Optimising surveillance systems for early disease detection

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October 2007
Secrets of success for epidemic disease control without vaccination

1) **Find it quickly:** Surveillance/Reporting
2) Contain it efficiently: Biosecurity
3) Kill it quickly: Slaughter
4) Trace source and spread: Outbreak investigation

**Not rocket science**

Surveillance and reporting is the first step

**Speed of case finding is vital**
• Most of the presentation is based on surveillance for HPAI H5N1

• This has been the disease which has raised the profile of surveillance, particularly active surveillance

• But the basic principles apply to surveillance for the early detection of any infectious disease
Types of surveillance

• Active vs. “Passive”
  – Active means we go out and look for information
  – Passive means that vet services wait for information to come

• Scanning vs. Targeted
  – Scanning means constantly searching in the general population
  – Targeted means looking in selected sections of the population

• They are often combined
  – Scanning passive  Constant before and during outbreaks
  – Targeted active   Around outbreaks
  – Scanning active   In “high risk” areas – useful? possible?
  – Scanning active   Useful? Feasible?
Scanning passive surveillance

- We describe a system in which we depend on farmers/private vets/vet technicians to report disease to veterinary services as “passive”

- All domestic poultry are checked every day by their keepers.

- “Passive” has a negative connotation. Who is being passive?

- The farmers lead this activity and they are very actively checking their birds

- We need to find and promote a different term
Sensitivity of scanning passive surveillance

• Potentially 100% because all birds checked every day

• What is the actual sensitivity? Unknown

• Even if working at only half of potential, 50% sensitivity is better than any feasible active surveillance system

• How can you optimise the detection threshold?

• The key to passive surveillance is maintaining and improving farmer co-operation in recognising and reporting the things you want them to recognise and report
Optimising the detection threshold of a passive surveillance system

- Remove disincentives to reporting
- Build trust. This takes time
- Build links with owners, vet technicians, private vets, govt vets
- Two way communication: Listening as well as telling
- Don’t limit exchanges to the disease of interest
- Have to be offering something in return for collaboration, but not financial incentives.
- For instance, knowledge and increased advice
Collaboration: Owners

Have to be sure that owners
  – understand and have confidence in the response to a report
  – Have been involved in developing and have accepted what the consequences of a positive result will be
  – are sure of receiving compensation and at what rate

Incentives for owners
  – not needed
  – remove the disincentives
Collaboration: Private vet services

Includes private vets, vet technicians, vet pharmacies

Have to be sure that private veterinary services
  – support the planned response
  – will express this support to owners
  – have reliable information on HPAI that they can share with owners

Incentives for private vet service:
  – General information on animal diseases and treatments
  – Improved vaccine supplies or cold chain
Collaboration: Government

Government needs a communications strategy in peace time

Government must have confirmed plans for
  – proportionate response to outbreaks
  – reliable payment of compensation (amount and speed of payment)

Government must stick to what it has agreed to do

Incentives for government
  – improved image nationally and internationally
  – lower overall disease control costs
Reporting

Must ensure that the owners know
  – what to report (case definitions and trigger points)
  – who to report to (village headman, vet technician, local vet, govt vet, hotline)
  – how to report (contact details)

Must ensure that vet technicians/private vets know
  – How to respond to a report
  – What requires onward reporting and how to do that

Have to be sure that local govt vets
  – know how to respond to a suspect report
  – can and will respond consistently and quickly
Case definitions

- What should you tell owners to report?

- Case definitions for commercial poultry do not work in backyard poultry

- Backyard poultry love to die in the night leaving just a tantalising hint of froth on the beak

- Need a more subtle set of case definitions. Have been developed in Turkey and Indonesia
**Indicators for passive surveillance systems**

- Records of suspect cases investigated and outcome
- Records of samples tested (what, why and how) in lab and results
- Negative results are important
- Trends over time
- Set levels as for GREP?
- Should become an OIE requirement?
- Part of OIE PVS system?

Could use PDS to assess performance of passive surveillance system if clinical signs are clear cut
HPAI Turkey  
Passive surveillance results: 01-Apr-06 to 01-Dec-06

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<th>Domestic</th>
<th>Wild</th>
<th>Total</th>
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<tbody>
<tr>
<td>Received</td>
<td>395 (55)</td>
<td>235 (40)</td>
<td>630 (95)</td>
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<tr>
<td>Unsuitable</td>
<td>12 (1)</td>
<td>27 (9)</td>
<td>39 (10)</td>
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<tr>
<td>Tested</td>
<td>383 (54)</td>
<td>208 (31)</td>
<td>591 (85)</td>
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<tr>
<td>Test ongoing</td>
<td>6</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>Test completed</td>
<td>377</td>
<td>207</td>
<td>584</td>
</tr>
</tbody>
</table>

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<tr>
<th></th>
<th>Domestic</th>
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<tbody>
<tr>
<td>Negative</td>
<td>377</td>
<td>207</td>
<td>584</td>
</tr>
<tr>
<td>Suspect</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Positive</td>
<td>0</td>
<td>0</td>
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</tr>
</tbody>
</table>

The figures in brackets show the change since the previous report. Around a 100 samples have been received in the past month, more than one third of which are from wildbirds. As is to be expected, dead wildbirds are often not suitable for testing.
Active surveillance

- Scanning active surveillance entails visiting every location with domestic poultry on a regular basis.
  - resource intensive
    - rarely spare unused resources available
    - other activities may suffer
  - biosecurity

- Targeted active surveillance uses of risk profiling to target high risk areas and time
  - How much of national risk will be covered if only include “high” risk?
  - What is “high” risk and what is therefore “low” risk?
  - biosecurity
Active surveillance

- Do you have the resources?
- What return will you get for your resources?
- What will you have to neglect to do it and what might happen because of this neglect?
- Benefit cost analysis
Active surveillance

Take the example of HPAI

• HPAI is an acute disease with a short and non-detectable incubation period and a short clinical course

• You have to be present at the time it is occurring to detect it clinically

• You can find after the event that the disease has been present, but that implies delay in detection and spread

• In Turkey, 14,000 villages visited, 10 flocks per village
  • No HPAI found, but some ND
  • Does that mean the disease was absent?
Sensitivity of active surveillance systems

– Scanning: Depends on frequency of visits

– Targeted: Depends on frequency of visits and proportion of overall risk in the targeted population and time
Resources for scanning active surveillance in villages in Turkey

• 40,000 villages in Turkey

• Visiting each once a month would need 437 vets working full time if each vet can visit 5 villages a day

• Is once a month enough?

• HPAI is a highly infectious disease with short incubation period, acute onset and short duration.

• The disease may start the day after your visit or any day in the following 28

• A monthly visit covers only 3% of risk days so 3% of total risk

• High resource use, low sensitivity
Targeted active surveillance: Risk profiling

• Identify high risk areas
  – mapping
  – local knowledge
  – ornithologists
  – etc.

• Focus active surveillance on those areas

• But how much risk is being covered?
Relative risk vs. Actual risk

- Risk profiling is used to find populations at higher risk than the background level of risk
- What does high(er) risk mean?
- It is a measure of relative risk
- But what is the actual absolute risk?
Concept of “risk”: where and when?

- Over a year, 100% of that year’s risk is spread over the whole country in space and time.
- There is no time or location with poultry present that has zero risk.
- Every bird has 365 bird days of risk every year.
- Some birds are at more risk than others, but which?
Risk profiling: Where is the risk?

High risk areas. 5km around wetlands with large migratory waterfowl populations.
Risk profiling: Where is the risk?

Risk is 10x other areas of country and contains 5% of the domestic poultry.

95% of domestic poultry,
How much risk is in the high risk area?

• If 5% of the birds and a 10x risk close to wetland areas compared to areas further away

• How much of the overall risk is in the high risk area?

• 5% of pop / 10x risk multiplier = 35% of overall risk
Percentage of overall risk in high risk areas

Risk level in high risk area relative to rest of country (Nx)

Proportion of poultry pop in the high risk area
- 20%
- 10%
- 5%
- 2.5%
50:50 point in risk

- 2.5% of birds in high risk area / 40x risk multiple = 51%
- 5% / 20x = 51%
- 10% / 10x = 53%
- 20% / 5x = 56%

BUT even if we know (or can guesstimate) the percentage of birds in the defined high risk area, what is the risk multiplier?

AND what risk multiplier equates to high? 20x? 2x?
Effect of frequency of targeted active surveillance visits on sensitivity

- 5%/10x seems a likely figure
- The high risk area includes 35% of overall risk
- A weekly visit covers 1/7 of the risk days, approx 14% of risk days.
- Total national risk covered will be around 5%
- As good or better than scanning active and for less input, but still relatively insensitive
- Are weekly visits feasible?
- Are the resources available?
Resources for targeted active surveillance in villages in Turkey

• Visiting 5% of villages once a week during a four month risk period would need 88 full time vets working for that period

• For a highly infectious disease with short incubation period, acute onset and short duration, is once a week enough?

• How good are we at identifying risk?
Index case in Turkey, 2007. Risk?
Other types of active surveillance

• Clinical: Relies of detection of clinical signs

• Syndromic: For HPAI this is the same as clinical signs

• Sampling: Take samples from animals and test them.
  – Which animals?
  – How many samples do you need to take?
  – How much resource is available?
  – How quickly can it be replenished?
  – How do you maintain a surge capacity?
  – How much will it cost?
  – Sensitivity?
Targeted active surveillance in the presence of epidemic disease

Undertaken around known outbreaks (surveillance zone)

- Accepted as necessary
- Usually required by law
- Does detect outbreaks early

BUT

- Farmers still find most outbreaks first even in outbreak areas
- Be careful farmers don’t assume passive surveillance not important.
- Biosecurity
For diseases with significant non-clinical phases

Active surveillance using sampling is required for control/eradication of diseases

• with significant spread in the absence of clinical signs and detectable infection before serious spread
e.g. Brucellosis, bovine TB

• where infection may be masked by vaccination:
e.g. FMD (NSP testing ), HPAI
An alternative approach to active surveillance

Instead of risk profiling and focusing on higher risk areas, select concentration points where animals from all risk zones, high and low.

But must still be additional to passive surveillance, not a replacement.
Live bird markets

• Live bird markets CONCENTRATE risk rather than targeting high risk areas.
• Don’t need to make assumptions
• Cheap to get samples because risk comes to you
• Target all sick and dead birds
• Build relationships, gather intelligence

BUT
• will only indicate that the virus is present in a general area, not exactly where
• Virus will have been present for some time
• How many samples? Sensitivity?
• Cost
• Implications for lab surge capacity
Participatory disease search (PDS)

- Resource intensive: dedicated teams?
- Frequency of visits?
- Good for getting (recent) historical data for intelligence
- Not likely to be useful for early disease detection
- Sensitivity and specificity will depend greatly on case definitions
- Problem of confirmation of diagnosis (no samples)
- Use where passive surveillance cannot be made to work
- Could use as a check on passive surveillance
Take home message 1

- Passive surveillance is still the bedrock of early disease detection
- Almost all outbreaks have been discovered this way even in areas where outbreaks have already occurred
- Its coverage is wider and sensitivity higher than can be achieved by feasible active surveillance
- Passive surveillance will deliver for all TADs
- Remove disincentives to reporting
- Build collaboration with stakeholders in peace time
- Governments need to be persuaded to do this
- There is no quick fix
Take home message 2

Active surveillance programs CANNOT replace passive surveillance and MUST NOT detract from it.

Relatively infrequent active surveillance visits are unlikely to enable early detection of acute diseases with short incubation periods and duration of clinical signs.

Active surveillance should be additional to a passive surveillance system: Focus on risk concentration points.

PDS has a role if passive surveillance isn’t working and also to check how well passive surveillance is working.
Conclusions and questions

- It is government that needs to change, not owners
- They need to actively engage in dialogue with owners and their private veterinary systems
- How do we achieve this?
"Hey, wait a minute! This is grass! We've been eating grass!"