

# vet

January 2023

Veterinary Emerging Topics (VET)<sup>™</sup> Report



## The impact of Big Data in veterinary medicine



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Since 2017, Banfield Pet Hospital® and the North American Veterinary Community (NAVC) have collaborated on a [series of Veterinary Emerging Topics \(VET\)™ Reports](#). They focus on combining the power of data with open, solution-based dialogue to enhance patient outcomes in veterinary care. Past reports have centered on [antimicrobial agents](#), [osteoarthritis](#) and [obesity](#), and [quality and safety improvement in veterinary medicine](#). In the 2023 VET Report, we look closely at the data that support these efforts and how they impact the veterinary profession, the pets, and the people we serve.

Thanks to digital technologies and sophisticated analytical techniques, we can collect and process larger amounts of more diverse data faster than before. This use of Big Data can uncover patterns and insights that are otherwise hidden. Its power has revolutionized nearly every industry. In human healthcare, Big Data creates opportunities to improve the monitoring, control, and treatment of diseases as well as hospital and health system operations.

This report presents several examples of how Banfield uses data to impact veterinary healthcare for the entire profession. Identifying risk factors for anesthesia-related mortality led to the development of medical quality standards to make anesthetic procedures safer for pets. Modeling renal disease enabled the identification of at-risk pets, facilitating early detection and increasing time for intervention. Analyzing rare adverse reactions to vaccines helped us to recognize risk factors so teams can tailor their care to minimize each pet's risk. Comparing antimicrobial usage with new industry guidelines showed where we can modify practices to ensure the future efficacy of these agents.

Each of these insights was fueled by Big Data. More than three million pets visit Banfield's 1,000+ locations every year. Although the scale of Banfield's data is unique, the knowledge it yields can be applied across the profession.

Banfield and NAVC partnered to produce this report in pursuit of our shared goals to advance the veterinary profession and improve veterinary medicine. Our purpose at Banfield is simple: A BETTER WORLD FOR PETS. At NAVC, we strive for a world in which all veterinary healthcare teams thrive. We hope this report inspires you to put data to work in your practice by implementing the action steps outlined in our examples or instituting your own data and analytics programs. Together, we can realize the promise of Big Data to create a positive impact in veterinary healthcare.

Respectfully,

Molly McAllister, DVM, MPH  
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[Banfield Pet Hospital](#)

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Chief Veterinary Officer  
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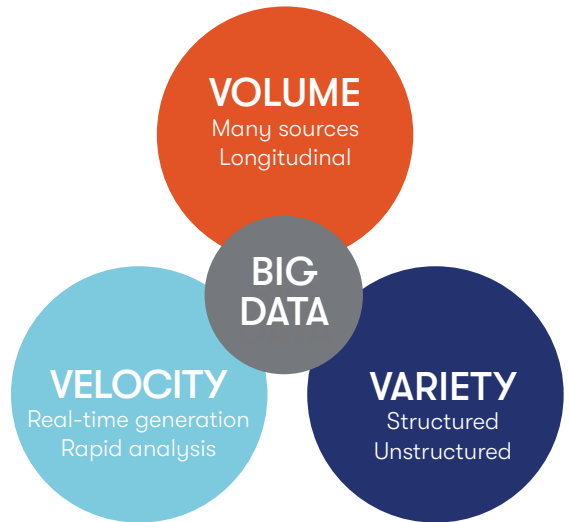
# Big Data in veterinary medicine

The adoption of digital technologies has profoundly changed how we generate data. The quantity and diversity of the information we collect and the speed at which it's collected are increasing exponentially. The term Big Data was coined to describe datasets that are large, complex, and rapidly accumulating. These datasets overwhelm traditional methods of data management with their volume, variety, and velocity. But new algorithms and analytical approaches can reveal relationships and trends that would otherwise remain undiscovered.

Insights from Big Data have transformed how organizations operate across many sectors of the economy, from retail to entertainment to healthcare. In healthcare, Big Data has changed our understanding of health and disease, patient care, and hospital management. Trends in veterinary medicine often follow shifts in human healthcare, and the Big Data revolution is no exception. In animal health, Big Data can help to identify high-risk populations, model epidemiological processes, monitor trends, and detect emerging threats.<sup>1</sup> Data collected longitudinally and at regular intervals over the patient's lifespan are ideal to inform our understanding of health and disease in both pets and people.<sup>2</sup>

Key to maximizing the value of Big Data in veterinary medicine is embracing the digital technologies that power it, such as electronic medical records and advanced data management systems. Information stored in paper records doesn't easily lend itself to the analyses needed to derive insights. The data structure is also important. Unstructured data (such as free text notes) can be time and resource intensive to analyze, and even structured data can prove challenging if the structure is unique to a practice or practitioner. Aggregating patient records to yield population-level insights requires data cleaning, standardization, and transformation, which can be expensive and labor-intensive.

## Challenges with Big Data



# Creating impact with Big Data

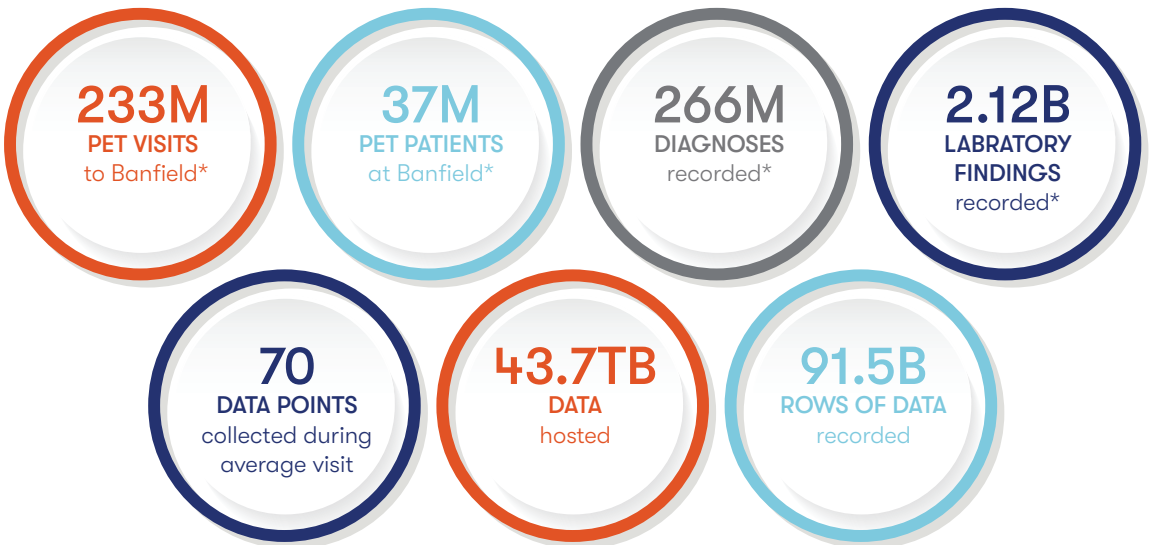
Banfield Pet Hospital uses a proprietary data and electronic medical records (EMR) system that was initially built in 1994. The EMR system captures both structured data (e.g., diagnoses, examination findings, laboratory test results, treatments/services) and unstructured data (e.g., medical notes).

Data from pet visits to more than 1,000 Banfield locations across the country are sent to our headquarters daily, where our research team can study them at scale. As of 2021, Banfield's EMR includes data from more than 9.5 million visits and 3.5 million pets, with an average of about 70 data points recorded per visit. We use these data to monitor trends in pet health and disease, to improve quality in veterinary medicine, and to strengthen our hospitals. We are dedicated to sharing our findings with the veterinary community.

In this report, we will feature some examples of how we use Big Data to create impact in veterinary medicine:

- Reducing anesthesia-related mortality
- Identifying pets at risk of renal disease
- Recognizing risk factors for vaccine-associated adverse events
- Enhancing antimicrobial usage and pharmaceutical stewardship

## BY THE NUMBERS Banfield's EMR system



\*These numbers represent the data collected since the inception of of Banfield's EMR system in 1994, up until October 2022.



# Big question

## Can we make anesthesia even safer?

Although it is rare, even small reductions in anesthesia-related mortality can have enormous significance for patients, clients, and veterinary teams. As part of the quality improvement program at Banfield, we focused on reducing anesthesia-related mortality in dogs and cats.<sup>3</sup>

### Big Data

We first collected peer-reviewed literature, professional guidelines, and position statements for information on systemic or universal risks inherent to any anesthetic procedure. We also scrutinized internal medical records and safety reports to recognize local risks that vary by hospital and veterinary team.<sup>4</sup> Having thus identified the systemic and local risks associated with anesthesia, we developed and implemented [medical quality standards \(MQS\)](#) to mitigate them.<sup>5</sup> We monitor anesthesia-related mortality on an ongoing basis through Banfield's EMR system.

### Big impact

Six months after the implementation of MQS, mortality rates decreased, preventing at least one additional death per 10,000 procedures. We have seen ongoing and sustained reductions in these rates and, to date, have recorded the lowest mortality rates ever measured. Even with this positive impact, we will continue to 'chase zero' and continuously utilize data to make improvements where possible.

### Put this into your practice

Review the MQS<sup>6</sup> and our other [resources on anesthesia](#).<sup>7</sup> Compare the performance at your practice to ideal standards and consider any gaps as potential opportunities for quality improvement.<sup>7</sup>





# Big question

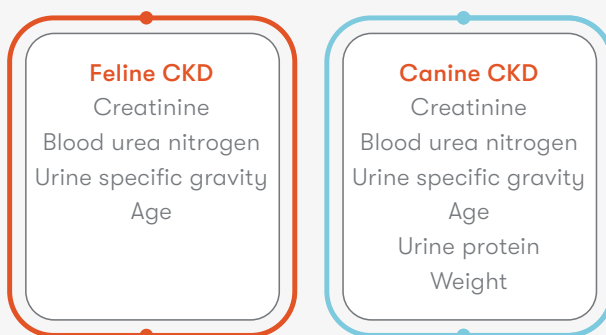
Which pets are most likely to develop chronic kidney disease?

Chronic kidney disease (CKD) occurs in an estimated 10% of senior cats<sup>8</sup> and 0.5–1.0% of dogs<sup>9</sup> in the United States, with a higher incidence in some populations. CKD is the leading cause of mortality in cats >5 years of age<sup>9</sup> and generally has an even worse prognosis in dogs.<sup>10</sup> Identifying pets at greatest risk of developing CKD creates the opportunity to monitor them closely for early signs of disease, and potentially provide interventions that may slow the onset of disease.

## Big Data

Our medical record data was used to build models for predicting the risk of developing CKD in cats and in dogs by applying advanced machine learning methods to data collected during routine veterinary practice visits. Data from about 910,000 cats and 6.5 million dogs who visited Banfield locations during a 22-year period was used. Four risk factors useful in predicting feline CKD and six risk factors useful in predicting canine CKD were found. One year prior to the diagnosis of chronic kidney disease, the feline model had a sensitivity of 63% while the canine model showed sensitivity of 68%. Each model had strong rule out capabilities with a specificity of 99% and negative predictive value of 99% respectively.

### Components of predictive models for CKD in cats and dogs

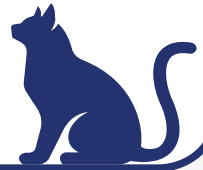


## Big impact

Machine learning applied to Big Data can support veterinary decision-making by improving early detection of CKD and potentially, other serious conditions. Early detection provides a greater opportunity for intervention, which can result in a better quality of life and longer survival. As these models are new, the best interventions with the most impact are still being determined. Options include early dietary therapy, minimal use of nephrotoxic medications, and avoidance of hypotensive episodes during anesthesia. Because they rely on data already collected during routine veterinary practice, the models could be readily implemented in hospital practice or diagnostic laboratory software, such as [RenalTech](#), to directly support veterinarians making clinical decisions.

### Put this into your practice

Early detection may rely on regular testing, so if you suspect a pet might be at risk for CKD (due to history, genetic susceptibility, or other factors), emphasize the importance of biannual or annual office visits and blood and urine sample analysis.







# Big question

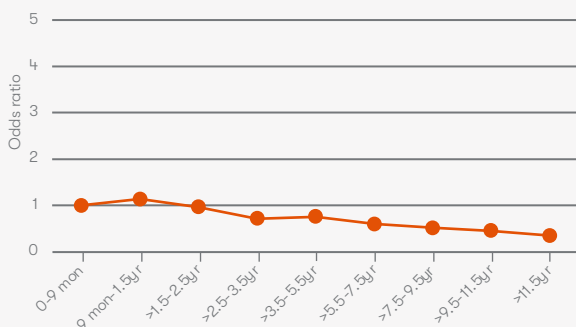
## How common are vaccine-associated adverse events?

Vaccine-associated adverse events (VAAEs) are rare, but clients who are concerned about them may decline or delay their pets' vaccinations, leaving them vulnerable to preventable infectious diseases. Veterinary teams need accurate information about VAAEs to inform veterinary risk assessment and client communication regarding vaccination.

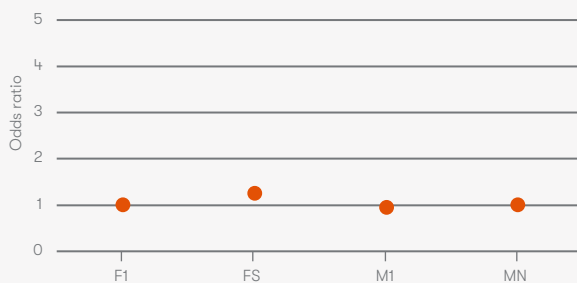
### Big Data

In 2005, we partnered with Purdue University's College of Veterinary Medicine to analyze the incidence and possible risk factors of VAAEs in 1,226,159 dogs vaccinated from 2002 to 2003.<sup>10</sup> We recently completed what we believe to be the largest VAAE study of dogs to date – a similar analysis of canine VAAE incidence and risk factors in almost five million dogs vaccinated from 2016 to 2020.<sup>11</sup> Incidence in this more recent analysis was 18.4 VAAEs per 10,000 dogs vaccinated, less than half what it was more than 15 years ago (38.2 VAAEs per 10,000 dogs vaccinated).<sup>12</sup> Smaller dogs, particular breeds of dogs, and those receiving multiple vaccines in the same visit were more likely to experience a VAAE.<sup>12</sup>

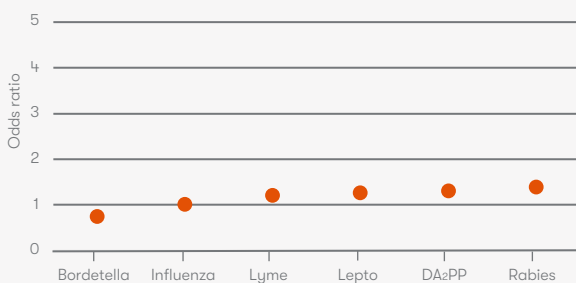
### Age categories



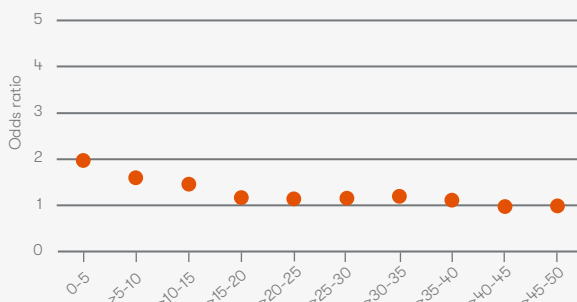
### Sex and neuter status



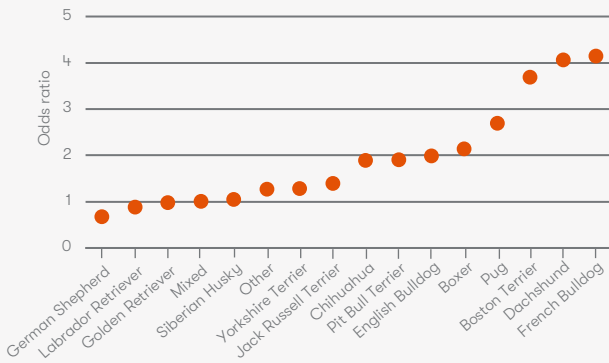
### Individual vaccines



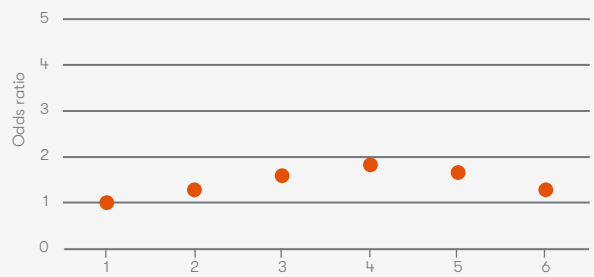
### Weight categories (kg)



## Selected breeds



## Number of vaccines



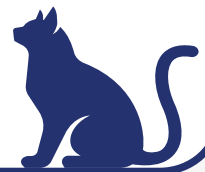
### Big impact

The large drop in the overall incidence of VAAEs over time suggests that newer vaccines are safer. This likely speaks to the diligence and responsibility of vaccine manufacturers to make their products as safe and effective as possible.

The variation in incidence among breeds suggests that genetic factors may influence the risk of VAAE the most. To follow up on this possibility, we are partnering with [Wisdom Panel](#), the world's leading pet DNA service, to better define the at-risk population. Using Big Data on genomics, we are investigating genetic mutations or markers that might predict an individual animal's risk of VAAE. Additional studies on feline VAAEs are planned, as well as an in-depth investigation into the potential role of vaccination in the development of certain immune-mediated disorders.

### Put this into your practice

Personalize your vaccine recommendations for each pet, considering age, size, breed, and lifestyle. If a pet has experienced a VAAE or has one or more risk factors for a VAAE, discuss options with your clients to minimize future risks including altering vaccine schedules.





# Big question

Do updated professional guidelines present new opportunities to improve antimicrobial stewardship?

Urinary tract infections (UTIs) are a common indication for antimicrobial use in veterinary medicine. When the International Society for Companion Animal Infectious Diseases (ISCAID) updated its guidelines for diagnosing and treating UTIs in pets,<sup>13,14</sup> we wondered whether the new guidelines could present opportunities to improve antimicrobial stewardship. Banfield and all of the Mars Veterinary Health practices are dedicated to promoting antimicrobial stewardship as part of our [commitment to sustainability](#).

## Big Data

We analyzed laboratory testing (urinalysis, culture, and sensitivity) and antibiotic prescription practices (drug type, dosage, and duration) for 58,164 dogs and 23,505 cats who were diagnosed with UTIs at Banfield hospitals from May 2020 to May 2021.<sup>15</sup> We compared those diagnostic and prescription practices with the new ISCAID recommendations for UTIs to identify possible opportunities to reduce antimicrobial usage.

We found that while the ISCAID-recommended first-line treatments for UTIs were frequently utilized, cefovecin (a long-acting, injectable antimicrobial) was sometimes used as a first-line treatment. When we surveyed veterinarians about their antibiotic prescribing practices, main drivers of decision-making included concerns of patient noncompliance or owner preference. We also noted this trend in our 2017 and 2018 VET™ Reports on antimicrobial usage in cats.<sup>16</sup> Engaging clients in conversations about responsible antibiotic use and treatment plan compliance and employing fear-free and low-stress handling methods may help encourage the use of recommended first-line treatments and facilitate compliance with treatment plans at home.

The new ISCAID guidelines also recommend a shorter duration of treatment for UTIs than has historically been used, which could substantially reduce antimicrobial drug dispensation.

## Big impact

The judicious use of antimicrobial agents is essential to limit the development of resistant microorganisms<sup>17</sup> and preserve our long-term ability to provide high-quality medical care to both pets and people.

### Put this into your practice

Keep abreast of updates to professional guidelines and seek out opportunities to improve diagnostic and prescribing practices. Helpful resources include the [2022 AAFP/AAHA Antimicrobial Stewardship Guidelines](#)<sup>18</sup> and the [International Society for Companion Animal Infectious Diseases \(ISCAID\) antimicrobial guidelines](#)<sup>19</sup>.



# The future of Big Data in veterinary medicine

Realizing the full potential of Big Data to improve disease detection, delivery of care, and sustainability in veterinary medicine will require consistent, collaborative efforts to collect the necessary information. Several veterinary data repositories have been developed by academic and nonprofit institutions across the world,<sup>20</sup> and some have collected tens of millions of records already.<sup>21</sup>

Recently, Associates from Banfield and [Mars Veterinary Health](#), along with their colleagues at [Mars Petcare](#), have teamed up to develop the biggest dataset in veterinary medicine yet.<sup>22</sup> The [MARS PETCARE BIOBANK™](#) will include data collected from 10,000 dogs and 10,000 cats over a 10-year period from routine wellness checks, blood and fecal tests, genome sequencing, gut bacteria analysis, and home environment and lifestyle (as reported by owners using standardized questionnaires).

Analyzing these data will yield real-world insights into pet health that will one day empower pet owners and veterinary teams to personalize care for every dog and cat, a peek into the future of veterinary medicine.

## Conclusion

Banfield and NAVC hope you will join us in using Big Data to advance veterinary medicine. Each example presented in this report includes actions that you can take in your own practice. You can also consider expanding your use of electronic medical records and other digital technologies, conducting data and analytics work at your hospital, or contributing to one of the large data aggregation efforts in progress. In each case, you'll be improving the quality of veterinary medicine and advancing pet health. Those improvements in pet health will only be accelerated when we collaborate and contribute to Big Data.

## References and resources

1. VanderWaal K, Morrison RB, Neuhauser C, et al (2017) Translating Big Data into Smart Data for Veterinary Epidemiology. *Frontiers in Veterinary Science* 4, 110.
2. Paynter AN, Dunbar MD, Creevy KE, et al (2021) Veterinary Big Data: When Data Goes to the Dogs. *Animals* 11, 1872.
3. Banfield Pet Hospital. Veterinary Emerging Topics Report 2022. <https://www.banfieldexchange.com/VET-Report>
4. Matthews NS, Mohn TJ, Yang M, et al (2017). Factors associated with anesthetic-related death in dogs and cats in primary care veterinary hospitals. *Journal of the American Veterinary Medical Association* 250, 655-665.
5. Morrison JA, Spofford N, Yang M, et al (2022) Development and implementation of veterinary anesthesia medical quality standards for primary care. *Veterinary Anaesthesia and Analgesia* 49, 233-242.
6. Banfield Pet Hospital. Anesthesia Medical Quality Standards. <https://www.banfieldexchange.com/Anesthesiaresources>
7. McAllister M (2022) The 4 I's of quality improvement in veterinary medicine. *dvm360*. <https://www.dvm360.com/view/the-4-i-s-of-quality-improvement-in-veterinary-medicine>
8. Bradley R, Tagkopoulos I, Kim M, et al (2019) Predicting early risk of chronic kidney disease in cats using routine clinical laboratory tests and machine learning. *Journal of Veterinary Internal Medicine* 33, 2644–2656.
9. Kokkinos Y, Morrison J, Bradley R, et al (2022) An early prediction model for canine chronic kidney disease based on routine clinical laboratory tests. *Scientific Reports* 12, 14489.
10. Moore GE, Guptill LF, Ward MP, et al (2005) Adverse events diagnosed within three days of vaccine administration in dogs. *Journal of the American Veterinary Medical Association* 227, 1102-1108.
11. 2022 American College of Veterinary Internal Medicine Forum, Austin, TX.

12. Adverse events diagnosed within three days of vaccine administration in dogs. Moore GE; Guptill LF; Ward MP; Glickman NW; Faunt KK; Lewis HB; Glickman LT. <https://pubmed.ncbi.nlm.nih.gov/16220670/>
13. International Society for Companion Animal Infectious Diseases. Guidelines and Consensus Statements. <https://www.iscaid.org/guidelines>
14. Weese JS, Blondeau J, Boothe D, et al (2019) International Society for Companion Animal Infectious Diseases (ISCAID) guidelines for the diagnosis and management of bacterial urinary tract infections in dogs and cats. *Veterinary Journal* 247, 8-25.
15. Weese JS, Webb J, Ballance D, et al (2021) Evaluation of antimicrobial prescriptions in dogs with suspected bacterial urinary tract disease. *Journal of Veterinary Internal Medicine* 35, 2277–2286.
16. Banfield Pet Hospital. Veterinary Emerging Topics Report 2018. <https://www.banfieldexchange.com/VET-Report>
17. Banfield Pet Hospital. Veterinary Emerging Topics Report 2017. <https://www.banfieldexchange.com/VET-Report>
18. 2022 AAFP/AAHA Antimicrobial Stewardship Guidelines. <https://www.aaha.org/aaha-guidelines/2022-aafpaaha-antimicrobial-stewardship-guidelines/home/>
19. International Society for Companion Animal Infectious Diseases (ISCAID) antimicrobial guidelines. <https://www.iscaid.org/guidelines>
20. Association for Veterinary Informatics. National Data Aggregation Projects. <https://www.avinformatics.org/National-Data-Aggregation-Projects>
21. Cima G (2022) Researchers see hope, progress in big data. *AVMA News*. <https://www.avma.org/news/researchers-see-hope-progress-big-data>
22. MARS Petcare Biobank. <https://marspetcarebiobank.com/>



