Compounding Solutions for Exotic and Nondomesticated Fauna in Australia: An Investigative Study

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ABSTRACT
Veterinarians face many challenges during routine administration of medication to animals. This study investigated the nature of the problems that veterinarians encounter in practice and assessed the potential benefit of pharmaceutical compounding interventions for exotic and nondomesticated fauna. The research was conducted at three large wildlife theme parks on the Gold Coast, Australia, using a multi-method design of qualitative techniques including semi-structured interviews accompanied by field note observations. Themes identified through the data analysis related to: the enthusiasm of veterinarians towards pharmaceutical compounding; medicated foods commonly being employed in practice; a lack of suitable commercially available medications; time constraint problems and incompatibilities between feeding and dosing intervals. A decisive factor identified in the uptake of compounding in veterinary care was the net cost of the compounding procedure when compared to the figurative “value” of the animal. In conclusion, the study found that pharmaceutical compounding would be able to deliver more effective solutions than current techniques employed for a majority of veterinary medication problems in the area of exotic and nondomesticated veterinary practice. Pharmacists therefore have an opportunity to diversify their business model while providing an important service to the community.

INTRODUCTION
Veterinarians and animal handlers frequently experience difficulties when administering medicines to exotic and nondomesticated fauna. Further, there are few commercially available U.S. Food and Drug Administration-approved products for exotic animals, and many commercially available veterinary medicines are not available in suitable delivery systems. In many cases, veterinarians are required to use medication under "extra-label" or "off-label" use, since it is uneconomical for pharmaceutical companies to provide products that are approved to treat rare veterinary medical conditions or common conditions in exotic species. Therefore, an excellent opportunity exists for pharmacists to use their knowledge, skills, and abilities to provide compounded preparations to this sector of the veterinary market.

The pharmacy profession in Australia is currently exploring new models of practice and is moving towards the provision of additional professional services. Veterinary compounding offers an opportunity for pharmacists to diversify their business model while providing an additional service to the community with the potential to generate additional income for their pharmacy.

A paucity of published research exists concerning pharmaceutical compounding and its potential use in the Australian veterinary setting. The aim of this study was therefore to identify themes and patterns related to problems encountered by veterinarians in relation to drug administration. The study also assessed the potential for pharmaceutical compounding to provide improved solutions for administering medicines to animal patients and thus improve therapeutic outcomes for exotic and nondomesticated fauna.

This study utilized qualitative research methodology. Semi-structured interviews and observations were used to collect data. This enabled the researchers to obtain information about viable uses of compounding by assessing veterinarians opinions of its value within their field as well as the success of their previous experiences with pharmaceutical compounding. The nature of the difficulties that veterinari-
ians and animal handlers experience was also determined to assess the feasibility of future compounding solutions. Common themes investigated related to dose administration issues to explore whether compounding could achieve improved therapeutic outcomes. Finally, current methods employed by veterinarians to address problems related to dose administration were examined and evaluated.

METHODS

This study was conducted at three large wildlife theme parks on the Gold Coast, South-east Queensland, Australia, during April 2008, using observation and interview methods.

Observations

Exotic and nondomesticated fauna were carefully observed in their captive setting with permission from, and assistance of, their handlers. Observations of the animals allowed insights into the way they were medicated, housed, handled, and fed and most importantly how they interacted with their handlers. Detailed notes of animal behaviors were made. The observations informed the sampling method for the interviews.

Semi-structured Interviews

A purposeful sampling process was applied in collaboration with a local compounding pharmacist, who had a working relationship with a number of veterinarians on the Gold Coast. Participants were chosen based on their clinical experience and place of employment, since this allowed the identification of qualified veterinarians who were working with and possessed extensive knowledge of medicating exotic and nondomesticated fauna. The three veterinarians selected were well-established practitioners who held chief positions within zoos and wildlife sanctuaries and had a combined total of over sixty years practical experience.

The semi-structured interviews conducted with the three participants ranged between 60 and 90 minutes each.

An interview guide (Figure 1) was developed to gain insight into the meanings, interpretations, values, and experiences of veterinarians in their field of veterinary practice. This tool was subsequently tested and modified to improve the questions and prompts before conducting the interviews. Interview questions and prompts were designed to obtain information and opinions regarding specific issues while still encouraging the interviewee into open discussion. By adopting this method of interviewing, the interviewee had the freedom to modify the sequence of questions, change the wording, and probe or extend aspects of the interviewee's responses, while allowing the interviewees to be in control of the questions. This process allowed the interviewee to provide their opinion, substantiate proposed problems, and to present new problems they had encountered in their experience. Further, the process allowed the interviewer to trigger or steer the interviewee into talking about broad areas or themes. The questions used were mostly open ended, leaving room for prompts and follow-up questions, which helped to stimulate a response and extract more information rather than seeking predictable closed facts. It enabled the researchers to seek the participants' stories, perspectives, and issues that had not been anticipated or considered prior to the study. The interviews were held in a naturalistic setting—the participants' place of work—which provided an ideal location for a qualitative interview.

Data Analysis

Data consisted of transcribed audio-taped, semi-structured interviews, and field note observations. Content analysis was enhanced through triangulation of the data. Transcripts were qualitatively coded with the assistance of NVivo 8, a qualitative data analysis computer software package (QSR International Pty., Ltd., Victoria, Australia). The data were continuously analyzed to identify core themes and concepts, and to label and organize these into key concept relationships for further analysis. Comparison of ideas expressed across the interviews, definition of meanings, elaboration of underlying or hidden themes, and key concepts were further explored to find answers to the research question, or until no more themes could be identified and a theory was concluded. Through peer review, evaluation, and application of the themes found from the qualitative data analysis, together with appraisal of the coding system and triangulation of results, the bias of the researchers was minimized and the analysis was opened up to underlying themes. Cross-sectional analysis was completed on a case-by-case basis to draw out additional themes from the data.

RESULTS

A wide variety of exotic and nondomesticated fauna were observed at three large

Figure 1. Interview design.

All interviews started with questions followed by prompts to be used, if necessary, to extract further information and explanation of the initial questions:

➢ First could you please tell us about your veterinary experience?
  • Where did you study?
  • Where have you worked?

➢ Are there any specific issues that come to mind within your day to day happenings?
  • What have you tried?
  • Why isn't it working?
  • How do you think it might improve with the application of compounding techniques?

➢ We have some specific cases, e.g. kangaroo pellets, polar bear, wombat—have you worked with any of these animals before?
  • If you had medication problems with these animals, how would you first try to resolve this?
  • What resources would you consult?

➢ What is your opinion on the potential of compounding techniques to improve the quality of treatment that your animals may receive?
  • Do you believe being involved with these available services will significantly improve the health of your animals, compared to what is currently available/ your current technique?
  • Why? why not?

➢ Have you tried using any compounding techniques in the past to try and solve a problem?
  • Was there a positive or negative result as a direct consequence to using a compounded medication?
  • How did the outcome affect your view on using compounding to help you solve your veterinary problems?
wildlife theme parks on the Gold Coast. Analysis of the semi-structured interviews and field note observations assisted in identifying and extracting the following themes associated with pharmaceutical compounding in the exotic and non-domesticated veterinary practice and to identify possible barriers towards compounding.

**Enthusiasm Towards Compounding**

All three participants expressed an interest in pharmaceutical compounding, were of the opinion that these services were underutilized by the veterinary profession, and believed that it would be beneficial for them to utilize compounding services in their area of veterinary practice.

[Interviewee 1]

It's been beneficial already.

[Interviewee 2]

I think it's underutilized definitely... It certainly makes a difference especially with some animals—you just can't get them to take medications. If you can compound it into a suitable and palatable solution... it can make all the difference.

[Interviewee 3]

Yes, I am open to compounding. We have to use virtually everything off-label and use various means to get animals to take them... so compounding can be useful in that way.

**Time Restrictions in Differing Practice Settings**

Time constraints were identified as a barrier towards utilizing compounding in private veterinary practice. However, this was not the case in zoos and wildlife parks.

[Interviewee 2]

I think with private practice you're too busy [and] don't have time to call [a] compounding chemist and say could you try and do this? [It] might take a week or so. The client doesn't want to wait around and wants an answer there and then. That's certainly my impression, and, when I was in private practice, I never actually consulted a compounding pharmacist.

**Acute Versus Chronic Treatments**

Veterinarians are often faced with an animal which is in an acute condition. In these situations, it was found that the aim was to administer the dose by whichever means necessary, using force if required, to ensure that the animal was treated as quickly and efficiently as possible.

[Interviewee 3]

Compounding takes time. If I'm in an acute situation, I just want to shove it down its throat or dart it... anything to help it... [however] in chronic conditions compounding could be a viable option.

**Medicated Food as a Dosage Form**

It is common practice to disguise medication in an animal's favorite food or a high-sugar food. However, it was identified in the field note observations and the participants' input that animals frequently reject medicated food due to an unpalatable taste or smell.

[Interviewee 1]

It's difficult because drugs are bitter and some of the animals can smell the drugs pretty well; they just turn their noses up at whatever you're trying to administer so you have to find things like molasses, honey, jam, peanut butter, and stuff like... that you can put drugs into.

[Interviewee 3]

[The dingoes] was a dynamo. She would just refuse to eat for a few days, and we just gave up in the finish...she was impossible to medicate, so when it comes time for her to have an ordinary worm tablet, we get someone that she likes and just stuff it down her throat. Putting it into her food just doesn't work; she's really cunning and really smart.

**Administration to Evasive Animals**

It was found that veterinarians will principally resort to remote drug administration using projectile dart injections when medicating animals that refuse, or are not easily able, to be restrained or caught.

[Interviewee 1]

Generally, in captivity the difficulty is you can't get your hands on the animals... so it's always remote drug administration [generally].

[Interviewee 3]

You get to the ones where you virtually can't catch them, because they are grumpy... like a big wombat or kangaroo. We'll dart them with an injectable form in a case like that.

**Reduced Options in Decreased Appetite**

The participants identified that oral drug administration was very difficult in animals that were rejecting food due to lack of appetite or severe illness. In these cases, treatment options were generally limited to remote drug administration or euthanasia.

[Interviewee 1]

With really large animals... if they are not eating then you know to deliver drug by injection and you do that via dart.

[Interviewee 3]

They tried [compounding pharmacies] to make us things that failed, and we just abandoned them [the preparations] because he [the tiger] was very uraemic and really sick; he didn't want to eat and definitely didn't want to eat anything new.

**Unsuitable Commercially Available Medications**

Most commercial veterinary products were found to be unavailable in appropriate volumes, concentrations, or dosage forms for exotic and non-domesticated fauna.

[Interviewee 2]

A lot of medications might come in tablet form, and you really want it to come in a liquid, you can't put a tablet down a bird's throat.

[Interviewee 3]

We get the injectable synthetic penicillins... which are in a vial and you need to mix them up [and] use them over 24 hours... we can't crack open at $25 vial of antibiotic and use a tenth
of a cc and throw the rest away and do the same thing the next day.

Feeding Frequency and Dose Requirement Incompatibilities

Medicines that require to be dosed more than once or twice a day were seen to pose a problem for animals that were fed less frequently than the drug dosage indicated.

[Interviewee 2]

Snakes are a good example. You normally don’t feed them more than once a week, so when you have to medicate them every two days … you have to feed them a very small bit of food otherwise they get digestive problems.

DISCUSSION

Participants presented a variety of problems and explained their approach and the resources they consulted when attempting to overcome medication problems. A variety of scenarios were identified where, through the utilization of pharmaceutical compounding, both dosing and compliance in exotic and nondomesticated fauna could be improved. Aspects identified through the qualitative analysis related to:

- The enthusiasm of veterinarians towards the use of pharmaceutical compounding
- Medicated foods commonly being used in practice
- A lack of suitable commercially available medications
- Problems relating to time constraints where compounding may not be feasible
- Incompatibilities between feeding and dosing intervals

In order to properly assess the viability of the use of pharmaceutical compounding, several problems were initially investigated and subsequently examined for possible compounding applications. The primary advantages that this service could bring were assessed and key limitations were also considered. Common themes relating to dose administration issues and the solutions to these problems that were being employed by the veterinarians evaluated were identified. To assess the viability of compounding within the field, it is necessary to determine whether pharmaceutical compounding has the potential to provide a more effective solution.

Practical Applications of Pharmaceutical Compounding in Veterinary Practice

Pharmacists are trained in the disciplines and sciences of drug delivery and have the skills and knowledge to design safe, effective, and high-quality medications. In circumstances where a commercially available product is unsuitable for use or requires alteration before use, compounding may be beneficial and could provide more appropriate techniques of dilution. The correct utilization of excipients including buffers, suspending agents, anti-oxidants, and preservatives, in addition to assigning an appropriate shelf-life, could be applied to ensure that administered and stored medicines are stable and safe for use. When compared to currently employed methods such as the use of medicated foods, compounding is advantageous, as it provides a superior method for manipulating standard formulations in extra-label use medicines and should provide greater safety and efficacy in preparations for future use. However, a fundamental limitation is in acute or immediate treatment, whereby the process of designing, compounding, and preparing an appropriate formulation would be too time consuming and subsequently preclude prompt administration.

In instances where animals reject medicated food or where an animal is evasive or too hard to catch, compounding may be beneficial in that it can provide additional avenues of taste masking through medicated food or more efficient vehicles for drug delivery. This would provide a less stressful, less stuff-intensive method of administration, especially in high-frequency or chronic indications. Furthermore, it would be less disruptive when having to medicate one animal in a larger group of animals. There are, however, limitations. For example, it may be a costly and time-consuming, trial-and-error process until a suitable taste mask is found. Animals may accept the dose the first time and then reject it before a dosing routine could be established as they become aware of unusual circumstances. Animals may not eat all of their food, thus proper dosage may not be achieved. In addition, individual dosing may be difficult if the animal is fed in an area where multiple animals share the same feed and housing conditions.

Where an animal rejects food due to a loss of appetite or due to a poorly tasting oral dosage form or medicated food, compounding may provide a solution through the design of a dosage form for an alternative route (e.g., transdermal dosage form). However, limitations to formulating a new dosage form include time constraints and financial costs. The animal may not be worth medicating in situations where a particular species of animal may be overpopulated and, therefore, not considered to be worth the cost of treatment. In addition, the medical challenge presented by the animal may be severe and relate to therapeutic areas that may be incurable.

In situations where a medication dose is required to be administered at a higher frequency than the animal would otherwise eat, compounding can be beneficial, as it would provide the potential for development of sustained-release formulations, thus reducing dosing frequency while maintaining drug efficacy. This should reduce stress to the animal during drug administration by reducing interruptions to the feeding patterns. Compounding would also provide lower, long-term costs and require decreased animal handling than high-frequency dosing. A limitation of this compounding application, however, includes the higher initial cost to develop the formulation. Furthermore, a sustained-release oral tablet may require preventing the medication from being chewed or crushed, which may lead to complications when medicating food. In this case, implants and slow-release granules may provide further options for sustained-release dosage forms.

Viability of the Use of Pharmaceutical Compounding in Veterinary Practice

It was found within all themes concerning compounding that therapeutic outcomes could be enhanced in exotic and nondomesticated fauna, with some limitations. The frequent limitations in treatment availability for these animals heightened the importance of compounding in this field of veterinary practice. A decisive factor in treatment utilization and consequently the uptake of compounding in veterinary care is the net cost of the compounding procedure when compared to the figurative "value" of the animal. The value of the animal refers to both the emotional worth of the animal's health to the owner, as well as the monetary value that the animal may bring as an attraction to an establishment. The latter is more relevant to exotic and nondomesticated fauna that are kept as attractions in wildlife sanctuaries and zoos where the animal is an investment for the business and the health...
of the animal can be viewed as an important maintenance cost.

A process flowchart, shown in Figure 2, outlines the application of pharmaceutical compounding to improve therapeutic outcomes in practice and identifies potential barriers to the uptake of compounding in veterinary practice.

Limitations

All participants were purposefully selected, and had been involved in a prior study with the University, and were prepared to participate and be questioned. Since the veterinarians already had a working relationship with the local compounding pharmacist, it could be inferred that they were predisposed to the proposition that compounding could be beneficial, as opposed to veterinarians that may not have had any prior exposure to compounding.

Additional studies should be conducted with larger sample sizes to develop further understanding for the potential uptake of veterinary compounding by pharmacists. The underutilization of pharmaceutical compounding, identified through this research, highlighted the need for both the education of pharmacists and veterinarians to emphasize the relevance of this application to both professions. A training program in veterinary therapeutics for Australian pharmacists similar to those currently available in the U.S. may also be beneficial.

CONCLUSION

This study found that through the use of pharmaceutical compounding, veterinary medication management in exotic and non-domesticated fauna could be improved. The study served to identify themes and patterns related to problems encountered by veterinarians in relation to dose administration and to inform the development of effective strategies and design principles for future compounding endeavours in this area of veterinary practice. Compounding pharmacists have an opportunity to fill the practice gaps in medical treatment of these animal patients, thus providing support for an important "therapeutic orphan" market.

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