




Nottingham University Hospitals NHS Trust

**Realising a Full Digital Pathology Solution Combined
with Lean Workflow to Shorten Diagnosis Times,
Improve Quality, and Boost Pathologist Productivity**

**Paul Chenery – Speciality General Manager
Head of Quality, Training & Strategic Improvement**



Cellular Pathology Services

What We Do?

80,000 Histopathology Samples per annum

8,000 Cytopathology Samples per annum

Who Are We?

34 Consultant Pathologists

25 WTE Biomedical Scientists (B5-7)

Where We Work?

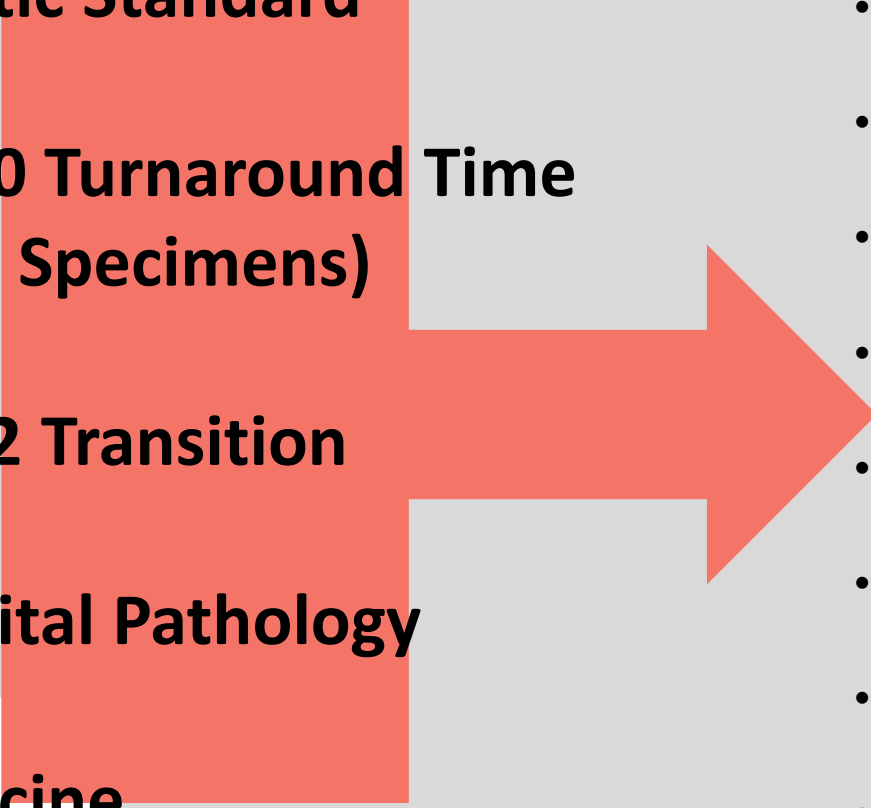
Dual sited service:

- **Queen's Medical Centre** – Core Services, Diagnostic Cytopathology, Neuropathology, Mortuary
- **City Campus** – Satellite dissection laboratory, Haematological Malignancy Diagnostic Services, Mortuary
- **Treatment Centre** – Moh's Intraoperative Services



Nottingham University Hospitals
NHS Trust

The Start of Great Change.....

- **Faster Diagnostic Standard**
 - **NHS England 10 Turnaround Time
(98% All Specimens)**
 - **ISO 15189:2022 Transition**
 - **Implement Digital Pathology**
 - **Precision Medicine**
- 
- **Consultant Pathologist Shortfall**
 - **Aging Workforce**
 - **Skills Shortage**
 - **Historic Patient Delays**
 - **Historic Financial Debts**
 - **Weak Quality Legacy Systems**
 - **Highly Manual Procedures**
 - **NHS Mindset**

The Target

98% ALL SPECIMENS

10 DAY TURNAROUND TIME

DIAGNOSTIC, PROGNOSTIC AND
THERAPEUTIC PATIENT OUTCOMES

The Reality

+1.5 days sample
arrival

+2 days dissection
backlog

+2 days QC backlog

Cancer Screening
Programme cases
already at breach date
before arrival

+2 days booking in
backlog

+4 days microtomy
backlog

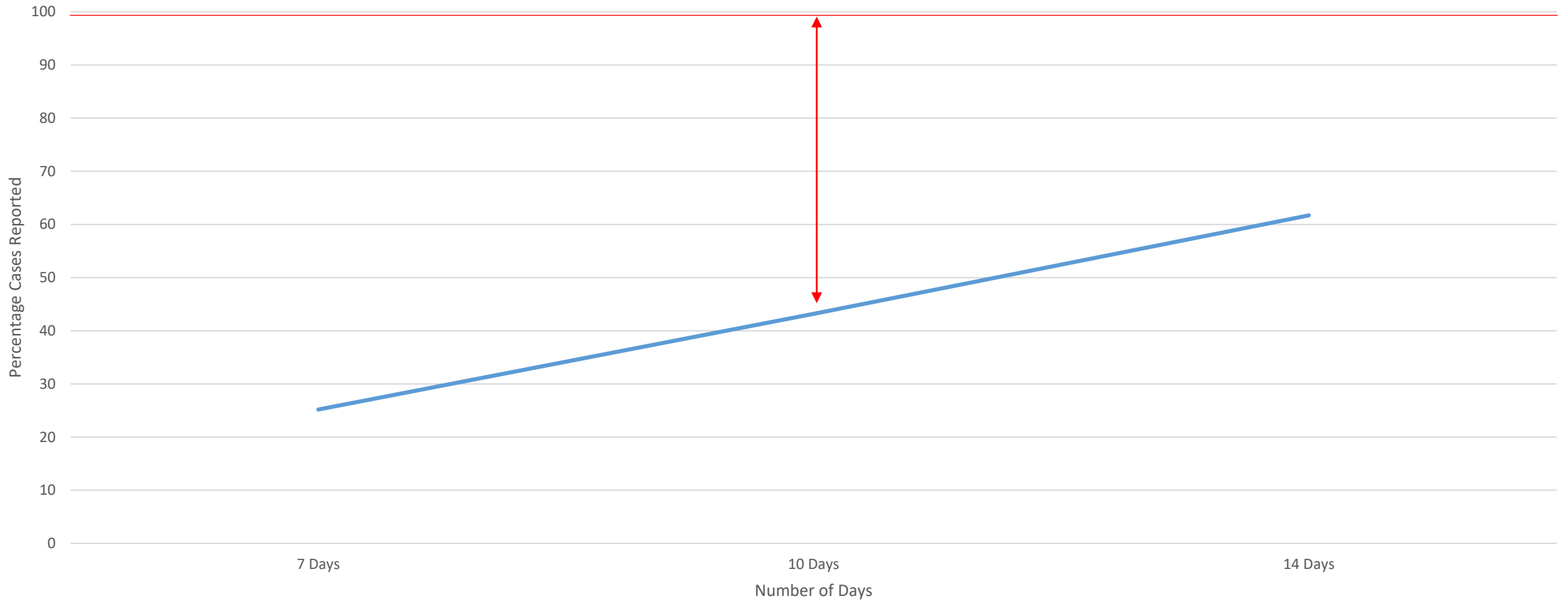
~ 11.5
backlog days

Still to Consider

+1 DAY
WHOLE SLIDE SCANNING

Target	7 Days	10 Days	14 Days
All Cases	25.2%	43.2%	61.7%

Reporting Rate of All Specimens - October 2022



INTRODUCTION OF WHOLE SLIDE SCANNING

APPROACH

Lean Six Sigma Training

Kaizen Event

Establishment Review

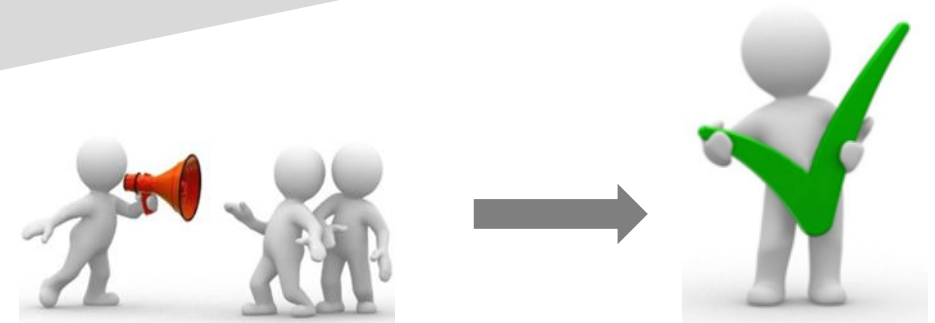
Lean Six Sigma - Training and Development

Key Drivers

- ① **Mindset and Culture - Promoting change commitment**
- ① **Lean Principle - “BETTER, FASTER and/or CHEAPER”**

Waste Reduction, Process mapping

- ① **Six Sigma - Reduce VARIANCE**

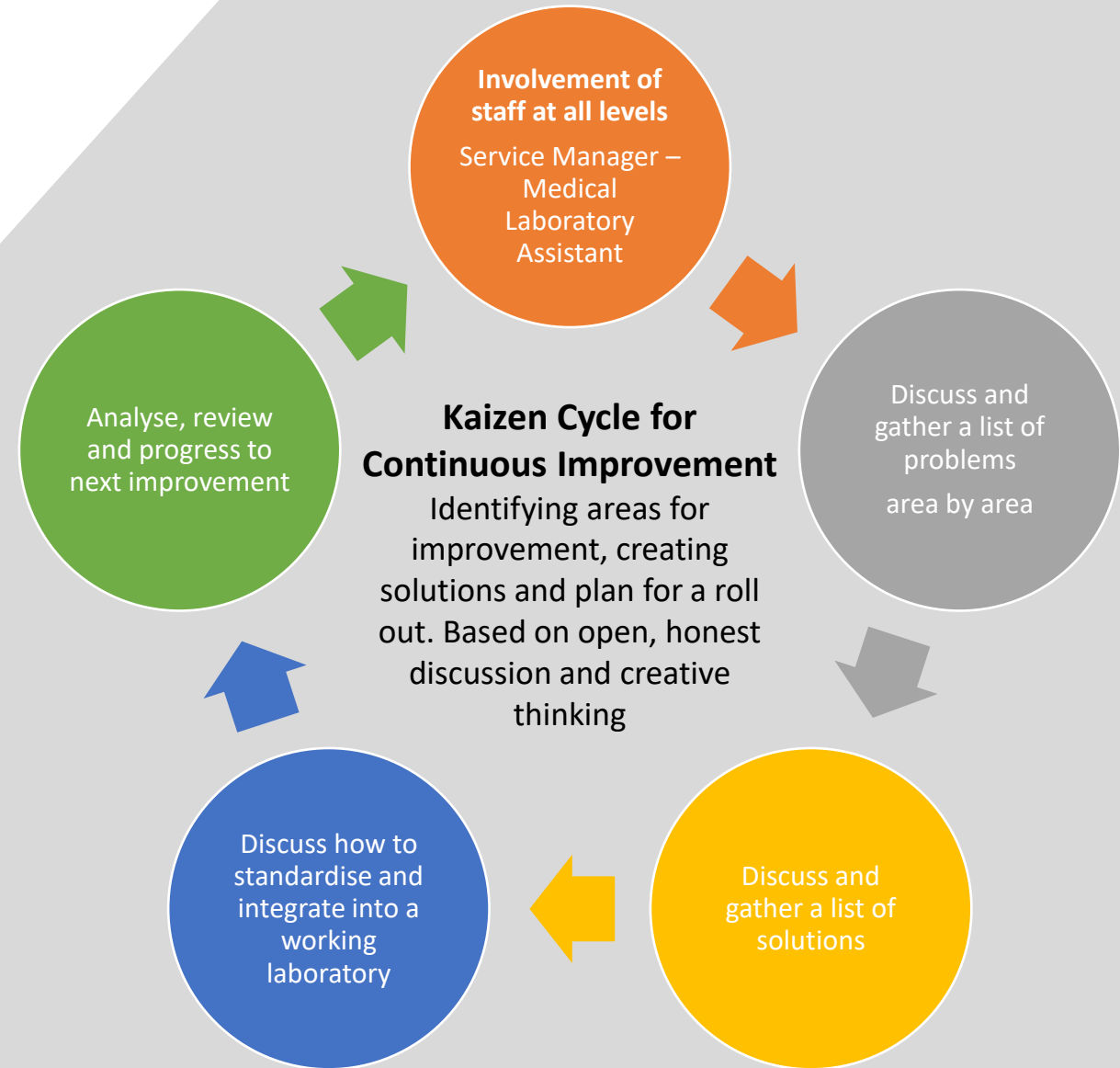


Kaizen Event

Key Themes

- Process
- Environment
- People
- Too many checks
- Too many information management systems

'Creative thought and resetting the minimum standard'



Batch Mentality, Urgency Clarity and Continuous Workflow



Establishment Review

Investment in QUALITY



Dedicated Quality Team and staffing escalation system



Scheduled monthly planning and action groups



Systematic interrogation, review and update of quality management system

Investment in TRAINING



Appointed departmental training lead



Development of higher scientific roles



Additional CPD, training and workshop events at all levels

Investment in CONTINUAL IMPROVEMENT



Industry leading Lean Six Sigma Education



Appointment of Transformation Manager and Transformation Lead



Dedicated project management time

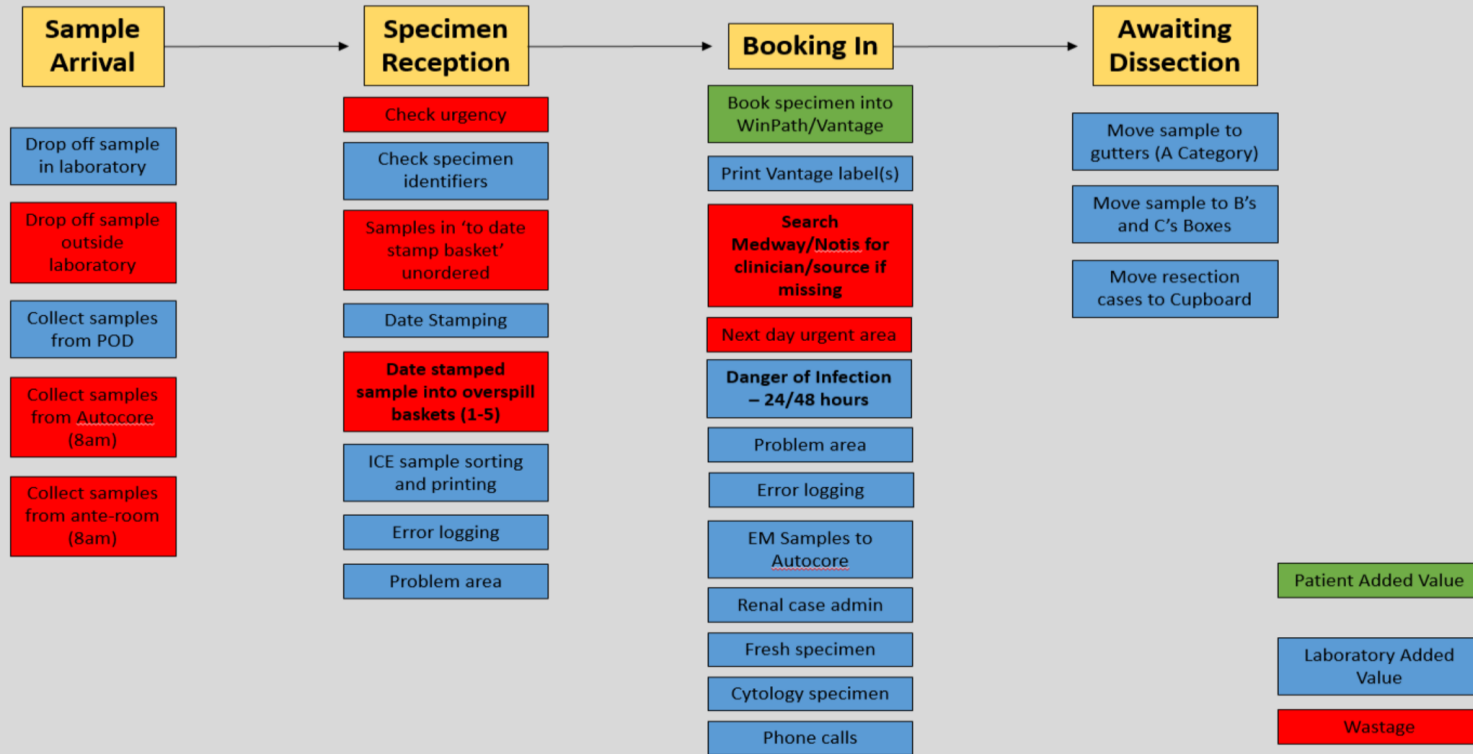
IMPLEMENTATION

Workflow Review

Creation of new workstations

Workflow Review

Specimen Reception and Dissection



- What is important to the patient?
- Managing risk and efficiency
- Processes for the many and not the few

Process Mapping

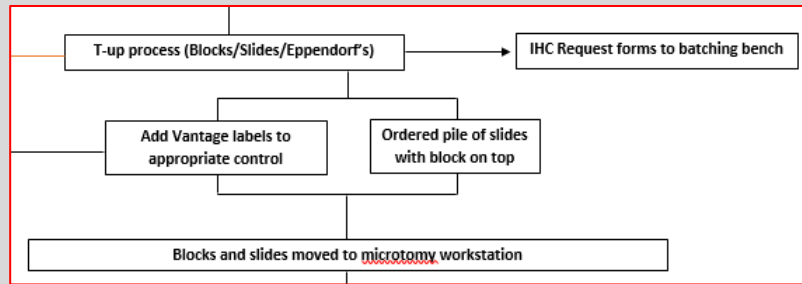
Waste Inventory

Overproduction	<ul style="list-style-type: none"> • Samples unordered when stored in reception (Pre and Post date stamp) and booking in baskets
Waiting	<ul style="list-style-type: none"> • Proformas added to case at dissection and not stored in specific location • Special staining authorisation required for liver biopsies • Work stations not occupied or inconsistently executing primary role • Peak capacity limited to x2 booking in workstations • Staff using Medway and <u>Notis</u> to correct missing Clinicians/Source details • Checking for urgency • Samples unordered when stored in reception (Pre and Post date stamp) and booking in baskets
Over-Processing	<ul style="list-style-type: none"> • WinPath and Vantage Label generation (Systems not bi-directional) • Samples unordered when stored in reception (Pre and Post date stamp) and booking in baskets
Motion	<ul style="list-style-type: none"> • ICE booking in form printing • Pod system located in a different room • Samples unordered when stored in reception (Pre and Post date stamp) and booking in baskets
Transportation	<ul style="list-style-type: none"> • 8am – collecting specimens from <u>Autocore</u>, Ante-room and Pod System ~ 1 hours lost each morning • Distribution of fresh, intra-operative, cytological specimens to other labs • Taking EM, Genetic and other specimens to <u>Autocore</u>
Inventory	<ul style="list-style-type: none"> • Empty workstations on breaks/lunches • Unused decalcification
Defects	<ul style="list-style-type: none"> • Problem area – Non Acceptance policy and when performed • No user friendly cut-up timetable and MDT Timetable available • No specified areas for dropped off specimens, city specimens and out of service hours specimens • Ventilated cabinet door broken

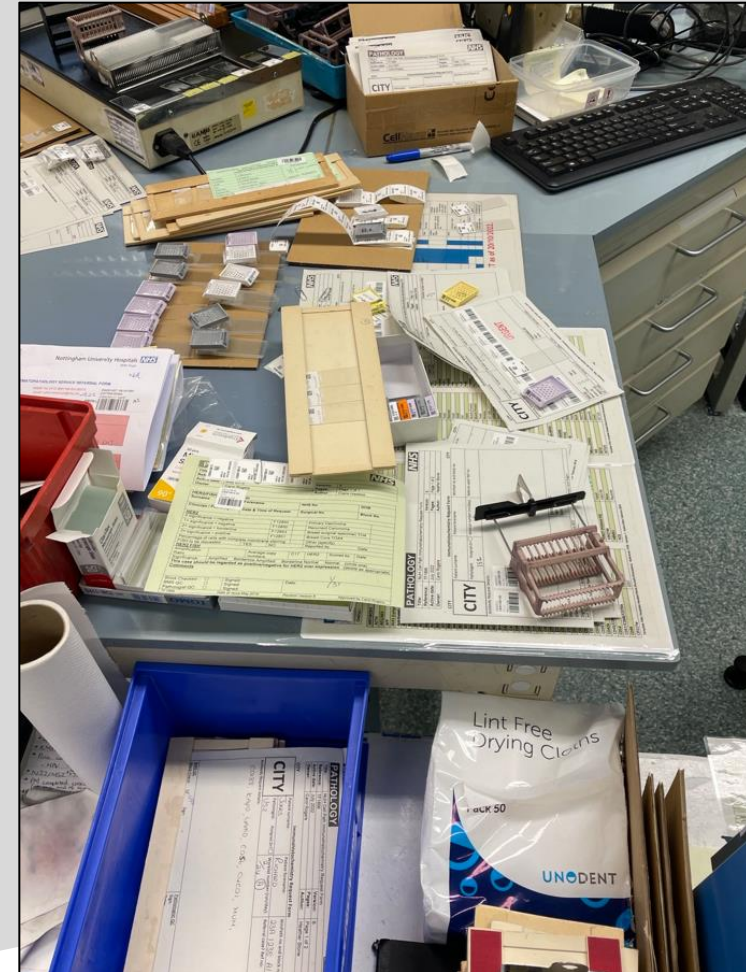
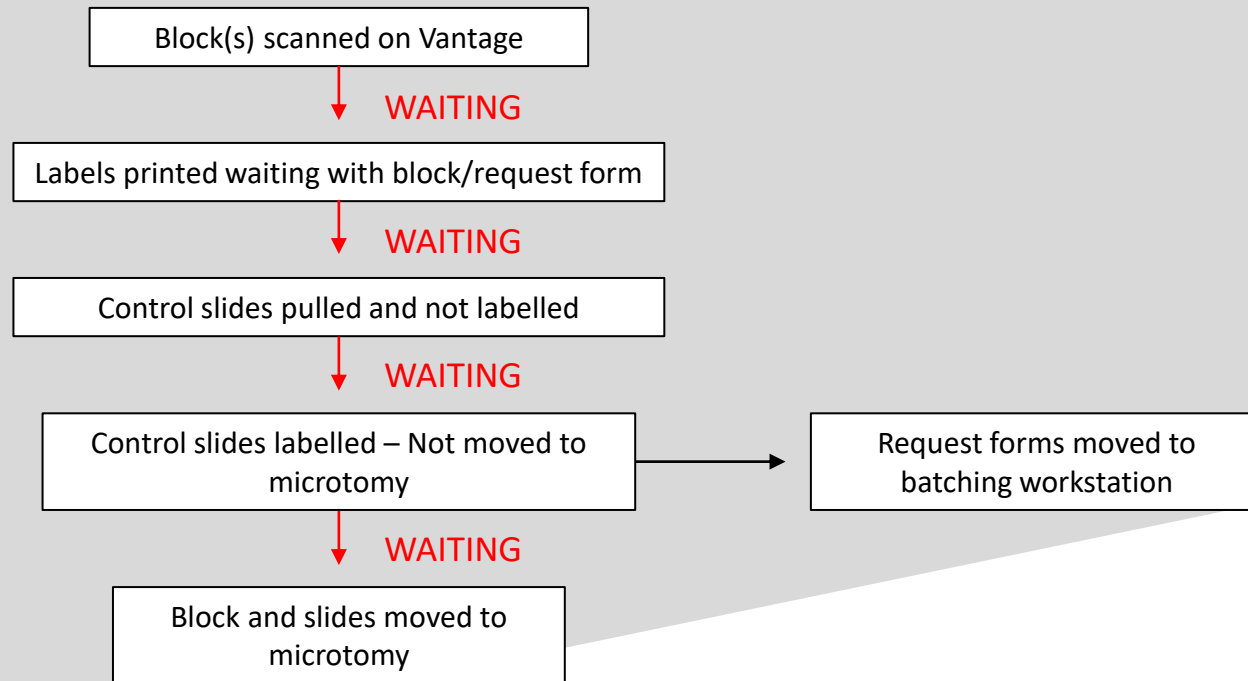
‘Waste is a silent thief stealing your time, resources and potential’

Legacy Mismanagement

High Level



Detailed View



Example – Microtomy Preparation

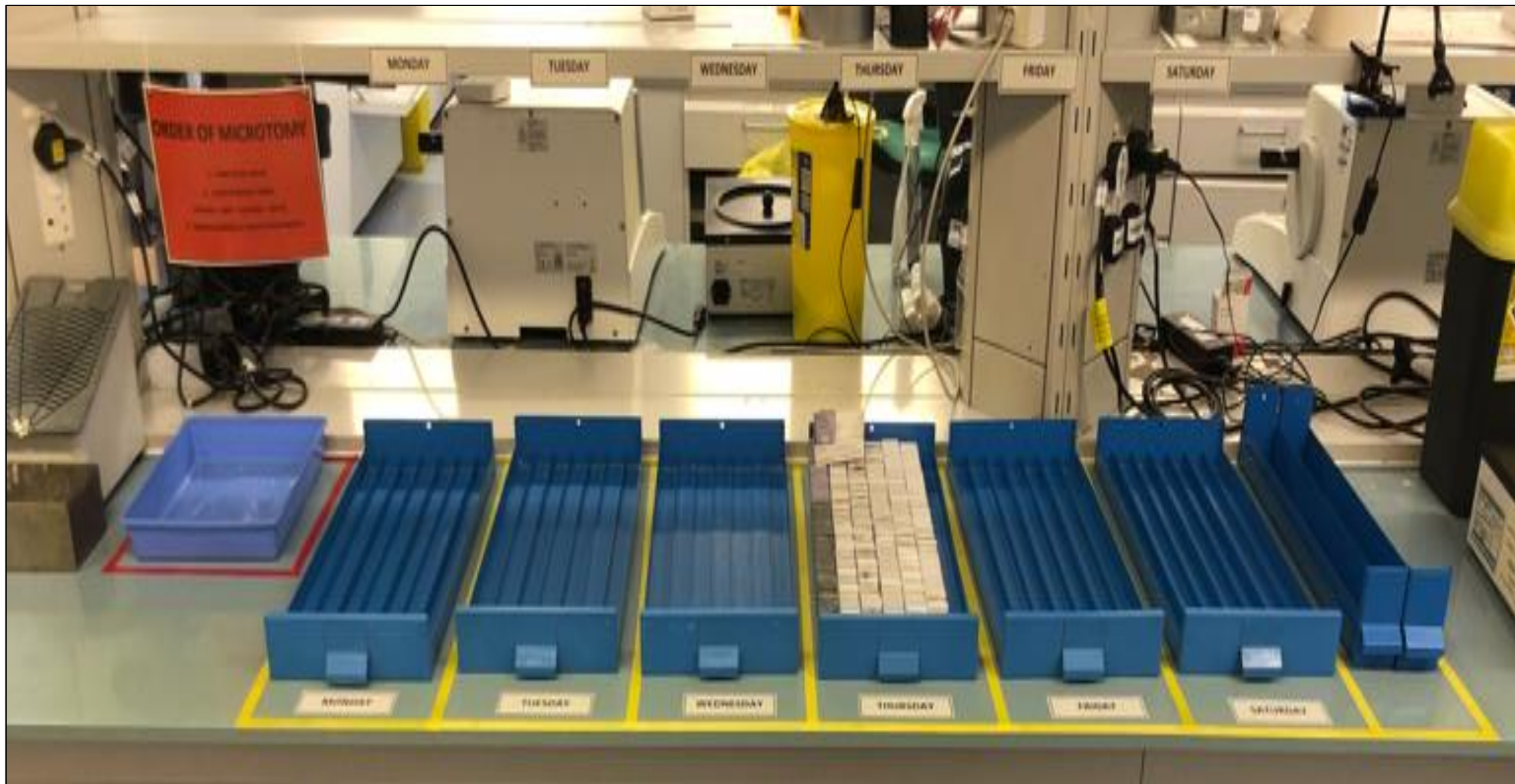
See it, Believe it



See it, Believe it



Microtomy

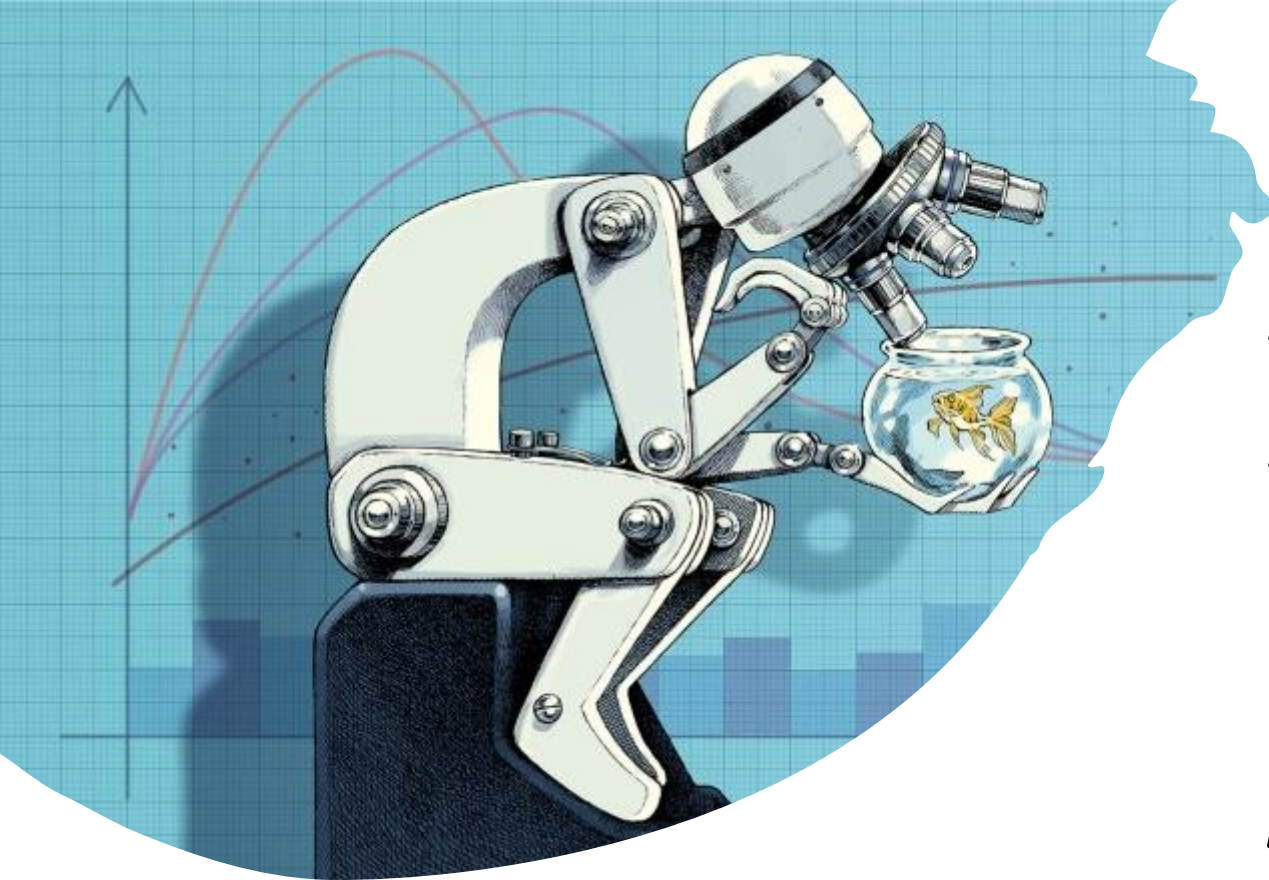


QC



Digital Quality Control



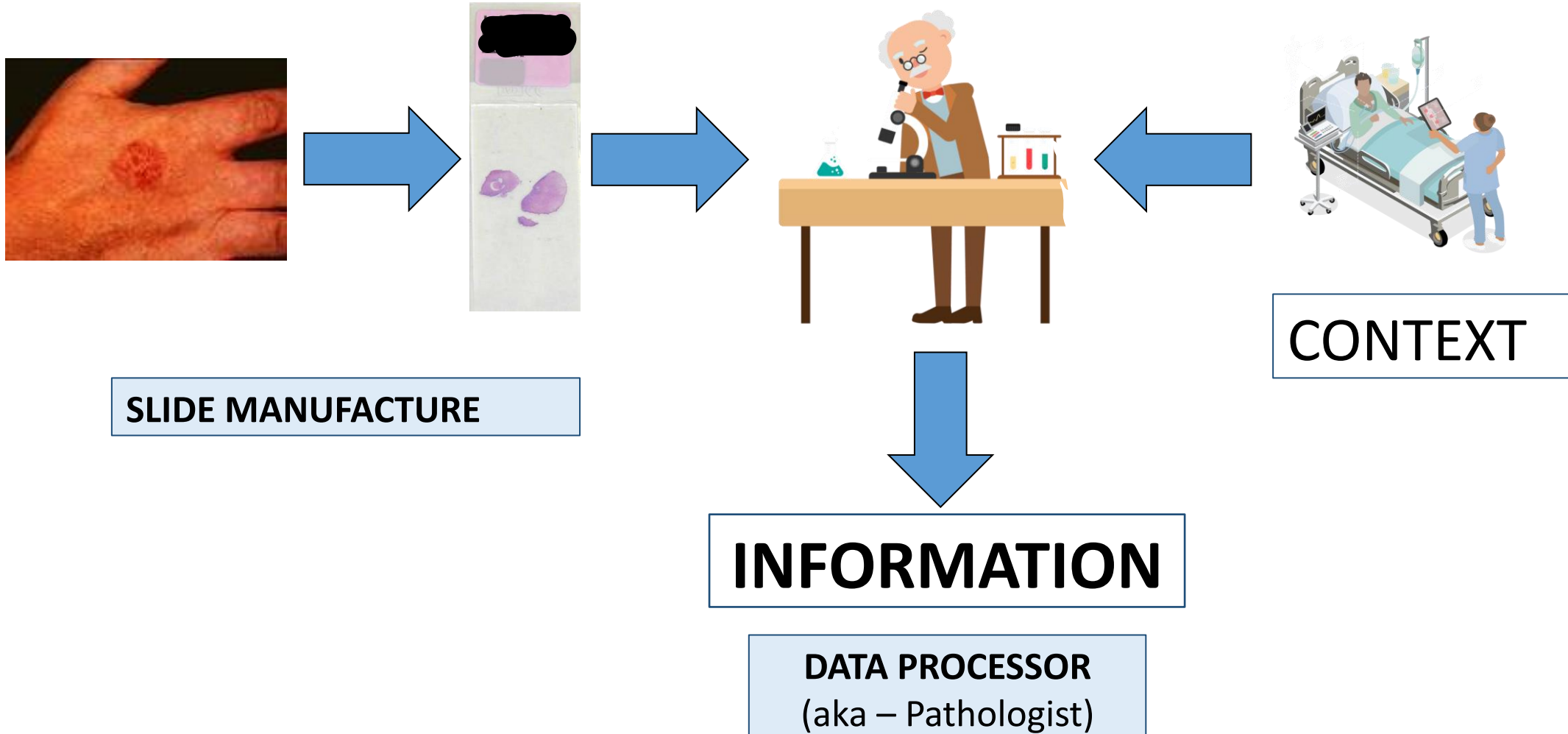


*It's not just a Digital
Microscope....*

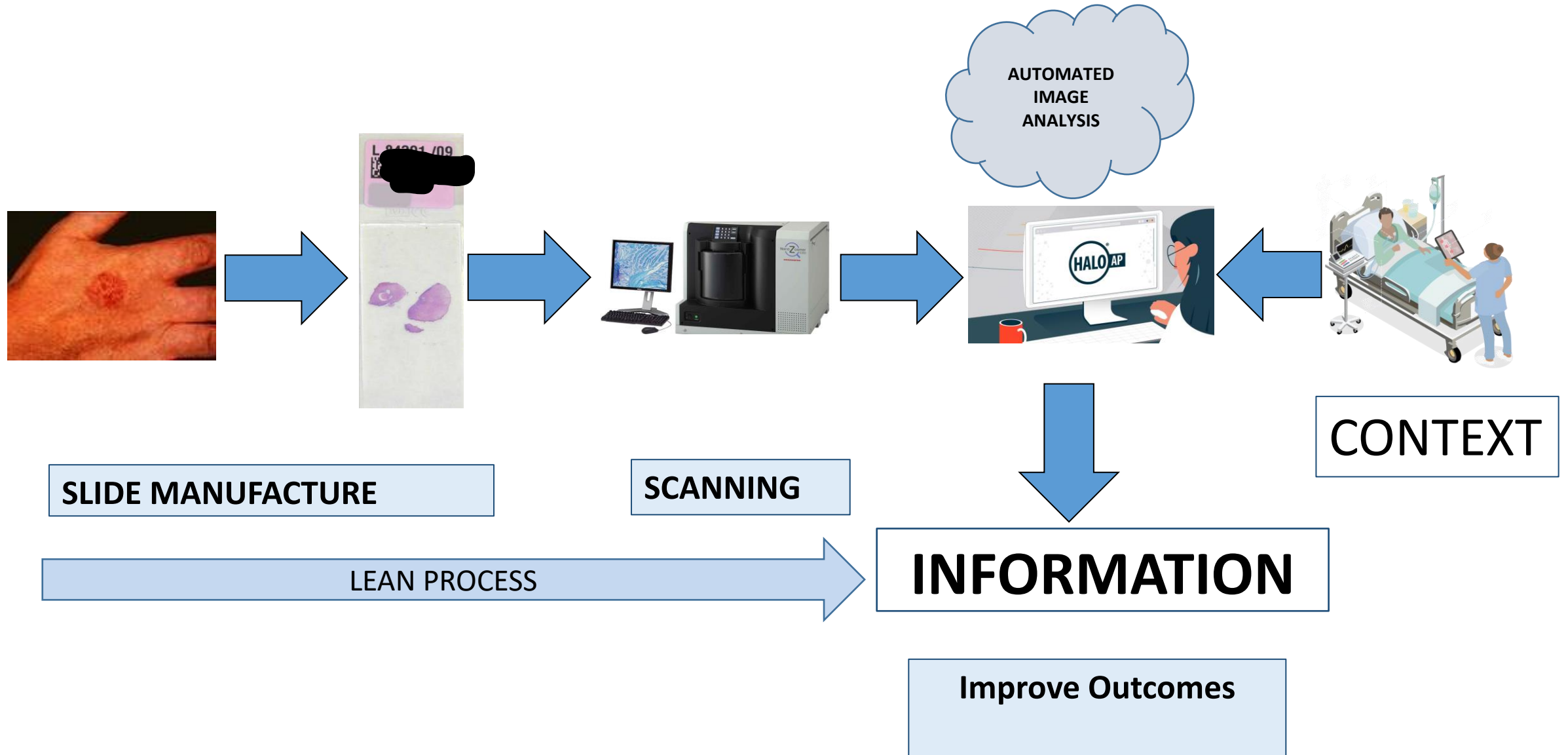
*it's about transforming
the way Cellular
Pathology is delivered
as a service*



HISTOPATHOLOGY



DIGITAL HISTOPATHOLOGY



Accelerating Diffusion of Innovation: Maloney's 16% Rule[©]

Psychology of Influence[^]

Scarcity

Social Proof

Maloney's 16% Rule:

Once you have reached 16% adoption of any innovation, you must change your messaging and media strategy from one based on scarcity, to one based on social proof, in order to accelerate through the chasm to the tipping point.

Key Opinion Leaders

The Tipping Point+

T
H
E
C
H
A
S
M

2.5%

13.5%

34%

34%

16%

Adoption Profile*

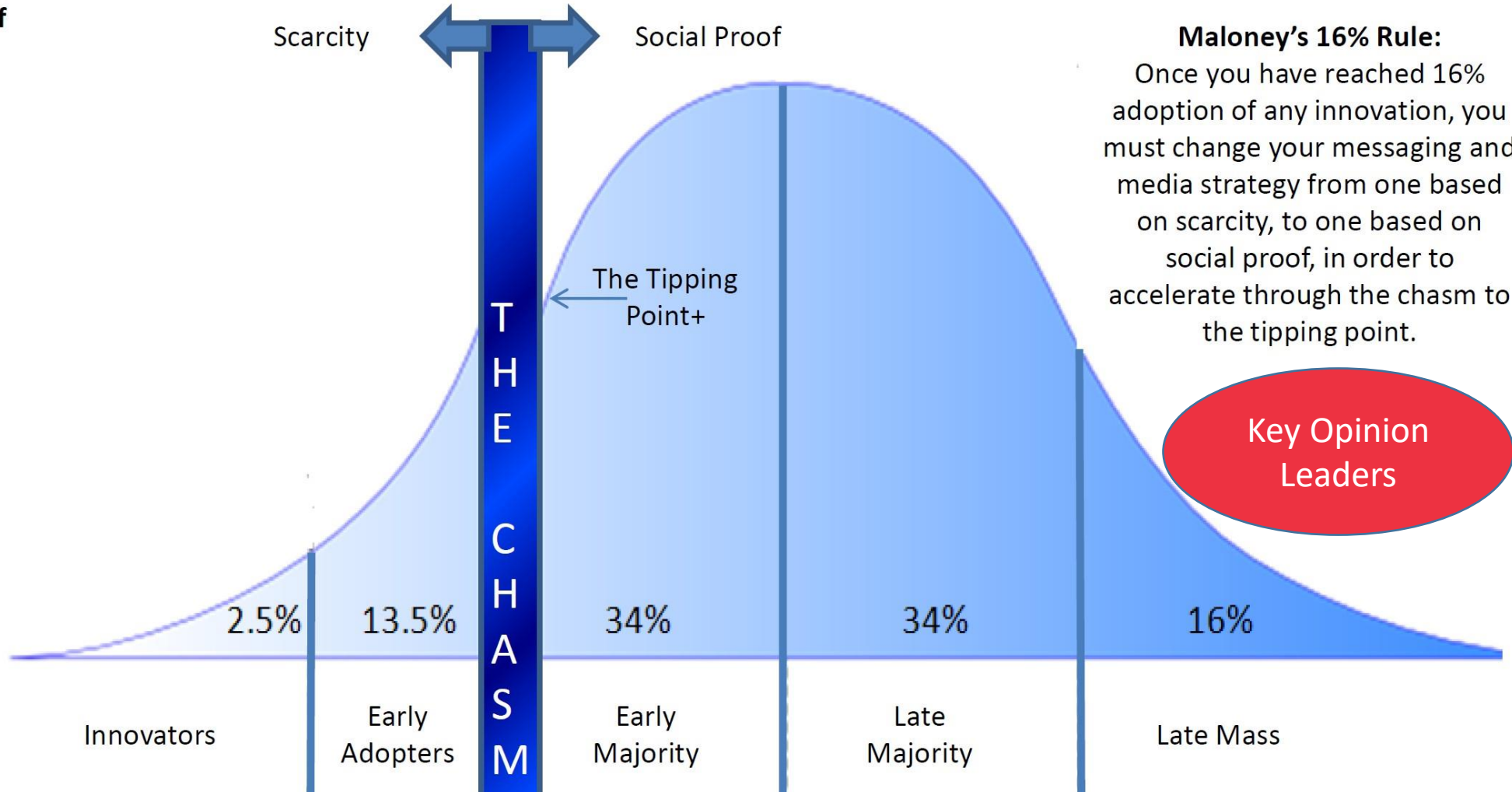
Innovators

Early Adopters

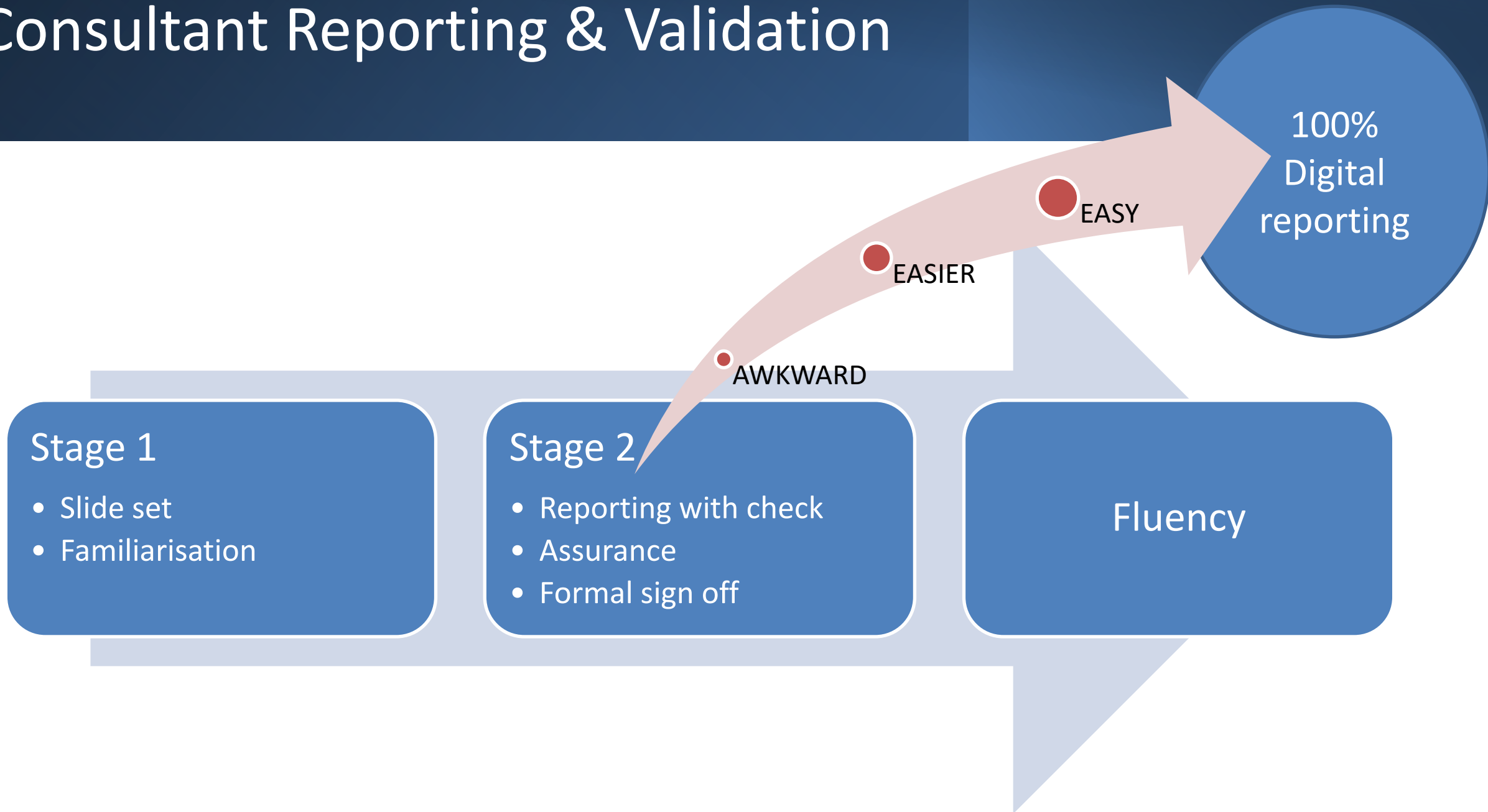
Early Majority

Late Majority

Late Mass



Consultant Reporting & Validation

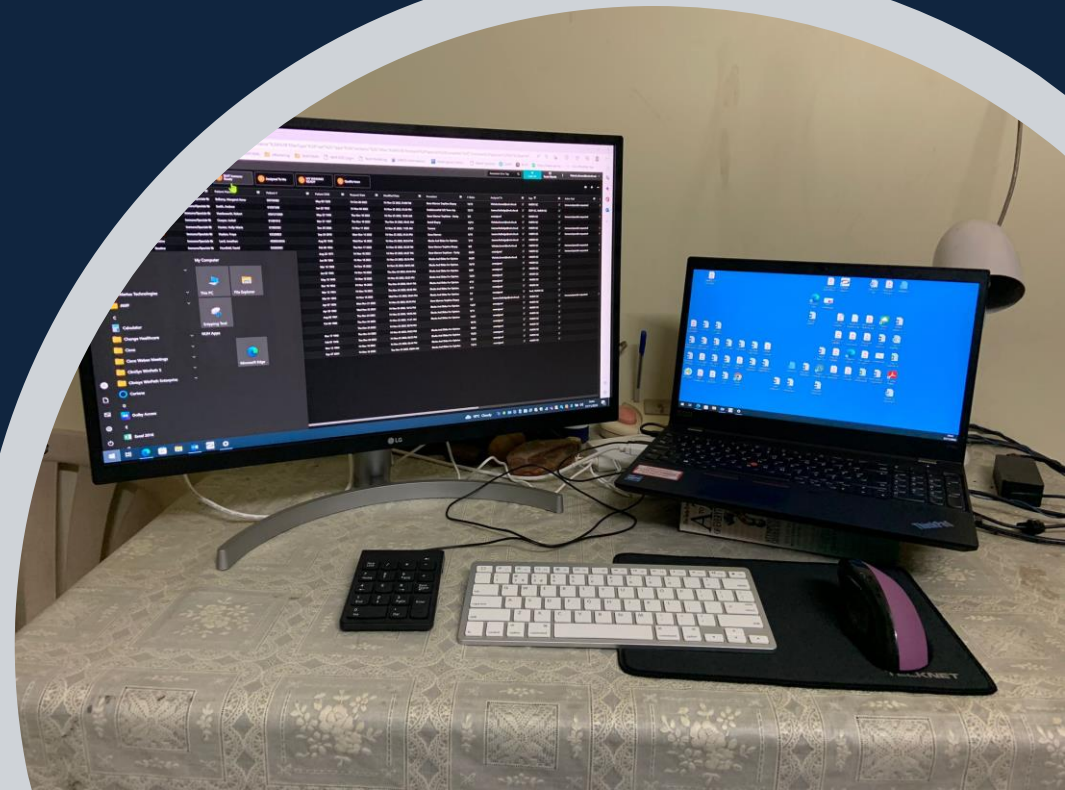


Moving to a virtual working environment

Grantham, England

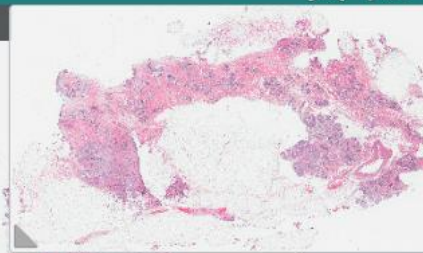
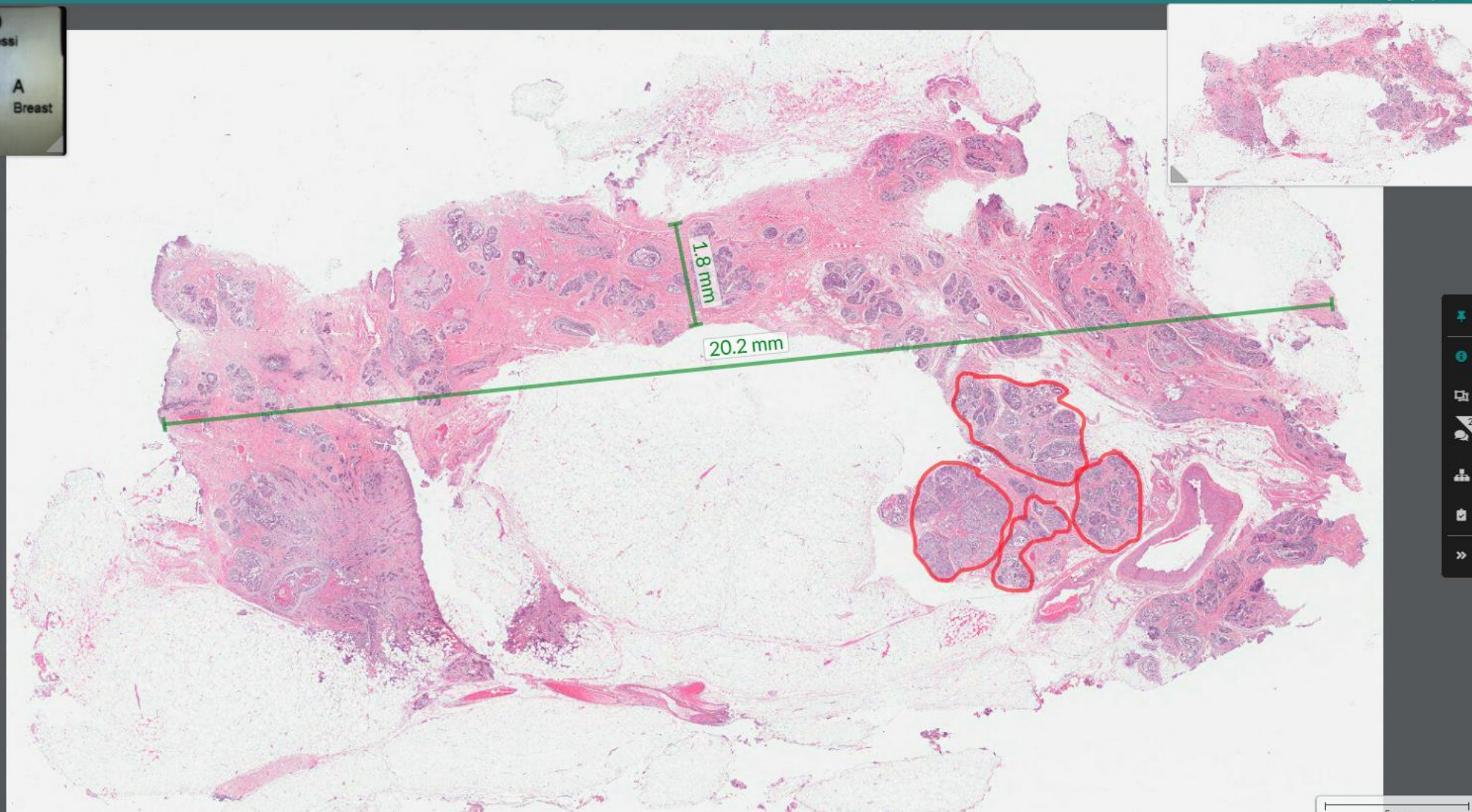
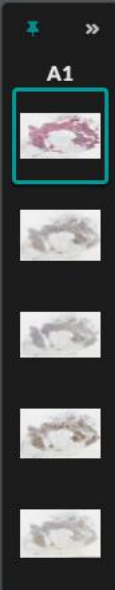


Nagpur, India



A1-1-H&E

S08-03009
Maria Rossi
H&E
A
Breast



Overview

Accession Id	S22-09108H
Priority	Routine
Status	Ready
Collaborators	Everyone
Assigned To	erunde@indicalab.com
Tags	Incr - IHC
Tumor Boards	Breast - Weekly

Reference

Requested	Fri Mar 18 2022
Facility	Vanderbilt University Medical C...
Physician	Dr. John Doe
Contact Info	john_doe@email.net 555-555-10...
Bench	Breast

Gross Specimen

Procedure	Biopsy
Site	Left Breast
Collected	Tue Jul 13 2021

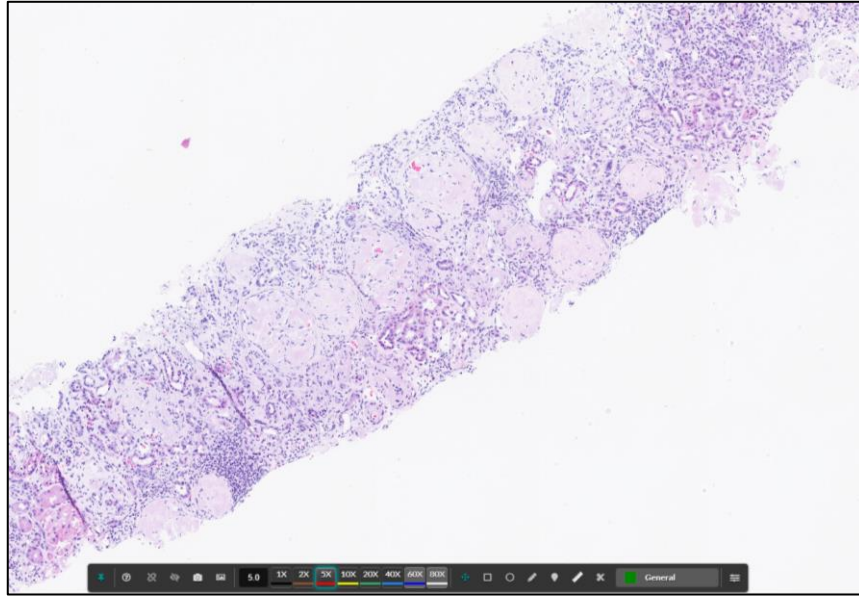
Solid mass with a variable consistency. Firm to hard, gray-white in appearance with yellow-white streaks of necrosis and foci of hemorrhage and some areas of cystic change. Some areas composed largely of neoplastic and inflammatory cells are soft and fleshy. Irregular or stellate outline with indistinct borders and a nodular configuration with well-circumscribed contours. Stellate tumor showing gray-white strands of tissue radiating into the surrounding fat.

Patient

Record #	10008000
Name	Jane Doe
DOB	Dec 23 1961

Case Study

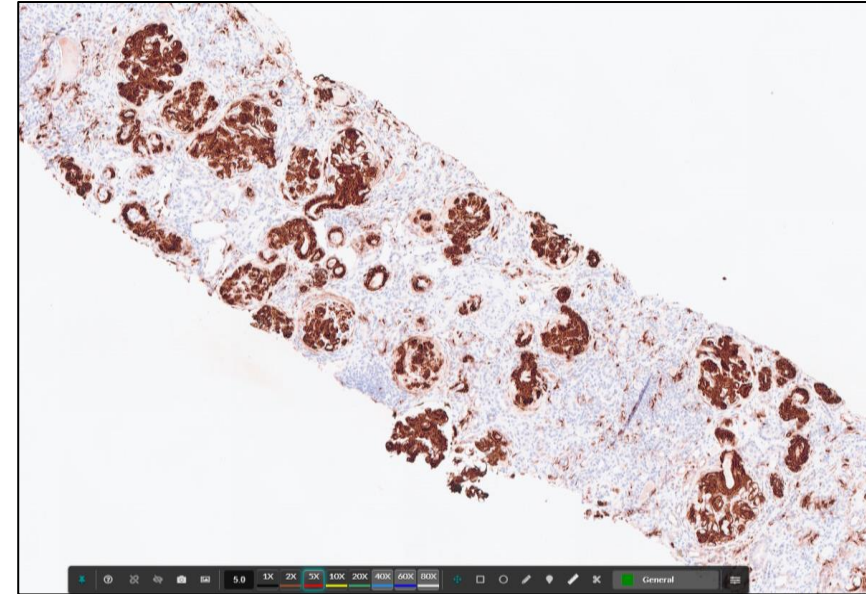
Diagnosis - Native Biopsy: Serum A amyloidosis



H&E

Amorphous pink material

Expansion of mesangium with nodules of eosinophilic material

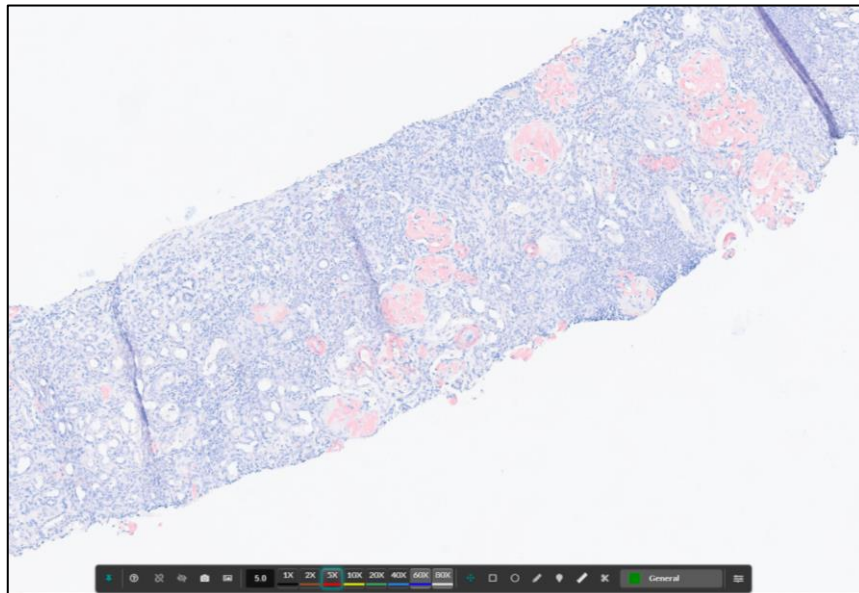


Serum Amyloid A

Immunohistochemistry

Nodules stain strongly positive for serum amyloid A

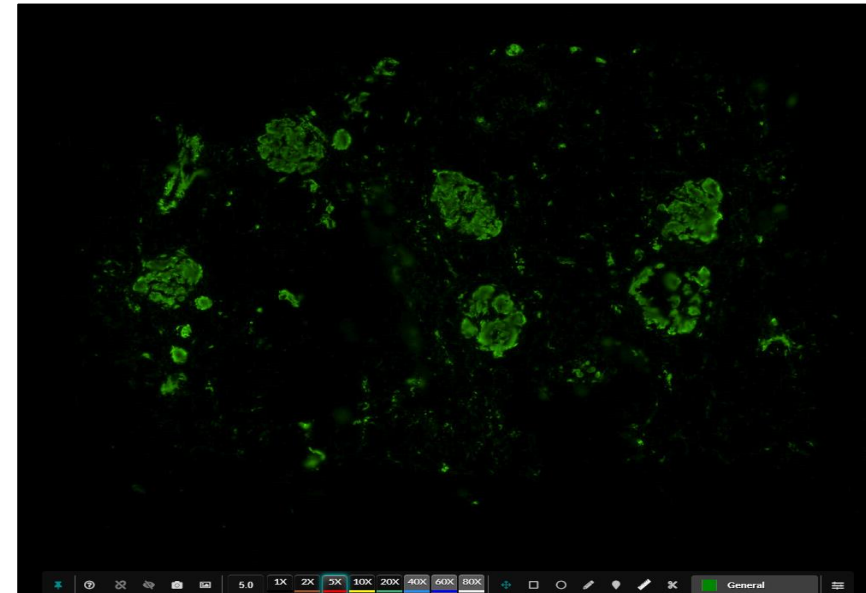
No mesangial, endocapillary or extracapillary proliferation



Congo Red

SPECIAL STAIN

Nodules are congo red positive



Immuno- fluorescence

Serum Amyloid A

6 glomeruli strongly positive (+3)

Systemic Problems (NHS-wide)



LIMS capability

NHS infrastructure old
Integration with IMS & AI
problematic



Pathologist Training

Transition from glass
to digital
RCPath exam still on glass.
Still need glass slides
for training



Future Funding

Trust business cases
Difficult NHS-wide financial
situation



Archive storage

Evolving models

Benefits



Greater Flexibility

- Faster review of cases
- Much easier 2nd opinions
- Home working
- Improved TAT



Productivity

- Falls during validation
- Rises with experience



Team Morale

- Sense of shared achievement
- Closer relationship between lab and consultants



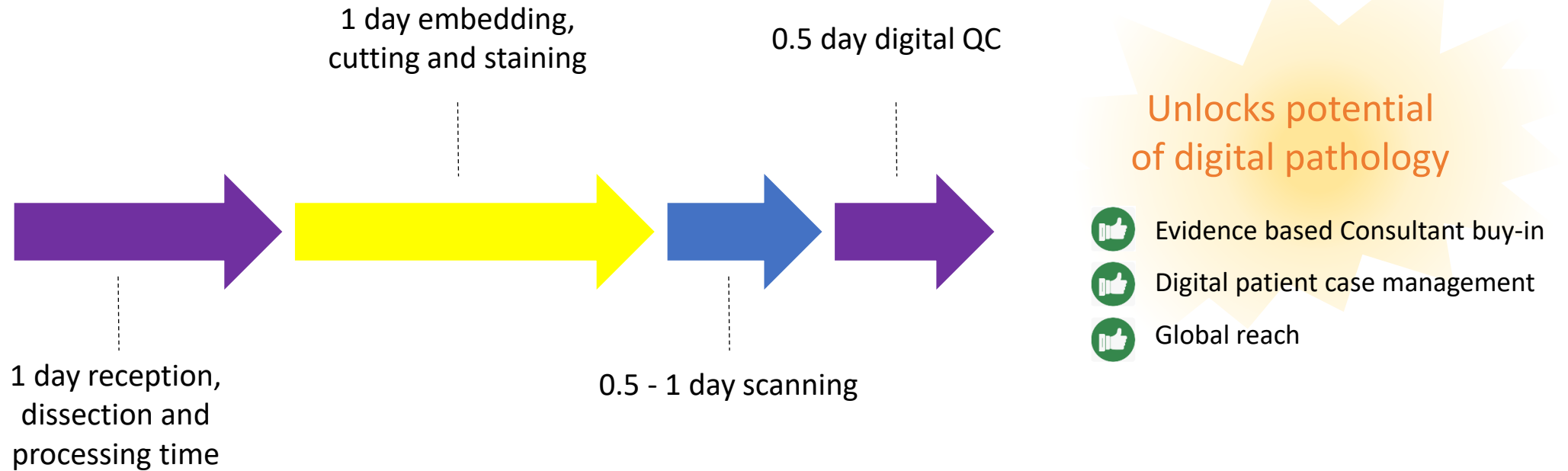
OUTCOME

Lean and Digital Workflow

Capacity and Demand Gains

Futureproofing

Lean Workflow



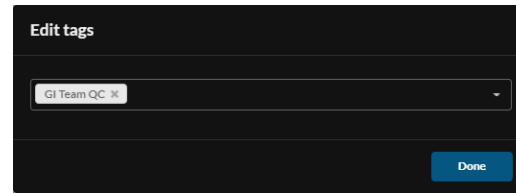
“The changes have allowed the team to see broad potential where traditional methods are now aligned with automation and digital capabilities. The new process standard provides rapid turnaround and ease of access for case review with the same quality methodology foundations. The process is now streamlined to allow expedited movement of specimens, improving day-to-day operation and ultimately the experience of the people we care for”

Nicole Crow, Biomedical Scientist

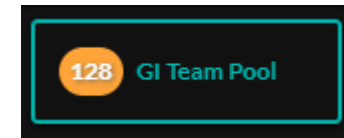
All specialities now report without glass.



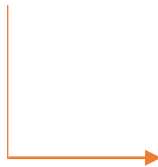
Digital Quality Control



Tag and sign out



Pathologists select cases from Case List



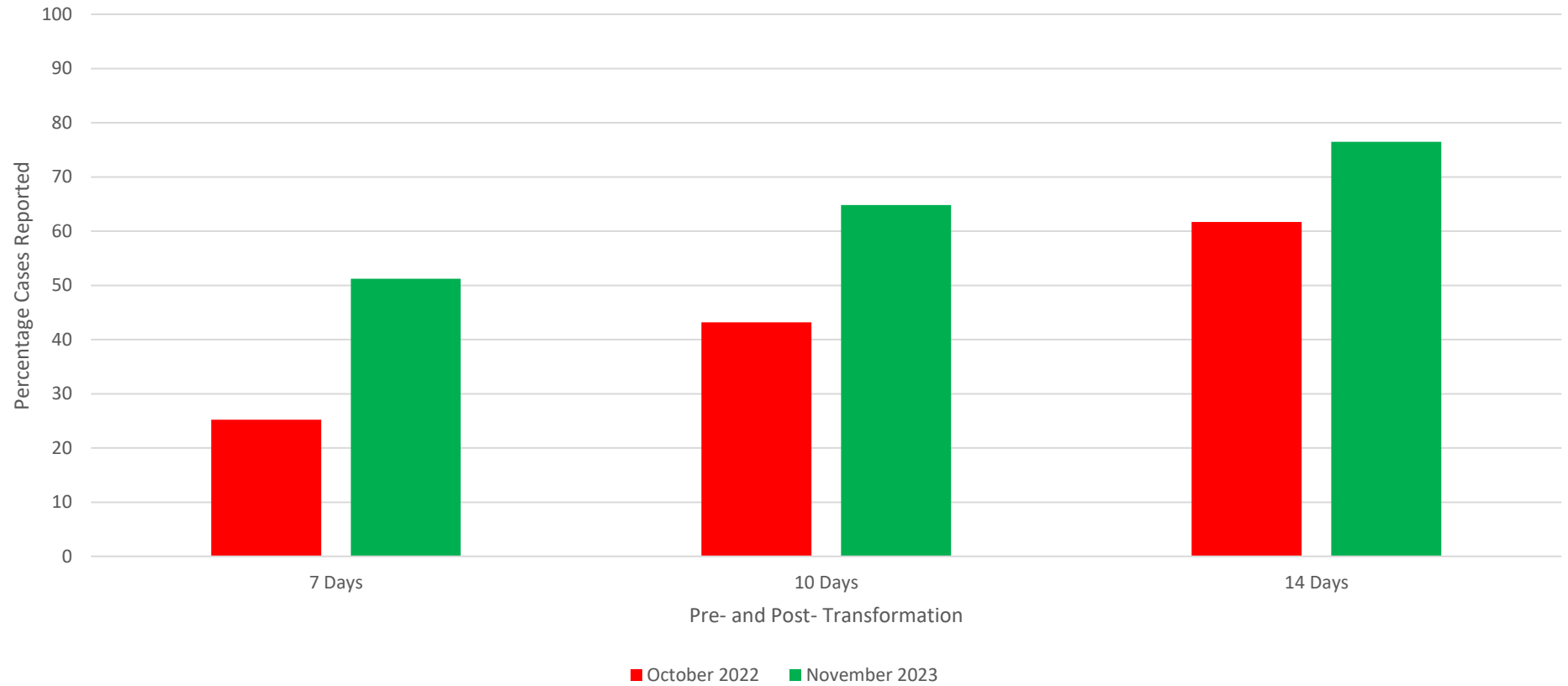
Request card and microscope slides to archive

- ✓ Reduced workflow steps
- ✓ Visual performance reviews
- ✓ Inter-discipline case management
- ✓ Digital Multi-disciplinary Team Meetings
- ✓ Digital referral case review
- ✓ Improved audit and troubleshooting trails

NUH Status Report

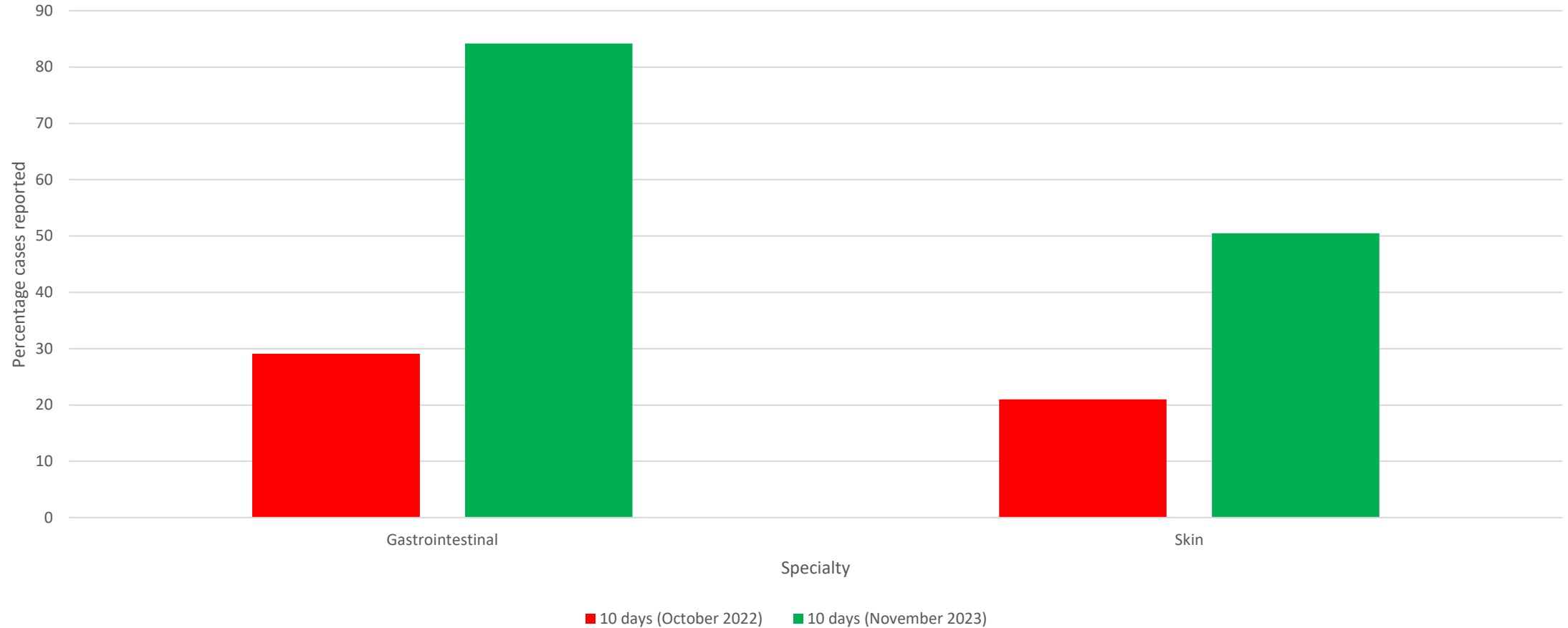
- 👍 UKAS Accreditation for primary diagnostic reporting acquired 2023
- 👍 100% Consultant Pathologists validated for digital reporting
- 🎯 Department forecast for glassless – April 2024

Comparison of Overall Cases Reported



Target	7 Days	10 Days	14 Days
October 2022	25.2%	43.2%	61.7%
November 2023	51.2%	64.8%	76.5%
Change	↑ 26%	↑ 21.6%	↑ 14.8%

Glassless Specialities - Before and After



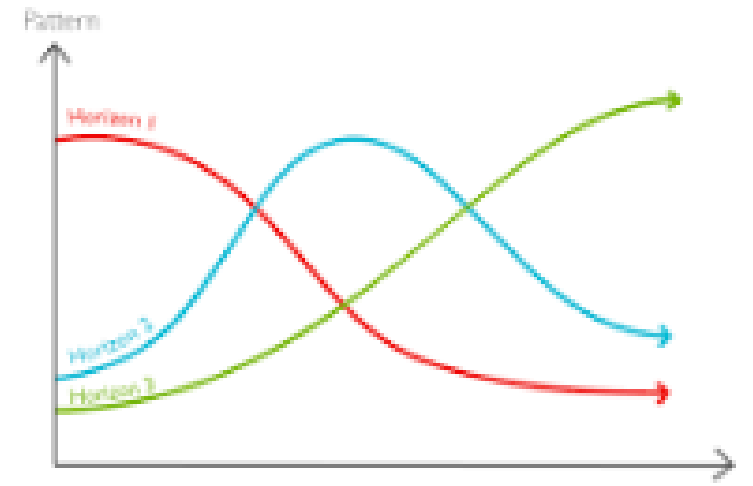
Speciality	GI	Skin
October 2022	29.1%	21.0%
November 2023	84.2%	50.5%
Change	↑ 55.1%	↑ 29.5%



**Reflection and
Future Thoughts**

Future Thoughts – Cellular Pathology Blueprint

- Adoption and integration of artificial intelligence
- Collection of measureable data to demonstrate and understand productivity and efficiency
 - Quality driven, sustainable, targeted
- Development and advancement of Biomedical Scientist and emerging workforce
 - Higher Scientific roles – Histopathology Reporting
 - Utilisation of artificial intelligence – molecular marking
 - Bioinformaticians, speciality digital services
- Diagnostic and clinical liaison roles and projects



SR1786-036
 Status ● Assessment Required

PATIENT John Doe DOB Jan 01 1950 (74y)
 MRN SP263-126 SEX Male

Previous Case Next Case Accession # Search cases

Case List Clinical Trials Tumor Boards Slides kmckinley@indicalab.com

1A-1-H&E

SR1786 - 036
 IIE
 CAPD_Letter

Off

Add Assay

- Lung Macrodissect AI v1.0
 - Algorithm Pre-Processing
 - Tissue Detection
 - Image QC
 - Benign Epithelial Detection
 - Benign Epithelial Nuclei
 - Tumor Detection
 - Tumor Density
 - Dissection Region

Results

1A-1-H&E

Total Cell Count, WSI	41,640
Tumor Cell Count, WSI	15,583
% Tumor Content, WSI	37.4
Total Cell Count, Dissection Area	17,042
Tumor Cell Count, Dissection Area	9,479
% Tumor Content, Dissection Area	55.6

Dissection Area

1A-1-H&E

% Tumor Content, WSI 37.4
 % Tumor Content, Dissection Area 55.6

1 mm

0.6 1X 2X 5X 10X 20X 40X 60X 80X

Approve Reject

Reflection

- **Actions speak louder than words**
- **Performed on no expenditure – In-house expertise**
- **We had to be brave – hold the majority**
- **Huge amounts of hidden potential**
- **Proud achievement**

Acknowledgements

- EWC
- Nottingham University Hospitals Laboratory Staff
- Indica Labs – Katie McKinley

Finally...

Any Questions?