

REVASIA Research Program Workshop, 15th April 2015

Innovative methods to evaluate animal health
surveillance systems in South East Asia

Moving from Research to Policy Decision



Capture-Recapture

Quantitative evaluation of
surveillance system performances





Estimation of the size of a population of animals

- Basic principle of the CR studies: two capture sessions

- Two consecutive capture sessions.
- The capture protocol is such that at a given session all the animals in the population have the same probability of being captures

1st session: 30 individuals captured and marked

2nd session: 60: 10 already captured /marked at the 1st session, 50 unmarked

➡ Capture probability at the second session of the individuals marked at the first session can be estimated by $10/30 : 0.33333$

➡ If the capture probability at the 2nd session is homogeneous (no difference between individuals marked at the 1st session and individuals not captured at the 1st session), this capture probability can be applied to all the individuals captured at the 2nd session

➡ $N * 0.33 = 60$
 $N = 60 / 0.33 = 180$

Source: V. Grosbois, CIRAD



Transposition to epidemiology

- Underreporting (cases that are never reported) is a frequent issue in epidemiological investigation.
- CR methods are used to estimate the size of a population of infected/diseased epidemiological units
- Epidemiological units can be individuals, holdings, villages.....



Transposition to epidemiology

- In the analogy with studies of animal populations sizes
 - Capture sessions are replaced by **independent lists** of infected epidemiological units arising from distinct sources of information
 - "To be captured" during a given capture session then translates into "**to be recorded in a given list**"
 - "Capture probabilities" are referred to as "**ascertainment probabilities**"
 - There is no individual marking but the detected units need to be **identifiable in all the lists** : case matching between lists

Source: V. Grosbois, CIRAD



Global objectives of capture-recapture applications

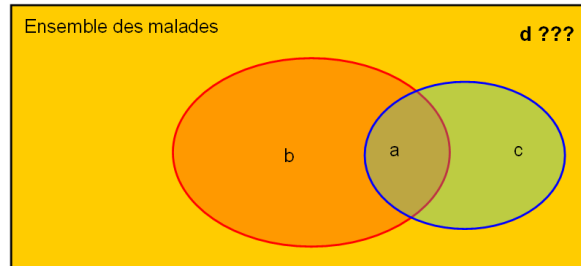
- Diseases surveillance
 - Detection processes are always imperfect
 - Passive notifications
 - Low clinical affections...
 - Lots of what is looked for remains undetected
 - Sampling of the population





Source: V. Grosbois, CIRAD



Performance evaluation: 1. Multilist Capture-Recapture



-  b = number of cases detected only by source 1
-  c = number of cases detected only by source 2
- a = number of cases detected by both sources
- d = overall cases



Performance evaluation: 1. Multilist Capture-Recapture

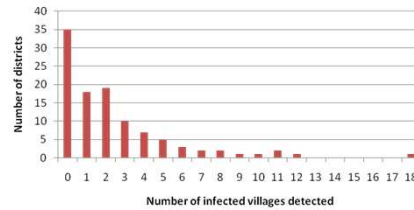
- Training on CR Hanoi May 2014, participants: DAH, NIHE, NIVR
- Concept note proposed by NIHE to assess **real exposure to dog bites and Se of rabies human surveillance system**
- Study ongoing, partnership between NIHE and Cirad



Capture-Recapture: 2. Unilist evaluation

Number of infected villages detected	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Total
Number of districts	35	13	19	10	7	5	3	2	2	1	1	2	1	0	0	0	0	0	1	107

Zero-inflated count data



- Description of data distribution adapted distribution model (Binomiale, Poisson, NegBin)

Vergne et al. A Zero-inflated models for identifying disease risk factors when case detection is imperfect: application to HPAI in Thailand. PVM 2014

Source: T Vergne, CIRAD



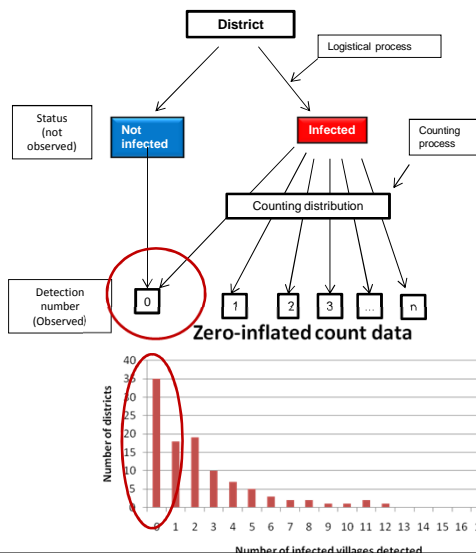
Case study : H5N1 HPAI in Vietnam

- Official notification list from DAH
- Study period:
 - 2010-2011 (Mass vaccination)
 - 2011-2012 (no/less vaccination; novel strain)
- Co-variate: Province risk level (from 1-3) (different vaccination protocols)
- Objective= To compare system Se between the different periods



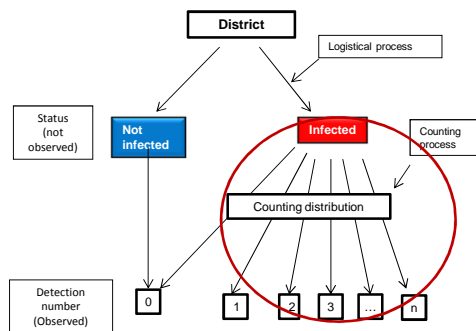
Case study : H5N1 HPAI in Vietnam Real prevalence

Estimated total infected units [IC 95%] (Observed infected units)			
Period	09/10	10-11	11-12
Province	58 [22-64] (22)	23 [17-34] (17)	48 [25-64] (20)
District	55 [36-82] (33)	49 [36-65] (24)	142 [30-333] (30)



Case study : H5N1 HPAI in Vietnam Detection probability

Probability to detect at least one infected unit (%) [IC95%]			
Period	09-10	10-11	11-12
Province	34% [21-53]	74% [56-89]	58% [40-61]
District	61% [45-77]	47% [28-70]	40% [28-98]

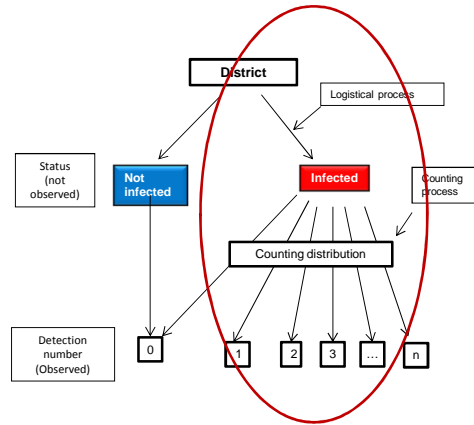




Case study : H5N1 HPAI in Vietnam Overall Sensitivity

Results

Overall sensitivity (%)			
[IC 95%]			
Period	09-10	10-11	11-12
Province	34% [33- 100]	74% [50- 100]	42% [31-78]
District	61% [40-91]	49% [37-67]	48% [13-100]



Case study : H5N1 HPAI in Vietnam Effect of Vaccination

Results: effect of vaccination

Risk level	2010-2011	2011-2012
1	Ref	Ref
2	1.76 [0.59-5.26] <i>p</i> =0.3	5.88 [1.53-25] <i>p</i> =0.009
3	1.26 [0.25-2.5] <i>p</i> =0.68	5.61 [1.54-20] <i>p</i> =0.009

- 2010-2011 (vaccination):

Not significant association

- 2011-2012 (no/less vaccination):

Significant association: Provinces classified « at high risk (level 3)» have 5 times more chances to be infected

OR [IC 95%]

Vergne T, Grosbois V, Jobre Y, Saad A, AbdelNabi A, Galal S, Kalifa M, Abdelkader S, Dauphin G, Roger F, Lubroth J, Peyre M. Avian influenza vaccination of poultry and passive case reporting. *Egypt. Emerg Infect Dis [Internet]*. 2012 Dec [16/11/12]. <http://dx.doi.org/10.3201/eid1812.120616>



Case study : H5N1 HPAI in Vietnam Results summary

- Sensitivity range: 30% - 74% (but large IC)
- **Model validation:** level of risk increase with risk of infection
- **Vaccination** reduces the probability of infection



Case study : H5N1 HPAI in Vietnam Recommendations

- Methodology: results could be validated with additional data set
- CR method can be used to assess and review control strategies (even with imperfect data, low surveillance sensitivity)
- Sensitivity of HPAI surveillance in Vietnam is not optimum: need to understand why and identify corrective actions (**qualitative evaluation**)
 - ➔ ● To improve use of resources, efficiency
 - To ensure validity and relevance of control strategies

SNATrop / OASISTrop



Qualitative evaluation of
surveillance system process



SNAT- Surveillance Network Analysis Tool



- Standardised tool
- In depth analyses operational efficacy and quality of surveillance systems

Epidemiol. Infect., Page 1 of 11. © Cambridge University Press 2011
doi:10.1017/S0950268811000161

OASIS: an assessment tool of epidemiological surveillance systems in animal health and food safety

P. HENDRIKX^{1*}, E. GAY², M. CHAZEL², F. MOUTOU³, C. DANAN⁴,
C. RICHOMME⁵, F. BOUE⁵, R. SOUILLARD⁶, F. GAUCHARD⁷ AND B. DUFOUR⁸

OASISTrop: an assessment tool for surveillance systems in animal health and food safety in the Least Developed Countries

Faverjon C, Minodier M, Goutard F, Sinthasak S, Pathammavong S, Douangngneum B, Naipospos T, Holl D, San S, Sinal H, Hendrikx P, Dufour B, Peyre M..
Epidemiology and infection 2015 (submitted)



STRUCTURED QUESTIONNAIRE

Section 2 CENTRAL INSTITUTIONAL ORGANISATION

To tick the case just click on it, if it does not work you might need to activate the macros in Word.

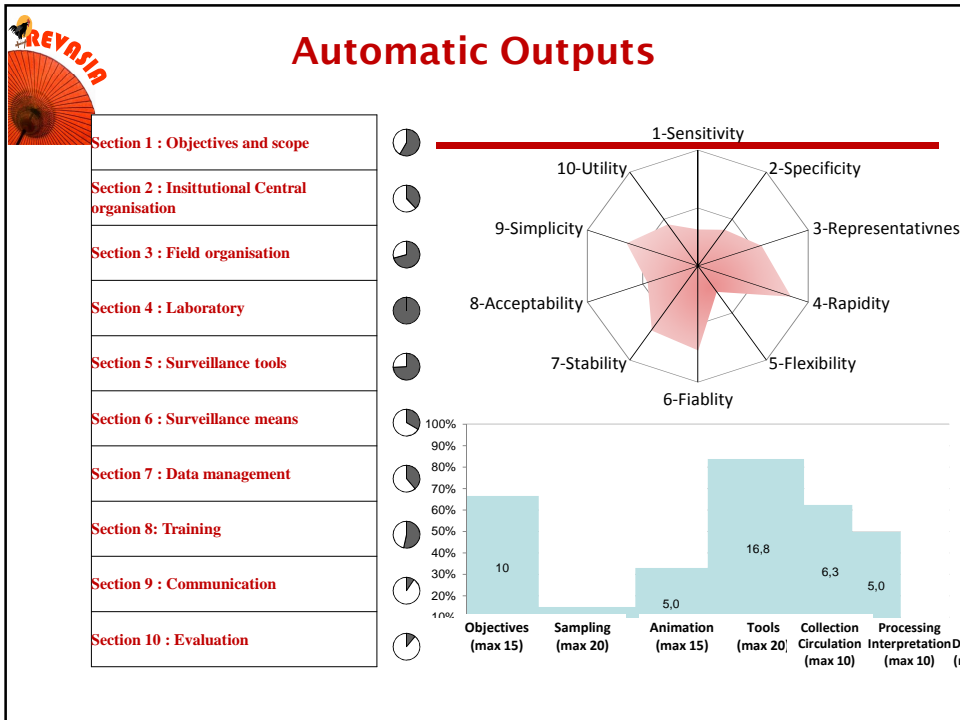
2.1 CREATION OF THE NETWORK Date of creation of the network Did the network function in a non-formal manner prior to being established? <input type="checkbox"/> Yes <input type="checkbox"/> No <i>(if no, when)</i>	
2.2 INSTITUTION RESPONSIBLE FOR SURVEILLANCE 2.2.1 General information Name (institution) Relevant Ministry Address Telephone Fax E-mail	
2.2.2 Human resources (precise if the information are covers the entire system, including data collectors or if it covers only a part which will need to be defined) Number of Engineer / Researchers / Manager Part of Veterinarians (CVN) Number of technicians (technician with 2 or 3 years of training) Number of other staff (secretary, driver, etc.)	
2.3 CENTRAL UNIT Existing <input type="checkbox"/> Yes <input type="checkbox"/> No Operational <input type="checkbox"/> Yes <input type="checkbox"/> No <i>(if not, when)</i>	
2.3.1 Composition Formalised composition <input type="checkbox"/> Yes <input type="checkbox"/> No <i>(if not, when)</i> Composition (number of staff and address) Human resources in the central unit (in full time equivalent) Coordinator Name Organisation Title allocated (% compared to full time) Coordinator task definition Animation manager Name	
2.3.2 Roles and responsibilities Defined <input type="checkbox"/> Yes <input type="checkbox"/> No <i>(people know what to do but it is not written down)</i> Formalised <input type="checkbox"/> Yes <input type="checkbox"/> No <i>(people know what to do and it is written down)</i> Describe : Central Unit activities Material means specific for the Central Unit <input type="checkbox"/> Yes <input type="checkbox"/> No Financial means <input type="checkbox"/> Yes <input type="checkbox"/> No if yes : Specific to the Central Unit (Human resources) <input type="checkbox"/> Yes <input type="checkbox"/> No Integrated into the general budget <input type="checkbox"/> Yes <input type="checkbox"/> No Adequacy of material and financial means <input type="checkbox"/> Yes <input type="checkbox"/> No	
2.4 STEERING COMMITTEE OR EQUIVALENT (BODY OWING STRATEGIC ORIENTATION TO THE SYSTEM) Existing <input type="checkbox"/> Yes <input type="checkbox"/> No Operational <input type="checkbox"/> Yes <input type="checkbox"/> No When there is no steering committee, what or what structure defines the principal orientation of the system?	
2.4.1 Composition Formalised composition <input type="checkbox"/> Yes <input type="checkbox"/> No List Veterinarian services <input type="checkbox"/> Yes <input type="checkbox"/> No <i>(with)</i> Laboratories <input type="checkbox"/> Yes <input type="checkbox"/> No <i>(with)</i> Other professionals (for example merchants, associations, etc.) <input type="checkbox"/> Yes <input type="checkbox"/> No <i>(with)</i> Cost recovery (equipment) <input type="checkbox"/> Yes <input type="checkbox"/> No <i>(with)</i> Livestock projects <input type="checkbox"/> Yes <input type="checkbox"/> No <i>(with)</i>	

RVAT - Surveillance Network Analysis Tool - September 2019 version 9


Scoring Grid

	A	B	C	D
1	SNAT - Scoring grid			
2				
3	Network XXX			
6	Sections and questions	Score (0 to 3)	Comments	
7	Section 1: Objectives and context of surveillance		<i>Point on the cell to access the scoring guide</i>	
8	1.1. Relevance of surveillance objectives	3		
9	1.2. Level of detail, accuracy, and formalization of objectives	0		
10	1.3. Taking partners' expectations into account	1	To score, choose from the following options: Score of 3: All partners are listed with their corresponding expectations identified, and taken into account in the surveillance objectives. Score of 2: The expectations of a majority of partners are identified. Score of 1: The expectations of a minority of partners are identified and/or taken into account. Score of 0: Absence of identification and/or recognition of partners' expectations of	
11	1.4. Coherence of the diseases under surveillance with the sanitary situation (existing/exotic diseases or threats)	3		
12	Total	7		
13	over	12		

Graph1 Scoring criteria output 1 Output 2 Output 3 list-criteria Calculation sheet



Sustainability




SNATrop

Graphical output 1

[Click here to close the sheet](#) [Click here to see the feedback sheet](#)

Sections	Result of evaluation per each section	Percentage of satisfaction	Evolution with Financial contributions					
			6 month later	% of satisfactio	1 year later	% of satisfactio	2 years later	% of satisfactio
Section 1: Objectives and text of surveillance		97%		97%		43%		43%
Section 2: Central institutional organization		43%		43%		43%		43%
Section 3: Field institutional organization		51%		51%		51%		51%
Section 4 : Laboratory		74%		74%		74%		74%
Section 5: Surveillance tools		80%		80%		80%		80%
Section 6: Surveillance procedures		22%		22%		22%		22%
Section 7: Data management		44%		44%		44%		44%
Section 8 : Formation		38%		38%		38%		38%
Section 9 : Communication		51%		51%		51%		51%
Section 10 : Evaluation		22%		22%		22%		22%



Corrective actions

To get started click to classify the criteria. For each critical point, the criteria used are classified according to their weights and their score. In each table the first criteria need to be improve in priority

Feedback for output 2



Click here to close the sheet Click here to class the criteria Referencing question Close referencing question

Disease present

Objectives




Criteria	Score	Referencing question	Missing points
6.A Appropriateness of surveillance procedures with the system's objectives	0	Section 5 (part 1) question 50, 48 a	60
1.D Coherence of the diseases under surveillance with the sanitary situation (existing/exotic diseases or threats)	3	Section 1 question 3	0
1.C Taking partners' expectations into account	3	Section 1 question 4	0
1.A Relevance of surveillance objectives	3	Section 1 question 1 and 3	0
1.B Level of detail, accuracy, and formalization of objectives	3	Section 1 question 1 and 2	0

Output 2 Feedback_output_2 (2) Output 3 Feedback_output_3 Calculation sheet financial sheet financial Resume Cost-ar

Cost analysis

- Expenses linked to activities
- Expenses linked to efficacy criteria

 Cost/criteria
 Cost /outputs
 Cost/improvement

SNAT Scoring grid		
Section 1: Objectives and context of surveillance		
1.A. Relevance of surveillance objectives	Meeting costs	
1.B. Level of detail, accuracy, and formalization of objectives		
1.C. Taking partners' expectations into account		
1.D. Coherence of the diseases under surveillance with the sanitary situation (existing/exotic diseases or threats)		
Section 2: Central institutional organization		
2.A. Existence of an operational management structure (central unit)	Central Unit functioning costs	meetings, human resources
2.B. Existence of an operational steering structure that is representative of the partners (steering committee)	Steering committee costs	meetings
2.C. Existence of a scientific and technical committee for the system	technical committee costs	meetings
2.D. Organization and operations of the system laid down in regulations, a charter, or a convention established between the partners	Human resources	meetings
2.E. Frequency of meetings of the central coordinating body	Meeting costs	
2.F. Supervision of intermediary units by the central level	Human resources	meetings
2.G. Adequacy of the central level's material and financial resources		
Section 3: Field institutional organization		
3.A. Existence of formal intermediary units covering the entire territory	Functioning of intermediary units	Cost/number of IL data management costs
3.B. Active role of intermediary units in the functioning of the system (validation, management, feedback)	Functioning of intermediary units	
3.C. Implementation of supervision by the intermediary level	Functioning of intermediary	

E.g. Operational costs

		COST USD (%)	IMPROVEMENT COST USD (%)
Section 1 : Objectives and scope		1%	1%
Section 2 : Insitutional Central organisation		2%	2%
Section 3 : Field organisation		20%	15%
Section 4 : Laboratory		40%	0%
Section 5 : Surveillance tools		10%	5%
Section 6 : Surveillance means		20%	40%
Section 7 : Data management		5%	10%
Section 8 : Training		1%	20%
Section 9 : Communication		0.5%	5%
Section 10 : Evaluation		0.5%	2%

Acknowledgments

CR HPAI Vietnam

- Dr. Van Dang Ky, DAH
- Vu Mai Quynh Giao, internship student

SNATrop cost calculations

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