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## Final Report FY'04

Drazen M. Jukic, MD, PhD  
Leslie M. Anthony;  
Jonhan Ho, MD

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# The IMITS



- Focused on US Air Force and UPMC development and implementation of prototype telemedicine systems and advanced technology applications;
- Telepathology allows sharing of microscopic images among pathologists;
  - For diagnosis, consultation, and training.
- At UPMC:
  - Activities focused on the clinical Implementation of Whole Slide Imaging (WSI);
  - Structured proof of concept applications and technical performance assessments.



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# The IMITS



- Results will lay the groundwork for development of a strategic plan for implementation of WSI;
  - At Air Force locations;
  - At UPMC locations.
- The Air Force advanced work from FY 02;
  - Continued development and application of the static image system;
  - The Medical Center at Keesler AFB served as the hub;
  - Spoke sites at Eglin and Travis AFBs.
  - Air Force sites and UPMC held Case of the Week sessions via the Telepathology site on AF Knowledge Now through the AF Portal.
  - The Air Force also continued to pursue certifications to enable an integrated static, robotic, and whole slide Telepathology network.



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# Deliverables



- The IMITS Telepathology project for 2004 focused on four main projects with each project broken into sub-deliverables.
  - Project 1: Clinical Implementation of Whole Slide Imaging
  - Project 2: Improve Whole Slide Imaging Technology
  - Project 3: Integration of Advanced Algorithms
  - Project 4: Integration of Static, Robotic and Whole Slide Telepathology Network



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# Project 1



- To demonstrate the utility of WSI as a technology;
- To show that WSI can be used reliably in clinical environment.
- Controlled validation studies to assess the feasibility and functionality of using WSI to perform Quality Assurance and Primary Diagnosis in anatomic pathology.
- The project had four sub-deliverables:
  - DITSCAP certification of approval to operate
  - List of participants in working group with Radiology Informatics
  - Requirements for whole slide image capture robot and barcode labeling integration
  - Final report to include outcome of test/evaluation of whole slide imaging robots



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# Project 1



- Major thesis:
  - Automated, high-speed, high-resolution WSI systems are capable of operations in the clinical environment.
  - Systems that are expected to become increasingly more capable over time.
- IMITS to utilize robotic devices (WSI imagers) - can digitize entire slides automatically, rapidly and at high resolution - with an infrastructure (similar to a PACS system);
- To leverage digital slides into a much more efficient, higher quality pathology practice.



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# Controlled Clinical Validation Studies – Quality Assurance (QA)



- QA – an important component of anatomic pathology practice;
- QA is mandated by CAP in the accreditation of laboratories;
- Anatomic pathology QA is usually done by having a second pathologist “review” the work of the primary pathologist.
  - This works for small practices in single locations;
  - Breaks down when in large, geographically distributed health system or practices.
  - Moving slides between facilities is cumbersome, expensive and time consuming.
  - WSI could provide a mechanism to significantly improve QA such environments.



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# Quality Assurance (QA) Study



- No published data on the use of WSI in anatomic pathology quality assurance prior to this.
- Retrospective, comparative study;
- 24 full cases focusing on genitourinary pathology
  - (including 47 parts and 391 slides);
- Independently reviewed with traditional microscopy and WSI.
  - ~ 50% were neoplastic cases.
  - Discrepancies evaluated by a consensus committee at the end of the study.



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# Quality Assurance (QA) Study



- Pathologists felt that glass and WSI methods were comparable for case review;
- No difference reported in perceived case complexity or diagnostic confidence between the methods.
- Four (4) cases with clinically insignificant discrepancies:
  - Two from glass slide review;
  - Two with WSI review.



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# Quality Assurance (QA) Study



- Conclusions:
  - Viable modality for surgical pathology QA;
  - Scenario - multi-facility health systems that needs to establish inter-facility QA.
  - Major issues limiting the implementation:
    - Not the image acquisition or quality;
    - Rather - image management issues such as the pathologist's interface, the hospital's network and integration with the laboratory information system.
- The study has been published in by *Human Pathology*, a respected peer reviewed scientific journal (citation: # # #).



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# Primary Diagnosis Study



- Primary diagnosis - practice of evaluating tissue samples grossly and microscopically;
- Rendering a complex diagnosis in the form of anatomic pathology report disseminated to clinicians and patients;
- This study was designed to be the most realistic evaluation of WSI that has ever been done.



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# Primary Diagnosis



- Precisely emulated the complete primary diagnosis process:
  - Including integration of the laboratory information system;
  - Ordering of special stains and recuts;
  - Rendering of a complete, written report with full diagnostic comments.



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# Primary Diagnosis



- Three pathologists;
- 25 cases with 31 parts.
- LIS (CoPath) used to emulate real sign-out conditions including entering a full diagnostic field and comment (when appropriate) and ordering additional stains and recuts.
- For each case, a committee documented discrepancies between diagnoses and formed a “consensus” report that was then compared with the microscope-based report from the clinical archives (original sign-out report)



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## Primary Diagnosis



- In 17 of 25 cases, there were no discrepancies;
- In eight (8) of the remaining cases, there were 12 discrepancies;
- Three (3) in which image quality could be at least partially implicated.
- Very positive result that does not mean that WSI is as good as a microscope.



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# Primary Diagnosis



- Every image was readable;
  - But nearly every virtual slide had areas in which image quality (focus and dynamic range) was less than perfect.
  - In some cases, there was evidence of over-compression and regions made “soft” by less than perfect focus.
- We expect that the systems will continue to get better, image quality and speed will continue to improve;
- Still, further validation studies will be needed to guide development of this technology.



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# *Immunohistochemistry Study*



- In current practice, a pathologist confronted with atypical focus in a prostate biopsy can order appropriate IHC stains. The local histology lab cuts the appropriate slides that must then be couriered to the central IHC lab where the staining is done. The stained slides are then returned to the pathologist via a scheduled courier.
- It is possible that whole slide imaging of stained slides in an IHC lab could make IHC morphology available to pathologists in a much timelier manner. The IHC study is designed to test the pathologist's ability to interpret IHC staining in prostate needle biopsies by comparing automated WSI with traditional glass slide microscopy.



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# *Immunohistochemistry Study*



- The study tests the potential application of WSI across geographically dispersed health systems, such as UPMC, which has a single central IHC lab that serves many hospitals.
- The study takes place at UPMC and includes evaluators from UPMC and Johns Hopkins University.
- We anticipate that the study will be completed by the end of June 2006