This workshop will provide participants with a broad introductory overview of the field of digital pathology (DP), including:

- Applications, benefits and limitations of DP
- DP technology and financial considerations (primarily whole-slide imaging)
- Interoperability, regulatory, workflow
- Hands-on session focused on basic digital slide viewing using a variety of digital slides
Speakers

Lewis Hassell, MD  
Associated Professor of Pathology,  
University of Oklahoma

William DeSalvo, BS,  
HTL(ASCP)  
System Production Manager,  
Sonora Quest Laboratories

Elizabeth Chlipala,  
BS, HTL(ASCP)QIHC  
Partner, Premier Laboratory, LLC
Applications & Benefits of WSI

Lewis A. Hassell, MD
Associate Professor of Pathology
University of Oklahoma
So does DP scratch an itch we have?
Pathologist’s primary unmet need is improving the quality and efficiency of pathology services

DATA MANAGEMENT CHALLENGES

LOGISTICAL CHALLENGES

DEMOGRAPHIC CHALLENGES

- Aging pathologists community
- Geographic shortages
- Increase in sub-specialty expertise
- Increase in biopsies (aging population, less invasive surgical procedures)
- Increase in tests, driven by new CDx
- Increase in patient advocacy

@dpatweet #PV14
Digital Pathology – Definition & Historical Context

Digital Pathology is an environment for the management and interpretation of pathology information that is enabled by the digitization of a glass slide.

Today, WSI is considered the primary means of DP image capture; other approaches include:

- **Camera on a microscope** (single field-of-view)
- **Robotic microscopy** (remote control of microscope stage, objective lens turret and focus; single field-of-view)
- **Whole slide imaging** (capture/assemble multiple fields-of-view to create an image corresponding to an entire glass slide)
Overview of a Digital Pathology system

- All applications of digital pathology utilize some (all) of the primary three functions of a DP systems; which are enabled by specific hardware and software capabilities.
- Successful implementation requires user training, validation, IT integration, etc...

Primary Functionality
- Remote Viewing
- Image Analysis
- Data Management

Hardware & Software Capabilities
- Image Capture
- Image Management
- Image Analysis
- Image Viewing
- Image Storage
- Interface to LIS, EHR...
So what’s it really good for?

- (Making a Tissue Diagnosis!)
- EDX
- Professional
- Consulting
- Imaging
- Research and new tool development
- Business uses

Will it end up as a Door-stop at DCPA?
Applications - Undergrad Pathology Education

- Upwards of 60% of US medical schools use Digital Slides exclusively.
- Adoption in Dental Schools, Veterinary Schools and other fields is also significant.
- Student response – increased time spent studying slides, lowers barriers to access and results in better or no change in performance on examination.
- Could it still be made more effective and engaging? YES!
Virtual Slide Database

Breast

* denotes core annotated slides for General Pathology

Return to Contents

- Breast--Colloid carcinoma
- Breast--Ductal carcinoma in situ
- Breast--Epithelial hyperplasia
  Description Focal pathologic hyperplasia
- Breast--Fibroadenoma
- Breast--Fibroadenoma

Support by grants from:
National Library of Medicine
Research Resources/NIH

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Acknowledgments
Database Technology
Resident Education

- ACGME Competencies
- Atlas for case review
- Remote Conferencing
- Skill building, core and advanced
- Standardization
- Progress assessments
- Board Review

- User Interface Critical!
Postgraduate Education

• Digital slides are now almost ubiquitous in pathology meetings covering anatomical pathology
• Transform the ability to create enduring educational materials
• Engage interaction beyond the meeting room- On-going virtual meeting
• Are they used as much, more than, or less than glass slides from prior slide seminars?
GASTROINTESTINAL PATHOLOGY - Esophagus

Unknown Case #1

Place mouse here for Clinical History.
Click here to view the Answers, Test and Reference Information.

Unknown Case #2

Slide 1

Place mouse here for Clinical History.

Temporarily Out of Service
we apologize for the inconvenience
Proficiency Testing and Qualifying Exams

• CAP Proficiency Testing DigitalScope™

• American Board of Pathology AP exams:
  – Mexican Qualifying exam:
  – European exam still uses glass

• Competency assessments, pre-employment, or with new modalities, e.g. WSI FS or Validating IHC interpretation
Self-Directed Learning

• Board Review
  http://pathinfo.wikia.com/wiki/Pathology_Links

• Slide Sharing services- “Just in Time” learning and consultation

• Journals employing WSI

• Textbooks and on-line atlases
  https://digitalpathologyassociation.org/whole-slide-imaging-repository
Hematoxylin-eosin staining of a large cell carcinoma. 1, http://goo.gl/N1PGuy: Negative mucicarmine staining of a large cell carcinoma (original magnifications ×400 [A through D]).
Optimized Archival Management

• Loss avoidance (referral of unique slides)
• Maintenance for teaching and patient care after consultation
• More rapid retrieval for comparison with current materials (enhanced patient care)
• Simultaneous consultations
• Patient-retained records (24andMyslides?)
• Reduce tissue consumption (recuts)
Image Analysis

- Area Quantification
- Cell Quantification
- Tissue Pattern Recognition
- Feature Quantification
Image Analysis- Clinical uses
Advanced Image Analysis


@dpatweet
Advanced Image Analysis

• Computer-Assisted Diagnosis
• Morphologic feature based searches
• Spectral Partition and automated quantitation, reconstructions, manipulation
• Automated ROI selections and harvest by laser-capture
• More, and more to come
Consultation

• “Local” – colleague within the same practice, but at a different site
  - Real time QA
  - Specialist practices
  - Intra-op

• Remote consultants – Dr. Gno Itall

• Consensus Panels

• Study or Trial enrollment
International Consultation Service

Referring pathologist → Slide Scanner and Server → Internet/Cloud/Server → Consultant Pathologist A → Consultant Pathologist B
Consultation -
Integration of Multiple Locations
“Consultation”
Technical Services

- Specialized, slide-based service performed at off-site lab, then slide is digitized and access opened to provider

- Professional, interpretive services performed locally
Quality Control

ER Protein Controls over time
Quality Assurance

- Optimize current QA reviews; shorten TAT
- JIT consultation
- Optimize section and stain quality
- Lower barriers to review of prior slides
- Tighten kappa value on problematic areas
Business Uses

• Archival storage for faster retrieval for case comparison, reduced clerical costs
• Expedited consultation at lower cost
• Marketing “value-add” for clients and patients
• Archiving unique or limited availability materials (e.g. medical-legal materials, in-coming consults)
Limitations of WSI -
A short list of problems to be solved

• Large files take added time to load and manipulate over slower networks,
• Z-stack and high magnification challenges make use in cytology and hematology less efficient and somewhat problematic
• Retention of WSI over time will require abundant storage space
• Point-of-care microscopy
Other Limitations

- Polarized light
- Condenser adjustment to enhance refraction
Benefits
Benefits

• Students – learn anywhere, anytime, and anything
• Quality of diagnostic opinion
• Speed of consultation opinion
• Value-adds – what you couldn’t do w/glass
  - Patient and MD education
  - Advanced image analysis
  - Archiving and transport
Digital Pathology will enable pathologists to play an increasingly important role in the future of patient care.
DP is a vibrant market that continues to attract new entrants, including large companies.
Adoption of digital pathology is well under way for specific uses; installed base > 1,500 systems

<table>
<thead>
<tr>
<th>Application</th>
<th>Education</th>
<th>Research</th>
<th>Clinical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teaching and self-education</td>
<td>Proficiency testing</td>
<td>Biomarker discovery (image analysis)</td>
<td>Consultations (IOCs, formal/informal)</td>
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<tr>
<td></td>
<td></td>
<td>General research</td>
<td>Quality Assurance</td>
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<td></td>
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<td>Tumor boards</td>
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<td></td>
<td></td>
<td></td>
<td>Archival &amp; Retrieval (prior cases, risk management)</td>
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<td></td>
<td>Decision Support</td>
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<td></td>
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<td></td>
<td>IHC Quantification – FDA clearance</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Primary diagnosis – FDA approval (full adoption)</td>
</tr>
</tbody>
</table>

- Most common clinical applications are tumor boards, consultations, archival/retrieval and IHC quantification
- 60% are using DP for clinical use, 80% for education & research
- Most clinical users have adopted DP for 3 specific uses; strong demand to add more
- 85% surgical pathology, 15% cytology/hematology
Engraftment vs. Rejection

• Host organism – climate and culture
• Population dynamics
• External defenses – Regulation
• Validation protocols – dosage
• Needs basis – What is the context?
  - Clinical
  - Educational
  - Quality
  - Efficiency
FIGURE 1. How individual adoptions compose diffusion.
Concerns-Based Adoption Model

- Change is a process, not an event.
- Change is accomplished by individuals.
- Change is a highly personal experience.
- Change involves developmental growth.
- Change is best understood in operational terms.
- The focus of facilitation should be on individuals, innovations, and context.
Technology and Financial Considerations

William DeSalvo, BS, HTL(ASCP)
System Production Manager,
Sonora Quest Laboratories
Technologies of Digital Pathology

• Scanners

• IT Infrastructure

• Viewers

• Image Management Software
Whole Slide Scanners - Overview

Creates whole slide images from slides.

Key characteristics:
- Speed
- Image Quality
- Slide Loading Mechanisms
- Scan Types
- Operator Time Required

No device is best for all use cases or purposes
Whole Slide Scanners Considerations - Speed

Scan Time = Time/Slide  (ex: 60 seconds)
Throughput = Slides/Time  (ex: 30 slides/hr)

Auto assembly plant example...
~24 hours to build each car
~50 cars built per hour

1 / Scan Time ≠ Throughput  !!!
Include load / unload time, selection of scan areas, re-scan rate, slide movement time, and parallel operations.
Whole Slide Scanners Considerations - Image

- Magnification = enlargement to sensor
- Resolution = smallest identifiable feature.
  - Resolution is combination of optical magnification, optical net aperture, and sensor resolution.

- No standards between scanners - Best evaluation is to look at the images.
Whole Slide Scanners - Magnification & Resolution

With a microscope, your eyeball is the sensor.

With a digital pathology, your eyeball views a projection on a screen.

Computers can enlarge view of an image to any size.

Image resolution determines crispness of image as it is enlarged.
Both images captured with 20X magnification objective.

10 microns / pixel on sensor
0.05 microns / pixel optical resolution

5.5 micron / pixel on sensor
0.0275 microns / pixel optical resolution

Apparent magnification at full resolution is 1.7X larger.
Whole Slide Scanners Considerations – Loading Mechanisms

- **Total Capacity** = maximum unattended operation
- **Cartridge Size** = # of slides per load unit
- **Continuous** = ability to load w/o interruption
- **Override** = ability to immediately scan STAT

Best mechanism varies by use case
Considerations include staffing schedules, turnaround time variations, batch sizes, etc.
Whole Slide Scanners Considerations – Scan Types

- Brightfield vs. Fluorescence
- 20X–60X air vs. 80X-100X oil immersion
- Single-plane vs. Z-stacking
- Slide format – 1x3, 2x3 or larger

- Generally, one device cannot serve all slide types, use cases or specimen types
Whole Slide Scanners
Overview

Provide performance, reliability, and support.

Key components:

– Network
– Storage
– Systems Management
– Integration

Determine scope early to identify stakeholders to include in planning:

- Departmental Solution vs. Enterprise Solution
IT Infrastructure Considerations - Network

- Latency = time for roundtrip (ms)
- Bandwidth = amount of data/time (GB/sec)

Between point A and B...

How much time for 1 car to travel?
How many cars per hour travel?

- Requirements differ for storing images (moving the whole image file) versus viewing images (streaming on demand).
IT Infrastructure Considerations - Storage

- File Size = size per image
  - File sizes will vary by lab based on mix of image compression format, scan resolutions, and average tissue per slide.
- Volume = images/year
- Retention = time to keep images

- Incorporate requirements such as backups, availability, and legal requirements/mitigation.
IT Infrastructure Considerations - Integration

- Data = eliminating redundant entry
- Workflow = experience working across apps
- Storage = use common enterprise platform
- Imaging = sharing between diagnosticians
  - Common Systems: APLIS, Barcoding, PACS
    NOTE: Check minimum versions and platform for compatibility
  - Common Standards: HL7, IHE, DICOM

- Identify how the integration will facilitate the user workflow before diving into specifications.
IT Infrastructure Considerations - Reliability

• Backup = protection against data loss
• Availability = required uptime level
• Disaster Recovery = continuity after catastrophe

• Higher levels of reliability incur additional costs that must be weighed against impact to business.
IT Infrastructure Considerations – Security & Privacy

• Meet local privacy laws
• Fulfill organizations policies

• Most organizations have defined requirements or audit questionnaires for all new IT solutions.
Image Viewer Overview

Allows user to view and interact with images.

Deployment types:
- Installable Client
- Web Browser Based
- Mobile Application

Functionality, performance, and intended uses may vary between viewers from same vendor.
Organize images to support the use case.

Providers:
- Digital Pathology Scanner Manufacturers
- Digital Pathology Software-only Providers
- Lab Information Systems (LIS)
- In-house Developed Solutions

Evaluate solutions against your use case(s).
Financial Considerations
Costs associated with implementing a digital pathology systems

Total Cost = Primary Costs + Other Costs

Primary Costs
- Scanning instruments – range of choices
- Software licenses – varies based on use
- Implementation and training – varies by complexity and integration

Other Costs
- Maintenance & Support
  - HW & SW -- break fix, routine service, and upgrades
- Post-Implementation Training
  - Critical to continue to benefit from the technology post-implementation
- Storage / IT
  - Highly dependent on storage strategy and business service levels
- Labor
  - Scanning, image Q&A, ongoing IT monitoring and support
Consider cost/slide as a potential metric for assessing a DP system

A faster scanner is not necessarily more cost-effective
- e.g., 2x faster and 3x more expensive is not more cost-effective
- Scanning prep and re-scan rates have labor costs

Factors to include in cost/slide include
- Labor costs to load/unload slides
- Labor costs to set scanning parameters
- Labor costs to Q/A digital slides
- Reliability / up-time (a system that’s “down” is not adding value)
- Ease of use (a system that’s easier to use requires less user time)
- Storage (a more highly compressed image file requires less storage)
- Viewing performance (a “sluggish” viewer requires more time)
Acquisition Models

A variety of purchasing models exist to acquire solutions:

- **Outright purchase**
  - high upfront payment with ongoing maintenance
- **Lease**
  - fixed monthly payments for period of time
- **Usage-based**
  - ex: pay per slide or case

Considerations to balance:

- Short-term expenses versus total long-term costs
- Availability of budget initially versus ongoing
- Predictability of use
Some applications have strong ROIs for pathology department -- reduce travel time, reduce admin time, reimbursements
  - digital IHC
  - frozen sections
  - archive and retrieval

Others have a strong ROI for the institution but not for the pathology department -- improved quality, clinician/patient satisfaction, competitiveness
  - tumor boards
  - consultations
  - quality assurance

ROI for using DP clinically requires a “big picture” perspective beyond the benefits only to the pathology department
Regulatory & Compliance and Workflow Considerations

Elizabeth Chlipala, BS, HTL (ASCP) QIHC
Partner, Premier Laboratory, LLC
The extent of how regulatory and compliance impacts the use of WSI is related to the environment. Therefore the process and guidelines followed can vary, but may share some similarities. The costs associated with these processes also needs to be considered.

- Health Care – clinical
- GLP – regulated or non-clinical
- Non-GLP – not regulated – preclinical, drug discovery
- Education
Regulated - GLP

Follow FDA Guidelines and Industry Standards:

Federal Register - 21 CFR part 58, 21 CFR part 11

- Validation of equipment – IQ, OQ
  - IQ - Installation Qualification
  - OQ – Operational Qualification
- Validation of process – PQ or UAT
  - Process Qualification
  - User Acceptance Testing

The extent, how and what is validated will be dependent upon Quality Management

- Dependent on the complexity and criticality of the instrument or process
- Governed by your SOP’s


http://tpx.sagepub.com/content/41/1/115.full.pdf+html


http://tpx.sagepub.com/content/35/3/450.full


Health Care – Clinical

Validate for specific application – the entire process or the outcome of that process is validated

- Secondary consultations
- Frozen sections
- Image Analysis - ER/PR, Her2, Her2 FISH
  - 510K cleared kits, algorithms – still must validate in house
  - validate staining, validate algorithm
- May be moving towards IQ/OQ/PQ
Follow the CAP guidelines for validation in clinical settings

- Develop a team of individuals who will work on this process, needs to include all areas of the lab that are impacted by the whole slide scanning process and digital read or image analysis
- Determine a plan of action
  - Define the process - work flow documents, forms, etc.
  - Define the individuals involved in each step of the process
- Write a validation plan or protocol
- Review that plan or protocol
- Execute that plan or protocol
- Compile results and write a report
  - In research we write a technical report

Follow the CAP guidelines for validation in clinical settings
Health Care - Resources


2. DPA White Paper.  

3. CAP/ASCO Guidelines for ER/PR and Her2  

4. Archive of Pathology and Laboratory Medicine. Validation of Whole Slide Imaging for Primary Diagnosis in Surgical Pathology  
Non-GLP – Preclinical, Drug Discovery

Not Regulated – So.........what is required??

• Quality and Process controls in place for staining, scanning and analysis

• Validation – not required, but good science would recommend some type of process that essentially checks the following:
  – Quality of staining and scanned images acceptable
  – If image analysis is utilized there should be checks to assure that the algorithms are working properly
    • In and out image review
    • Method comparison
    • Statistical methods – Slope and R² values
Education

Not Regulated

• Student interaction positive
• Management and access to images
# Regulatory and Compliance - Overview

<table>
<thead>
<tr>
<th>Environment</th>
<th>Task</th>
<th>Agency/Standard</th>
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</thead>
<tbody>
<tr>
<td>Health Care</td>
<td>Primary Diagnosis</td>
<td>FDA – not approved currently – requires vendor PMA CAP/CLIA – utilize guidelines set by CAP – develop as laboratory developed test</td>
</tr>
<tr>
<td></td>
<td>Secondary Consultation</td>
<td>FDA – 510K cleared digital read</td>
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<tr>
<td></td>
<td>Frozen Section Diagnosis</td>
<td>CAP/CLIA – Internal Validation</td>
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<tr>
<td></td>
<td>Digital Read</td>
<td>IQ/OQ/PQ</td>
</tr>
<tr>
<td></td>
<td>Image Analysis - ER/PR, Her2</td>
<td>FDA – 510K IHC Kit and Algorithm</td>
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<tr>
<td></td>
<td></td>
<td>CAP/CLIA – Internal Validation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IQ/OQ/PQ</td>
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<tr>
<td>GLP - Regulated</td>
<td>Primary Diagnosis – Tox Path</td>
<td>FDA – not approved currently – requires vendor PMA</td>
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<tr>
<td></td>
<td>Secondary Consultation/Peer Review</td>
<td>Federal Register – 21 CFR part 58, 21 CFR part 11 Internal Validation - IQ, OQ, PQ, UAT</td>
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<tr>
<td></td>
<td>Image Analysis</td>
<td>FDA - 510K cleared for specific applications</td>
</tr>
<tr>
<td>Non-GLP</td>
<td>Any Task</td>
<td>Not Regulated</td>
</tr>
<tr>
<td>Education</td>
<td>Any Task</td>
<td>Not Regulated</td>
</tr>
</tbody>
</table>
Workflow Considerations

The process of creating, scanning, management, utilization and storage of whole slide images

Currently not part of the histology/pathology process – additions to both TAT and staff responsibility
The Decision Making Process – Equipment

Type of scanner
– what is being scanned------histology, cytology, hematology, large format (2x3 or >)
– brightfield, fluorescent, or both

How many scanners
– load and throughput
– environment dependent - clinical/research/education
Software and Storage/Archive

Software
- Image management and viewing
- Image Analysis
- Reporting
- Interoperability - LIS
- Bundle or different providers

Storage/Archive
- Internal/External – Cloud
- Back-up
Additional decisions to be made

Location of scanner
What will be scanned
Scan in batches or a tray at a time
What magnification – 20x, 40x, 100x – specimen dependent
Who will be responsible for scanning
Who will be responsible for image/data management
Who will have access to images
How do you notify that images are available
How and who will be trained
Is validation required
Do I need system integration (LIS)
Is there any data migration
Image life cycle management
SLIDE PREPARATION – Process Controls

Develop embedding and sectioning criteria for all sample types

- embedding orientation – skin, gut, etc.
- section thickness
- tissue placement/orientation on slide, number of sections per slide
- overall section quality – define what is acceptable
- IHC for image analysis will have different quality criteria than for subjective scoring
- QC in place – prior to scanning and after scanning
Examples
Interoperability and LIS

Interoperability eliminates the duplicate entry of data and provides immediate access to information across the workflow, providing for:

• Reduction in manual work
• Reduction in case turnaround time
• Reduction in errors
Digital Pathology in the AP Workflow

Digital Pathology outside clinical workflow
QC, teaching, education, tumor boards, etc.

Digital Pathology within the clinical workflow
Integrated Imaging Workflow

**Initiation**
- Order
- Collection
- Transport
- Receiving and Accessioning
- Grossing

**Digital Preparation**
- Transport
- Case Assignment
- Case Assembly
- Slide Scanning
- Histology

**Analytic**
- Case Selection
- Case Review
- Additional Slides
- Diagnosis Entry
- Report Signout

**Documentation**
- Result Delivery

**Communication**
Existing APLIS/DPS Implementations
Metadata in the Barcode

APLIS Software

Digital Pathology Software*

Basic information encoded in the barcode

Digital Slide Viewer

1

2

Scanner

3

4

5

@dpatweet

#PV14
Existing APLIS/DPS Implementations
Dynamic Metadata Exchange

1. Accession Number
or other key encoded
in the barcode

2. Scanner

3. Digital Pathology
Software*

4. 7

5. Digital Slide
Viewer

6. 6

APLIS
Software

Digital Pathology
Software*
Existing APLIS/DPS Implementations

APLIS Integrated Viewing

1. Scanner
2. Digital slide ready
3. APLIS Metadata
4. Results
5. APLIS Software
6. View the digital slide
7. Digital Pathology Software*
8. Annotations, Report Images, Analysis Submitted

Digital Slide Viewer
Digital Pathology Workflow is Divided Between WSI System and AP LIS

- Notification of case availability – maybe WSI
- Accessioning into AP LIS – AP LIS
- Distribution of case to pathologist – WSI, APLIS
- Slide review and interpretation – WSI
- Generation of report – AP LIS
- Additional studies if needed – AP LIS

With time, integration between WSI and AP LIS should increase.
Notification of Case Availability

**Routine pathology**
- Slides are created in the laboratory
- Consult slides arrive with necessary (hopefully) paperwork

**Digital pathology**
- Slides must be scanned – *successfully* – to create digital slides
- Some type of notification so that the recipient knows when digital slides are available or “received”
- Slides do not arrive
Accessioning into AP LIS – Digital Consults

**Routine pathology**
- Lab personnel match slides with information in accompanying documents to confirm:
  - Patient/case ID and slide labels match
  - All slides are received
  - Slides are not damaged
  - All necessary accompanying information is present
- Case is accessioned into LIS

**Digital pathology**
- Lab personnel need access to required information (see next slide) in order to accession case:
  - Electronic requisition?
  - Available in slide viewing software?
  - e-mail?
- Lab personnel need access to the digital slides in order to confirm:
  - Patient ID and slides match
  - All expected slides are available
  - No obvious scan problems
- Case is accessioned into LIS
Distribution of Case to Pathologist

Routine pathology
• Slides, working draft report from LIS, and other paperwork with necessary information (e.g. requisition) are delivered to pathologist

Digital pathology
• Pathologist needs notification that case is waiting.
  – Working draft from LIS may be delivered to pathologist
• Pathologist needs to see other necessary information
  – Access to scanned documents?
  – Printout of electronic requisition?
Pathologist Slide Review and Interpretation

Routine pathology
- Pathologist places slides on microscope and navigates slides at own pace
- Pathologist arrives at diagnosis based on review of glass slide

Digital pathology
- Pathologist accesses digital slides in viewer system and views on monitor
  - Needs to know how to locate digital slides for each case
- Pace of navigating slides is determined in part by system response time for viewing slides
- May need to defer diagnosis to glass slide review
Generation of Pathology Report

Routine pathology

- Creation of pathology report in LIS typically accomplished through:
  - Dictation with transcription
  - Direct entry
  - Speech-to-text

Digital pathology

- Options for creation of report in LIS are differ depending on functionality
- If at remote location, pathologist needs access to LIS and/or transcription services, voice recognition or a procedure is needed for documentation and eventual report
- Should report note that digital pathology was used in the case?
More pathologist time per case will be required for digital pathology

• Using digital pathology will be a slower experience for a pathologist than is moving a glass slide around on a microscope.
  – Navigation of and viewing of microscopic fields by virtual microscopy
  – System and network response times (latency) can cause issues

• Additional time per case could be expected to increase with increasing case complexity (number of slides, amount of tissue per slide).
Hands on Portion of the Workshop
Hands-On Session Guidelines

Logistics

- Every course attendee should have a team number (1-2) and a participant number (1-8).
- Every team is assigned to a different workstation.
- Each team will complete two 30-min exercises and every team member will participate in both exercises.
  - Exercise #1 - Basic Viewer Functionality
  - Exercise #2 – Viewing Different Sample Types
- We will wrap up with team discussion and reporting of findings to the entire group.
Exercise #1: Basic Viewer Functionality

Objective: Demonstrate the following basic viewing capabilities using 20x digital slide images

- Panning/zooming
- Viewing multiple images side-by-side
- Creating annotations and running positive pixel count image analysis

<table>
<thead>
<tr>
<th>Participant</th>
<th>Digital Slide(s)</th>
<th>Action</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ex1_H&amp;E20_1</td>
<td>Open H&amp;E slide, examine at low power, pan and zoom</td>
<td>Tumor or Tonsil H&amp;E</td>
</tr>
<tr>
<td>2</td>
<td>Ex1_IHC20_1</td>
<td>Open IHC slide and view side-by-side with corresponding H&amp;E slide (Ex1_H&amp;E20_1)</td>
<td>Beta-catenin-1 or CD3 E272</td>
</tr>
<tr>
<td>3</td>
<td>Ex1_IHC20_2</td>
<td>Open IHC slide and view side-by-side with corresponding H&amp;E slide (Ex1_H&amp;E20_1) and corresponding IHC slide (Ex1_IHC20_1); total 3 slides</td>
<td>Beta catenin EP35 or CD3 rabbit polyclonal</td>
</tr>
<tr>
<td>4</td>
<td>Ex1_H&amp;E20_2</td>
<td>Open H&amp;E slide, examine at low power, pan and zoom</td>
<td>Goat bone H&amp;E</td>
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<tr>
<td>5</td>
<td>Ex1_SS20</td>
<td>Open SS slide and view side-by-side with corresponding H&amp;E slide (Ex1_H&amp;E20_2)</td>
<td>Goat bone Safranin O</td>
</tr>
<tr>
<td>6</td>
<td>Ex1_IHC20_1, Ex1_IHC20_3</td>
<td>Open IHC slide; annotate small region and run positive pixel count image analysis; review results</td>
<td>IHC Stain image analysis</td>
</tr>
</tbody>
</table>
Exercise #2: Viewing Different Sample Types

Objective: Demonstrate viewing different sample types
- Comparing 40x slides to 20x slides
- Viewing slides with defects
- Viewing thick slides
- Viewing different sample types (cytology, hematology)
- Viewing multiple sections on one slide, measuring distance using “digital ruler”

<table>
<thead>
<tr>
<th>Participant</th>
<th>Digital Slide(s)</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ex2_H&amp;E20_1, Ex2_H&amp;E40_1</td>
<td>Open the 20x and 40x H&amp;E slides, view side-by-side and observe differences</td>
</tr>
<tr>
<td>2</td>
<td>Ex2_H&amp;E20_2</td>
<td>Open H&amp;E slide and examine areas with artifacts (tissue folds, bubbles, etc.)</td>
</tr>
<tr>
<td>3</td>
<td>Ex2_H&amp;E20_3</td>
<td>Open H&amp;E slide and examine image quality when tissue section too thick</td>
</tr>
<tr>
<td>4</td>
<td>Ex2_Cyto20_1</td>
<td>Open cytology slides and examine areas of slide that are out of focus</td>
</tr>
<tr>
<td>5</td>
<td>Ex2_Hem100_1</td>
<td>Open hematology slide and evaluate 100x resolution</td>
</tr>
<tr>
<td>6</td>
<td>Ex2_H&amp;E20_4</td>
<td>Open H&amp;E slide and examine multiple sections of same slide; open slide again and compare side-by-side (at different magnification); measure distance using ruler</td>
</tr>
</tbody>
</table>