

## Working Group 1 White Paper: Key factors Entering Epidemiological Modeling

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The team summarized its goals for the white paper as: Taking stock of epi models and their purpose - guidelines for good practice; developing principles of good epidemiological modeling practice; defining the landscape for best practices in epidemiology modeling; advocating for client-oriented approaches; and developing a practical landscape for best modeling practice in epidemiology.

### Motivations and their Relation to Modeling

Models should be considered in regard to the motivation they address, including appropriate and excluding unnecessary parameters, state variables, and structural assumptions. Thus, some would argue, the motivation for the model should determine the structure of the model. The motivation in creating a model should also consider the social value provided by addressing the underlying dilemma the model should be cognizant of and the social value it generates by addressing the underlying motivation.

Why is this important? The intended users and audience are also of critical importance when designing the model, analysis, and in interpreting and communicating the results.

However, there are many other motivations for epidemiological modeling. A partial list is the following:

- Prevent an Outbreak
- Limit Spread during the first stages of an outbreak
- Practice
  - Resource allocation for effective mitigation/control
  - Resource allocation for effective prevention
  - Resource allocation for effective surveillance
- Theory
  - Understanding/Predicting impact of individual inputs on effective mitigation
  - Understanding/Predicting impact of individual inputs on effective prevention
  - Understanding/Predicting impact of individual inputs on effective surveillance
- Identify relevant dynamics for disease outbreaks and new dynamics for already

- circulating disease
- Understand Evolutionary Pressures on disease systems
  - Predict Evolutionary Changes in disease dynamic systems
  - Identify 'At Risk' Groups
  - Make recommendations to clinicians for balancing individual care vs public health outcomes
  - Inform an audience to promote adoption/adherence to policy recommendations

### Approaches and Issues in Epi Modeling

Among the approaches well-suited to the criteria involving motivation and social value, modelers have to consider how different approaches further refine the motivation/social value/utility to different stakeholders. Among the issues to consider are: scale/aggregation/disaggregation of individuals; statistical issues; dynamical issues; process complexity; data complexity. Issues modelers need to consider are identifying the main variables and parameters, data fitting, appropriate complexity, inference robustness, where the underlying information is coming from, data collection, and the tradeoff between data collection and motivation for doing models.

To enable good discussion of their model, modelers should engage with a team of multidisciplinary experts and practitioners relevant to the problem.

Modelers and decision makers should be aware of what models can/cannot do. They can be used for quantitative reasoning for decision support and comprehension. However, they may not necessarily be moved to another context (may not be portable). Models provide quantitative and conceptual support for qualitative thinking. They are not intrinsically valuable but provide value in their ability to generate insight and aid decision support.

There are international/cultural issues facing modelers. In addition, basic science in modeling should presume that there will be (attempted) translation to practical use and so should prepare for it. However, all have to recognize a realistic timeline to translation.

### Data

Data collection is a key component of epi modeling. One has to identify data gaps, determine the available data, and design data collection methods keeping in mind the motivation and the approach.

The scale of data should match the expected interpretation of the outcomes; similarly, proposed data collection should be identified with respect to the timescale in which the question must be answered, ideally with modelers contributing to the design of data collection early in surveillance system design. Modelers should be in the room when the decisions are made about what data should be collected.