BIG-R BAA Topic #1 Title: Modeling the Path to COVID-19 Recovery

Available Funding: $600,000; The Government anticipates 1 award, but may make more than 1 award, or none.

Topic Post Date: **July 21, 2020**

Abstract Due Date: **August 4, 2020**

Proposal Due Date: **September 9, 2020**

For questions and submission, please contact:

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Background

(U) The COVID-19 pandemic ranks among the most disruptive disasters to confront the United States during the last half-century, eliciting wide-ranging impacts to healthcare, the economy, and national security. This outbreak challenged nation states and organizations around the world, and posed unprecedented logistical impediments to first responders. Given impacts to NGA's customer base—the warfighter, the policymaker, and the first responder—NGA is soliciting proposals for applied geospatial research and development that will support economic and humanitarian recovery and inform efforts to anticipate and mitigate subsequent waves of the pandemic, as well as biological threats in the future.

(U) In the absence of a vaccine or effective pharmaceutical therapy, non-pharmaceutical interventions (NPIs)—such as social distancing mandates, travel restrictions, mask policies, and mandatory business closures—constitute the most viable infectious disease mitigation measures at the disposal of policymakers. Epidemiological evidence suggests that the unprecedented magnitude with which nation states employed NPIs to combat COVID-19 yielded substantial reductions in the incidence of infection. However, these NPIs also inflict notable societal and socioeconomic costs, impacting supply chains, local businesses, and mental health. Accordingly, there is a strong incentive to identify and prioritize classes of NPIs that optimize this cost-benefit tradeoff.

(U) To more effectively combat viral respiratory pandemics of the future, the biodefense enterprise must develop data-driven frameworks for the implementation and relaxation of NPIs. The viability of an NPI ultimately depends upon its efficacy in reducing the proliferation of the infectious agent, and the willingness of the underlying population to adhere to the intervention. While the former is driven by epidemiological parameters, the latter is largely a function of sociocultural processes. The COVID-19 pandemic offers a valuable case study for retrospective analysis of the interplay between these epidemiological and sociocultural variables in the context of NPI deployment. These analyses will offer the public health community a set of empirical lessons-learned that can be leveraged to inform policymakers during subsequent waves of infection.

Scope

(U) This topic seeks to fund retrospective analyses of the early stages of the COVID-19 pandemic that explore the nexus of human behavior, human mobility, and spatial heterogeneity in infectious disease

transmission. Predictive analyses that build upon historical data will be considered as well. Proposed efforts should focus on cases outside of the United States.

(U) This topic seeks to address two primary research questions:

(1) How do spatial and temporal heterogeneity in behavioral and sociocultural variables (e.g., skepticism of Western medical intervention, heterogeneity in sentiment toward travel restrictions, etc) translate into quantitative population-scale variation in adherence to NPIs within a region?
(2) How does adherence to NPIs translate into quantitative spatiotemporal variation in patterns of infectious disease transmission?

(U) In this context, sociocultural variables refer to behavioral and cultural factors proposed to influence adherence to NPIs.

(U) The outcome of this effort will be a mechanistic analytic framework and software tool that allows the user to: (1) quantify spatiotemporal variation in sociocultural variables of interest, (2) quantify spatiotemporal variation in adherence to NPIs, (3) identify sociocultural variables that correlate with adherence to NPIs, and (4) estimate relationships between spatiotemporal variation in adherence to NPIs and infectious disease outcomes.

(U) Please note that in this study, NGA is not interested in approaches that rely upon the use of survey data. Rather, successful applications will propose to leverage scalable, digital data sources to address the research topics listed above (e.g., exploitation of geo-tagged social media data to quantify spatial variation in sentiment toward travel restrictions, exploitation of digital mobility proxy data to quantify spatial variation in adherence to those interventions, etc.). NGA will not provide data sets, and we encourage applicants to integrate public/open source or commercial data sets into the study design.

Metrics and Milestones:

Milestone	**Metric**	**Base Period (# months)**
Milestone 1: Develop methodology to quantify spatial and temporal variation in behavioral/sociocultural variables. Example: Exploit geo-tagged social media data to quantify temporal variation in sentiment toward government-mandated travel restrictions amongst provinces in country X.	(A) ≥5 behavioral/sociocultural variables (B) Sub-national spatial resolution (e.g., variation amongst provinces, cantons, or municipalities) (C) ≤1-month temporal resolution (D) ≥1-year timeframe	12
Milestone 2: Develop methodology to quantify temporal heterogeneity in population-scale NPI adherence amongst administrative units	(A) ≥3 NPI adherence metrics (B) Sub-national spatial resolution (e.g., variation amongst provinces, cantons, or	12

Example: Exploit digital mobility proxy data to quantify temporal variation in adherence to mandated travel restrictions amongst provinces in country X.	municipalities) (C) ≤1-month temporal resolution (D) ≥1-year timeframe	
Milestone 3: Use multivariate statistical framework to quantify relationships amongst sociocultural variables and NPI adherence metrics within and amongst administrative units. Example: Use random forest regression to quantify the relationship between heterogeneity in behavioral/cultural variables and variation in NPI adherence metrics amongst provinces in country X and within provinces over time.	(A) For each NPI adherence metric, a multivariate statistical assessment of the relationship amongst sociocultural variables and NPI adherence (controlling for covariates as necessary) (B) Demonstration of a statistically significant correlation ($p<0.05$) between ≥3 behavioral/sociocultural variables and ≥2 NPI adherence metrics, respectively, after controlling for covariates.	12
Milestone 4: Quantify spatiotemporal heterogeneity in SARS-CoV-2 transmission within and/or amongst administrative units Example: Use phylogeographic methods to exploit geo-tagged SARS-CoV-2 molecular sequence data to quantify spatiotemporal variation in transmission amongst provinces in country X.	(A) Sub-national spatial resolution (e.g., variation amongst provinces, cantons, or municipalities) (B) ≤1-month temporal resolution (C) ≥1-year timeframe	12
Milestone 5: Use multivariate statistical framework to quantify relationships amongst spatiotemporal variation in adherence to NPIs and infectious disease outcomes Example: Use generalized linear model to quantify the relationship between heterogeneity in NPI adherence metric and estimates of SARS-CoV-2 transmission amongst provinces in country X.	(A) A multivariate statistical assessment of the relationship amongst NPI adherence metrics and infectious disease outcome metric (controlling for covariates as necessary) (B) Demonstration of a statistically significant correlation ($p<0.05$) between ≥2 NPI adherence metrics and ≥1 infectious disease outcome metric, respectively, after controlling for covariates.	12

Specific metrics, as outlined in the table above, should be developed by the applicant and tailored to the

particular approach described in the proposal. Proposed metrics must be clearly defined, and the methodology used to quantify candidate relationships must be clearly outlined. Proposals should also include a discussion of ways in which the proposed approach improves upon the existing state-of-the-art and should outline a strategy to quantify these improvements.

Deliverable Items:
(U) The proposer shall deliver a project kick-off briefing with a detailed schedule and experimental research plan, as well as mid-point and close-out briefings that provide a quantitative assessment of progress on key performance metrics in the Metrics and Milestones table.

(U) Each proposal submitted in response to this topic shall contain a Validation and Verification (V&V) plan that describes the methodology for evaluating the performance metrics of the proposed solution. NGA will construct independent test and evaluation (T&E) protocol based on the proposed V&V plans, aimed at validating achievement of required performance metrics.

(U) Finally, the expected outcome of this study will be a proof-of-concept analytic software tool (either made publicly available or delivered directly to NGA) that allows the user to: (1) quantify spatiotemporal variation in sociocultural variables of interest, (2) quantify spatiotemporal variation in adherence to NPIs, (3) identify sociocultural variables that correlate with adherence to NPIs, and (4) estimate relationships between spatiotemporal variation in adherence to NPIs and infectious disease outcomes.

(U) To accompany this tool, the performer will provide a proof-of-concept analytic report (either published in a peer-reviewed academic journal or delivered directly to NGA) applying these capabilities to a proposed use case of interest.

ITEM	DESCRIPTION	DUE DATE
Deliverable 1: Kick-off Briefing	Briefing in support of a project kick off meeting that details the experimental approach, schedule and milestones	15 days after contract award
Deliverable 2: Monthly Status Reports	Reports that briefly summarize work accomplished, any challenges or issues that may impact cost/schedule/performance or needs NGA input, and intended actions for the next reporting period. (Not anticipated to exceed one to two pages)	Once per month from contract award to the end of the period of performance
Deliverable 3: Mid-point Briefing	Briefing (format to be proposed) providing project research progress towards key performance metrics.	Six months after contract award
Deliverable 4: Validation and Verification (V&V) Plan	Plan that describes the methodology for evaluating the performance of the proposed solution.	

		Six months after contract award
Deliverable 5: Technical Report	Final written technical report that addresses research methodology, results, and discussion. Final report may be formatted for publication in a peer-reviewed journal.	12 months from contract award
Deliverable 6: Project Outbrief	Final brief to NGA Research that highlights research results and lessons learned. This shall include annotated text of the voice track of the presentation	12 months from contract award
Deliverable 7: Proof-of-concept analytic software tool	Analytic software tool (written in either R or Python programming language) used to implement proposed methodology. Deliverable can be made publicly available or delivered directly to the NGA Technical POC.	12 months from contract award

Data/IP Considerations:
(U) All data used in this analysis and results of the analysis may be released at the discretion of the NGA technical point of contact within the constraints of the classification and release policy. The NGA technical point of contact may release products to persons or organization on an item-by-item or all-inclusive basis.

Security Considerations:
(U) The work effort may contain information up to UNCLASSIFIED, and we anticipate that the scope of work can be completed at the UNCLASSIFIED level.

Place of Performance:
(U) Research activities outlined in this proposal will be conducted at the performers' organizations.

Period of Performance:
(U) The period of performance shall be up to 12 months.