Reflective Essay - Lang Prize - Samvardhini Sridharan

Understanding the Future of Preventative Medicine

As a Genetics and Genomics major, I have become keenly aware of the impact my field has on both clinical medicine and scientific innovation. Last summer, I was fortunate enough to conduct 14 weeks of independent research at Stanford University, where I participated in projects within the Radiology Department. There were innumerable new things I learned each day, but perhaps the biggest takeaway was that informatics and technology are the future of medicine. The more I read, the more I realized that images, along with genetic data, will become the future of diagnostics. The act of using medical imaging to diagnose diseases and abnormalities is radiomics. Radiogenomics combines imaging with blood draws and other samples to draw diagnostic conclusions. While the field is extremely new, it holds abundant promise. Likely, in our lifetime, such diseases as cancer and cirrhosis will be detected by imaging well before patients become symptomatic. This will save countless lives.

Scope and Coverage

I composed literature reviews on Radiomics and Radiogenomics twice during the 2018 - 2019 school year – first for UWP102B (Writing in the Biological Sciences) and then for UWP104E (Writing for Science). I approached the papers with a different angle each time to meet class-specific requirements. For UWP102B I used a systems-based approach, focusing on how radiomics and radiogenomics were applied to different organ systems, mainly the prostate, breast, lung, and liver. For UWP104E (submitted here), I narrowed the scope of the review to only ultrasound (US) and radiomics in breast cancer research. I chose to disregard papers which used other imaging modalities, such as CT and MRI, and searched for more primary sources which employed US technology. Besides the subject of the paper, the overlap between the two reviews was minimal, with only two sources in common.

Attacking the same field from a different perspective allowed me to understand the robustness of literature databases and the best practice techniques to finding high-quality sources to use. I began both studies by defining the scope of the essay. For my first review, I was expected to write about 2500 words. I budgeted that I would likely have enough space to distinguish radiomics and radiogenomics, as well as discuss a multitude of technologies and organs that would benefit from the novelty of the two fields. Relative to the paper I composed

for UWP104E, the scope was large. Here, I must underscore that "large" did not mean I would be dealing with decades of primary sources, but rather about 100 papers within the last seven years (with only a handful of these papers published in journals of international repute). Conversely, UWP104E had a 1350-word limit, which meant I would only be able to discuss one imaging modality in one organ system (the breast). Hence, the approach to both these papers differed significantly despite being on the same subject matter.

Currency

Radiomics and radiogenomics are objectively new fields in biomedical informatics. However, with scientists eager to coin new -omics terms, I believed it would be easy to find literature which referenced these emerging fields as keywords. Before I began searching for sources for my literature review, I hypothesized my main difficulty would be the mischaracterization of primary sources as "radiomics" or "radiogenomics" papers, when in fact they were other applications of quantitative biology. But I soon discovered that these fields are so novel, that there hasn't been an opportunity to mistakenly distort them – in reality, there are very few papers to begin with. Radiomics did not exist a decade ago; technology had not caught up to clinical practice then. And once big data became the newest informatics fad, the amount of publications increased rapidly – yet compared to other forms of health informatics, radiomics and radiogenomics are still in their infancy.

Search Strategies

I met with Dr. Ruth Gustafson once I decided the scope of my project, both for the paper I composed for UWP102B and UWP104E. Despite being the shorter review paper, I found that UWP104E posed a heftier challenge! Before commencing on the different search tools, databases, and information sources, I set three main guidelines for the types of sources I would use for my paper. (1) Primary sources only, meaning that any paper used would have to contain a methods section or equivalent. (2) Peer-reviewed and published in journals that were not predatory. (3) English-language publications, so that I would be able to synthesize information without having to use translators prone to misconstruing scientific conclusions. With these guidelines in place, Dr. Gustafson helped me tailor my approach to tackling the literary and scientific challenge at hand.

PubMed: Successes and Failures

In an emerging field like radiomics, I quickly realized that limiting the methodology to one imaging system (ultrasound) made it difficult to find primary sources that were not literature reviews. At this point I was stuck – with my UWP102B review, Dr. Gustafson had suggested using PubMed, which led to several different papers, at least twenty which were candidates for synthesis into my essay. While review papers were also in the mix, the MeSH searches led to more items found due to the broad scope. In fact, the main searches used the queries **radiogeno*** and **radiom***, yielded enough primary sources that I chose not to build a complicated MeSH in order to achieve the breadth that I aimed for. Instead, once I found papers that interested me, I looked to the sources internally cited to build a bibliography that was comprehensive. After our meeting, I looked at the PubMed tutorial in order to reaffirm the best practices.

However, for UWP104E, this search became much more complicated, with the MeSH becoming a mess of keywords. For example, "**Ultrasonography" [Majr] AND radiogen*** was the foundational search, as well as the wide array of terms that are often interchanged with them. Ultimately, there were only 11 items found, of which over half were review papers. Despite the low yield, considering the novelty of the field, the four sources gleaned from PubMed were used in my paper, and were critical to furthering my knowledge of the subject.

BIOSIS and Embase: Successes and Failures

As I did with UWP102B, I looked for internal citations that could be useful, however, Dr. Gustafson also suggested using BIOSIS, via Web of Science. Here, I was able to use both the cited references as well as multiple collections to look for papers that PubMed either missed or did not reference. Using BIOSIS led me to notice that many of the papers in the database were from European journals, with some articles published in German. I realized that the database had its own "MeSH," and I would have to tailor my search to its constraints. For example, instead of using the word **"ultrasonography"** I would have to use the European equivalent **"sonoelastography**." By using flexible search terms, I was able to find three more sources (many of the others were already referenced in PubMed) to incorporate into my paper. As a final attempt, Dr. Gustafson suggested using Embase. Even if the database did not provide new information, it would serve as a "check" in how comprehensive the approach

was. As expected, many of the consequent results had already been scraped off PubMed and BIOSIS.

The review I composed for UWP104E was an exercise in using different library databases, helping me understand when to switch from one database to another, as well as the nifty tools each had in order to address a scientific question. While building the MeSH in PubMed was extremely fruitful for UWP102B, the narrow scope of my UWP104E paper made the search too restrictive. BIOSIS via Web of Science allowed me to find more sources – and there was likely more to find, especially with the related records function, however, the word limit served as a natural boundary to the papers I referenced.

Citations and Tools

After collecting the papers, I used Mendeley to read and annotate them. As a UC Davis student, I have free access to a desktop download of the app, which was helpful in marking up the selected articles and making notes to reference. I could easily organize these notes, making the experience relatively painless. Mendeley also sent me emails about new journal articles in the field. When writing my review for UWP104E, this was a helpful place to reference, even though most of the recommendations were review articles. An MLA Citation guide was also used to make sure the citations Mendeley produced within the app were correct. Overall, Mendeley was an invaluable tool during the review process, and I will very likely be using it in the future.

Credibility, Diverse Viewpoints and Accuracy

Each perspective and paper cited within my review presented a unique approach to radiomic and radiogenomic experiments. The field is so new, that no research group has established authority. In addition, experiments are addressing scientific questions for the first time – so flaws in the approach are visible, and biases apparent. This leaves plenty of gaps in the field that are yet to be addressed. However, I was not particularly worried – new fields such as these are not immune to the initial stages of scientific growth, despite being data driven. I was more concerned about whether the conclusions made sense, and if experiments were conducted ethically.

Each of the papers I read presented different opinions on the future of radiomics research. While reading these studies, I made it a point to understand the diversity of thought

within the field. Although some research methods overlapped between experiments with similar questions, many were considerably different. Writing a review that presented these differing viewpoints as well as reconciled their similarities proved to be a challenge.

Discernibly, I did not have the liberty of choosing which references I used in my work, as the pool was small to begin with. However, to get to a point where a paper met the criteria, I set was taxing. Early on, it was clear the field is not large or developed enough for me to be particular about the viewpoints of the studies, or the stances of research groups. To compensate, I was hypercritical of all the papers, even those from institutions of repute. With so little known by the scientific community, all conclusions are still tentative at best. Hence, I approached each paper with the following questions: (1) what was the problem they solved and (2) what are the holes in the methods and conclusions that can be addressed by future experiments. I aimed to answer these two questions when referencing a source, highlighting the pros and cons of the studies, and focusing on what can be done differently in the future.

Conclusion

I was provided the unique opportunity to compose two review papers over the 2018 - 2019 school year. By choosing to write on the same subject, I had the wonderful opportunity to work closely with library staff to understand the databases I would need to reach my goals. Despite their similarities, these two review papers had very different literature search processes. As a student, this was a lesson in how the angle of inquisition is often more important than the question itself. While I cannot claim to be fluent in conducting literature searches just yet, I am aware about the multitude of resources available to me. This makes me confident that, should I have to write another review paper in the future, I will know exactly where to begin.