PEER REVIEWED

How the "Four Pillars" of Modern Diagnostics are Improving Animal Health and Welfare

Traditional diagnostic technologies – from ultrasounds and x-rays to testing kits and reagents – are a routine part of supporting good animal health through detecting disease and enabling treatment. However, recent innovations mean the field of diagnostics is moving beyond just point-in-time readings that confirm a veterinarian's suspicion about an animal's health.

Modern diagnostics encompass a much broader role that underpins the animal health ecosystem, bringing benefits from better animal welfare to greater efficiency and sustainability.

Today, diagnostic tools are not only faster and more accurate when it comes to identifying ill-health, but they are also unlocking greater capacity for prevention, pre-empting diseases and other health changes before they adversely impact an animal. In addition, through advances in surveillance and monitoring, diagnostics can provide a more complete picture of animal health than ever before, allowing veterinarians and keepers to maintain animals in good health, comfort and wellness.

Across the sector, developments in diagnostic technologies are creating new and emerging opportunities for animal health professionals by ultimately increasing veterinary intelligence. With more and better data, and new ways to interpret and aggregate it, veterinarians can make clinical decisions with a deep understanding of their patient's condition, genetics, underlying health and more. All of this points to a revolution in how animals are raised, cared for and treated.

From disease prevention to heightened, more holistic surveillance, seizing upon the "four pillars" of modern diagnostics technologies presents veterinarians and other professionals with an unprecedented opportunity to optimise both the wellness and wellbeing of the animals they treat.

Surveillance

To begin with, new technologies and systems that monitor animal health are providing veterinarians and health agencies with more insight, both at macro and micro levels.

For example, technologies driven by diagnostics can track the prevalence and movement of specific diseases and parasites, which is vital at a macro level for maintaining infection control and bio-secure borders when it comes to the livestock trade. This information can also be shared with pet owners so they can take precautionary steps, including vaccination, other preventatives, and treatments to protect their pets from infection and the people around them.

The Companion Animal Parasite Council, for example, produces a parasite forecast map[1] to give county-level assessments of health risks to pets across the US, helping veterinarians and pet owners make informed choices based on clear science when developing parasite prevention strategies. This is essential since certain parasites are moving into new territories and the "traditional" risks for many regions may no longer be accurate. However, this is reliant upon pets receiving regular, widespread testing to ensure an accurate picture of prevalence and movement.

Such detailed surveillance of disease spread also plays a key role in One Health policies and approaches, particularly when it comes to vector-borne zoonotic diseases that pose a threat to both animals and people. Similarly, diagnostics can highlight where a disease is spreading to new areas, often now as a result of climate change and rising temperatures that allow parasites to thrive in different parts. This is crucial in ensuring that that the right control and treatment products are directed to affected areas.

Meanwhile, diagnostics also offer an essential surveillance tool on farms, where regularly screening for a disease like influenza or porcine reproductive and respiratory syndrome (PRRS) can give an indication of a potential disease outbreak before it takes hold. Recent advances in digital diagnostics mean that blood, urine and tissue samples can now be analysed on-site, increasing the speed, accuracy and efficiency of identifying a health issue, which means veterinarians and farmers can treat a developing outbreak before it becomes symptomatic and starts spreading.

However, effective surveillance relies upon effective sampling. Ensuring that farmers and veterinarians understand the need to test a representative sample of herds or flocks is crucial to unlocking the preventive value.

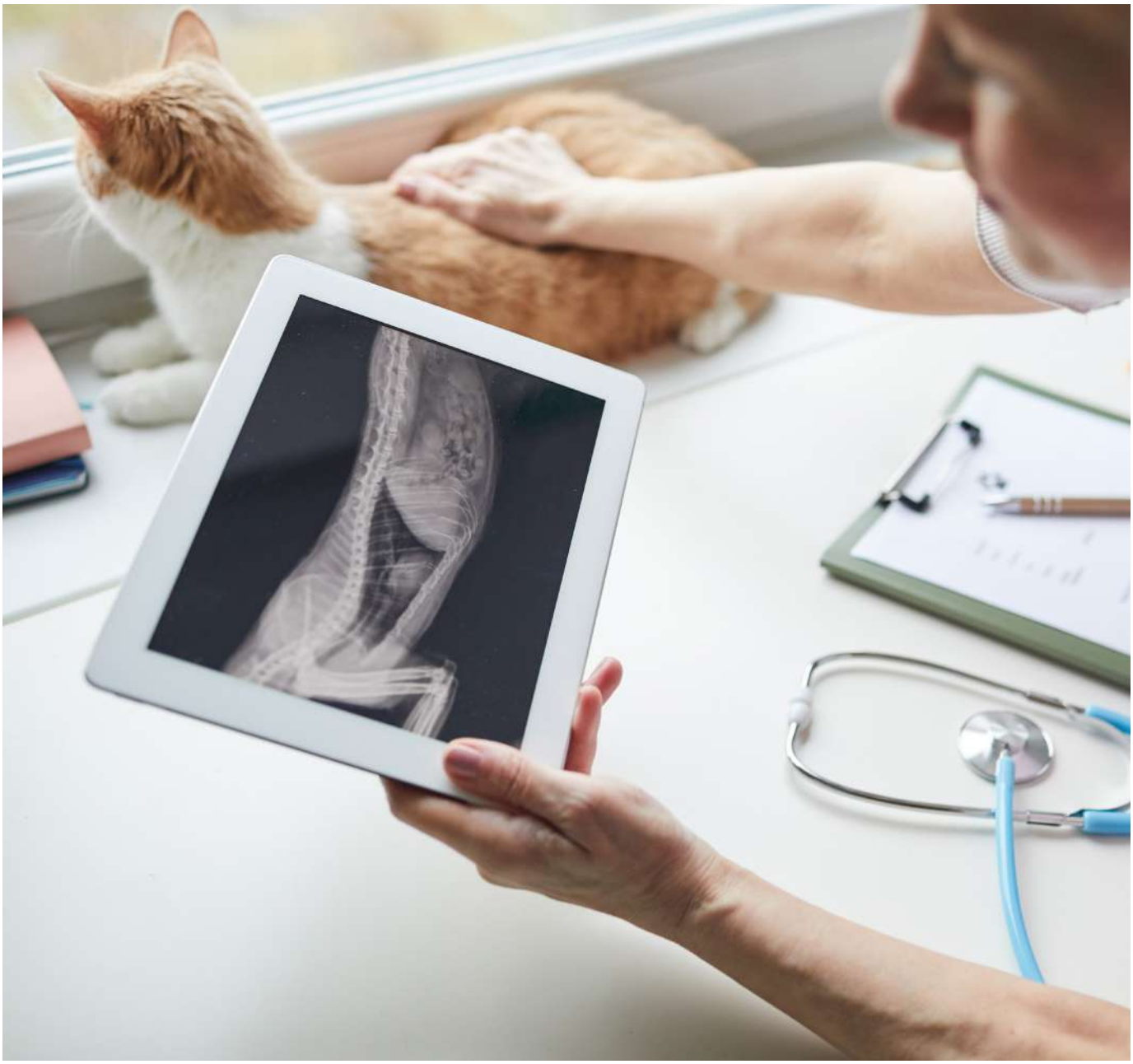
Developments in automated monitoring, such as microphone sensors, heat and motion cameras, and pedometers, have also relieved the burden of observation on an ongoing basis, streamlining the process of managing herd health in a way that would be unviable without the help of technology. With an estimated one in every five[2] farm animals typically lost to disease every year, this kind of surveillance can translate to savings on farms, gains for animal welfare and lower levels of emissions, not to mention more food reaching the supply chain.

Prevention

The rise of digital diagnostics, machine learning and the connectivity of the Internet of Things is fuelling a generation of powerful disease prevention tools that harnesses new capabilities to capture and analyse health indicators.

For example, smart ear tag monitoring devices can digitally report back every 20 minutes on four aspects of cattle health: eating, movement, heat detection and fertility, allowing monitoring systems to flag the earliest sign of change that might indicate an illness before it manifests. Complementing this with rapid, point-of-care diagnostic testing means an illness can be detected, diagnosed, and treated before it has a chance to spark a wider outbreak or spill over to people.

Meanwhile, "Big Data" can transform an animal's existing health and diagnostic records into a tool of prevention, identifying the subtle onset of chronic illnesses before they take hold and harm an animal's wellbeing. And when scaled up regionally, nationally, and even globally, animal health records become greater than the sum of their parts. Powered by tools like artificial intelligence, "patient-like-mine" platforms



can cross-reference health characteristics and predict the likely health trajectory of an animal based on comparisons to other similar profiles. Veterinarians can then model potential treatments and consider how similar patents have responded.

Genomic sequencing provides another tool in the prevention toolbox, allowing veterinarians to build a more comprehensive health profile for an individual animal to allow them to identify not only disease but genetic predispositions to disease and response to different treatments. Such technology enables the veterinarian and owner to develop a health plan directly tailored to the animal that aims to avoid certain conditions, detects them quickly if they occur and enables custom treatment protocols based on their genetic profile. This ultimately can lead to a longer, healthier life for the pet.

Wellness

Diagnostics are not only instruments of disease detection; they also provide a window into overall wellness, which is much more than the absence of infection. The vast amounts of data that veterinarians are now able to collect thanks to improved diagnostic technologies are helping to produce a more informative animal health "baseline", which has multiple implications and advantages.

When used regularly, diagnostics allow veterinarians to understand an animal's typical health indicators, such as blood cell counts or urine gravity, which varies from animal to animal. This can then be complemented by monitoring tools that help track how it feeds, its behaviour, its activity, and other signs of wellbeing.

Using this information, veterinarians can track health trends, recognise subtle indicators of change, and quickly diagnose serious problems such as kidney or liver disease, which, without the underlying baseline data, may remain hidden.

For example, regular thyroid panels provide a clear picture of an animal's typical hormone levels, a critical regulator of an animal's metabolism. Minor shifts in this can lead to hypothyroidism, which causes weight gain, energy loss, and recurring infections, among other health issues. Understanding an animal's baseline hormone level enables a veterinarian to

see when even minor shifts are occurring rather than relying on "typical" ranges for a breed, size, and age profile.

Urinalyses are an important part of kidney assessment and can also help detect illnesses like diabetes. However, the physical and chemical properties of each pet's urine will differ, which is why setting a baseline and tracking its profile offers a much deeper understanding of an individual pet.

The indicators of kidney disease or urinary inflammation can often be subtle at first and a close understanding of a pet's unique urine properties mean the first indicators can be better recognised, enabling early action that avoids unnecessary discomfort for a patient.

Such baseline data can also be used alongside the big "patient-like-mine" tools, which refer veterinarians to previous treatments to guide their own case-by-case clinical decisions.

With a clearer picture of what "good health" means for each individual animal, veterinarians can be better placed to respond when a change in health status occurs, and tailor care and treatment plans to be most effective. Such developments have contributed to the rising life expectancy of pets, with the average dog in the US living[3] 11.8 years in 2016, up from 10.5 years in 2002.

Medicalisation

Finally, modern diagnostics is the key to optimising medicalisation. Without the right information from an accurate diagnosis, it is impossible to effectively treat, create health plans, or understand hidden or underlying issues that an animal may have.

Ultimately, diagnostics is data, data is knowledge, and knowledge is power – in this case, the power to act in a way that achieves better health outcomes for each animal.

With preventative and predictive innovations in diagnostics, such as AI-powered tools, veterinarians are now able to parse this vast amount of data and identify diseases earlier, enhancing the probability that medicines will deliver a positive and timely impact in each case.

Likewise, more accurate diagnostic data is also helping to inform more responsible and sustainable use of antibiotics, which helps to reduce the threat of antibiotic resistance and its risks for both people and animals.

With more diagnostic data available, veterinarians can take more informed decisions about when, and if, antibiotics are required, and are able to apply other treatments and interventions before antibiotics may become necessary. For example, regular screening of herd and flock samples allows livestock veterinarians to identify a potential outbreak before it spreads among large numbers.

This empowers veterinarians and farmers to firstly isolate the affected animals and limit the outbreak, and secondly, to determine whether a pre-emptive group treatment is needed to nip the disease in the bud. Moreover, it is now a requirement in the EU to have a clinical diagnosis before administering antibiotics, making reliable diagnostics crucial to the welfare of animals facing bacterial disease.

Furthermore, the knowledge derived from diagnostics also enables precision therapies that are tailored to the individual animal's medical condition. For instance, within the field of oncology, deeper understanding of a pet's genetics can help a veterinarian select a treatment protocol specific to that animal versus plans developed for the wider breed or even species. This can lead to higher probability of treatment success.

Conclusion

Across the board, technological innovations are creating a more active role for diagnostics, helping veterinarians to take a proactive, rather than reactive, approach towards animal wellness and wellbeing.

Ultimately, the sustainability of caring for animals, whether livestock or pets, hinges on the capacity to deliver good animal health and wellbeing, and diagnostics play a fundamental role. From extending the life expectancy of pets through new tools that better monitor their baseline wellness to reducing the losses of food-producing animals to disease, the ability to monitor, identify and treat health changes comes back to diagnostic technologies.

And not only do innovations that increase the efficiency, accuracy and functionality of diagnostics allow animals to remain in good health, they allow animals to thrive and reach their full potential, bringing benefits for people and planet.

With more than half of households in major markets[4] owning a pet, the ability to provide a longer, healthier life reinforces the human-animal bond and allows pet owners to enjoy more years of valuable companionship. Similarly, as demand rises around the world for meat, milk and eggs, livestock health is an increasingly important driver of productivity and sustainability, with positive impacts for food, nutrition and economic security. Just five animal diseases made up two-thirds of outbreaks[5] between 2000 and 2016, impacting global food production and trade, making early and comprehensive diagnosis a tool of economic growth.

In sum, these key developments in modern diagnostics technologies have transformed how animal health professionals plan for, and deliver, healthcare to animals. Early interventions to track, stop or treat a disease reduces the burden of ill-health – on animals, their guardians and society at large, with animal diseases directly impacting the income, employment, disease risk and food security of billions of people worldwide. The "four pillars" of modern diagnostics are upholding more than ever, that prevention is better than cure, supporting the foundation for healthier and happier animals.

REFERENCES

1. https://petdiseasealerts.org/forecast-map/#/
2. https://www.oie.int/fileadmin/Home/eng/Media_Center/docs/pdf/Key_Documents/ANIMAL-HEALTH-EN-FINAL.pdf
3. https://www.reuters.com/article/us-money-pets-longevity/your-money-as-pets-live-longer-they-may-need-long-term-health-care-idUSKCN11J25D
4. https://www.gfk.com/insights/mans-best-friend-global-pet-ownership-and-feeding-trends
5. https://www.oie.int/fileadmin/Home/eng/Publications_%26_Documentation/docs/pdf/TT/2016_A_84SG_9.pdf

Carel du Marchie Sarvaas

Carel du Marchie Sarvaas, executive director of the global animal health association HealthforAnimals