Security and Informatics in Pathology

ForPath Workshop

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University Hospital of Liège
Belgium

Pathology Informatics

= Science of the capture, storage and processing of information in the laboratory setting

-> Security and privacy

-> Decision support

-> Interface development

-> Modelling

-> Bioinformatics

-> Whole Slide Imaging (WSI)

WSI: OUTLINES

1) Main technological features

2) Advantages

3) Drawbacks

4) Current applications and future developments

-> The example of the "Cytomine" plateform at the ULg (B. Stevens)

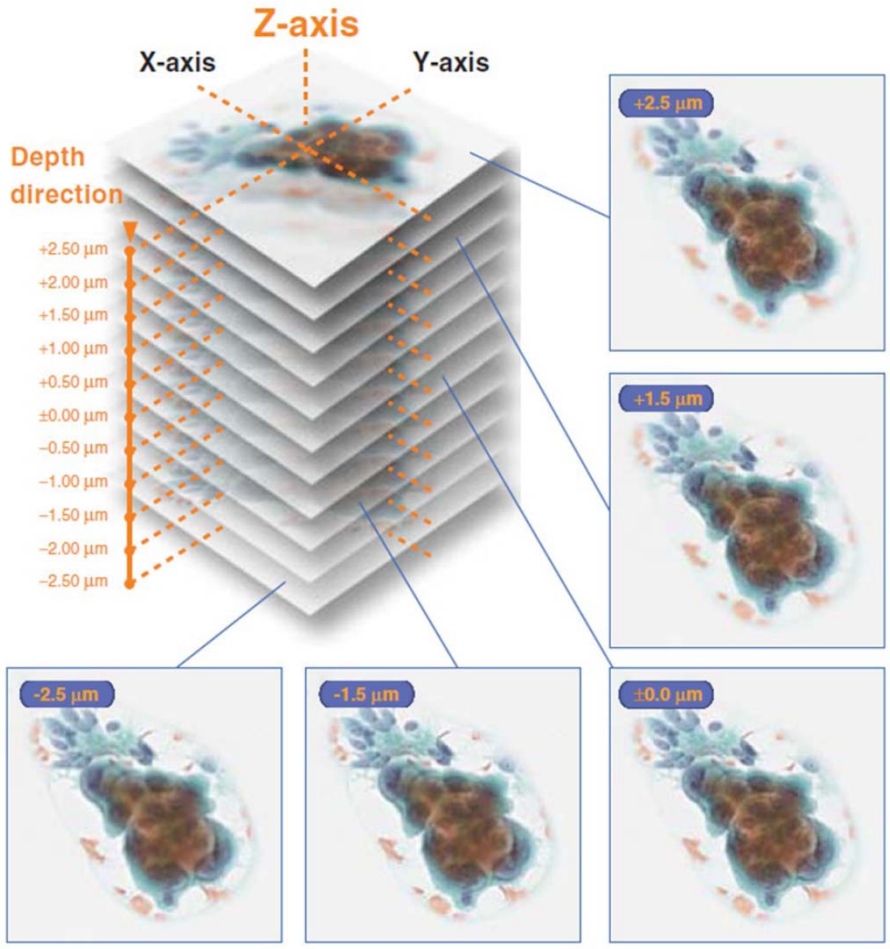
WSI: main technological features

= Process by which glass microscopic slides are scanned and then viewed on a computer as virtual slides

microscope

The virtual slides may be explored in a way comparable to the conventional microscope

1) Viewing at different magnifications
2) Navigation in each direction
3) Allowing focusing up and down



WSI: critical components

- Hardware (scanner)
- Software (image creation and management)
- Network connectivity

Capacity: one slide vs hundred slides

Image acquisition techniques & speed

Ability to scan multiple focus layers → 3D images

Ability to scan fluorescent labelled cells

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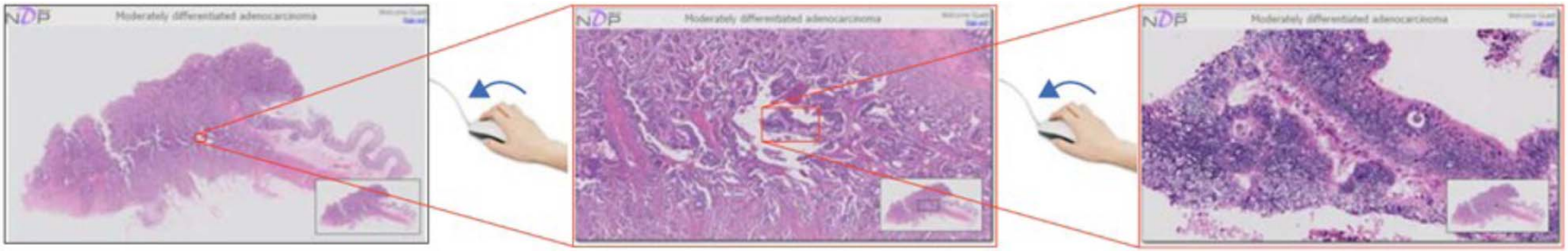
WSI: advantages

- Overview image together with the high power view

Overview image together with the high power view



→ Better orientation within the slide and easier navigation in the different regions of interest

WSI: advantages

- Overview image together with the high power view
- Slide availability

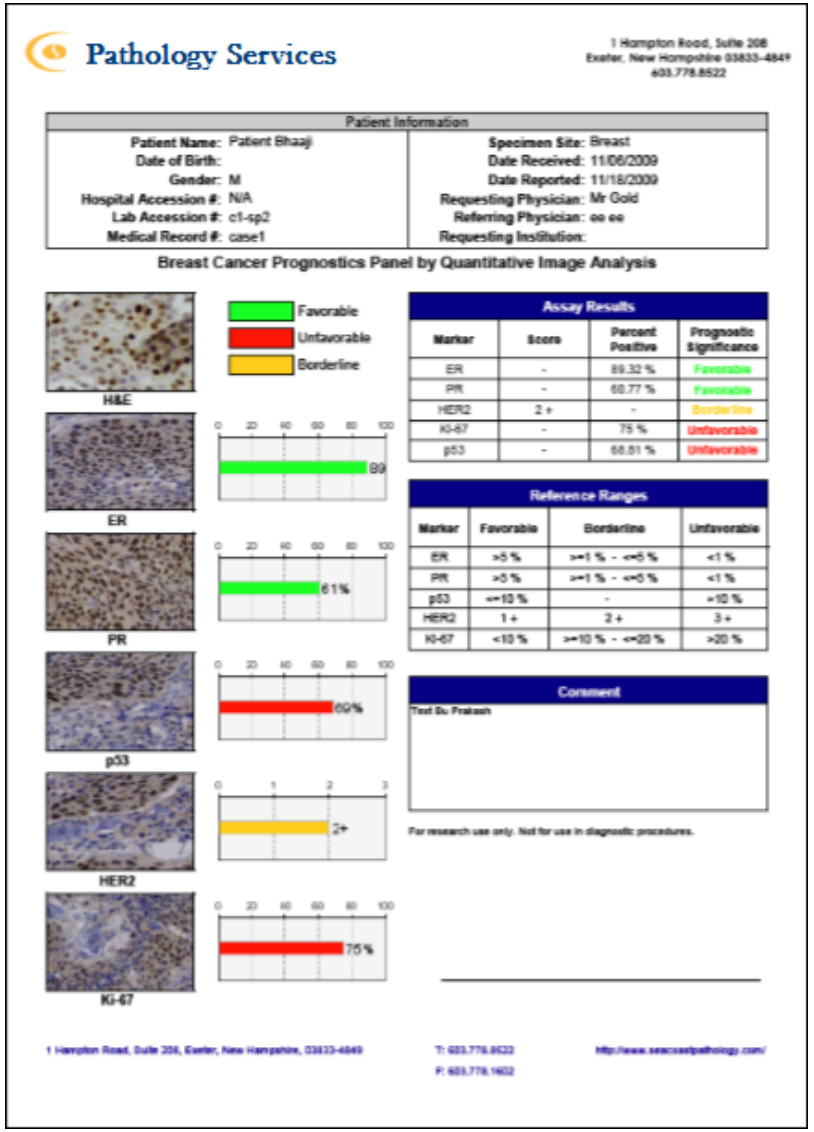
Slide availability

→ No need to request slides from outside institutions -> no more slide transport from remote labs

→ No need to go to the slide storage room -> no more wasted time for the technical staff looking for lost slides or pulling old bx for comparison, …

Slide availability

→Integration of the images in the electronic patient file



Pathology Services

1 Hampton Road, Suite 208
Exeter, New Hampshire 03833-4849
603.778.8522

Patient Information

Patient Name:	Patient Bhaaji	Specimen Site:	Breast
Date of Birth:		Date Received:	11/06/2009
Gender:	M	Date Reported:	11/16/2009
Hospital Accession #:	N/A	Requesting Physician:	Mr Gold
Lab Accession #:	c1-sp2	Referring Physician:	oo oo
Medical Record #:	case1	Requesting Institution:	

Breast Cancer Prognostics Panel by Quantitative Image Analysis

Favorable
Unfavorable
Borderline

H&E
ER
PR
p53
HER2
Ki-67

Assay Results

Marker	Score	Percent Positive	Prognostic Significance
ER	-	89.32 %	Favorable
PR	-	60.77 %	Favorable
HER2	2 +	-	Borderline
Ki-67	-	75 %	Unfavorable
p53	-	68.81 %	Unfavorable

Reference Ranges

Marker	Favorable	Borderline	Unfavorable
ER	>5 %	>=1 % - <=5 %	<1 %
PR	>5 %	>=1 % - <=5 %	<1 %
p53	<=10 %	-	>10 %
HER2	1 +	2 +	3 +
Ki-67	<10 %	>=10 % - <=20 %	>20 %

Comment

Text Dr. Prakash

For research use only. Not for use in diagnostic procedures.

1 Hampton Road, Suite 208, Exeter, New Hampshire, 03833-4849
T: 603.778.8522
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http://www.seacoastpathology.com/

WSI: advantages

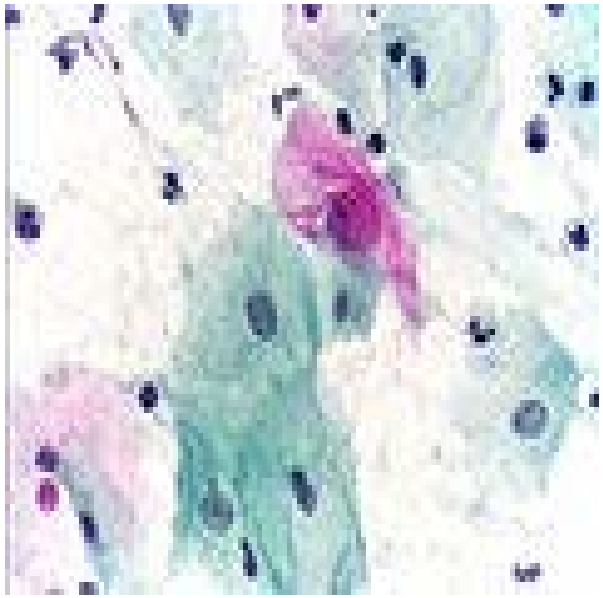
- Overview image together with the high power view
- Slide availability
- Portability

« Anytime from anywhere »

WSI: advantages

- Overview image together with the high power view
- Slide availability
- Portability
- Permanence of the images

Permanence of the images

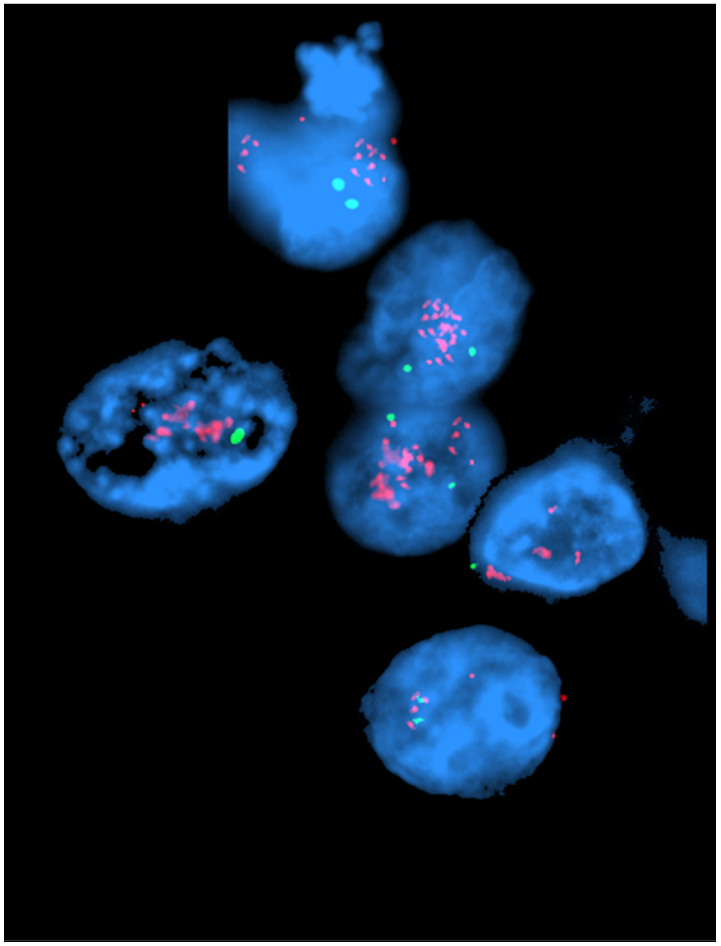


Saved image

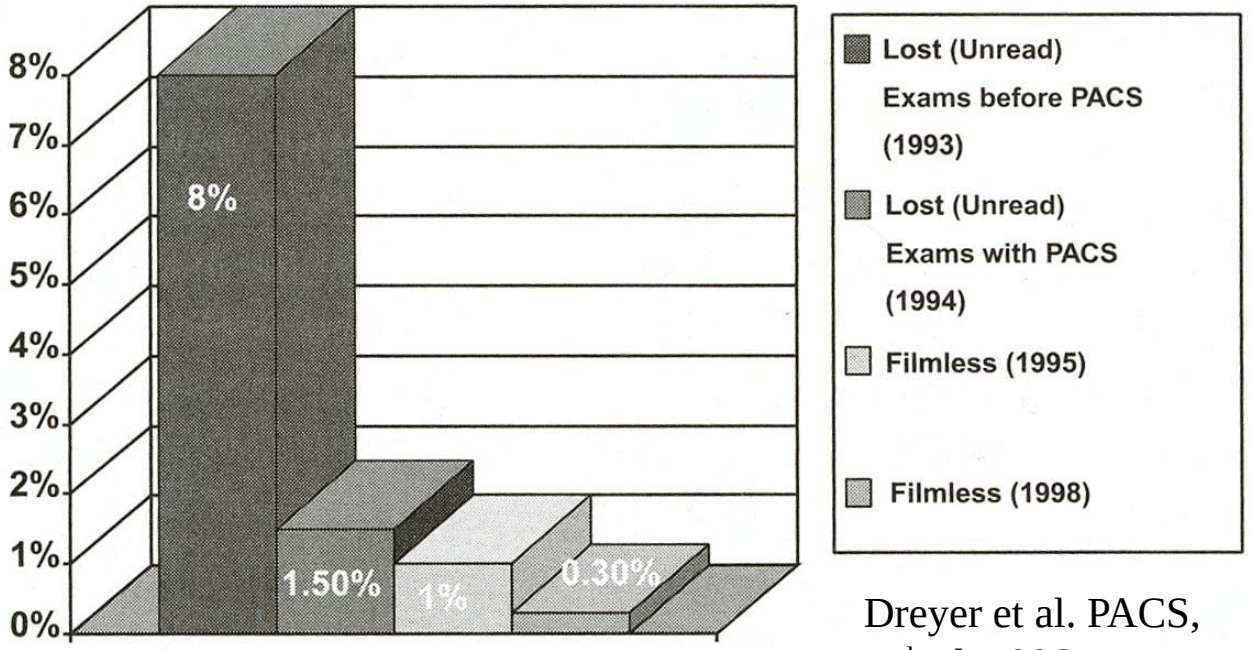
PCR

Permanence of the images

Saved image



Permanence of the images



Dreyer et al. PACS, 2nd ed. 2006

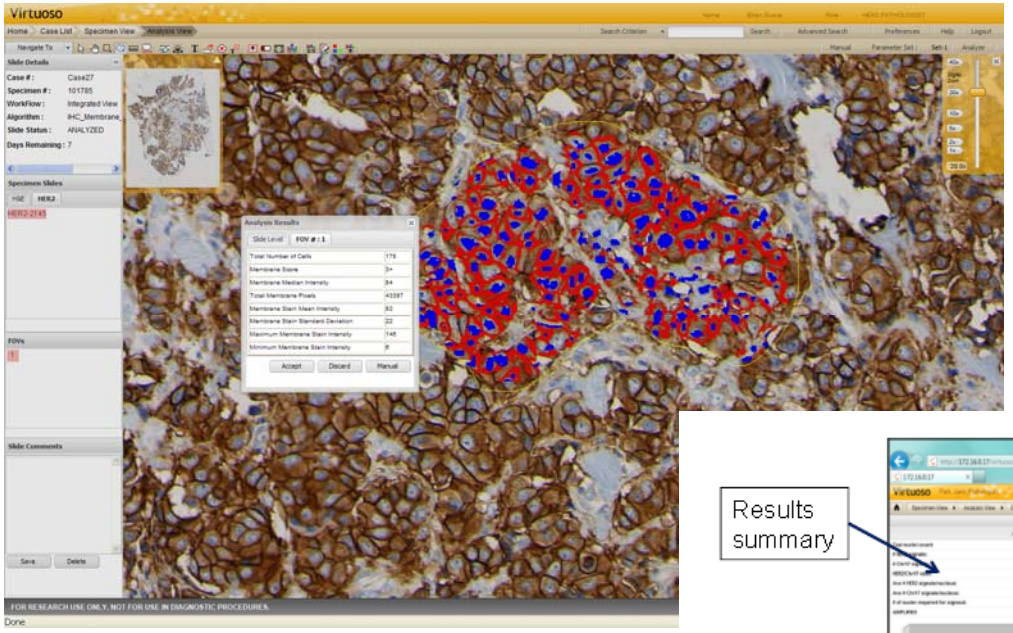
FIGURE 5.1

"Lost" films. Examinations not interpreted by radiologists.

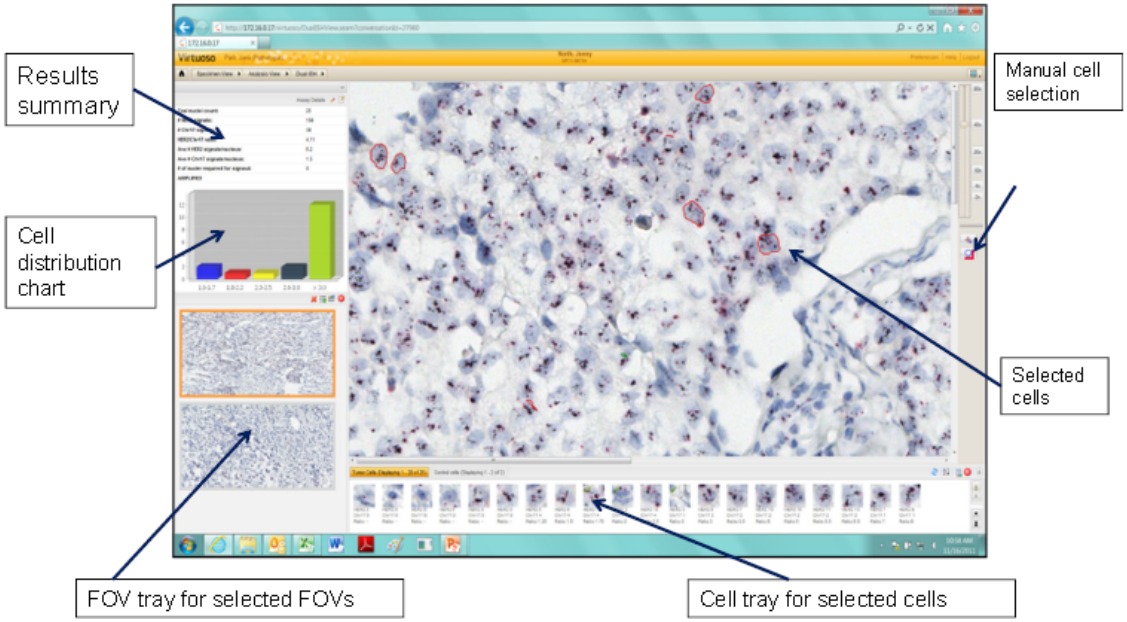
WSI: advantages

- Overview image together with the high power view
- Slide availability
- Portability
- Permanence of the images
- Use of automated image analysis algorithms

Use of automated image analysis algorithms



→ Quantification of biomarkers



WSI: OUTLINES

1) Main technological features

2) Advantages

3) Drawbacks

4) Current applications and future developments

-> The example of the "Cytomine" plateform at the ULg (B. Stevens)

WSI: drawbacks

- Time of scanning: 50 mm^2 at x20: 1-4 min
- Storage of the images: one single digital slide -> 3-50 Gigabites
- Current unclear regulatory guidelines: use of WSI in routine diagnosis?
- Diagnosis longer compared to glass slide?
- Costs: direct (scanner,…) and indirect (support, technical time,…)

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WSI: current applications

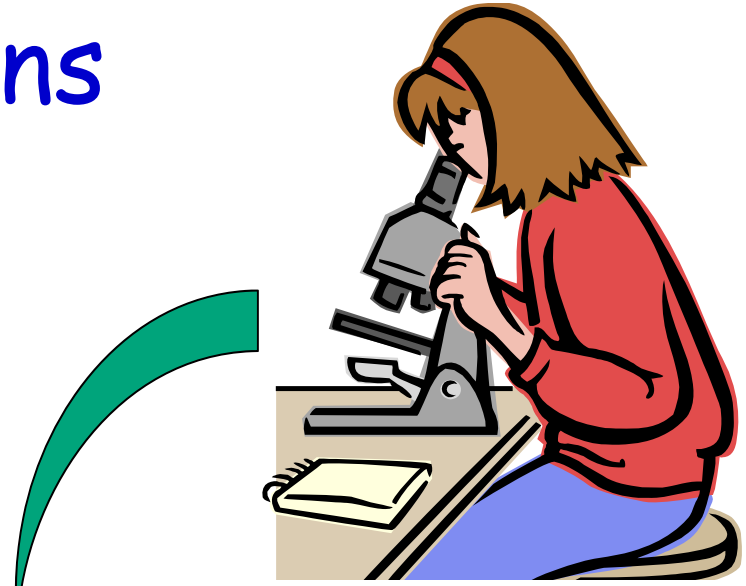
1. Education

Education: why to shift to virtual microscopy?

1. Financial restrictions

Financial restrictions

- Many slide sets are necessary for the practical lessons
- Variation between serial sections from the same tissue blocks
- Light microscopes need qualified technical staff to maintain them



OM

WSI

Education: why to shift to virtual microscopy?

1. Financial restrictions
2. Reduction in the amount of time allocated to education in pathology
3. New learning approaches such as problem based learning (PBL)
4. Decreased number of pathology graduates and lower number of colleagues enrolling academic careers

Education: why to shift to virtual microscopy?

1. Financial restrictions
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4. Decreased number of pathology graduates and fewer colleagues taking up academic posts
5. Preference of students

Preference of students

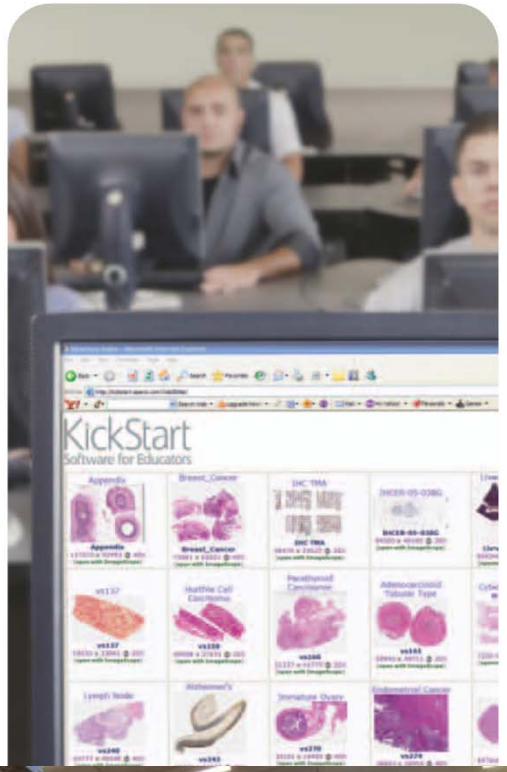
1) Most students do not like using light microscopes for the examination of tissue sections:

- « …light microscope difficult, frustrating and tiresome,… »
- « poor quality of light microscopes »

2) Very good feedback of students for virtual microscopy

Education: advantages of WSI

- Access to an unlimited number of students
- No variation between serial sections from tissue blocks
- Possibility for annotations, links, questions, videos, sound clips,…
- Possibility to learn pathology outside practical lessons



WSI: current applications

1. Education
2. Digital diagnosis

Digital diagnosis

- Current use of WSI:
  - Consultations of difficult cases (possibility to discuss cases online & to have a diagnosis within hours)
  - Remote frozen section diagnoses (pathology labs distant from hospitals; night emergencies)
- First line diagnosis???

WSI: current applications

1. Education
2. Digital diagnosis
3. Tumor Boards
4. Quality Assurance (cases distributed virtually -> money saved compared to glass slides)

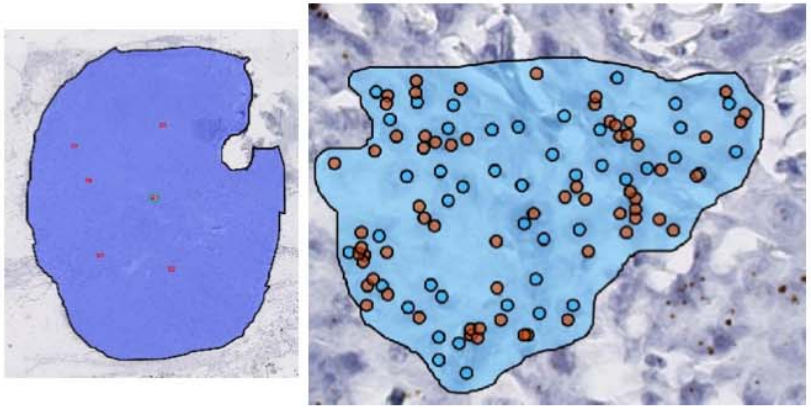
External quality assurance organisations

Body	Host country	External QA scheme	Accreditation	Website
UK NEQAS ICC & ISH	UK	✓		www.ukneqasicc.ucl.ac.uk
CPA	UK	Accredits UK NEQAS ICC & ISH schemes	✓	www.cpa-uk.co.uk
UK Accreditation Service	UK		✓	www.ukas.com
CAP	USA	✓	✓	www.cap.org
Canadian QA	Canada	✓		www.qmpls.org www.cancercare.on.ca
NordiQC	Norway, Denmark, Sweden, Finland	✓		www.nordiqc.org
AFAQAP	France	✓		www.afaqap.org
RCPAQAP	Australia, New Zealand	✓		www.rcpaqap.com.au

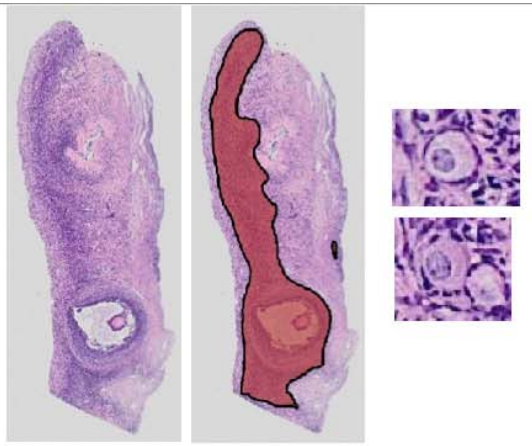
WSI: current applications

1. Education
2. Digital diagnosis
3. Tumor Boards
4. Quality Assurance (cases distributed virtually -> money saved compared to glass slides)
5. Research

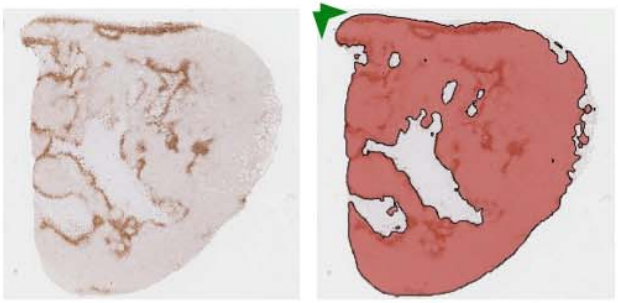
Research



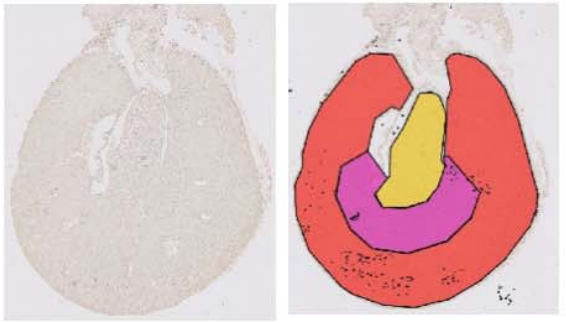
RNAScope counting, breast tumors
(C. Josse, GIGA)



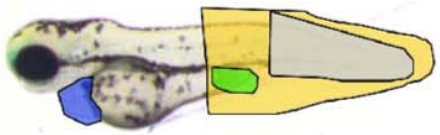
Follicule Counting, ovarian,
(C. Munaut, GIGA)



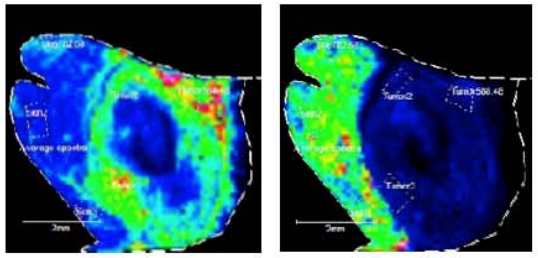
Tumor/necrosis segmentation & IHC quantification
(Ph. Martinive, GIGA)



IHC Couting, nephrology (F.Jouret, GIGA)



Zebrafish phenotype recognition
(M.Muller, GIGA)



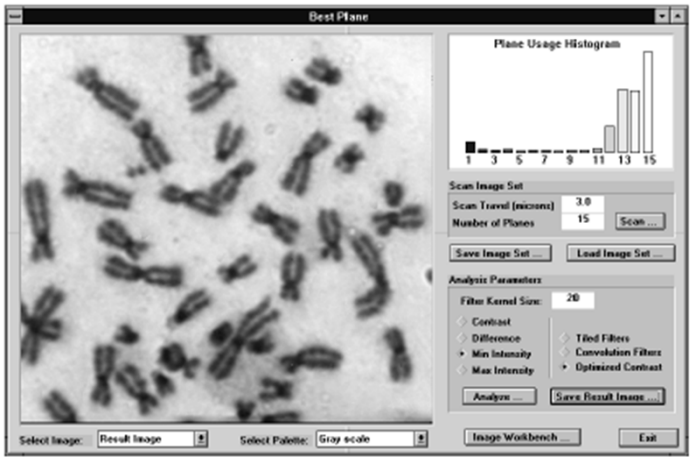
MALDI imaging (E. De Pauw, GIGA)

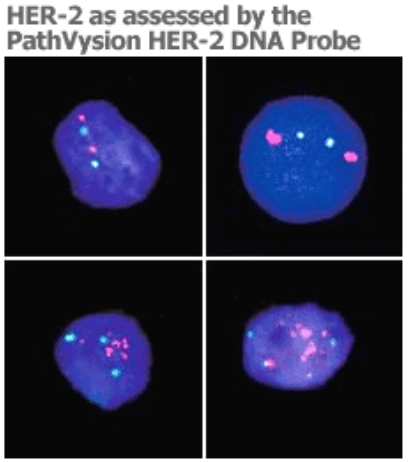
WSI: future developments

- Faster scanning speed and better compression algorithms
- Cheaper storage solutions -> routine scanning of all cases ???
- Large multicenter validation studies for the use of WSI in primary routine diagnosis

Some IVD devices already use digital imaging

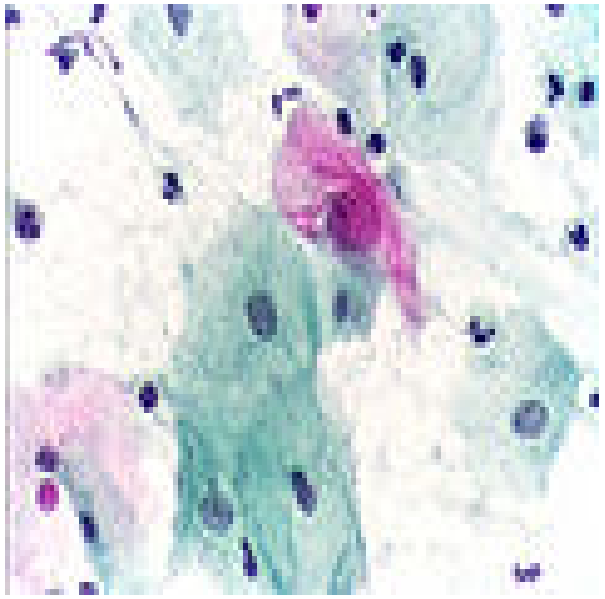
- Hematology analyzers
- Chromosome analyzers
- Urine analyzers
- FISH enumeration systems



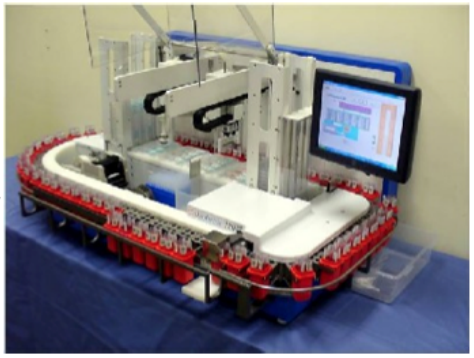


Some IVD devices already use digital imaging

- Cervical Cytology Imaging Systems
  - Cytyc/Hologic ThinPrep Imaging System
  - Becton Dickinson/TriPath FocalPoint Guided Screening System



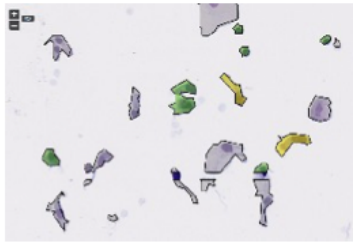
Automation of Pap test screening

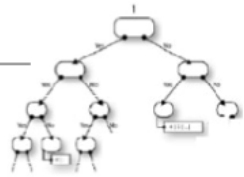


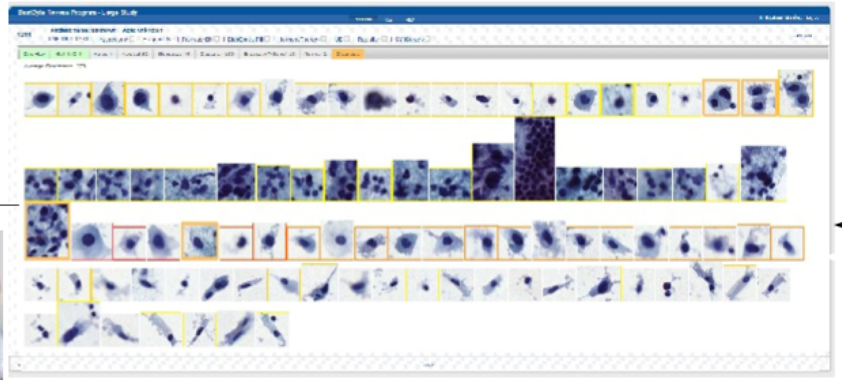
120 slides/hour

CellSolutions
INNOVATORS IN CYTOLOGY

~ 60K cells per slide
~ 65K x 135K pixels







Final diagnosis

Cytotechnologist + pathologist web review of most suspicious cells according to our image recognition algorithms

Classify & rank every cells (3min/slide)

Project with CellSolutions (www.cellsols.com) on PAP test (US)
Successful pilot study at CHU Liège in [2012,2013] (Dr. Ph. Delvenne, A. Delga)
Next steps [2013-...]: clinical trial in the US for FDA approval

Conclusion

"Digital pathology is no longer a dream. Doctors have begun to diagnose diseases by using computers like microscopes…It's a change that promises faster diagnoses for patients and potential cost savings for hospitals."

Story on PBS's Nightly Business Report, July 10, 2008

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