Limitations of a qualitative risk assessment framework for MRSA colonisation in dogs

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INTRODUCTION

- Meticillin-resistant *Staphylococcus aureus* (MRSA) is a clinically important pathogen in humans and dogs (**Figure 1**).
- MRSA may also exist as a commensal organism. Dogs may be reservoirs of MRSA for humans, and the same strains are found in dogs and humans in close contact.
- However, the relationship between MRSA carriage in humans and dogs is poorly defined.
- A risk-based approach was proposed to assess the potential contribution of dogs to the occurrence of MRSA in humans and the contribution of humans to MRSA in dogs.
- **A qualitative assessment of the risk of MRSA acquisition in a dog was undertaken as the first step in this data-sparse area.**

Figure 1: MRSA infection in dogs

Table 1: Combination of occurrence probabilities of parameters (Moutou *et al.*, 2001)

Result of assessment of parameter 2	Result of assessment of parameter 1			
	Negligible	**Low**	**Moderate**	**High**
Negligible	Negligible	Low	Low	Moderate
Low	Low	Low	Moderate	Moderate
Moderate	Low	Moderate	Moderate	High
High	Moderate	Moderate	High	High

MATERIALS AND METHODS

- A conceptual model was developed (**Figure 2**) to describe the pathways by which a dog could be colonised with MRSA within a 24 hour period.
- A qualitative description of risk for the parameters within each step (1-7) for each pathway (A-D) was obtained from a review of the literature, using both published and unpublished data.
- Categorical risk estimates ranged from 'negligible' to 'high'.
- An overall risk estimate was obtained using stepwise matrix combinations (**Table 1**) of the parameters used to inform individual steps and associated transmission routes for each pathway.

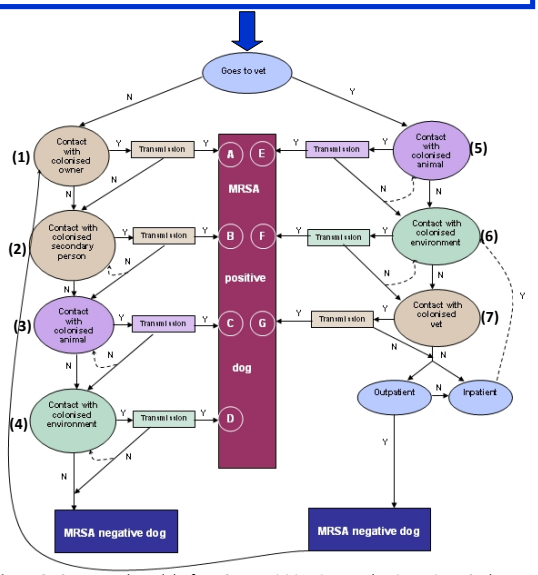

Figure 2: Conceptual model of MRSA acquisition in any dog in a given 24 hour period. Flow is not directional (i.e. steps (1)-(4) and (5)-(7) may not be sequential).

RESULTS

- In attempting to adopt this approach, many **limitations** were encountered.
- Some of these have been defined previously (Cox *et al.*, 2005);
  1. A direct qualitative rating system that satisfies monotonicity cannot represent the product risk function as required by this model (Figure 1).
  2. Loss of information occurs due to inconsistencies in categorical parameters with successive layers of qualitative coding.
  3. Inability to model dependencies results in loss of discriminative ability of the output.
- However, using a semi-quantitative approach, whereby upper and lower bounds for each parameter were estimated was also limited due to:
  1. Inability to account for variability and uncertainty.
  2. Inability to represent proportional spread between categories.
  3. Lack of discriminative ability and misleading classification of outcome measures that result from forcing qualitative measures into arbitrary quantitative bounds.
  4. Rapid divergence of upper and lower estimates after multiplicative combination to span the entire range of probability estimates.

CONCLUSIONS

- **Qualitative and semi-quantitative risk assessment approaches have limited applicability for this problem.**
- It is likely that the limitations are **generalisable** to other complex disease scenarios (in contrast to the more familiar uses of these techniques for import and food safety risk assessments).
- Non conformity to sequential step-wise progression through defined events or modules and numerous complex dependencies and permutations require consideration.
- The resulting inability to undertake model-driven data-sourcing, invitation of comment and assessment of the potential benefit of subsequent quantitative assessments is regrettable, particularly in data-sparse areas such as this.
- **A qualitative approach is not always the most appropriate first step to risk assessment.**

REFERENCES

Cox, L.A. Jr., Babayev, D. & Huber, W. (2005). Some Limitations of Qualitative Risk Rating Systems. *Risk Analysis*, 25(3), 651-662

Moutou, F., Dufour, B. & Ivanov, Y. (2001). A Qualitative Assessment of the Risk of Introducing Foot and Mouth Disease into Russia and Europe from Georgia, Armenia and Azerbaijan. *Rev. sci. tech. Off. Int. Epiz.*, 20(3), 723-730.