There has been a shift in the way veterinary medicine is taught. In order to better prepare students for the realities of veterinary practice schools are filling their curriculums with problem based learning methods (Lane 2008). Veterinarians require a certain level of base knowledge, for instance familiarity with animal physiology, but rote memorization and basic understanding of biology are not enough to prepare veterinary students for more in-depth clinical cases. The jump from theoretical to practical can be difficult and is tied to a lack of technical knowledge and a need for improved problem solving skills (Giling 2009). The exponential increase in digital information and ease of information access through online databases has created an illusion of easy information seeking. However, to sift through data and find pertinent information it is necessary to cultivate lifelong learning skills. Veterinary schools and libraries can both work to facilitate critical thinking and self directed learning by implementing curriculum with relevant context and requiring students to have a deeper understanding of information. Behaviors learned as students should continue outside of school and improve the drive for evidenced based veterinary medicine to become regular practice for veterinarians.

Staying current in your discipline is an essential part of veterinary practice. There is no one easy answer for how veterinarians should go about keeping up to date and for each person preferences will vary. Reading over current veterinary journals and attending continuing education are traditional ways for vets to build ongoing awareness. In today's more dynamic setting there are also a variety of collaborative ways to search for information. The resources annotated here will be a mix of traditional and dynamic. This list is not meant to be used as a single reference. Instead it should be considered part of the larger picture, helping integrate independent learning into veterinary school curriculum. An annotated bibliography is not a dynamic document, so as an example of how to bring together traditional resources and emerging technology this paper will also include brief example videos, created and hosted by Jing (http://www.jingproject.com/). The videos interspersed through out the paper allows readers to view features and critiques brought up in the annotation in a unique way. Mixing medias hopefully makes the experience more memorable and provides an example for how new technology can be used as an educational tool for veterinary students.

The goal is for veterinary students to learn critical evaluation and applications while navigating veterinary resources and to also walk away viewing information seeking as a continual progression of their education (Krokenburger 2007). The hope is to implant pedagogies which encourage development of practical and critical skills, so upon entering the field veterinarians can feel confident in their personal body of knowledge and have the ability to use information technology efficiently and effectively.
Article Indexes and Abstracts

More often now, veterinary schools integrate information literacy into student curriculum. Part of the education involves making sure students know what large bibliographic databases are available, so that the first place they turn to for information is providing high quality, peer reviewed resources. But in these larger databases simple keyword searching is often not enough to lead students to what they are looking for. Each database has its own terminology, but the basic concepts of subject headings and citation searching are lessons students need to learn in order to make their information seeking experience seem intuitive as they move between databases.

PubMed

PubMed is a free service provided by the U.S. National Library of Medicine (NLM) at the National Institute of Health (NIH). The database allows users to search through MEDLINE and it contains over 19 million citations for biomedical literature. As with any large database it can be difficult to retrieve information from PubMed, especially when you are searching for a general topic rather than a specific article. NLM offers a free PubMed training classes to teach search strategies and familiarize students with the search tools. There are also brief video tutorials available that go over basic search strategies, using MeSH and how to personalize your PubMed experience using MyNCBI. (Video 1: http://tinyurl.com/23d9wd8) NLM also created a "Veterinary Query Details" page (http://www.nlm.nih.gov/services/veterinarymed_details.html) which highlights various search terms one might use while seeking veterinary information in PubMed. The list is long, and while it is impractical to memorize the terms it helps emphasize the extensive coverage MeSH provides and the power of using MeSH in your search.

ISI Web of Knowledge

Web of Knowledge is a subscription search platform produced by Thomson Reuters which allows users to search through numerous databases. Databases which will most likely contain veterinary information include: CABI, Zoological Record, Biological Abstracts, and Web of Science. With access to over 23,000 journals the Web of Knowledge is one of the larger and more popular databases for higher education needs. Web of Knowledge contains strong analytical tools which allow users to refine, analyze and manage their search. Thomas Reuters offers training opportunities through live online sessions and recorded video, covering search strategies, citation management and specific guidance for the individual databases mentioned above (http://science.thomsonreuters.com/training/). Identifying valid, high quality articles can
be challenging, but Web of Knowledge allows users to move forward and backward through citations, making it easier to form a complete picture of the search and judge how valid the article is. (Video 2: http://tiny.cc/oyxe8) Many of the integrated features, such as EndNote and ResearcherID are powerful tools, but can be easily underutilized if students are not taught and encouraged to use them. If veterinary school faculty/librarians could establish students as users of these tools it could set a precedence for future veterinarians with strong information organization skills.

Consultant (http://www.vet.cornell.edu/consultant)

Cornell University College of Veterinary Medicine, through the work of Dr. Maurice E. White, runs an online diagnostic support system. The tool is not a traditional article index database, however after searching through diagnoses and clinical symptoms it does provide literature citations. Consultant is a simple and useful example of how digital information can be put together to produce a valuable veterinary tool. If continually maintained Consultant could potentially be used to find recent articles about specific diagnoses. It could also allow veterinarians to gather what new clinical research/medicine/methods are indicating about treatments. Veterinary students who are going through inquiry based learning techniques are being taught more in-depth information seeking skills, encouraging use of tools such as Consultant helps promote ideas of information integration. This means moving beyond utilizing the convenience of online tools and motivating veterinarians to become contributors and active participants of the communities helping make such tools possible. The hope is to create an attitude that would allow tools like Consultant to become a stronger more focused diagnostic aid similar to MD Consult but with veterinary focus.

Electronic Resources

The shift from paper to digital was a jump most scientists took gladly, once electronic versions were stable and available consistently. However, the ease of access large databases provide allows negative search habits to form. When veterinary students begin research they need to be empowered with strong search strategies so they seek out quality information. Understanding the scholarly research process and how important primary resources are is a slice of the information literacy skill set (Kaplowitz 2005). Veterinary curriculum committees and veterinary libraries can work toward integrating information literacy into the classroom, which should include the ability to find electronic resources beyond searching through article databases. Veterinary students working through case-based examples learn how to seek out information, and the process of finding the information is often more important than the solution itself. As e-
reference grows there will be a larger demand for helping veterinarians mentally organize resources, which the following examples strive to do.

Veterinary Medicine Library at University of Illinois Urbana Champaign (VetMed Library) ([http://www.library.illinois.edu/vex/](http://www.library.illinois.edu/vex/))

Every veterinary school will have a library. For students doing formal academic research, it should be one of the first places they turn to locate materials. The library should be trusted to supply high quality resources. The library subscribes to ebooks, electronic journals, databases and more, granting students access to millions of resources. The library also creates a framework for how to get started through information literacy workshops and the layout of the website. While students will not always have access to subscribed resources they can use the library website as a hub for finding information. Libraries should also be reaching out to the students to generate library awareness. Implementing collaborations with patrons markets the library as an evolving entity, not just as a place where books are stored.

The VetMed Library website points students to relevant categories of veterinarian information. 'Article Indexes & Abstracts' guides patrons to many of the previously mentioned databases such as PubMed and Web of Knowledge. 'Collection' contains links to numerous reference materials, including ebooks and subject specific journals. 'Services' helps let the patron know what can be done at the library and provides libguides teaching patrons how to find and checkout materials. 'Selected Resources' lists quick links to popular online information sources. All these categories cover a plethora of veterinary information, and the website is clean and simple, making it easy to skim over and find the necessary link. However, a few changes to make the website more 'in the moment' could make VetMed Library more interactive. A live newsfeed of local veterinary events could help students find places to network and volunteer. Brief videos featuring journals or database search skills could be posted in a blog or a twitterfeed, growing virtual awareness of the veterinary collection, similar to the way a physical display works in a library (Video 3: [http://tiny.cc/tc7zj](http://tiny.cc/tc7zj)). Workshops and instruction could be advertised so faculty know they can turn to the library for information literacy needs. These changes encourage patrons to continually revisit the library to receive relevant veterinary news and helps librarians keep in touch with patron information needs. It can be a challenge to balance between a website that is too busy or too sparse, but if VetMed Library remains flexible it could improve user services and insure its electronic resources are being found and utilized.
Intute Virtual Training: Veterinary Medicine (http://www.vts.intute.ac.uk/tutorial/veterinary/)

Intute is a free online service created from a consortium of seven universities in the United Kingdom. The goal of Intute is to present web resources which have been evaluated as valid and useful for specific areas of interest. The hope is to promote successful internet research skills in students entering universities needing a way to sort through the millions of bad resources.

Intute offers a Virtual Training Suite of over 50 subjects, including veterinary medicine. The tutorial is a simple interface that takes users through a series of linear pages. The training walks users through the importance of scholarly communication, from research, to conferences to social media. Then the tutorial presents a large list of veterinary resources, broken into categories: Educational materials, Learning materials, Publications, Electronic journals, Bibliographic databases, Library catalogues, Internet research tools, Professional organizations, Conferences and events, Social media and News and media. The categories contain a synopsis explaining their importance to research and each resource has a brief description. Setting the training apart is the ability for users to add links into a virtual basket, so at the end of the tour a collection of the resources the user liked will all be gathered in one place to be saved and referred back to on a later date. In essence, the user is creating their own reference tool. Later in the tutorial search strategies are recommend and then the user is asked to practice, allowing comparison of search results to make it clear how search strategies can improve result precision.

These interactive features of the tutorial make Intute a great way to introduce veterinary students to information seeking. If it was possible to connect the tutorial back to the specific veterinary school, students could use the tutorial to connect immediately through proxy to find resources. It would also be beneficial if other universities could use Intute to create specific search strategy lessons on their own, allowing libraries to insert lessons on how to search the electronic catalog or subject specific lessons on PubMed. However, allowing personalization means risking quality control of the product. What Intute has now is a valuable resource which will hopefully continue to grow.

Organizations

Professional groups were the original social networking crowd and today still provide a formal way for ideas to be spread and connections be made. Another benefit of professional organizations is representation; from a local to national level members can view their group as providing a strong unified voice, standing up for its members and hopefully taking steps for positive progression. Relevant to our current topic, professional groups create opportunities for its members to learn about new trends, techniques and skills in their field. The following groups
represent a small portion of the available organizations for veterinarians to join, and as with any profession there are more specialized groups. However, veterinarian students should recognize the value of participating in any professional organization, and a consideration might be to integrate organizational participation into their curriculum. By having students take part, the school is opening a door for further contribution and allowing students to see first hand the value of organization involvement.

International Veterinary Information Service (IVIS) ([http://www.ivis.org/](http://www.ivis.org/))

IVIS is a non-profit organization with a goal to help provide up-to-date veterinary information to all levels of professionals working in a veterinary field. After a free registration, identifying how you are connected to veterinary science, users are granted access to resources available through the IVIS website. The bulk of the resources are contained in the IVIS “library” which functions as more of a central hub, leading users to external links for various veterinary resources. The IVIS books are available freely online, however most of the journals would require users to go back and search through their own library or purchase the copies themselves. Other useful resources include numerous conference proceedings, preset PubMed search parameters for veterinary journals, and information about conferences and continuing education courses many of them available online. The content of the IVIS website is invaluable, it allows veterinary professionals to connect with multiple avenues of information through networking with veterinarians worldwide and view new journals, conference proceedings and reviews. This is a resource veterinary students should be aware of, however in order for IVIS to reach out to the new veterinary students emerging from inquiry based learning programs a few changes will be necessary.

An important change IVIS could make, would be to make their website more personalized for their users. If patrons could enter their institutions proxy information, relevant veterinary journals would be instantly available if the patron’s library already pays for a subscription. Another way to personalize IVIS resources would be to improve the linear information access. ([Video 4: http://tiny.cc/ie1mj](http://tiny.cc/ie1mj)) Currently, patrons click through the sources one at a time to reach a single work. There are many ways of making the information accessible in a more dynamic format, for example creating RSS feeds for a number of the IVIS pages would allow users to focus their information seeking on relevant areas of veterinary medicine. It is also surprising that IVIS does not appear to have any online forums setup to allow discussion between members, or offer professional reference help from the IVIS team. All these suggested changes require varying levels of work, and there are many other possible modifications available. As long as IVIS focuses on updating the website so veterinary information is easy to find, access and utilize it will continue to be a valuable resource.
Evidence Based Veterinary Medicine Association (EBVMA) (http://www.ebvma.org/)

Evidence-based veterinary medicine (EBVM) is an offshoot of the fairly recent evidence-based medicine (EBM) movement. The main model for medical diagnosis is based on the professional making judgments based on their knowledge and experience. EBM/EBVM includes current medical evidence as a part of the diagnosis process. However, to include current medical evidence in clinical decision making the veterinarian needs to have an effective search method. The goal of the Evidence Based Veterinary Medicine Association (EBVMA) is to integrate current research data as part of regular practice in veterinary medicine.

EBVMA is a new comer in veterinary organizations and remains a small group, but its goals align with the changes in veterinary student curriculum and the growing trend for veterinarians to work collaboratively. The new EBVMA website is sparse now, but what it promises holds huge potential for future veterinarians. The basic premise for the EBVMA website is to create a collaborative research community, to help veterinarians find a common ground to aggregate ideas. This means building integrated tools to improve search results through veterinary literature, and bringing together veterinarians with similar research ideas. The four sections under construction, Discover, Learn, Practice and Share each strive to enable veterinarians with the skills they need to become efficient information users with the help of new technology (Video 5: http://tiny.cc/awybw). Veterinary students can help groups like EBVMA by supporting emerging technologies, or joining the EBVMA team. The impact of EBVMA has yet to be seen, but it will hopefully be a positive one.

American Veterinary Medical Association (AVMA) (http://www.avma.org/)

Established in 1863, the American Veterinary Medical Association (AVMA) is one of the larger associations supporting veterinarians, representing over 80,000 members. Striving to advance the veterinary profession AVMA provides a range of information from scientific to lay. Some interesting resources include job listings for veterinary members, a virtual veterinary practice resource center, and numerous animal and public health brochures for the public. One of the down sides to being so large is the broad range of information produced and with so many avenues members might have a hard time wading through to get to an item on their area of interest. However, as you explore through the AVMA website there are a number of dynamic information pathways, all which make AVMA more accessible. However, the following examples are not useful unless veterinarians are willing to make the most of them.
AVMA has a member only forum called the Network of Animal Health (NOAH) discussion groups, which is split into focuses ranging from veterinary specializations to work concerns. Forums engage veterinarians in a virtual community of peers, but like most online groups it requires active participation to be beneficial. AVMA also has a twitterfeed, produces podcasts, has a YouTube channel and numerous RSS feeds. (Video 6: http://tiny.cc/otc5b) These information pathways allow veterinarians to receive AVMA information in an assortment of ways without requiring participation. It is impressive that AVMA makes use of so many emerging technology trends, especially when faced with the challenge of trends changing so quickly. As new generations of veterinarians grow, schools, libraries and organizations need to continually build awareness for current information trends, therefore increasing their marketability and teaching veterinarians new skills.

Social Media

In order to allow social medias to flourish they need to be established as a valid and useful tool. Assigning students to a forum journal discussion group, using or creating video in class, or beginning an e-portfolio containing 'social media activity' as a category are all instances which could be part of veterinary school programs. Encouraging academic use of web technologies helps promote active interaction with information and creates a larger knowledge support for veterinarians world wide. Veterinary students can become more confident information seekers if they build up their flexibility to receive information in diverse ways.

Science Blogs (http://scienceblogs.com/)

Science Blogs is an extensive collection of over 80 scientist blogging about their field of expertise and thoughts on science in general. The blogs are split into categories: Life Science, Physical Science, Environment, Humanities, Education, Politics, Medicine, Brain & Behavior, Technology and Information Science. While there is not a veterinary medicine category, Life science does frequently cover animal science topics. All the sections are available through RSS and are highly active, getting updated multiple times a day. It is easy for people to feel overwhelmed by the amount of information available today. Teaching students how to utilize tools such as RSS readers will help them take control over the information they want to see. However, the next step is then making sure the information students seek out is more than extracurricular interests. Science blogs is a good mix of fun science information and stimulating discussion of old and new scientific debates, so it may be a good stepping stone for introducing blogs as way to keep in touch with the scientific community. If enough interest is generated Science blogs may one day have a veterinary medicine category.
Veterinary Radiology (http://www.veterinaryradiology.net/)

Veterinary Radiology is a blog written by Dr. Allison Zwingenberger, she posts xray images of various animal cases for assessment and diagnosis from her readers. The idea is simple and it allows readers to comment and receive feedback from a practicing veterinary radiologist. The blog gives brief background about the animal, then usually provides multiple high quality images of the xrays. Through the comments readers and Dr. Zwingenberger discuss what information can be found in the xray and the ultimate diagnosis of the problem. Veterinary students could peruse the archives to practice their radiology skills, and also build their knowledge of normal radiology through the image references provided in the Cases section. There is also extensive information provided in the Resources and Articles sections. This blog is an excellent example of how simple continuing education can be utilizing a self publishing format.

Royal Veterinary College (RVC) - Veterinary Science on the Move Podcast (http://www.rvc.ac.uk/review/Podcasts/)

The Royal Veterinary College (RVC) of London has an Electronic Media Unit (EMU) which is "a dedicated unit to develop multimedia learning resources." The EMU is involved in numerous innovative projects including a virtual dentistry class, a large wiki dedicated to information for veterinary students and an ongoing podcast. All the projects are worth a closer look and provide great examples of collaborative efforts of multiple people in the veterinary world. The podcast has currently released 45 episodes, interviewing various experts at RVC. Topics cover animal diseases, treatment, biology and more. The podcast functions as another way for users to receive information, a nice change from reading, but it can also be used to initiate more. Veterinary students could listen to the talks and form discussions groups, or they could form podcasts of their own on topics they find interesting. The Electronic Media Unit provides a space for projects like these to bloom and be experimented with. Other veterinary schools should consider the strength of bringing together faculty, students and other universities to allow exploration for innovative information technologies.

Fully Vetted (http://www.petmd.com/blogs/fullyvetted)

Fully Vetted is a blog hosted by PetMD, a pet medical information website designed for public reference. The blog is written by Dr. Patty Khuly and covers topics in small animal veterinary work such as what filler is in pet food, travel anxiety and choosing a veterinarian.
Knowledge on these topics are necessary for students who are going to be talking to concerned pet owners. While some of the topics may seem like common knowledge after veterinary school, having a resource to point patients to and a reference to help make your responses more eloquent can be invaluable. In the process of inquiry based learning, veterinary students should be able to see how invaluable a good source of information is, but later on in their careers they will be the ones people turn to. Practicing their own marketing skills and becoming articulate can be done by creating something similar to Fully Vetted. Social medias are an great way to connect with the public and help create stronger relationships. So, by integrating and validating blogs, twitter, RSS and other creative information pathways into the curriculum veterinary schools will be graduating veterinarians better prepared to collaborate and communicate with each other and the public.

Conclusion

Veterinary students need to emerge from school with a core knowledge level and practical competency. In order to do this schools are creating curriculums which integrate traditional teaching methods with problem based learning (Lane 2008). Information literacy is essential to the development of independent learning. To emphasize deeper learning skills students need exposure and practice using veterinary resources, from expert article database searching to utilizing social medias. Current awareness and evaluation of information pathways, and the effectiveness of teaching strategies should be continually assessed to insure students are emerging as critical thinkers with successful career skills.
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