Poster Session

Presented in the
Grand Ballroom
Wyndham Grand Pittsburgh Hotel

Wednesday, May 6, 2015

10:20-11:20 am
And
3:35-4:00 pm

Listed in alphabetical order by First Author

An Alternative to SOAP: Formatting Electronic Medical Records for Pathologists

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Content:
Widespread adoption of electronic medical records (EMR) was designated a national goal in 2009 by the American Recovery and Reinvestment Act. Although many of the core objectives set by the act are outside the scope of a normal pathology practice, the College of American Pathologists is encouraging pathologists to coordinate with clinicians in adopting the new technology. EMRs are written in the format of Subjective, Objective, Assessment and Plan, which isn't used in pathology. Pathology notes describe the final diagnosis, micrscopic and gross description. Although there are a few EMRs such as CoPath and Epic which accommodate the unique format of pathology, they are hospital-based systems and aren't available for pathology departments with independent consultation services.

Technology:
The Praxis IV EMR system from Infor-Med was installed on a PC with Windows XP operating system and a 1 terabyte hard drive with remote access capability through the Tulane Internal network.

Design:
A basic template was written in the format of Final Diagnosis, Microscopic Description, and Gross Description under patient Instructions; subsequent consults for that disease were created under that template. Cataloging the data this way allowed for the creation of a "tree of documents" where multiple presentations of a disease were stored under a single disease term. This led to the creation of a diagnostic library of templates for each unique disease entity which could be modified as necessary**.**

Results:
Standard EMRs use templates written in a Subjective, Objective, Assessment and Plan format and are static with pre-programmed checklists. The Praxis EMR uses dynamic templates instead which can be developed and modified by the user. The authors repurposed the Assessments and the Instructions sections to develop a diagnositc library of searchable, customizable templates catalogued by each disease and referenced by frequency of use. The templates allowed users to rapidly generate and modify a consult note from a specific disease template and populate it with an individual patient's unique information.

Conclusion:
Current EMRs use an unsuitable format for pathology. However, Praxis is flexible enough to give independent pathology departments a viable alternative to generate consult notes and interface with other EMRs.

Live Robotic Telepathology: A Comparative Evaluation of VisionTek® M6 and VisionTek® Digital Microscopes

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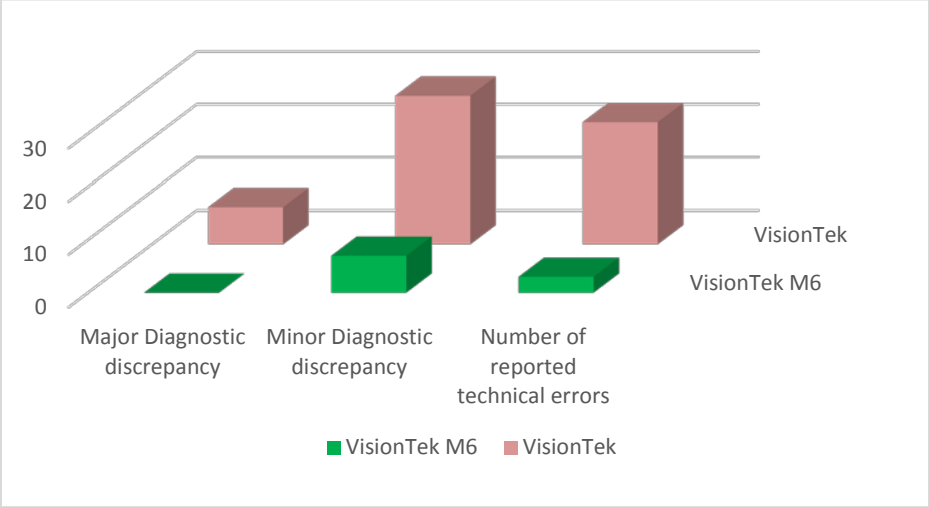
Content:
VisionTek digital microscopes offer hybrid live robotic microscopy and slide scanning capability (WSI, PSI). The new VisionTek M6 has faster scan speeds at 0.275 um/pixels (1.5 min vs 3 min for 15 x 15mm), higher magnification objectives and digital magnifications, illumination control and gamma correction for enhanced subcellular detail examination, and multiple z-plane capture at single field of view. We compared the performance of the VisionTek M6 to the VisionTek for telepathology.

Technology:
VisionTek M6 (Sakura Finetek, USA) with 5x, 20x and 40x objectives and digital magnifications of 2.5x, 10x and 63x. VisionTek (Sakura Finetek, USA) with 2.5x, 10x, 20x objectives and 40x digital magnification. TeamViewer (version 8.0.18051) for digital microscope remote control and live image review.

Design:
A total of 60 prostate biopsy and 20 fine needle aspiration slides were examined via telepathology using VisionTek M6 and a conventional microscope with a 2 week washout period. Findings were compared to prior validation results for VisionTek.

Results:
VisionTek M6 showed better concordance (97% vs 84%) for digital vs. glass diagnostic performance. VisionTek M6 showed slightly better concordance than VisionTek (98% vs 95%) for digital vs. glass satisfactory evaluations. Figure 1 shows that VisionTek M6 resulted in fewer diagnostic discrepancies and less technical errors.



Conclusion:
Live robotic telepathology of surgical pathology biopsies and cytopathology cases using the VisionTek M6 resulted in improved diagnostic performance and fewer technical errors. The higher magnifications together with increased precision when remotely changing objectives greatly improved remote live slide review. Incorporating technology into digital microscopes that enhances resolution for live review and z-scanning capabilities contributes to improved image quality and thereby clinical performance, especially for remote review of cytology slides.

The Road to "Personalized Medicine": How Can Patient-Specific Forecasts of Survival be Developed?

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Content:
Cancer survival is generally estimated with univariate Kaplan-Meier and multivariate Cox hazard models, which do not provide survival probabilities or odds for individual patients. There is a need to develop patient-specific predictive forecasting models based on clinical, pathologic, molecular and other data. Bayesian statistics are increasingly been employed to develop forecasting models based on multivariate conditional probabilities, but they have been seldom applied for the estimation of survival for individual cancer patients.

Technology:
A simple Bayesian model was created using Excel (Microsoft, Redmond WA) and the Bayes' theorem formula, to demonstrate the effect of prior probabilities of 5-year survival by age and gender on the conditional probabilities of

survival estimated for patients with stage II non-small cell lung carcinoma (NSCLC), and/or chronic obstructive pulmonary disease (COPD).

Design:
Data from age and gender specific life tables (Centers for Disease Control 2010), were used to obtain prior probabilities of 5-year survival. Conditional probabilities of survival for patients with severe COPD (FEV1 <37%) and/or Stage II NSCLC were used to explore the effect of a multivariate Bayesian model on individualized posterior probabilities of survival.

Results:
Multiple models by age and gender were calculated. Table I shows an example of 5-year posterior probabilities of survival for 60-year-old Caucasians.

Patient population 60 year-old, Caucasian	**5-year probabilities of survival (%)**	
	Male	**Female**
Prior probability	95	97
Posterior probabilities		
Stage II NSCLC*	88	92
COPD**	84	90
Stage II NSCLC and COPD	68	78

* Based on Kaplan-Meier estimates of 5-year survival of 36% for patients with Stage II NSCLC
** Based on Kaplan-Meier estimates of 5-year survival of 26% for patients with severe COPD

Conclusion:
The Bayesian models provide posterior probabilities of survival that are quite different from averages published in literature for severe COPD and Stage II NSCLC patients. Bayesian derived posterior probabilities are heavily influenced by prior probability of survival. Further studies based on specific cohorts are needed to evaluate the utility of this methodology for the development of patient-specific forecasting models of survival for cancer patients.

Applied Informatics for Clinical Sequencing: A Tailored Data Sciences Experience for Molecular Diagnostics

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Content:
In an age of decreasing nucleotide sequencing costs, clinical exome sequencing has become a major diagnostic modality in personalized medicine. Significant challenges include (a) issues arising from management of high-volume data, (b) clinician understanding of the uses and limitations of sequencing, and (c) lack of a standardized data-driven culture in personalized medicine. At our institution, we have chosen to tackle these problems by designing and implementing a novel training paradigm in molecular informatics.

Design:
The experience begins with an axiomatic introduction to computer science, including systems architecture, procedural and object-oriented programming, and software engineering principles. Following this, participants are immediately tasked with creating an exome analysis pipeline utilizing the Broad Institute's Genome Analysis Toolkit (GATK) Best

Practices. GATK has the advantage of being the most popular exome analytics toolkit for research and increasingly for clinical care; as such, it has extensive documentation on pipeline assembly and validation. Throughout the experience, participants are offered mentorship and guidance at all times, with the expectation of independence by the end. Once participants have successfully assembled and tested their pipelines, they are given a curated 50-genome set against which their pipelines can be formally validated.

Technology:
Virtualization Software: Oracle VirtualBox 4.3; Guest Operating System: Ubuntu Linux Server 14.04 LTS 64-bit; Exome Sequencing Software: BWA 7.5, Picard 1.94, SamTools 1.19, GATK 3.3

Results:
Five participants thus far have taken this experience, ranging from a graduate student from our institution's Medical Scientist Training Program to an attending pathologist in molecular diagnostics. All 5 have successfully assembled and validated their pipelines. In doing so, participants have gained deep experience in genomic informatics – a subject that is often treated as a blackbox at many institutions.

Conclusions:
This experience shows the utility of informatics training as directly tailored to a pathology subspecialty. By enhancing the participants' understanding of sequencing analysis, we have helped create a bridge between clinical care, research, and informatics. This bridge has already begun to form the foundations of a Big-Data and analytics-driven multidisciplinary culture at our institution, which we believe will lead both directly and indirectly to more effective diagnostics and improved patient outcomes.

A Web 2.0, Extensible Clinical Decision Support System for Perioperative Management of Antiplatelet Therapy in Patients with Coronary Stents

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Content:
Consensus-based standardized management protocols improve care and increase clinician compliance with recommended practice guidelines. Ensuring institution-wide accessibility and ease of use is critical for adoption in clinical practice. Institutions often develop flowcharts for standardization of clinical care, but these flowcharts are often so complex that they are not readily usable in the clinical milieu. In order to solve these problems, we designed, created, and deployed a database driven online decision tree for a protocol for preoperative antiplatelet therapy in patients with coronary stents developed by our institution's multidisciplinary Anticoagulation Task Force.

Technology:
Server Hardware: Toshiba Portege M750 (Intel Core 2 Duo CPU P8600 @ 2.4 GHz x2, 2GB DDR2 RAM, 160GB HDD); Operating System: Ubuntu Linux Server 14.04 LTS 64-bit; Web Server: nginx 1.7.7; Database Management System: MariaDB 10.0.14; Programming Language: PHP-FPM 5.5; User Interface Framework: Twitter Bootstrap 3.2.

Design:
The flowcharts developed by the Anticoagulation Task Force were translated into an application that separates each decision point and displays the next designated point based on the user's input. All possible paths and results are collected in tables in a central database. The user clicks through multiple decision points until arriving at a clinical recommendation. The design is responsive, providing an appropriate user experience for different form factors (*e.g.* desktop, tablet, smartphone).

Results:
The Protocol for Preoperative Antiplatelet Therapy with Coronary Stents (PATC) is accessible on institutional computers, as well as personal tablets and mobile devices. In preliminary testing, it has greatly simplified and clarified perioperative management of antiplatelet therapy in patients with coronary stents.

Conclusions:
We created an interactive, online decision tree that provides clinical recommendations in accordance with our institution's consensus guidelines. We are actively gathering statistics on workflow improvement and error reduction. Future upgrades to our clinical decision support system include data persistence for analytics. This project underscores the utility of clinical informatics in providing workflow- and culture-appropriate decision support for complex clinical situations.

Retrospective Blinded Study of Thyroid Fine Needle Aspirates (FNAs) Using Whole Slide Imaging (WSI) Compared to Glass Slides for Primary Diagnosis

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Content:
The utility of WSI for primary diagnosis of thyroid FNAs remains unclear. The goal of this study was to investigate the diagnostic accuracy, interobserver agreement, and feasiblitiy of WSI for a series of thyroid FNAs compared to traditional light microscopy.

Technology:
Leica SCN 400 digital scanner.

Design:
Twenty-five consecutive previously diagnosed thyroid FNAs were retrieved and two cytopathologists (#1 and #2) independently reviewed all glass slides (smears, LBP and cell block). These were then scanned using the Leica SCN 400 digital scanner and reviewed in the digital image hub (Leica Biosystems) after a washout period of at least 1 week. Diagnoses for glass slides and WSI were based on The Bethesda System. The original diagnosis was considered correct; concordance was based on degree of agreement with the original diagnosis and analyzed between cytopathologists.

Results:
Case distribution and interobserver agreement for the two modalities are shown in the table below. The total percent of correct diagnoses was 74% with similar findings between glass slides and WSI (74% vs. 70%, p=0.8). However, WSI had an overall lower interobserver agreement (k=0.52) compared to glass slides (k=0.74), with the lowest level in atypia of undetermined significance (AUS) cases (0.52). Benign cases had the greatest level of WSI interobserver agreement (k=0.90). There was one major (two step) discrepancy for WSI (benign classified as suspicious for malignancy) and no major discrepancies for glass slides. Specific limitations of WSI reported by cytopathologists included increased effort required to screen/maneuver digital images, increased length of time required to review digital images (particularly LBPs), and perceived decrease in nuclear cytologic detail.

	Glass (original glass, #1, #2)	**WSI (#1, #2)**
	% agreement (κ)	% agreement (κ)
Overall (n=25)	78 (0.74)	60 (0.52)
Unsatisfactory (n=5)	86 (0.83)	60 (0.52)
Benign (n=13)	94 (0.93)	92 (0.90)
AUS (n=6)	44 (0.33)	0 (-0.20)
Suspicious for follicular neoplasm (n=0)	0	0
Suspicious for malignancy (n=1)	33 (0.20)	1 (-0.20)
Positive for malignancy (n=0)	0	0

Conclusion:
WSI of thyroid aspirates showed poorer interobserver agreement compared to review of glass slides. Further studies of WSI are warranted to minimize limitations and enhance utilization in thyroid cytology.

Cost-effective approach to analyzing operational data in the Anatomic Pathology Laboratory

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Content:
The modern anatomic pathology laboratory operating with an LIS is expected to provide a high level of data availability. However, out of the box reports included with most LIS at installation rarely suffice to satisfy the varied needs of the laboratory. Many laboratories, lack the expertise to write reports using sophisticated high-end reporting tools, leaving them to expensive consultant fees, or even compiling data manually. Here we report our experience with custom report writing and data analysis that currently supports most divisions in our laboratory, using low-cost, readily available office software.

Technology:
Queries are written using Microsoft Access (Redmond, WA) with a read-only ODBC connection to the Sunquest Copath LIS database (Tucson, AZ) and analyzed/displayed in Microsoft Excel

Design:
The LIS acquires multidimensional data with every step of processing clinical samples. With an intimate understanding of the processes in the laboratory and knowledge of the LIS database structure, we developed custom queries to obtain and analyze sets of data that are supporting the decision making processes in the laboratory.

Results:
Requests for multiple reports were reviewed from pathologists, staff from Quality Assurance, Billing and Lab Administration, as well as clinicians.
We summarized all the requests and developed a functional set of timestamps in the laboratory workflow that could be used to satisfy these requests as well as drive process improvements related to cases as well as to procedures/addenda. For billing and productivity, we created several queries that can be combined to provide a meaningful summary of each pathologist's workload.

Conclusions:
The use of an ODBC driver combined with inexpensive desktop office software provided us with a cost effective way to quickly create and modify flexible reports for multiple and varied purposes in the clinical laboratory. As long as HIPAA compliant access restrictions are observed, we feel that pathologists should insist on the inclusion of an ODBC driver with every LIS installation.

SNOMED Encoding in Pathology Report

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Content:
There is an auto-encoding function for SNOMED III in our eleven anatomical pathology laboratory information systems in the Hong Kong Hospital Authority. For reporting pathology result, apart from printing report, pathologists are using SNOMED III to encode the "Diagnosis result" in their local LISs.
An operation list of SNOMED III codes including locally created terms and synonyms has been created in the Hong Kong Hospital Authority. The creation of the operation list serves two purposes; to enhance the SNOMED III encoding process in LIS, and to create a mapping to a standard list of SNOMED CT.
The data retrieval and analysis of pathology report can be made either by SNOMED III or SNOMED CT concepts.

Technology:
In local LIS, the SNOMED III encoding process is made by a matching of typed keywords in the Diagnosis field to the SNOMED III operation list in a local LIS dictionary. The encoded SNOMED III codes are stored along with the each pathology report.

Design:
A working group has been formed with the hospital pathologists, IT and health informatician. The objective of the working group is to create a corporate–wise operation list of SNOMED III codes and a standard list of SNOMED CT

Steps to create the operation list and standard list:

- Associate with the eleven local SNOMED III tables
- Cleanse the locally created terms
- Map the SNOMED III codes to SNOMED CT concepts
- Submit new concepts to IHTSDO if needed
- Deploy the corporate-wise SNOMED III operation list to local LIS
- Create a mapping table of SNOMED III operational list to the SNOMED CT standard list

Results:

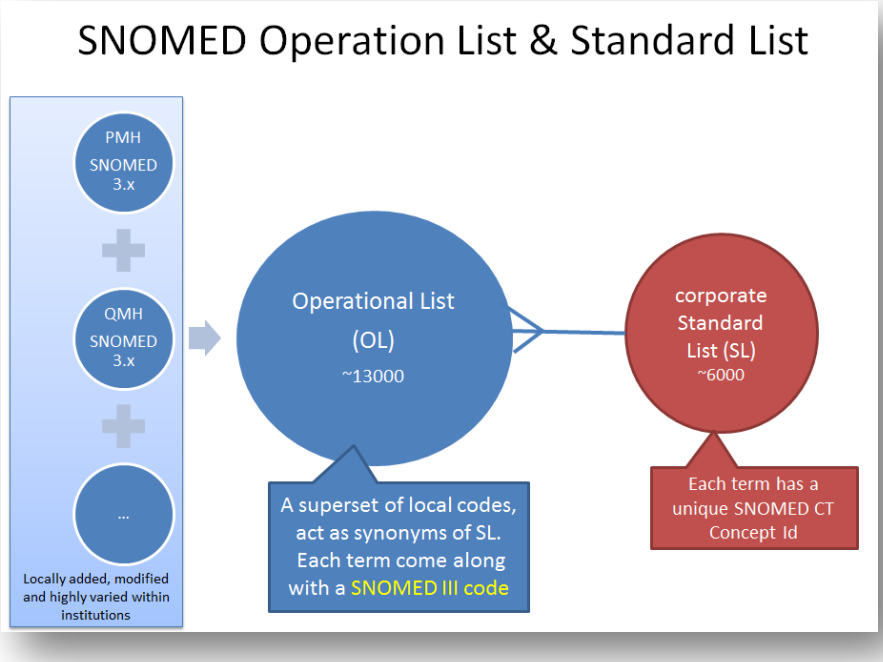
- The corporate-wise SNOMED III operation list contains over 13,000 terms and their synonyms.
- The SNOMED CT standard list has 6000 distinct SNOMED CT concepts,

Conclusions:

- The benefits of the creation of corporate-wise SNOMED III operation list and SNOMED CT standard list are:
  - To enhance the automatic encoding in LIS
  - To facilitate data retrieval and analysis of pathology data
  - To be a groundwork for clinical information exchange in ePR and secondary use of pathology data

Appendix:

A Mapping Diagram between Operation List (SNOMED III) and Standard List (SNOMED CT)



BBQ'D: An Extensible, Open-Standards, Web 2.0 Pathology Education Crowdsourcing and Analytics Platform

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Content:
Medical education has undergone a profound paradigmatic shift. Older lecture-based didactic methods have given way to systems- and problem-based small group learning. With the growing realization that Big Data analytics and Informatics are core competencies of the future of medicine, we stand at the brink of another profound transition in medical education. At our institution, we have designed, implemented, tested, and deployed an open-standards, Web 2.0 pathology education crowdsourcing, testing, and analytics platform codenamed "BBQ'D" as an experiment in flipped-classroom methodologies.

Technology:
Server Hardware: Dell Precision T3600; Host Virtualization Hypervisor: VMWare ESXi 4.1.0; Guest Operating System: Ubuntu Linux Server 14.04 LTS 64-bit; Web Server: nginx 1.7; Database Management System: MariaDB 10.0; Programming Language: PHP-FPM 5.5; User Interface Framework: Twitter Bootstrap 3.3

Design:
BBQ'D consists of the following components: a question submission module, a peer review module, a quiz/test module, and an analytics platform. Students are actively encouraged to both review the study material and gain an understanding of proper test question writing by writing boards-type review questions in the question submission module. Instructors can edit and approve submitted questions in the peer review module. The quiz/test module can be used both for self-study and formal testing. Student performance metrics – from time spent on questions to a breakdown of student performance on subject areas – are made available by the analytics platform.

Results:
BBQ'D has been designed, implemented, tested, and deployed for both undergraduate and graduate medical education. It is currently under formal consideration as a teaching modality by our institution's Undergraduate Medical Education committee, and will be made available for beta testing shortly. The analytics platform in particular is recognized to be of immense potential for future medical education.

Conclusions:
Specially-tailored informatics systems have the potential to revolutionize the state of the art in education. Flipped-classroom and practicum-based methodologies especially stand to benefit from such systems. We will monitor BBQ'D use patterns and statistics going forward. When a critical mass of validated review questions has been established, we will also load BBQ'D onto single-board Linux computers to be sent to medical schools in Zambia and other resource-poor areas.

HemaVue: A Web-Based Portal for Digital Peripheral Blood Smears

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Content:
Morphological evaluation of a peripheral blood smear by clinicians is occasionally required for patient management. Traditionally, this involves a hematologist requesting a patient's blood smear from the hematology laboratory for microscopic review. This is time consuming for clinicians, manually intensive for lab staff, and only available for a limited time period before the glass slide gets discarded. In several hematology labs at our institution we use

CellaVision instruments that employ automated digital techniques to quantify and classify cells on peripheral blood smears. Our aim was to make these "digital blood smears" remotely available to clinicians.

Technology:
CellaVision DM96 (AB, Lund, Sweden) digital hematology analyzers. Hardware included a Microsoft Windows Server (2008) and Microsoft SQL Server (2012). Microsoft Internet Information Services 7 web server software and ColdFusion 9 middleware.

Design:
We created a website called "HemaVue" that runs on a Microsoft Windows Server. The website provides a portal to a database of tables on a Microsoft SQL Server. The tables comprise data for CellaVision runs from three instruments located in separate labs. The patient databases include images (jpeg files of blood cells) and associated metadata (patient details and blood counts). Data is exported to the database daily by lab personnel from standalone workstations. An automated process checks for exports, archives a copy of the export file, and notifies the database administrator and network manager if the export was not run. Using this secure web portal, users can remotely look up a patient's digital blood smear.

Results:
The database currently has over 3.5 million images for around 23,000 patients. Over 130 users have access to the HemaVue site, including hematology/oncology faculty and lab technicians. Maintaining this service is challenging since the CellaVision system does not typically support exporting its data. With three laboratories supplying digital data from separate systems, occasionally run identifiers may overlap. Adding a new database column rectified some incidents, and manual intervention is sometimes required.

Conclusions:
The HemaVue web-based portal permits clinicians at our institution to remotely view their patient's digital peripheral blood smears anywhere and at any time. These digital blood smears are permanently retained. The next phase of our project is to incorporate patient digital blood smears into the electronic medical record.

A quick prototyping methodology for segmenting histology images

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Content:
There are tremendous inefficiencies in how histology/pathology slides are evaluated in the clinic. Use of computer aided diagnostics to evaluate these slides has the potential to improve the efficiencies in the pathology practice: by providing quantitative assessments, consistent analyses, fast throughput and better usage of the time of trained pathologists. Our idea is to design and develop these systems for specific disease areas.
In addition the images have a color component which gives even better option to extract features from images. However, variety of data requires a quick way to do prototype testing of segmentation method. Our expertise with Matlab (The MathWorks, Inc., Natick, Massachusetts, United States.) and understanding of image processing helped develop the Graphic User Interface based prototype for testing out the results. This results in scalable model that eventually can be tested modified and finally plugged into the workflow in a relatively short amount of time.

Technology:
High resolution microscopic digital images of Safranin-O stained histological sections were obtained and saved as TIFF images for further analysis. The Graphic User Interface for image analysis was developed using several toolboxes within Matlab (The MathWorks, Inc., Natick, MA, United States.)

Design:
The histology images (Saff-O stained sections of bovine plugs) were segmented into background and foreground1,2,.. (sections of same osteochondral plug) . The following algorithm steps were involved

a. Graphics User Interface (allow user to select relevant image(s) for processing)
b. Select background image to get background intensity values for normalization
c. Apply normalization to the foreground image
d. Extract the region of interest and quantify the results

Results:
The goal of this study was to develop a software model to compare the quantification of the stained slides to the GAG content of DMMB Assay and find a correlation between the two. The correlation for N=42 was strong (R^2 = 0.93) and statistically significant ($p < 0.05$), indicating that quantifying the red content from Safranin-O stained histology sections reflects the GAG content of the cartilage tissue.

Conclusion:
Developing a scalable and flexible GUI based "testing platform" can allow easy modification of the parameters to achieve the desired performance to be close to human judgment ("gold standard") in efficient manner.

An optimized color space for the analysis of digital images of H&E stained slides

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Content:
Hematoxylin and Eosin (H&E) staining is ubiquitous in pathology practice and research. As digital pathology has evolved, the reliance of quantitative methods that make use of H&E images has similarly expanded. For example, cell counting, structure classification, and nuclear morphometric methods all rely on the accurate identification and demarcation of cell nuclei from other structures and from each other. One of the major obstacles to quantitative analysis of H&E images is the high degree of variability often observed between different samples and different laboratories. Variability typically makes images difficult to model and causes the generalizability of most algorithms to suffer. In an effort to characterize this variability, as well as to provide a substrate that can potentially mitigate this factor in quantitative image analysis, we developed a technique to project H&E images into an optimized space more appropriate for many image analysis procedures.

Technology:
ScanScope XT Aperio Technologies Inc.

Design:
We used hierarchical clustering, machine learning, and color space transformations to classify 44 H&E stained whole slide images of resected breast tumors according to the biological structures that are present. This procedure takes a single H&E image as an input and produces a classification map of the image that predicts the likelihood of a pixel belonging to any one of a set of user-defined structures (e.g. cytoplasm, stroma). By reducing these maps into their constituent pixels in color space, an optimal reference vector is obtained for each structure, which identifies the color attributes that maximally distinguish one structure from other elements in the image.

Results:
We show that tissue structures can be accurately classified using this semi-automated technique. By comparing reference vectors across different images, we obtained a quantitative depiction of H&E variability for each structure.

Conclusions:
The variability of H&E stained images can be definitively measured using the proposed technique. This measurement can potentially be utilized in the laboratory to help calibrate daily staining or identify troublesome slides. Furthermore, by aligning reference vectors derived from this technique, images can be transformed in a way that standardizes their color properties and makes them more amenable for image processing.

Applications of Clinical Looking Glass Software for Effectiveness and Clinical Significance of Endometrial Cells Presence in PAP Smears

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Content:
Endometrial cancer is the most common malignancy of female genital tract in the United States. Currently there is no accepted screening test. Suspicion for endometrial cancer is based on symptoms and presence of Endometrial Cells (EMC) in pap smears. Bethesda 2001 recommends reporting normal EMC in women over 40 years. We intend to use the Clinical Looking Glass software to extract this information and assess the effectiveness of the EMC diagnosis with respect to capturing significant pathology.

Technology:
Clinical Looking Glass version 4.3.1, a user-friendly interactive software application developed at Montefiore Medical Center, Bronx, NY to evaluate health care quality, effectiveness, and efficiency.

Design:
A cohort was created with the CLG tool to extract the cytology report of female patients over 40 years old diagnosed with EMC present in pap smears in 2010 along with subsequent surgical pathology reports. The data was exported in an excel file and analyzed.

Results:
The cohort consisted of 117 female patients with a diagnosis of EMC in pap smears on 2010. The average age was 55.6 years old. After manual verification of the Cytopathology reports, we classified these patients in two categories: 103 patients with EMC present and 14 patients with atypical EMC present. Then, we manually selected Surgical Pathology reports related to gynecological procedures as follow-up of pap smear diagnosis. From patients with diagnosis of EMC, only 36 patients (35%) were worked-up with a benign outcome. From the patients diagnosed with atypical EMC, four were followed up and one had a positive diagnosis of endometrial adenocarcinoma.

Conclusions:
The Clinical Looking Glass software is very useful creating cohorts of specific demographics, time periods and diagnosis search. Nevertheless, the searching criteria used were not enough to eliminate the manual work of going through every report to extract the information needed for the study. From the information obtained we can be tempted to conclude that the EMC diagnosis and follow-up is not cost effective, but a bigger study is needed requiring more manual work or a better approach.

Feasibility of Using the Panoptiq Imaging System for Telemicrobiology

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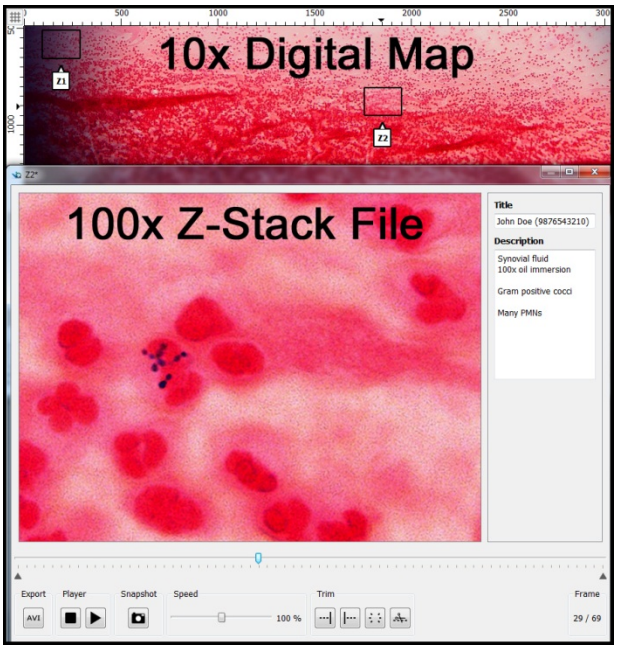
Content:
Telemicrobiology is challenging because of the high magnification and fine resolution required to identify microorganisms. The Panoptiq imaging system combines low power panoramic image acquisition with simultaneous high power recording for regions of interest. The aim of this study was to evaluate the feasibility of using Panoptiq for telemicrobiology.

Technology:
Panoptiq v.3.1.2 (ViewsIQ, Richmond, British Columbia, Canada) software was used for image acquisition, and Panoptiq View 3.1.2 (ViewsIQ) software was used for image viewing. Hardware included a Dell Precision Tower 5810, Olympus BX45TF microscope, and Prosilica GT (Allied Vision Technology) digital camera.

Design:
20 challenging microbiology cases were selected. Glass slides included blood smears, tissue biopsies, cytology samples, and Gram-stained specimens and positive blood cultures. The slides contained bacteria, mycobacteria, fungi, and parasites. Panoptiq was used to acquire multi-objective digital images in two stages: slides were first digitally mapped at 10x objective magnification and then select Z-stacks of areas of interest were recorded at 100x (oil immersion).

Results:
Image acquisition was easy and took approximately 3 minutes/slide. Registration maps were built by manually previewing the slide at low power (10x), and these maps (.svs format) ranged in size from 1.1 to 45.5 Mb. Annotated Z-stack videos of regions of interest were captured with 100x oil immersion magnification, and these Z-stack files ranged in size from 15.5 Mb to 175 Mb (approximately 1.0 Mb per Z-frame). The software highlighted each location on the map that had an accompanying Z-stack file, and the user could open each Z-stack in a pop-up window for closer inspection (see Figure of synovial fluid containing Gram positive cocci). The main challenge was correctly registering 100x fields to the 10x digital map.



Conclusion:
Panoptiq is a promising digital imaging system with potential for telemicrobiology use. Benefits of this system include its small footprint, ease of use, speed of image acquisition, low and high magnification capabilities, and extensive Z-stack capacity. Further software enhancement is needed to accurately register 100x regions of interest to low magnification digital maps.

Implementation of Whole Slide Imaging in a Histology Laboratory for Image Archiving of High Volume Pathology Practice

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Content:
Although whole slide imaging has been widely accepted in education and research settings, its implementation in a clinical pathology practice is not without challenges. Workflow, data storage and personnel support are common challenges encountered in clinical laboratories. The Department of Pathology at Dartmouth-Hitchcock Medical Center (DHMC) has successfully implemented routine whole slide scanning for archiving in the histology laboratory of a high volume pathology practice.

Technology:
Whole slide imaging

Design:
The Department of Pathology at DHMC has been performing whole slide scanning for slide archiving for two years, using two Leica SCN400 scanners (4-slide and 384-slides) in histology laboratory. This service is supported by two histotechnologists and a high school student. One to four pertinent positive cytopathology, dermatopathology, surgical pathology and consultation slides, are selected and documented in pathology report. The slides are then submitted for routine or priority scanning after the cases are signed out throughout the day, maintaining a continuous throughput. Priority slides are scanned in a 4-slide scanner, while routine slides are scanned in a 384-slide scanner. Images are reviewed for their quality, including sharpness, clarity and areas of interest inclusion; then uploaded to a server at the hospital data center. Scanned slides are marked and filed in the slide storage room.

Results:
In 2014, the total number of clinical slides scanned was 19,066 representing 19% of accessioned cases. The average turnaround time for routine and priority scanning were 24 and 0.5 hours respectively. The scanning process requires 0.75 of a FTE of either a histotechnologist or support staff and adds a step between sign out and slide filing. Scanner operation and quality control of images are best performed by histotechnologists. All pathologists now rely on whole slide images for image capture, conferences, tumor boards and teaching; and have abandoned the use of digital microscope camera. Storage of image files at hospital data center enables image viewing throughout intranet and ensures data security and reliability.

Conclusion:
We have shown that whole slide image scanning could be integrated to a busy pathology service, with a well-designed workflow, histotechnologist support, and a supportive staff to assist in system integration.

Utilization of Whole Slide Image Digital Pathology Communication System for Surgical Pathology Quality Assurance Program

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Content:
Whole slide imaging has been around for more than a decade, but pathologists' comfort and familiarity with using such a system varies. Quality assurance program (QA) is an important component of a surgical pathology service and generally employs a multitude of case review methods. The Department of Pathology at Dartmouth-Hitchcock

Medical Center (DHMC) validated and established a post-sign out QA program using whole slide images, supported by a whole slide image (WSI) digital pathology communication system.

Technology:
Whole slide imaging

Design:
The Department of Pathology at DHMC has been performing routine WSI archiving of pertinent slides for the past two years. To establish a post-sign out QA, positive or malignant biopsy case is accessioned to Corista DP3™ digital pathology communication system. Archived whole slide images of the case are then imported from the departmental image database to and merged with patient demographics, clinical information, gross description and pathologic diagnosis from the laboratory information system in the Corista system through its interface. Histotechnologists and trained support staff provide quality control of the imported whole slide images. The Corista system then routes the case to another pathologist who did not sign the case out for QA. The QA pathologist reviews the case on personal desktop computer and provides agreement or disagreement to the diagnosis of the original pathologist. If disagreement arises, the pathologist may communicate to other pathologists for resolution of the diagnosis and follow the departmental QA protocol. The system captures all steps and communications, and provides a timely QA report.

Results:
The benefits of QA using WSI digital pathology communication system: (1) improved QA workflow, (2) reduction in QA steps, (3) elimination of glass slide circulation between pathologists, (4) improvement of pathologists' familiarity and comfort to a diagnostic WSI system, (5) pathologists' preparation for WSI telepathology in the future.

Conclusion:
We have established a case review QA program utilizing a WSI digital pathology communication system, which significantly improves our QA and its workflow, and indirectly prepares pathologists for diagnostic telepathology in the future.

Using Adaptive eLearning in Cervical Cytopathology Resident Education

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Content:
The integration of technology into physician training has the potential to substantially improve the breadth and quality of medical education. This use of technology is particularly relevant in the field of pathology, where critical visual information can be presented in innovative ways. Smart Sparrow (Smart Sparrow Pty Ltd, Sydney, Australia) is an online system that is designed to facilitate the integration of technology and adaptive learning into medical education.

Technology:
Smart Sparrow is an adaptive, web-based elearning platform that can be used to present information and provide real-time feedback. The technology uses student responses to individualize the educational curriculum, based on current research and learning theory. In contrast to systems that rely on expensive servers to house files and host programs that require firewall protection, Smart Sparrow is cloud-based and can be accessed outside of a protected system.

Design:
Smart Sparrow technology was used to create an adaptive elearning module covering basic cervical cytopathology principles and Bethesda System terminology, intended for pathology residents at various levels of training. Static images and whole scanned slides from our institution's cytopathology archives were integrated into the software. Accompanying explanatory text and relevant feedback were also provided. An identical assessment of knowledge was given to learners before and after engaging with the module. Basic demographics were also collected. Institutional guidelines regarding research on human subjects were followed.

Results:
The cervical cytopathology elearning module has been created and well received by cytopathology faculty and residents with varying cytopathology experience. A broader evaluation is pending to formally evaluate the utility of this technology. The assessment given before and after using the module will allow for a quantitative metric of learning.

Conclusion:
In addition to the positive feedback from residents and faculty to the Smart Sparrow technology, we anticipate that learners will show improvement in their cervical cytopathology knowledge following completion of the module. These data will help establish the utility of Smart Sparrow and adaptive elearning in the education of not only pathology residents but medical trainees at all levels and specialties. In the future, this tool could also be used by residency programs for competency-based assessment.

Web application design as an adjunct to resident teaching in pathology informatics

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Content:
In order to meet the demands placed on today's pathologist, increasing emphasis is being placed on resident education in informatics. Giving residents a meaningful, standardized experience with a live informatics project, however, can be difficult for numerous reasons. We wanted to see if a small-scale, hands-on project could be used to supplement the didactics of an informatics rotation for pathology residents without prior programming experience.

Design:
A web application was chosen for several reasons, including the abundance of development tools, cross-platform compatibility, and increasing popularity. The resident was encouraged to create a project meeting three criteria: immediate utility, personal interest, and feasibility of completion within two weeks. The project chosen was a template to generate placental pathology reports which could be easily transferred into LIS.

Technology:
A web-based development environment, Cloud9 (www.c9.io; San Francisco, CA, USA), was selected for ease of setup and configuration. The application uses the basic triad of languages common to most web applications: HTML5 (www.w3.org, W3C) to describe content, cascading style sheets (W3C) to style content for presentation, and javascript (Mozilla, Mountain View, CA, USA) to add functionality. Two additional open source frameworks were used to abstract low level mechanics in order to focus on broad design concepts: Bootstrap (www.getbootstrap.com, Twitter, San Francisco, CA, USA) for style and layout, and AngularJS (www.angularjs.org, Google, Mountain View, CA, USA), a javascript framework utilized for manipulation of HTML content.

Results:
With guidance from a faculty member, the resident was able to learn basic syntax and use the previously mentioned tools to complete a fully functional prototype within one week. The project was successful in significantly reducing the time needed to transcribe a paper checklist into a formatted report. Additionally, the resident was very engaged and had positive feedback about the experience.

Conclusion:
The overall objective was achieved and the resident gained familiarity with some fundamental informatics concepts in a relatively short period of time. Small project-based experiences such as this may be useful in supplementing resident education, especially for those with an interest in informatics.


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