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Title: Analysis of Subject Matter Expert (SME) Feedback on the First Version of the Biosurveillance Analytics Resource directory (BaRD)

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Intended for: Report to sponsors and subject matter experts who participated in the BaRD review
Report

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Analysis of Subject Matter Expert (SME) Feedback on the First Version of the Biosurveillance Analytics Resource directory (BaRD)

Report to DTRA-JSTO-CBD

Los Alamos National Laboratory (LANL)

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1.0 Introduction

As part of a recently funded project, LANL was tasked with the development of the BaRD, a reference tool in support of the Biosurveillance Ecosystem (BSVE) that will serve to enhance situational awareness during an infectious disease outbreak and provide timely and relevant information to support effective decision making to prevent, stop or control an outbreak or epidemic. The BaRD is being designed to enable rapid selection of appropriate models for use in disease prediction, monitoring, or forecasting at various population levels. It is a searchable, relational database that catalogs and classifies model specific information to allow facile reporting on tools of interest. The prototype tool is currently being developed for 5 infectious diseases (Influenza, Malaria, Dengue, Cholera, and Foot and Mouth Disease). The development process of the BaRD involves three steps;

a) Create a model characterization framework that can be used to specifically categorize models. The framework would characterize a model's underlying structure and function as well as its potential utility for biosurveillance operations
b) Identify and catalog models into the database according to the characterization framework
c) Develop a web-hosted search/selection tool

LANL developed a detailed model characterization framework and used it to build the data entry version of the BaRD in Filemaker Pro. A limited number of models for each of the 5 diseases listed above have been entered into this version of the BaRD to assess the utility of this characterization framework. However, prior to completing entry of all models into the database, it was deemed to be prudent to vet both the framework as well as the BaRD with a panel of Subject Matter Experts (SMEs) to ensure that both the manner in which model information was being characterized as well as the types of models being included in the data base, were accurate.

To that end, LANL assembled an SME panel that spanned model developers, decision makers, and analysts and demonstrated the characterization framework and the data entry version of the tool in order to obtain feedback. This report describes the SME vetting process, an analysis of the feedback received and next steps in the path to development of the search and find version of the BaRD.

2.0 SME panel development and BaRD demonstration

The entire process of SME panel vetting, from the first invitation to join the panel to performing an analysis of the SME feedback took approximately 4 months and included the following steps;
1) Determination of list of invitees for the SME panel
2) Sending the invitations
3) Receiving affirmative responses and scheduling BaRD demonstrations
4) Obtaining oral feedback from the SMEs on the day of the BaRD demonstrations, which included an overview presentation and a demonstration of the first version of the BaRD.
5) Obtaining written feedback from the SMEs after providing a written questionnaire, a glossary of terms used in the BaRD and the preliminary characterization framework.
A list of names and entities that would be qualified to serve on the SME panel was prepared following consultation with the sponsors and the DOD disease forecasting working group, a review of literature pertaining to models for the 5 infectious diseases to be included in the prototype version, and a review of the SME panel that had been developed for the data streams evaluation project. A total of 82 people were sent invitations to be on the SME panel. Following the scheduling of three demonstration sessions, a total of 29 people attended and of those, 17 provided written feedback. Table 1 lists the agencies represented and identifies the

final participants in the BaRD demonstrations. The final panel included model developers, analysts, decision makers and professionals performing operational biosurveillance.

Table 1 - Final list of participants in the BaRD demonstrations

Name	Affiliation	Demo Date	Written Survey Response
Latham, Mike	CDC	8/22/13	
Meltzer, Martin	CDC	9/10/13	
Quitugua, Teresa	DHS	8/28/13	
Freeze, Mark	DHS/NBIC	8/28/13	
Sparks, Morgan	DTRA	8/22/13	
Brown, Julia	DTRA	9/10/13	Yes
Beckham, Tammy	FAZD	9/10/13	
Kaufman, James	IBM	9/10/13	Yes
Althouse, Ben	JHU, Bloomberg School of Public Health	9/10/13	Yes
Burkom, Howard	JHU/APL	8/22/13	Yes
Loschen, Wayne	JHU/APL	8/22/13	
Buczak, Anna	JHU/APL	9/10/13	
Del Valle, Sara	LANL	9/10/13	Yes
Kiang, Richard	NASA	8/22/13	Yes
Vespignani, Allesandro	Northeastern University	8/22/13	
Scott, Aaron	NSU USDA	9/10/13	Yes
Pullum, Laura	ORNL	8/28/13	Yes
Ramanathan, Avind	ORNL	8/28/13	Yes
Corley, Courtney	PNNL	9/10/13	
Pancerella, Carmen	Sandia National Lab	9/10/13	Yes
Hyman, Mac	Tulane University	8/28/13	
Perez, Andres	UC Davis	8/28/13	Yes
Peterson, Townsend	University of Kansas, Lawrence	8/22/13	Yes
Morse, Andy	University of Liverpool	8/22/13	Yes
Colwell, Rita	University of Maryland	9/18/13	
Marathe, Madhav	Virginia Tech, VBI	8/22/13	Yes (group response)
Eubank, Stephen	Virginia Tech, VBI	8/28/13	Yes (group response)
Lewis, Bryan	Virginia Tech, VBI	8/28/13	Yes (group response)
Schlegelmilch, Jeffrey	Yale New Haven Health	8/28/13	Yes

Total attended demonstrations: 29 SMEs **8/22/13 demo:** 9 **8/28/13 demo:** 9 **9/10/13 demo:** 10 **9/18/13 demo:** 1 **Affiliation Representation:** **Academic (10):** JHU Bloomberg School of Public Health, JHU/APL, University of Kansas Lawrence, Northeastern University, Tulane, UC Davis, University of Liverpool, University of Maryland, Virginia Tech VBI, Yale **Commercial (1):** IBM **Government Agency (7):** CDC, DHS, DHS/NBIC, DTRA, DHS-FAZD, NASA, NSU USDA **National Laboratory (4):** Los Alamos, Sandia, Oakridge, Pacific Northwest
Total questionnaire response: 15 (17 SMEs) **Affiliation Representation:** **Academic (6):** JHU/Bloomberg School of Public Health, JHU/APL, University of Kansas Lawrence, UC Davis, University of Liverpool, Virginia Tech, Yale **Commercial (1):** IBM **Government Agency (3):** DTRA, NASA, NSU USDA **National Laboratory (3):** Los Alamos, Sandia, Oakridge

3.0 Analysis of oral SME feedback

During each of the three BaRD demonstration sessions, the LANL team captured participant feedback in written notes and recorded chat logs from the web based teleconference (Go To Meeting). Overall, SME feedback was very positive and the tool was deemed to be useful not only for members of the biosurveillance community who would like to use operational epidemiological models, but also to model developers for describing their models and including them in the tool. The manner in which a model was classified and its operational features described was also acceptable, with a few suggestions for adding on or calling out some details that may have been hidden under other categories. Some general themes were common through all sessions and there was no disagreement with the objective of the tool or the development process. Specific, but commonly occurring comments made during the demonstrations could be divided into two main categories: comments related to the model characterization framework, and comments related to the BaRD. These are listed below;

3.1 Characterization framework

1. Outputs of models need to be called out under their own category rather than being included under operational features.
2. Model classification should call out stochastic or deterministic terminology to describe models.

3. Model classification should also include “within host or across host” description of the model.
4. There should be a “caveats” section in the framework that allows a model developer to identify specific use cases for the model and assumptions that are specific to the model
5. Under model utility descriptions, it may be useful to include a “model readiness level” category
6. Platforms and models developed for a specific disease or purpose need to be clearly differentiated in the framework.

3.2 BaRD

1. There should be a summary page/schematic for each model in the BaRD that describes in simple, non-jargon terms what the model does and what its limitations are.
2. Include a glossary of terms in the BaRD.
3. Special attention should be paid to describing the verification and validation of a model with defined criteria for levels of V&V.
3. There needs to be defined criteria for model inclusion into the BaRD. Too many models that are not very operational will not make this tool useful and will dilute the content.
4. Curation of the model information can be crowd sourced through a wiki type interface.
5. SMEs would like access to the prototype version for testing.
6. The scoring scheme for model documentation needs to be further clarified.
7. To make the BaRD a focused search engine, it may be necessary to define its scope more narrowly. There should be a statement in the tool that provides specific use cases.

4.0 Analysis of written SME feedback

The purpose of the questionnaire (Appendix A) requested of the SMEs was three-fold: 1) to gather feedback regarding the appropriateness of the model characterization framework and the implementation of the framework in the BaRD data entry tool; 2) to elicit SME opinion regarding the features and functionality that would be most useful in the (future) BaRD search and selection tool; and 3) to elicit SME opinion regarding specific models for inclusion in the BaRD. The paragraphs below describe both general and specific comments for each of these goals

4.1 Model characterization framework: Overall approach

14 of 15 responders agreed with the overall approach to the characterization framework. The one dissenting opinion believed that the framework was too general and that "the system (BaRD) will not discriminate sufficiently among good and bad models".

While the 14 other responders agreed with the overall approach, there were specific suggestions for refinement:

- Explicitly define 'Model' and differentiate between 'Model' and 'Model Platform (multiple SMEs)
- Create a 'Model Output' section, rather than having model outputs be a component of 'Model Utility' (multiple SMEs)
- Keep the framework to a one-page handout, and possibly combine sections (one SME)
- Explain how the framework would be used/changed based on the potential end-user (analyst, decision maker, researcher)
- Provide the scope of the framework

4.2 Model characterization framework: Individual sections

14 of 15 responders agreed with the section headings, but had suggestions on how to improve and refine the sections. *The SME that disagreed with the overall approach did not provide any specifics regarding the Framework Sections, and is not represented in the analysis below.*

4.2.1. Model purpose:

11/14 responders agreed with the stated model purpose as written

Suggestions:

- add 'consequence assessment'
- add 'what-if scenarios' and models as data-sources for other models
- expand to include planning (e.g., allocation of resources, effect of interventions etc.) and response

4.2.2. Model question

All responders agreed with the Model Question/Objective

Suggestions:

- expand / elaborate
- focus on outcomes
- provide a specific or categorical list of questions

4.2.3. BSV goals

9/14 responders agreed with the stated goals, the other 5 would generally expand or refine goal definitions

Suggestions:

- make the goals more precise - this comment was in regard to the feasibility of actually attaining early detection of a health threat; in practice the health event is not detected early, rather a signal of the health event is detected early.

- possibly combine Model Question with BSV Goal
- One responder wanted to use a narrower definition of biosurveillance (as syndromic surveillance) and argued that after early detection Situational Awareness and Consequence Management are not biosurveillance but public health surveillance
- add 'what if' goal
- expand baseline awareness to include planning or exercise development

4.2.4. Model classification

All responders agreed with the model classification section, although several had suggestions regarding how to refine and/or expand this section, or had questions as to how specific kinds of models would be classified (such as models that assessed pandemic potential or data assimilation). One SME regarded the Model Classification as good information but not a big factor for choosing a model by a decision maker.

Suggestions:

- add economic models
- add hybrid models - or show how hybrid models would be classified
- distinguish between models of disease transmission within a host and then between hosts
- Show how other models would be characterized, for instance if one uses agent based models, other models used include models defining agents, models synthesizing the interaction structure, models for policy and behavior, and models for interventions, etc.

4.2.5. Model Tools

Most responders agreed with this framework section, but needed clarification. It was recognized that this section could become too detailed and be a 'never-ending' list.

Suggestions:

- distinguish between model and platform tools
- add mathematical tools that estimate R_0, and include more machine learning methods
- show clear distinction between model representations (classification section) and model solutions (tools section)

4.2.6. Model Inputs

All responders agreed that this framework section was necessary. Several wanted to know where specific inputs would be captured - some of the suggestions overlapped with the Model Utility framework section.

Suggestions:

- include data format of inputs
- differentiate for platforms and models
- include data access issues
- include digital data, data that include behaviors, data related to logistics, supply chain, and policy

4.2.7. Model utility

This section received the most attention, especially regarding issues of how to distinguish models of the same general type.

Suggestions:

- expand
- use TRL definitions but change to Model Readiness Level
- simplify, be more focused
- clearly define 'verify and validate'; possibly change 'validated' to 'tested'
- remove 'model outputs' and make 'model outputs' its own framework section
- include how much testing has been done outside of the developer team and what performance measures were of those tests
- distinguish among the different kinds of documentation
- add model evaluation
- add model transparency
- add developer comments on use of model for decision support
- indicate how reliable the model is in particular situations
- include operational aspects such as the hardware platform, parallel or sequential execution, operating system requirements, software application needed to visualize results, type of interface the model runs on
- add integrability of model with other models - is the model 'modular'
- add maturity level, development stage, current funding status, known number of users, and if sensitivity analysis has been performed
- indicate standard of validation
- indicate model's 'extensibility'

4.3 BaRD tool: This section of the questionnaire focused on the BaRD data entry tool that was shown at each demonstration session. SMEs were asked how well the BaRD tool captured model attributes based on the Model Characterization Framework, and what features would be important for incorporating into the future development of the BaRD search and selection tool.

4.3.1. BaRD data entry tool

11 responders thought that the current BaRD data entry tool captured model information very well. Two SMEs wanted to have more time with the tool in order to assess. The SME that did

not agree with the overall approach to the characterization framework did not provide specific comments about the BaRD.

Several SMEs thought model entry would be enhanced if model developers/owners could directly enter information, possibly in a wiki format.

Suggestions:

- Adding new model description should be easier. Please look at BRC centers funded by NIH.

4.3.2. BaRD search and selection tool: What type of functionality would be most useful?

Suggestions:

- search by type of decision that needs to be made
- keyword search
- have drill-down functionality
- search by platform
- search by model availability
- search by relevant disease
- search by pathogen
- search by classification
- search by what data the user has and find models that could be implemented
- search by the years of data that model runs have been done
- search by a list of driving data sets for the model
- search by availability of input data sets
- search by desired outputs
- search by model maturity, availability
- search by developer organization
- search by how recent the model is
- search by location of the source code, location of documentation, contact information
- search by geolocation (where model has been actually used)

4.3.3 BaRD search and selection tool: What features would be most useful?

Suggestions:

- Simplify the search language depending on end-user, possibly have different search interfaces depending on if the user is an analyst or a researcher
- Show which models are used for different diseases or outbreaks
- Have the ability for model developers to characterize own models

- Add a summary table and model reports
- Include references and links to documentation
- Indicate availability and process of obtaining data sets
- Address the robustness of a model - how the input uncertainty leads to output uncertainty
- View models side by side for comparison
- Make open source
- Map where models have been used
- Be able to select down to a list of fundamental or canonical models for the disease of interest, with examples of papers employing the models and a list of go-to people who are willing to implement the models
- Be able to use the bard to find potential collaborators, location of models, scale of models, and the data sets driving the models
- Compare and contrast models based on different inputs
- Show how models compare by outputs
- Show what types of decisions a model can help answer (mitigation, treatment)
- make the catalog available for wiki interaction
- methods that allow data collection, access to data and access to models

4.3.4 BaRD: Usefulness to SME panel

14/15 of the responders stated that the BaRD, if realized as shown, would or could be useful in their work.

4.4 BaRD model inclusion:

12/15 SMEs provided names of models that they believed should be included in the BaRD.

4/15 SMEs characterized at least one model according to the Model Characterization Framework

5.0 Conclusions and path forward

Based on LANL analysis of both oral and written feedback from the SMEs it was concluded that while the overall characterization framework for models was acceptable, certain specific additions would refine it and capture the model information better. Common themes emerged in both the oral and written feedback. There was a consensus that once finalized, this framework could be published in a peer reviewed journal and offered as a foundation to describe models using a common syntax. LANL has refined the model characterization framework following this feedback. The BaRD tool was also approved with specific suggestions for its improvement that have been considered forthe next version of the tool. Finally, the search and find BaRD will be designed using the specific suggestions provided by the SMEs.

Rather than list the specific modifications that have been made to the model characterization framework and BaRD search and find tool, we have attached the following

revised documents and screen shots that show the specific modifications made based on SME feedback (Appendix B, C, D);
1) Appendix B: The revised model characterization framework titled “Model Handout 10-22-13”
2) Appendix C: The revised glossary of terms and definitions used in the characterization framework titled “Model Framework 10-22-13”
3) Appendix D: Screenshots of specific tabs in the BaRD search and find tool where changes have been made titled “BaRD_Screenshots 10-22-13”

Additionally, if SMEs would like to be included as co-authors on the publication that LANL intends to submit then we would like to request that all SMEs to please read through the revised documents and submit written feedback to LANL.

LANL is most grateful for the valuable feedback provided by all the SMEs and will make the prototype BaRD tool available for operational testing once ready.

Appendix A: SME questionnaire

Purpose of questionnaire:

- To obtain feedback on functionality of the BaRD tool and the accuracy of the framework for refinement and application to the BaRD characterization tool
- To elicit models that would be appropriate for the BaRD
- To elicit opinions on how to refine the scope of use for the BaRD

A] Please briefly describe your current role in the context of infectious disease modeling:

B] Framework and tool:

1) Do you agree with the overall approach to the characterization framework or would you modify the framework in some fundamental way? Please explain.

2) For each category defined in the framework (sent as read ahead material) please indicate

i) if all elements have been identified, or if new elements should be added

ii) if definitions are appropriate or should be changed

iii) other comments

Model Purpose:

Model Question:

BSV Goals:

Model Classification:

Model Tools:

Model Inputs:

Model Utility:

3) Based on the demonstration, how well do you think the BaRD captures the information in the characterization framework?

4) Features of the search and selection tool for the BaRD are still being considered.

a) What type of functionality would be most useful in the search tool?

b) What features would assist you in finding models that meet your needs?

5a) Would the BaRD search/selection tool (once developed) be useful in your work?

b) What features would you like to see in the search/selection version that would be useful for your work?

C] BaRD model inclusion:

1) Please let us know about any models you believe should be included in the BaRD and, if possible, specify features of the model in the context of the characterization framework (a template is attached).

Name of model	Website, reference paper and/or contact information

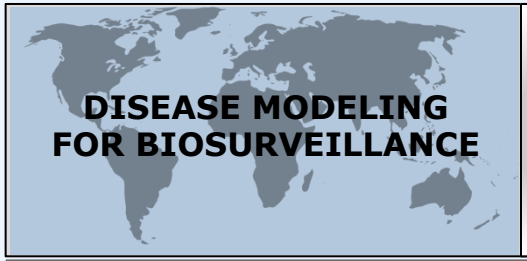
D] BaRD model characterization template: We are looking for high level characterization of the models (although specific detail is welcome)

1) Please fill out the table by referring to the BaRD model framework

Name of model Contact information, Reference paper and /or Website	
Purpose (monitoring, prediction, detection, forecasting)	
Model Objective	
Biosurveillance goal(s) (early warning, early detection, situational awareness, consequence management)	

Model Classification (Risk mapping, anomaly detection disease dynamics - use framework to further classify Disease dyanmics)	
Model Tools	
Model Inputs	
Model Utility (Operations, Flexibility, Reliability)	
How easy / appropriate was it to use this characterization framework for this model?	

E] Please feel free to share any additional thoughts, comments, ideas, or questions, including any comments regarding the pre-demo materials and the demonstration itself. We value your experience and knowledge in this area!



DISEASE MODELING FOR BIOSURVEILLANCE

Purpose

Monitoring	*Capability to assess the current disease situation*
Prediction	*The probability determination that a disease outbreak will occur at a given time or location*
Detection	*Capability to discern the occurrence of a disease outbreak*
Forecasting	*The probability determination of the extent, duration, and/or magnitude of a disease outbreak*
Assessment	*Evaluation or estimation of consequences, scenario appraisal*

Model Question / Objective

Scope

BSV Goals

Early Warning of Health Threats | **Early Detection of Health Events** | **Situational Awareness** | **Consequence Management**

Baseline Awareness → **Time**

Conceptual Model

Risk Mapping
Risk factor analysis displayed spatially or spatio-temporally

Anomaly Detection
Alerts over thresholds: Finding patterns in data that do not conform to expected behavior

Economic Models
Process of identifying or evaluating economic effects

Disease Dynamics
Progress and/or behavior of disease within a host or population

Disease Model (States/Compartments)

Analytical Equation-Based | **Simulation Agent/Individual-Based**

Network Structure

Model Tools : Computational, Machine learning, Regression, Statistical …

Tool Purpose: Model Fit, Model Validation, Parameter Estimation, Time series Analysis, Threshold Detection …

Model Inputs
Host Population, Disease, Vector/Reservoir
Environment (natural, social, built), Control Efforts

Model Outputs

Assumptions and Limitations of Conceptual Model

Model Utility

Data

Data sources required
Availability of data sets
Data is spatially referenced
Accuracy and completeness of data
Documentation

Verification Validation

Model verification
Model validated for purpose built
Sensitivity analysis of parameters
Uncertainty (input, output)
Comparison with other models
Comparison with real system
Model independently tested
Documentation

Operations

Model and developer team accessibility
Funding support
Model used for decision support
Extensibility, model adaptation time
Source code / software availability
Hardware platform, OS
Computational time
Cost to implement, documentation

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Model: Framework

Model Purpose, Q, Scope

Model Purpose

Monitoring

Capability to assess the current disease situation

Prediction

The probability determination that a disease outbreak will occur at a given time or location

Detection

Capability to discern the occurrence of a disease outbreak

Forecasting

The probability determination of the extent, duration, and/or magnitude of a disease outbreak

Assessment

Evaluation or estimation of consequences, scenario appraisal

Understood in the context of biosurveillance:

"The process of gathering, integrating, interpreting, and communication essential information related to all-hazards threats or disease activity affecting human, animal or plant health, to achieve early detection and warning, contribute to overall situational awareness of the health aspects of an incident and to enable better decision making at all levels" - National Strategy for Biosurveillance, 2012

Model Question

The specific objective for developing and implementing the model

Question Categories

- Study disease process
- Evaluate control strategy
- Assess economic impact
-

Starting list of categorical questions for the BaRD

Model Scope

Specificity and Granularity

Scope Categories

- Specific outbreak
- Specific disease and location
- Specific disease
- Specific location
- General framework / platform

A model that is highly specified for a particular population, time, or location may not be applicable to other populations, times or places - Garner 2011

The difference between a model and a model platform is in the degree of specificity and granularity - both are still 'models' and referred to as such in the literature

Model: Framework

BSV Goals

Biosurveillance Goals

Early warning of health threats

Surveillance that enables the identification of potential threats, including emerging and re-emerging diseases, that may be undefined or unexpected

Early detection of health events

Surveillance that enables identification of disease outbreaks (either natural or intentional in origin), or events that have occurred, before they become significant

Situational awareness

Surveillance that monitors the location, magnitude, and spread of an outbreak or event once it has occurred

Consequence Management

Surveillance that assesses impacts and informs response to an outbreak or event

t

Baseline Awareness

Information that can inform and facilitate the achievement of the above surveillance goals and can be related to population demographics, and health, the natural, social and built environment and underlying disease patterns and characteristics

BSV goals developed in data streams framework

Model: Framework

Conceptual Model

'Model Classification' changed to 'Conceptual Model' as used in Garner 2011 and Reeves 2011.

"a conceptual model is a verbal or graphical representation of the system under study. Ideally it should be formulated into a document which describes the chosen modeling methods, model assumptions and parameter estimates" - Garner 2011

By using the term Conceptual Model, the overall approach of the model can be described and separated from the details associated with the operational aspects of the model.

Risk Mapping

Risk factor analysis displayed spatially or spatio-temporally

Types

- Occurrence Mapping
- Ecological Niche Modeling
- Hotspots, spot maps
- Spatial Risk Mapping
- Spatial-Temporal Risk Mapping
- Neural Net
- Risk Factor Analysis

Anomaly Detection

Alerts over thresholds; finding patterns in data that do not conform to expected behaviour

Outbreak detection algorithms; threshold algorithms

Algorithms developed to detect changes from expected results, usually used on surveillance data, can be temporal, spatial, or space-time detection algorithms

Other Anomaly detection algorithms; threshold algorithms

Algorithms developed to detect changes in 'fringe' areas (i.e. transition areas between highly seasonal endemic areas and epidemic areas)

- Regression (GLM)
- Time Series (ARIMA)
- Smoothing
- Hidden Markov
- Wavelet
- EWMA (exponentially weighted moving average)
- MA (moving average)
- CUSUM (cumulative sum)
- MPM (moving percentile method)
- RLS (Recursive Least Squares)
- Coefficient of variation

Specific algorithms (may also be captured under tools)

The term 'fringe' is used to show transition areas from highly seasonal endemic areas to epidemic. Map 'fringes' and look for shifts in 'fringes'detect areas of high inter-annual variability of transmission (high variability of seasonally or annually averaged incidence) (Morse, SME response)

Model: Framework

Conceptual Model

Disease Dynamics

Progress and /or behavior of disease within a host or population

Disease Model

Epidemiological model describing disease spread /transmission, can be used for both host and vector populations

- States used in model (S,E,I,R, …)
- Heterogeneity
- Resolution
- Structure

Analytical, Equation-Based Model

Model built from mathematical equations (differential or difference) that consider disease dynamics at a population or compartmental level

Components

- Stochastic
- Deterministic
- Discrete Time
- Continuous Time
- Linear/nonlinear

Simulation / Agent-based

Model that can simulate disease dynamics down to an individual level

Names of specific Types

- Cellular automata
- Metapopulation

Network Structure

The structure used to define the relationships underlying the disease transmission model

Names of specific Types

- Contact tracing
- Household
- Small -world
- Lattice
- …

Economic Models

Process of identifying or evaluating the economic effects of an event, incident, or occurrence

Types

- Risk /benefit analysis
- Economic assessment
- Resource planning/budgeting

Possible broader term:

Consequence Assessment- Process of identifying or evaluating the potenial or actual effects of an event, incident, or occurrence. Term from DHS Risk Lexicon, 2008, also Forde-Folle 2011

Model: Framework

Model Tools

Model Tools	Type/Name
Computational	▪ Markov Chain Monte Carlo Techniques ▪ Monte Carlo ▪ GLM (Generalized Linear Model)
Machine Learning Rule-based algorithms	▪ Neural Networks ▪ MaxEnt (maximum entropy) ▪ more to add (sara del valle..)
Regression	▪ Linear ▪ Logistic ▪ Probit ▪ ARIMA, SARIMA ▪ Box-Jenkins
Statistical	▪ Bayesian ▪ Markov chain ▪ EWMA (exponentially weighted moving average) ▪ MA (moving average) ▪ CUSUM (cumulative sum) ▪ MPM (moving percentile method) ▪ RLS (Recursive Least Squares)
Tool Purpose	▪ Model Fit ▪ Model Validation ▪ Parameter Estimation ▪ Parameter Optimization ▪ Time Series Analysis ▪ Threshold Detection ▪ Movement between disease states

Model: Framework

Model Inputs

Category	Sub-Categories (not exhaustive)
Disease Data relevant to the natural history of the disease; epidemiological information	▪ Reproductive Number ▪ Latent, incubation and infectious periods
Host Population Data relevant to the infected population	▪ Demographics ▪ Density ▪ Mobility ▪ Behaviour ▪ Spatial Distribution ▪ Phenotype / Genotype ▪ Heterogeneity
Vector/Reservoir Data relevant to the vector or reservoir populations	▪ Densitites ▪ Biting Rates ▪ Mobility ▪ Behaviour
Environment Data relevant to the natural, built and social environment	▪ Climate ▪ Temperature ▪ Geography ▪ Land use ▪ Natural Disasters ▪ Population displacement ▪ Regulations ▪ Economics
Control Efforts Data relevant to mitigation, interventions and consequence management	▪ Vaccination ▪ Isolation ▪ Social distancing ▪ Culling ▪ Biosecurity Measures ▪ Pharmaceutical

also
Physical, economic, technological, management, socio-political, social behaviour

Model: Framework

Model Outputs, Assumptions, Limitations

Model Outputs

Identification and description of constraints, caveats and suppositions associated with the developed conceptual model

Output Categories (examples)

- Study disease process
- Evaluate control strategy
- Assess economic impact

Both categorical and detailed model outputs described

Assumptions and Limitations of Conceptual Model

Identification and description of constraints, caveats and suppositions associated with the developed conceptual model

Regarding

- Disease
- Location
- Model components
- Parameters
-

Assumptions and limitations clearly documented and available for review

Model: Framework

Model Utility

Model Utility	Indicator
Data	▪ Data sources required ▪ Availability of data sets ▪ Data is spatially referenced ▪ Accuracy and completeness of data ▪ Documentation
Verification and Validation Confidence in the model for accurate and credible outputs	▪ Model verification: conceptual model has been adequately translated into formula or computer code and performs as intended - no coding or logic errors. ▪ Model validated for purpose built ▪ Sensitivity analysis of parameters ▪ Uncertainty analysis (input, output) ▪ Comparison with other models ▪ Comparison of model with real system ▪ Model tested outside of developer team ▪ Documentation
Operations The ability to use the model in an operational setting	▪ Model and developer team Accessibility ▪ Funding Support ▪ Model used for decision support ▪ Extensibility ▪ Model adaptation time ▪ Source Code / Software availability ▪ Hardware platform, Operating System, coding language ▪ Software application needed to visualize results ▪ Computational time ▪ Cost to Implement ▪ Documentation

Model Utility

"The purpose of model evaluation is not to demonstrate that a model is a true or accurate representation of a system, but to subject it to sufficient scrutiny so that it may be used with an appropriate degree of confidence to aid decision-making" - Reeves 2011

Transparancy: assumptions clearly documented and available for review

Extensibility:
How could the model be extended to another disease or location, by 1) only changing parameter values, 2) changing the conceptual model, 3)modifying the code / mathematics 4) software uses hard-coded parameter values vs data files

Biosurveillance Analytics Resource Directory

Model

Overview | Disease | Location | Conceptual Model | Tools | Inputs / Outputs | Data | Utility | Docs | Notes | Framework

ID MOD0057

Disease

Name

Acronym

Creation Date

Overview

Purpose

Question Category

Model Question

Scope

Main Conceptual Model Type

Based on Model Resource

Primary Organization

Contacts

Select Contact

Go to Contact | New Contact

Sponsoring Agency(s)

Primary Developer

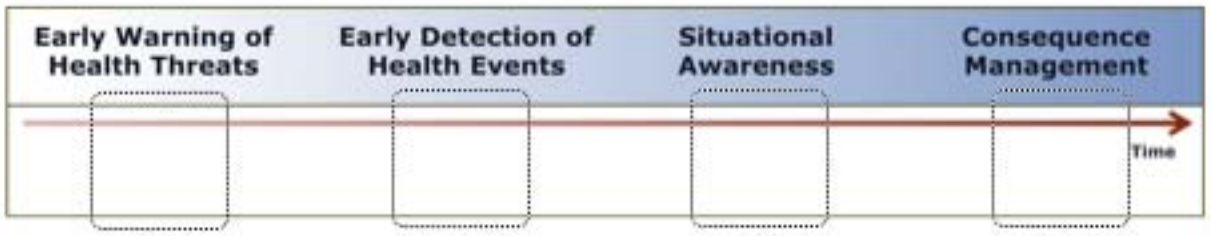
Select Agency

Role

Notes

Go to Agency | New Agency

Biosurveillance Goal



☐ Baseline Awareness

Model Utility

Readiness

Websites/URLs

Open in Browser

Open in Browser

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Home Page

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Biosurveillance Analytics Resource Directory

Model

Conceptual Model Classification: A BaRD model may include more than one than one model type.

Model Type

Model subtype

Notes

Disease Dynamics Compartments / States

Disease Dynamics Implementation

Disease Dynamics Primary Network (if used)

Disease Dynamics Other Network (if used)

Model Properties

New Property

Model Assumptions

Model Limitations

Biosurveillance Analytics Resource Directory

Model

Model Question: same field as on overveiw tab

Model Inputs: Category

Choose Input

Input Category

Model Inputs: Description

Model Outputs: Category

Choose Output

Output Category

Model Outputs: Description

Biosurveillance Analytics Resource Directory

Model

Data Sources are the actual data inputs used by the model (to get values for the parameters, for instance). Models can have multiple data sources - some may be readily accessible (like the US Census, and be in the BRD as a resource already. Others may only be a internal data generated by the research group . Please choose a data stream category for each data source. If there is a paper associated with the data source then include the paper in the Docs tab and for purpose select

Data sources used in model

Data Stream Category

Name / description

Notes

Website

Open URL

BRD Resources used in model

If you think a data source should be in the BRD but isn't. Then go back to the Home Page (button below), selcet Browse BRD and add a new record.

Select BRD Resource

Go To BRD Record

Website

Notes

Note: Go To BRD record opens a new window. Close this window when finished with the BRD record.

Data

Data Sources Required

Availabiltiy

Spatially referenced

Quality

Notes

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Model

Overall Model Utility Scale:

Score from 1-3 (one being least ready, 3 being most ready)

Model Documentation

1: Only described in peer-reviewed journal article
2: Has technical documentation
3: Has the equivalent of a 'user manual'

Model Association

1: Model only linked to a research group through documentation (such as research team from a university that has published an article describing results)
2: Model is linked to a website specific to the model
3: Model is currently in use and is being actively promoted for use by others

Model Distribution

1: Model code/software not accessible/ available
2: Model code/software is available for distribution for limited use
3: Model code/software is readily available either open-source, by subscription/registration, or by purchase

Readiness

Overview:

OPERATIONS

Model Accessibility

Developer Team Accessibility

Funding

Used in Decision Support

Extensibility

Source Code / Software Availability **URL**

Source Code Language Source Code URL

Hardware Platform

Computational Time

Adaptation Time

Cost

Notes: Operations

Verification Validation

Verification

Validation

Sensitivity Analysis of Parameters

Uncertainty Analysis

Comparison with other other models

Comparison with real system

Independently tested

Notes: Verification and Validation

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