Food and Agriculture Organization of the United Nations

SUSTAINABLE DEVELOPMENT GOALS

Economic assessment to optimize surveillance systems

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Methods in Economics to guide decision-making

- Cost-Benefit Analysis (CBA) and Cost-Effectiveness Analysis (CEA) are widely used methods in Economics to assess interventions/policies/decisions/investments

- CBA:
  - Compares both costs and benefits in monetary terms
  - It allows aggregating benefits of different nature (e.g. human lives saved VS biodiversity)
  - It can be polemic (e.g. value of a human life saved) and/or rely on modeling (e.g. what would happen if an infected bird leaves the market?)

- CEA:
  - Uses effectiveness units to measure the benefits (DALYs, lives saved, infected animals prevented)
  - Benefits of different nature cannot be aggregated
  - It is relatively easier to conduct and less sensitive, and still provides good information for decision-making

The value of surveillance depends on how the information generated is utilized

"Cost-Effectiveness Analysis (CEA) is a technique to examine both the **costs** and **outcomes** of one or more interventions. It **compares** an intervention to another intervention (or the status quo) by estimating how much it cost to gain **a unit** of an outcome"

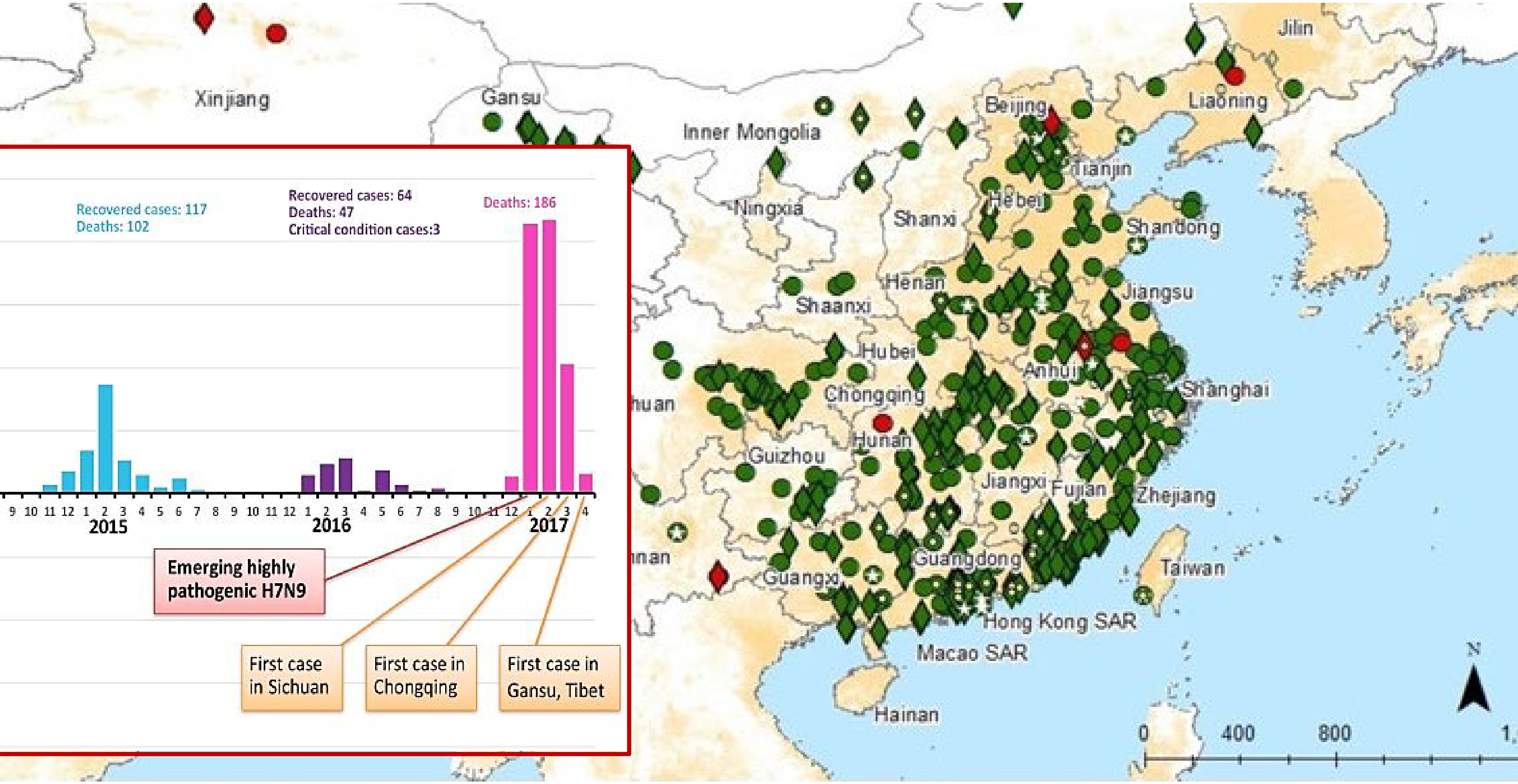
"USD per virus mutation detected"

"USD per animal deaths averted"

"USD per infected birds leaving the market averted"

Cost-Effectiveness Analysis for Early Detection


… Welcome to August 30th, 2017


Xinjiang
Gansu
Inner Mongolia
Ningxia
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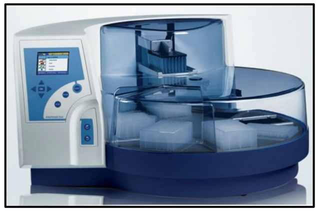
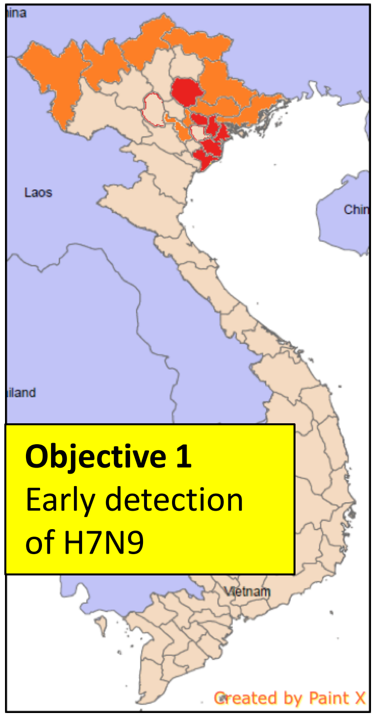
Henan
Hubei
Chongqing
Hunan
Guizhou
Jiangxi
Fujian
Zhejiang
Guangdong
Guangxi
Hong Kong SAR
Macao SAR
Hainan
Taiwan
Beijing
Tianjin
Hebei
Shandong
Jiangsu
Anhui
Shanghai
Liaoning
Jilin
0
400
800
Recovered cases: 117
Deaths: 102
Recovered cases: 64
Deaths: 47
Critical condition cases:3
Deaths: 186
2015
2016
2017
Emerging highly pathogenic H7N9
First case in Sichuan
First case in Chongqing
First case in Gansu, Tibet

Photo by K. Inui (2017)

		Sampling	Sample transportation	Testing	Total time
	Portable PCR	1 hour		2 hours	**3 hours**
	Lab-based PCR	1 hour	**Days**	2 hours	**3 hours + Days**

Is it cost-effective to adopt the portable PCR to improve the early detection system?

Test steps	At the sampling site		Laboratory
Step 1: **RNA extraction**	 Taco mini $5,000		 $35,000
Step 2: **Real-time PCR**	 Pockit plus $1,600	**Compact** **Simple** **Cost less** **Same results**	 $40,000
2024/10/29	Portable equipment Easy reagent storage (RT to 4C) Simple test procedure		Costly equipment Reagent storage in freezer Requires skilled lab operator interpretation



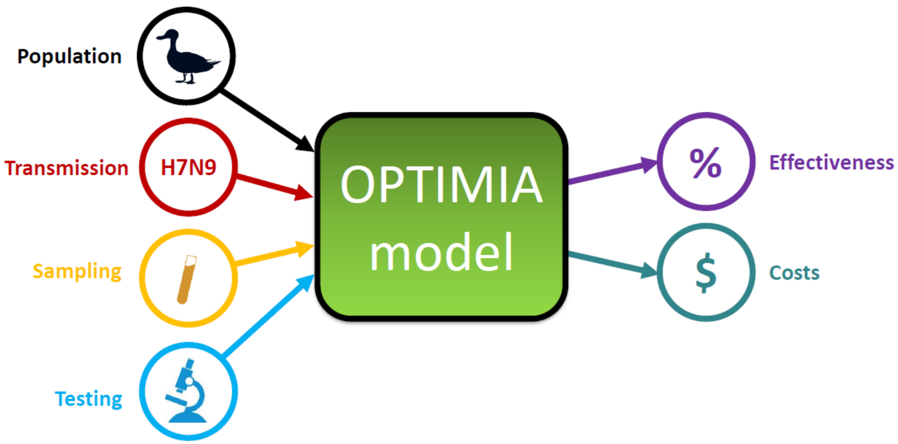
Routine surveillance

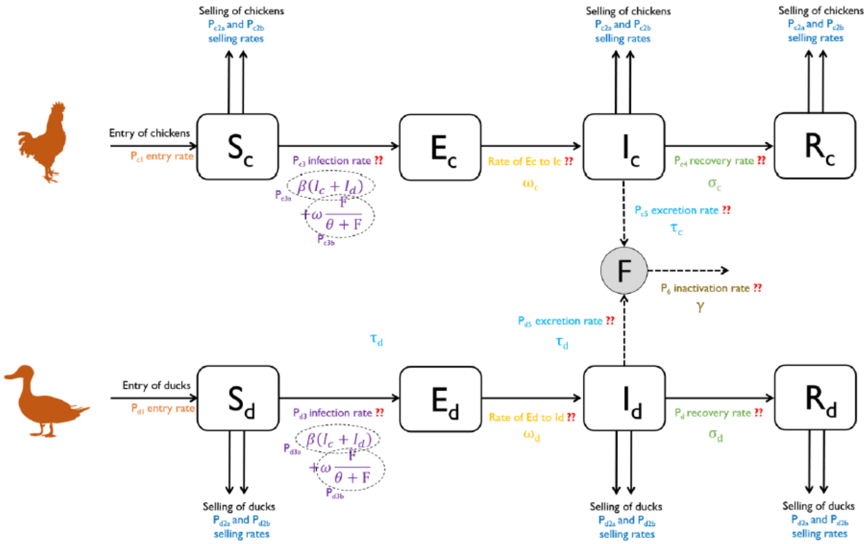
Intensive H7N9 surveillance using Pen-side PCR

- 5 months (Dec – April)/year
- 5 provinces in the north
- Total 11 LBMs (in 5 provinces)
- Sample 2 times/week
  - 40x11x2x4=3520 samples/month

Additional H7N9 surveillance

Contract with ENVT (IHAP) to develop a model for avian influenza (AI) virus transmission in live bird markets and deliver a regional workshop on evaluation AI control policies in live bird markets





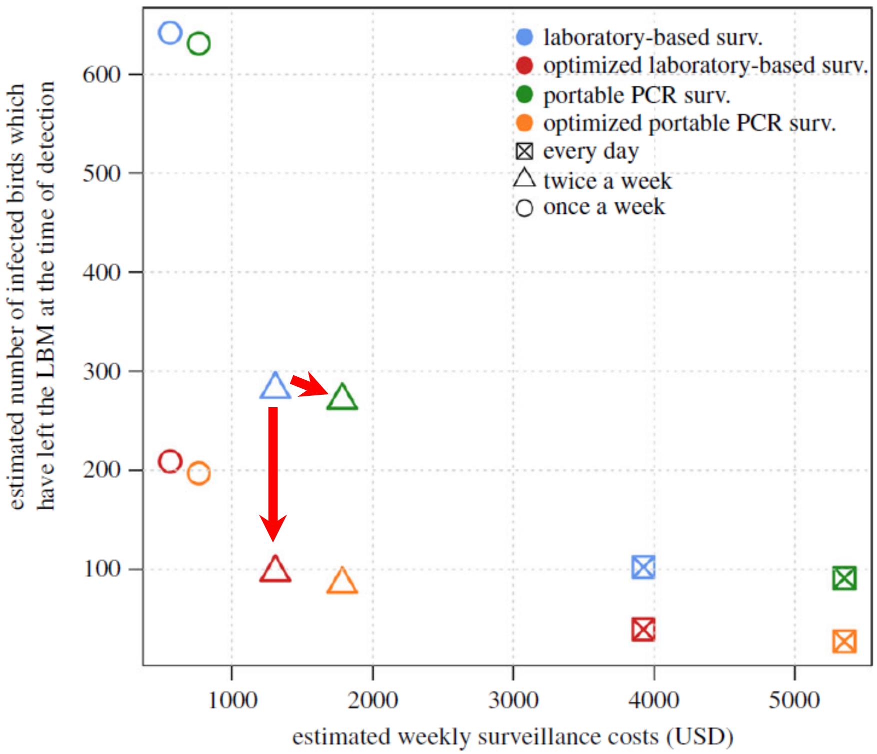
Source: Guinat et al., 2021

	Sampling frequency	Most likely detection delay since virus introduction (day)	Probability that the virus remains undetected within 15 days after its introduction	Expected number of infected birds that have left the LBM at the time of detection (average)	Estimated surveillance costs per week during peace time ($)
1	Everyday	1	0	10	1890
2	Twice a week	2	0.01	21	630
3	Once a week	5	0.15	56	270

Cost-effectiveness of S1 (everyday) vs S2 (twice a week):

- **Change in the number of infected birds leaving the market before detection: 11**
- **Change in the weekly cost of surveillance: 1260**
- CER[S1vsS2] = 114 USD [every week before introduction] per infected bird averted

What should be the Cost-Effectiveness threshold?



The model does not incorporate the risk-based approach of sampling sick birds (no data available to assess such gain in sensitivity)

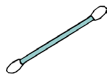
Figure 4. Estimated weekly costs (in USD) and estimated number of infected birds which have left the LBM at the day of detection for the different surveillance strategies at Giếng Vuông LBM, Lang Son province, Vietnam.

Source: Guinat et al., 2021

Cost-Effectiveness Analysis for Virus Monitoring

Virus monitoring in Bangladesh's live bird market system

- Surveillance strategies to be evaluated:
    1. Baseline: 3 pools of 6 environmental samples each tested individually



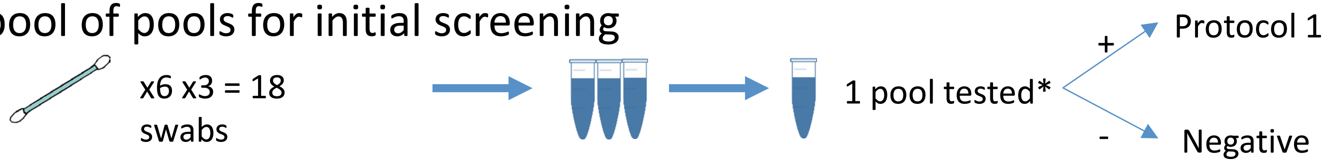
x6 x3 = 18 swabs

3 pools tested

Virus monitoring in Bangladesh's live bird market system

- Surveillance strategies to be evaluated:
  1. Baseline: 3 pools of 6 environmental samples each tested individually

  2. Pooling extraction: 3 pools of 6 environmental samples pooled into one pool of pools for initial screening



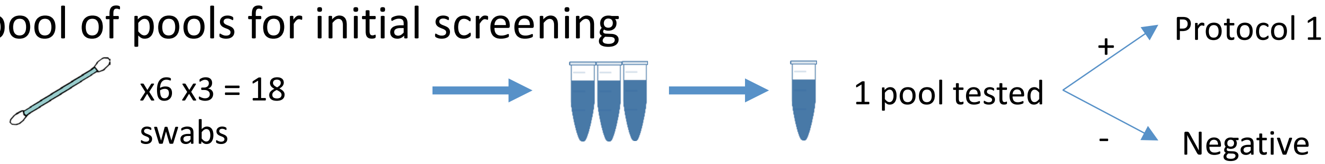
*Scenarios with and without loss in sensitivity

Virus monitoring in Bangladesh's live bird market system

- Surveillance strategies to be evaluated:

1. Baseline: 3 pools of 6 environmental samples each tested individually

2. Pooling extraction: 3 pools of 6 environmental samples pooled into one pool of pools for initial screening



3. Reduced sampling: 1 pool of 6 environmental samples

- Reduced sampling (strategy 3) lead to significant savings compared with the baseline (strategy 1):
  - The cost of surveillance would be cut by **58%** by switching from strategy 1 to strategy 3
- Using the data from Bangladesh, the most effective sampling area is the selling (or exposure) area.
  - Adopting strategy 3 (vs strategy 1) and selecting the exposure/selling area for collecting the environmental samples, would lead to
    - Savings: **47,540 USD** yearly
    - Loss in efficiency: **20%** of positive markets misclassified for influenza A and **29%** misclassified for H5 (false negatives)

Is this trade-off acceptable?

Protecting people, animals, and the environment every day

Acknowledgements

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