





# Scottish Pathology Network

# The Future Face of Pathology

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# What I will cover today

## New and potential future developments in Pathology

- Workforce developments
- Workload developments
- Technology developments
- Future developments
- The lab of the future??
- **No product placements!**

# Change is ever present

- “Scarcely anything material or established which I was brought up to believe was permanent or vital has lasted. Everything I was sure or taught to be sure was impossible has happened”.
- **Winston Churchill 1930**

# Histopathology service delivery

- Increasing centralisation
- Driven by Carter report and Sustainability & Transformation Plans (STP) in England and the recent 29 hub model in England
- Shared or distributed services model/groups of regions in Scotland
- Centralisation of surgical specialties
- Network approach
- Centralisation of specialist services such as molecular pathology
- Central approval of specialist tests (Scottish molecular pathology consortium)
- Digital pathology

# Immunohistochemistry

- Increasing automation
- Role of support workers
- Move to “ready to use” markers & kits
- Ever expanding range of new markers
- New Pathologists are heavily dependant
- Quantitative assessment
- Impact of accreditation to ISO15189

# Cervical cytology

- Increasing centralisation
- Move to HPV primary screening
- Many countries already committed
- Australia started on 1<sup>st</sup> May 2017
- Wales to start in September 2018
- Scotland will go live late 2019
- Impact on workforce

# Diagnostic cytology

- Impact of centralisation of cervical cytology
- Use of ICC and molecular pathology
- Loss of cytopathologist focus
- Move to cytology reported by specialist
- Rapid On Site Evaluation (ROSE)
- Real potential for development
- IBMS ASD in non-gynae



# Mortuary and post mortem service

- Declining requests for hospital post mortems
- Declining interest among pathologists (diploma now optional)
- Centralisation of service
- Professionalisation of workforce
- Impact of rising number of bariatric bodies

# Workforce developments

- Advanced roles for biomedical scientists
  - Cervical cytology
  - Tissue dissection
  - Histopathology reporting
  - Molecular Pathology
  - Rapid On-Site Evaluation (ROSE)
- Blurring of professional boundaries
- Increasing specialism among pathologists
- Increasing opportunities for biomedical scientists
- Changing roles for pathologists

# Medical workforce issues

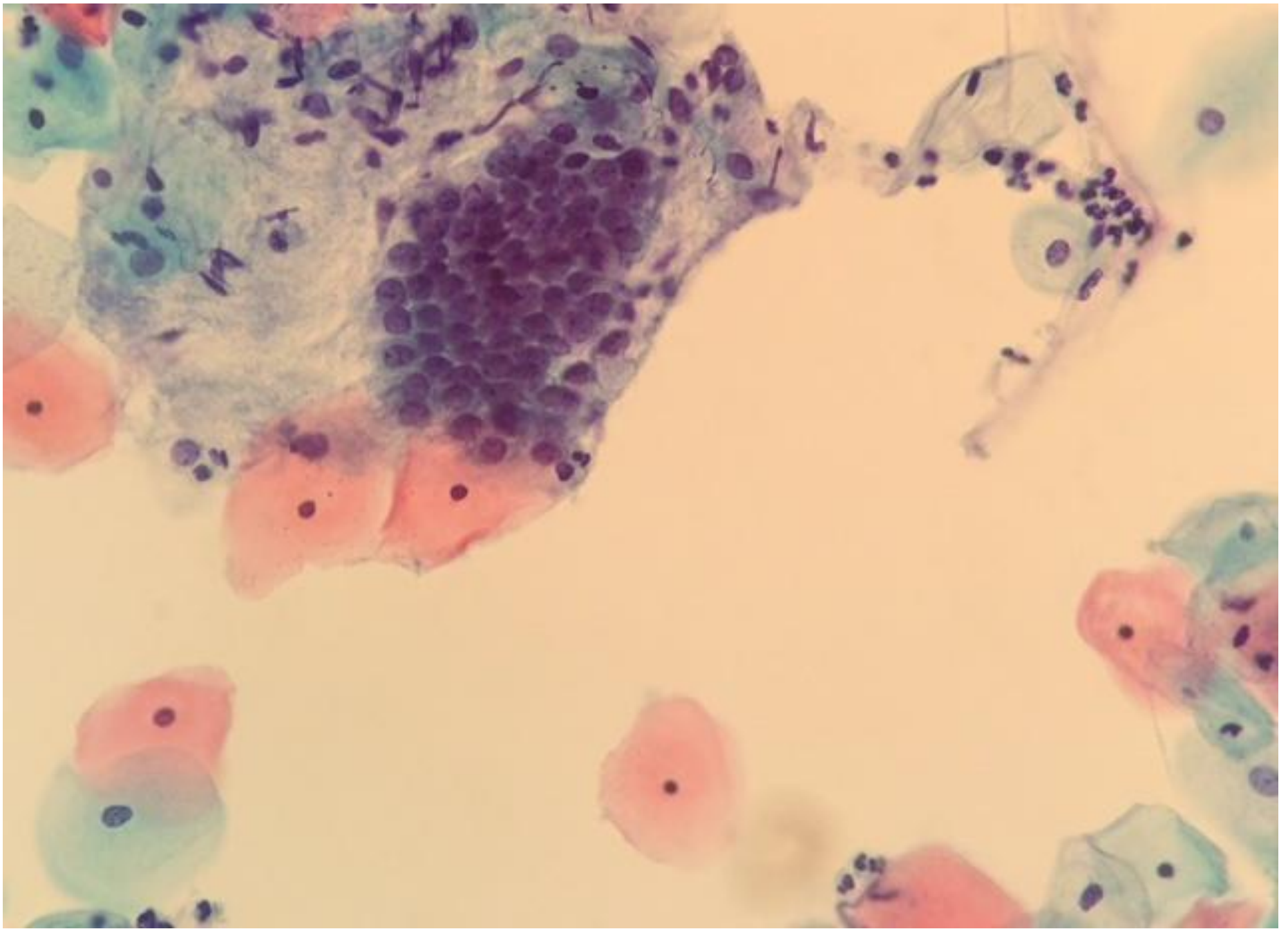
- Forecast retirements
- Trainee numbers/is pathology attractive?
- Impact of leaving the EU
- Pension Taxes
- Training for the future
- Increasing specialisation
- Role in training/mentoring biomedical scientists

# Digital pathology

- A potential game changer!
  - Full slide scanning
  - Digital education
  - Remote reporting & second opinions
  - Digital analysis
  - Artificial intelligence & Computer based reporting
  - Storage and archiving
- Blurring of LIMS, Digital pathology and tracking systems
- An enabler for future developments!
  - Look at radiology!

# Computational pathology

- Live panel discussion live sponsored by Philips.
- **November 30<sup>th</sup> at 14:20 GMT**
- **Talking points include:**
  - **What does computational pathology mean to pathologists?**
  - **What need is there for computational pathology?**
  - **Relevance today and the impact on care delivery**
  - **Is the technology ready for this change?**
  - **How can computational pathology be used to improve the practice of pathology?**
  - **Attendees qualify for 1 CPD point, issued by the Royal College of Pathology.**





**13th EUROPEAN CONGRESS  
ON DIGITAL PATHOLOGY**  
– HOSTED BY THE GERMAN SOCIETY OF  
PATHOLOGY –  
[www.digitalpathology2016.org](http://www.digitalpathology2016.org)  
MAY 25th–28th, 2016  
LANGENBECK-VIRCHOW-HAUS  
BERLIN, GERMAN





# 13th European Congress on Digital Pathology

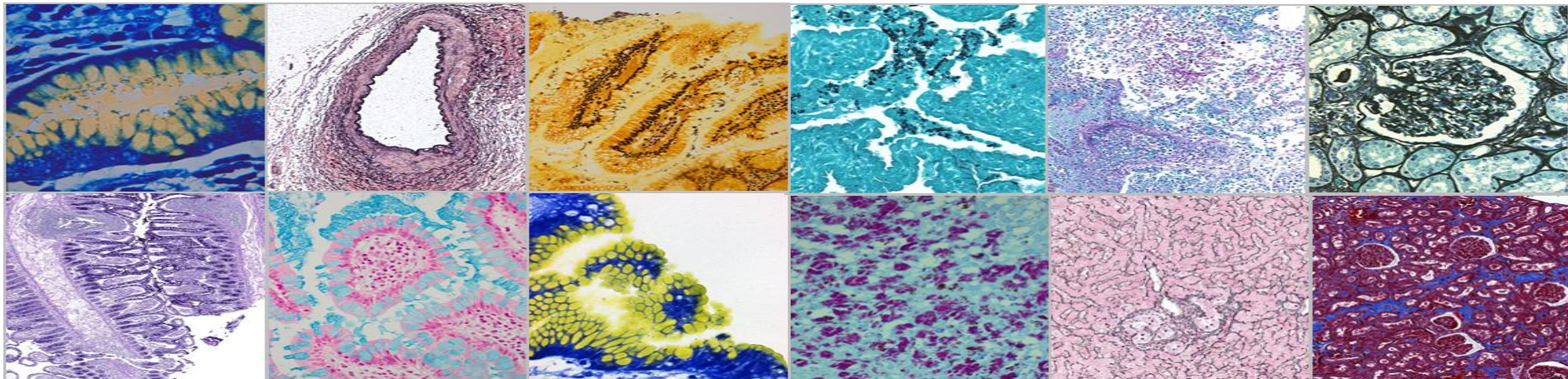
- Telepathology
- Data Integration and Modelling
- Virtual Microscopy
- Computer Aided Diagnosis
- Topology
- Imaging in Clinics and Research
- Clinical Workflow Integration
- Digital Pathology Workflow Integration
- Molecular & Integrative Pathology

# Automation in Histopathology

- H&E Staining/coverslipping
- Tracking systems
- Special stains
- Automated embedding
- Automated microtomy
- Automated Archiving
- Digital pathology
- Diagnostic Algorithms/Artificial Intelligence

# Automated special stains: Benchmark stain repertoire

- AFB (Acid Fast Bacilli)
- Alcian Blue for PAS
- Alcian Blue
- Alcian Yellow
- Congo Red
- Diastase
- Elastic Stain
- Giemsa
- GMS II
- Gram Stain
- Iron Stain (Perls)
- Jones H&E or Jones Light Green
- Light Green for PAS
- Mucicarmine
- PAS
- Reticulum Stain
- Steiner Stain (Wathin Starry)
- Trichrome Stain



# Automated embedding/microtomy

- Relatively recent development
- Still struggling to get a foothold
- Inevitable way forward for large centralised laboratories
- Sakura are the main players

# Tissue-Tek® AutoSection® Automated Microtome



## Efficiency

- Automated trimming freeing up experienced technicians
- Less rework due to high consistent quality, saving cost
- Easy and safe recutting leading to less spare sections and decreased over production
- Highly improved ergonomics, reducing labour cost

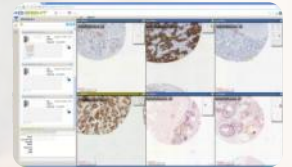
## Speed

- 10 second Auto-trimming
- Perfect fit with Tissue-Tek® AutoTEC® & Paraform

## Quality

- Eliminating tissue loss , especially important with recuts due to AutoAlign™ technology
- Precise and consistent high-quality sectioning for every technician and tissue type
- Consistent section thickness, especially important with IHC

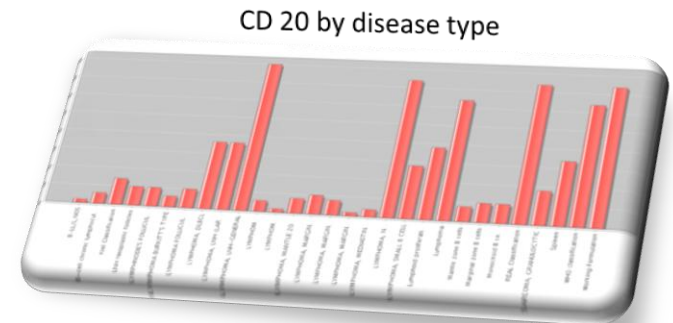
## A Fully-Integrated, Cellular Pathology Laboratory Management Solution





# Tracking and Management System

Open-Platform Tracking Solution  
Cellular Pathology Report  
Statistical Reporting Package  
Archive Management  
Inventory Management System





## Take control of patient tissue blocks

The Thermo Scientific™ Syntri™ Arcos™ Block Management System is designed to minimize errors, increase productivity and keep your laboratory's resources focused on what matters most – positive patient outcomes.



### Lost blocks – a thing of the

- The Arcos system maintains a record of all blocks in storage that are accessed and searched.
- Check-out and check-in every block is, who checked it back and why it was needed.
- Readily identify blocks checked out rather than anticipated.



### Increased accuracy

- The Arcos system eliminates the risk of human error in the hand-sorting process.
- After check-out, blocks are automatically updated in the system.

### Database integrity

- Redundant protection: you can choose to automatically archive your data to a secure storage network or cloud-based system.
- Control individual user data access and modification permissions.



### Archived in an instant

- Simply place your blocks in the Arcos tray right at the microtome. At the end of the day, push the tray into the scanner. In about two minutes, the Arcos system will scan, photograph and record the position of every block in the tray. Simply enter the location where you will store the tray and your database is immediately updated.
- No more time-consuming manual sorting; scan hundreds of blocks at once.

### Reliable retrieval

- Find tissue blocks quickly and easily. Select the block you're after and the Arcos system will tell you where the tray is located in your archive, and the exact position of the block within the tray.
- Time to return the block to storage? Simply place it in the next tray to be scanned; the Arcos system will automatically update your database to reflect its new position.

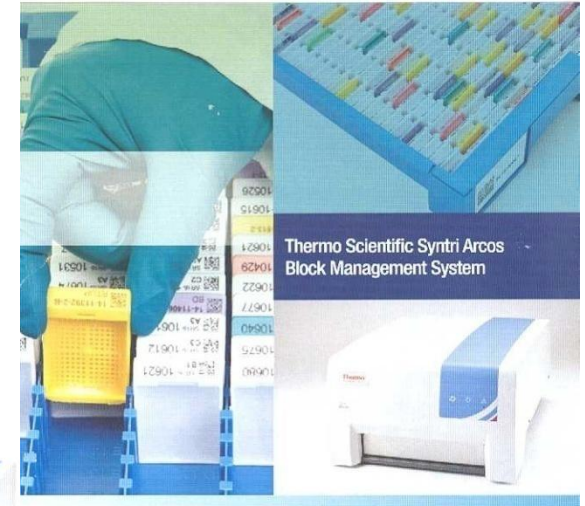


### Proven savings

- The Arcos system has been shown to save thousands of man-hours per year in busy laboratories – up to one-and-a-half full time employees.
- The system's speed and efficiency allow you to keep your laboratory's resources focused on what matters most – positive patient outcomes.

### A natural fit for your workflow:

- The compact form factor of the scanner is designed to fit neatly within space-challenged laboratories.
- Save up to three meters (ten feet) of workspace previously reserved for sorting and stacking blocks.



Thermo Scientific Syntri Arcos Block Management System

**ure. simple. savings.**

A breakthrough in tissue block management

- Protect precious patient tissue blocks from misplacement and loss
- Fast, flexible and efficient storage and retrieval
- A natural fit for modern laboratories



# Automation in cervical screening

- Liquid based cytology (the enabler)
- Automated sample processing
- Automated screening
- Imaging assisted screening
- HPV testing
- Sample handling

# Complete Automation for Cervical Health Screening

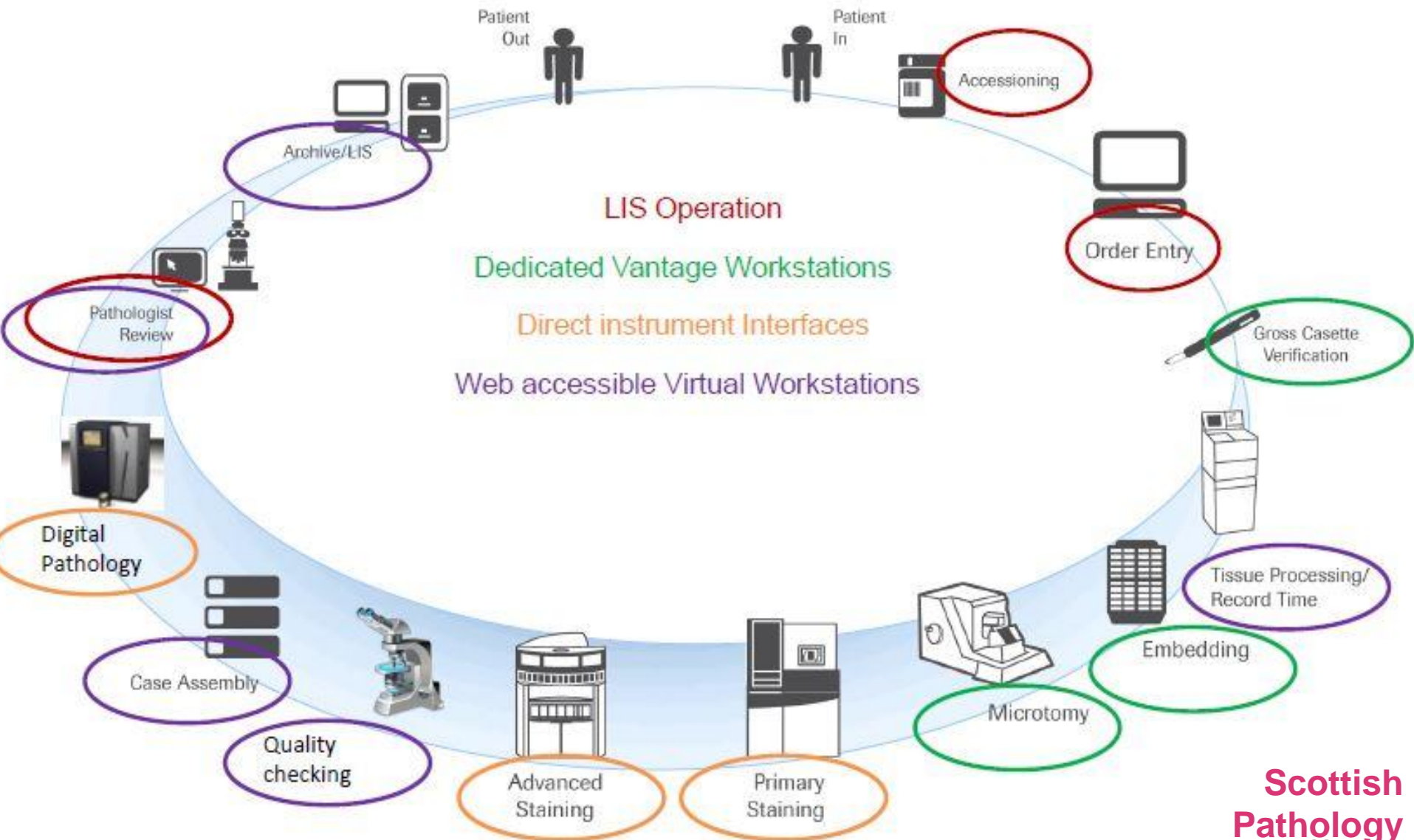
One vial. Multiple options. One complete solution.



# Tracking systems & Logistics

- End to end tracking: source to archiving
- Track and trace labelling (like Amazon!)
- Interface with LIMS
- Error reduction
- Bar code driven
- One slide/block at a time approach
- Stock control and JIT ordering (like Tesco!)
- Staff productivity, workflow and traceability data
- Roche Vantage, Leica Cerebro

# VANTAGE integration



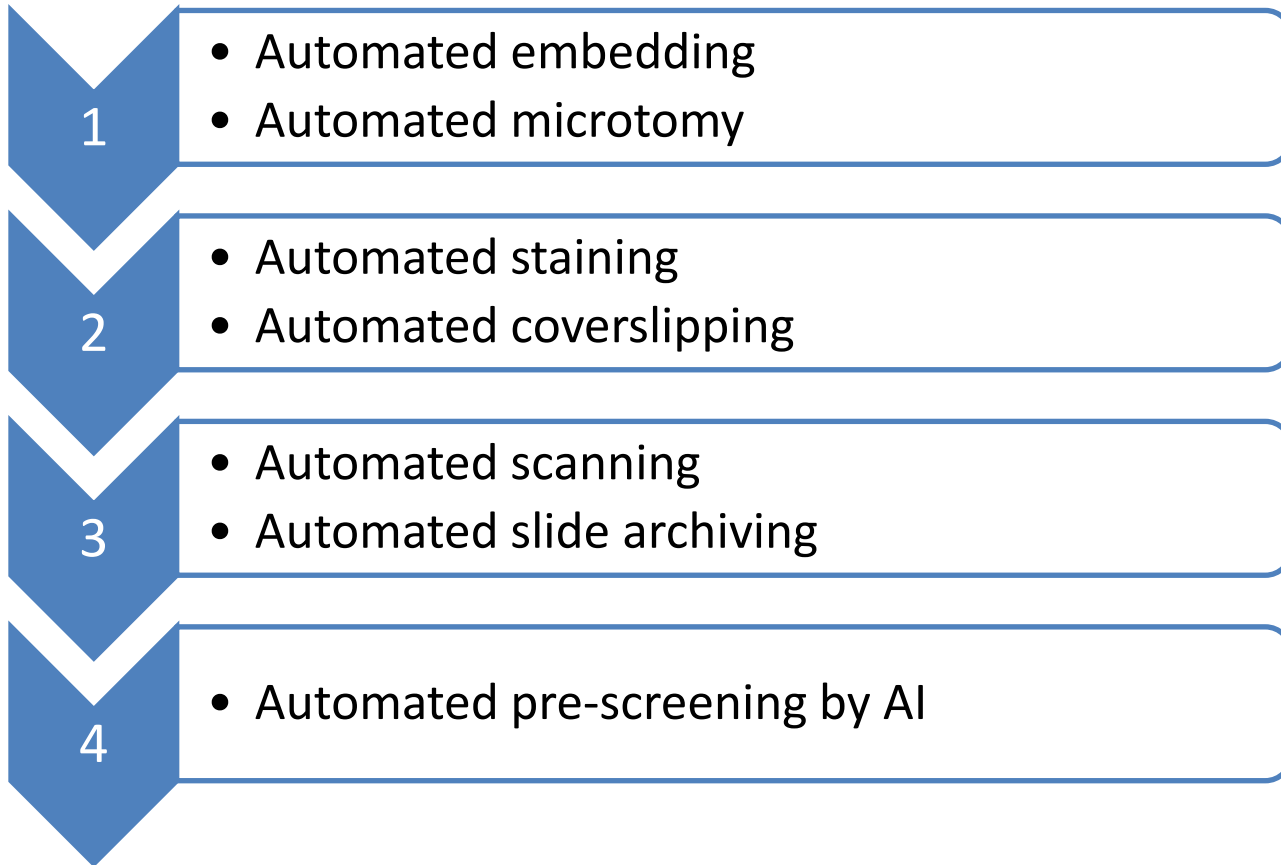
## VANTAGE

### *Workflow & Tracking*

*Blend of computer **HARDWARE & SOFTWARE***

- An automated & sophisticated histology **specimen tracking system**.
- **Management system:** Process, quality and productivity in the lab
- A tool to assist in the laboratory **leaning** process





# Changing face of the workforce

- Increasing roles of support workers
- Changing roles for pathologists
- Decreasing number of biomedical scientists in cell path
- Part time posts
- Advanced practice roles
- Glass ceilings beginning to develop holes.....

# Histopathology reporting by biomedical scientists

- First biomedical scientists now reporting biopsies and resections
- Intensive training
- Close co-operation with RCPATH
- Dramatic progress, unprecedented in other countries
- Recognition of biomedical scientists



# Advanced practitioner role in cervical cytology

- Now dominate cervical cytology in the UK
- Declining number of cytopathologists (diploma now optional)
- Advanced practitioners have filled the gaps
- Service now led by biomedical scientists
- Wider screening programme role
- Role in HPV primary screening laboratories
- Consultant equivalent

# Advances in diagnostic cytology

- Molecular pathology
- Immunocytochemistry
- Flow cytometry
- Cell blocks
- ROSE/EBUS
- FISH
- Next Generation Sequencing (NGS)
- Progress in other (developing) countries
- Doing more with less...

# The future: workforce

- Further development of advanced roles for biomedical scientists
- Increasing role of support workers
- Develop relationships with medical staff and medical colleges
- Blurring of professional boundaries
- Inevitable move to BMS reporting
- Changing role of Pathologists

# The future: workload

- Increasing diagnostic biopsies (Scottish cancer statistics)
- Development of in vivo triage/diagnosis
- ? Declining cancer resections
- ? Increasing IHC requests
- Declining role for EM, special stains
- Increasing role of molecular pathology and genetics in diagnosis, tumour typing and prognostic markers (may reduce IHC)
- Impact of personalised medicine

# What is driving the change

- Rethinking patient pathways
- Personalised medicine
- Increasing specialisation
- Shrinking financial resource
- Advances in clinical procedures which do not require pathology
- Added value from cellular pathway (companion diagnostics)
- Expansion of traditional roles
- Advances in technology

# Cancer Research UK's pathology report

16 recommendations, key findings which these recommendations are based on:

- Demand is increasing – both due to more referrals, but also more complexity per referral.
- Consultant capacity (numbers) has been increasing, but not as much as demand.
- As a result – drop in research/changes in ways of working; difficulty recruiting; outsourcing and backlogs; waiting times increasing

# Other new developments

- Liquid biopsies: Tumour type-specific, multi-biomarker next-generation sequencing (NGS) assays with >98% specificity in genes found in plasma samples.
- Low-Cost Microendoscope: low-cost solution opens new doors for low-resource regions and, in many cases, allows operators to rule out malignancy without the need for a pathologist to review biopsies

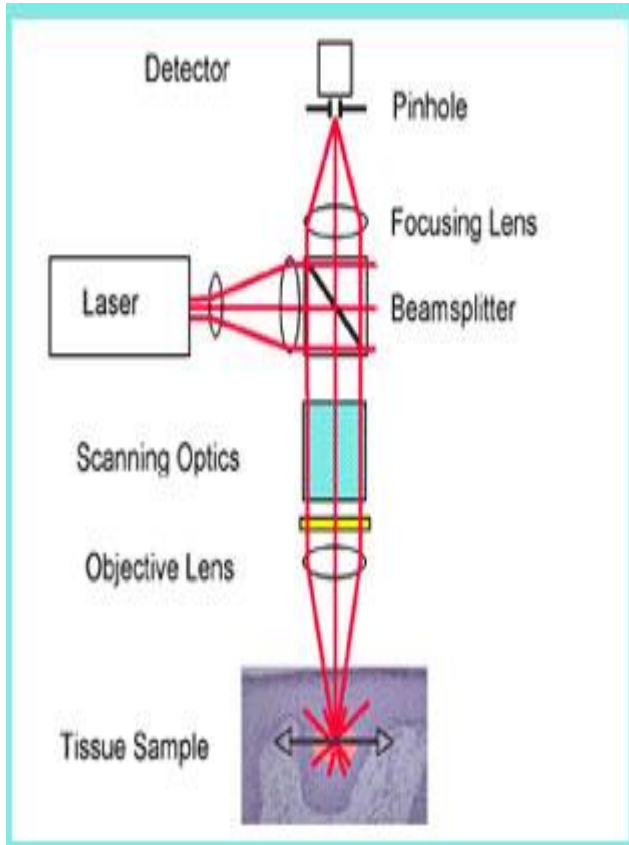
# Circulating tumour cells

- The CELLSEARCH<sup>®</sup> Circulating Tumor Cell Kit is intended for the enumeration of circulating tumor cells (CTC) of epithelial origin (CD45-, EpCAM+, and cytokeratins 8, 18+, and/or 19+) in whole blood.
- The presence of CTCs in the peripheral blood, as detected by the CELLSEARCH<sup>®</sup> CTC Test, is associated with decreased progression-free survival and decreased overall survival in patients treated for metastatic breast, colorectal, or prostate\* cancer. The test is to be used as an aid in the monitoring of patients with metastatic breast, colorectal, or prostate cancer.



# Confocal laser scanning microscopy

- In vivo and ex vivo examinations using confocal laser scanning microscopy
- Allow for an “optical biopsy” using a non-invasive procedure.
- To generate confocal images, a laser beam in the near infrared range is directed through an interconnected lens system and a beamsplitter onto the area of skin to be examined
- Cellular microstructures of skin can thereby be depicted cell by cell in clearly defined horizontal “optical cross-sections”.



## Multiplexed Ion Beam Imaging (MIBI)

A novel approach to immunohistochemistry that uses secondary ion mass spectrometry and antibodies labelled with elemental mass tags to visualize dozens of proteins simultaneously in a single tissue section.

MIBI is compatible with formalin-fixed, paraffin-embedded tissue specimens.

A novel imaging mass spectrometer has been developed capable of super resolution imaging and 100-fold faster sample throughput than previously reported.

These tools are being used to comprehensively enumerate immune cell populations in normal and neoplastic solid tissues, to construct classifiers for predicting disease progression in pre-invasive cancer lesions, and to develop quantitative IHC assays to be used in a clinical setting.

# Impact of new technologies

- Morphological assessment by pathology professionals is being squeezed from both ends:
  - A reduction in sample numbers due to advances in imaging and in vivo triage
  - A move to morphologic assessment of tissue sections by AI

# Is big beautiful?

- Already we have huge Labs.
- In Australia. The Douglas Hanley-Moir (Sonic) operates 24/7 for Scientists and Pathologists. 4000 Blocks per day.
- This is the norm in USA
- Creeping into Europe
- The way forward?
- Not necessarily beautiful but inevitable.....

# The lab of the future??

- It will be big!
- Tracking systems will be mandatory
- Different patterns of working (24/7)
- Increased complexity (prostatic cores)
- Digital pathology revolution
- Molecular pathology/genomics/genetics
- Diagnostic algorithms
- Focus on quality
- A new approach to management required

# The lab of the future??

- Doing more with less (samples and staff!)
- Less specimen handling
- Less “unnecessary” biopsies and excisions
- Controlling “downstream” (ROSE)
- More “end to end” automation
- More support staff
- Less scientists and pathologists
- More extended roles for scientists
- Increasing workload and size of department

# Future training requirements

- Statistics and mathematics
- Genetics, genomics
- NGS & liquid biopsy
- Informatics, data handling, pattern recognition
- Molecular pathology
- Digital pathology
- Proteomics
- Ethics, QM



# Models for future service delivery

- Large processing labs with wide use of BMS dissection
- BMS triage based reporting
- BMS specialist reporting
- Off site pathologist specialist reporting
- Where do pathologists fit in?
- Off site frozen section reporting

# What should we do?

- Plan and engage!
- Engage with your professional body and network
- Ensure you are best placed for the developing roles
- Develop training courses
- Focus on digital pathology, molecular pathology, BMS dissection and reporting

# Summary and conclusion

- Radical changes on how we deliver the cellular pathology service is on the horizon
- Patient and patient pathway focussed
- Centralisation is inevitable
- A new way of managing and delivering the service is required

# References

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- Carter report: <https://www.ibms.org/estudents/go/news,1079>
- National Society for Histotechnology: [nsh.org/](http://nsh.org/)
- <http://www.darkdaily.com>



**Thank you**