Maximising the benefits of Serological Monitoring and Reporting

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Luuk Stooker, DVM
Senior Product Manager BioChek
Forecast on food

The global spendings on food are estimated to grow until 2030 with 70%.
Forecast on meat consumption

Source: de Heus
Challenges

- Global Population:
  - 1950: ca. 2.8 bn
  - 2016: ca. 7.0 bn
  - 2050: ca. 9.0 bn

- Arable Land per Head:
  - 1950: ca. 5,100 m²
  - 2016: ca. 2,100 m²
  - 2050: ca. 1,500 m²

Source: FAO, WRI
www.Foodsecurity.nation.de
www.BioChekSMARTvet.de
Today’s trends

Doctors from South Africa

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Dr. Jeremy David O'Keeffe  MD, MRCPI
UNIVERSITY OF PRETORIA, SCHOOL OF MEDICINE, PRIMARY AVENUE AND HYPERTROPHIC MEDICINE DEPT. OF PCD-5, (CHL, MBBCh)

Query Fee: €13.00
Phone & Video: €29.99

[Ask a Query] [Get a Phone Call-back] [Video Chat]
‘Power’ is moving towards Digital

For 2017 the number of mobile phone users is forecast to reach 4.77 billion

2016 estimates, 3.4 billion people accessing the internet = 47% of world population

Businesses using data will see $430 billion in productivity benefits over their competition not using data by 2020

International Institute for Analytics

Big Data in healthcare used to predict epidemics, cure disease, improve quality of life and avoid preventable deaths

In the very near future, you could also be sharing this data with your doctor who will use it as part of his or her diagnostic toolbox

Becoming more and more important in every business segment every year
Poultry and data

How to boost poultry profits, productivity with data
Broad and fully analyzed data can improve day-to-day decision making, driving production and raising profits.

Is the poultry industry making the most of its data?
Data collection, application and sharing is now easier than ever, but is the poultry industry fully making use of the techniques and data available to it?

Putting data collection, analysis to work in managing poultry production

The value of interpretation
Yet the very information that is most important to keep farms running in the best possible way can sometimes become lost because of the growing volume of data available. Data without proper and timely interpretation are simply data. It does not offer insight into finding solutions to possible problems.
Opportunities and Challenges

One of the biggest hurdles in the quest for data-driven healthcare:
“Huge amount of data siloed in archives controlled by different doctors' surgeries, hospitals, clinics and administrative departments”

Source: Forbes

“Fast data” and “actionable data” will replace big data.
Companies should focus on asking the right questions and making use of the data they have — big or otherwise

Source: smartdatacollective
Big Data

Serology!!!
Why monitoring?

There are two major categories of diseases on a farm:
• Clinical (signs are recognized, primarily mortality)
• Subclinical (signs are not visible, primarily performance)

Diseases on a farm are costly → monitoring is a management tool

Monitoring subclinical disease requires “inside look”:
• Necropsy of “normal” flock representatives
• Serology = history of flock immune response to antigens
  ▪ Routine serology is baseline
  ▪ Serology from clinical flocks compared back to routine baseline

Source: Dr. Phil Stayer, Corporate Veterinarian for Sanderson Farms, Inc.
Serology =

*History of flock immune response to antigens*

1. **Monitor disease status of flock (serological baselines)**
   - Create different antigen (viral) baselines: IBDV, IBV, NDV, REO
   - Evaluate effects of implemented changes
   - Monitoring for freedom of diseases: AI, MG, MS

2. **Monitor quality of vaccination**
   - Live priming antigens before killed exposure: CAV, IBDV, IBV, NDV, REO
   - Evaluate effects of vaccination: CAV, IBDV, IBV, NDV, REO

3. **Diagnose flock disease challenge**
   - Routine challenges: CAV, IBDV, IBV, NDV, REO
   - Unique antigens: CastV, FAdV
Sampling frequency?

Replacement Breeder Pullets & Hens

• Who? ~ All flocks sampled
• When? ~ At least 3 times, preferably more
  – Sample prior to killed antigen exposure
  – Sample after killed antigen exposure
  – Sample late in life for antibody persistence

Broilers

• Who? ~ At least one flock per location per week, more if sick
• When? ~ Late in life as possible for maximal antibodies
Serological Baselines

• Use baselines from manufacturer as starting point

• Develop own baselines AND adjust to changes
  ▪ Vaccine program changes
  ▪ Field pressure changes
  ▪ Differences in vaccine application
  ▪ Differences in sample moments

• Regional differences are important
  ▪ Vaccine programs can differ
  ▪ Neighborly congestion

• Acknowledge normal variation
  ▪ “Normal” flocks may have range of ELISA results → trend reporting key
  ▪ Some diseases may produce mild variations (supports diagnostics)
Case 1

*Increased airsacculitis incidence*

- Complaint from the slaughterhouse. USDA plant veterinarian saw an increase in airsacculitis incidence

- Head vet of the company looked into her serology data
Case 1

“This is some pretty cool information. It is amazing how quickly the Del072 hit and spread through the complex. Both broilers and breeders are affected as it is documented in our recent serology testing.”
Case 1

“When I looked at ALL broilers and breeders the company has never seen titers like this, even in our pullets and breeders that receive an inactivated vaccine”
Case 1

*Head veterinarian comments*

“This was definitely a teaching moment to show how rapidly a new bronchitis strain could appear.”

“The complex was able to use this graphic information to explain to the USDA plant veterinarian why the plant has had a significant increase in airsacculitis. They discussed how we caught it quick and that an intervention is already in place (Del072 vaccine started last week).”

“It does mean a lot to us that we are now able to use our serological data more effectively.”
Case 2

*Egg drop and hatchability issues*

- Company using different ELISA kits from different providers
- IBD and IBV from company 1
- NDV from company 2 because of kit being OIE certified
- Multi-age farm, 6 houses
- Egg drop and hatchability issues mid lay in house 1
- Want to check IBD/IBV/NDV inactivated vaccine application
- During production revaccinated for NDV
Case 2

IBD

![Graphs showing titer groups for IBD cases.](image-url)
Case 2

IBV

Count: 23
Mean: 5112
SD: 4848
CV: 96
Min: 2218
Max: 7963
Date: 1/5/00
Dil: 1:500

Count: 23
Mean: 6177
SD: 1992
CV: 33.9
Min: 128
Max: 4988
Date: 1/5/00
Dil: 1:500

IBV
Case 2
Case 2
Case 3

Change in vaccination program

Old program:

• 3 live reovirus priming vaccines (day of age, 3 weeks, 6 weeks).
• 3 live IBD priming vaccines (2 weeks, 4 weeks, 6 weeks).
• 2 different commercial killed IBD/REO vaccines in one shot injected

New program:

• Same live program for both IBD as well as REO
• 1 commercial killed IBDV/REO and 1 autogenous reovirus vaccine in one shot

Assumed no change in IBDV or REO titers due to >100% dose
• 2 killed IBDV/REO vaccines given ensure all birds injected rather than 200% dose.
• 1 killed IBDV/REO should induce 100% response.
Case 3

Baseline titer calculations

| IBD | Mean Titer/Mean VI For All Flocks: | 9973/687 |
|     | Minimum Mean Titer/VI:             | 3317/67  |
|     | Maximum Mean Titer/VI:             | 18614/5722 |
|     | Standard Deviation of mean flock titters: | 3457 |
|     | Coefficient of variation of mean flock titters: | 35 |

![Plot showing titer calculations for different conditions](image-url)
Case 3

Baseline titer calculations

<table>
<thead>
<tr>
<th>REO</th>
<th>Mean Titer/mean VI for all flocks</th>
<th>Minimum Mean Titer/VI:</th>
<th>Maximum Mean Titer/VI:</th>
<th>Standard deviation of mean flock titers:</th>
<th>Coefficient of variation of mean flock titers:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>11908/284</td>
<td>5276/75</td>
<td>24131/768</td>
<td>4011</td>
<td>33</td>
</tr>
</tbody>
</table>

![Graph showing baseline titer calculations](image.png)
Case 3

✓ Took time to see full effect of vaccine change
  - More than one flock to see response to program
  - Older hen sera needed to see end of response

✓ Analyzing serology may reveal unseen issues
  - Assumed full dose was adequate
  - Didn’t appreciate benefit of 2X dose

✓ Analyzing serology may change behavior
  - Moved back to 2X commercial + 1 autogenous

Source: Dr. Phil Stayer, Corporate Veterinarian for Sanderson Farms, Inc.
Case 4

*Lower titers than expected*

- Big integrator in Asia
- Interpretation based upon manufacturer baselines
- NDV Titers lower than manufacturer baselines

Vaccine (application) failure?

Different baseline?
Case 4

<table>
<thead>
<tr>
<th>Assay</th>
<th>Type</th>
<th>Age Interval</th>
<th>Target Titer Range</th>
<th>Target CV Range</th>
<th>No. Flocks</th>
<th>% In Target</th>
<th>% Above Target</th>
<th>% Under Target</th>
<th>% CV OK</th>
<th>% CV High</th>
<th>% CV Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>NDV</td>
<td>BB</td>
<td>22 Week(s) - 64 Week(s)</td>
<td>10000 - 20000</td>
<td>20 - 60</td>
<td>26</td>
<td>35</td>
<td>0</td>
<td>65</td>
<td>92</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td>IBV</td>
<td>BB</td>
<td>22 Week(s) - 64 Week(s)</td>
<td>4000 - 12000</td>
<td>20 - 50</td>
<td>26</td>
<td>80</td>
<td>4</td>
<td>8</td>
<td>80</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>REO</td>
<td>BB</td>
<td>22 Week(s) - 64 Week(s)</td>
<td>7000 - 15000</td>
<td>15 - 60</td>
<td>5</td>
<td>80</td>
<td>20</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Case 4

Flock titers over time

NDV

<table>
<thead>
<tr>
<th>live (Clone36, NDV, Lasota)</th>
<th>2000 - 8000</th>
<th>3 - 5 wks</th>
<th>100%</th>
<th>100 - 400</th>
</tr>
</thead>
<tbody>
<tr>
<td>inact.</td>
<td>16000 - 25000</td>
<td>5 - 8 wks</td>
<td>100%</td>
<td>100 - 2000</td>
</tr>
</tbody>
</table>
## Case 4

### Baseline titer calculations

<table>
<thead>
<tr>
<th>NDV</th>
<th>9439</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum Mean Titer</td>
<td>6048</td>
</tr>
<tr>
<td>Maximum Mean Titer</td>
<td>13887</td>
</tr>
<tr>
<td>Standard Deviation of mean flock titers</td>
<td>2074</td>
</tr>
<tr>
<td>Coefficient of variation of mean flock titers</td>
<td>22</td>
</tr>
<tr>
<td>Number of flocks</td>
<td>26</td>
</tr>
</tbody>
</table>

### Graph

![Graph showing titer values for different houses](image)
Case 5

Increased mortality

Elevated mortality after 5th week of grow-out with respiratory signs.

- Tracheas and cecal tonsils taken at start mortality.
  - Only IBV isolated from tissue samples.
  - Serotypes isolated: Arkansas (90%) and Connecticut (10%).
- Sera taken as close to harvest as possible (9 week grow out).

Vaccination programs.

<table>
<thead>
<tr>
<th>sale date</th>
<th>in ovo</th>
<th>Day of Age</th>
<th>16-20 Days of Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>01/01/14: HVT</td>
<td></td>
<td>C2</td>
<td>AR, CT, MA</td>
</tr>
<tr>
<td>09/26/14: HVT</td>
<td></td>
<td>C2</td>
<td>AR, CT, MA</td>
</tr>
<tr>
<td>10/31/14: rHVT-NDV</td>
<td>n/a</td>
<td>AR, CT, MA</td>
<td></td>
</tr>
<tr>
<td>12/22/14: rHVT-NDV</td>
<td>n/a</td>
<td>AR, CT, MA</td>
<td>AR, CT, MA</td>
</tr>
<tr>
<td>02/09/15: rHVT-NDV</td>
<td>n/a</td>
<td>AR, CT, MA</td>
<td>CT, MA</td>
</tr>
</tbody>
</table>
Case 5

Period: 
Complex: 
Age: 
Assay: 

Weeks: 
2 Weeks(s) - 10 Weeks(s) 
IBV NDV

Start field boost
Stop field boost
Start IBV-NDV
Start 3-way field IBV
Start 2-way field IBV

Mean Titer for All
Minimum GMT:
Maximum GMT:
Standard Deviation
Coefficients of Variation

Flock: 1 bar depicts the mean (or gmt) titer per flock
Case 5
Case 5

Vaccination programs.

<table>
<thead>
<tr>
<th>Date</th>
<th>Vaccine Type</th>
<th>Sale Date</th>
<th>Age Range</th>
<th>Virus Type</th>
<th>Virus Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>01/01/14</td>
<td>HVT</td>
<td>01/01/14</td>
<td>0-16</td>
<td>NDV</td>
<td>IBV</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>AR, CT, MA</td>
<td>AR, CT, MA</td>
</tr>
<tr>
<td>09/26/14</td>
<td>HVT</td>
<td>09/26/14</td>
<td>0-16</td>
<td>NDV</td>
<td>IBV</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>AR, CT, MA</td>
<td>AR, MA</td>
</tr>
<tr>
<td>10/31/14</td>
<td>rHVT-NDV</td>
<td>10/31/14</td>
<td>0-16</td>
<td>n/a</td>
<td>AR, CT, MA</td>
</tr>
<tr>
<td>12/22/14</td>
<td>rHVT-NDV</td>
<td>12/22/14</td>
<td>0-16</td>
<td>n/a</td>
<td>AR, CT, MA</td>
</tr>
<tr>
<td>02/09/15</td>
<td>rHVT-NDV</td>
<td>02/09/15</td>
<td>0-16</td>
<td>n/a</td>
<td>AR, CT, MA</td>
</tr>
<tr>
<td>05/08/15</td>
<td>rHVT-NDV</td>
<td>05/08/15</td>
<td>0-16</td>
<td>C2</td>
<td>AR, CT, MA</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>16-20</td>
<td>B1</td>
<td>CT, MA</td>
</tr>
</tbody>
</table>

Source: Dr. Phil Stayer, Corporate Veterinarian for Sanderson Farms, Inc.
Case 6

Affected breeder flock

- Big integrated company in Europe
- Routine sampling of breeders
- No routine analysis
- 39 weeks problems occurred in flock of 6983 birds
  - Egg production down
  - Hatchability down
  - Mortality up
- Different assays run
Case 6
Case 6
Case 6

<table>
<thead>
<tr>
<th>Impact on Production</th>
<th>Costs per 6983 birds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drop in egg production</td>
<td>Loss of €1029</td>
</tr>
<tr>
<td>Total 4114 eggs lost</td>
<td></td>
</tr>
<tr>
<td>Drop in hatchability</td>
<td>Loss of €2871</td>
</tr>
<tr>
<td>Total 8203 chicks lost</td>
<td></td>
</tr>
<tr>
<td>Increase mortality rate by 2%</td>
<td>Loss of €1063</td>
</tr>
<tr>
<td>Total 140 birds lost</td>
<td></td>
</tr>
</tbody>
</table>

Total losses per 6983 birds of up to € 4 963 or > € 0.71 per BB bird
### Case 6

<table>
<thead>
<tr>
<th>Type</th>
<th>Cost per Bird (€)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IBV INFECTION BB at 39W</td>
<td>0.710</td>
</tr>
<tr>
<td>ELISA MONITORING (IBV)</td>
<td>0.014</td>
</tr>
<tr>
<td>RE-VACCINATION PROGRAM</td>
<td>0.063</td>
</tr>
<tr>
<td>(3x extra lives with combination of Mass and Variant strains)</td>
<td></td>
</tr>
</tbody>
</table>

Prevention and early detection of disease by ELISA monitoring and extra live vaccination could have saved €0.71 / bird vs. cost of €0.077 / bird

*This represents a 9 fold return on investment!*
Future

- Warning system when test results are out of range
- Customized push messages in the app
- On site barcoding system for sample submission
- Datamining
  - Disease status
  - New vaccines coming into the market
  - Compare baselines
- qPCR and serology data together in reports
Take-home messages

✓ The poultry industry continues to expand both in size as well as across borders. Good data management and analysis are critical to efficient, cost-effective production

✓ Fast and actionable data allow for quick decision making

✓ Testing without analysing results is a waste of valuable time and resources

✓ The right software provides better flock health surveillance, resulting in higher return on investment
Contact

**BioChek Netherlands**

BioChek
Fokkerstraat 14
2811 ER Reeuwijk
The Netherlands
Tel: +31 (0)182 582 592
Fax: +31 (0)182 599 360
E-mail: info@biochek.com

**BioChek USA**

BioChek
3 Southgate Road
ME 04074 Scarborough
United States
Tel: +01 (207) 883-3003
E-mail: timgoode@biochek.com