A Functional Tool for the Prioritization of Zoonotic Diseases in Ontario

Emergency Management Research Expo
December 2, 2014

Victoria Ng, BSc (Hon.) PhD and Jan M. Sargeant, DVM, MSc, PhD
Centre for Public Health and Zoonoses and Department of Population Medicine, University of Guelph
Background

• Prioritization is necessary due to finite resources – But, no consensus on best method to prioritize diseases

• Previous work:
  • 21 criteria to prioritize zoonotic diseases were identified via focus groups
  • A range of levels for each criterion was identified by conducting a literature review of 62 zoonotic pathogens, 4 levels for each criteria were derived based on quartiles from the values for the 62 pathogens
  • The importance (weight or score) for each level within each criterion was determined using a conjoint analysis approach – completed by public, human and animal health professionals in Canada and the US (N=3000)
Disease criteria for prioritization

- high-risk groups: H / A
- control measures: H / A
- socio-economic burden: H / A
- disease trend: H / A

Severity: H / A
Duration: H / A
Case-fatality: H / A
Incidence: H / A


Scientific information
• Then use information on each disease and weightings for each level of each disease criteria to obtain a prioritized list of zoonotic diseases


• BUT ....
  – Some stakeholders commented that they wouldn’t want to use the same weightings (e.g., based on organization mandate) .... OR
  – Would want different disease options (sub-sets of the 62 diseases or addition of other diseases) .... OR
  – Wanted to better understand how the weighting on the disease criteria influenced the prioritization of the diseases
Multi-criteria Decision Analysis (MCDA)

- Aid to thinking and decision-making, does not make the decision
- Allows individuals to make choices in the presence of multiple competing criteria
- Decision-makers with specific objectives will have different preferences (e.g. managers, policy-makers, industry, medical and veterinary professionals)
- Does not require consensus on competing criteria, members make their own judgment contributing to a joint decision
Current study (OMAFRA Emergency Mngt): What the researchers did

• Created an Excel-based tool combining MCDA with Conjoint Analysis (CA): individuals indicated their strength of preferences for disease characteristics (MCDA), these weights were then combined with Ontario-specific CA-derived scores (extracted from national study).

• The tool can generate multiple outputs by presenting alternative lists of recommended diseases reflecting individuals’ preferences.

• The tool provides a shared platform for disease prioritization amongst different stakeholders as well as a general framework for disease prioritization.
Impact of the research

• Tool was presented to collaborators (including OMAFRA representatives) in May 2014 and to OMAFRA managers in July 2014 – well received with interest in using the Tool
• Formally registered as an invention at the U of G in July 2014
• Currently exploring opportunities to commercialize the Tool, options include:
  – License the Tool for further development to a private software company
  – License the Tool to insurance companies (identified as a potential interested stakeholder by the Catalyst Centre)
Acknowledgements

• Collaborators including OMAFRA, Public Health Ontario, Public Health Agency of Canada, Canadian Food Inspection Agency
Demonstration of the tool
### HUMAN-RELATED DISEASE CRITERIA

<table>
<thead>
<tr>
<th>Rank</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. SEVERITY OF THE ILLNESS IN HUMANS</td>
<td>1.00</td>
</tr>
<tr>
<td>2. DURATION OF ILLNESS IN HUMANS</td>
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</tr>
<tr>
<td>3. CASE-FATALITY IN HUMANS</td>
<td>1.00</td>
</tr>
<tr>
<td>4. INCIDENCE OF THE DISEASE IN THE ONTARIO POPULATION IN THE LAST FIVE YEARS</td>
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</tr>
<tr>
<td>5. HIGH-RISK GROUPS IN HUMANS</td>
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</tr>
<tr>
<td>6. EFFICACY OF CONTROL MEASURES IN HUMANS</td>
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</tr>
<tr>
<td>7. ECONOMIC BURDEN OF THE DISEASE IN HUMANS IN ONTARIO</td>
<td>1.00</td>
</tr>
<tr>
<td>8. DISEASE TREND IN THE ONTARIO POPULATION IN THE LAST FIVE YEARS</td>
<td>1.00</td>
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</table>

### ANIMAL-RELATED DISEASE CRITERIA

<table>
<thead>
<tr>
<th>Rank</th>
<th>Weight</th>
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</thead>
<tbody>
<tr>
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<td>11. CASE-FATALITY IN ANIMALS</td>
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<td>12. INCIDENCE OF THE DISEASE IN THE ONTARIO ANIMAL POPULATION IN THE LAST FIVE YEARS</td>
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</tbody>
</table>
**DISEASE PRIORITY LIST**

Diseases and scores are automatically generated on clicking the generate disease scores button from Step 5.

Diseases are presented in order from highest priority (highest overall score) to lowest priority (lowest overall score).

**STEP 4:** Select the diseases you would like to prioritize from the cells below (click on each cell individually to bring up the drop-down menu button on the right-hand side). A list of corresponding diseases will automatically populate once diseases are selected. Additional diseases (with additional data input) can be included in the 'Disease matrix for tool' tab.

Click the 'Clear disease list' button to clear the entire list.

**STEP 5:** Click the button below to generate scores for the diseases selected in Step 4. Scores are calculated from a combination of the weights assigned to each disease criterion (Step 2) and the baseline model selected (Step 3).

Click the clear button to clear scores before the next run. This will also clear the disease list and scores from the disease priority list (columns N and O).

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<table>
<thead>
<tr>
<th>DISEASE LIST</th>
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<th>SCORE</th>
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<td>Bovine diseases</td>
<td>Botulism</td>
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<td>Anaplasmosis/Canine granulocytic anaplasmosis</td>
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<td>Marburg haemorrhagic fever</td>
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<td>Powassan virus</td>
<td>Shigellosis</td>
<td>Marburg haemorrhagic fever</td>
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</tbody>
</table>
## Disease Priority List

Diseases and scores are automatically generated on clicking the generate disease scores button from Step 5. Diseases are presented in order from highest priority (highest overall score) to lowest priority (lowest overall score).

### Disease List

<table>
<thead>
<tr>
<th>Disease List</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>American trypanosomiasis (Chagas' disease)</td>
<td>502.89</td>
</tr>
<tr>
<td>Anaplasmosis/Canine granulocytic anaplasmosis</td>
<td>386.95</td>
</tr>
<tr>
<td>Anthrax</td>
<td>423.33</td>
</tr>
<tr>
<td>Babesiosis</td>
<td>389.05</td>
</tr>
<tr>
<td>Botulism</td>
<td>514.71</td>
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<tr>
<td>Bovine Tuberculosis</td>
<td>326.40</td>
</tr>
<tr>
<td>Brucellosis</td>
<td>432.19</td>
</tr>
<tr>
<td>Crimean-Congo hemorrhagic fever</td>
<td>498.16</td>
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<tr>
<td>Cysticercosis/Taeniasis</td>
<td>310.09</td>
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<tr>
<td>Eastern Equine encephalitis</td>
<td>462.48</td>
</tr>
<tr>
<td>Ebola virus hemorrhagic fever</td>
<td>654.09</td>
</tr>
<tr>
<td>Escherichia coli infection</td>
<td>484.07</td>
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<tr>
<td>Hantavirus pulmonary syndrome</td>
<td>457.74</td>
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<td>Hendra virus</td>
<td>551.92</td>
</tr>
<tr>
<td>Influenza (H5N1)</td>
<td>588.15</td>
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<tr>
<td>Japanese encephalitis</td>
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<tr>
<td>Listeriosis</td>
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<tr>
<td>Marburg hemorrhagic fever</td>
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<tr>
<td>Nipah virus encephalitis</td>
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<tr>
<td>Q fever</td>
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<tr>
<td>Rabies</td>
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<td>Rift Valley fever</td>
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<td>Trichinosis</td>
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<tr>
<td>Tularemia</td>
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</tr>
<tr>
<td>variant Creutzfeldt-Jakob disease (CJD)/BSE</td>
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<tr>
<td>Venezuelan Equine Encephalitis</td>
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<tr>
<td>West Nile virus</td>
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<tr>
<td>Western Equine encephalitis</td>
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### Score List

<table>
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If we reduce the weighting on human criteria and re-calculate....