NATIONAL SCIENCE FOUNDATION
2415 EISENHOWER AVENUE
ALEXANDRIA, VIRGINIA 22314

NSF 22-054

Dear Colleague Letter: Incorporating Human Behavior in Epidemiological Models (IHBEM)

March 1, 2022

Dear Colleague:

The National Science Foundation seeks to stimulate fundamental interdisciplinary, potentially transformative research concerning the incorporation of human social, behavioral, and economic processes into mathematical epidemiological models. As part of this effort, this Dear Colleague Letter (DCL) invites Research Advanced by Interdisciplinary Science and Engineering (RAISE) proposals that incorporate research and scientific insights about human behavior, economics, and social dynamics to improve mathematical epidemiological models. NSF is supporting this effort through its Division of Mathematical Sciences (DMS) in the Directorate for Mathematical and Physical Sciences (MPS), Divisions of Social and Economic Sciences (SES) and Behavioral and Cognitive Sciences (BCS) in the Directorate for Social, Behavioral, and Economic Sciences (SBE), and the Division of Environmental Biology (DEB) in Directorate for Biological Sciences (BIO).

BACKGROUND

The COVID-19 pandemic revealed three important facts about epidemiological modeling:

- epidemiological models are invaluable, essential tools in combating a pandemic;
- current models are far less useful than they could be for coping with an ongoing pandemic; and
- a large community of researchers is available and eager to contribute to the development and improvement of these modeling efforts.

Current models have proved insufficient in part due to human behavioral, social, and economic processes that are missing from the models but that have appeared to be key to understanding the course of the pandemic. These processes include structural characteristics, such as differential living conditions and patterns of social interaction, and behavioral characteristics, such as responsiveness to incentives and information by different

segments of the population. With the outbreak of the pandemic, numerous researchers from a variety of disciplines made contributions: they offered mathematical models, developed and ran simulations, and collected and analyzed large amounts of data. Their efforts were not as effective or useful as they could have been, however, in part because of weaknesses in dealing with behavioral and social processes (see NSF-sponsored conference on behaviorally modulated models in mathematical epidemiology).

The IHBEM effort is motivated by the urgent need to provide more reliable modeling tools to inform decision making and to evaluate public health policies during pandemics and other public health crises, with the premise that important advances will be made by incorporating human behavioral and social processes into mathematical epidemiological models. A key reason for building such a research program is that unintended outcomes of public health interventions should not be unanticipated.

SUMMARY OF OPPORTUNITY

Each proposal submitted in response to this DCL should be convergent in nature and depend for its advancement on the coordinated interaction of two or more PIs/co-PIs, with participation necessarily from the mathematical sciences and the social, behavioral, and economic sciences, and possibly from the biological sciences as well. Each proposal should be focused on a significant and well-delineated research challenge that integrates research on behavioral, social, and economic processes and mathematical epidemiological models. Examples of research challenges (see NSF-sponsored conference on behaviorally modulated models in mathematical epidemiology) include, but not are limited to: 1) Behavioral realism and sensitivity analysis; 2) Incorporation of behavioral change; 3) Incorporation of multiple environments: climate, seasonal, political, social; 4) Incorporation of population heterogeneity and policy models; 5) Data needs and integration for rich mathematical epidemiological models; and 6) Use of non-human data for model validation and verification. All proposals should address metrics to assess the success of the research project. Training of students and postdoctoral researchers at the intersection of the mathematical sciences and social, behavioral, and economic sciences is encouraged. Research teams are required to disseminate the results of their work in a timely and effective fashion.

NSF welcomes proposals that include efforts to broaden participation of underrepresented groups in science, technology, engineering and mathematics (STEM) (e.g., women, minorities, and persons with disabilities) in the development of the research agendas. Proposals from minority-serving institutions are encouraged, as are opportunities for participation by undergraduate and graduate students and postdoctoral fellows.

PREPARATION INSTRUCTIONS

Potential research teams are required to first contact the Division of Mathematical Sciences

via the Program Suitability and Proposal Concept Tool (ProSPCT) web form at https://suitability.nsf.gov/s/. The web form requests a project title, list of team members, summary of the project concept (up to two pages), and applicability to the RAISE guidelines contained in Chapter II.E.4 of the NSF Proposal & Award Policies & Procedures Guide (PAPPG). To ensure proper processing, the title of the ProSPCT submission should begin with: "RAISE:IHBEM" and identify MPS/DMS as the Target Unit with one or more of SBE/SES, SBE/BCS, or BIO/DEB as additional target units. To get started, users are required to provide their Login.gov credentials and then complete and submit the form. Submissions should be completed by April 1, 2022 (earlier if possible).

NSF Program Directors will consider the ProSPCT submissions, and those that fall within the scope of this DCL will receive an email from an NSF Program Director authorizing submission of a full RAISE proposal. PIs must upload the authorization email to the Supplementary Documentation section of the proposal. Requests deemed inappropriate for consideration under this DCL or the RAISE proposal type will also receive an email response.

Proposals in response to this DCL should be submitted to DMS via the Mathematical Biology Program (PD 18-7334). To facilitate effective review, proposal titles must begin with "RAISE:IHBEM." Proposals submitted in response to this DCL should be prepared and submitted in accordance with the guidelines for the preparation and submission of RAISE proposals contained in PAPPG Chapter II.E.

Full proposal submissions are due May 15, 2022 and will be accepted only if accompanied by written (email) authorization to submit (obtained in response to the research concept outline). Proposals submitted without written authorization from an NSF Program Director will not be accepted or will be returned without review.

Proposals in response to this DCL should adhere to the following RAISE guidelines in Chapter II.E.4 of the PAPPG. RAISE is a funding mechanism to support bold, interdisciplinary projects whose:

- Scientific advances lie in great part outside the scope of a single program or discipline, such that substantial funding support from more than one program or discipline is necessary.
- Lines of research promise transformational advances.
- Prospective discoveries reside at the interfaces of disciplinary boundaries that may not be recognized through traditional review or co-review.

To receive funding as a RAISE-appropriate project, all three criteria must be met. Proposals responsive to this DCL, therefore, must include a section stating how each of these three criteria is met. RAISE proposals may request up to $1,000,000 in total costs (including indirect costs) over up to five years.

See PAPPG Chapter II.E.4 for specific instructions about preparing RAISE proposals.

Please note all proposals may receive external reviews. This will occur by review panel, external *ad hoc* reviewers, or a combination thereof.

Inquiries about the DCL, general inquiries, and questions about submission of IHBEM proposals should be directed to NSF-IHBEM@nsf.gov.

Sincerely,

Kellina M. Craig-Henderson, Acting Assistant Director
Directorate for Social, Behavioral and Economic Sciences (SBE)

Sean L. Jones, Assistant Director
Directorate for Mathematical and Physical Sciences (MPS)

Joanne S. Tornow, Assistant Director
Directorate for Biological Sciences (BIO)