



International Telecommunication Union

# Digital Imaging in Pathology

## for Standardization

Yukako Yagi

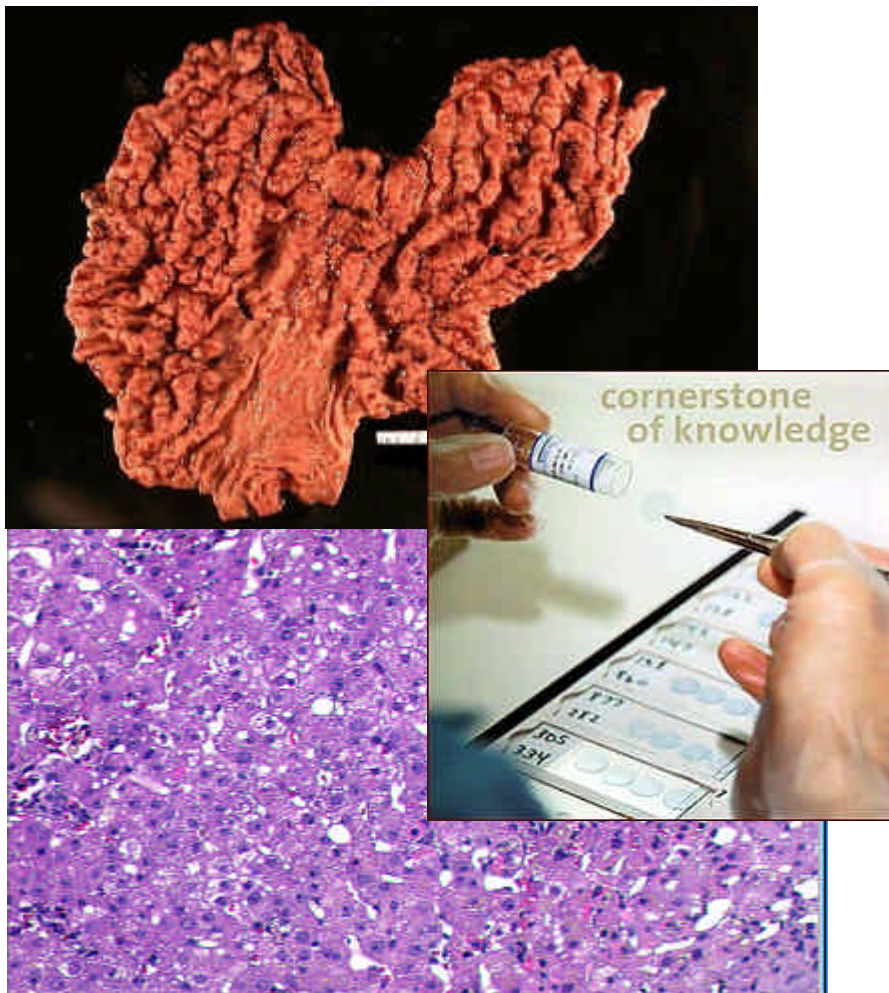
Director, Telepathology University of Pittsburgh  
Medical Center Health System, USA

Workshop on Standardization in E-health  
Geneva, 23-25 May 2003



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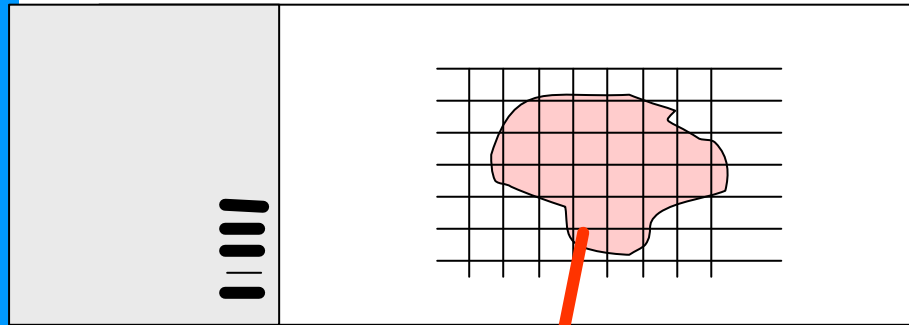
# Pathology Imaging



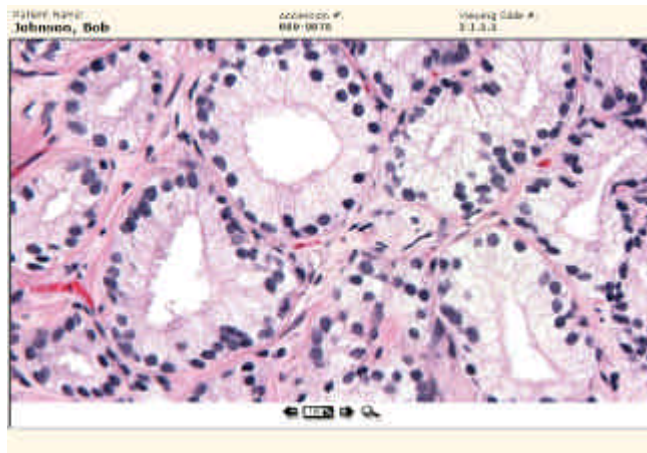
- Involved in the care of virtual every patient that sees any doctor
- We analyze blood and tissue for the presence and nature of disease.
- **70%** of data in the Electronic Medical Record is from Pathology
- **Over 70%** of the requests for data from the Electronic Medical Record are for Pathology data
- **80%** of data used by decision support programs is from Pathology
- Pathology Informatics is a growing, distinct subspeciality



# A Digital Slide



- o One square cm of tissue imaged at 0.41  $\mu\text{m}/\text{pixel}$  = 1.8 GB



# Difficulty of Image Standardization in Pathology

## System Components (Components can decide image quality)

1. Microscope
2. Optical Coupler
3. Camera
4. Computer
5. Monitor/Screen
6. Software/Hardware for Image acquisition, compression and manipulation
7. Image Format

- There are many choices for each component
- Each component presents a variety of options to the user
- Each user can pick any kinds of each component
- The same system setting can get different image quality by user





# Difficulty of Image Standardization in Telepathology

## Purpose of Telepathology

1. Primary Diagnosis
2. 2<sup>nd</sup> Opinion
3. Education

## Type of Telepathology

1. Static (store & forward)  
Static (live)
2. Dynamic without Robotic
3. Dynamic with Robotic microscope
4. Hybrid
5. Virtual Slide/Whole Slide Imaging
6. Human factor in most image capture settings

Depending on the purpose, different type of telepathology, usage and image quality are required.

New Technology:

[Virtual/Whole Slide Imaging](#) brought the possibility of standardization in pathology like radiology



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Tasks

- [Work List](#)
- [Case \(S01-00104\)](#)
- [Conference](#)
- [Search](#)

Tools

Resources

Support



InterScope Technologies  
Intelligent tools for pathology™

Log Off

Full Screen Where Are Show Text Compare Related Case Report Share Cas Measure

Patient Name:

**Dolley Madison**

Accession #:

**S01-00104**

Viewing Slide #:

**1.1.1.1** ✓

- ✓ 1.1.1.1
- 2.1.1.1
- 2.1.2.1
- 3.1.1.1



◀ 0.39% ▶ 🔍

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Full Screenshot Where Are Show Text Compare Related Case Report Share Case Measure

Patient Name: **Dolley Madison**      Accession #: **S01-00104**      Viewing Slide #: **1.1.1.1** ✓

- ✓ 1.1.1.1
- 2.1.1.1
- 2.1.2.1
- 3.1.1.1



← 6.25% → 🔍

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**Tools**

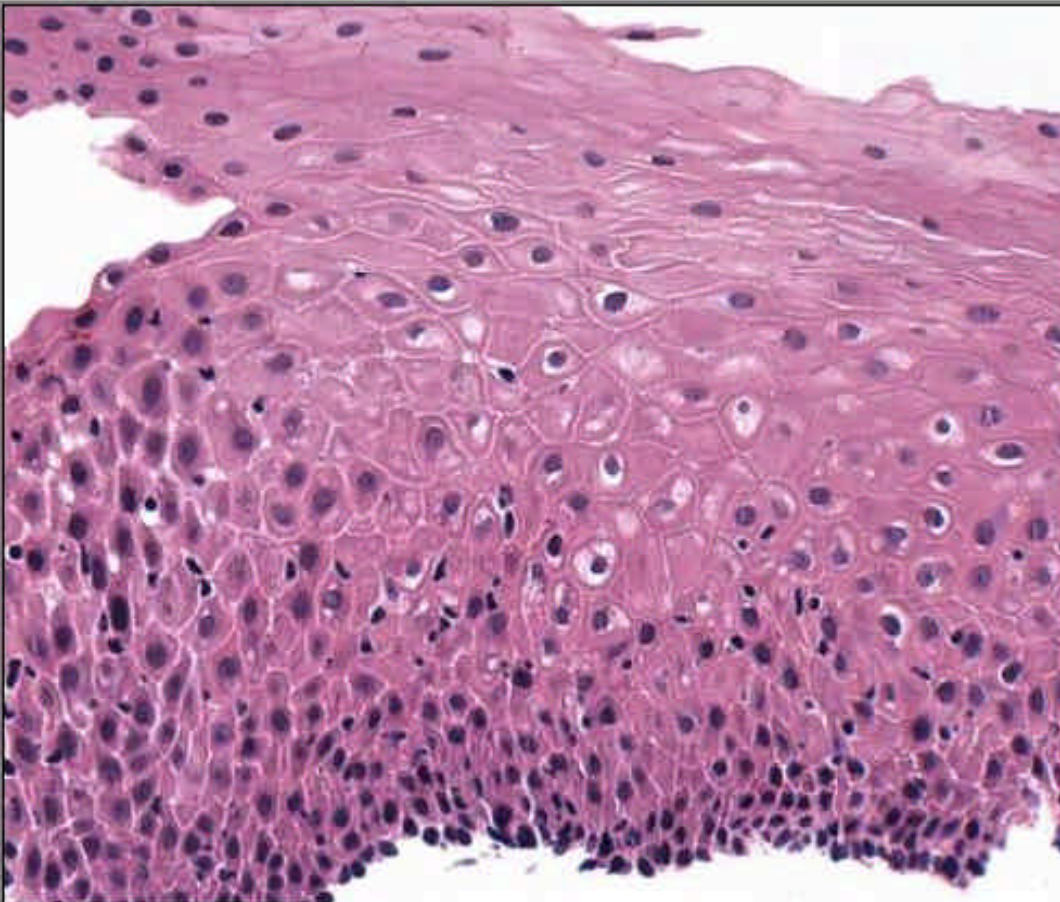
**Resources**

**Support**

  
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Patient Name: **Dolley Madison**      Accession #: **S01-00104**      Viewing Slide #: **1.1.1.1** ✓

1.1.1.1 ✓  
2.1.1.1  
2.1.2.1  
3.1.1.1



← 50% → 🔍

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Compare

Related Cases

Report

Share Case

Answer

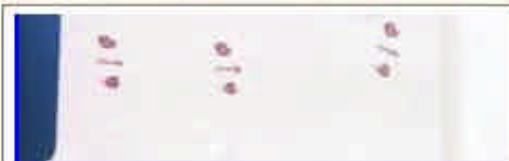
<<Back

Patient Name:

**Madison, Dolley**

Accession #:

**S01-00104**



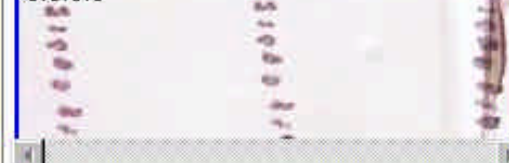
2.1.1.1.1



2.1.2.1



3.1.1.1



Accession Date: **10/19/2000** MRN: **999820372**  
Procedure Date: **10/18/2000** DOB: **6/19/1948**  
Signout Date: **Not Signed Out** Sex: **Female**  
Attending MD: **Walter Brown, DR**

**PATIENT HISTORY:**

Polyps

**GROSS DESCRIPTION:**

1. Esophagogastric Junction, Biopsy: A formalin container is received labeled with the name "D. Madison" and "bx E-G Junction". It contains three 0.1 cm. diameter items of tan soft tissue that are submitted in toto as #1.
2. Stomach, Not otherwise specified, Biopsy: A formalin container is received labeled with the name "D. Madison" and "gastric bx". It contains a 0.1 cm. diameter item of tan soft tissue that is submitted in toto as #2.
3. Colon, Sigmoid, Polypectomy: A formalin container is received labeled with the name "D. Madison" and "sigmoid colon polyp". It contains multiple fragments of tan soft tissue that in aggregate are 0.4 cm. in diameter. They are submitted in toto as #3.

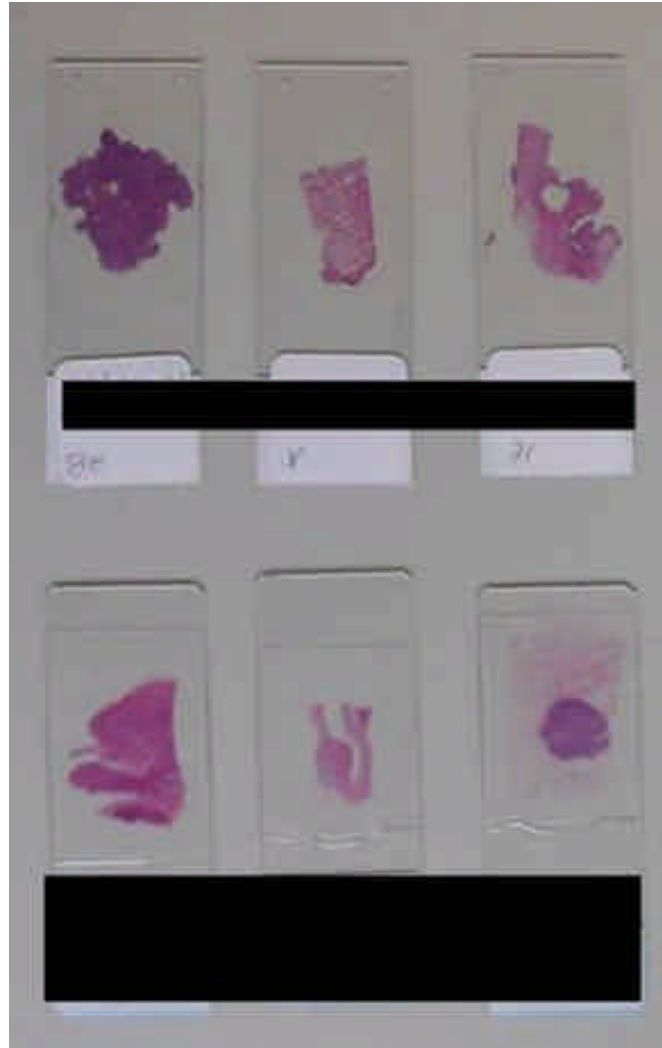
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[\\*Patient Demographic](#) [\\*Patient History](#)  
[\\*Gross Description](#)



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## Before imaging.....



Glass slide may need standardization....

- Thickness
- Color of Stain
- Depending on Dye
- Depending on Institution

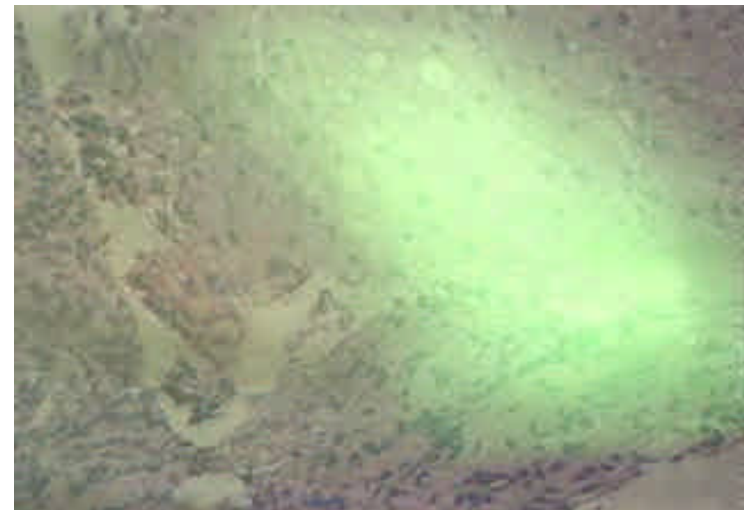
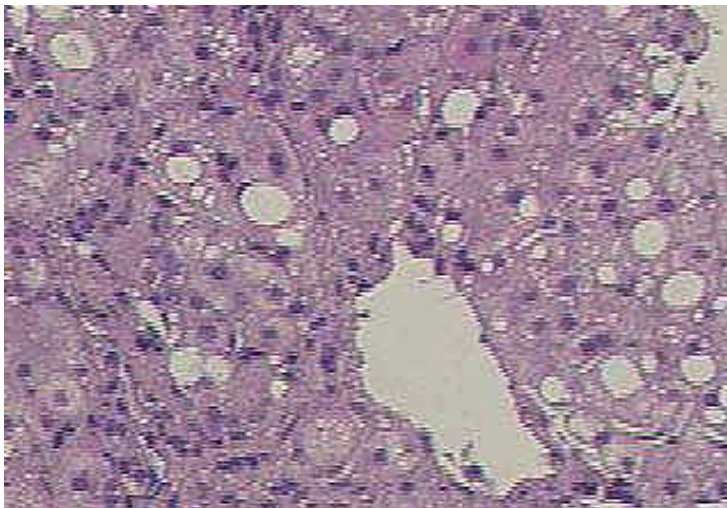
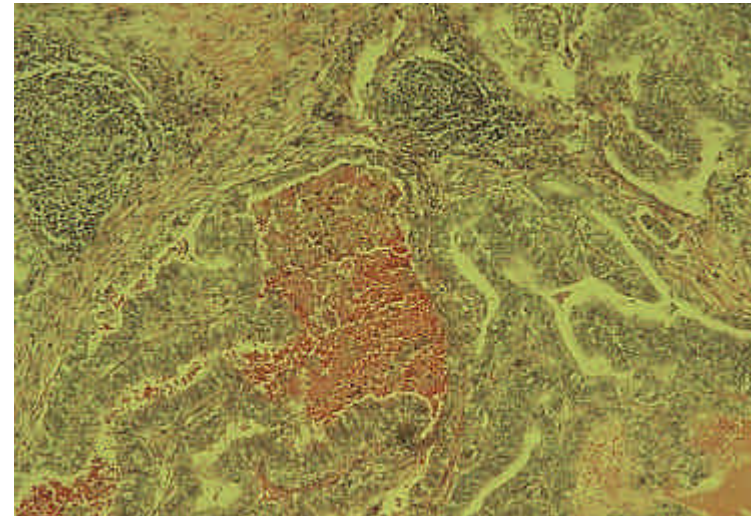
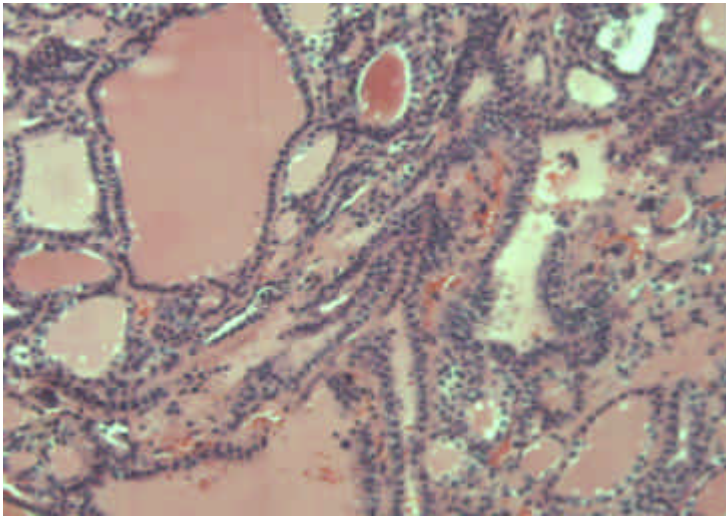
Stain color difference with same stain effect on diagnosis when we use telepathology more than under the microscope





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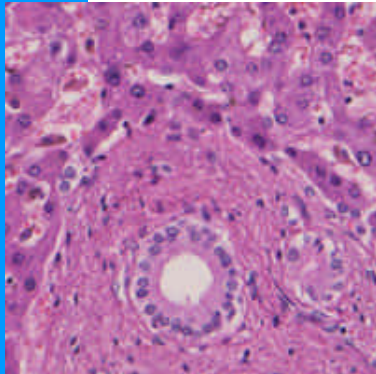
# Example of unacceptable images



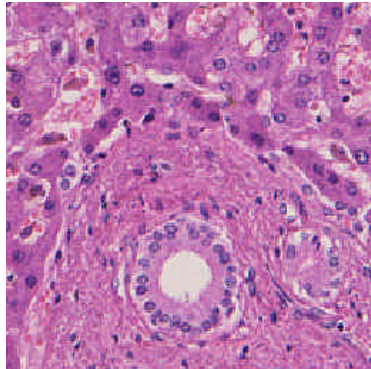
# Difference between systems

H&E stain

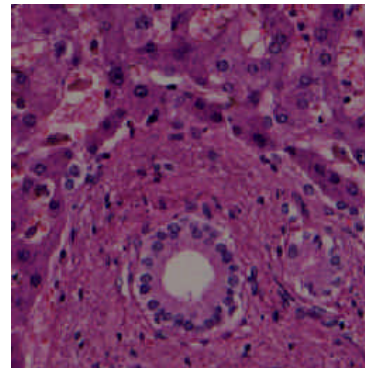
System1



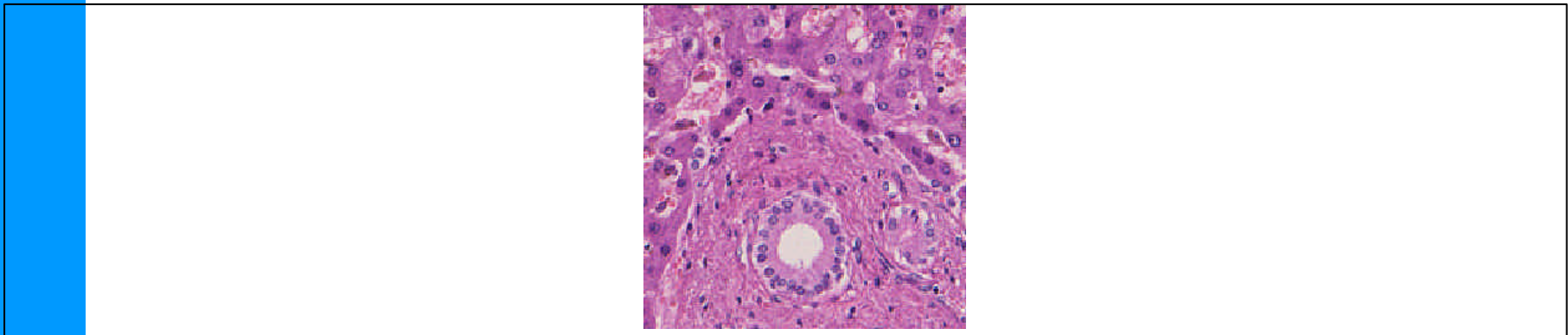
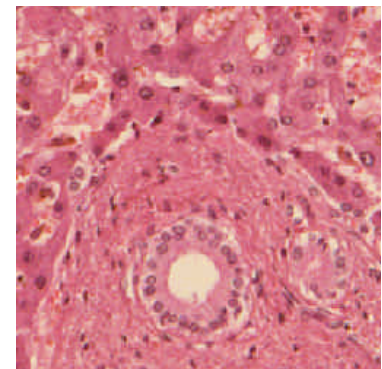
System2



System3



System4





## How we communicate by telepathology

- o Using same system at all locations especially when hardware remote control required
- o Web Based/e-mail based system using JPEG for static image based
- o Import/Export image/text data between different systems
- o H323, H320 for Dynamic image

# Problems of Current telepathology/Imaging system

## Static Image Telepathology

- Area selection and Image capture by referring pathologist

## Dynamic Image Telepathology

- Image Quality of Dynamic Image
- Robotic microscope/stage is not common in pathology

## All

- Time Consuming



## The meaning of Image Standardization in Pathology

- o Anyone at any place can see the same color and same quality of image
- o Imaging should provide something better than microscope direct observation

## Solutions

- o Remove the human factors
- o Correct the differences between systems and materials by digitally
  1. Whole Slide Imaging
  2. Imaging Microscope
  3. Deployment of Color Reproduction Technology



## Solution 1

# Imaging Microscope

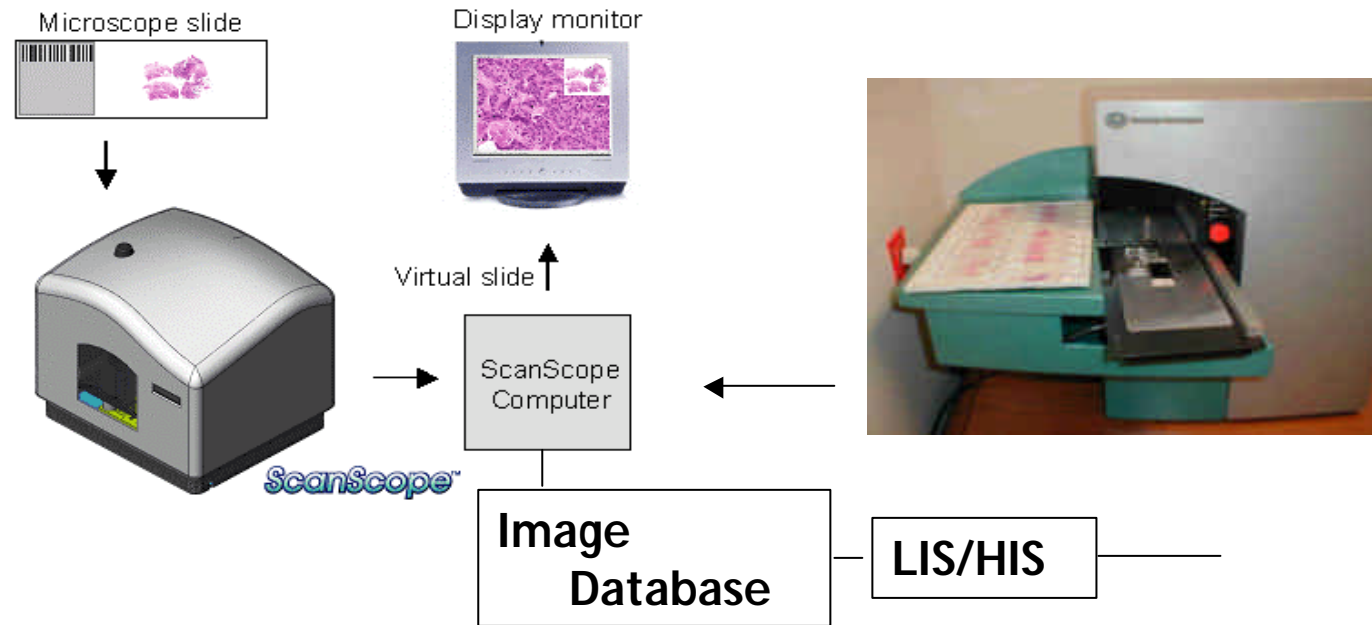
- o Robotic microscope can remove the human factors such as focus, filter and brightness) of microscope usage by the software
- o Some of new robotic microscopes have a built-in camera and a motorized stage.  
It can be used to standardize image quality

## Solution 2 Whole Slide Imager

- o Automatically scan entire glass slide within acceptable time for the frozen section (during the surgical operation)
- o No influence by human factor
- o Pathologist can use image as if they are using the microscope from anywhere in the world

# Solution 2

## Whole Slide Imager



Like PACS for Pathology

## **Solution 2**

### **Whole Slide Imager**

### **Current Status**

Several imagers are available.

However further QA (technical/clinical) evaluations are necessary and they are on-going

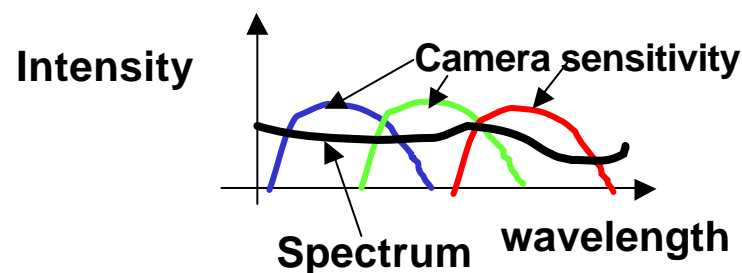
No system is enough for clinical usage at this moment

It will be available by end of this year from a number of companies

# Solution 3

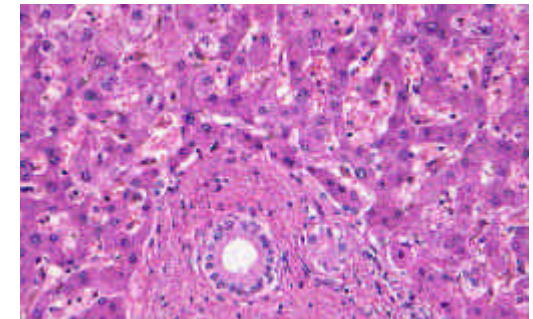
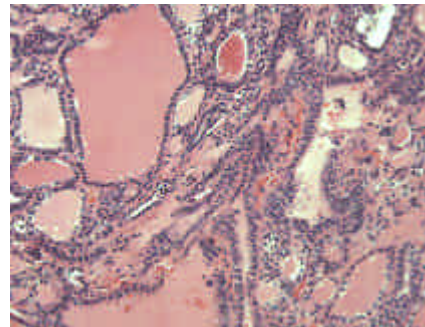
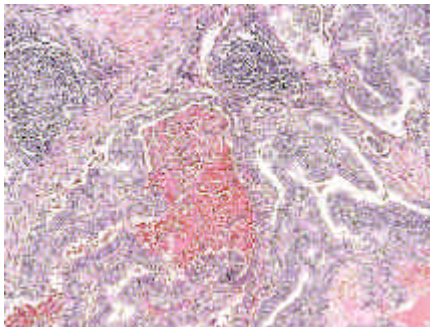
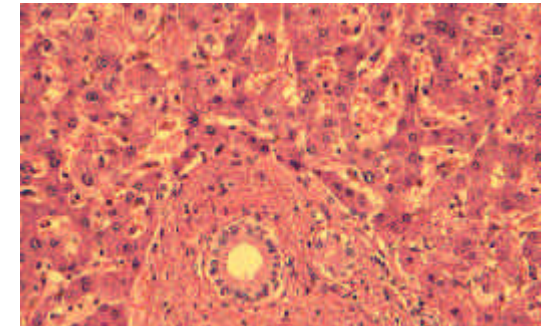
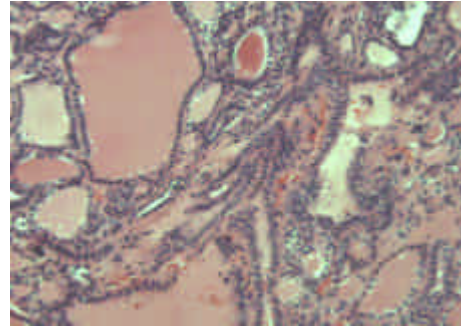
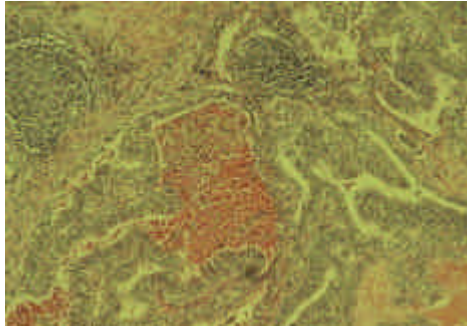
## Color Reproduction Technology

- o Using spectral analysis and proper calibration, the color reproduction/standardization is possible.



# PATHOLOGY

## Optics & Color Calibration





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## For Standardization

- Combination of Color Reproduction and Whole Slide Imager or Color Reproduction and Imaging microscope are the starting point to establish standards in Pathology Imaging.
- For places that don't have such a hardware, the software can support them to bring the image quality to acceptable level
- Once pathology images are standardized within pathology, DICOM3 or other standard will provide a mechanism to share image files.

# Conclusion

## Image standardization

International Organization can provide.....



Calibration Slide will be provided to all users

