Parameter Development

Introduction to Epidemiologic Simulation Modeling

August 6-10, 2007

Fort Collins, Colorado, USA

Outline

1. Description
2. Getting started
3. Basic characteristics of parameters
4. Sources of data for parameters
5. Assigning values to parameters
6. Concluding thoughts

Input Parameters

- Input parameters in *NAADSM* are values or ranges of values that characterize or describe biological events
- Six types of parameters are used throughout *NAADSM*:
  1. Yes/no values
  2. Integer values
  3. Floating point numbers
  4. Probabilities
  5. Probability density functions
  6. Relational functions

Where do you start?

- Define the problem
- Use your model to identify data needs
  - Research the topic
  - Identify the data you have
  - Identify gaps in knowledge
  - Collect data to fill in the blanks

Basic Considerations

- Parameters should make biological sense
- Parameters should represent real life
  - Real life is variable, subject to chance, and contains uncertainty
- Sensitivity analysis should be carried out to assess the influence of uncertain parameters on the model outcome

Sources of data

- Field data or ‘veterinary intelligence’
- Analysis of past outbreaks
- Subject matter experts
- Scientific literature

With respect to most diseases, all the data required for comprehensive models are not available

Field data or ‘veterinary intelligence’

Good data are available but epidemiolgical knowledge is lacking

		Quantity/quality of data	
		Poor	Good
Epidemiological knowledge	Poor	(a) Exploratory – hypothesis development	(c) Empirical/analytical – hypothesis testing
	Good	(b) Simplified representation of past events with data assumptions. Guarded predictive use (‘what if?’) BUT with uncertainty limits	(d) Good representation (‘simulation’) of past events. Can be used in a predictive manner (‘what if?’) IF the future is predictable

Source: Taylor N ls in informing disease control policy development a

Lack of data or unpredictable behavior

Good data and knowledge = High quality parameters and models

Analysis of past outbreaks

- Past outbreaks are a potential source of data
  - Identify important epidemiological determinants of that particular epidemic
    - Foot-and-mouth disease outbreak in the UK, 2001
    - Foot-and-mouth disease outbreak in the UK, 2007
    - Pseudorabies virus outbreak in Wisconsin, 2007
    - Highly pathogenic avian influenza outbreak in British Columbia, 2004

Subject matter experts

- Lack of data and/or knowledge about the population of interest
  - What is the probability of the animal straying?
    - The value of parameters have to be assigned when there is no objective evidence
      - Assign values based on best guess (assumption)
        - Minimum, maximum, most likely
      - Distribution reflects uncertainty, resulting from a lack of precise knowledge

‘Sometimes animals stray from one farm to another’

Scientific Literature

- Etiologic Agent
  - Survival of agent in different conditions
  - Infectious doses by different routes to different species
  - Incubation period
    - Parameter based on assumption that the incubation period in the modeled population will be the same as measured in different populations.
  - Exposure
    - Exposure to a source of infection may or may not result in a unit becoming infected.

Utilizing information to develop parameters

- Collate, analyze, and interpret all information
- Parameters must be given a quantitative value

Assigning values to model parameters

- Values assigned to model parameters are often uncertain due to lack of good quality data
- Parameters must be given as quantitative values
  - Some values are more easily knowable than others
    - Number of farms and animals in a given county
  - Other values are difficult to measure in real life
    - Who bumps into whom and how often?
- Simplifications and assumptions are made to over come this issue

Concluding thoughts

- The simplifications, assumptions, and limitations must be fully appreciated by all users
- The process of developing parameters can be viewed as an aid to understanding the systems being modeled
- Modeling is a mixture of science and art, but because modeling is a quantitative discipline it can appear entirely scientific and ‘real’.