability and polarization undermines the ability of individuals to find and understand accurate public health messages. There was broad agreement that the new information ecosystem requires focused infodemic management. It was posited that utilizing a singular "voice of expertise" for public health messaging is not an effective communication approach, particularly considering that myriad competing voices exist on various social media platforms. Participants discussed the need for health system professionals to receive specific education and training to understand this changing information ecosystem. It was noted that people turn to social media and communication platforms (e.g., WhatsApp) as preferred sources of information for various reasons, and one participant suggested that the ability to receive information in a person's preferred language is a major factor. Participants emphasized the need for additional studies on messaging across closed messaging platforms, even though these platforms (e.g., WhatsApp) are difficult to study because members must be invited into discussions.

Participants also noted that public health messaging experiences competition for viewership and engagement from other, less accurate sources, particularly on social media and closed messaging groups that often provide mis/disinformation. It was argued that messages from public health authorities need to effectively compete as an independent, trusted source of reliable information. Public health messages need to consider societal and community rationale behind reliance on given social media outlets found among specific parts of the public *writ large*. Developing local information hubs that aggregate a wide variety of information

providers in a community was proposed as an evidence-based option for addressing these challenges. Participants noted that the responsibility for messaging cannot be offloaded onto small organizations with staff that are often not well-trained and do not have sufficient resources.

Healthcare infrastructure was another major challenge identified by debaters to effective communication. Participants emphasized that developing a deeper understanding of community groups requires sustained community engagement efforts. A consistent mistake that has been made is to wait for a crisis to build relationships with communities. Some medical institutions use the relationships built during the HIV and COVID-19 period to bring information and vaccines that address other health concerns (e.g., diabetes). Engaging with communities on an ongoing basis enhances and preserves the relationship between these institutions and their respective communities.

Sustained relationship building and communication between medical institutions and communities was asserted to be essential for improving public trust. Uruguay's pandemic response was suggested as an example of the consequences of declining public health communication during the crisis. Although Uruguay was praised for its initial pandemic response, according to one debater, the minimal engagement of the healthcare system with the public led to decreased usage of masks and failures to obtain vaccines, resulting eventually in serious outbreaks of COVID-19. According to the debater, authorities in Uruguay have now acknowledged constant engagement with society as a high priority for addressing infectious diseases. Such comparative analyses can help to update public health messaging, which was characterized as remaining relatively consistent since the global infectious disease outbreak in 1918-19 (e.g., washing hands, wearing masks, and social distancing). Understanding why specific health messaging works better than others is an important question to address looking forward.

While participants reached a consensus that there is no "one-size-fits-all" solution for community engagement, there are a variety of approaches that have helped different communities develop trust. Emphasizing the role of Emergency Health Departments as a public health messaging intervention site is critical. It was posited that nearly 20% of the U.S. population receives healthcare access only through Emergency Health Departments. Underserved populations (e.g., immigrants, houseless persons, and those without health insurance) often face obstacles such as access to the internet, primary care doctors, and/or a pharmacy to get information about healthcare options. It was conveyed that Emergency Health Departments are open 24 hours a day, seven days a week, and there are about 160 million visits per year in the U.S., making this institution a high-volume enterprise that can reach

underserved populations. It was suggested that studies on public health messaging within Emergency Health Departments found that the degree of success in messaging to underserved communities varies significantly. The critical need for Emergency Health Departments to tailor their messaging to their communities to satisfy the accessibility standards was strongly emphasized.

Another community engagement tool that can be utilized for public health messaging involves community libraries. Some community libraries have offered COVID-19 pandemic translation services and organized vaccination programs and can provide digital access through computer and hot spot loans as well as free Wi-Fi within the building. Other services community librarians have provided is access to digital resources (e.g., signing up for health care). Public libraries were praised for being digital community centers.

Nurturing sustained relationships between academic, public, private, federal, and state government bodies requires ongoing relationship building and communication. Sustained engagement with communities was suggested as a needed step for building support for vaccine uptake. Public health authorities in Seattle were offered as an example, as they reportedly observed a noticeable inequity in vaccine uptake, motivating them to utilize longstanding relationships with several community-based organizations and churches to establish vaccination sites where vaccine coverage was low. Establishing these relationships with community organizations can promote more unified public health response to a public health threat and increase vaccination among populations that experienced the hardest impacts.

It was expressed that a significant amount of money went into funding community-level work, including community health workers, in the U.S., particularly through a Federal Office of Minority Health grant called "Advancing Health Literacy," which focused on COVID-19 messaging outreach at a local level (e.g., county or city level). Community health workers were funded through the Health Resources and Services Administration. The CDC also provided community health worker funding multiple times throughout the pandemic. Multiple participants argued that, since the Crisis and Emergency Risk Communication models utilized during the pandemic were designed for shorter-term events than the COVID-19 pandemic, the need to understand how to manage a pandemic occurring on an extended life cycle is critical. Developing appropriate messaging for appropriate audiences was asserted to requires crisis communication exercises and ongoing social science research. Participants indicated that there needs to be further consideration of the institutional structural obstacles that hinder the production of effective messages.

Participants suggested the best practices and criteria available for government

agencies, non-profit organizations, and universities to use for crisis and emergency risk communication were often ignored in the framing and development of public health messages. In the U.S., a federal law called the Plain Writing Act requires all federal executive branch agencies to use plain language, which would have required all pandemic communication from the U.S. government to be written in plain language. Many participants expressed their disapproval that communication was not written in plain language. U.S. federal agencies are required to take part in a number of processes that take an extended amount of time to turn funding into a public health message. It was argued that the internal clearance process for developing public health messages could be more organized, and that the communicators in government agencies rarely prevail in arguing for plain language or audience-centered communication.

It was asserted that there are fewer Ph.D.-level communicators within federal agencies than there have been in the past, and it was argued that more highly qualified communicators need to be present in these agencies and government, overall. Public health-related decision-making requires the engagement of the community members directly affected by decisions. Participants posited that the often-used focus group approach, while gathering opinions at a specific point in time, is not sufficient for formulating effective decisions tailored to specific community needs. The critical role of establishing public confidence in scientific literacy and expertise was repeatedly emphasized during the discussion.

The debate underscored the idea that, while many people seek credible scientific information concerning public health, sound, community-wide decisions emerge only from ongoing discussions during non-crisis periods. Providing healthcare literacy and crisis response training by well-informed public health communicators is essential for establishing scientific credibility in the time of public health emergencies.

Position Paper Seven
Rumors, Misinformation, and Responses**

Ms. Renée DiResta
Technical Research Manager, Stanford Internet Observatory,
Stanford University, Stanford, California, U.S.

Summary

Vaccines are a critically important public health intervention. Maintaining public trust in vaccines, therefore, is a significant priority for physicians, public health officials, and governments. Vaccine hesitancy has existed since the introduction of smallpox variolation. Opposition claims are inflected for specific vaccines or outbreaks but fall into six persistent categories of concern: safety, toxicity, religiosity, distrust of industry, liberty, and conspiracy. As the COVID-19 pandemic progressed and vaccines became available, predictable claims within the six longstanding categories re-emerged. These claims, while similar in substance to past allegations, spread along an information infrastructure, designed for participatory sharing and well-suited to propagating rumors, and reached large global audiences who were paying attention to pandemic content. Online influencers and partisan media played a significant role in making rumors go viral before the facts could be known, while authoritative voices and institutions appeared slow to communicate. Social media platforms attempted to curate "good" information and moderate "bad", while not having full visibility into accuracy, and struggled with the perception that such efforts amounted to censorship. Some community health groups and physicians made attempts at counter-speech to correct misperceptions and instill confidence, but often had a minimal understanding of what claims were spreading and poor capacity for networked response. Fixing these problems requires: (i) rethinking communication styles, (ii) prioritizing building trust *before* a crisis requires it, and (iii) developing partnerships that enable networked responses to prebunk broad categories of claims, transparently communicate the best possible available information, and counter-speak against specific false rumors.

Current realities

"Infodemics" that accompany outbreaks are also a well-established phenomenon, and the COVID-19 "infodemic" was anticipated by many. Recent research into

the rumors and narratives around COVID-19 vaccines between 2021-2022 reinforced prior findings that vaccine concerns often involve recycled longstanding claims, observing that viral stories spanning media and social media reflected six longstanding categories: safety concerns, arguments from liberty, distrust of pharmaceutical company motives/impact on disadvantaged populations, debates on the efficacy of the vaccines, religious arguments, and a broad array of conspiracy theories that layered an element of malicious intent onto other categories (e.g., a profiteering billionaire caused the pandemic to mass-vaccinate people with dangerous vaccines and thus reduce the population). While claims were inflected to fit the COVID-19 mRNA vaccines (i.e., spike protein shedding), most involved elements that have circulated about other vaccines in the past. Analysis of two categories, "safety concerns" and "liberty concerns" shows contrast in the content style and the potential responses to messages.

Rumors about the safety of COVID-19 vaccines began prior to their release and have persisted since. One common theme involved concerns of severe side effects (e.g., rashes, blood clots, fertility issues, cardiac inflammation, death). Some narratives focused specifically on the harmful impact of vaccines on vulnerable groups (e.g., children, elderly, pregnant women).This content often incorporates personal anecdotes and videos, which invoke an emotional response from the audience, particularly if they feel that they have heard similar stories before. This combination of factors aligns with a sociological understanding of rumors, which thrive on some degree of *familiarity* that makes an audience receptive, an element of *novelty* that inspires the hearer to share the story, and significant *salience* that makes the community feel it is important to share. Similar stories going viral (e.g., rumors of sudden cardiac deaths) reinforce the perception that something is wrong, that others are similarly concerned, and that there is some truth to the claim. Sociological literature describes the rumoring process as an alternative to authoritative sources and potentially an indication that authoritative sources are not trusted.

Social media facilitates the distribution of personal narratives that are difficult to verify or counter. However, safety narratives took on less-personal forms as well, such as false claims about shedding or ingredients. One recurring example was misrepresented statistics, often drawn from unverified claims found within Vaccine Adverse Event Reporting System (VAERS) data. VAERS is a crucial tool to identify vaccine safety issues, and there is value in transparency. However, prominent influencer accounts turned it into a source of misinformation by adding baseless extrapolations, generating frightening statistical claims with wide reach. These types of claims have appeared before and been leveraged to erode confidence in childhood vaccines (e.g., MMR); this is due, in part, to the fact that general audiences do not

understand VAERS. However, predictability did not translate into preventability, and the COVID-19 VAERS claims spread among many online communities.

A second category of prevalent content focused on liberty, framing government initiatives for increasing vaccination rates (e.g., mandates and requirements) as overreach and a breach of individual liberties. This content is primarily political opinion, rather than falsifiable claims (which social media companies *did* try to moderate). While platforms rightly attempt to maximize free expression, this attempt at a neat delineation created a loophole that political influencers exploited by linking liberty arguments to demonstrably false claims about the vaccines, simultaneously exposing their audiences to both. This has also happened with prior vaccines, but COVID-19 claims resonated with significantly more people, many of whom were already angry over the liberty implications of lockdowns and masks. This highlights a key point: platform moderation is challenging to implement and does not ultimately solve the communication or trust issues underpinning hesitancy. Indeed, occasionally overeager platform enforcement against rumors or opinion triggered a broader backlash, enabling creators of false claims to recast themselves as victims of censorship.

While the claims and narratives are well-established, social media has led to a proliferation of new voices that the public consulted for information about COVID-19 vaccines alongside traditional sources (e.g., medical providers). Wellness and lifestyle influencers, medical-credentialled influencers, conspiracy theorists, political pundits, and even a handful of state-sponsored trolls from Iran, Russia, and China shared claims about COVID-19 vaccines, inflected for their followers. Some were likely motivated by genuine interest, though there is also an economic incentive: sensational posts generate views, which can translate into additional income or clout. Additionally, the antivaccine movement has been present on social media since the earliest days, and it is well-networked: a post by one Page or YouTube channel is widely shared by the rest. During the pandemic, many longstanding antivaccine influencers significantly increased their followings by effectively networking into other influencer communities. Public health institutions, by contrast, were largely not networked, and did not often create the type of content resonant with social media audiences.

As vaccine-related content spread, social media platforms responded by labeling, downranking, or removing misleading content, or accounts that frequently spread it. At times this led to a backlash as creators alleged that they had been silenced, which created a second wave of interest in the forbidden message or helped them grow followers on less-moderated platforms. Censorship concerns sparked

lawsuits, as some deplatformed influencers claimed that the federal government had colluded with the social media companies to stifle their speech.

An "infodemic" cannot be solved by posting more facts alone, or by taking down content. Rumors and public trust crises are not caused by a lack of facts. Perhaps most importantly, there is a time offset today between when a rumor goes viral on social media and when there is a strong scientific consensus that may be communicated to the public. Influencers capture public attention with their commentary, even as public health institutions are reticent to communicate without clear answers. Institutional communicators may additionally have difficulty knowing what is truly viral, because narratives are not evenly distributed among all communities. Governments, public health officials, and physicians are then left in a position of trying to change minds or fact-check viral claims after-the-fact.

Scientifically credible approaches and challenges

There are several approaches to addressing interrelated trust and communication challenges, which might be summarized with an adaptation of a common marketing phrase: "Right message, right messenger, right time."

The fact that many vaccine-related rumors share longstanding predictable characteristics suggests promise for *prebunking*, sometimes referred to as "inoculation," which seeks to strengthen individual agency in information consumption by educating people on recurring tropes and rhetoric surrounding a topic. Exposing their persistence, and discussing why they are resonant, may reduce novelty and make people think before sharing them.

Content goes viral *because people collectively make it go viral*. Influencers create it, individuals share it, and social media platform algorithms boost it. Therefore, a second approach to communication is for science communicators to build their own networks of support. Sharing each other's content is key to maximizing visibility and increasing share-of-voice.

Both prebunking and countering narratives requires trusted messengers. Information may be rejected if it comes from someone perceived as a partisan or cultural outsider. Leveraging influencers and community organizations is one solution. Encouraging physicians to participate more directly and frequently in the public conversation, to build their own audiences, is another.

There are additional interventions that address the supply of misinformation, by striving to reduce it or shifting financial incentives that drive it, but these approaches require collaboration with social media platforms, which may change their policies unexpectedly.

Implementing these suggestions requires overcoming challenges including

institutional distrust, the overwhelming volume and sensational nature of false and misleading claims, and the difficulty of fact-checking certain content due to missing data or evolving consensus. Overcoming distrust will require an intentional, resource-intensive effort from public health professionals to regularly reach out to communities and communicate transparently.

Evidence-based options (EBO) and actionable next steps (ANS)

Countering mis- and disinformation and combating rumors surrounding vaccines (or future pandemics) requires a multistakeholder approach to address the twin challenges of trust and communication.

- Implement prebunking campaigns by public health communicators that target prevalent and recurring tropes and themes, to enable audiences to better contextualize long- standing anti-vaccine claims when they appear. Communicate frequently with the public, acknowledge unknowns, and discuss emerging consensus to build trust.
- Foster stronger and closer relationships between physicians and the communities they serve through social media engagement, prior to crises, to build trust.
- Develop support networks for amplifying accurate information, counter-speech, or rapid-response fact-checks, to better address the fact that rumors thrive in times of significant uncertainty and are supercharged by the speed of social media.
- Establish relationships/collaboration between media researchers, media companies, public health, and outside workers before an acute crisis, to enable understanding of the information environment and assist in understanding what information is most accurate.

A position paper prepared for presentation at the ISGP Debate/Caucus Conference on "Foresight from the COVID-19 Pandemic: Science, Policy, and Communication" (COVID-SPC), organized and convened using an internet format on February 27 - March 1, 2023.

Debate Seven Summary

This not-for-attribution Debate Summary was prepared by the ISGP staff from an audio recording, and its transcription, of the debate of the position paper prepared by Ms. Renée DiResta (see position paper above and author biographical information in the Appendix). Ms. DiResta initiated the debate with a 5-minute

statement of her views and then actively engaged the conference participants, including other authors, throughout the remainder of the 55-minute debate period. This Debate Summary represents the best effort of the ISGP to accurately capture the comments offered and questions posed by all participants, as well as those responses made by Ms. DiResta and other participants. Given the not-for-attribution format of the debate, the views comprising this summary do not necessarily represent the views of Ms. DiResta, as evidenced by her position paper. Rather, it is, and should be read as, an overview of the discussion and exchange of views and priorities, both in support of, and in opposition, to points expressed by all those participating in the debate.

The significant challenges and potential approaches associated with addressing misinformation, disinformation, and/or rumors were discussed extensively and included issues pertaining to: (i) social media platform moderation, (ii) fragmentation/polarization and the role of trusted messengers, (iii) algorithmic curation, (iv) communication by scientific organizations, (v) censorship and misinformation, (vi) inoculation/pre-bunking, and (vii) mandates. These discussions elicited significantly diverse perspectives on the current state of information dissemination and the ways in which individuals, organizations, and platforms are responding to the challenges posed by rumors, misinformation, and political polarization during and after the COVID pandemic.

During the COVID-19 Pandemic, social media played a key role in the dissemination of information purported to be accurate representations of credible scientific understanding, but routinely shared content that was not accurate nor reflected evidence-based data. It was contended that, in some cases, social media became a medium for the active distribution of inaccurate information that supported misleading views and conclusions that often resulted in dangerous outcomes and distrustful sentiments. The overall deluge of misleading information was identified as a source of major disruptions in the degree to which the public *writ large* could discern evidence-based information from parochial ideas designed to proffer specific political agendas via misleading the public. Multiple debaters contended that there is a need for social media platform policy interventions that effectively address inaccurate content on social media platforms. It was indicated that this could entail the platform determining whether certain content violates their policies, and subsequently having the options to (i) flag inaccurate content and provide accurate context and information, (ii) reduce the distribution of inaccurate content, and/or (iii) remove the content from their platform. If content were to be "removed," it might be taken down completely. The "reducing" option refers to limiting its distribution to fewer individuals through Algorithmic Curation ensuring

that a post that has been reduced may not be seen by as many people, unless they have specifically chosen to receive that content from a particular account or page. The "inform" option may involve putting up an interstitial or a label that alerts people that the content may be disputed or inaccurate. This latter approach was noted as a way of enabling platforms to fact check and correct information that may be harmful, but to preserve the option to have the information remain online based on freedom of expression principles.

It was posited that content deemed significantly harmful (e.g., fake cures) would typically be removed entirely during the COVID-19 pandemic. If the content is merely inaccurate and potentially resulting in harm only over a longer time period, it was suggested that an "inform interstitial" option may be appropriate since censorship or complete removal of the content could have negative consequences (e.g., reducing public trust).

Even though this is how a platform moderation intervention might work, it was argued that, during the COVID-19 Pandemic, most content shared would be better characterized as "rumor(s)" (i.e., unofficial information circulating in society passed from person to person, often without knowing whether it is true or false) rather than "misinformation." Addressing rumors was argued to present unique challenges compared to addressing misinformation, as there was no fact-check or correction mechanism made available by social and messaging platforms designed to address rumors.

It was suggested that such rumor phenomena are not new and have been observed during prior outbreaks (e.g., Zika, Ebola, smallpox). A consistency in the framing of rumor narratives was claimed to be observed during different infectious disease threats, with slight variations tailored to fit the context of any current disease event. Reliance on anecdotes and personal stories was argued to be a characteristic of rumors disseminated on the internet, challenging efforts by social media platforms to distinguish between facts and misinformation. To address this issue, it was suggested that "counter-speech," characterized in the debate as a bottom-up process involving trusted members of the community, could be an effective approach to responsibly correct misinformation and contextualize rumors. Practicing physicians and influencers who are trusted by their communities were suggested as interlocutors who can engage in counter-speech through community-driven efforts to address rumors.

It was also contended that the capacity of social media platforms for messaging is crucial for ensuring the broad reach and impact of messages being generated by these trusted messengers. Concerns were raised that antivaccine organizations have already established a presence on social media platforms, thus creating a

more entrenched network than those attempting to combat misinformation. The recurrence of rumors was described as a phenomenon that has yet to be fully studied, and building capacities for understanding (i) how narratives spread online and (ii) how different communities respond to those messages were identified as critical for addressing inaccurate public health information. "Pre-bunking" was recommended by some participants as an effective approach for mitigating negative impacts from rumors, misinformation, and disinformation.

Epistemological and political fragmentation in contemporary society were identified as causes for a lack of public acceptance regarding scientific understandings and other belief systems. It was suggested that this fragmentation leads to the creation of isolated bubbles of information, partisan polarization, and the emergence of networked communities on social media. It was claimed that these communities were often tied to long-standing partisan politics and well-funded partisan groups who pivot their focus from their typical policy advocacy (e.g., lobbying on longstanding partisan issues) to current phenomena as a strategy for amassing an audience. It was asserted that these movements need not be characterized as grassroots movements originating from the public *writ large*.

It was noted that ongoing studies are designed to understand the evolution and adaptation of these long-standing vaccine narratives in the context of COVID-19. It was also stressed that finding trusted messengers within communities, such as medical professionals, to address vaccine-related concerns was important. During the COVID-19 Pandemic, society was late to implement these types of approaches. Public health offices had not established these types of relationships with trusted messengers within these communities who could disseminate information effectively. Establishing centralized entities that rapidly distribute accurate information throughout specific communities was suggested, and entities for communication between state and local election officials were cited as potential examples or models. It was emphasized that a networked response representing "one voice" from an influencer or trusted messenger is not effective in countering the spread of misinformation.

In the social media sphere, the importance of carefully selecting public health spokespersons with established expertise and experience (e.g., from HIV programs) was stressed. Debaters posited that groups such as The AIDS Vaccine Advisory Coalition and other advocacy groups have been successful in building strong community connections and effectively communicating targeted messages to key populations. The necessity of drawing lessons from such experiences was emphasized in efforts to engage diverse communities. During the COVID-19 Pandemic, participants noted that such connections were made during the early

stages of the Operation Warp Speed vaccine trials, especially as sound scientific understanding was used to develop resources such as the COVID-19 dashboard from Johns Hopkins University. Without the development of additional advocacy groups from civil society, it was asserted that the public health communities may not be able to adequately respond to the constant assault from sources spreading rumors and misinformation in the future.

Debaters emphasized that civil society groups formed around specific legislation or issues have a limited lifespans that can be extended with renewed funding, potentially compromising the authenticity or perceived authenticity of such groups. The key to successful network building for public health messaging was suggested to be collaboration among existing influencers and individuals who are passionate about the issue, but who are not necessarily affiliated with any specific organization or group that may eventually compromise the authenticity or perceived authenticity of their messaging. It was stressed that the collaboration among civil society and public health officials is crucial in messaging responses on any public health topic going forward.

Situations where the commercial interests of media platforms create echo chambers promoting parochial information or opinions were asserted to reinforce misinformation or rumors. These chambers strengthen public belief in misinformation by distorting public understanding of evidence-based options, making it more difficult for individuals to consider alternative views concerning complicated topics. It was conveyed that a person who follows a storyline about a negative health reaction is more likely to click on similar stories, and algorithms are designed to show them more of such stories. The need to determine which approaches taken by public health officials and responders are most effective in these situations was expressed. To counter these conditions, it was noted that media platforms have attempted to surface reliable information by implementing features such as "carousels" on Facebook and "knowledge chapters" on Twitter. Concern was expressed that curating algorithms can select only from the available inventory of posts and by ranking their value based on their relevance to a specific individual, impacting the dissemination of accurate information, particularly when a lack of content is available. One of the criteria reportedly used in the ranking function is the determination of whether the content is "borderline" and contrasts existing moderation policies. This procedure characterizes "down-ranking."

Despite the efforts of media platforms to curate content fairly, there remains significant opposition from the public *writ large* who perceive content moderation as an unfair censorship regime. This is especially evident in the U.S. media and conservative circles, where any intervention (Remove, Reduce, Inform) is seen as

censorship. To counter this, a group called "This is our shot" composed of physicians worked to create compelling content to share on social media.

It was emphasized that efforts to strike a balance between the need for fast and broad messaging to address problematic content as well as to tailor messaging for specific demographics through trusted messengers need to be strengthened. It was, however, noted that optimizing how, and by whom, health information is communicated remains a challenge. It was acknowledged that the extent of official response by institutions varies and not every institution or organization needs to participate in the same way when it engages in public communication about important issues. Physicians may have more flexibility to speak candidly and quickly than official public health officials. The absence, or delay, of response by public health officials, however, was posited to often create a void that platform algorithms may fill with unofficial content. During the early stages of the COVID-19 pandemic, there was a significant time offset between when people were searching for information on social media and when the public health institutions issued a proactive communication. This delay allowed for unofficial content to dominate the conversation. In this regard, a prompt official response, even if they are simply acknowledging that the issue is being evaluated, was recommended as a way to help fill the void and prevent misinformation from spreading.

The manner in which public health messaging is effectively formulated to address both the scientific and public health aspects, as well as the personal safety concerns of individuals, was purportedly required for addressing two seemingly contradictory goals: (i) finding willing, well informed public health officials in every state to endorse consistent messages and (ii) engaging independent groups of qualified physicians (e.g., "This Is Our Shot" with hashtag #TIOS) and healthcare professionals who share personal experiences at the individual and local level. The enthusiasm of thousands of physicians community-wide to advertise their vaccinations after the approval of COVID-19 vaccines was cited as an example of efforts to counteract scary images that had gone viral. Their experiences on social media illustrated that vaccinations were effective and generally safe.

Combating misinformation during the process of making accurate information publicly available was identified as a challenge, given the potential backlash against perceived censorship. Efforts by the European Commission to identify false rumors during the pandemic were claimed to have engendered significant controversy among some European communities regarding censorship concerns. To address these challenges, it was emphasized that more government attention needs to be given to the refinement of public messaging to balance the dissemination of accurate evidence-based information without precipitating concerns over censorship.

Initial policies developed by platforms in response to misinformation, especially vaccine related misinformation, were posited to have developed in response to measles outbreaks in 2019. It was conveyed that these policies precluded accepting funding from antivaccine organizations for advertisements and disincluded their social media "groups" from site "recommendation" functions. The intention of such policies was suggested to be focused on allowing participation by antivaccine communities on social media platforms, while reducing opportunities for recruiting new group members. It was suggested that social media platforms did not employ the same degree of confidence in enforcing these policies during the COVID-19 pandemic, potentially due to COVID vaccines being relatively recently developed countermeasures.

It was noted that the current lack of understanding on how to effectively combat misinformation has supported renewed research focused on detection and fact checking. While fact checking alone is not viewed as effective in countering misinformation, it was observed that public responses to fact checks often result in increased rumors and mocking comments that denigrate the fact-checking organization. It was contended that many of public responses rejected the validity of the fact-checked information, and even viewed fact checks as an institutional effort to control a narrative. Identifying and elevating the voices of individuals who are receptive and willing to engage in counter-speaking against misinformation from within specific hesitant communities was suggested to be a more effective approach. Content creators who converse with their audience were also identified as having the potential to be effective communicators in countering misinformation as they tend to have more extensive reach and engagement than those with fewer followers. The challenges of inconsistent public health messaging and the comparatively low levels of influential social media engagement from public health or physician communities on these issues were noted, and it was posited improvements can be made by creating a centralized point of contact or network among professional organizations focused on improving effective public communication via trusted messengers and promoting health literacy.

Research on media literacy directed toward public education concerning recurring narratives, or "common tropes", and rhetorical techniques underpinning propaganda and misinformation has expanded (e.g., Jigsaw from Google Alphabet). Examples in the use of vague language (e.g., they) as a red flag for conspiratorial language reflect a modernization of work from the 1930s by the Institute for Propaganda Analysis that aimed to recognize fascist propaganda. The application of these studies of emotional responses to rhetoric can be valuable in examining the media language and the distinction between fact-based and non-fact-based claims.

Attention was given to the possibility of modernizing the education system by reintroducing methods to recognize propaganda and misinformation. It was posited that improved media literacy throughout the population can improve policies supporting not only pandemic preparedness, but other societal issues emerging from misinformation. Early-stage teaching of individuals, including students, to recognize the narratives and building blocks of misinformation was suggested to be an effective approach to combating misinformation.

The utilization of networks, together with agent-based analyses, modeling, and data transfer, is useful in developing community-wide understanding of misinformation. While advertisers routinely identify pivotal nodes of influencers within the community on whom to focus, emphasis for combating misinformation on disease outbreaks was reportedly given to nano-influencers having significant impact on smaller groups. Current social media platforms (e.g., Twitter, Instagram, Facebook) provide multiple opportunities for network analyses. Direct engagements with communities often offer access to the most "authentic" influencers.

The importance of differentiating between broad (e.g., national, regional) versus tailored responses to vaccine hesitancy was emphasized. Certain narratives resonated with specific communities in which historical concerns of medical distrust, high maternal mortality rates, and social injustices attributed to governmental actions are prevalent. The participation of trusted influencers with authentic, evidenced-based information was emphasized as essential to differentiate misinformation from the often difficult actions needed to address the urgencies arising from disease outbreaks.

While the tone and messaging of memes and internet culture are effective in creating shareable content, it was cautioned that such content needs to be carefully crafted. While some profiles employing humor to share engaging yet informative content gained popularity, it was cautioned that special attention needs to be given to avoid insensitive or disrespectful messages to those impacted by COVID-19. Memes reflecting humor and avoiding derogatory tone were identified as an option for effective provaccine communication.

The serious challenges that vaccine "mandates" present to decision-makers are exacerbated by media opinions, compartmentalized public opposition, diverse scientific advice, and rapidly updating research and survey results. Policies and decisions referred to by members of the public and some media sources as "vaccine mandates" originated from different sources, including legislative actions attempting to balance community health with personal belief exemptions (e.g., SB277 in California). Early-stage, pre-pandemic discussions concerning the rationale for

vaccine mandates as a tool to avoid catastrophic public health outcomes was posited to be essential for avoiding the contentious, unproductive arguments that ensued during COVID-19. Conclusive decisions, enforceable across the geographical landscapes (i.e., national, regional, and international) across which infectious disease outbreaks expand are essential to protect public health *writ large*.

The structural complexity within social media platforms (i.e., flat for Twitter, heretical for Facebook) was considered to be an impactful factor in how rumors and misinformation propagated and thus, how regulatory frameworks need to be structured and enforced. The significant challenge of resolving these issues was acknowledged, especially within the United States where recent Supreme Court cases evaluating the responsibility of platforms for the content (e.g., Gonzales vs Google and Twitter vs Taamneh) concluded that terrorism and the spread propaganda have precedence. Similar challenges pertain to platform liability. It was noted that social media platforms have been indemnified with the power to moderate content, but not necessarily penalized for not moderating. These conclusions were viewed as fluctuating as threats vary from national security to public health emergencies.

The ecosystem created by the interconnectivity among social media platforms opens numerous strategic options when considering how to address misleading, incorrect rumors and misinformation pertaining to infectious disease outbreaks. The open platform Twitter has large, but transitory audiences where specific, trending topics quickly draw massive public attention. The closed platforms of Facebook and others having closed groups attract sustained membership and participation, both of which foster deeper community ties and activism. The right-wing attention given to the platforms of Parler and Truth Social, deriving from their concerns about potential censorship on mainstream platforms, foster a closed crowd dynamic with sustained movement and interconnecting relationships. It was emphasized that each of these platforms present completely different opportunities and limitations for combating false rumors and misinformation about infectious disease outbreaks.

Acknowledgment

The Institute on Science for Global Policy (ISGP) wishes to acknowledge the numerous individuals and organizations that made important contributions to the organization of the invitation-only ISGP "Foresight from the COVID-19 Pandemic: Science, Policy, and Communication (COVID-SPC)" Program and the ISGP COVID-SPC Conference that was conducted on an internet format on February 27, 28, and March 1, 2023, from Tucson, Arizona.

The ISGP is especially indebted to the authors of the seven Position Papers addressing a variety of critical topics fundamental to obtaining an accurate understanding of what foresight can be gained from recent events and experiences driven by the COVID-19 pandemic (see program agenda). The Position Papers provided the material on which each debate and plenary caucus focused throughout the three-day event. Biographical information for these seven Position Paper authors is included in this ISGP COVID-SPC Conference Book. The ISGP is very grateful for their time in writing the Position Papers as well as exceptional presentation and contribution for enriching the program and advancing the discourse on this important topic.

The ISGP greatly appreciates the willingness of the more than 150 subject-matter experts and leaders in the scientific, governmental, public advocacy, and private sector communities worldwide who agreed to be interviewed by the ISGP staff as they prepared and organized the content of and participation in the ISGP COVID-SPC conference.

The success of every ISGP conference critically depends on the active engagement of all invited participants and Position Paper authors in the often-intense debates and probing plenary caucuses that are conducted under the Chatham House Rule (no attribution). The exchange of strongly held views, innovative proposals, and critiques generated from comments and questions throughout the debates and plenary caucuses fosters an unusual, and perhaps unique, environment focused on clarifying understanding for both the specialist and non-specialist. These debates and plenary caucuses address specific questions related to formulating and implementing effective research, public, private sector, and governmental policies that span scientific, regulatory, public messaging, and business decisions. The ISGP is greatly indebted to all participants for their active engagements and willingness to share their expertise and perspectives.

The members of the ISGP Board of Directors also deserve recognition for their time and efforts in helping to create a viable, increasingly relevant, not-for-profit organization committed to addressing many of the most important scientific, technological, and societal questions of our time. Their brief biographical backgrounds are presented in this ISGP COVID-SPC conference book.

The energetic, highly professional interviewing, analysis, and writing skills of the ISGP staff were essential to organizing and structuring the conference itself as well as recording the often-diverse views and perspectives expressed in the critical debates and plenary caucuses as the areas of consensus (AoC) and actionable next Steps (ANS). The biographies of the ISGP staff are provided in this ISGP COVID-SPC conference book.

The ISGP receives financial support from U.S. government agencies and departments and unrestricted gifts and donations from private-sector entities, philanthropic organizations, and individuals. In the specific case of the ISGP COVID-SPC program and conference, funding was obtained from Battelle, Illumina Inc., Sanofi Pasteur, Abbott Laboratories, and Quest Diagnostics and from the North Atlantic Treaty Organization (NATO). General financial support provided to the ISGP by philanthropic entities as well as donations from individuals including Mr. Edward and Ms. Jill Bessey, Dr. David Moran, Amb. Thomas Pickering, and Dr. George and Ms. Charlene Atkinson was also used in support of the ISGP COVID-SPC program and conference. The ISGP expresses its sincere appreciation to all these generous organizations and individuals.

Dr. George H. Atkinson
Founder and Executive Director
Institute on Science for Global Policy
May 10, 2023

Biographical Information of Position Paper Authors

Col. Nelson L. Michael, M.D., Ph.D.

Dr. Michael, is the Director of the Center for Infectious Diseases Research, Walter Reed Army Institute of Research in Silver Spring, Maryland. Previously, Dr. Michael was the Director of the U.S. Military HIV Research Program (MHRP) at the Walter Reed Army Institute of Research, an international HIV vaccine research program that successfully integrates HIV/AIDS prevention, care, and treatment. A Colonel in the United States Army Medical Corps, Dr. Michael entered his Army service in 1989 in the program's Department of Vaccine Research and later served as the Chief in the Department of Molecular Diagnostics and Pathogenesis. He was appointed Director in 2006. His research interests include HIV molecular pathogenesis and host genetics, HIV clinical research, and HIV vaccine development. He is currently an Associate Professor of Medicine with the Uniformed Services University, and is a Diplomat, with the American Board of Internal Medicine. Dr. Michael has served on committees, boards, and working groups, including the Vaccine Research Center Scientific Advisory Working Group (NIAID, NIH), Office of AIDS Research Advisory Committee (NIH), AIDS Research Advisory Committee (NIAID, NIH), AIDS Vaccine Research Working Group (DAIDS, NIAID, and NIH), Center for HIV/AIDS Vaccine Immunology Scientific Advisory Board, Office of the Global AIDS Coordinator Scientific Steering Committee, the Scientific Committee of the Global HIV AIDS Vaccine Enterprise, and the PEPFAR Scientific Advisory Board.

Dr. Sunil Solomon, M.B.B.S., Ph.D., M.P.H.

Dr. Suhas Solomon is a Professor of Medicine, in the Division of Infectious Diseases, at the Johns Hopkins University School of Medicine. He is also the Chairman of the YR Gaitonde Medical Educational and Research Foundation, Chennai, India. He completed his medical training at the Sri Ramachandra Medical University in Chennai, India, and received a master's in Public Health and a doctorate in Epidemiology from Johns Hopkins University. Dr. Solomon has been elected into the Phi Beta Kappa honors society for academic excellence and the Delta Omega Public Health honors society. His research is focused on the epidemiology, clinical management, and access to HIV and HCV care among vulnerable Indian populations, such as people who inject drugs and men who have sex with men. He has more than 100 peer-reviewed publications in several highly ranked journals.

In 2015, he was one of the first recipients of the Avenir Award, a Director's Award from the National Institutes of Health, U.S., aimed at identifying individuals who propose high-impact research and who show promise of being tomorrow's leaders in the field of drug abuse and HIV.

Dr. Michael Kurilla, M.D., Ph.D.,

Dr. Kurilla directs the National Center for Advancing Translational Sciences' Division of Clinical Innovation, which includes overseeing the Clinical and Translational Science Awards (CTSA) Program. CTSA supports innovative solutions to advance the efficiency, quality, and impact of translational science with the ultimate goal of getting more treatments to more patients more quickly. Prior to joining NCATS in December of 2017, he served as director of the Office of BioDefense, Research Resources, and Translational Research within the National Institute of Allergy and Infectious Diseases (NIAID), where he focused on translational efforts toward infectious disease product development, including vaccines, therapeutics, and diagnostics with a particular emphasis on biodefense and emerging infectious disease threats. Prior to joining NIAID in 2003, Kurilla was an associate director for infectious diseases at Wyeth. He also worked at Dupont in antimicrobials and on clinical microbiology and molecular pathology at the University of Virginia Health Sciences Center. Dr. Kurilla holds a Ph.D. in microbiology and immunology as well as an M.D. from Duke University, was a postdoctoral research fellow at Harvard Medical School, and completed a residency in pathology at Brigham and Women's Hospital. His B.S. degree is in chemistry from the California Institute of Technology.

Dr. Stephen Thomas, M.D.,

Dr. Thomas is an Infectious Diseases physician-scientist from State University of New York's (SUNY) Upstate Medical University. He is a Professor of Medicine and Professor of Microbiology & Immunology. Dr. Thomas was the Chief of the SUNY Upstate Infectious Diseases Division from 2016-2021 and has Directed the Institute for Global Health and Translational Science since 2018. In 2022, Dr. Thomas was appointed The Frank E. Young, M.D .'56, and Leanne Young Endowed Chair of Microbiology & Immunology. Prior to joining Upstate, Dr. Thomas spent 20 years in the U.S. Army, serving at the Walter Reed Army Institute of Research and completing his career as the institute's Deputy Commander for Operations. He also served as the Infectious Diseases Consultant to the U.S. Army Surgeon General and U.S. Central Command's regional infectious diseases expert. Dr. Thomas specializes in the study of infectious diseases with a focus on diseases caused by viruses.

Dr. Georges Benjamin, M.D., MACP, FACEP(E), FRSPH, FFPH

Dr. Benjamin is a well-known health policy leader, practitioner, and administrator. currently serves as the executive director of the American Public Health Association, the nation's oldest and largest organization of public health professionals. He is also a former secretary of Health for the state of Maryland. Dr. Benjamin is a graduate of the Illinois Institute of Technology and the University Of Illinois College Of Medicine. He is board certified in internal medicine, a Master of the American College of Physicians, a fellow of the National Academy of Public Administration, a fellow emeritus of the American College of Emergency Physicians, and a member of the National Academy of Medicine. He serves on several nonprofit boards, such as Research!America, the Truth Foundation, and the Reagan-Udall Foundation. He is a former member of the National Infrastructure Advisory Council, a council that advises the President on how best to ensure the security of the nation's critical infrastructure.

Dr. Cynthia Baur, Ph.D.,

Dr. Baur is a health literacy and health communication expert focused on improving health literacy at the individual, family, community and organizational levels. She directs the University of Maryland Horowitz Center for Health Literacy, the nation's first academic health literacy center, and is a professor in the Department of Behavioral and Community Health. In 2022, Dr. Baur and other advocates worked with Maryland Delegate Joseline Peña-Melnyk, who sponsored Maryland HB1082, to designate the Horowitz Center as the state's consumer health information hub. Dr. Baur is the Principal Investigator on multiple federal and state-funded projects on health literacy, clear communication, digital health, diabetes prevention, and organizational health literacy improvement. During the COVID-19 pandemic, the Center provided communications support to Maryland local health departments and coalitions and supported the Maryland Department of Health and local health departments on the state's diabetes action plan. Dr. Baur provides training and expert advice to local, state, and national committees and initiatives. Before coming to UMD, she served for almost 20 years in the federal Office of Disease Prevention and Health Promotion and the Centers for Disease Control and Prevention (CDC), U.S. Department of Health and Human Services. She was CDC's Plain Language and Health Literacy Lead from 2011 to 2016.

Ms. Renée DiResta

Ms. DiResta is the Technical Research Manager at the Stanford Internet Observatory, a cross-disciplinary program of research, teaching, and policy engagement for the study of abuse in current information technologies. Ms. DiResta's work examines

the spread of narratives across social and media networks, how distinct actor types leverage the information ecosystem to exert influence, and how policy, education, and design responses can be used to mitigate manipulative dynamics. She has advised Congress, the State Department, and other academic, civic, and business organizations, and has studied disinformation and computational propaganda in the context of pseudoscience conspiracies, terrorism, and state-sponsored information warfare.

Biographical Information of ISGP Board of Directors

Dr. George Atkinson, Chairman

Dr. Atkinson founded the Institute on Science for Global Policy (ISGP) and is an Emeritus Professor of Chemistry, Biochemistry, and Optical Science at the University of Arizona. He is former head of the Department of Chemistry at the University of Arizona, the founder of a laser sensor company serving the semiconductor industry, and Science and Technology Adviser (STAS) to U.S. Secretaries of State Colin Powell and Condoleezza Rice. Together with the U.S. Department of Energy, he led the U.S. Department of States negotiations on the lTER - Nuclear Fusion Program, and coordinated State Department engagement on H5N1 Avian Influenza. He also created and launched the Jefferson Science Fellows program for senior U.S. scientists to become directly engaged with the U.S. Department of State. He founded and launched the ISGP in 2008 as a new type of international forum in which credible experts provide governmental and societal leaders with understanding of the science and technology that can be reasonably anticipated to help shape the increasingly global societies of the 21st century. Dr. Atkinson has received National Science Foundation and National Institutes of Health graduate fellowships, a National Academy of Sciences Post-Doctoral Fellowship, a Senior Fulbright Award, the SERC Award (U.K.), the Senior Alexander von Humboldt Award (Germany), a Lady Davis Professorship (Israel), the first American Institute of Physics' Scientist Diplomat Award, a Titular Director of the International Union of Pure and Applied Chemistry, the Distinguished Service Award (Indiana University), an Honorary Doctorate (Eckerd College), the Distinguished Achievement Award (University of California, Irvine), and was selected by students as the Outstanding Teacher at the University of Arizona. He received his B.S. (high honors, Phi Beta Kappa) from Eckerd College and his Ph.D. in physical chemistry from Indiana University. He was the former President of Sigma Xi, The Scientific Research Society. His educational scientific research and diplomatic achievements have been recognized with distinguished appointments and awards in 16 countries.

Dr. Janet Bingham, Member

Dr. Bingham is former President of the George Mason University (GMU) Foundation and Vice President of Advancement and Alumni Relations. GMU is the largest research university in Virginia. Previously, she was President and CEO of the

Huntsman Cancer Foundation (HCF) in Salt Lake City, Utah. The foundation is a charitable organization that provides financial support to the Huntsman Cancer Institute, the only cancer specialty research center and hospital in the Intermountain West. Dr. Bingham also managed Huntsman Cancer Biotechnology Inc. In addition, she served as Executive Vice President and Chief Operating Officer with the Huntsman Foundation, the private charitable foundation established by Jon M. Huntsman Sr. to support education, cancer interests, programs for abused women and children, and programs for the homeless. Before joining the Huntsman philanthropic organizations, Dr. Bingham was the Vice President for External Relations and Advancement at the University of Arizona. Prior to her seven years in that capacity, she served as Assistant Vice President for Health Sciences at the University of Arizona Health Sciences Center. Dr. Bingham was recognized as one of the Ten Most Powerful Women in Arizona.

Mr. Fred Downey, Member

Mr. Downey is a former U.S. Army strategist and longtime defense and international affairs expert on Capitol Hill and was vice president of national security at Aerospace Industries Association (AIA). Downey joined AIA from the office of Connecticut Senator Joe Lieberman where he served as Senior Counselor and Legislative Aide for Defense and Foreign Affairs. He had been the senator's key staff person on these issues for 12 years. As Lieberman's representative to the Senate Armed Services Committee, Downey staffed the senator in his role as chairman of the Airland Subcommittee, overseeing Army and Air Force policy and budget issues and the annual defense authorization bill. Before joining Lieberman, Downey worked on defense analytical services for TASC. That came after a 24-year career in the U.S. Army, including Pentagon postings as Assistant to the Director of Net Assessments at OSD and Strategy Team Chief for the Strategic Plans and Policy Directorate on the Department of the Army Staff.

Dr. Linda Duffy, Member

Dr. Duffy recently retired as a U.S. Federal Government Senior Scientist Administrator in the Department of Health Human Services, National Institutes of Health, at the National Center for Complementary and Integrative Health, where she currently serves as a post-retirement Special Volunteer to the Director. Among her many service achievements at the NIH, she launched and chaired the Trans-NIH Probiotics/Prebiotics and Microbiome Inter-agency Work Group and served for many years as an Inter-agency Subject Matter Expert in ad hoc advisory capacities as committee member and Chair. Dr. Duffy received a DHHS Innovation Award in 2016 and was appointed to serve in the dual role of Senior Scientific Advisor in

the DHHS Office of the Secretary, within the Office of the National Coordinator, Division of Science Technology. Prior to her distinguished federal government career, she was a former Peace Corps Volunteer in Cote d'Ivoire, West Africa and subsequently served in a dual capacity as Scientific Director of the Women and Children's Health Research Foundation and as a Distinguished Professor Emeritus with former joint appointments in the Departments of Pediatrics, Epidemiology, and Microbial Pathogenesis at the University of Buffalo. She received her Master's degree from Dartmouth College and completed her doctoral and postdoctoral studies under NIH National Cancer Institute Research Fellowships at the University of Buffalo

Admiral Thomas B. Fargo, USN (Ret.), Member,

Admiral Fargo became the Chairman of Hawaiian Electric Industries (HEI) in May 2020. HEI is the parent company for Hawaiian Electric Company, American Savings Bank and Pacific Current. He previously served for nine years as the Chairman of Huntington Ingalls Industries. Following a 35-year career serving the U.S. Navy and the Department of Defense, Admiral Fargo transitioned to corporate leadership in 2005 as President of Trex Enterprises, a privately held high technology company. He also served as a Managing Director of J.F. Lehman and Co, with principal responsibilities as President and CEO of HSF Holdings/Hawaii Superferry. He held the John M. Shalikashvili Chair in National Security Studies at the National Bureau of Asian Research from 2009 to 2016. Admiral Fargo completed his military career as Commander of the U.S. Pacific Command. As the senior U.S. military commander in East Asia, the Pacific and Indian Ocean areas, he led the largest unified command while directing the joint operations of the Army, Navy, Marine Corps and Air Force across 100 million square miles. His 35 years of service included five commands in the Pacific, Indian Ocean, and Middle East as well as six tours in Washington, DC. Born in San Diego, CA, he attended high school in Coronado, CA, and Sasebo, Japan. He graduated from the United States Naval Academy and has additional Governance, Business and Financial training from Harvard and Stanford Universities. He is a 1989 recipient of the Vice Admiral James Bond Stockdale Award for Inspirational Leadership, and a 2013 recipient of the Naval Academy Distinguished Graduate Award. In September 2022, he was a recipient of the Lone Sailor Award.

Dr. Thomas Fingar, Member

Dr. Fingar is a Shorenstein APARC Fellow in the Freeman Spogli Institute for International Studies at Stanford University. He was the inaugural Oksenberg-Rohlen Distinguished Fellow in 2010-2015 and the Payne Distinguished Lecturer at Stanford in 2009. From 2005 through 2008, he served as the first Deputy Director of National Intelligence for Analysis and, concurrently, as Chairman of the National

Intelligence Council. Dr. Fingar served previously as Assistant Secretary of the State Department's Bureau of Intelligence and Research (2000-2001 and 2004-2005), Principal Deputy Assistant Secretary (2001-2003), Deputy Assistant Secretary for Analysis (1994-2000), Director of the Office of Analysis for East Asia and the Pacific (1989-1994), and Chief of the China Division (1986-1989). Between 1975 and 1986 he held positions at Stanford University, including Senior Research Associate in the Center for International Security and Arms Control. Dr. Fingar is a graduate of Cornell University (A.B. in Government and History, 1968), and Stanford University (M.A., 1969 and Ph.D., 1977 both in Political Science). He has authored or edited six books, dozens of articles, and served as the approving editor on approximately 20,000 US government assessments.

Dr. Claire Fraser, Member

Dr. Fraser is the Dean's Endowed Professor, and the Director of the Institute for Genome Sciences at the University of Maryland School of Medicine in Baltimore, where she holds joint faculty appointments in the Departments of Medicine and Microbiology and Immunology. Until 2007, she was President and Director of The Institute for Genomic Research (TIGR) in Rockville, MD, and was involved in the early phases of the Human Genome Project. She led the teams that sequenced the genomes of nearly 100 microbial organisms, an effort that launched the new field of microbial genomics. Her current research interests are focused on the role of the human microbiome in health and disease. Her previous work with the FBI on the Amerithrax investigation between 2001 and 2008 led to the identification of four genetic mutations in the anthrax spores that allowed the FBI to trace the material back to its original source. She is one of the world's experts in microbial forensics and the growing concern about its dual uses – research that can provide knowledge and technologies that could be misapplied. Dr. Fraser has authored more than 300 publications, edited three books, and served on the editorial boards of nine scientific journals. Her list of numerous awards include: the E.O. Lawrence Award, the highest honor bestowed on research scientists by the Department of Energy; the Promega Biotechnology Award from the American Society of Microbiology; and the Charles Thom Award from the Society for Industrial Microbiology. She has been elected to Maryland Women's Hall of Fame, been named an Influential Marylander honoree, and was awarded the World Trade Center Institute's International Leadership Award. Dr. Fraser is a member of the National Academy of Medicine, and in 2019, she served as President of American Association for the Advancement of Science (AAAS) from 2020 – 2021.

Dr. George Korch, Member

Dr. Korch is currently the President of GeoBIO LLC, a consulting entity established to provide advice and expertise in biodefense, medical countermeasure development and public health policy, and is the former director of Battelle National Biodefense Institute's National Biodefense Analysis and Countermeasures Center (NBACC), a government biodefense research laboratory created by the Department of Homeland Security. He was part of the creation of the NBACC in the wake of the establishment of the Department of Homeland Security in 2003. Dr. Korch previously served in Fort Detrick as the commander of the U.S. Army Medical Research Institute of Infectious Diseases. Previousl;y, Korch served for several years as the science adviser to the assistant secretary of preparedness and response for the Department of Health and Human Services. He briefly served as acting assistant secretary for preparedness and response due to the departure of a colleague from the role to the Department of Defense. Dr. George Korch holds a doctorate from the Department of Immunology and Infectious Diseases at the Johns Hopkins University Bloomberg School of Hygiene and Public Health, where he is a visiting professor in the Department of Microbiology and Immunology. He is also a member of the American Association for the Advancement of Science, has several scientific publications and has been awarded numerous civilian and military awards and honors.

Dr. David Moran, Member

Dr. Moran is President of Technology International Partnerships, LLC, and Past-Publisher of Sigma Xi, The Scientific Research Society, "American Scientist" and the "Chronicle of the New Researcher." He has served as President of the National Technology Transfer Center; Director of Industrial Advanced Development & Industrial Outreach, Advanced Technology, Office of Naval Research; Program Element Administrator for Nuclear Propulsion, R&D, Naval Material Command; Director, David Taylor Institute; Assistant Technical Director, Director of Research, and Technology Director, Naval Ship R&D Center. His professional experience in research and teaching at universities includes the U.S. Naval Academy, Full Professor, Navy Chair; West Virginia University; George Washington University; Research Naval Architect, US Navy. He earned a Ph.D. in Hydrodynamics & Mathematics, IIHR; Sc.M., M.I.T, Ocean Engineering, Hydrodynamics; Sc.B., M.I.T.; Harvard University; University Iowa; and Graduate, Federal Executive Institute. He served at Harvard University's JFK School as Senior Official for National Security. He is a member of the Boards of: Tucker Community Foundation; Community Trust Foundation; Preston Community Fund; and Past-Treasurer, Board of Directors,

Maryland Garrett College. His publications include 102 Scientific Papers, 12 Patents in Hydrodynamics and Aerodynamics, and two published Books.

Mr. Joseph Nimmich, Member

Mr. Nimmich is a Partner at Potomac Ridge Consulting. He formerly was Senior Executive Advisor at Booz Allen Hamilton's Civil and Commercial Group. Prior to Booz Allen Hamilton, he served as the Deputy Administrator of the Federal Emergency Management Agency (FEMA) from September of 2014 until January 2017. During his tenure, his primary focus was on strengthening and institutionalizing FEMA's business architecture over the long term to achieve the Agency's mission. He joined FEMA in 2013, as the Associate Administrator for the Office of Response and Recovery. He was responsible for directing the Response, Recovery, and Logistics Directorates, as well as the Office of Federal Disaster Coordination. Prior to joining FEMA, he was the Director of Maritime Surveillance and Security at Raytheon Corp., where he directed maritime surveillance and security operations, as well as their emergency response capabilities. He served in the U.S. Coast Guard for more than 33 years, retiring as a Rear Admiral. His Coast Guard assignments included the First Coast Guard District based in Boston, Massachusetts, where he was responsible for all Coast Guard operations across eight states in the northeast and 2,000 miles of coastline from the U.S.-Canadian border to northern New Jersey. He earned his M.B.A. from the Stern School of Business at New York University.

Dr. Charles Parmenter, Member

Dr. Parmenter is a Distinguished Professor Emeritus of Chemistry at Indiana University. He also served as Professor and Assistant and Associate Professor at Indiana University in a career there that spanned nearly half a century (1964-2010). He earned his bachelor's degree from the University of Pennsylvania and served as a Lieutenant in the U.S. Air Force from 1955-57. He worked at DuPont after serving in the military and received his Ph.D. from the University of Rochester and was a Postdoctoral Fellow at Harvard University. He has been elected a Member of the National Academy of Sciences and the American Academy of Arts and Sciences, and a Fellow of the American Physical Society and the American Association for the Advancement of Science. He was a Guggenheim Fellow, a Fulbright Senior Scholar, and received the Senior Alexander von Humboldt Award in 1984. He has received the Earle K. Plyler Prize, was a Spiers Medalist and Lecturer at the Faraday Society, and served as Chair of the Division of Physical Chemistry of the American Chemical Society, Co-Chair of the First Gordon Conference on Molecular Energy Transfer, Co-organizer of the Telluride Workshop on Large Amplitude Motion and

Molecular Dynamics, and Councilor of Division of Chemical Physics, American Physical Society.

Ambassador (ret.) Thomas Pickering, Member

Mr. Pickering is Vice Chairman of Hills & Co, international consultants. He co-chaired a State-Department- sponsored panel investigating the September 2012 attack on the U.S. diplomatic mission in Benghazi. He served as U.S. ambassador to the United Nations in New York, the Russian Federation, India, Israel, El Salvador, Nigeria, and the Hashemite Kingdom of Jordan. Mr. Pickering also served on assignments in Zanzibar and Dar es Salaam, Tanzania. He was U.S. Under Secretary of State for Political Affairs, president of the Eurasia Foundation, Assistant Secretary of State for Oceans and International Environmental and Scientific Affairs, and Boeing Senior Vice President for International Relations. He also co-chaired an international task force on Afghanistan, organized by the Century Foundation. He received the Distinguished Presidential Award in 1983 and again in 1986 and was awarded the Department of State's highest award, the Distinguished Service Award in 1996. He holds the personal rank of Career Ambassador, the highest in the U.S. Foreign Service. He graduated from Bowdoin College and received a master's degree from the Fletcher School of Law and Diplomacy at Tufts University and a second master's degree from the University of Melbourne in Australia.

Mr. Tom Quinlan, Member

Mr. Quinlan has specialized expertise in rebranding traditional businesses and pivoting physical content into the digital space by leveraging digital marketing, data analytics, business intelligence, and data management solutions. He is currently the CEO and President of R. R. Donnelley & Sons Company, and has served as Chairman and CEO of LSC Communications, Executive Vice President of Operations and Business Integration at Moore Wallace, and Senior Vice President and Treasurer of World Color Press. He has served on the Boards of Trustees Pace University, YMCA of Greater New York, Curry College, The American Ireland Fund, and the US Army War College. He received the Franklin Award for Distinguished Service. He received an Masters in Business Administration in Finance from St. John's University and graduated with a Bachelor of Science degree in Business Administration, Pace University

Dr. Eugene Sander, Member

Dr. Sander served as the 20th president of the University of Arizona (UA), stepping down in 2012. He formerly was vice provost and dean of the UA's College of Agriculture and Life Sciences, overseeing 11 academic departments and two schools,

with research stations and offices throughout Arizona. He also served as UA Executive Vice President and Provost, Vice President for University Outreach and Director of the Agricultural Experiment Station and Acting Director of Cooperative Extension Service. Prior to his move to Arizona, Dr. Sander served as the Deputy Chancellor for biotechnology development, Director of the Institute of Biosciences and Technology, and head of the Department of Biochemistry and Biophysics for the Texas A&M University system. He was Chairman of the Department of Biochemistry at West Virginia University Medical Center and Associate Chairman of the Department of Biochemistry and Molecular Biology at the College of Medicine, University of Florida. As an officer in the United States Air Force, he was the assistant chief of the biospecialties section at the Aerospace Medical Research Laboratory. He graduated with a bachelor's degree from the University of Minnesota, received his master's degree and Ph.D. from Cornell University and completed postdoctoral study at Brandeis University. As a biochemist, Dr. Sander worked in the field of mechanisms by which enzymes catalyze reactions.

Dr. David Schejbal, Member

Dr. Schejbal is the President of Excelsior University. He was appointed in 2020, after two years as Vice President and Chief of Digital Learning at Marquette University. This followed 11 years as Dean of Continuing Education, Outreach and E-Learning at the University of Wisconsin-Extension. In this role, Dr. Schejbal helped launch the new UW Flexible Option, the first system-wide competency-based, self-paced learning option in the nation. Prior to coming to Wisconsin, Dr. Schejbal spent eight years at the University of Illinois at Urbana-Champaign. There he was associate vice chancellor and director of Continuing Education. Dr. Schejbal previously served as the Associate Dean of the University College and the Director of Summer Sessions and Special Programs at Northwestern Universit. He is a member of the executive committee of the Council of Environmental Deans and Directors and served four terms on the board of the University Professional and Continuing Education Association. Dr. Schejbal earned his B.A .from Iowa State University, and earned a Ph.D. in Philosophy from the University of Connecticut in 1990. His affiliations with industry organizations include serving as a member of the executive committee of the Council of Environmental Deans and Directors, a member of the governing board of the Competency-Based Education Network, chair of the Board of Visitors of the Army War College, and the past president of the University Professional and Continuing Education Association. Dr. Schejbal has earned several professional awards including the University of Wisconsin-Extension Chancellor's Award for Excellence; and the University Professional and Continuing Education Association

Outstanding Program Award for the Bachelor of Science in Sustainable Management.

Dr. Ben Tuchi, Member and Secretary/Treasurer

Dr. Tuchi serves on the boards of two additional non-profit corporations; he is Treasurer of the Campus Research Corporation and President of the Arizona Research Park Authority. He received his B.S. and M.S. degrees in Business Administration from the Pennsylvania State University and his Ph.D. in Finance from St Louis University. His full time teaching career began in 1961 at St. Francis College and continued until 1976 at West Virginia University. From 1976 through 1996 he served in cabinet levels at West Virginia University, The University of Arizona, The University of North Carolina at Chapel Hill, and finally as Senior Vice Chancellor for Business and Finance of the University of Pittsburgh. During those assignments he was simultaneously a tenured professor of finance. He retired from the last executive post in 1996 and returned to a full- time teaching position as Professor of Finance at the University of Pittsburgh, until his retirement in 1999. For the two years prior to his retirement he was the Director of Graduate Programs in Business in Central Europe, at Comenius University, making his home in Bratislava, The Slovak Republic.

Ms. Frances "Fran" Ulmer, Member

Ms. Ulmer is a Visiting Senior Fellow at the Belfer Center's Arctic Initiative and is the former Chair of The Nature Conservancy's Global Board of Directors. She was a Visiting Professor in the Department of Earth System Science at Stanford University from 2017 to 2018. Ms. Ulmer was appointed by President Obama as the Chair of the U.S. Arctic Research Commission in March 2011 and served in that role until August 2020. From 2014 to 2017, Ulmer was a Special Advisor on Arctic Science and Policy at the State Department. In June 2010, President Obama appointed her to the National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling. From 2007 to 2011, she served as Chancellor of the University of Alaska, Anchorage (UAA), Alaska's largest public university. Before that, she was a Distinguished Visiting Professor of Public Policy and Director of the Institute of Social and Economic Research at UAA. She served as an elected official for 18 years as the mayor of Juneau, a state representative and as Lieutenant Governor of Alaska. She previously worked as legal counsel to the Alaska Legislature, legislative assistant to Governor Jay Hammond and Director of Policy Development for the state. In addition, she was the first Chair of the Alaska Coastal Policy Council and served for more than 10 years on the North Pacific Anadromous Fish Commission. Ms. Ulmer earned a J.D. cum laude from the University of Wisconsin Law School, and has been a Fellow at the Institute of Politics at Harvard Kennedy School.

Dr. Maria Velissariou, Member

Dr. Velissariou is a Fortune 100 R&D executive with diverse global experience driving vision and strategy, innovation, and advocacy in high-impact corporate and nonprofit organizations. Throughout her career she has been strategically focused on translating science and technology opportunities into scalable innovation solutions. She is an advocate for sustainable food systems, science-based policy, and funding for food research. Dr. Velissariou is motivated by business value creation combined with human, societal and environmental outcomes. She served as the Global Corporate R&D VP and CSO for Mars. She led the function's enterprise-wide approach for Quality and Science in partnership with the business segments and equipped R&D with new digital capabilities. Before Mars, she held senior leadership positions including the Institute of Food Technologists. Quaker Foods North America, and PepsiCo. Additionally, she served in various roles at Kraft Foods and Dow Corning Europe. She founded Maria Velissariou Consulting LLC, providing advisory services in Food and Beverage and adjacent sectors. She also partners with the Kirchner Group as Managing Director focused on Innovation, Growth and Development. Dr. Velissariou received a Ph.D. and M.S. in Biochemical Engineering from the University of Birmingham (UK), and a B.E. in Chemical Engineering from the Aristotle University of Thessaloniki (Greece). She also completed executive studies at Oxford and Cornell. Dr. Velissariou serves in various board and advisory positions in the profit and nonprofit sectors, is mentor to entrepreneurs, and has been a long-standing advocate for women in STEM with a focus on the underserved. She has presented at various global conferences and featured in diverse media.

Additional ISGP Board Participants

Mr. Richard Armitage, Special Adviser

Mr. Armitage is the President at Armitage International, where he assists companies in developing strategic business opportunities. He served as Deputy Secretary of State from March 2001 to February 2005. Mr. Armitage, with the personal rank of Ambassador, directed U.S. assistance to the new independent states (NIS) of the former Soviet Union. He filled key diplomatic positions as Presidential Special Negotiator for the Philippines Military Bases Agreement and Special Mediator for Water in the Middle East. President Bush sent him as a Special Emissary to Jordan's King Hussein during the 1991 Gulf War. Mr. Armitage also was Deputy Assistant Secretary of Defense for East Asia and Pacific Affairs in the Office of the Secretary of Defense. He graduated from the U.S. Naval Academy. He has received numerous U.S. military decorations as well as decorations from the governments of Thailand,

the Republic of Korea, Bahrain, and Pakistan. Most recently, he was appointed an Honorary Companion of The New Zealand Order of Merit. He serves on the Board of Directors of ConocoPhillips, ManTech International Corporation, and Transcu Ltd., is a member of The American Academy of Diplomacy as well as a member of the Board of Trustees of the Center for Strategic and International Studies.

Jennifer Boice, Special Assistant to the Board

Ms. Boice worked for the ISGP in a number of capacities since 2010. Before that, she worked in the newspaper industry for 25 years, primarily at the Tucson Citizen and briefly at USA Today. She was the Editor of the Tucson Citizen when it was closed in 2009. Additional appointments at the Tucson Citizen included Business News Editor, Editor of the Online Department, and Senior Editor. She also was a business columnist. She received her M.B.A. from the University of Arizona and graduated from Pomona College in California with a degree in Economics.

In Memoriam

Mr. Jim Kolbe, Member

For 22 years, Mr. Kolbe served in the United States House of Representatives, elected in Arizona for 11 consecutive terms, from 1985 to 2007. Mr. Kolbe served as a Senior Transatlantic Fellow at the German Marshall Fund of the United States, and as a Senior Adviser to McLarty Associates, a strategic consulting firm. He advised on trade matters as well as issues of effectiveness of U.S. assistance to foreign countries, on U.S.-European Union relationships, and on migration and its relationship to development. He was also Co-Chair of the Transatlantic Taskforce on Development with Gunilla Carlsson, the Swedish Minister for International Development Cooperation. He was an adjunct Professor in the College of Business at the University of Arizona. While in Congress, he served for 20 years on the Appropriations Committee of the House of Representatives, was chairman of the Treasury, Post Office and Related Agencies subcommittee for four years, and for his final six years in Congress, he chaired the Foreign Operations, Export Financing and Related Agencies subcommittee. He graduated from Northwestern University with a B.A. degree in Political Science and then from Stanford University with an M.B.A. and a concentration in economics.

Dr. Mike Buch, Member

Dr. Buch held B.A., M.S., and Ph.D. degrees in Analytical Chemistry and Biotechnology. He had nearly three decades of experience in the consumer healthcare industry in various roles of increasing responsibility with some of the

world's leading companies. He served as Chief Science Officer and Board Member at Young Living Essential Oils and had expertise in leading global strategic development programs, open innovation programs, licensing programs, consumer healthcare R&D, advanced technologies labs, advanced optical analysis labs, and biosensor design and research. He was also a member of several prestigious associations, including the American Chemical Society, The New York Academy of Science, and the American Association for the Advancement of Science.

Dr. Henry Koffler

Dr. Koffler served as President of the UA from 1982-1991. He also held UA professorships in the Departments of Biochemistry, Molecular, and Cellular Biology, and Microbiology and Immunology, positions from which he retired in 1997 as Professor Emeritus of Biochemistry. He was Vice President for Academic Affairs, University of Minnesota, and Chancellor, University of Massachusetts/Amherst, before coming to the UA. Dr. Koffler served as a founding Governor and founding Vice-Chairman of the American Academy of Microbiology, and as a member of the governing boards of the Fermi National Accelerator Laboratory, the Argonne National Laboratory, and the Superconducting Super Collider Laboratory. Among the honors that Dr. Koffler has received are a Guggenheim Fellowship and the Eli Lilly Award in Bacteriology and Immunology.

Biographical Information of ISGP Leadership and Staff

Dr. George Atkinson, Executive Director, and Founder

Dr. Atkinson is an Emeritus Professor of Chemistry, Biochemistry, and Optical Science at the University of Arizona. His professional career includes academic teaching, research, administration, roles as a corporate founder and executive, and public service at the federal level. He is the former Head of the Department of Chemistry at the University of Arizona, the founder of a laser sensor company serving the semiconductor industry, and the Science and Technology Advisor (STAS) to U.S. Secretaries of State Colin Powell and Condoleeza Rice. In 2014, Dr. Atkinson was named president of Sigma Xi, The Scientific Research Society. Based on principles derived from his personal experiences, he launched the ISGP in 2008 as a new type of international forum in which credible experts provide governmental and societal leaders with the objective understanding of the science and technology that can be reasonably anticipated to help shape the increasingly global societies of the 21st century.

Mr. Ciaran Fitzpatrick, Senior Fellow

Mr. Fitzpatrick graduated with Honors from Eckerd College, where he received a B.S. in Biology (Molecular), a B.A. in International Relations & Global Affairs, and minors in Chemistry and Spanish. At Eckerd, he was a Ford Apprentice Scholar and worked as a cell biology research assistant, studying *C. elegans* as model genetic organisms for researching Parkinson's disease. In the Summer of 2018, he completed an internship with Heart to Heart International, an organization that provides health access, humanitarian development, and crisis relief locally and abroad. He aims to conduct impactful biological research and to use scientific communication to bridge the gap between research and policy. He takes a special interest in the fields of genomics, global health, and biodiversity.

Ms. Euphemia Anderson, Senior Fellow

Ms. Anderson is a recent graduate of the College of Agricultural Life Science at The University of Vermont, where she received a B.S. in Environmental Studies with a focus on Sustainability. Her interest in sustainable development and the intersection of science and business ignited during her internship with the Sustainable Economies Program at Manomet, a non-profit headquartered in Massachusetts, where she worked directly with businesses and communities on practices that enhanced

their economic viability and quality of life while also reducing their environmental footprint. She also held an internship with ECHO Leahy Center for Lake Champlain in Burlington, Vermont, where she facilitated broad-scale access to science education within the Burlington community. She holds a special interest in climate change mitigation, renewable energy, and small business sustainability.

Ms. Camelia Bou, Senior Fellow

Ms. Bou graduated from Northeastern University with a bachelor's in International Affairs and Economics and continued her studies in the Environmental Science and Policy Master's Program. During her time at Northeastern University, she participated in Genocide and its Aftermath Dialogue of Civilizations Program, a faculty-led study focused on the effects of genocide in Greek society. As part of one of her graduate courses, she attended COP 26 Glasgow virtually as an observer, where she had the opportunity to explore her interest in international climate policy. Ms. Bou worked at the Rian Immigrant Center in the Learning Exchange Program as a program assistant, helping students and recent graduates from Ireland on the J-1 visa with their job search in the United States. She is fluent in English and Spanish and is at a beginner level French. She hopes to continue to work in the environmental justice and policy field.

Ms. Sophie Bartholomaus, Fellow

Ms. Bartholomaus is a graduate of Roanoke College, where she earned a B.A. in Public Health. She has a strong desire to teach others and help communities which is rooted in her work with the Local Environmental Agriculture Program (LEAP), a nonprofit located in southwestern Virginia. Through her work with LEAP, she was able to inform the local public on the importance of local, sustainable farming, and bringing green spaces and community gardens to areas with food insecurity. She has gained experience in program development, grant proposal writing, budgeting, and community outreach through working with various nonprofits. A s a student, she was able to not only gain these skills but also expand on them to see what primary-level implementations may be needed to promote positive impacts.

Ms. Tory Brewster, Fellow

Ms. Brewster graduated from the University of Redlands, receiving a B.A. in Political Science, Public Policy, and Environmental Studies. Upon graduating, she worked as an Americorp CivicSpark Fellow completing her first service year with the Coachella Valley Association of Governments and her second service year with the City of Beverly Hills. As a CivicSpark Fellow, she completed urban greening research and created a volunteer program to map land management issues on

conservation lands. Additionally, she assisted in drafting a plastic and polystyrene ban ordinance, supported local efforts to comply with a statewide food recovery initiative (SB1383), developed a local Green Business Program, and supported the development of a local Climate Action and Adaptation Plan. After completing two service years as a CivicSpark Fellow, she became a Climate Campaign Fellow for Pacific Environment. At Pacific Environment, she supported the "Ship It Zero" Campaign and Pacific Environment's climate program legislative initiatives. She holds a special interest in environmental justice, conservation, as well as climate change mitigation and adaptation.

Mr. Haileyesus Tadesse, Fellow

Mr. Tadesse is a graduate of Loughborough University in the U.K., where he earned his M.S. in Environmental Monitoring for Management. After graduating, he joined the development sector, where he worked with government offices and donors on projects with a focus on livelihood improvement, watershed management, stakeholder coordination and engagement, and natural resources governance. In the past, he has participated in various research projects and led the development of successful project proposals with partners. Mr. Tadesse enjoys working with communities and strives to see the coordination of policies and institutions for effective delivery of solutions to current global challenges.

Ms. Katie Durante, Senior Fellow

Ms. Durante is a recent graduate of Eckerd College, where she received a double B.A. in Biology with a focus on Ecology and Environmental Studies. Her interest in land management and environmental education stems from her internship at Boyd Hill, a nature preserve in Saint Petersburg, Florida. There she effectively removed invasive species and became well-versed in plant identification. Her interest in education was also formed through her co-presidency of the beekeeping club at Eckerd College, where she collaborated with the school to create more favorable conditions for the hive. She hopes to work at national parks through environmental education programs to spread knowledge of the importance of environmental sustainability.

Mr. Adam Greco, Fellow

Mr. Greco is an undergraduate student at the University of Florida, double majoring in International Studies and Political Science. He is also one of the founding members and former Vice President of the Florida John Quincy Adams Society, the university's largest club dedicated to International Relations. Mr. Greco studied with Sciences Po Paris in the Summer of 2022, focusing on European Union policy, and studies with them currently with a more varied course load. In addition, He has academic

publications with the Center for International Maritime Security and the Journal of Strategic Security. Mr. Greco holds a special passion for developmental economics, geopolitical affairs, and sustainability.

Mr. Kyaw "Joe" Khine, Fellow

Mr. Khine graduated from the University of Virginia, where he earned his master's degree in Public Policy. Upon graduating, he worked at the Weldon Cooper Center for Public Service as a research and policy analyst, providing demographics research and data analysis support to the Virginia Department of Education. Before joining ISGP, he worked remotely as a consultant for Thibi Consultancy. He worked on data journalism projects, provided research, and created data visualizations for media organizations and non-profits based in Southeast Asia. As a student, Mr. Khine interned with WWF and Proximity Designs Social Enterprise in Myanmar, where he developed his passion for sustainability and economic development. He also holds a B.Sc. in Environmental Geosciences and is fluent in English and Burmese. He hopes to continue working on the intersection of sustainability, food security, and environmental policy in Southeast Asia.

Mr. Mattia Anfosso Lembo

Mr. Lembo is a former employee of the Embassy of Italy in Accra, Ghana. He graduated with honors from the University of Trieste in 2019, where he earned a master's degree in Diplomacy and International Cooperation. He also holds a master's course in Diplomatic Studies from the Italian Society for International Organization (SIOI) based in Rome, Italy. During his time at the Embassy of Italy in Accra, Mattia had the chance to immerse himself in an international environment. Through daily analysis and the preparation of reports on West African politics and economy, he acquired a great knowledge on how African countries, with the help of Western and Asian countries, are working to overcome major problems that afflict their population, such as terrorism, famine, and drought. Mr. Lembo ultimately hopes to work at the United Nations to foster positive relations with various audiences from different political and economic organizations as well as with national and international institutions. He is passionate about science, history, geopolitics, international relations, and philosophy. He is fluent in Italian, English and has a good working knowledge of French.

Mr. Ian Shotts, Fellow

Mr. Shotts is a graduate of The Ohio State University where he earned a B.A. in International Relations and Diplomacy, a degree he pursued after exposure to a number of languages and cultures growing up. One of Mr. Shotts' most valuable

professional experiences was a research project in the Central Valley of Costa Rica where he measured the ecological and social impacts of climate change on local farmers. His dedication to investigation continued as he researched state and federal law in the private sector in addition to undertaking supplemental positions at the Environmental and Social Sustainability Research Program and Center for Life Sciences Education at The Ohio State. His continued studies at the graduate level at the Universidad Autónoma de Madrid and his former undergraduate institution cemented his passion for the public policy and science, ultimately leading him to the ISGP. Mr. Shotts' interests primarily lie in the environment, climate change, public policy, and political philosophy.

Ms. Rebecca Simison, Fellow

Ms. Simison is a graduate of the University at Albany with a B.A. in World History and American Politics. Ms. Simison has experience in political research, government, and advocacy work and has served as a Legislative Aide in the New York State Assembly, as well as the Associate Vice President for Research and Policy at the New York State Coalition for Children's Behavioral Health. As a student, Ms. Simison also served as a Policy Research Intern at the Rockefeller Institute of Government in Albany, NY, conducting research and publishing a policy brief on the economic and structural barriers to higher education in the US. Ms. Simison has a passion for nuanced and well-researched policies that will improve people's lives.

ISGP Programs and Conferences

ISGP books from ISGP conferences listed below are available to the public without charge and can be downloaded from the ISGP Web site: www.scienceforglobalpolicy.org. Hardcopies of these books are available by contacting info@scienceforglobalpolicy.org.

Most recent

- *Foresight from the COVID-19 Pandemic: Science, Policy, and Communication*, convened using an internet format February 27-March 1, 2023.
- *Global Pathways to Hydrogen Energy Futures - Island Community Priorities*, convened using internet platforms spanning fifteen (15) time zones on June 21-23, 2022 (Western Hemisphere), with funding from the Hawaii Natural Energy Institute (HNEI) at the University of Hawaii, Manoa, Hawaiian Electric Industries (HEI), HEI Charitable Foundation, Hawaii Gas, the Ulupono Initiative and the ISGP.

ISGP Signature Conferences (ISC) conferences and books:

Emerging and Persistent Infectious Diseases (EPID):

- *Focus on Antimicrobial Resistance,* convened March 19–22, 2013, in Houston, Texas, U.S., in partnership with the Baylor College of Medicine.
- *21st Century Borders/Synthetic Biology: Focus on Responsibility and Governance*, convened December 4–7, 2012, in Tucson, Arizona, U.S., in partnership with the University of Arizona.
- *Focus on Societal and Economic Context*, convened July 8–11, 2012, in Fairfax, Virginia, U.S., in partnership with George Mason University.
- *Focus on Mitigation*, convened October 23–26, 2011, in Edinburgh, Scotland, U.K., in partnership with the University of Edinburgh.
- *Focus on Prevention*, convened June 5–8, 2011, in San Diego, California, U.S.
- *Focus on Surveillance*, convened October 17–20, 2010, in Warrenton, Virginia, U.S.
- *Global Perspectives* convened December 6–9, 2009, in Tucson, Arizona, U.S., in partnership with the University of Arizona.

Food Safety, Security, and Defense (FSSD):

- *Equitable, Sustainable, and Healthy Food Environments*, convened May 1–4, 2016 in Vancouver, British Columbia, Canada, in partnership with Simon Fraser University.

- *Food Security and Diet-linked Public Health Challenges* convened September 20–23, 2015 in Fargo, North Dakota, in partnership with North Dakota State University.
- *Focus on Food and the Environment*, convened October 5–8, 2014, in Ithaca, New York, in partnership with Cornell University.
- *Focus on Food and Water,* convened October 14–18, 2013, in Lincoln, Nebraska, U.S., in partnership with the University of Nebraska–Lincoln.
- *Focus on Innovations and Technologies,* convened April 14–17, 2013, in Verona, Italy.
- *Global Perspectives* convened October 24, 2012, in Arlington, Virginia, U.S., in partnership with George Mason University.

ISGP Global Challenges (IGC) conferences and books:

ISGP Climate Change Program (ICCP)

- *The Shore's Future: Living with Storms & Sea Level Rise*, convened November 20–21, 2015, in Toms River, New Jersey, in cooperation with the Toms River Working Group, Barnegat Bay Partnership, Barnegat Bay Foundation, and the Jay and Linda Grunin Foundation.
- *Sea Level Rise: What's Our Next Move?*, convened October 2–3, 2015, in St. Petersburg, Florida, in cooperation with the St. Petersburg Working Group.

ISGP Climate Change Arctic Program (ICCAP)

- *Sustainability Challenges: Coping with Less Water and Energy,* convened June 5, 2015, in Whittier, California, in cooperation with the Whittier Working Group.
- *Living with Less Water*, convened February 20–21, 2015, in Tucson Arizona, in cooperation with the Tucson Working Group.

ISGP Academic Partnerships (IAP) conferences and books:

- *Socioeconomic Contexts of Sustainable Agriculture* convened October 14–15, 2016, in Danbury, Connecticut, in partnership with Western Connecticut State University.
- *Water and Fire: Impacts of Climate Change*, convened April 10–11, 2016, in Sacramento, California, in partnership with California State University.
- *Communicating Science for Policy*, convened August 10–11, 2015, in Durham, North Carolina, in partnership with Sigma Xi, The Scientific Research Society.
- *Food Security: Production and Sustainability*, convened April 24–25, 2015, in St. Petersburg, Florida, in partnership with Sigma Xi, The Scientific Research Society, and Eckerd College.

- *Safeguarding the American Food* Supply, convened April 10–11, 2015, in Collegeville, Pennsylvania, in partnership with Sigma Xi, The Scientific Research Society, and Ursinus College.
- *Focus on Pandemic Preparedness,* convened April 11–12, 2014, in Collegeville, Pennsylvania, U.S., in partnership with Ursinus College.

ISGP Science and Governance (S&G) conferences and books:

- *Science and Governance: The Future of Modern Agriculture conference, convened September 22, 2020, in a hybrid in-person (Rome, Italy) / internet format, with support from The Office of Agricultural Policy, U.S. Department of State.*
- *Sustainable Agriculture: The Role of Plant Breeding Innovation conference, convened November 17-19, 2020, in an internet format, with support from the American Seed Trade Association and Euroseeds.*
- *Climate Impact on National Security (CINS–1, CINS–2A, CINS–2B), convened November* 28–December 1, 2016, April 3–4, 2017, and May 17–19, 2017 in partnership with the U.S. Army War College in Carlisle, Pennsylvania.
- *The Genomic Revolution* convened September 6, 2014, in cooperation with the Parliamentary Office on Science and Technology of the British Parliament within the House of Lords. London, United Kingdom.