

Subj: Invitation to join the IMAG/MSM **MULTISCALE MODELING AND VIRAL PANDEMICS** Working Group

Dear Colleague

We would like to invite you to join a new Interagency Modeling and Analysis Group (IMAG) – Multi-scale Modeling Consortium (MSM) Working Group (WG) entitled **MULTISCALE MODELING AND VIRAL PANDEMICS**.

The ongoing COVID-19 pandemic has provided a striking example of the real-world importance of mathematical and computational modeling. Epidemiological simulations have become key technologies for optimizing responses by clinicians and policy makers around the world. Because epidemiological models had already been developed and validated for other infectious, these models were available for rapid repurposing when the COVID-19 crisis started. As a result, sophisticated epidemiological models of COVID-19 are informing healthcare professionals and public leaders as they develop medical and political responses.

Unlike the epidemiology models, we currently lack reusable multiscale, mechanism-based tools for the modeling of viral infections. With partial exceptions for influenza and HIV/AIDS, few computational models attempt to collectively understand the key drivers of infection. Even the most sophisticated models do not usually include the details of immune response and inter-organ interactions that seem critical to COVID-19. Therefore, there is a need to develop reusable models that can be used in both current and future viral epidemics. In addition, there is an emerging opportunity to develop personalized models, or “digital twins,” of individual patients (as discussed in general terms at the last IMAG/MSMS meeting). The COVID-19 pandemic has highlighted the critical importance of patient specific data such as lung CT scans, immune profiles from repeated blood draws, comorbidities and other information from patient health records. The personalization of models is key to addressing the unpredictability of patient response in COVID-19 cases.

These and other challenges make clear that the determination of an effective response to viral pandemics is a multiscale many-faceted problem whose solution has to rely on multiscale mathematical and computational models. The IMAG/MSM community is ideally positioned to lead an initiative to develop and help execute a strategy for developing and applying this technology.

Focus and structure of the working group: The community of modelers developing epidemiological and population-scale models is already extensive and well-integrated, in part due to the **NIGMS MIDAS** program. Within-host modeling of viral pathogens is much more limited. Therefore, the working group will initially focus on within-host scales, in particular the complex interactions between viral infection, host physiology, and the immune system. A long-term deliverable of the working group will be an overall strategy for a coordinated multi-scale modeling effort which becomes a customizable translational technological platform for rapidly creating improved personalized prognoses and therapies in response to emerging viral pandemics.

The working group will be organized as follows:

A steering group: consisting of approximately 20 scientists, including modelers, data scientists, experimental and clinical domain experts, such as immunologists and virologists and representatives of affected communities and potential tool users, with special emphasis on the effects of the disease on disproportionately affected populations.

A collection of **subgroups**, broadly covering the following topics (this list is preliminary; we welcome any suggestions for additional topics):

- Innate immune response
- Adaptive immune response
- Host-pathogen interactions
- Drug development
- Vaccine development
- Individual organ systems, in particular the lungs, given the importance of respiratory viral infections
- Vascular response and pathology
- Comorbidities
- Transport models in the lungs, lymph and blood
- Integration of scales
- Personalization of models, data requirements
- Integration of the within-host and population scales
- Modeling technologies, requirements for model credibility, reproducibility, model integration challenges
- Optimization of model design and delivery for target users, including policy makers and clinicians
- Training and outreach for both scientific and general communities

The steering group and subgroups will contain scientists from academia, the private sector, and government, also relying heavily on the members of the other IMAG working groups. Membership in the working group is open to all scientists. In addition, the co-leads will proactively invite scientists to join the steering group.

If you are interested in participating in the IMAG/MSM WG please fill out the form at:

<https://forms.gle/1ZnbpKSAaGHbLmUUA>

If you would like more information please visit the IMAG/MSM Multiscale Modeling and Viral Pandemics WG page at:

<https://www.imagwiki.nibib.nih.gov/working-groups/multiscale-modeling-and-viral-pandemics>

If you have questions or suggestions, please feel free to contact any of the WG organizers listed below.

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