

Incorporating Human Behavior in Epidemiological Models (IHBEM)

PROGRAM SOLICITATION

NSF 23-546



National Science Foundation

Directorate for Mathematical and Physical Sciences
Division of Mathematical Sciences

Directorate for Social, Behavioral and Economic Sciences
Division of Behavioral and Cognitive Sciences
Division of Social and Economic Sciences

Directorate for Biological Sciences
Division of Environmental Biology



National Institutes of Health

National Institute on Drug Abuse

Submission Window Date(s) (due by 5 p.m. submitter's local time):

April 03, 2023 - April 14, 2023

March 01, 2024 - March 15, 2024

March 1 - March 15, Annually Thereafter

IMPORTANT INFORMATION AND REVISION NOTES

Any proposal submitted in response to this solicitation should be submitted in accordance with the *NSF Proposal & Award Policies & Procedures Guide* (PAPPG) that is in effect for the relevant due date to which the proposal is being submitted. The NSF PAPPG is regularly revised and it is the responsibility of the proposer to ensure that the proposal meets the requirements specified in this solicitation and the applicable version of the PAPPG. Submitting a proposal prior to a specified deadline does not negate this requirement.

SUMMARY OF PROGRAM REQUIREMENTS

General Information

Program Title:

Incorporating Human Behavior in Epidemiological Models (IHBEM)

Synopsis of Program:

The Incorporating Human Behavior in Epidemiological Models (IHBEM) Program supports research that incorporates research on social and behavioral processes in mathematical epidemiological models. The program provides support for projects that involve balanced participation from the mathematical sciences and from the social, behavioral, and economic sciences.

Cognizant Program Officer(s):

Please note that the following information is current at the time of publishing. See program website for any updates to the points of contact.

- Zhilan J. Feng, Program Director, MPS/DMS, telephone: (703) 292-7523, email: zfeng@nsf.gov
- Joseph M. Whitmeyer, Program Director, SBE/SES, telephone: (703) 292-7808, email: jwhitmey@nsf.gov
- Katharina Dittmar, Program Director, BIO/DEB, telephone: (703) 292-7799, email: kdittmar@nsf.gov
- Susan Wright, Program Director, NIH/NIDA, telephone: (301) 443-1124, email: susan.wright@nih.gov
- Amina Eladdadi, Program Director, MPS/DMS, telephone: (703) 292-8128, email: aeladdad@nsf.gov
- Trisha Van Zandt, Program Director, SBE/BCS, telephone: (703) 292-8740, email: pvanzand@nsf.gov

Applicable Catalog of Federal Domestic Assistance (CFDA) Number(s):

- 47.049 --- Mathematical and Physical Sciences
- 47.074 --- Biological Sciences
- 47.075 --- Social Behavioral and Economic Sciences
- 93.279 --- National Institute on Drug Abuse

Award Information

Anticipated Type of Award:

Standard Grant or Continuing Grant or R01 project (if the proposal is selected to be funded by NIH/NIDA)

Estimated Number of Awards: 10 to 15

Approximately 10 to 15 awards from this competition may be made by either NSF or NIH at the option of the agencies, not the grantee. The number of awards will depend on the quality of received proposals and budget availability.

Anticipated Funding Amount: \$4,000,000 to \$5,500,000

Up to \$5,500,000 per year for new awards (up to \$3,500,000 from NSF and up to \$2,000,000 from NIH/NIDA), subject to availability of funds and receipt of meritorious proposals, with total budgets of up to \$1,000,000 for an award duration of 3-4 years.

Eligibility Information

Who May Submit Proposals:

The categories of proposers eligible to submit proposals to the National Science Foundation are identified in the *NSF Proposal & Award Policies & Procedures Guide* (PAPPG), Chapter I.E. Unaffiliated individuals are not eligible to submit proposals in response to this solicitation.

Who May Serve as PI:

There are no restrictions or limits.

Limit on Number of Proposals per Organization:

There are no restrictions or limits.

Limit on Number of Proposals per PI or co-PI: 1

A person may be PI or co-PI on no more than ONE proposal. Participating in a proposal as other senior personnel does not count in this limit. Changes in investigator roles post-submission to meet the eligibility limits will not be allowed. **It is the responsibility of the submitters to confirm that the entire team is within the eligibility guidelines.**

Proposal Preparation and Submission Instructions

A. Proposal Preparation Instructions

- **Letters of Intent:** Not required
- **Preliminary Proposal Submission:** Not required
- **Full Proposals:**
 - Full Proposals submitted via Research.gov: *NSF Proposal and Award Policies and Procedures Guide* (PAPPG) guidelines apply. The complete text of the PAPPG is available electronically on the NSF website at: https://www.nsf.gov/publications/pub_summ.jsp?ods_key=pappg.
 - Full Proposals submitted via Grants.gov: *NSF Grants.gov Application Guide: A Guide for the Preparation and Submission of NSF Applications via Grants.gov* guidelines apply (Note: The *NSF Grants.gov Application Guide* is available on the Grants.gov website and on the NSF website at: https://www.nsf.gov/publications/pub_summ.jsp?ods_key=grantsgovguide).

B. Budgetary Information

- **Cost Sharing Requirements:**

Inclusion of voluntary committed cost sharing is prohibited.
- **Indirect Cost (F&A) Limitations:**

Not Applicable
- **Other Budgetary Limitations:**

Not Applicable

C. Due Dates

- **Submission Window Date(s)** (due by 5 p.m. submitter's local time):

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Proposal Review Information Criteria

Merit Review Criteria:

National Science Board approved criteria. Additional merit review criteria apply. Please see the full text of this solicitation for further information.

Award Administration Information

Award Conditions:

Additional award conditions apply. Please see the full text of this solicitation for further information.

Reporting Requirements:

Additional reporting requirements apply. Please see the full text of this solicitation for further information.

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I. INTRODUCTION

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
- 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 to understanding the course of the pandemic, in part, due to human behavioral and social processes that are missing from the models. 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. As a result, the mathematical models and, tools for model analyses and simulations that were developed to respond to the pandemic were not as effective or useful as they could have been.

The IHBEM program 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 may be made by incorporating human behavioral and social processes in mathematical epidemiological models. The goal of this program is to minimize unintended outcomes of public health interventions.

II. PROGRAM DESCRIPTION

The purpose of the Incorporating Human Behavior in Epidemiological Models activity is to support interdisciplinary collaborations that integrate research on behavioral and/or social processes in mathematical epidemiological models. Projects supported under this activity should be collaborative in nature and depend for their advancement on the coordinated interaction of two or more PIs/co-PIs, with balanced participation from both the mathematical sciences and the social, behavioral, and economic sciences. Additional participants from other disciplines, especially the biological sciences, are also welcome.

Each project should focus on a significant and well-delineated research challenge that integrates behavioral and social processes into mathematical epidemiological models. Examples of research challenges include, but not are limited to:

1. *Behavioral realism and sensitivity analysis.* A common crucial flaw attributed to epidemiological models of the COVID-19 pandemic has been a failure to incorporate realistic models of behavior. The challenge, therefore, is to incorporate realism while at the same time maintaining the tractability of the models. This realism includes differences in behavioral and social distributions along different characteristics of human populations and their intersections, including income, age, region, religion, race and ethnicity, gender, and education. Accompanying the incorporation of these behavioral models should be sensitivity analyses that determine how and to what extent these characteristics matter for predicting the outcomes of different pandemic-related interventions.
2. *Incorporation of behavioral change.* People's behavior changes over time: it may change as they acquire more information, in strategic response to others' (including organizations' and governments') behaviors, because of fatigue or increasing stress or increasing deprivation, and so forth. The implication is that incorporating fixed assumptions about behavior into epidemiological models may be inadequate for understanding how best to respond to a pandemic. A dynamic approach that embraces how behavior changes over time will be important.
3. *Incorporation of multiple environments: climate, seasonal, political, social.* Climate affects human epidemiology in many ways, one of those being that it affects human behavior. Climate change also affects animal habitats, which can affect human-animal interactions such that some pathogens originally occurring only among animals may become transmissible in a human population. Climate is related to seasonal variation, which again has strong effects on patterns of human behavior. Political and social environments, while fundamentally different from climatic and seasonal environments, also exert a strong influence on behavior. Incorporation of these and other environmental considerations into epidemiological models is essential especially because of how they vary over different localities and how they change over time.
4. *Incorporation of population heterogeneity and policy models.* The COVID-19 pandemic has highlighted that disease may affect different segments of the population differently. Considering this heterogeneity, it may be important to model endogenous mechanisms describing decision-makers' enactment of public health policies (such as social distancing, mask wearing, vaccination) and social policies (for example, eviction moratoria, childcare provisions, and employment flexibility), and how these rules influence public health and welfare. This involves modeling political factors, communication, behavioral responses, and interactions between dynamically coupled processes.
5. *Data needs for rich mathematical epidemiological models.* As rich theoretical models are built with, for example, different possible transmission methods and behavioral responses, it becomes valuable to analyze what data are required to validate the models, and what data are necessary to separate and arbitrate between models, while acknowledging the limitations posed by data that are either observational or unrepresentative.

Projects need not focus on human pathogens or human hosts, although such research must still incorporate human behavior and/or social processes. Examples of research on non-human systems include: how changes in behaviors or farming practices affect the transmission of foot-and-mouth disease, how economic factors affect the global spread of pathogens through the pet trade, or how hunting affects the spread of prions in white-tail deer.

All proposals should include metrics to assess the success of the research project. In addition, the training of students and postdoctoral researchers at the intersection of the mathematical sciences and social, behavioral, and economic sciences is encouraged. Discuss how trainees will be recruited, mentored, and retained, and explain how these efforts will increase participation of people from all demographics, thereby including those underrepresented in the scientific enterprise. Research teams are required to disseminate the results of their work in a timely and effective fashion.

III. AWARD INFORMATION

Under this solicitation, proposals may be submitted for up to four years duration and with budgets totaling no more than \$1,000,000. The budget must be commensurate with the project and thoroughly justified in the proposal. The IHBEM Program expects to fund approximately 10-15 awards per year, depending on the quality of submissions and the availability of funds.

Upon conclusion of the review process, meritorious proposals may be recommended for funding by either NSF or NIH, at the option of the agencies, not the proposing organizations. Unattributed reviews and the panel summary will be shared with NIH. Proposals selected for funding by NIH will need to be reformatted and resubmitted to that agency. Subsequent submission and grant administration procedures will be in accordance with the individual policies of the awarding agency. Further information will be provided to these applicants after selection.

IV. ELIGIBILITY INFORMATION

Who May Submit Proposals:

The categories of proposers eligible to submit proposals to the National Science Foundation are identified in the *NSF Proposal & Award Policies & Procedures Guide* (PAPPG), Chapter I.E. Unaffiliated individuals are not eligible to submit proposals in response to this solicitation.

Who May Serve as PI:

There are no restrictions or limits.

Limit on Number of Proposals per Organization:

There are no restrictions or limits.

Limit on Number of Proposals per PI or co-PI: 1

A person may be PI or co-PI on no more than ONE proposal. Participating in a proposal as other senior personnel does not count in this limit. Changes in investigator roles post-submission to meet the eligibility limits will not be allowed. **It is the responsibility of the submitters to confirm that the entire team is within the eligibility guidelines.**

Additional Eligibility Info:

NIH/NIDA and its staff are ineligible to be involved in any proposals submitted to this funding opportunity, including as unfunded collaborators, via letters of collaboration or support, or via any other means.

NIH/NIDA Eligibility: Clinical trials are not allowed. The NIH will only consider applications that do not propose clinical trials. Individuals who are considering submitting a proposal in response to this solicitation should review <https://grants.nih.gov/ct-decision/> in determining whether the project meets the NIH definition of a Clinical Trial.

V. PROPOSAL PREPARATION AND SUBMISSION INSTRUCTIONS

A. Proposal Preparation Instructions

Full Proposal Preparation Instructions: Proposers may opt to submit proposals in response to this Program Solicitation via Research.gov or Grants.gov.

- Full Proposals submitted via Research.gov: Proposals submitted in response to this program solicitation should be prepared and submitted in accordance with the general guidelines contained in the *NSF Proposal and Award Policies and Procedures Guide* (PAPPG). The complete text of the PAPPG is available electronically on the NSF website at: https://www.nsf.gov/publications/pub_summ.jsp?ods_key=pappg. Paper copies of the PAPPG may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-8134 or by e-mail from nsfpubs@nsf.gov. The Prepare New Proposal setup will prompt you for the program solicitation number.
- Full proposals submitted via Grants.gov: Proposals submitted in response to this program solicitation via Grants.gov should be prepared and submitted in accordance with the *NSF Grants.gov Application Guide: A Guide for the Preparation and Submission of NSF Applications via Grants.gov*. The complete text of the *NSF Grants.gov Application Guide* is available on the Grants.gov website and on the NSF website at: https://www.nsf.gov/publications/pub_summ.jsp?ods_key=grantsgovguide. To obtain copies of the Application Guide and Application Forms Package, click on the Apply tab on the Grants.gov site, then click on the Apply Step 1: Download a Grant Application Package and Application Instructions link and enter the funding opportunity number, (the program solicitation number without the NSF prefix) and press the Download Package button. Paper copies of the Grants.gov Application Guide also may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-8134 or by e-mail from nsfpubs@nsf.gov.

In determining which method to utilize in the electronic preparation and submission of the proposal, please note the following:

Collaborative Proposals. All collaborative proposals submitted as separate submissions from multiple organizations must be submitted via Research.gov. PAPPG Chapter II.E.3 provides additional information on collaborative proposals.

See PAPPG Chapter II.D.2 for guidance on the required sections of a full research proposal submitted to NSF. Please note that the proposal preparation instructions provided in this program solicitation may deviate from the PAPPG instructions.

The following instructions supplement or deviate from the PAPPG:

- a. Title: To facilitate timely processing, the title of the proposal should begin with the five characters "IHBEM:" and the title of a collaborative project should begin with the designation "Collaborative Research: IHBEM:." All proposals in a collaborative project should have the same title. Please note that if submitting via Research.gov, the system will automatically insert the prepended title "Collaborative Research" when the collaborative set of proposals is created.
- b. Results from Prior NSF and/or NIH Support: If any Principal Investigator (PI) or co-PI identified on the project has received NSF or NIH funding with (i) an award with an end date in the past five years, or (ii) any current funding, including any no cost extensions, information on the award(s) is required. Each PI and co-PI who has received more than one award must report on the award most closely related to the proposal. No more than three total pages may be used to describe the results, which must be summarized in a single, separate section, clearly titled "Results from Prior NSF/NIH Support."

The following information must be provided:

- The NSF or NIH award number, amount, and period of support
 - The title of the project
 - A summary of the results of the completed work, including accomplishments related to the Broader Impact activities supported by the award
 - Evidence of research products and their availability, including, but not limited to: data, publications, samples, physical collections, software, and models.
- c. Management Plan: All proposals must include a Management Plan, no more than 3 pages long, submitted as a separate Supplementary Document. The plan should discuss the role of each investigator, as well as the governance and organizational structure of the leadership team and the research project, including communication plans, process for making decisions on scientific directions, and procedures for resolving conflicts. The estimated amount of time committed to the project must be provided for each of the key personnel; those with other supported research must also explain how they will allocate time and effort among the projects.
 - d. Protection of Human Subjects/Use and Care of Vertebrate Animals: Both NSF and NIH have rules regarding the use of human subjects and/or vertebrate animals in research. Proposals that involve human subjects or use vertebrate animals MUST INCLUDE the information required by both agencies. See the NSF PAPPG AND the NIH SF 424 application guide for additional information (<https://grants.nih.gov/grants/how-to-apply-application-guide/forms-g/general/g.500-phs-human-subjects-and-clinical-trials-information.htm>). Information on the use of human subjects and/or vertebrate animals is considered in the review of the proposals and should be submitted separately as a Supplementary Document.

- e. Letters of Collaboration: Letters of collaboration document significant collaborative arrangements and must be limited to stating the intent to collaborate and should not contain endorsements or evaluation of the proposed project or investigators. The recommended format for letters of collaboration is as follows:

"If the proposal submitted by Dr. [insert the full name of the Principal Investigator] entitled [insert the proposal title] is selected for funding by NSF or NIH, it is my intent to collaborate and/or commit resources as detailed in the Project Description or the Facilities, Equipment or Other Resources section of the proposal."

The Project Description should document the need for and nature of collaborations, such as intellectual contributions to the project, permission to access a site, an instrument, or a facility, offer of data, samples and materials for research, logistical support to the research and education program, or mentoring of U.S. students at a foreign site. All letters of collaboration must be included at the time of submission as separate Supplementary Documents.

B. Budgetary Information

Cost Sharing:

Inclusion of voluntary committed cost sharing is prohibited.

C. Due Dates

- **Submission Window Date(s)** (due by 5 p.m. submitter's local time):

April 03, 2023 - April 14, 2023

March 01, 2024 - March 15, 2024

March 1 - March 15, Annually Thereafter

D. Research.gov/Grants.gov Requirements

For Proposals Submitted Via Research.gov:

To prepare and submit a proposal via Research.gov, see detailed technical instructions available at: https://www.research.gov/research-portal/appmanager/base/desktop?nfpb=true&pageLabel=research_node_display&nodePath=/researchGov/Service/Desktop/ProposalPreparationandSubmission.html. For Research.gov user support, call the Research.gov Help Desk at 1-800-673-6188 or e-mail rgov@nsf.gov. The Research.gov Help Desk answers general technical questions related to the use of the Research.gov system. Specific questions related to this program solicitation should be referred to the NSF program staff contact(s) listed in Section VIII of this funding opportunity.

For Proposals Submitted Via Grants.gov:

Before using Grants.gov for the first time, each organization must register to create an institutional profile. Once registered, the applicant's organization can then apply for any federal grant on the Grants.gov website. Comprehensive information about using Grants.gov is available on the Grants.gov Applicant Resources webpage: <https://www.grants.gov/web/grants/applicants.html>. In addition, the NSF Grants.gov Application Guide (see link in Section V.A) provides instructions regarding the technical preparation of proposals via Grants.gov. For Grants.gov user support, contact the Grants.gov Contact Center at 1-800-518-4726 or by email: support@grants.gov. The Grants.gov Contact Center answers general technical questions related to the use of Grants.gov. Specific questions related to this program solicitation should be referred to the NSF program staff contact(s) listed in Section VIII of this solicitation.

Submitting the Proposal: Once all documents have been completed, the Authorized Organizational Representative (AOR) must submit the application to Grants.gov and verify the desired funding opportunity and agency to which the application is submitted. The AOR must then sign and submit the application to Grants.gov. The completed application will be transferred to Research.gov for further processing.

Proposers that submitted via Research.gov may use Research.gov to verify the status of their submission to NSF. For proposers that submitted via Grants.gov, until an application has been received and validated by NSF, the Authorized Organizational Representative may check the status of an application on Grants.gov. After proposers have received an e-mail notification from NSF, Research.gov should be used to check the status of an application.

VI. NSF PROPOSAL PROCESSING AND REVIEW PROCEDURES

Proposals received by NSF are assigned to the appropriate NSF program for acknowledgement and, if they meet NSF requirements, for review. All proposals are carefully reviewed by a scientist, engineer, or educator serving as an NSF Program Officer, and usually by three to ten other persons outside NSF either as *ad hoc* reviewers, panelists, or both, who are experts in the particular fields represented by the proposal. These reviewers are selected by Program Officers charged with oversight of the review process. Proposers are invited to suggest names of persons they believe are especially well qualified to review the proposal and/or persons they would prefer not review the proposal. These suggestions may serve as one source in the reviewer selection process at the Program Officer's discretion. Submission of such names, however, is optional. Care is taken to ensure that reviewers have no conflicts of interest with the proposal. In addition, Program Officers may obtain comments from site visits before recommending final action on proposals. Senior NSF staff further review recommendations for awards. A flowchart that depicts the entire NSF proposal and award process (and associated timeline) is included in PAPPG Exhibit III-1.

A comprehensive description of the Foundation's merit review process is available on the NSF website at: https://www.nsf.gov/bfa/dias/policy/merit_review/.

Proposers should also be aware of core strategies that are essential to the fulfillment of NSF's mission, as articulated in *Leading the World in Discovery and Innovation, STEM Talent Development and the Delivery of Benefits from Research - NSF Strategic Plan for Fiscal Years (FY) 2022 - 2026*. These strategies are integrated in the program planning and implementation process, of which proposal review is one part. NSF's mission is particularly well-implemented through the integration of research and education and broadening participation in NSF programs, projects, and activities.

One of the strategic objectives in support of NSF's mission is to foster integration of research and education through the programs, projects, and activities it supports at academic and research institutions. These institutions must recruit, train, and prepare a diverse STEM workforce to advance the frontiers of science and participate in the U.S. technology-based economy. NSF's contribution to the national innovation ecosystem is to provide cutting-edge research under the guidance of the Nation's most creative scientists and engineers. NSF also supports development of a strong science, technology, engineering, and mathematics (STEM) workforce by investing in building the knowledge that informs improvements in STEM teaching and learning.

NSF's mission calls for the broadening of opportunities and expanding participation of groups, institutions, and geographic regions that are underrepresented in STEM disciplines, which is essential to the health and vitality of science and engineering. NSF is committed to this principle of diversity and deems it central to the programs, projects, and activities it considers and supports.

A. Merit Review Principles and Criteria

The National Science Foundation strives to invest in a robust and diverse portfolio of projects that creates new knowledge and enables breakthroughs in understanding across all areas of science and engineering research and education. To identify which projects to support, NSF relies on a merit review process that incorporates consideration of both the technical aspects of a proposed project and its potential to contribute more broadly to advancing NSF's mission "to promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense; and for other purposes." NSF makes every effort to conduct a fair, competitive, transparent merit review process for the selection of projects.

1. Merit Review Principles

These principles are to be given due diligence by PIs and organizations when preparing proposals and managing projects, by reviewers when reading and evaluating proposals, and by NSF program staff when determining whether or not to recommend proposals for funding and while overseeing awards. Given that NSF is the primary federal agency charged with nurturing and supporting excellence in basic research and education, the following three principles apply:

- All NSF projects should be of the highest quality and have the potential to advance, if not transform, the frontiers of knowledge.
- NSF projects, in the aggregate, should contribute more broadly to achieving societal goals. These "Broader Impacts" may be accomplished through the research itself, through activities that are directly related to specific research projects, or through activities that are supported by, but are complementary to, the project. The project activities may be based on previously established and/or innovative methods and approaches, but in either case must be well justified.
- Meaningful assessment and evaluation of NSF funded projects should be based on appropriate metrics, keeping in mind the likely correlation between the effect of broader impacts and the resources provided to implement projects. If the size of the activity is limited, evaluation of that activity in isolation is not likely to be meaningful. Thus, assessing the effectiveness of these activities may best be done at a higher, more aggregated, level than the individual project.

With respect to the third principle, even if assessment of Broader Impacts outcomes for particular projects is done at an aggregated level, PIs are expected to be accountable for carrying out the activities described in the funded project. Thus, individual projects should include clearly stated goals, specific descriptions of the activities that the PI intends to do, and a plan in place to document the outputs of those activities.

These three merit review principles provide the basis for the merit review criteria, as well as a context within which the users of the criteria can better understand their intent.

2. Merit Review Criteria

All NSF proposals are evaluated through use of the two National Science Board approved merit review criteria. In some instances, however, NSF will employ additional criteria as required to highlight the specific objectives of certain programs and activities.

The two merit review criteria are listed below. **Both** criteria are to be given **full consideration** during the review and decision-making processes; each criterion is necessary but neither, by itself, is sufficient. Therefore, proposers must fully address both criteria. (PAPPG Chapter II.D.2.d(i). contains additional information for use by proposers in development of the Project Description section of the proposal). Reviewers are strongly encouraged to review the criteria, including PAPPG Chapter II.D.2.d(i), prior to the review of a proposal.

When evaluating NSF proposals, reviewers will be asked to consider what the proposers want to do, why they want to do it, how they plan to do it, how they will know if they succeed, and what benefits could accrue if the project is successful. These issues apply both to the technical aspects of the proposal and the way in which the project may make broader contributions. To that end, reviewers will be asked to evaluate all proposals against two criteria:

- **Intellectual Merit:** The Intellectual Merit criterion encompasses the potential to advance knowledge; and
- **Broader Impacts:** The Broader Impacts criterion encompasses the potential to benefit society and contribute to the achievement of specific, desired societal outcomes.

The following elements should be considered in the review for both criteria:

1. What is the potential for the proposed activity to
 - a. Advance knowledge and understanding within its own field or across different fields (Intellectual Merit); and
 - b. Benefit society or advance desired societal outcomes (Broader Impacts)?
2. To what extent do the proposed activities suggest and explore creative, original, or potentially transformative concepts?
3. Is the plan for carrying out the proposed activities well-reasoned, well-organized, and based on a sound rationale? Does the plan incorporate a mechanism to assess success?
4. How well qualified is the individual, team, or organization to conduct the proposed activities?
5. Are there adequate resources available to the PI (either at the home organization or through collaborations) to carry out the proposed activities?

Broader impacts may be accomplished through the research itself, through the activities that are directly related to specific research projects, or through activities that are supported by, but are complementary to, the project. NSF values the advancement of scientific knowledge and activities that contribute to achievement of societally relevant outcomes. Such outcomes include, but are not limited to: full participation of women, persons with disabilities, and other

underrepresented groups in science, technology, engineering, and mathematics (STEM); improved STEM education and educator development at any level; increased public scientific literacy and public engagement with science and technology; improved well-being of individuals in society; development of a diverse, globally competitive STEM workforce; increased partnerships between academia, industry, and others; improved national security; increased economic competitiveness of the United States; and enhanced infrastructure for research and education.

Proposers are reminded that reviewers will also be asked to review the Data Management Plan and the Postdoctoral Researcher Mentoring Plan, as appropriate.

Additional Solicitation Specific Review Criteria

In addition to Intellectual Merits and Broader Impacts, reviewers will be asked to consider:

1. The extent to which the proposed topic and research integrate behavioral and social processes into mathematical epidemiological models, as evidenced in the Project Description and Management Plan
2. The extent to which the research team is well balanced between those with expertise in the mathematical sciences and the behavioral and social sciences.
3. The extent to which the Management Plan is comprehensive and well-developed, including but not limited to project management methods, coordination of the research team, soundness of the budget, and feasibility of the schedule.
4. The appropriateness of the metrics to assess the success of the project included in the proposal.

Reviewers may be requested to provide numeric NIH overall impact scores from 1 (highest) to 9 (lowest) based upon their evaluations of the intellectual merits and broader impacts of the applications.

Overall Impact refers to the likelihood that the project will exert a sustained, powerful influence on the research field(s) involved and is based on the following five core review criteria and relevant additional review criteria. An application does not need to be strong in all categories to be judged likely to have major scientific impact.

The five core review criteria for NIH are:

- **Significance.** Does the applicant discuss the strengths and weaknesses of the rigor of the prior research used to support the proposed project? (Rigor of the prior research, which includes preliminary and published results, concerns the quality and strength of the research being cited by the applicant as crucial to support the application; this is distinct from the hypothesis or justification.) How will the proposed research address weaknesses, gaps, important problems, or critical barriers to progress in the field? If the project aims are achieved, how will scientific knowledge, technical capability, and/or clinical practice be improved? Will successful completion of the aims change the concepts, methods, treatments, technologies, services, or preventative interventions that drive this field?
- **Investigator(s).** Are the principal investigator (PI), project director (PD), collaborators, and other researchers well suited to the project? For those in the early stages of independent careers, do they have appropriate experience and training? For more established investigators, have they demonstrated an ongoing record of accomplishments that have advanced their field(s)? If the project is collaborative or multi-PD/PI, do the investigators have complementary and integrated expertise; are their leadership approach, governance, and organizational structure appropriate for the project?
- **Innovation.** Does the application challenge and seek to shift current research or clinical practice paradigms by utilizing novel theoretical concepts, approaches or methodologies, instrumentation, or interventions? Are the concepts, approaches or methodologies, instrumentation, or interventions novel to one field of research or novel in a broad sense? Is a refinement, improvement, or new application of theoretical concepts, approaches or methodologies, instrumentation, or interventions proposed?
- **Approach.** Are the overall strategy, methodology, and analyses well-reasoned, appropriate, and supported by rigor in the prior research to accomplish the project's specific aims? Is there scientific rigor in the proposed study? (Scientific rigor is defined as the strict application of the scientific method to ensure robust and unbiased experimental design, methodology, analysis, interpretation, and reporting of results.) Are potential problems, alternative strategies, and benchmarks for success presented? If the project is in the early stages of development, will the strategy establish feasibility, and will particularly risky aspects be managed? Have the investigators presented adequate plans to address relevant biological variables (e.g., sex, age, weight, health condition, human ethnicity, animal species and strains, etc.) for studies in vertebrate animals or human subjects? If the project involves human subjects, are there plans for the protection of human subjects from research risks, and the inclusion (or exclusion) of individuals on the basis of sex/gender, race, and ethnicity, as well as the inclusion (or exclusion) of individuals of all ages (including children and older adults), justified in terms of the scientific goals and research strategy proposed?
- **Environment.** Will the scientific environment in which the work will be done contribute to the probability of success? Are the institutional support, equipment, and other physical resources available to the investigators adequate for the project proposed? Will the project benefit from unique features of the scientific environment, subject populations, or collaborative arrangements?

As relevant to the proposed project, the following additional review criteria will be addressed and considered in the determination of scientific merit and rating as part of the Overall Impact score.

- **Protections for Human Subjects**
- To be considered human subjects research, the participating individuals must be living and identifiable, and the data and/or specimens are specifically obtained for the proposed research. For research that involves human subjects but does not involve one of the categories of research that are exempt under 45 CFR Part 46.104, the committee will evaluate the justification for involvement of human subjects and the proposed protections from research risk relating to their participation according to the following review criteria: 1) risk to subjects, 2) adequacy of protection against risks, 3) potential benefits to the subjects and others, and 4) importance of the knowledge to be gained. For research that involves human subjects and meets the criteria for one or more of the eight categories of research that are exempt under 45 CFR Part 46.104, the committee will evaluate: 1) the justification for the exemption, 2) human subjects involvement and characteristics, and 3) sources of materials.
- **Inclusion of Women, Minorities, and Individuals Across the Lifespan.** When the proposed project involves human subjects and/or NIH-defined clinical research, the committee will evaluate the proposed plans for the inclusion (or exclusion) of individuals on the basis of sex/gender, race/ethnicity or if non-US residents, as well as the inclusion (or exclusion) of individuals of all ages including children (under 18 years old), adults (18 to 64 years old) and older adults (over 64 years old) to determine if it is justified in terms of the scientific goals and research strategy proposed.
- **Vertebrate Animals.** The committee will evaluate the involvement of live vertebrate animals as part of the scientific assessment according to the following criteria: (1) a concise description of proposed procedures involving animals, including identifying the species, strains, ages, sex, and total

number to be used and if involved, the sources of dogs or cats; (2) the justifications that the species are appropriate for the proposed research and explaining why the research goals cannot be accomplished using an alternative model (e.g., computational, human, invertebrate, in vitro); (3) the interventions to minimize discomfort, distress, pain and injury; and (4) the justification for euthanasia method if NOT consistent with the American Veterinary Medical Association Guidelines for the Euthanasia of Animals. Reviewers will assess the use of chimpanzees as they would any other application proposing the use of vertebrate animals.

- **Biohazards.** Reviewers will identify potential biohazards (biological organisms or their products, such as toxins, that pose a threat to human health) and other hazards (such as radioactivity, dangerous chemicals, or recombinant DNA) that are known in their professional community to pose a particularly significant risk to research personnel and/or the environment. Reviewers will assess whether materials or procedures proposed are potentially hazardous to research personnel and/or the environment, and if needed, determine whether adequate protection is proposed.

B. Review and Selection Process

Proposals submitted in response to this program solicitation will be reviewed by Ad hoc Review and/or Panel Review.

Reviewers will be asked to evaluate proposals using two National Science Board approved merit review criteria and, if applicable, additional program specific criteria. A summary rating and accompanying narrative will generally be completed and submitted by each reviewer and/or panel. The Program Officer assigned to manage the proposal's review will consider the advice of reviewers and will formulate a recommendation.

Upon conclusion of the review process, meritorious proposals may be recommended for funding by either NSF or NIH, at the option of the agencies, not the proposing organizations. Unattributed reviews and the panel summary will be shared with NIH. Proposals selected for funding by NIH will need to be reformatted and resubmitted to that agency. Subsequent submission and grant administration procedures will be in accordance with the individual policies of the awarding agency. Further information will be provided to these applicants after selection.

NSF Process: After scientific, technical and programmatic review and consideration of appropriate factors, the NSF Program Officer recommends to the cognizant Division Director whether the proposal should be declined or recommended for award. NSF strives to be able to tell applicants whether their proposals have been declined or recommended for funding within six months. Large or particularly complex proposals or proposals from new awardees may require additional review and processing time. The time interval begins on the deadline or target date, or receipt date, whichever is later. The interval ends when the Division Director acts upon the Program Officer's recommendation.

After programmatic approval has been obtained, the proposals recommended for funding will be forwarded to the Division of Grants and Agreements or the Division of Acquisition and Cooperative Support for review of business, financial, and policy implications. After an administrative review has occurred, Grants and Agreements Officers perform the processing and issuance of a grant or other agreement. Proposers are cautioned that only a Grants and Agreements Officer may make commitments, obligations or awards on behalf of NSF or authorize the expenditure of funds. No commitment on the part of NSF should be inferred from technical or budgetary discussions with a NSF Program Officer. A Principal Investigator or organization that makes financial or personnel commitments in the absence of a grant or cooperative agreement signed by the NSF Grants and Agreements Officer does so at their own risk.

Once an award or declination decision has been made, Principal Investigators are provided feedback about their proposals. In all cases, reviews are treated as confidential documents. Verbatim copies of reviews, excluding the names of the reviewers or any reviewer-identifying information, are sent to the Principal Investigator/Project Director by the Program Officer. In addition, the proposer will receive an explanation of the decision to award or decline funding.

NIH Process: Proposals selected for funding consideration by NIH will be invited to submit reformatted applications to the Division of Receipt and Referral (DRR) in NIH's Center for Scientific Review (CSR). A receipt date of approximately March 15 annually is in effect for the NIH formatted applications. Following the initial peer review, recommended applications that have been resubmitted to the NIH are required to go to second level review by the Advisory Council or Advisory Board of the awarding Institute or Center. The following will be considered in making funding decisions:

- Scientific and technical merit of the proposed project as determined by scientific peer review.
- Availability of funds.
- Relevance of the proposed project to program priorities.

Subsequent award processing and grant administration procedures will be in accordance with NIH policies and procedures.

VII. AWARD ADMINISTRATION INFORMATION

A. Notification of the Award

Notification of the award is made to *the submitting organization* by an NSF Grants and Agreements Officer. Organizations whose proposals are declined will be advised as promptly as possible by the cognizant NSF Program administering the program. Verbatim copies of reviews, not including the identity of the reviewer, will be provided automatically to the Principal Investigator. (See Section VI.B. for additional information on the review process.)

B. Award Conditions

An NSF award consists of: (1) the award notice, which includes any special provisions applicable to the award and any numbered amendments thereto; (2) the budget, which indicates the amounts, by categories of expense, on which NSF has based its support (or otherwise communicates any specific approvals or disapprovals of proposed expenditures); (3) the proposal referenced in the award notice; (4) the applicable award conditions, such as Grant General Conditions (GC-1)*; or Research Terms and Conditions* and (5) any announcement or other NSF issuance that may be incorporated by reference in the award notice. Cooperative agreements also are administered in accordance with NSF Cooperative Agreement Financial and Administrative Terms and Conditions (CA-FATC) and the applicable Programmatic Terms and Conditions. NSF awards are electronically signed by an NSF Grants and Agreements Officer and transmitted

electronically to the organization via e-mail.

*These documents may be accessed electronically on NSF's Website at https://www.nsf.gov/awards/managing/award_conditions.jsp?org=NSF. Paper copies may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-8134 or by e-mail from nsfpubs@nsf.gov.

More comprehensive information on NSF Award Conditions and other important information on the administration of NSF awards is contained in the NSF *Proposal & Award Policies & Procedures Guide* (PAPPG) Chapter VII, available electronically on the NSF Website at https://www.nsf.gov/publications/pub_summ.jsp?ods_key=pappg.

Administrative and National Policy Requirements

Build America, Buy America

As expressed in Executive Order 14005, [Ensuring the Future is Made in All of America by All of America's Workers](#) (86 FR 7475), it is the policy of the executive branch to use terms and conditions of Federal financial assistance awards to maximize, consistent with law, the use of goods, products, and materials produced in, and services offered in, the United States.

Consistent with the requirements of the Build America, Buy America Act (Pub. L. 117-58, Division G, Title IX, Subtitle A, November 15, 2021), no funding made available through this funding opportunity may be obligated for an award unless all iron, steel, manufactured products, and construction materials used in the project are produced in the United States. For additional information, visit NSF's [Build America, Buy America](#) webpage.

Special Award Conditions:

Grants made by NSF will be subject to NSF's award conditions. Grants made by NIH will be subject to NIH's award conditions (see <http://grants.nih.gov/grants/policy/awardconditions.htm>).

C. Reporting Requirements

For all multi-year grants (including both standard and continuing grants), the Principal Investigator must submit an annual project report to the cognizant Program Officer no later than 90 days prior to the end of the current budget period. (Some programs or awards require submission of more frequent project reports). No later than 120 days following expiration of a grant, the PI also is required to submit a final project report, and a project outcomes report for the general public.

Failure to provide the required annual or final project reports, or the project outcomes report, will delay NSF review and processing of any future funding increments as well as any pending proposals for all identified PIs and co-PIs on a given award. PIs should examine the formats of the required reports in advance to assure availability of required data.

PIs are required to use NSF's electronic project-reporting system, available through Research.gov, for preparation and submission of annual and final project reports. Such reports provide information on accomplishments, project participants (individual and organizational), publications, and other specific products and impacts of the project. Submission of the report via Research.gov constitutes certification by the PI that the contents of the report are accurate and complete. The project outcomes report also must be prepared and submitted using Research.gov. This report serves as a brief summary, prepared specifically for the public, of the nature and outcomes of the project. This report will be posted on the NSF website exactly as it is submitted by the PI.

More comprehensive information on NSF Reporting Requirements and other important information on the administration of NSF awards is contained in the NSF *Proposal & Award Policies & Procedures Guide* (PAPPG) Chapter VII, available electronically on the NSF Website at https://www.nsf.gov/publications/pub_summ.jsp?ods_key=pappg.

Awardees will be required to submit the Research Performance Progress Report (RPPR) annually and financial statements as required in the NIH Grants Policy Statement.

A final progress report, invention statement, and the expenditure data portion of the Federal Financial Report are required for closeout of an award, as described in the *NIH Grants Policy Statement*.

The Federal Funding Accountability and Transparency Act of 2006 (Transparency Act), includes a requirement for awardees of Federal grants to report information about first-tier subawards and executive compensation under Federal assistance awards issued in FY2011 or later. All awardees of applicable NIH grants and cooperative agreements are required to report to the Federal Subaward Reporting System (FSRS) available at <http://www.fsrs.gov> on all subawards over \$25,000. See the NIH Grants Policy Statement for additional information on this reporting requirement.

VIII. AGENCY CONTACTS

Please note that the program contact information is current at the time of publishing. See program website for any updates to the points of contact.

General inquiries regarding this program should be made to:

- Zhilan J. Feng, Program Director, MPS/DMS, telephone: (703) 292-7523, email: zfeng@nsf.gov
- Joseph M. Whitmeyer, Program Director, SBE/SES, telephone: (703) 292-7808, email: jwhitmey@nsf.gov
- Katharina Dittmar, Program Director, BIO/DEB, telephone: (703) 292-7799, email: kdittmar@nsf.gov
- Susan Wright, Program Director, NIH/NIDA, telephone: (301) 443-1124, email: susan.wright@nih.gov
- Amina Eladdadi, Program Director, MPS/DMS, telephone: (703) 292-8128, email: aeladdad@nsf.gov

Trisha Van Zandt, Program Director, SBE/BCS, telephone: (703) 292-8740, email: pvanzand@nsf.gov

For questions related to the use of NSF systems contact:

- NSF Help Desk: 1-800-673-6188
- Research.gov Help Desk e-mail: rgov@nsf.gov

For questions relating to Grants.gov contact:

- Grants.gov Contact Center: If the Authorized Organizational Representatives (AOR) has not received a confirmation message from Grants.gov within 48 hours of submission of application, please contact via telephone: 1-800-518-4726; e-mail: support@grants.gov.

IX. OTHER INFORMATION

The NSF website provides the most comprehensive source of information on NSF Directorates (including contact information), programs and funding opportunities. Use of this website by potential proposers is strongly encouraged. In addition, "NSF Update" is an information-delivery system designed to keep potential proposers and other interested parties apprised of new NSF funding opportunities and publications, important changes in proposal and award policies and procedures, and upcoming NSF [Grants Conferences](#). Subscribers are informed through e-mail or the user's Web browser each time new publications are issued that match their identified interests. "NSF Update" also is available on [NSF's website](#).

Grants.gov provides an additional electronic capability to search for Federal government-wide grant opportunities. NSF funding opportunities may be accessed via this mechanism. Further information on Grants.gov may be obtained at <https://www.grants.gov>.

ABOUT THE NATIONAL SCIENCE FOUNDATION

The National Science Foundation (NSF) is an independent Federal agency created by the National Science Foundation Act of 1950, as amended (42 USC 1861-75). The Act states the purpose of the NSF is "to promote the progress of science; [and] to advance the national health, prosperity, and welfare by supporting research and education in all fields of science and engineering."

NSF funds research and education in most fields of science and engineering. It does this through grants and cooperative agreements to more than 2,000 colleges, universities, K-12 school systems, businesses, informal science organizations and other research organizations throughout the US. The Foundation accounts for about one-fourth of Federal support to academic institutions for basic research.

NSF receives approximately 55,000 proposals each year for research, education and training projects, of which approximately 11,000 are funded. In addition, the Foundation receives several thousand applications for graduate and postdoctoral fellowships. The agency operates no laboratories itself but does support National Research Centers, user facilities, certain oceanographic vessels and Arctic and Antarctic research stations. The Foundation also supports cooperative research between universities and industry, US participation in international scientific and engineering efforts, and educational activities at every academic level.

Facilitation Awards for Scientists and Engineers with Disabilities (FASSED) provide funding for special assistance or equipment to enable persons with disabilities to work on NSF-supported projects. See the *NSF Proposal & Award Policies & Procedures Guide* Chapter II.F.7 for instructions regarding preparation of these types of proposals.

The National Science Foundation has Telephonic Device for the Deaf (TDD) and Federal Information Relay Service (FIRS) capabilities that enable individuals with hearing impairments to communicate with the Foundation about NSF programs, employment or general information. TDD may be accessed at (703) 292-5090 and (800) 281-8749, FIRS at (800) 877-8339.

The National Science Foundation Information Center may be reached at (703) 292-5111.

The National Science Foundation promotes and advances scientific progress in the United States by competitively awarding grants and cooperative agreements for research and education in the sciences, mathematics, and engineering.

To get the latest information about program deadlines, to download copies of NSF publications, and to access abstracts of awards, visit the NSF Website at <https://www.nsf.gov>

- **Location:** 2415 Eisenhower Avenue, Alexandria, VA 22314
- **For General Information** (NSF Information Center): (703) 292-5111
- **TDD (for the hearing-impaired):** (703) 292-5090
- **To Order Publications or Forms:**
 - Send an e-mail to: nsfpubs@nsf.gov
 - or telephone: (703) 292-8134
- **To Locate NSF Employees:** (703) 292-5111

PRIVACY ACT AND PUBLIC BURDEN STATEMENTS

The information requested on proposal forms and project reports is solicited under the authority of the National Science Foundation Act of 1950, as amended. The information on proposal forms will be used in connection with the selection of qualified proposals; and project reports submitted by awardees will be used for program evaluation and reporting within the Executive Branch and to Congress. The information requested may be disclosed to qualified reviewers and staff assistants as part of the proposal review process; to proposer institutions/grantees to provide or obtain data regarding the proposal review process, award decisions, or the administration of awards; to government contractors, experts, volunteers and researchers and educators as necessary to complete assigned work; to other government agencies or other entities needing information regarding applicants or nominees as part of a joint application review process, or in order to coordinate programs or policy; and to another Federal agency, court, or party in a court or Federal administrative proceeding if the government is a party. Information about Principal Investigators may be added to the Reviewer file and used to select potential candidates to serve as peer reviewers or advisory committee members. See [System of Record Notices](#), NSF-50, "Principal Investigator/Proposal File and Associated Records," and NSF-51, "Reviewer/Proposal File and Associated Records." Submission of the information is voluntary. Failure to provide full and complete information, however, may reduce the possibility of receiving an award.

An agency may not conduct or sponsor, and a person is not required to respond to, an information collection unless it displays a valid Office of Management and Budget (OMB) control number. The OMB control number for this collection is 3145-0058. Public reporting burden for this collection of information is estimated to average 120 hours per response, including the time for reviewing instructions. Send comments regarding the burden estimate and any other aspect of this collection of information, including suggestions for reducing this burden, to:

Suzanne H. Plimpton
Reports Clearance Officer
Policy Office, Division of Institution and Award Support
Office of Budget, Finance, and Award Management
National Science Foundation
Alexandria, VA 22314

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