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**Use of cefovecin in a UK population of cats attending first opinion practices as recorded in electronic health records.**

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**KEYWORDS**

Antimicrobial, prescribing, indications, compliance

## **ABSTRACT**

**OBJECTIVE.** To use electronic health records to describe the use of cefovecin (Convenia; Zoetis UK), a third generation long-acting injectable antimicrobial, in a UK population of cats attending first opinion practice and to compare the use of Convenia to the licenced uses described on the UK Convenia datasheet.

**METHODS.** Data were obtained as an excel database from the Small Animal Veterinary Surveillance Network for all feline consultations containing the word Convenia and/or cefovecin from 1<sup>st</sup> September 2012 to 23<sup>rd</sup> September 2013 inclusive. Entries were classified according to body system treated, confirmation or suspicion of an abscess, evidence of microbiological evaluation being performed, any concurrent therapies given, and whether any reason was given for use of Convenia over alternative antimicrobials. Data were exported to IBM SPSS Statistics and descriptive analysis performed.

**RESULTS.** In total, 1,148 entries were analysed. The most common body system treated was skin in 553 (48.2%) entries, then urinary (157, 13.7%) and respiratory (112, 9.8%).

Microbiological evaluation was recorded in 193 (16.8%) entries, with visible purulent material most commonly cited in 147 (12.8%) entries. A reason for prescribing Convenia over alternative antimicrobials was given in 138 (12%) entries; the most cited was an inability to orally medicate the cat in 77 (55.8%) of these entries. Excluding 131 entries where no body system or multiple body systems were described, the use of Convenia complied with a licenced use in the UK datasheet in 710 (69.8%) of 1017 entries.

**CONCLUSION.** Most administrations were licensed uses however most entries did not describe any microbiological evaluation nor a reason for prescribing Convenia over alternative antimicrobials. Further education of the public and the veterinary profession is needed to promote antimicrobial stewardship in the UK. Health records provide a valuable tool to monitor both locally and at scale the use of important therapeutics like antimicrobials.

Information relevant to decision making should be recorded in individual animal health records.

## INTRODUCTION

Antimicrobials can be classed according to the microorganism they are acting against and can include antibiotics, antifungals and antiseptics. In the UK all veterinary antibiotics are prescription-only medicines (POM-V); therefore the responsibility for and control of antibiotic use rests with the prescribing veterinarian<sup>1</sup>. In this study, antibiotics are referred to by the more widely used term antimicrobials.

Antimicrobial resistance (AMR) is a global health concern in humans and animals<sup>2</sup>. There is much interest in determining ways to reduce AMR by advocating responsible veterinary antibiotic use including projects such as the Small Animal Medicine Society (SAMSoc) and British Small Animal Veterinary Association (BSAVA) Antibiotic Usage Guidelines<sup>3</sup>, and the Federation of European Companion Animal Veterinary Associations (FECAVA) European Antibiotic Use Guidelines<sup>4</sup>. In the UK around half of practices are members of the Royal College of Veterinary Surgeons Practice Standards Scheme. A component of this Scheme requires practices to demonstrate they use antimicrobials responsibly and are accountable for the choices made in such use<sup>5</sup>. One way to demonstrate this is to have local antimicrobial policies and/or use set protocols for treatment of common diseases and promote use of first line, licenced treatment choices. Notwithstanding this guidance, the use of written antimicrobial usage protocols is limited in general veterinary practice<sup>6</sup> although recent awareness may have increased their usage<sup>7</sup>.

Whether there is a genuine cause and effect of veterinary antimicrobial use and AMR in people is a contentious and complex issue, but at a basic level veterinarians have a professional responsibility to reduce AMR. This can be achieved through better understanding of appropriate antimicrobial use.

Cefovecin (Convenia; Zoetis UK) is a long-acting third generation cephalosporin injectable antibiotic, widely used in cats<sup>6</sup>. Convenia is the only cefovecin available for use in small

animals in the UK<sup>8</sup>. In human medicine, third generation cephalosporins are classed as ‘Critically Important Antimicrobials’<sup>9</sup>. It is accepted that reducing use of this class of drug conforms to antimicrobial stewardship<sup>10</sup> especially if adopting a ‘One Health’ approach with co-ordinated prudent use of antimicrobials in both human and veterinary medicine.

In the UK, Convenia is licenced for use in cats for the treatment of skin and soft tissue abscesses and wounds associated with *Pasteurella multocida*, *Fusobacterium* spp., *Bacteroides* spp., *Prevotella oralis*,  $\beta$  haemolytic Streptococci and/or *Staphylococcus pseudointermedius* and for treatment of urinary tract infections (UTIs) associated with *Escherichia coli*. A single subcutaneous dose of 8.0 mg/kg Convenia has a 14 day duration of activity<sup>8</sup>, currently the only injectable veterinary antimicrobial in the UK to provide more than 48 hours of action. Convenia is therefore unique in providing guaranteed compliance alongside broad spectrum, long-acting activity.

Data on the use of antimicrobials are available through surveillance systems such as the Small Animal Veterinary Surveillance Network (SAVSNET), a scheme established in 2008, becoming a joint venture between BSAVA and the University of Liverpool. SAVSNET receives routine downloads of diagnostic test results from commercial diagnostic laboratories and collects electronic health records in real time from veterinary practice consultations using a compatible version of practice management software (Premvet, Robovet and Teleos), throughout the UK, for the purposes of monitoring diseases. SAVSNET makes data available for research and improving public awareness of small animal diseases and prevention<sup>11</sup>. Clients of participating practices can opt out of data collection and are informed of the scheme through waiting room display information<sup>12, 13</sup>.

This study describes the use of cefovecin (Convenia; Zoetis UK) in a population of cats in first opinion practice in the UK as recorded in electronic health records obtained from

SAVSNET, and compares the use of Convenia to the licenced uses described on the UK Convenia datasheet.

## **MATERIALS AND METHODS**

Data were obtained as an excel database from SAVSNET for all feline consultations or entries containing the word Convenia and/or cefovecin in the clinical notes from 11 veterinary practices (total of 21 premises) from 1<sup>st</sup> September 2012 to 23<sup>rd</sup> September 2013 inclusive. Each case entry and individual animal were given an anonymous unique number by SAVSNET and had the following variables recorded for the study: signalment (age, sex, neuter status), breed (classified as purebred or crossbreed) and weight (recorded or manually extracted from clinical notes).

Duplicate case entries at an animal level, i.e. multiple visits for the same animal, and entries found not to have described Convenia administration were removed. Examples of entries omitted due to non-administration of Convenia contained text such as 'give Convenia if struggle to tablet' or 'due Convenia next week' in the clinical notes.

The dose of Convenia given was calculated from volume of Convenia administered and cat's weight, where such information was available in the clinical notes or recorded as tabulated data in the case of cat's weight. All valid entries were manually classified using information in the clinical notes into the body system being treated, namely skin (including cat bite abscesses), urinary, respiratory, cardiovascular, ocular, oral, gastrointestinal (including liver and pancreas), musculoskeletal, neurological, unclassified (if it was unclear which body system was being treated with Convenia due to lack of information in clinical notes) or multiple (if more than one body system was described and it was unclear which primary body system was being treated with Convenia).

The clinical notes were used to determine if evidence of an abscess was confirmed or suspected and defined by body system affected e.g. skin, oral (teeth), musculoskeletal, ocular, multiple (if more than one body system affected) or unclassified if abscessed body system could not be defined.

Additional information extracted manually from the clinical notes included temperature if recorded, whether any type of microbiological evaluation was recorded (comprising observation of purulent material and whether urinalysis, cytology or culture and sensitivity (C&S) were performed), and whether concurrent therapies were given. If a reason was cited for use of Convenia over alternative antimicrobials then this was recorded e.g. 'inability to medicate orally' or 'cat is a stray'.

The clinical notes were analysed by two co-authors (SB and VB) to control experimenter's potential bias. Entries were double checked by each co-author performing the analysis to ensure agreement.

To assess ages of cats with feline lower urinary tract disease (FLUTD) believed to be associated with UTIs, the ages of cats in the urinary body system entries were also examined separately.

All data were exported into IBM SPSS Statistics and descriptive analysis performed. Non-normally distributed data were described using range and median. The uses of Convenia described were compared to licenced uses on the UK Convenia datasheet<sup>8</sup>.

## **RESULTS**

Of 1,489 total entries, 297 duplicate entries and 44 non-Convenia entries were excluded, leaving 1,148 entries for analysis.

The median age of the cat population assessed was 9.1 years, range 0.1 to 23.2 years. There were 574 (50%) males, 529 (46.1%) females and 45 (3.9%) cats of unknown sex. Of males,



504 (87.8%) were neutered and 70 (12.2%) entire. Of females, 476 (90.0%) were neutered and 53 (10.0%) entire. Forty-five entries (3.9%) had no recorded neuter status. Entries comprised 999 (87%) crossbreeds, 121 (10.6%) purebred and 28 (2.4%) cats where breed was not recorded. Weight was recorded in 967 (84.2%) entries; median weight was 4.18 kg, range 1.74 to 9.05 kg.

The median dose of Convenia used was 8.0 mg/kg, range 3.5 – 21.5 mg/kg. Extreme variation in dose was caused by weights recorded on the practice management software that may not have been current or correct either due to age change i.e. a kitten weight recorded and now an adult cat or extreme weight gain or weight loss that had not been recorded.

Examples include a 15-month old cat that had a recorded weight of 1.86 kg from the practice management system that was given 0.5 ml Convenia (21.5 mg/kg) and an eight year old cat that had a recorded weight of 6.9 kg on the practice management system that was given 0.3 ml Convenia (3.5 mg/kg).

The most common body system treated (Table 1) was skin in 553 (48.2%) entries, followed by urinary in 157 (13.7%) entries and respiratory in 112 (9.8%) entries. There were 103 (9.0%) entries unclassified for body system treated due to lack of information in clinical notes.

There was evidence of a confirmed or suspected abscess, based on the clinical notes, in 231 (20.1%) entries; 199 (86.2%) of these were classified as 'skin' with respect to body system affected. The remaining confirmed or suspected abscesses were classified as either oral (associated with teeth; 14 entries, 6.1%), musculoskeletal (10 entries, 4.3%), multiple (five entries, 2.2%), ocular (two entries, 0.9%) and one (0.4%) unclassified due to lack of information.

Temperature was recorded in 327 (28.5%) entries; 106 of these (32.4%) were elevated at greater than 38.9°C<sup>14</sup>.

Some form of microbiological evaluation was recorded in 193 (16.8%) of 1,148 entries. The most cited evaluation was visible purulent material in 147 (12.8%) entries. Urinalysis with dipstick only was described in 22 (1.9%) entries, followed by urine sediment examination (negative for bacteria) in 11 (1%) and one entry where urine sediment results were unknown. Urinalysis was recommended in nine (0.8%) entries but not performed at the time of Convenia administration, and one entry noted unsuccessful cystocentesis. Five entries (0.4%) had other cytology examinations performed (excluding urine sediment examination) that were positive for bacteria and one other cytology that was negative for bacteria. Only five (0.4%) of the 1,148 entries indicated in clinical notes that samples were taken for bacterial C&S. One of these entries comprised a vet taking a swab to be submitted only if there was no post-treatment improvement; the remaining four entries had C&S performed and Convenia prescribed at the same time, whilst the vet awaited results. In 14 of the 1,148 entries (1.2%) the owner declined investigations for microbiological evaluation.

Of 1,148 entries, 525 (45.7%) had concurrent non-steroidal anti-inflammatory drug treatment; of these 489 (93.1%) had injectable or oral (or a combination of both) meloxicam with Metacam (Boehringer Ingelheim UK). Of 1,148 entries, 262 (22.8%) had concurrent steroid treatment; 99 (37.8%) of these had methylprednisolone acetate (Depo-Medrone V; Zoetis UK) and concurrent antimicrobials were used in 79 (6.9%) of total entries, e.g. fusidic acid (ocular, aural or topical) in 39 (49.4%) of these entries, clindamycin in 11 (13.9%), chloramphenicol (ocular) in 7 (8.9%) and clavulanic-potentiated amoxicillin in 5 (6.3%) entries.

A reason for prescribing Convenia over alternative antimicrobials was given in clinical notes of 138 (12%) entries; the most cited reason was inability to orally medicate in 77 (55.8%) of these entries; other reasons included the cat being a stray (12 entries), the owner being away

or the cat going into a cattery (11 entries), or the owner saying Convenia had worked previously (four entries).

With respect to the 157 urinary body system entries only; urinalysis using only a dipstick was described in 22 (14.9%) entries, urine cytology was performed in 12 (7.6%) entries; 11 being negative for bacteria. Nine (5.7%) urinary entries recommended that urinalysis be done despite prescribing Convenia at the same time. Assessment of age in urinary body system entries revealed that 78 (49.7%) entries were less than ten years of age.

To accurately assess compliance with the UK licenced uses on the UK Convenia datasheet, 103 (9%) entries were excluded because no body system was described in clinical notes; 28 (2.4%) were excluded because of the 'multiple' classification for body system, where it was not possible to infer the primary system of treatment and accordingly whether this may have included a licensed use or not. Of 1,017 remaining entries, the use of Convenia complied with the UK datasheet in 710 (69.8%) entries, comprising 553 skin entries and 157 urinary entries. Non-datasheet indications were described in the remaining 307 (30.2%) of 1,017 entries.

## **DISCUSSION**

This study reveals a degree of responsible use of Convenia in the vet-visiting population of cats assessed. Most entries (69.8%) complied with the UK Convenia datasheet and so were licenced uses. However, other non-licenced uses of Convenia were described (30.2%). Since some uses could not be determined due to lack of information in clinical notes, the percentage of licensed uses may actually be greater.

It is widely accepted that the veterinary profession must be proactive in its approach to AMR<sup>10</sup>. Although this study demonstrated a median prescribed dose of Convenia that complied with the data sheet, there was a wide range. Possible explanations for incorrect dosing included rounding of weight and incorrect estimations of weight, of concern if used to

prescribe an antimicrobial with a specific dose described in the datasheet. A limitation of weight assessment in this study is that some weights were obtained from tabulated data and some from the clinical notes, and the accuracy of these is not known.

One of the most remarkable findings was the low number of entries that recorded microbiological evaluation and visualisation of the purulent material was most frequently cited method of microbiological evaluation. Purulent material can be sterile, e.g. injection site reaction; so it may be wrong to assume microbial infection whenever there is purulent material. The lack of evidence of microbiological evaluation was most pertinent in the urinary body system entries where the presence of clinical signs associated with urinary disease may not necessarily indicate a UTI. Several conditions can cause FLUTD that may or may not have a bacterial component; a bacterial UTI is more commonly seen in senior and geriatric patients with comorbidities (e.g. chronic kidney disease, diabetes mellitus, hyperthyroidism)<sup>15</sup> whereas younger male cats are most commonly diagnosed with idiopathic cystitis, a sterile condition<sup>16</sup>. Interestingly, half of urinary entries that received Convenia in this current study were less than ten years of age. A lack of confirmed diagnosis could lead to misuse of antimicrobials<sup>9</sup>.

It is recognised that obtaining a urine sample for C&S is not appropriate or possible in every urinary case presented in a consultation, considering how difficult this can be in cats with cystitis and small bladders. However, where urine samples are obtained, the use of antimicrobials based solely on the results obtained on urinary dipsticks is of interest. The presence of positive changes for blood, protein and leucocytes does not infer bacterial infection and it is widely accepted that urinary dipstick leucocyte readings are unreliable in feline patients; urine cytology is more sensitive and specific for infection<sup>17</sup>. This study suggests that urine cytology is an under-utilised diagnostic tool that could provide valuable information to guide treatment.

In this study there was lack of evidence of recorded reasons in clinical notes for use of Convenia over alternative antimicrobials (88% entries had no reason given). This may be a limitation of the study as justification may have been discussed with an owner and not recorded in the clinical notes. Additionally, from the clinical notes, it was not clear if each consultation was an initial or repeat consultation and therefore we were unable to ascertain whether Convenia had been used as a first line or second line antimicrobial. It is acknowledged that Convenia is a unique veterinary product as a broad spectrum long-acting injectable antibiotic and hugely useful where compliance is an issue<sup>18</sup>; however, for the purpose of trying to reduce AMR, this class of antimicrobial should be prescribed prudently<sup>9</sup>. Indeed, it has been suggested that for pyoderma Convenia should only be prescribed as a first line antimicrobial where there is concern about compliance or difficulty with oral administration<sup>19</sup>. For confirmed, uncomplicated UTIs International Society for Companion Animal Infectious Diseases guidelines recommend a seven-day course of amoxicillin or trimethoprim-sulphonamides<sup>20</sup>. Veterinarians have a responsibility to demonstrate an understanding of appropriate antimicrobial use and reasons for choosing one treatment plan over another. Additionally, an important aspect of antimicrobial stewardship is maximising the use of alternative management options such as topical treatments, effective lavage and debridement of infected material, providing symptomatic relief, e.g. from pruritus and inflammation. Antimicrobials are not indicated in sterile idiopathic cystitis and treatment should focus on stress management, environmental enrichment and weight management. Furthermore it is important to consider whether use of antimicrobials could be avoided or reduced (in duration or spectrum).

Future studies could include specific questionnaires for the prescribing veterinarian about reasons for use of their treatment choice over alternative antimicrobials or actions. This study supports previous findings that antimicrobials are often prescribed without documented

confirmation of infection<sup>21</sup> and in the case of third generation cephalosporins, frequently without documented adequate justification.

Manual assessment and interpretation of clinical notes introduces a possibility of human error, especially where over 1,000 entries are viewed. However, this number of entries minimises variation on interpretation and analysis of patterns. Beyond the scope of this current study, future data analysis could include a control group of cats presenting to practices at the same time, where no Convenia was given.

We used data gathered from a small number of veterinary practices during pilot studies to establish the feasibility of SAVSNET methodologies to provide first opinion data on the use of antimicrobials in small companion animals. Thus, future analyses including data from a large number of practices currently recruited to SAVSNET would augment the current results, providing further understanding into antimicrobial prescribing practice in small animals.

Whilst owners may prefer convenience over the idea of orally medicating, not being able to use oral antimicrobials limits vets prescribing abilities and introduces a potential risk factor for AMR. This study supports previous findings that further education of the public and the veterinary team is needed to promote responsible antimicrobial usage<sup>22</sup>. Focus is needed on educating owners about orally medicating their cats and only choosing this class of drug or duration of treatment where absolutely indicated. There are many resources available to a veterinarian to which an owner can be directed or which can be promoted within practice material e.g. [www.youtube.com/user/iCatCare](http://www.youtube.com/user/iCatCare). Much work has occurred in human medicine to educate patients to trust doctors in the appropriate use of antimicrobials. We, as a profession, have an opportunity and responsibility to educate owners on appropriate antimicrobial use at the point of consultation and must routinely take the time to discuss antimicrobial stewardship.

## **CONCLUSION**

Most Convenia entries were in line with datasheet indications, however only a small percentage (12%) of entries included justification for prescribing Convenia over alternative antimicrobials. Most entries had no microbiological evaluation described and visualisation of purulent material was most cited.

Our recommendation is that veterinary professionals consider better education of owners on how to successfully administer first line oral antimicrobials as an alternative to prescribing a long-acting broad spectrum injection and reserve use of Convenia for cases where bacterial infection has been confirmed and non-compliance excludes oral medication. SAVSNET data have been used to provide valuable insight into the use of therapeutics in veterinary practice. We would encourage information relevant to decision making to be recorded in individual animal health records. This will further increase the use of electronic health records as a valuable tool to monitor both locally and at scale the use of important therapeutics like antimicrobials. This study also suggests that further education of the veterinary team is needed to continue to promote responsible antimicrobial usage.

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## **CONFLICT OF INTEREST STATEMENTS**

The authors do not have any potential conflicts of interest to declare.

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**Table 1.** Frequency of entries classified by Body System treated from SAVSNET database for all valid entries (1,148) for cefovecin/Convenia use.

<b>Body System treated</b>	<b>Frequency</b>	<b>Percent (%)</b>
Skin	553	48.2
Urinary	157	13.7
Respiratory	112	9.8
Unclassified*	103	9.0
Oral including dental	101	8.8
Musculoskeletal	41	3.6
Multiple**	28	2.4
Gastrointestinal including liver and pancreas	27	2.4
Ocular	19	1.7
Neurological	5	0.4
Cardiovascular	2	0.2

\* Used if unclear which primary body system was being treated with Convenia due to lack of information in clinical notes.

\*\*Used if more than one body system was described and it was unclear which primary body system was being treated with Convenia.