

Collaborating with Veterinary Pharmacists to Improve Access to the Literature of Veterinary Pharmacology and Pharmacy Practice

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Abstract

Objective: To partner with veterinary pharmacists to improve knowledge of and access to drug literature relevant to veterinary pharmacy through collaborative resource management, teaching, and research.

Methods: Veterinary Pharmacy residents rotate through the library for a research and drug information two-week block involving resource management, teaching, and research. The residents discussed possible projects with the library director and chose to collaborate with library staff to study the literature of veterinary pharmacology and pharmacy practice through mapping publications cited by authors of veterinary drug monographs hosted by the American Academy of Veterinary Pharmacology and Therapeutics, the 2016 issues of *Journal of Veterinary Pharmacology and Therapeutics (JVPT)*, and the 2015 print version of *Plumb's Veterinary Drug Handbook*.

Results: Resident-led resource management activities in 2016-2017 included recommending resources from the American Association of Colleges of Pharmacy's Basic Resources for Pharmacy Education list for purchase and suggesting revisions to PharmLibWiki-Veterinary Pharmacy. Teaching comprised a collaborative, interprofessional session for third-year veterinary students on drug information and prescription writing in the Success in the Clinics course. The research project used the methodology from the mapping the literature studies published in the *Journal of the Medical Library Association* of characterizing citations and dividing them into three zones based on Bradford's Law of Scattering. *JVPT* relied on journal articles (92%) much more than the monographs (65%) or *Plumb's* (55%), and *Plumb's* cited the most conference proceedings (27%). Literature older than five years is still cited; the rates of citation within five years of publication are higher for *Plumb's* (40%) than for *JVPT* (25%) or the monographs (17%). Indexing coverage for the Zone 1 and 2 journals comprising 2/3rds of the citations was above 90% in Web of Science, Scopus, and PubMed with unique veterinary content indexed by CAB Abstracts (88%). Health sciences libraries serving pharmacy and veterinary medicine education subscribe to 94% of the 33 journals from Zone 1 of *JVPT* and Zones 1 and 2 of the AAVPT monographs and *Plumb's*, while libraries serving pharmacy without veterinary medicine average 48%.

Discussion: Veterinary pharmacists and librarians have partnered on tangible improvements to collections, new learning opportunities, and a better understanding of the pharmacy literature. Veterinary pharmacy and pharmacology literature is sufficiently indexed in health and science databases to be discoverable. Access to full-text veterinary literature is not common for health sciences libraries without veterinary or medical schools in the United States and we recommend pharmacy programs offering education in veterinary pharmacy collaborate with veterinary libraries.

Introduction

Veterinary pharmacy is a specialized field of pharmacy involving the preparation and dispensing of medications for veterinary patients. In the United States, veterinary pharmacists are pharmacists specializing in clinical evaluation of medication management in all species. However, definitions vary as Ceresia et al. (2009) refer to traditional pharmacists who support the needs of the veterinarian as veterinary pharmacists, and pharmacists who practice solely in veterinary hospital pharmacies as veterinary pharmacy specialists. In the U.S., all licensed pharmacists train at pharmacy schools accredited by the Accreditation Council for Pharmacy Education (ACPE) and study medicinal chemistry, pharmacology, and pharmacotherapeutics. A 2015 survey found that 22% of responding pharmacy schools offered a voluntary veterinary pharmacy elective but only 4% of graduates from those schools completed this elective (Arnish et al. 2015). As of 2018, postgraduate options for pharmacists specializing in veterinary medicine include residencies offered on a yearly basis at North Carolina State University (NCSU), Purdue University, and the University of Wisconsin. Completion of one of these residency programs prepares the pharmacist for clinical evaluation of all species as well as additional training in areas such as species anatomy, physiology, toxicology, veterinary-only medications, and regulatory concerns.

Historically, the literature of veterinary pharmacy as a discipline has evolved from early articles about agricultural drug use to articles describing companion animals as family members deserving of the best available therapeutics. One of the earliest articles in a pharmacy journal encouraging veterinary pharmacy practice appeared in 1946 when veterinary bacteriologist Mark Welsh (1946) described opportunities available to pharmacists for supplying medications essential to the practice of veterinary medicine. In the 1950s, the *South Dakota Journal of Medicine and Pharmacy* published papers about the role of pharmacy in animal health and encouraged graduate courses in veterinary pharmacy (Scheve 1952; Redman 1954; Shirley 1957). The importance of an interprofessional relationship between pharmacists and veterinarians has been highlighted in Canada (Kernan 1977) and the United States (Nelson 1977). Nelson (1977) suggested the pharmacist should be a member of the public health team when veterinary drugs were needed in rural areas. He also listed seven universities having both pharmacy and veterinary colleges and reported that only 10 of the 1,163 pharmacy books in 1969 were classified as veterinary medicine.

Most articles about veterinary pharmacy as a distinct discipline, such as the Delphi study on the role and education of the veterinary pharmacist (Ceresia et al. 2009), focus on education since many pharmacists lack training in veterinary medicine. A 2012 letter to the

editor of the *Journal of the American Veterinary Medical Association* describes the veterinary community's concern about pharmacists, who lack training in veterinary pharmacology, filling prescriptions for veterinary patients (Larkin 2012). A second-year pharmacy student's letter (Ternamian 2016) praised the inclusion of a veterinary pharmacy article, "Five things every community pharmacist should know when dispensing for 4-legged patients" (Frankel et al. 2016) in *Canadian Pharmacy Journal*, thus illustrating the interest of pharmacy students in learning about veterinary pharmacy. Theberge and Sehgal (2016) advocated for continuing education for pharmacists through online resources or published articles. Collectively, these articles emphasize the importance of increasing veterinary medicine education in schools of pharmacy to ensure productive interactions between veterinarians and pharmacists as well as clinical competence in treating patients of all species.

A 2014 resolution (110-5-14) from the National Association of Boards of Pharmacy (NABP) recognizes that pharmacists dispensing veterinary medications should have access to pertinent and relevant resources necessary to provide excellent patient care for all species. It also encourages collaboration with veterinary schools (NABP, 2014). Veterinary pharmacy-specific organizations such as the Society of Veterinary Hospital Pharmacists (SVHP), the American College of Veterinary Pharmacists (ACVP) and the International College of Veterinary Pharmacy (ICVP) exist to support and document the credentials of pharmacists working with veterinary patients, however none of those organizations publishes a peer-reviewed journal. The main professional organization producing veterinary pharmacology literature is the American Academy of Veterinary Pharmacology and Therapeutics (AAVPT). AAVPT was incorporated in 1977 as the American College of Veterinary Pharmacology and Therapeutics with the purpose of promoting the science of veterinary pharmacology and therapeutics by supporting education and research in comparative pharmacology, clinical veterinary pharmacology, and other aspects of pharmacology of interest to the veterinary profession (AAVPT, n.d.). AAVPT sponsors the *Journal of Veterinary Pharmacology and Therapeutics (JVPT)* to publish reviews, summaries and primary research on all aspects of veterinary pharmacology, therapeutics and veterinary clinical toxicology.

Deepening Library-Pharmacy Collaboration at NCSU

The Veterinary Medicine Library (VML) staff are interested in providing drug information resources and increasing skills of veterinarians, veterinary technicians, students, and clients in finding and applying information to their practice. One of the VML strategic goals is to "Increase co-creation opportunities for Libraries staff to work with faculty, house officers, and students at all levels as co-learners or mentors on inquiry projects." VML looked

to NCSU Veterinary Pharmacy Director Gigi Davidson as a collaborator. Ms. Davidson has been a leader in veterinary pharmacy for both education and regulatory efforts, recently chairing the Compounding Expert Committee of the United States Pharmacopeial Convention. As a Diplomate of the International College of Veterinary Pharmacy, she is very engaged in creating the next generation of veterinary pharmacists and co-developed the one-year post PharmD residency program for Veterinary Clinical Pharmacy of which she serves as the Program Coordinator. She also precepts pharmacy students from other institutions. There has been a long relationship between the Libraries and the Veterinary Pharmacy in supporting residency training through collections and reference services. Both VML librarians attend the House Officer (intern/resident) seminar series where each pharmacy resident presents on a topic or project, and often we formally evaluate the presentation.

In Spring 2016, the Library Director was asked to participate in interviews for the Veterinary Clinical Pharmacy residents to engage candidates about their experiences providing drug information to practitioners and clients. The selected Veterinary Pharmacy residents rotated through the library for a two-week research and drug information block involving resource management, planning for teaching, and research on either their own project or a mutual project. This paper discusses the partnership with the pharmacy residents under the direction of Ms. Davidson to improve knowledge of and access to drug literature relevant to veterinary pharmacy through engaging with the veterinary pharmacy residents on collaborative resource management, teaching, and research.

Resource Management

Collaborative resource management activities proposed to the 2016-2017 residents included (a) collection development of pharmacy materials for the NCSU Libraries and gaining a better understanding of the resources to which pharmacists have access; (b) enhancing practitioner and client access to drug information resources, and c) recommending improved indexing of the literature of veterinary pharmacy in PubMed.

Collection development collaboration between the Libraries and the pharmacy began with a comparison of the pharmacy and pharmacology materials in the NCSU Libraries and materials housed in the pharmacy residents' office. We discussed whether the Libraries needed to maintain the most recent print copies of reference works to which the pharmacy had online access through their professional memberships or role as adjunct instructors at the University of North Carolina at Chapel Hill's Eshelman School of Pharmacy. We decided the veterinary library did not need to hold these items to meet clinical drug information needs,

but that there might be other clientele with reasons to consult the latest editions of the U.S. Pharmacopeia.

In terms of basic resources that the library should have to support staff pharmacists and rotating pharmacy students, we decided to review what materials on the American Association of Colleges of Pharmacy (AACP) Basic Resources for Pharmacy Education list were not held by the NCSU Libraries. The core collection in veterinary pharmacology begins with the library purchasing all items from the reading list for the American College of Veterinary Clinical Pharmacology (ACVCP). This list is mostly veterinary and only two titles overlap between the ACVCP and the AACP Basic Resources list. The list of AACP Basic Resources not currently held was shared with the pharmacy residents who considered 46 of the items for potential purchase. Examples of items added at their suggestion included *Review of organic functional groups: introduction to medicinal organic chemistry, 5th ed.*, and DiPiro's *Pharmacotherapy: a pathophysiologic approach, 8th ed.* The 2018 list is currently undergoing the same process (connect.aacp.org/viewdocument/basic-resources-for-pharmacy-educat-1) for pharmacy residents' feedback about what titles would be useful.

To enhance veterinary drug information access for practitioners in veterinary medicine or pharmacy and for their clients, residents reviewed potential sites and wrote annotations about them for consideration for PharmLibWiki's page on Veterinary Pharmacy (<http://pharmlib.pbworks.com/w/page/51702590/Veterinary%20Pharmacy>). The resources recommended for addition were LiverTox and DailyMed. Those annotations added to PharmLibWiki are also shared here.

Liver Tox (livertox.nih.gov): While not specifically for veterinary patients, Liver Tox provides background information on hepatotoxicity and mechanism of injury information which can be relevant to veterinary cases. It also discusses handling of hepatotoxic insults.

DailyMed (dailymed.nlm.nih.gov): This website of information contained in package inserts for U.S. FDA-approved drugs has an option for "animal drugs" which may be useful for pharmacists unfamiliar with veterinary medications. It provides links for how to report medication adverse effects and how to view FDA safety recalls for veterinary prescriptions.

We also explored the vocabulary of veterinary pharmacy to recommend improvements to Medical Subject Headings (MeSH) for veterinary pharmacy disciplinary terms. For example, we will submit to MeSH that veterinary pharmacy should be its own index term in the Pharmacy professional tree; those papers are currently indexed to Veterinary Medicine and one or more general pharmacy term. Another possibility discussed

but not yet pursued was proposing terms for routes of drug administration unique to animal anatomical features, e.g. intracoelomic for the coelom of reptiles.

Teaching

The Libraries supported the pharmacists in their efforts to provide initial and continuing education for pharmacists interested in veterinary pharmacy by helping update course materials with new editions of core resources and helping design and evaluate drug information exercises for veterinary students. Our first effort at interprofessional team-teaching comprised a collaborative session for third year DVM students on drug information and prescription writing in Success in the Clinics, a third-year professional skills course. The purpose of this course is to prepare veterinary students for their clinical rotations and the co-directors wanted to include a session on interprofessional collaboration focused on interactions with pharmacy.

The team included three pharmacists, a clinician double-boarded in cardiology and emergency/critical care, and two librarians. The range of professionals included was paramount in the veterinary students understanding what role each person filled as well as witnessing firsthand the interactions among the disciplines. We began planning in October 2016 for the course in February 2017. The class included a patient case introduction by the pharmacists, a clinical treatment discussion with the cardiologist combined with a discussion of health literacy/numeracy by the librarians, and a prescription-writing exercise by the pharmacists that was guided by the librarians helping students discover where to look for pertinent information related to both clinical and regulatory requirements.

Research

As we searched for articles on veterinary pharmacy to support our request to the National Library of Medicine's MeSH unit to improve discoverability of articles on veterinary pharmacy, we realized that there was little discussion on the literature of veterinary pharmacy. The literature of another pharmacy discipline, hospital pharmacy, had been mapped (Barrett et al. 2016). We agreed a research collaboration between the veterinary residents and the library staff to map the literature of veterinary pharmacy would be useful and decided to take the further step of understanding how that literature was available to pharmacy students. The summary of the research that follows is intentionally brief and focuses on the process behind the study since the manuscript is being submitted to a peer-reviewed open access journal for consideration.

Objective

Our purpose was to describe the literature relevant to veterinary pharmacy practice by identifying the variety of publications cited by authors of veterinary drug content, the age of references at the time of citation, and the discoverability and availability of the journals cited.

Methods

We used the mapping process based on Bradford's Law of Scattering from the Mapping the Literature papers published in *the Journal of the Medical Library Association* (Schloman 1997) with some changes in the core citation sources. Normally these studies rely on a few core journals as sources, but in consulting lists of veterinary core journals (Ugaz et al. 2010) only two titles were listed as primarily the subject Pharmacology and Therapeutics—*Veterinary Therapeutics* which ceased in 2010 and *Journal of Veterinary Pharmacology and Therapeutics (JVPT)*. At its inception in August 2016 the project focused on the 2016 issues of *JVPT* and the citations in veterinary drug monographs hosted by the AAVPT. We mapped a single year of *JVPT* rather than the three years typical of the mapping studies due to the volume of citations in one year of *JVPT* being close to the number in the monographs. After discussion between the residents and the library director, Sarah Danehower, a masters student in biochemistry working as a library assistant, coordinated and executed the data extraction. It took ten months from idea to first draft of manuscript.

In June 2017, after discussion with the pharmacy director and the residents, we decided to also map the references of the 2015 print version of *Plumb's Veterinary Drug Handbook* to reflect the literature used in practice. This effort was executed by VML student assistant Heather Paxson, a graduate student with a great deal of Excel experience. Analyzing and incorporating this data, as well as working through multiple rounds of edits and feedback on the manuscript took an additional ten months. Orienting the manuscript to a pharmacy audience rather than a library audience required some compromise. For example, the manuscript originally included a short history of the literature of veterinary pharmacy which is typical of the Mapping the Literature papers. This was viewed as interesting, but not relevant to the pharmacy education audience for which the study was intended and was therefore redacted. We included it in our introduction to this proceedings paper as we believe it may be of interest to this audience. Limited findings are shared here as our publication is being submitted to a peer-reviewed, open-access journal in summer 2018.

Results

The research project found that *JVPT* relied on journal articles (92%) much more than the AAVPT monographs (65%) or *Plumb's* (55%), and that *Plumb's* cited many conference

proceedings (27%). Literature older than five years is still cited; the rates of citation within five years of publication are higher for *Plumb's* (40%) than for *JVPT* (25%) or the monographs (17%). Indexing coverage for the Zone 1 and 2 journals comprising two-thirds of the citations was above 90% in Web of Science, Scopus, and PubMed. CAB Abstracts (88%) indexed unique veterinary content. Health sciences libraries serving pharmacy and veterinary medicine education subscribe to 94% of the 33 journals from Zone 1 of *JVPT* and Zones 1 and 2 of the AAVPT monographs and *Plumb's*, while libraries serving pharmacy without veterinary medicine average 48%.

Discussion

Veterinary pharmacy and pharmacology literature is sufficiently indexed in biomedical/science databases to be discoverable with careful searching. Access to full-text veterinary literature is not common for health sciences libraries without veterinary or medical schools in the United States and we recommend pharmacy programs collaborate with veterinary libraries to fulfill the NABP resolution. In 2018, about 37% of the libraries serving pharmacy programs participated in DOCLINE, a health libraries-focused North American resource sharing network where they might be able to obtain inexpensive interlibrary loans of veterinary articles and conference proceedings. We did not examine whether the 103 pharmacy libraries not in DOCLINE participated in other resource sharing networks to access materials. The next step for this project from the library perspective is to collaborate with international health librarians to understand the availability of global veterinary pharmacy literature. The Medical Library Association awarded the Librarians without Borders® Ursula Poland International Scholarship for 2018 to Kristine Alpi to begin this process at the 9th International Conference for Animal Health Information Specialists in Budapest, Hungary.

Conclusions and Possibilities

Veterinary pharmacists and librarians have partnered on tangible improvements to collections, new learning opportunities, and a better understanding of the pharmacy literature. The library team members learned about the pharmacy literature and how pharmacists use the veterinary literature through supporting these pharmacists in providing education to veterinary and human pharmacy students. The research project engaged the library student workforce in data extraction and analysis work and incorporated two graduate student assistants in co-authoring the manuscript.

From the pharmacy resident perspective, an immense amount of information and skill related to searching, processing, and evaluating literature was gained during this process. We

learned how to more effectively search the literature for applicable information as well as gained a better understanding of what types of veterinary literature were most commonly cited so that we could relay that information to pharmacists seeking information about veterinary medicine. Additionally, this project highlighted the skills of the librarians and has led to numerous interactions between residents and librarians for other studies and lectures.

The focus changed in the 2017-2018 residency year due to competing demands and interests, as well as turnover of residents. Since we were still wrapping up the research manuscript with the previous residents, we did not pursue a new joint research project with the current residents. Instead, focus turned to educational development. The library director served as a mentor for the current veterinary pharmacy residents pursuing teaching certificates and helped one of the residents develop a fundable outreach project. Possible future collaborations could include working more closely with pharmacy professional associations in our state to make them aware of veterinary pharmacy resources available online and through our library, perhaps through outreach tabling at their annual meeting. We hope that disseminating the peer-reviewed article widely will encourage pharmacy educators to collaborate with veterinary educators and librarians to increase access to and use of veterinary drug information to ultimately improve animal and human health.

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