Transforming NHS pathology with digital imaging

Dr Bethany Williams MBBS BSc
Digital Pathology PhD Fellow
Overview

• Digital pathology, strategic context, benefits and challenges

• Leeds Teaching Hospitals NHS Trust – clinical deployment of digital pathology for diagnosis

• Future directions
What is digital pathology?
Whole slide imaging scanners

Benchtop device
Load 1-400 slides
1-5 minutes to scan a single slide
Viewing software: Leeds Virtual Microscope
Strategic Context

- Increasing volume and complexity of workload
- Pressure on turnaround times
- Need to increase capacity
- Workforce crisis
- Drive towards centralisation and networking
Key advantages of digital slides over glass

- Easily and rapidly transferred and accessed by multiple users in multiple locations
- Do not degrade or fade or break
- Take us a step closer to a paperless NHS
The benefits of digital pathology

Improving workflows and efficiency:
- Diagnostic efficiency 10-15%
- Case tracking, archival and retrieval
- Workload allocation
- Case transfer times
- Faster diagnosis of urgent cases
- Faster access to 2nd opinion

Optimising the workforce:
- Flexible and remote working
- Recruitment and retention
- Supports parents, carers and those with chronic illness to remain in pathology
- Demand:capacity matching across networks
- Ergonomics
The benefits of digital pathology

**Improving service quality:**
- Information sharing and collaboration
- Expedited access to archived slides
- Synchronous analysis of slides
- More accurate cancer staging
- Audit, research and service improvement

**Improving patient safety:**
- Reduced risk of patient misidentification errors
- Reduced risk of specimen/slide loss and degradation
The Regional Network
Opportunities for laboratory consolidation and reorganisation of services
Pooling of reporting expertise and capacity
Opportunities for research and collaboration
Workforce flexibility
Closer matching of capacity and demand
Faster, safer MDT referral

The Institution
Leaner workload allocation
Paperless workflow
Enhanced recruitment and retention
Improvements in training and education
Rapid access to digital slide archive
Fewer misidentification errors
Fewer damaged, lost slides
More efficient diagnostic workflows
Faster turnaround times
Insourcing/outsourcing work

The Pathologist
Ergonomic improvements
Flexible and remote working opportunities
Easier measurement and annotation of slides
Enhanced access to second opinion, synchronous review of slides, review of archived material

The Patient
Faster time to diagnosis
Improved access to second opinion
Improved patient safety
What are the challenges?

• 1. Investment

• 2. IT support and integration

• 3. Pathologist training and acceptance
Clinical Deployment at Leeds TH NHS Trust
About us:

- Leeds Teaching Hospitals NHS Trust
  - Single site histology laboratory
  - Fully sub-specialised
  - 45 consultant pathologists, 30 trainee pathologists
  - ~ 290,000 H&E slides histology slides a year
  - About 1% of NHS histopathology workload

- Digital pathology team – doctors, laboratory staff, university fellows, project manager
- Dr Darren Treanor, Royal College Lead for Digital Pathology
Research and education

**Website**: 10,000 + virtual slides, slide library, e-learning, QA materials, papers, videos and more

[www.virtualpathology.leeds.ac.uk](http://www.virtualpathology.leeds.ac.uk)

**Powerwall**: 12 megapixels

Digital Workstation In Trainee Area
Leeds-Leica Digital pathology partnership: Aims

- Digital pathology deployment at Leeds
- Centre of excellence in clinical use of digital pathology
- Research-driven deployment
  - Lean process engineering
  - Quantify benefits vs costs
  - All histology slides scanned; All MDTs digital; All IHC reviewed digitally
  - All pathologists able to diagnose digitally – and helped to validate safely
- Outputs
  - Validation procedures
  - Scan capacity calculation
  - Display assessment
  - Business case/ ROI
  - Reference centre / visits
Clinical usage

• Currently - 40% of laboratory slides digitised and available for diagnosis
• ALL breast and neurology specimens, ALL slide and stain types
• ALL immunohistochemistry
• 6x Leica AT2 high capacity, 3x CS2 large format
• Total 9 scanners deployed for 100% deployment
• New workflows, new roles
Clinical usage

- 6 pathologists completed validation for primary diagnosis
- Custom workstations with high resolution, medical grade displays
- 6MP Barco, 8MP Eizo medical grade
- Most use gaming mouse/keyboard shortcuts
Deployment rollout in Leeds....

2017

- Breast primary diagnosis
- Neuropathology primary diagnosis and frozen section
- Immunohistochemistry

2018

- 100% digitisation – all slides scanned
- Specialty by specialty validation
- MDT
Evidence based digital pathology


The Leeds approach to clinical training and validation....

- Pragmatic
- Patient safety focused
- Professional engagement and education
How are we validating and training in digital pathology?

• Novel validation protocol
• Pathologist-centric
• Utilises evidence base

• Enables self-identification of digital diagnosis pitfalls, allows pathologist to gain confidence in risk mitigated environment, with early exposure to live digital reporting

• Allows development of workflow modifications to aid confident and competent diagnosis
Validation and training summary

Training
- 1:1 formalized training in digital microscope use
- Observed practice with feedback

Validation 1
- Training set
  - Test set of 20 challenging and informative specialty specific cases
  - View on digital, make notes, compare with glass immediately

Live cases
- Entire workload scanned prospectively (2 months)
- Diagnosis made on digital immediate glass check before sign out
What did they think?

Following training and validation, our pathologists are able to make 99% of their diagnoses on the digital microscope.
What do our pathologists and lab staff think?

• “this is the best thing that’s ever happened in pathology”

• “every day I get home and tell my husband I’m changing the world”
Dissemination

- International digital pathology deployment workshops hosted by Leeds

- Invited speakers at major European and US pathology conferences, UK Parliamentary and Scientific Committee
Virtual Pathology for the General Public

This section is designed to help the general public understand cancer, by showing examples of common cases at a microscopic level, using virtual slides.

Pathology is the study of disease, and cancer is a large part of the pathologists daily workload. Pathologists have to do five years medical training, 2 years basic medical practice and then specialist training for a minimum of 5 years. Some take a research degree in addition.
Future directions.....
Research and education networks

• Image databases

• Anonymised digital slides for clinical trials, research

• Machine learning
Augmented Intelligence

Computer Aided Diagnosis
- A tool for the 21st century pathologist
- Support the diagnostic process
- Perform repetitive/search based tasks
- Allow pathologist to concentrate on more complex, interpretive work
Take home messages

• Digital pathology benefits patients by improving safety, streamlining access to expert opinion and dual reporting.

• It improves the workflow and connectivity of laboratories and increases flexibility and efficiency of the workforce.

• Investment is needed in infrastructure, including IT systems, staffing and training.

• The NHS is positioned to lead the world in patient safety focused, evidence based clinical digital pathology deployment.
Thank you

bethany.williams2@nhs.net