Network analysis of surveillance system evaluation attributes: a way towards improvement of the evaluation process



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Evaluation of epidemiological and economic effectiveness of surveillance systems

INTRODUCTION

Surveillance system processes are complex systems driven by epidemiological, economic, social (including political, cultural) and environmental factors. In the last fifteen years extensive work has been conducted to define relevant criteria to evaluate the effectiveness of those systems.

Work is currently ongoing within RISKSUR project to agree on relevant evaluation attributes and their definitions.

The evaluation of surveillance systems could require an assessment of a large number of attributes, and could therefore become a complex and expensive issue.

STUDY OBJECTIVES

- 1. to validate the list of evaluation attributes (n=35) (organization and definitions),
- 2. to appraise the interest of network analysis for the identification of key attributes to be included in the evaluation process

MATERIAL & METHODS

- Expert Opinion: a minimum of 3 experts were assigned to complete the linking matrices for 3 case studies and to comment on the attribute definition; their uncertainty in the links provided and the limits of the approach
- Linking matrices: blank matrices of 35 x 35 attributes were provided (Excel spreadsheets); the links were directed and qualified (negative, positive or unknown)

Case studies:

- Early detection of highly pathogenic avian influenza (HPAI) in UK
- Case detection (endemic situation) of salmonella in pigs in Sweden
- Case detection (endemic situation) of HPAI in Vietnam
- Network development and analysis: one mode directed networks were developed for each case study, centrality indices (indegree, outdegree and betweeness) and component analysis were performed to compare the position and role of the attributes between the networks
- Data analysis: All the analyses were performed using the software R and the package for social network analysis ("sna"), version 2.3-1.

Table 1. Lists of evaluation attributes considered in the study

Organizational (n=11)	Functional (n=8)	Effectiveness	Value
		(n=12)	(n=3)
Organization and	 Acceptability and 	•Coverage	•Cost
management	engagement	 Representativeness 	Technical
 Training provision 	Simplicity	 Multiple utility 	impact
 Performance indicators 	Flexibility	 False alarm rate 	Benefit
and evaluation	 Portability 	•Bias	
 Resource availability 	 Interoperability 	Precision	
 Data collection 	 Data correctness and 	Timeliness	
 Sampling strategy 	completeness	Sensitivity	
Data storage and	 Stability and 	•PPV	
management	sustainability	•NPV	
 Internal communication 	 Historical data 	 Repeatability 	
 External communication 		Robustness	
and dissemination			
 Laboratory testing and 		\wedge	
analysis		/ \	\
 Data analysis 			
 Quality assurance 			
Most CENTRAL			
Accentability and engagement and most			

functio Portability

Figure 1. Example of evaluation attribute network (case study on HPAI surveillance in UK)

Data completeness and correctness Stability and sustainability

Organization and management

Data storage and management

Acceptability and engagement

Attributes IMPACTING

most the

others

IMPACTED

attributes

Data completeness and correctness

Training provision

Resource availability

Sampling strategy

Data analysis

Coverage

Results 2/ NETWORK ANALYSIS Complex network

or risk-based sampling)

attributes of the system.

organisation

Figure 2. List of attributes with the highest centrality indices accross all networks; in terms of intermediate position (betweeness value), most impacted (number of incoming links measured by indegree value) and impacting most others (numbers of outgoing links measured by outdegree value)

Two principal components: one including effectiveness attributes and the other one

Network structure variations according to surveillance components (e.g. random

Importance of functional and organizational attributes on the effectiveness

Results 1/ ATTRIBUTE DEFINITIONS and CATEGORIES

- Definition were not clear for: benefit, technical impact (assessing the system's performance); flexibility, portability (assessing the system's function); internal communication, laboratory management (assessing the technical processes)
- "technical impact" and "benefit" attributes were considered different from the other attributes (refer to the use of results from the surveillance system or the evaluation of the
- "multiple utility". was found to be more closely linked to organizational than effectiveness attribute category.

Discussion 1/ LIMITS OF THE APPROACH

- Variability between experts for one case study
- Laborious (1225 cell matrix)
- Interpretation of the nature of the links for inclusion in the Evaluation process

Discussion 2/ CORRECTIVE ACTIONS for NEXT STEPS

including both functional and organizational attributes

Figure 2 present the attributes with the highest centrality values

- Revised definition and categorization of the attributes
- Matrices to be split between attribute categories and lonely links with effectiveness attributes (3 matrices of 144; 132 and 96 cells); value attributes will be considered separately
- Next steps:
- Validation of the different networks produced by the individual experts
- Development of "generic" networks (according to surveillance context and evaluation objectives)
- Expert workshop to validate the generic networks

CONCLUSION

This study has allowed to validate the evaluation attributes list and definitions;

and to confirm the interest of network analysis to capture the interactions between attributes according to the different context of surveillance.

The second phase of this expert opinion will allow the identification of the most important attributes (and their proxy) to be included in the evaluation process.

