Diagnostics – taking a strategic and proactive approach to animal health

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In the context of poultry health, diagnosis has generally been applied in a retrospective or reactive way. By examining sick or dead birds, and samples taken from them, we have endeavoured to identify and understand the cause of the problem, and thus be in a position to apply appropriate measures.

In some cases, this diagnostic process would have been completed fast enough to influence the management of the sick flock and to restrict the impact of disease on others in the group.

But, identifying bacterial or viral pathogens by culture was at best slow, and at worst impossible. In most cases, the best we could do was to project the findings forward and hope that the next issue followed the same pattern. It was a case of shutting the stable door after the horse, pig or chicken had bolted, and hoping that the next animal would try to escape in the same way.

Move towards prevention

Over recent decades, our focus has moved away from cure and more towards prevention, and the insight provided by diagnostic tools has allowed us to take a more strategic and proactive approach to bird health.

Vaccination programmes and animal management can now be designed to address the specific disease challenges facing individual flocks in particular locations.

Diagnostic tools have evolved to the point where they are increasingly used to characterise the local pathogen profile, and maintain herd health by preventing likely disease threats. We have started to look forward more and try to get ahead of the game.

The application of molecular technology to the science of diagnostics is about to transform that evolution into a revolution. The advent of better diagnostic tools, such as more practical ELISA techniques, real-time PCR and next generation sequencing, mean that we can characterise animal pathogens faster and more precisely than ever before.

Pathogen sub-types can now be identified within hours of samples being taken – so veterinarians know what they are dealing with and can make informed decisions before the problem has time to develop. New, less invasive ways of sampling, such as ear notches and oral fluids, are making sampling easier and quicker, and further speeding up the process.

The presentation of many diseases is very similar and the diagnosis of disease complexes, such as swine respiratory disease (SRDC) and bovine respiratory disease (BRD), has historically been very difficult.

The development of multiple test platforms (multiplex), which can detect the presence of a range of common pathogens, provides a rapid method of characterising infections so that veterinarians know which pathogens they are dealing with. More and more of these types of test are now being developed by diagnostic companies.

Our ability to sequence the genome of specific pathogens not only means that we can differentiate between highly virulent and less virulent forms of the same pathogen, based on just minor differences in their genetic code.

For example, we can now determine exactly which type of BVD is affecting cattle in a particular area, and match it with the most appropriate commercial vaccine. In the same way, the future will see us being able to identify sensitivity markers in the genomes of bacteria and thus know which antimicrobial drug is most likely to be effective – improving outcomes and reducing the inappropriate use of antibiotics.

We may also be able to characterise the DNA of individual animals to determine optimal feed requirements for growth, and thus provide a tailored feed for each individual cow, pig or chicken. Diagnostic tools are getting much closer to the interventions, and providing nuances in the way we manage health issues.

Although the new generation diagnostics will facilitate this form of micromanagement at the individual animal level, its greatest value will probably be at the other end of the disease control spectrum: at regional or even global level.

Control even more important

Mankind's need for greater and more efficient protein production is undoubtedly putting greater pressure on animal health. Increased flock sizes mean that disease control and biosecurity are more important than ever before.

Increasing transportation of live animals, meat and meat products around the world, coupled with the huge increase in mobility of the human population, means that pathogens can spread faster and further than ever before.

They also have a greater opportunity to infect naïve populations and to develop new variants as a result of genetic drift and shift. The potential threat to the health of both

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production animals and the human population is greater than ever before.

There have been many examples of this threat in recent years, including avian influenza, swine flu, West Nile disease, and Schmallenberg virus. A good example was the emergence of porcine endemic diarrhoea (PED) virus in US swine facilities.

The symptoms were very general and resembled a transmissible gastro-enteritis (TGE), so it took a while to realise that this was actually something new.

Using phylogenetic analysis researchers were able to show that it was related to a virus in China. We do not know how it got to the US, although we suspect that it was transmitted somehow in feed. At an industry level, that allows us to look for holes in our biosecurity and to make appropriate changes. Molecular diagnostic tools have already proven their value in rapidly characterising emerging disease threats and providing clues as to their origin. This kind of information will help us to plug any holes in our biosecurity not just on-farm, but also on a regional and global level.

More importantly, it provides a means of taking a global view of disease surveillance and protecting animal health and food production for a growing population. As the risk from disease increases, the development of new and better diagnostic tools will be essential to keep pace in the 'arms race' against animal pathogens. The development of an effective disease surveillance system has been made possible by one other revolution: IT. The ability to handle and process huge amounts of information means that the data provided by modern diagnostic tools can be applied to much greater effect.

Upwards integration

At the local level, that means producers can track the health profile and disease threats on their own farms over time and thus develop an effective flock-based strategy – including vaccination, infrastructure, standard operating procedures, husbandry, etc. Not only can producers benchmark one group of birds against another, but they can also benchmark their performance against others in their area or other areas. This data can then be fed into national systems.

The combination of diagnostics and informatics means that disease data can be collected on a regional and national basis, and thus used to monitor and compare disease patterns and specific pathogens on a global basis. This gives us the potential to identify developing threats at the earliest possible point and to take action to stop regional or national challenges becoming global issues.

We have the tools to make this a reality; whether we have the will to cooperate effectively, remains to be seen.

Together with a change in the way we address poultry health issues, we will also see a change in personnel along with the need for new skills and knowledge.

Epidemiologists and statisticians will play an increasingly important role in analysing the data provided by information scientists and molecular technologists. Individual producers will have to get used to the idea of sharing information, albeit anonymously, with other producers, so that collectively all can benefit.

Governments and non-government organisations will also have to get used to sharing information on a global basis, and to taking action where required. Poultry health is rapidly becoming a global issue – and one that needs to be confronted collectively.

We are on the brink of a new way of thinking about the health of production animals. It could be argued that this is evolution rather than revolution – either way it certainly matches the rapid developments in global agriculture that we are currently seeing.

New diagnostic tools will change the way veterinarians approach the management of poultry health – giving them the means to spend much more of their time planning and implementing strategies to prevent disease, and much less time treating outbreaks of disease.

We have seen the age of treatment and the age vaccination – welcome to the age of diagnostics. ■