

Introduction to Digital Pathology

SPAN National Meeting

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History of the Light Microscope

- First compound light microscope was probably invented by Dutch spectacle makers Zacharias and Hans Jansen in the 1590's.
- Up to 30x magnification



Early Microscopes

- Anton van Leeuwenhoek (Dutch) made significant improvements (simpler design but higher quality lenses) in the mid 17th century.
- Up to 270x Magnification
- Described the first micro-organisms



Further developments

- Robert Hooke (UK) made design changes and used his microscope to good effect describing the first cells in his book, *Micrographica* of 1665.



Up to date



Radiology Changes



Comparison



No more!

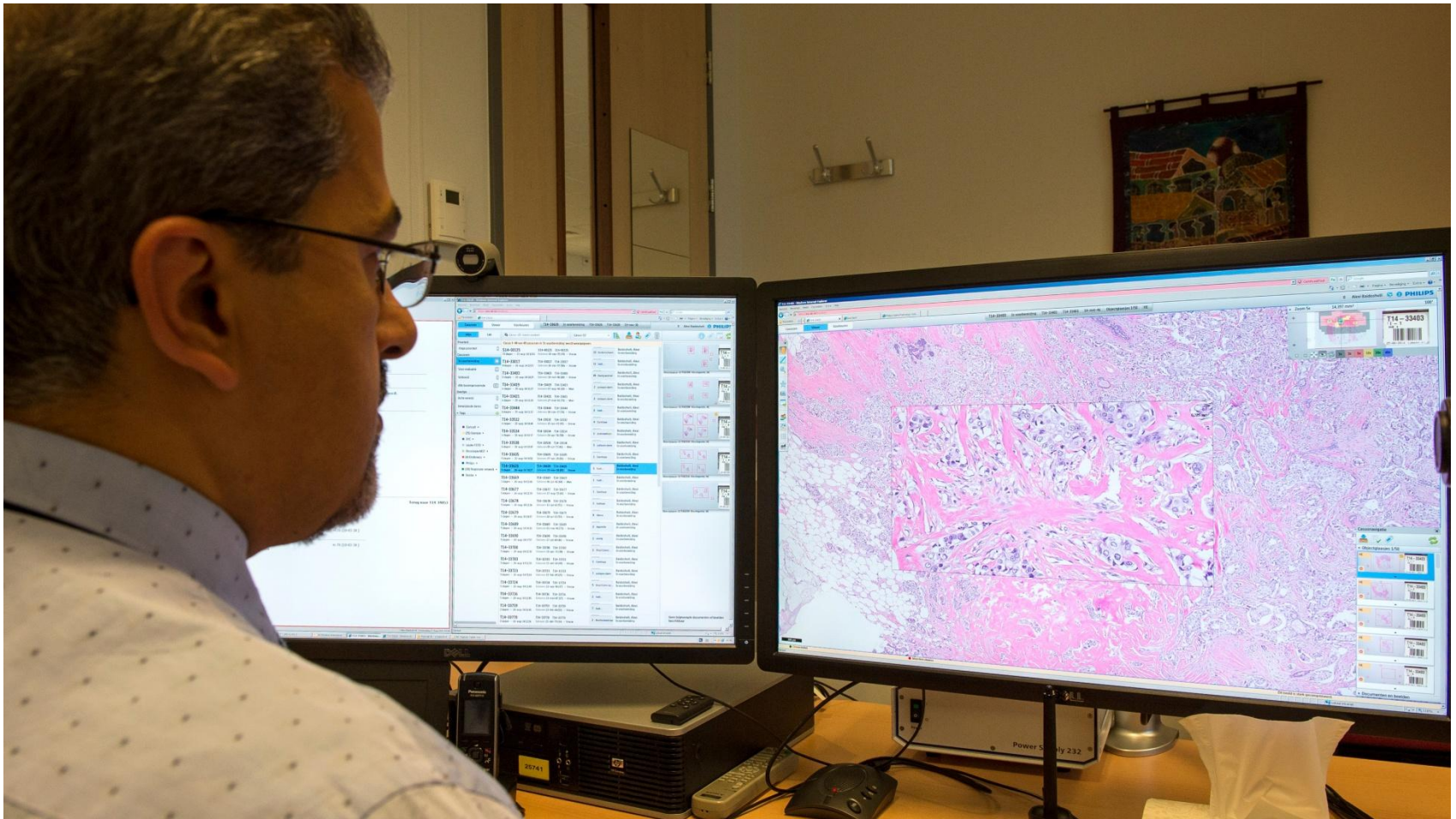


Pathology



Radiology

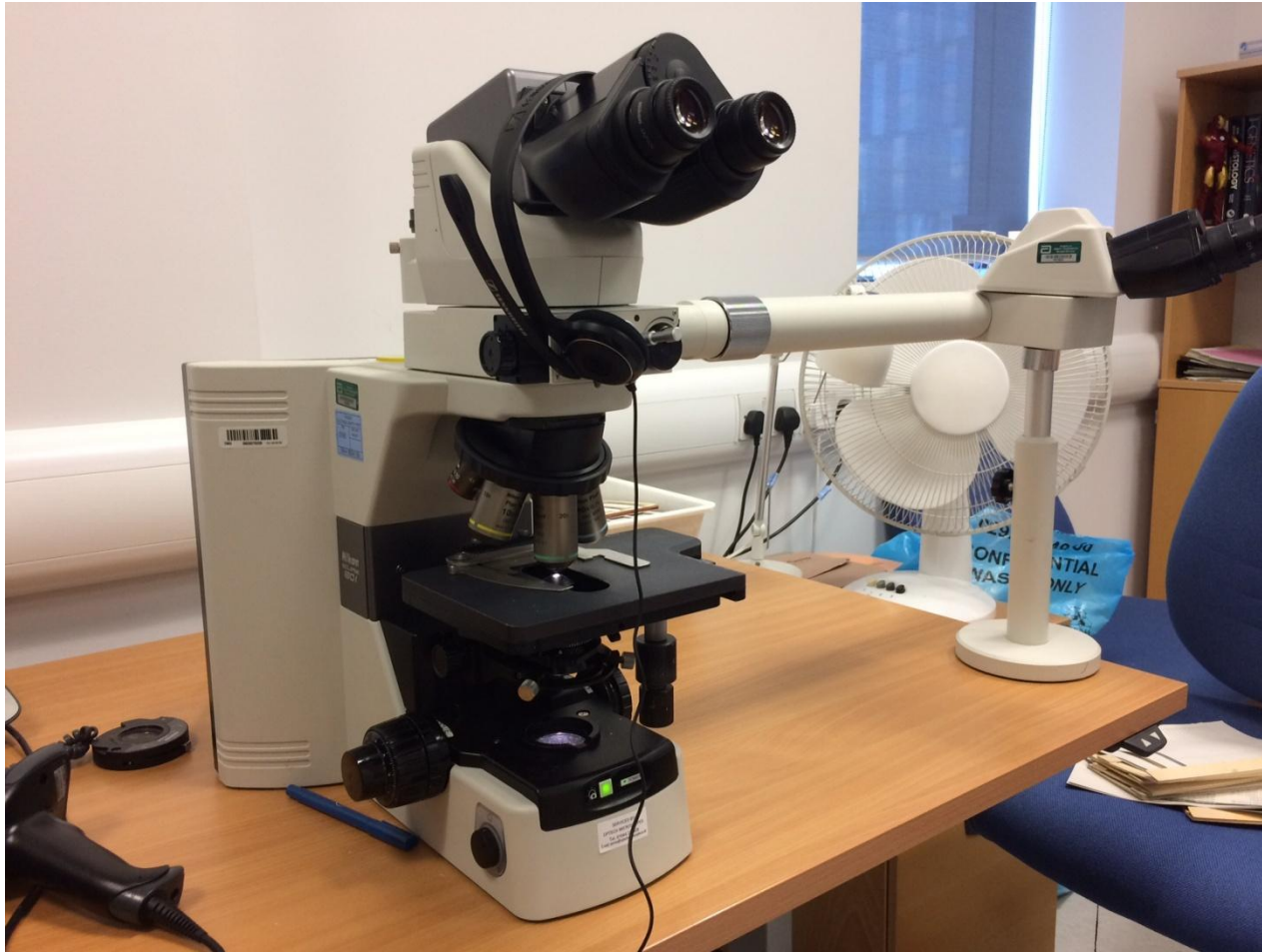
The future?



Pathology vs Radiology

- Why has it taken pathology so long to catch up with radiology?
 - Smaller market
 - Digital pathology is an additional step
 - Magnification leading to vast data size
 - Technology now only able to cope with data size and transfer rates

Magnification







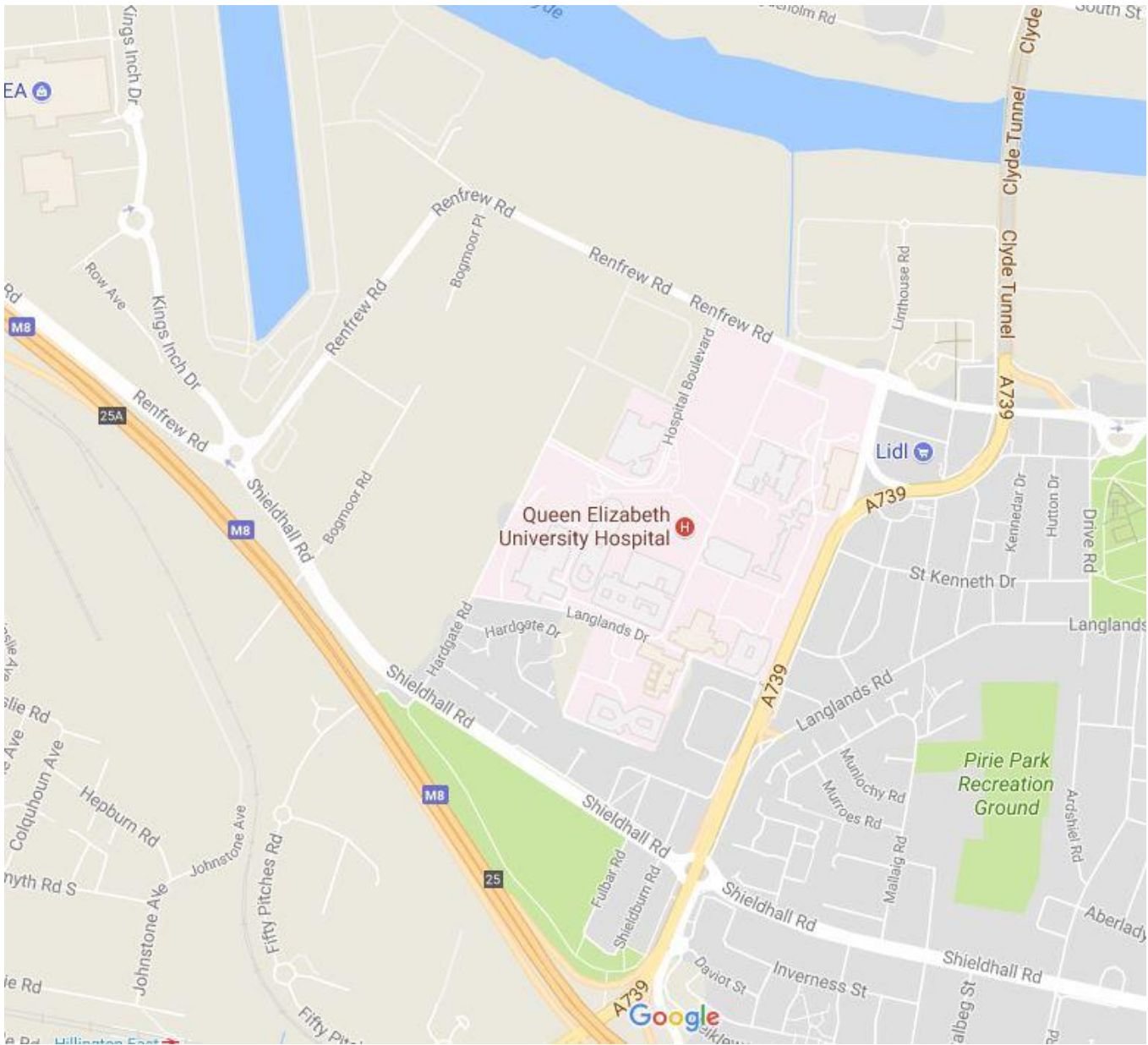


SCOTLAND

United Kingdom

NORTHERN IRELAND





Google Maps and Digital Pathology

- Zoom and pan technology developed for google maps underpins digital pathology.
- Whole slide image data is huge but data streamed in routine viewing is only a fraction (about 5%).
- For example you don't download a map of the world to find your way with Google maps.

Data Comparisons

Radiology PACS

- 60 MB Uncompressed per study
- 1MB compressed
- In 10 years, just reached 1 PB (1000 TB)

Digital Pathology

- 650MB per slide
- 4 GB per request
- In 7 years, anticipating at least 5 PB
- Won't reach steady state until 10-15 years

- Overall, data requirements are about 10 x higher.

Drivers for Digitisation

- Currently NHS Scotland manages 2 million glass slides per year
- Digitisation has been shown to improve efficiency – up to 12%
- Security and accessibility of archive
- Enables innovative models of working
 - Cross boundary work sharing
 - Working off site (other hot site or home)
 - Improved ergonomics
- Possibility of computer image analytics

You are Here: [Home](#) > [Health Portfolio](#)

Health Portfolio

- Mission
- Governance
- Programmes
- Latest News



Health Portfolio

The Health Portfolio considers a 'Best for Scotland' approach for some of the functions within Laboratories, Clinical Engineering, Pharmacy Aseptic Dispensing, Public Health and Radiology.

You can find out more about this in the [Programmes](#) section.

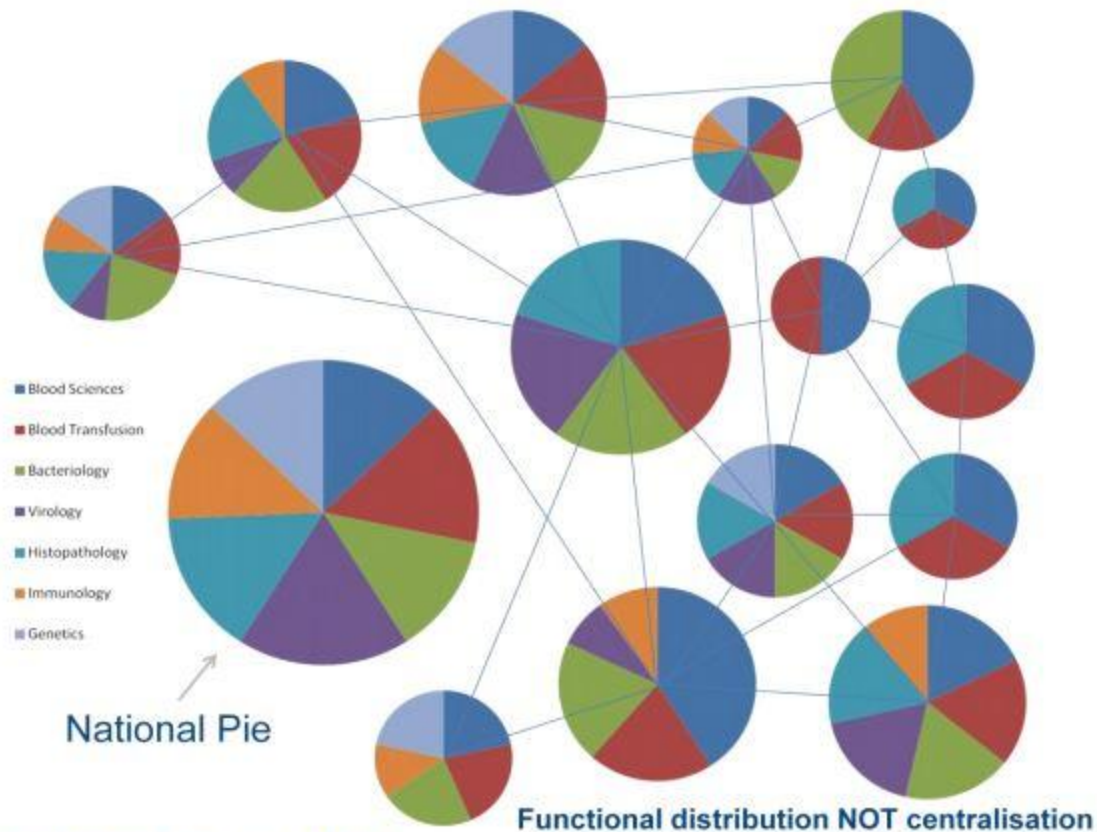


Figure 3: Distributed Service Model

The DSM enables delivery of the right testing repertoire in the right place at the right time to enable optimal patient care locally and nationally. There is a notional workload of varying degrees of complexity and volume described as the “national pie” in the figure 3. The DSM will deliver

Procurement

- Procurement Assisted by National Services Scotland
- Project Management and Clinical Leadership from GGC
- Two stage procurement
- Two site Pilot with NHS Lothian
- Implementation current (scanners/servers installed – workstations pending)

Funding

- Pilot funded through Cancer money and supported by shared services.
- Need to build business case for national funding.

Cost model

- National contract
 - Managed service contract
 - National data store
 - Board call off contract
 - Catalogue pricing
 - Model designed to enable smaller boards to come on board in a cost effective manner

Where are we now?

- Philips are the chosen supplier.
- Based in the Netherlands
- Strong presence in radiology PACS and leader in digital pathology.



Process of digital pathology



Philips UFS

- Highly automated
- Capacity of 300 slides (GGC 2500 slides/day)
- Prioritisation protocols
- Approximately 1 min scan time
- 5 scanners in GGC
- Over £150000



Workstation

- Powerful PC (similar to PACS)
- Two 24 inch Barco HD monitors (about 2.5 megapixels)
- Integrated workflow including LIS and Clinical Systems
- Working towards a national reporting system
- About £3000



What will Digital Pathology
Deliver?

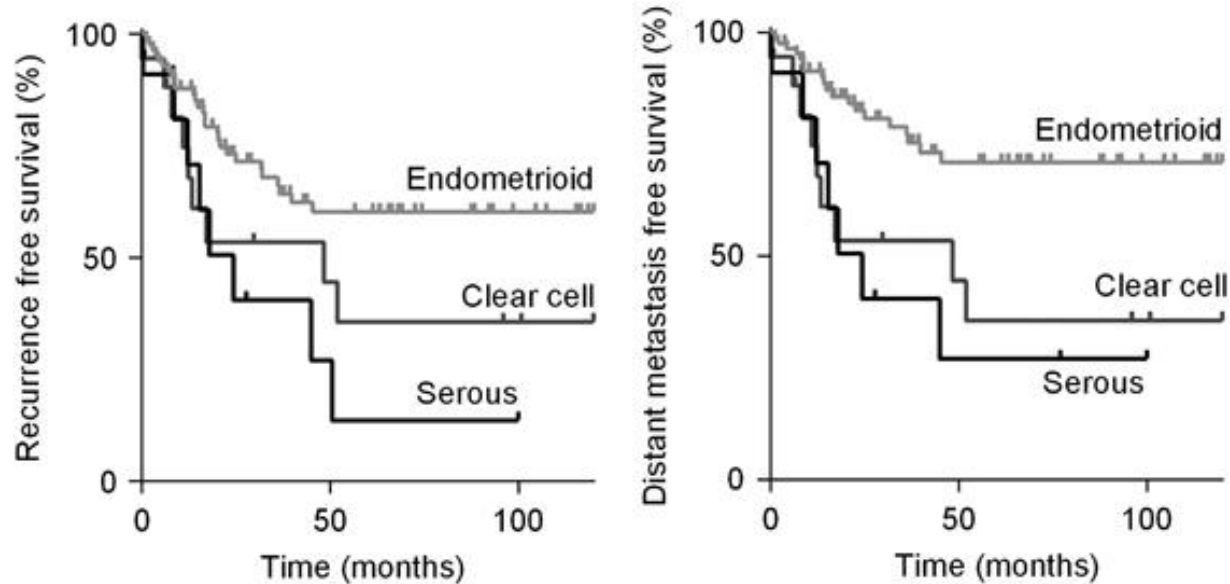
Precision/Stratified Medicine

- Excitement about Molecular Pathology, tumour genetics cutting edge technology

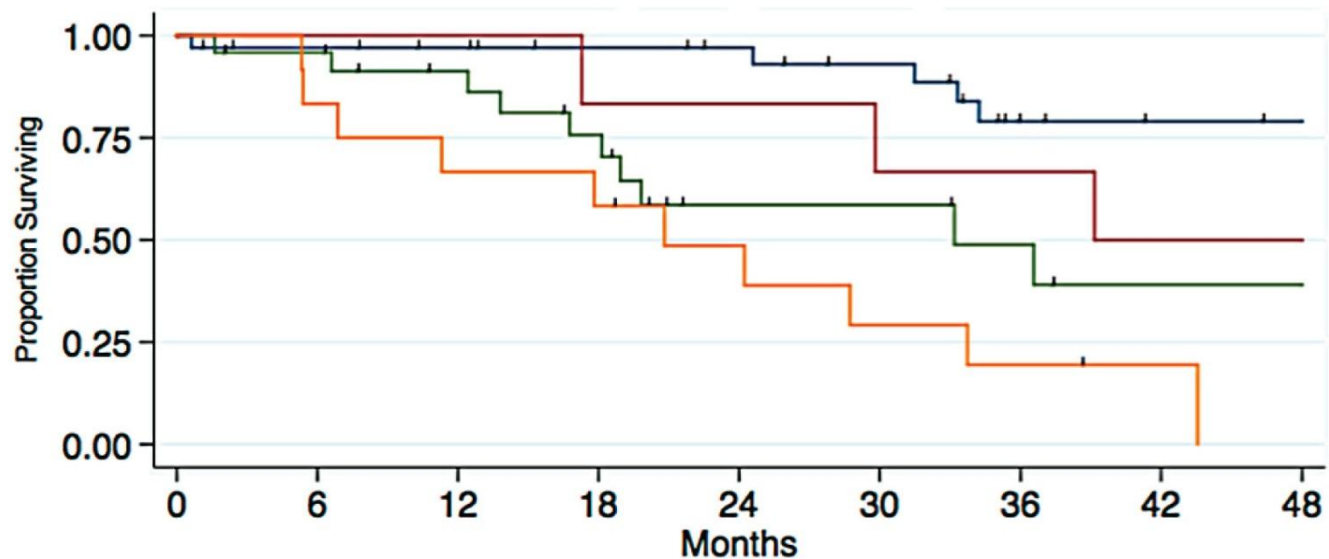


- If only someone could come up with a technique that took the patients
 - Genetic susceptibility
 - Environmental influences
 - Tumour genomics
 - Proteomics
 - Tumour microenvironment
- And display it in a way it can be quickly interpreted by an observer without massive computer power.

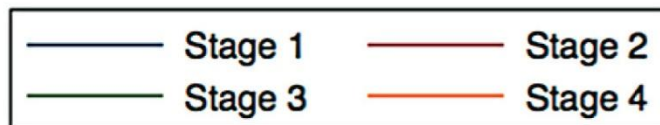
Endometrial Cancer Survival by type



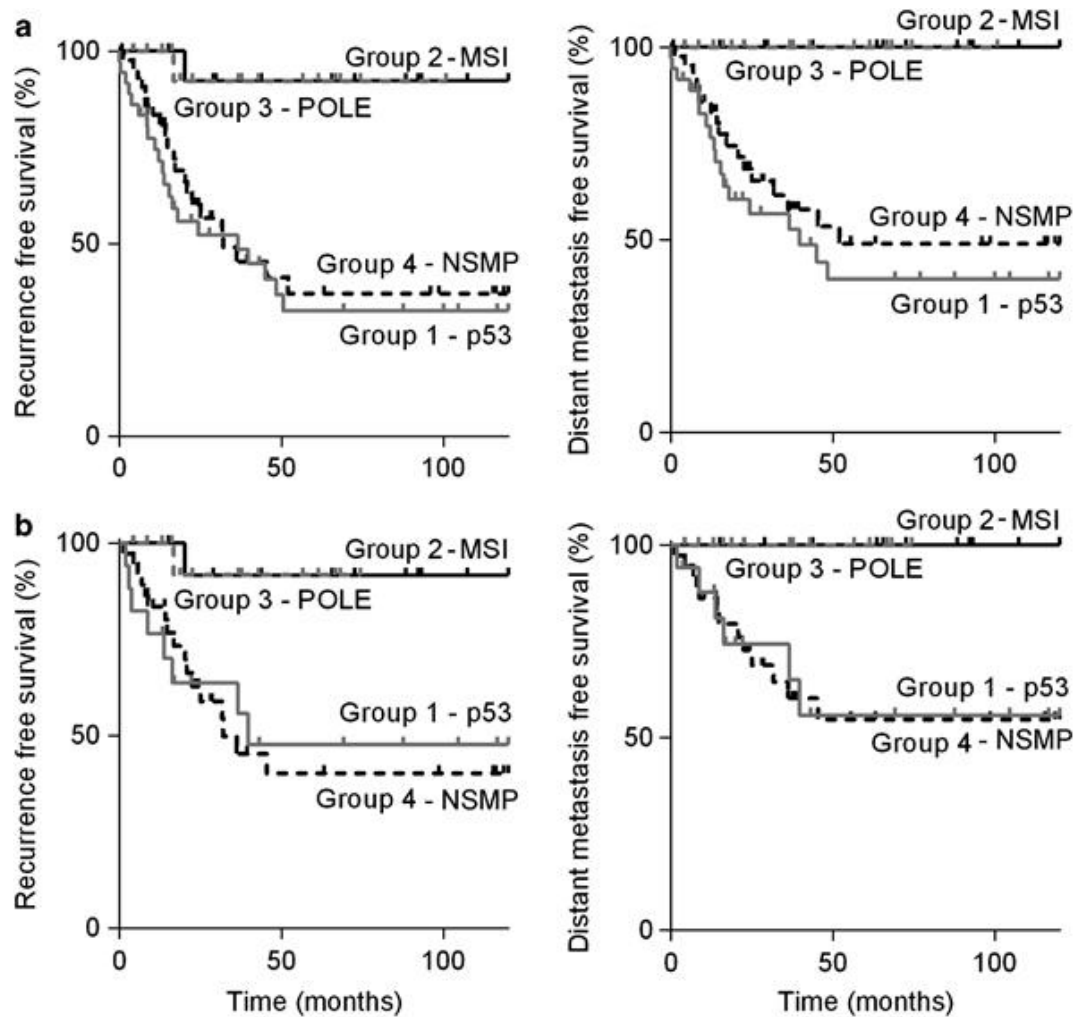
Endometrial (Serous) carcinoma survival by stage



Number at risk		0	6	12	18	24	30	36	42	48
Stage 1	34	31	29	26	24	21	13	11	10	
Stage 2	6	6	6	5	5	4	4	3	3	
Stage 3	24	22	18	14	7	7	5	3	3	
Stage 4	12	10	8	7	5	3	2	1	0	



Addition of molecular results

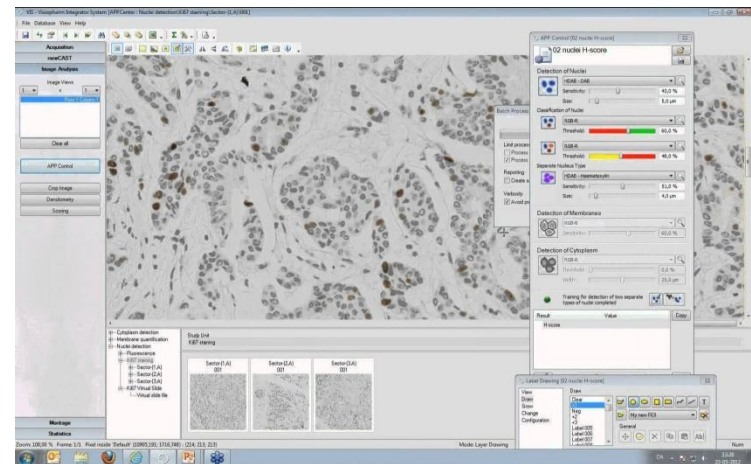
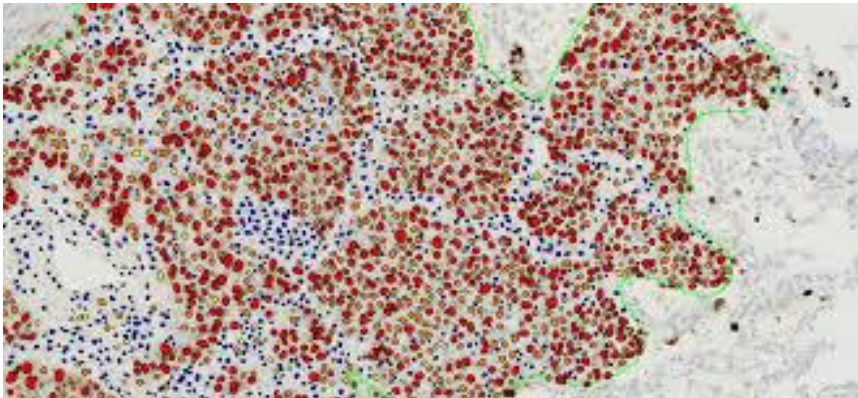


Addition of Computational Pathology

- Humans and computers have different skill sets
 - Humans – Pattern recognition and coping with minor variation.
 - Computers – Counting, measuring
- Perhaps with computational pathology we will unlock further stratification based on image alone?

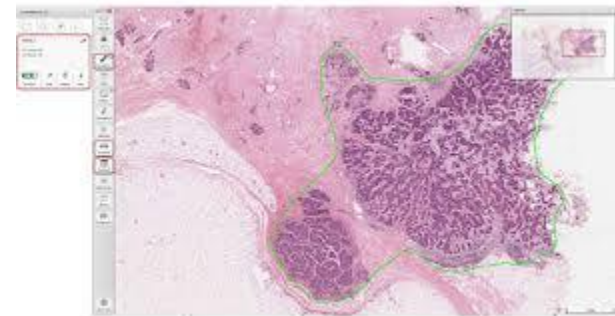
Image analysis

- Visiopharm CE-IVD
- Counting of ICC
- More accurate ER, PR, Ki67 and Her2



Path XL

- PathXL now part of the Philips group
- Use automated analysis to identify tumour
- Keen to partner through the Molecular Pathology Node



Big Data

- 2 million images a year across NHS Scotland
- Linked to molecular data and pathology reports
- Also clinical data/outcomes
- Amazing and valuable research and development resource for NHS Scotland
- Industry already wanting to partner

The future of histopathology

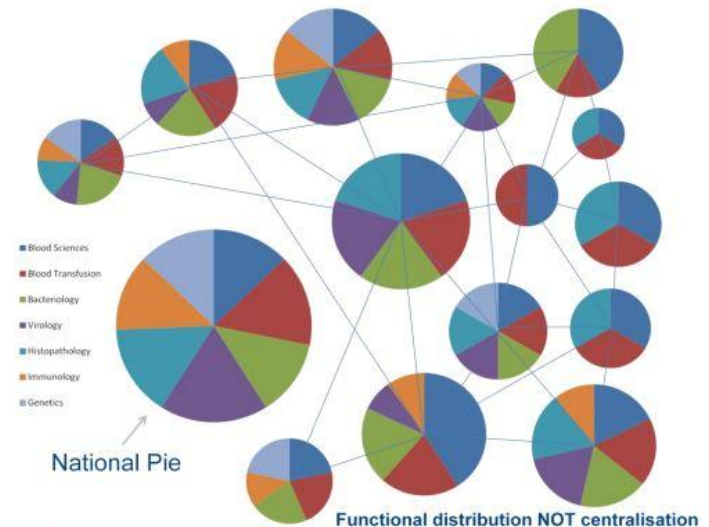
- Potential to build on our pilot and roll out Digital Pathology across NHS Scotland in a coordinated fashion
- Aim to be the first country in the world to be fully digitised
- Build on image analytics, leading to more precise diagnoses

What does this mean for the Pathology in Scotland?



Regional Working

- Digital Pathology is an enabler for a true distributed service model in pathology
- Functional teams working across multiple sites
- Realtime consultation or easy referral
- Seamless review of cases for MDT



National Working

- Useful for small volume specialist areas
 - Renal/transplant pathology
 - Paediatric pathology
 - Neuropathology

Challenges

- Reporting cases across Board boundaries
 - Governance issues
 - Data protection
 - IT security
 - Practicalities of multiple LIMS

Solutions

- Integrated reporting solution for digital pathology
- De-coupling reporting IT from laboratory IT, enabling a distributed model
- Enhanced reporting functionality compared with most current LIMS

Take home messages

1. Digital Pathology is here now!
2. (I believe) Digital Pathology is here to stay
3. True enabler
 - Digital microscope 😞
 - Digital workflow 😊
4. Great opportunity for NHS Scotland to be a world leader in digital pathology and associated R+D

Get involved!

- Arrange a visit to GGC or Lothian to experience the technology
- Possibility of expanding the pilot
- Help build the business case for national roll out
- Engage with service redesign to maximise the benefits of digital pathology
- Help build the national strategy for digital storage

Thank you
Questions?



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