A Gallery Based Approach to Learning Radiology in Medical School

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A Gallery Based Approach to Learning Radiology in Medical School

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ABSTRACT

A Gallery Based Approach to Learning Radiology in Medical School

Purpose: To create an organized online teaching resource for learning radiology that organizes radiological images by teaching points into extensive image galleries.

Methods: Images were collected from the electronic medical record/teaching files from collaborating radiologists. These images were then processed (with the help of a Python program created for this project), annotated, and then uploaded by topic into online teaching points to the website www.stepwards.com.

Results: Many different teaching modules were created and published online throughout the course of this project (outlined more below) that covered important topic such as normal/unremarkable radiological studies, radiological anatomy, and the radiological appearance of pathological conditions.

Conclusions: The efforts of this project were successful in creating the teaching modules to the originally desired specifications. The modules were so effective that they are currently being utilized by the Mount Auburn diagnostic radiology program to aid in teaching residents/trainees about key concepts in radiology. With this in mind, there is still much more work to be done, and many more teaching points in radiology that would benefit from additional teaching modules. One day it would be most effective to try and collaborate with others who share the goal behind this project in order to generate conent more quickly and efficiently.

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GLOSSARY OF ABBREVIATIONS

CT: Computed tomography
MRI: Magnetic resonance imaging

INTRODUCTION

Learning how to interpret radiological images in medical school can often be a daunting task. Few students enter their training with any experience in understanding the science behind, and the implications of radiological imaging. The training received in how to systematically process and comprehend various radiological modalities can also be variable during medical school, to the point that some graduates may not feel prepared to interpret common studies when they begin their residency. This is concerning simply because most all aspects of medical practice will rely upon radiology for both diagnostic and therapeutic purposes [1].

While many resources exist for students[2-4], few (if truly any) provide large galleries of high quality images that are organized in a way that directly correlates to how images are obtained and analyzed in a clinical setting. Given that interpreting and identifying key pathology on radiological imaging requires pattern recognition, it seems intuitive that students who have access to large galleries of images that reinforce the same pattern over and over again would greatly benefit from such a resource.

With this in mind, the goal of this project was to create large galleries of images that all reinforce the same radiological teaching point. It is the aim to organize images by their absence or presence of findings (such as pathology or key anatomy. "Normal" or "Unremarkable" examples of each study will serve as a reference point, while images that demonstrate specific disease pathology will also be organized in a similar fashion. Furthermore, the created galleries will be sub-stratified by imaging modality (X-ray, CT, ultrasound, MRI, etc) as well as the anatomical location that is imaged (such as the head, abdomen, pelvis, etc). Furthermore, images will be organized by their findings. The created galleries of images will be shared online on a free, publically available medical education website (www.stepwards.com) with the sole purpose of supporting the education of medical trainees.

Often times in medicine it is the information that is gathered from radiological imaging that is used to guide the clinical management of patients. Imaging serves many important functions in a clinical context, ranging from corroborating physical exam findings (such as confirming a pneumonia in the lungs when rhonchi was heard over the lung fields) to serving a therapeutic function (like the barium enema in the case of a suspected intussuception in a child [5]). It is for this reason that in today's practice of medicine (especially as the cost of acquiring imaging continues to drop) it is very unlikely to find any patient chart that does not have any radiological imaging.

In light of this, it is important to appreciate radiology loses its utility within clinical practice if the acquired studies cannot be properly interpreted. For example, if a chest X-ray is ordered to confirm the presence of a suspected pneumonia in a patient, it provides no additional information those reading the

study do not know how to properly detect pneumonia. It is for this reason that making the process of learning radiological interpretation as efficient and effective as possible is a worthwhile endeavor in helping trainees maximize the value of imaging they will order and rely upon in the future.

In the fields of medicine and medical education implementing the usage of pattern recognition for training purposes is clearly established. Students practice physical exam components on a variety of standardized and real patients in order to learn how to detect both "normal" and "pathological" features. Histology courses aspire to show students multiple examples of the same tissue type/glandular structures in order for them to detect histological patterns. Companies such as UWorld, Kaplan, Firecracker, and Memorang have built an industry around this same concept of pattern recognition/iterative concept reinforcement and applied to standardized testing in medical school.

For the field of radiology specifically these concepts are also quite precedented. The world health organization at one point has even created a document advocating for the more efficient usage of pattern recognition in diagnostic imaging [6]. Some work has also been dedicated to the demonstrating how practice reading radiological studies attenuates a physician's visual working memory [7]. What's more, this same principle of using many examples of the same finding has been harnessed to train machines for the purposes of diagnostic radiology [8].

With all this in mind, it is clear that creating a resource that simplifies and streamlines the process of learning key radiological patterns would be beneficial for trainees. This project is unique in a few different ways, however it also strategically builds upon information and data that already exists across various platforms. There are many resources that currently exist for learning radiology[2-4], however all of them lack some (if not all) the core components that will make this proposed resource so unique.

STUDENT ROLE

The role of the student in this project covered a few different realms that are outlined more below:

Collection Of Images

The student was responsible for finding all of the images that were ultimately used in this project.

Processing Of Images

The images that were collected were processed and annotated by the student (to highlight key anatomy. Part of this image processing was automated by the student who created a computer program that would automatically create figures that were organized in a standardized format.

Creation Of Online Teaching Modules

The student was responsible for creating online teaching modules that organized the processed images and coupled them with written learning points in radiology to provide comprehensive teaching models for trainees. This involved uploading and organizing all of the images that were annotated, and researching/compiling relevant teaching points and writing out articles online.

Maintenance Of Website

The student was also responsible for maintaining and running the website that hosted all of the online teaching modules that were created. This included updating and optimizing all of the software that is required to run a server, its associated site, and all of the web applications that were used to create the online teaching modules.

METHODS

Image Acquisition

Radiological images were acquired from both the medical record at various institutions as well as from the teaching files of practicing radiologists that wished to support the efforts of this project. Images that all demonstrated the same radiological teaching point were generally acquired en masse when possible.

Creating Computer Program For Image Processing

Using python 3.6 and the associated Pillow library, a computer program was created to help automate the image processing required to create the final images that would be utilized for the published teaching modules.

Image Processing

The collected images were run through the python program and then annotated further in the Preview Mac OS 10 application when necessary.

Creation Of Teaching Modules

A medical education website (www.stepwards.com) has already been created at the start of this project that served to be where all of the teaching modules were created. Images were uploaded to this website and organized into image galleries using the Envira Wordpress image gallery plugin.

RESULTS

The results of this work (i.e. the teaching modules created) can all be found online on the radiology section of www.stepwards.com (http://www.stepwards.com/?page_id=10204). The created modules fall into the general categories outlined below:

Archive Of Unremarkable Studies

The following studies were compiled and archived to highlight what "Normal" studies look like:

- Chest X-rays (http://www.stepwards.com/?page_id=10703)
- Hand X-rays (http://www.stepwards.com/?page_id=22010)
- Abdominal X-rays (http://www.stepwards.com/?page_id=11131)
- Foot X-rays: (http://www.stepwards.com/?page_id=11360)

Archive Of Radiological Anatomy

The following studies were compiled and archived to highlight what "Normal" anatomy looks like:

- Calcarine Sulcus (http://www.stepwards.com/?page_id=22919)
- Central Sulcus (http://www.stepwards.com/?page_id=22705)
- Gyrus Rectus (http://www.stepwards.com/?page_id=23489)
- Inferior Frontal Gyrus (http://www.stepwards.com/?page_id=23312)
    - Pars Orbitalis (http://www.stepwards.com/?page_id=23352)
    - Pars Triangularis (http://www.stepwards.com/?page_id=23353)
    - Pars Opercularis (http://www.stepwards.com/?page_id=23354)
- Parieto-Occipital Sulcus (http://www.stepwards.com/?page_id=22903)
- Sylvian Fissure (http://www.stepwards.com/?page_id=23176)
    - Anterior Ascending Ramus Of The Sylvian Fissure (http://www.stepwards.com/?page_id=23276)
    - Anterior Horizontal Ramus Of The Sylvian Fissure (http://www.stepwards.com/?page_id=23237)
- Pituitary Gland (http://www.stepwards.com/?page_id=23586)

Condition Specific Radiology

The following studies were compiled and archived to highlight pathological conditions:

- Appendicitis (http://www.stepwards.com/?page_id=14764)
- Atelectasis (http://www.stepwards.com/?page_id=10243)
- Ascites (http://www.stepwards.com/?page_id=21362)
- Buerger Disease (http://www.stepwards.com/?page_id=21319)
- Cerebral Cavernous Malformation (http://www.stepwards.com/?page_id=21715)
- Cerebral AVMs (http://www.stepwards.com/?page_id=21714)

DISCUSSION

Improving the quality of medical education can be a daunting task simply because of how many facets of medical education exits. Radiology is one of these facets, however it itself is very broad in nature due to the fact that most all clinical workups rely upon diagnostic imaging to some extent. As radiology becomes more and more integrated into the practice of medicine, resources to expedite the process of teaching trainees how to interpret radiological studies becomes proportionally more important.

The work outlined and presented in this project aimed to help in the effort to make this type of training more accessible to a wider audience. The core principle that guided this work was that much of radiology (and medicine in general) relies upon sophisticated pattern recognition, which can be honed much more easily in trainees if they are given resources that isolate and reiterate each pattern that they would benefit from knowing. It is the belief of the author that trainees can learn much more easily if they are presented with teaching materials that embody this basic principle.

As shown in the results section above, the author was able to create extensive teaching modules that organized radiological images clearly by teaching point. These teaching modules spanned topics that included the appearance of "normal" or unremarkable studies, key anatomical structures, and condition specific pages that highlighted key features present in making the diagnosis of pathological conditions. These modules contained many images for each teaching point (i.e. an image gallery for each teaching point) that demonstrated the same concept over and over again to help aid the viewer in solidifying the teaching point. All of these teaching modules are hosted on the publicly available website called www.stepwards.com and can be accessed by anyone without the need to register or pay for access. The teaching modules were so effective that they were adopted by diagnostic radiology residency program at Mount Auburn Hospital to be used for resident education purposes (it can be found on their radiology resource page at (http://www.radclarity.com).

While the completed teaching modules (highlighted in the results section above) are an effective means to train others on their respective topics, they do not come free of challenges. Namely, the creation of these teaching modules was an incredibly time intensive process. Early on in the project it took so much time that the author began to also work on creating a computer program to automate image processing (which has been completed and implemented effectively). Even with the addition of this automation, it is worth appreciating how much more work remains to cover even the basics of radiology in this teaching module format.

Perhaps the barrier to this intuitive teaching style in the past has been the time required to collect high quality images that reiterate the same teaching point, while relying upon an electronic medical record system (for the source of these images) that does not organize its findings in this same manner. In

thinking about future directions, while the author will continue to produce these teaching modules at the fastest rate possible, it is accepted that working with others would dramatically increase the productivity and efficiency of this effort.

Given the free to access website (www.stepwards.com) that is used to host these teaching modules, it seems reasonable that other students could be convinced to help with this effort, and publish their work on the site. This would serve to not only create a teaching resource that all students could benefit from, but also can be used by the creator as an example to interviewers/possible employers as to their skills and commitment to medical education.

As is the danger with any collaborative venture, ensuring the quality and medical accuracy of the produced content can easily be compromised. To protect against this, radiologists in the teaching community could be paired with students and trainees to work on topics that interest the student, are useful for learners, and for which a teaching module might help the radiologist with their own teaching duties. Prospectively this model could be set up in such a way that these efforts benefit everyone involved: the student, the mentor, and every other viewer of the content created as a part of these efforts.

The hope of this work is to demonstrate the immense value that organizing and curating medical content (in this case specifically radiological images) can have on catalyzing learning. It is a labor intensive process that can be alleviated with the recruitment of more collaborators/contributors, however regardless the author believes that by looking at the teaching modules created for this project, it will be easy to agree that they were worth the trouble.

AKNOWLEDGEMENTS

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