A multicriteria decision analysis as an innovative approach to managing Lyme disease

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1. Introduction

- This presentation synthetizes the results from two projects financed by Public Health Canada, with a common core team:
  - Programme du projet pilote de système d'impact et de réaction aux maladies infectieuses (PPSIRMI); Projet: Information pour l'adaptation aux risques aux maladies vectorielles (10/02/2010 to 09/02/2012)
  - Preventative Public Health Systems and Adaptation to a Changing Climate Program; Project: Knowledge Transfer and Capacity Building in the Area of Decision Aid Tools to Manage Lyme Disease and Other Vector-Borne Diseases, in the Context of Adaptation to Climate Change (10/2014 to 31/03/2015)

Project 1: Information pour l'adaptation aux risques aux maladies vectorielles

Thanks to all stakeholders and experts
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Project 1 team

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Coordination
- Caroline Guénette

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RESEARCH ARTICLE

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Multi-criteria decision analysis as an innovative approach to managing zoonoses: results from a study on Lyme disease in Canada

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Abstract

Background: Zoonoses are a growing international threat interacting at the human-animal-environment interface and call for transdisciplinary and multi-sectoral approaches in order to achieve effective disease management. The recent emergence of Lyme disease in Quebec, Canada is a good example of a complex health issue for which the public health sector must find protective interventions. Traditional preventive and control interventions can have important environmental, social and economic impacts and as a result, decision-making requires a systems

Project 2: Multi-Criteria Decision Aid Tools in Public Health, workshops

- **Organized by** the Group for Research in Decision Analysis (GERAD), HEC Montréal, Polytechnique Montréal, McGill University, UQAM

- **In partnership with** the Université de Montréal's Veterinary Medicine Faculty

Project 2 team (1/2)

- Project leader
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  - Denise Bélanger, Professor with the Pathology and Microbiology Department at Université de Montréal

- Public health component
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  - Valerie Hongoh, Epidemiologist, PhD candidate: Consultant

Project Team (2/2)

- Multi-criteria decision aid component
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  - Bertrand Mareschal, Professor at the Solvay Brussels School of Economics and Management, Université Libre de Bruxelles, Belgium: Consultant
- Organizational and institutional analysis component
  - Camille Fertel, PhD Economics: Consultant
  - Johanne Léveillée, Faculty of Environmental Design: Consultant
- Project management
  - Rebecca Sueur, MA Public Administration: Consultant

2. DECISION-MAKING IN PUBLIC HEALTH: A NEED FOR PARTICIPATORY MULTI-CRITERIA DECISION ANALYSIS (MCDA)

Public Health: At the Interface of Science and Public Action

- Evidence based public health
  - Often quantitative appraisal

- However, there is recognition that there are other factors that influence decision-making

- ……………………………………………….Beyond evidence

Public Health and Multidisciplinarity

- Complex multidisciplinary process that includes several sectors of society

- In order to grasp a problem globally and coherently, it may be necessary to use various multidisciplinary approaches

The Last Few Decades in Public Health

- Approaches have been developed, including evidence-based public health (inspired from evidence-based medicine), burden of disease analysis, cost-effectiveness analysis, equity analysis, etc.

- However, these approaches are based on only ONE criteria

Multiple Criteria

- In simplifying complexity, we may lose important information

- Decision-makers must take into account multiple criteria simultaneously

- Multi-criteria approach for **prioritization** (preferences) is therefore very relevant, and even necessary

- Support for the decision: rational and transparent approach

Vector-Borne Diseases:
What makes the decision difficult relative to potential intervention for control, for example?

- Complexity – multidisciplinarity

- Uncertainty (ex: WNV)

- Importance of public perception (control interventions could be controversial, ref. WNV)

A lot of information (often with uncertainty) to manage in order to make a decision!
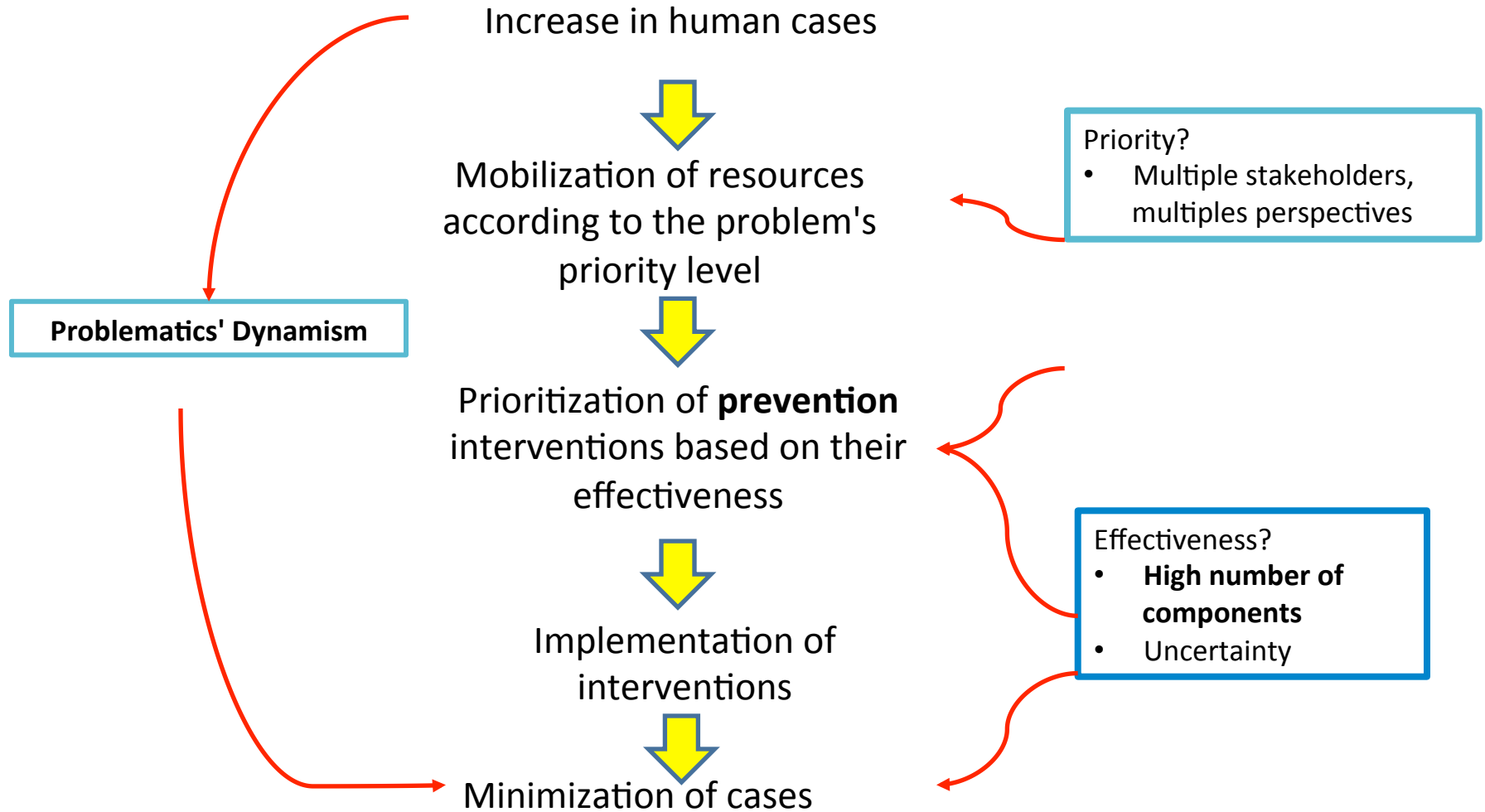
3. The Case of Lyme Disease

A complex ecology
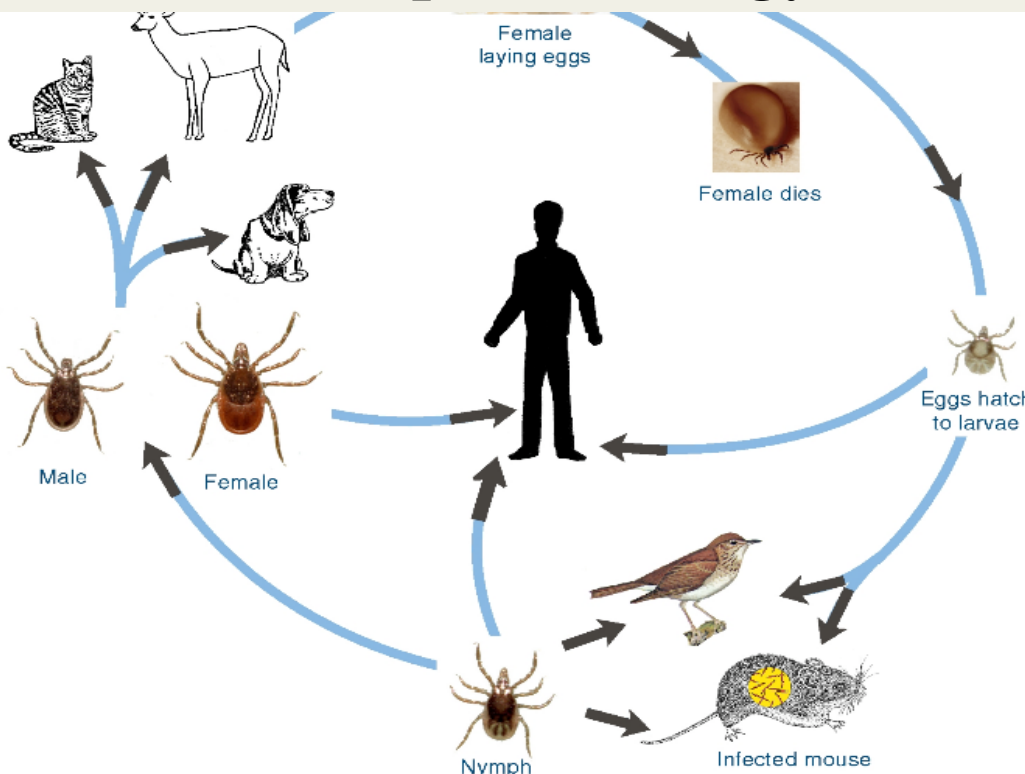
What are the best public health actions for Quebec?

**Environmental
Social
Economic**

Research objectives of the Pilot Project

1. To prioritize potential Lyme disease management actions using a multicriteria decision analysis (MCDA)

2. To evaluate the opportunities and challenges associated with the use of MCDA for public health planning

How Is the Prevention of Vector-Borne Diseases Complex?

Increase in human cases

Mobilization of resources according to the problem's priority level

Prioritization of **prevention** interventions based on their effectiveness

Implementation of interventions

Minimization of cases

Problematics' Dynamism

Priority?
- Multiple stakeholders, multiples perspectives

Effectiveness?
- **High number of components**
- Uncertainty

MCDA

1. Allows the integration of multiple decision criteria

   Complexity and multidisciplinarity

2. Makes it possible to **integrate and compare the interventions based on criteria that are both quantitative** (impact on incidence of human cases) and qualitative (ex: public acceptability)

   Uncertainty

3. Allows the integration of data that capture public opinion and perception in the choice of interventions

   Importance of public perception

Transparency – Coherence – Legitimacy

MCDA

4. Takes into consideration human, organizational and social factors

   – Helps in decision-making when several viewpoints, often conflicting, must be taken into account

   – MCDA...P

5. Formalizes the preferences of the various actors

6. Helps make more informed decisions

Methods

1. Define the problem

2. Identify stakeholders

3. Identify important issues

4. Define criteria and indicators

5. Identify alternatives

6. Evaluate performance of alternatives

7. Weight criteria

Problem structuring

8. Conduct decision analysis

9. Perform sensitivity analysis

10. Interpret the results

Decision analysis

Results

What public health actions should be prioritized in a context of LD emergence in the province of Quebec?

- Québec National Institute of Public Health
- National Public Health Laboratory
- Ministry of Agriculture, Fisheries and Food
- Ministry of Natural Resources and Wildlife
- Montérégie Regional Board of Health and Social Services
- Academic Expert

1- What surveillance actions are the most appropriate?
2- What control actions are the most appropriate?

1. Define the problem
2. Identify stakeholders
3. Identify important issues
4. Define criteria and indicators
5. Identify alternatives
Evaluate performance of alternatives
7. Weight criteria

Public health
- PHC1 Reduction in incidence of human cases
- PHC2 Reduction in entomological risk
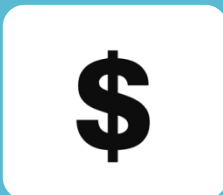- PHC3 Impacts of adverse health effects

Animal and environmental health
- AEC1 Impact on habitat
- AEC2 Impact on wildlife

Social impact
- SIC1 Level of public acceptance
- SIC2 Proportion of population benefitting from intervention

Strategic, economic and operational impact
- SEC1 Cost to the public sector
- SEC2 Cost to the private sector
- SEC3 Delay before results → (1) days; (2) weeks; (3) months; (4) years
- SEC4 Complexity
- SEC5 Impact on organisation's credibility

Results

Inclusion of control actions oriented toward:

- Environment
- Vector hosts
- Human populations

Performance matrix

Action	PHC1	PHC2	PHC3	AEC1	AEC2	SIC1	SIC2	SEC1	SEC2	SEC3	SEC4	SEC5
CONT0	1	0	0	1	1	3	4	1	0	3	1	1
CONT1a	2	3	2	16	8	2	1	1	1	2	4	3
CONT1b	2	3	2	48	18	2	4	2	0	2	4	3
CONT2	1	2	2	24	8	2	1	1	0	2	4	2
CONT3a	2	3	1	20	4	3	1	1	0	2	4	2
CONT3b	2	3	2	30	9	2	1	1	0	2	4	3
CONT4	2	3	2	3	12	3	1	2	1	4	4	2
CONT5	1	2	2	3	12	3	1	1	1	4	4	3
CONT6a	0	2	2	3	18	2	2	0	0	4	4	3
CONT6b	1	2	2	3	27	1	2	2	0	4	4	4
CONT7	1	2	0	12	6	3	1	2	2	4	4	2
CONT8	0	1	2	3	8	3	1	2	1	3	4	2
CONT9	0	1	2	3	8	3	1	2	1	3	4	2
CONT10	1	0	0	3	1	3	3	0	0	2	4	3
CONT11	2	0	2	1	1	3	3	1	0	2	5	2
CONT12	0	0	0	1	1	4	3	1	0	2	5	2

CONT0   Basic risk communications
CONT1a Small scale acaricide application
CONT1b Large scale acaricide application
CONT2   Application of insecticidal soap
CONT3a Small scale Landscaping
CONT3b Large scale Landscaping
CONT4   Topical acaricide to deer (4-poster)
CONT5   Feed-administered ivermectin to deer
CONT6a Deer hunting
CONT6b Deer culling
CONT7   Exclusion of deer by fencing
CONT8   Topical acaricide to rodents (Damminix)
CONT9   Topical acaricide to rodents (Bait boxes)
CONT10 Excluding people from high-risk public areas
CONT11 Human vaccination
CONT12 Making available special Lyme disease clinics

Results

Individual weighting of each criteria

Stakeholders weights for each category of criteria
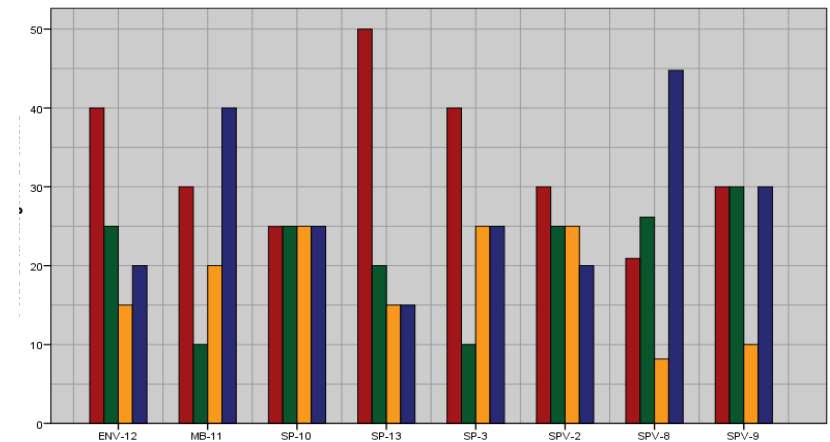
■ Public health
■ Animal and environmental
■ Social impacts
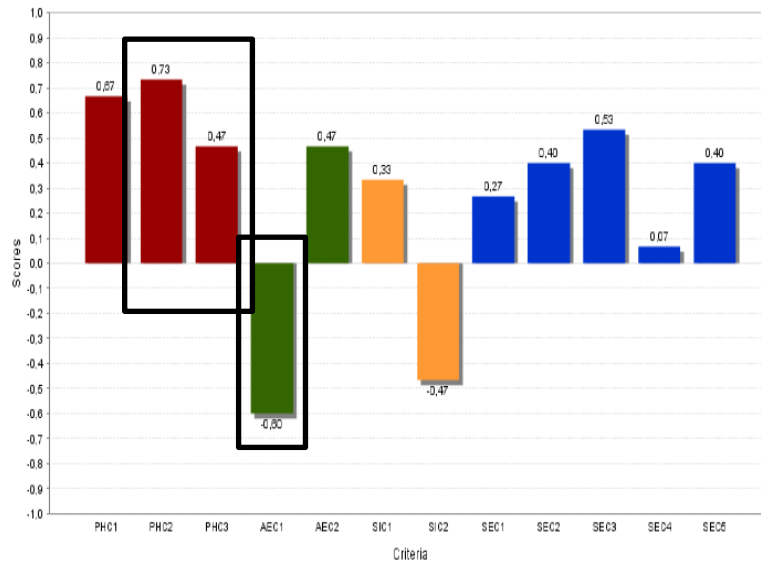■ Strategic & operationnal

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Results

Group ranking of actions

Actions		Rank	Score
CONT0	Basic risk communications	**1**	0.43
CONT11	Human vaccination	**2**	0.31
CONT3a	Small scale landscaping	**3**	0.28
CONT10	Excluding people from high-risk public areas	**4**	0.25
CONT12	Making available special Lyme disease clinics	**5**	0.23
CONT4	Topical acaricide to deer (4-poster)	6	0.03
CONT7	Exclusion of deer by fencing	7	-0.04
CONT1a	Small scale acaricide application	7	-0.04
CONT3b	Large scale Landscaping	8	-0.07
CONT1b	Large scale acaricide application	9	-0.08
CONT2	Application of desiccants	10	-0.14
CONT5	Feed-administered ivermectin to deer	11	-0.15
CONT8	Topical acaricide to rodents (Damminix)	12	-0.22
CONT9	Topical acaricide to rodents (Bait boxes)	12	-0.22
CONT6a	Deer hunting	13	-0.25
CONT6b	Deer culling	14	-0.33

Results

Actions profiles

Small scale landscaping

Human vaccination
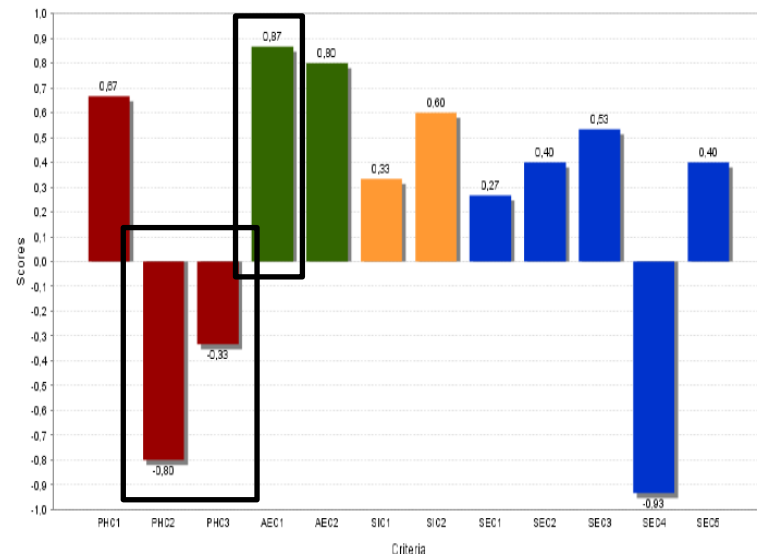
■ Public health
■ Animal and environmental
■ Social impacts
■ Strategic & operationnal

Aenishaenslin et al.,2013. **Multi-criteria decision analysis as an innovative approach to managing zoonoses: results from a study on Lyme disease in Canada.** BMC Public Health, 13:897.

MCDA strengths

One Health

Multiple decision criteria

Knowledge gaps

Rank alternatives

MCDA

Quantitative & qualitative

Institutional empowerment

Complexity

Participatory approach
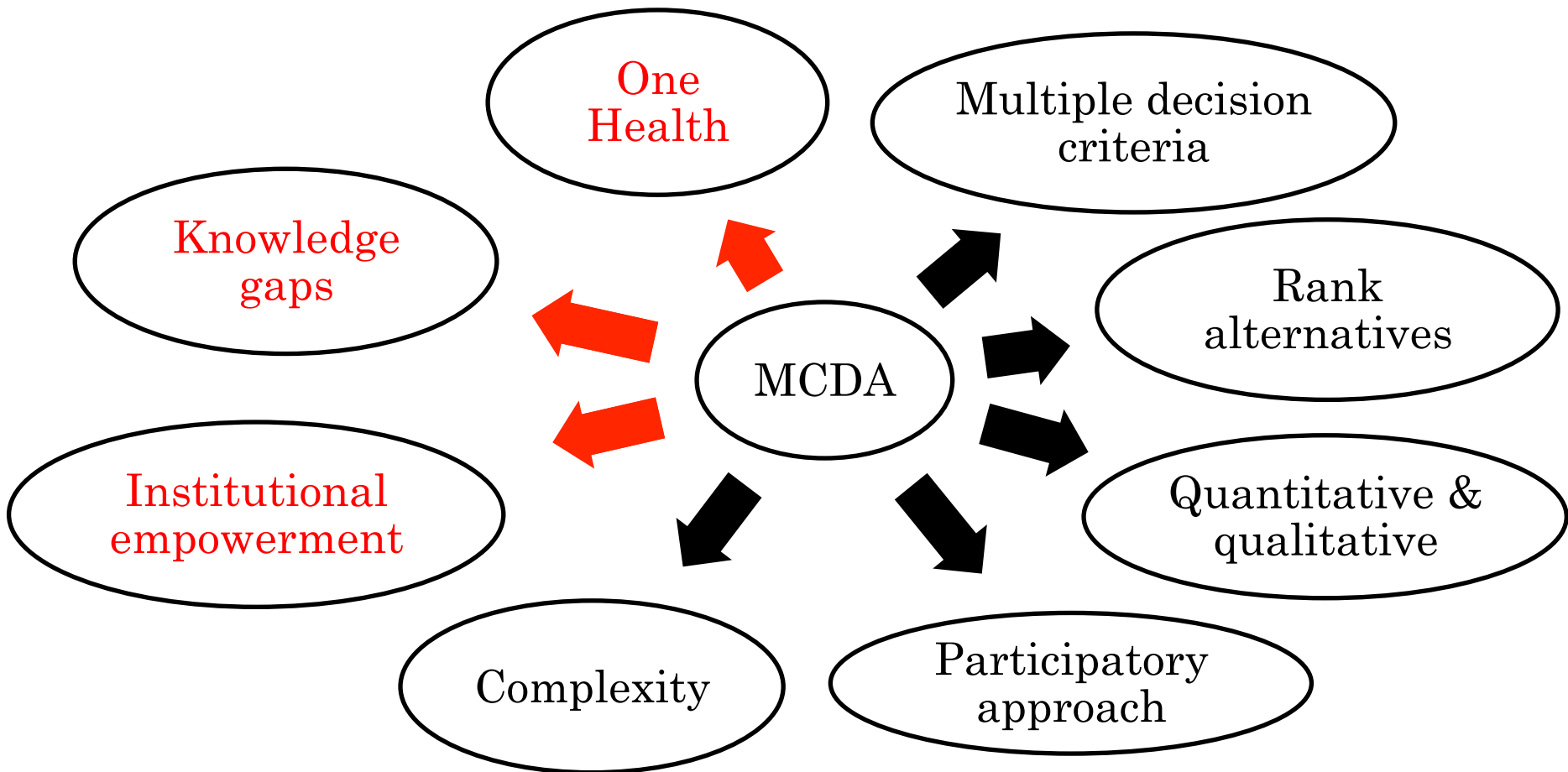
Added value of MCDA

- Helps structure and systematically document the different components of a health problem

- Allows an evaluation of the potential strengths and weaknesses of multiple options

- Can help identify potential points of consensus and conflict between the various participating stakeholders

- Helps documents knowledge gaps

- Each MCDA step produces a valuable result

- The tool can be adapted to various management contexts

4. INTERACTIVE WORKSHOP ON MULTI-CRITERIA DECISION AID IN PUBLIC HEALTH
CASE STUDY ON LYME DISEASE PREVENTION

Objectives

By means of a practical case study on Lyme disease prevention:

- Understand the added value of using multi-criteria decision aid tools (MCDA) to prioritize interventions in public health;

- Understand the different steps of an MCDA process when applied to vector-borne disease prevention;

- Experience the weighting of criteria and understand the added value;

- Gain a basic understanding of the types of results that can be obtained via multi-criteria decision analyses performed with the Visual PROMETHEE software.

Hypothetical Problem Setting

Given the steady increase in annual Lyme disease cases and a limited budget, a discussion group is being set up to provide recommendations regarding **Lyme disease prevention strategies (options, alternatives)** in regions most strongly affected by the disease.

Exercise 1: Identifying Stakeholders

In groups of 3 or 4, please discuss which stakeholders (organizations, experts, others) should be involved in the discussion process.

Exercise 1: Discussion

- Who would you include as stakeholders in the process?

- What concerns or advantages do you see in including one group of stakeholder versus another?

Exercise 1 : Take-Away Points

- Public health decisions traditionally made primarily by public health alone.

- Vector-borne disease management has implications for a number of organizations: environmental, animal health, outdoor recreational organizations, camps, advocacy groups.

- Active participation of diverse stakeholders in management discussions allows a variety of perspectives and concerns to be taken into account from the onset and can help improve acceptance and compliance, and improve the efficacy of eventual intervention decisions.

Exercise 2: Identifying Alternatives

In your current discussion groups, please make 1-2 suggestions on the most effective preventive strategy that should be used to help manage Lyme disease.

e.g.: Acaricide application to control tick populations

Exercise 2 : Discussion

- Do the proposed alternatives address the problem ?

- What additional information would you have wanted to help facilitate this discussion?

- How did you find this exercise: easy or difficult?

Exercise 2 : Take-Away Points

- The list of potential management strategies that is suggested is highly dependent on who is around the discussion table.

- Reminder: iterative process.

- The idea of the "best" management strategy is highly dependent on what criteria are used to judge performance.

- Consensus can be difficult to obtain.

Exercise 3: Role Playing

1. A citizen/user of public parks
2. A public park administrator
3. A public health representative

Exercise 3: Prioritizing Criteria

Within your multi-role groups, please put yourself in the role given to you, in order to:

- Discuss the issues that most concern you with regard to Lyme disease management and translate these into criteria

- Attempt to obtain a consensus on the three most important criteria for all group members

Exercise 3: Discussion

- What issues or criteria did you <u>not</u> agree on?

- What issues or criteria did everyone agree on?

- How did you find this exercise: easy or difficult?

Multiple perspectives, values, mandates…

A Simplified Example

Lyme Disease

- 5 options or alternatives
- 6 criteria
- 3 actors
  - A citizen/user of public parks
  - A public park administrator
  - A public health representative

Several Questions

1. What is(are) the best option(s)?
   - PROMETHEE Rankings
2. Why is it a good option?
   - GAIA, Profiles, Rainbow
3. What about the weights of the criteria?
   - GAIA, Walking Weights
4. Why not another option?
   - GAIA, Profiles, Rainbow
5. Are there any missing criteria?
   - Brainstorming
6. Is the proposed option a robust one?
   - Visual Stability Intervals

Multi-Stakeholders Model
in **Visual PROMETHEE**

- Stakeholders
  - Points of view
  - Hypotheses, etc.
- Evaluations
  - "Objective" criteria: common evaluations
  - "Subjective" criteria: scenario-dependent evaluations
- Specific preference structures
  - Weights, preference functions, threshholds, etc.

Multi-Stakeholder Model
in **Visual PROMETHEE**

- Adaptation of **PROMETHEE**
  - Comparison of individual rankings
  - Global (group) ranking (with possible weighing of the scenarios)
- Adaptation of **GAIA**
  - Three different analyses
    - **GAIA**-Criteria
    - **GAIA**-Scenarios
    - **GAIA**-Unicriterion

Lyme Example

- Three stakeholders ("scenarios")
  - A citizen/user of public park
  - A public park administrator
  - A public health representative
- Three multi-criteria tables
  - Different weightings of the criteria
  - Common evaluations

Several Stakeholder-Related Questions

1. Is there a consensus about the best option?
   - ➢ PROMETHEE Group ranking, GAIA-Scenarios
2. Who disagrees with the proposed option? Why?
3. How do the stakeholders individually influence the option?
4. Is it a robust option?

Exercise 4

Keeping your assigned role in mind, and using the distributed cards and weighting form, please <u>weight</u> the list of criteria.

Allocate 100 points according to your perception of their relative importance.

Exercise 4: Discussion

- Was it easy to obtain a consensus?

- Are you surprised by the differences or similarities in weightings given by different roles?

Discussion Questions

- Do you find this exercise/tool useful for structuring reflection about vector-borne disease management?

- Do you see a use for this type of approach in your organization?

5. Conclusions

- Importance of training workshops not only at the beginning but all along the decision process at key moments

- Implementation schedule of citizen participation according the contexts (hitorical, political, complexity, etc.) and potential impacts

- SWOT analysis of innovation penetration in organizations, institutions, and society.

Thank you for your attention

Questions?

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Speaker

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