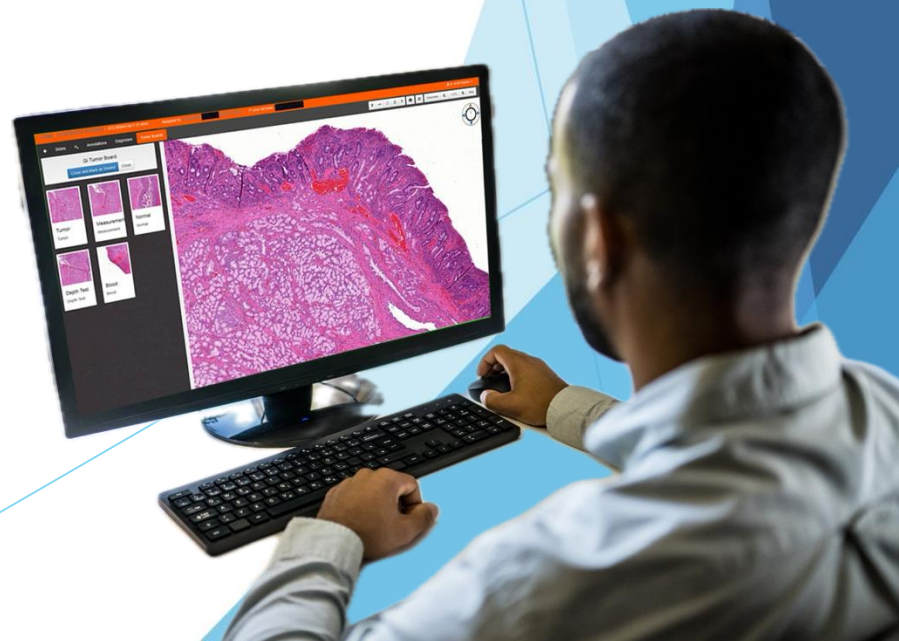
The Pursuit of Pixelated Perfection

….In the SW Peninsula Cancer network *and beyond*?

Dr. Tim Bracey MBChB BScHons PhD MRCS FRCPath
Consultant Pathologist, Royal Cornwall Hospital

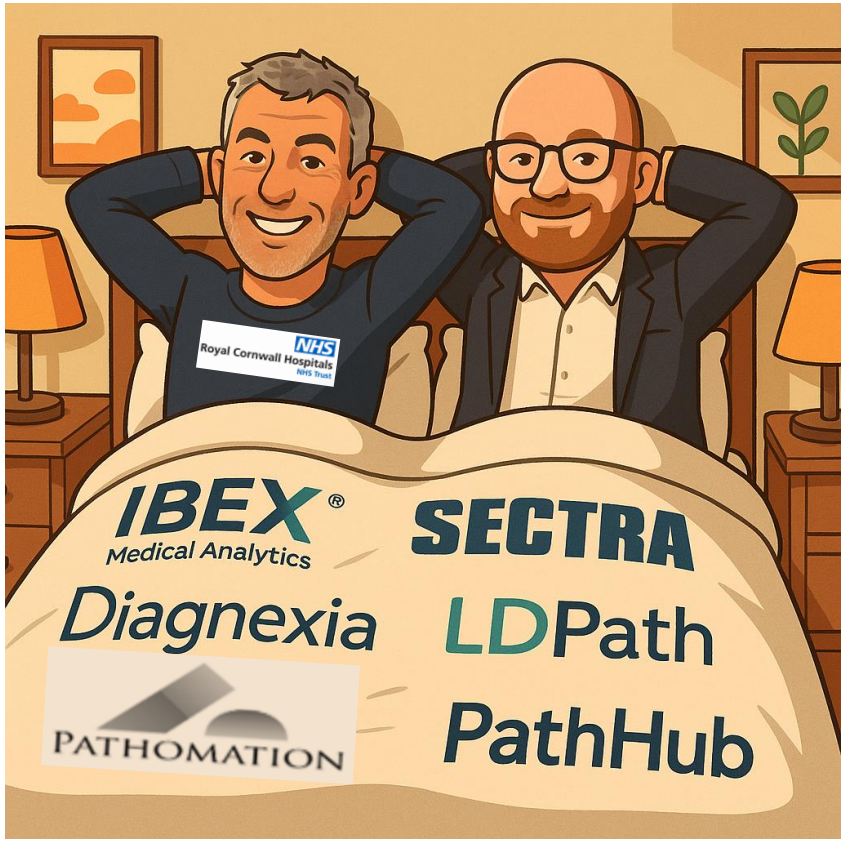


NHS
Royal Cornwall Hospitals
NHS Trust

NHS
Peninsula Pathology
NHS Network

Declaration of Competing Interest

“I have no competing financial interests or personal relationships that influenced the work reported in this presentation”

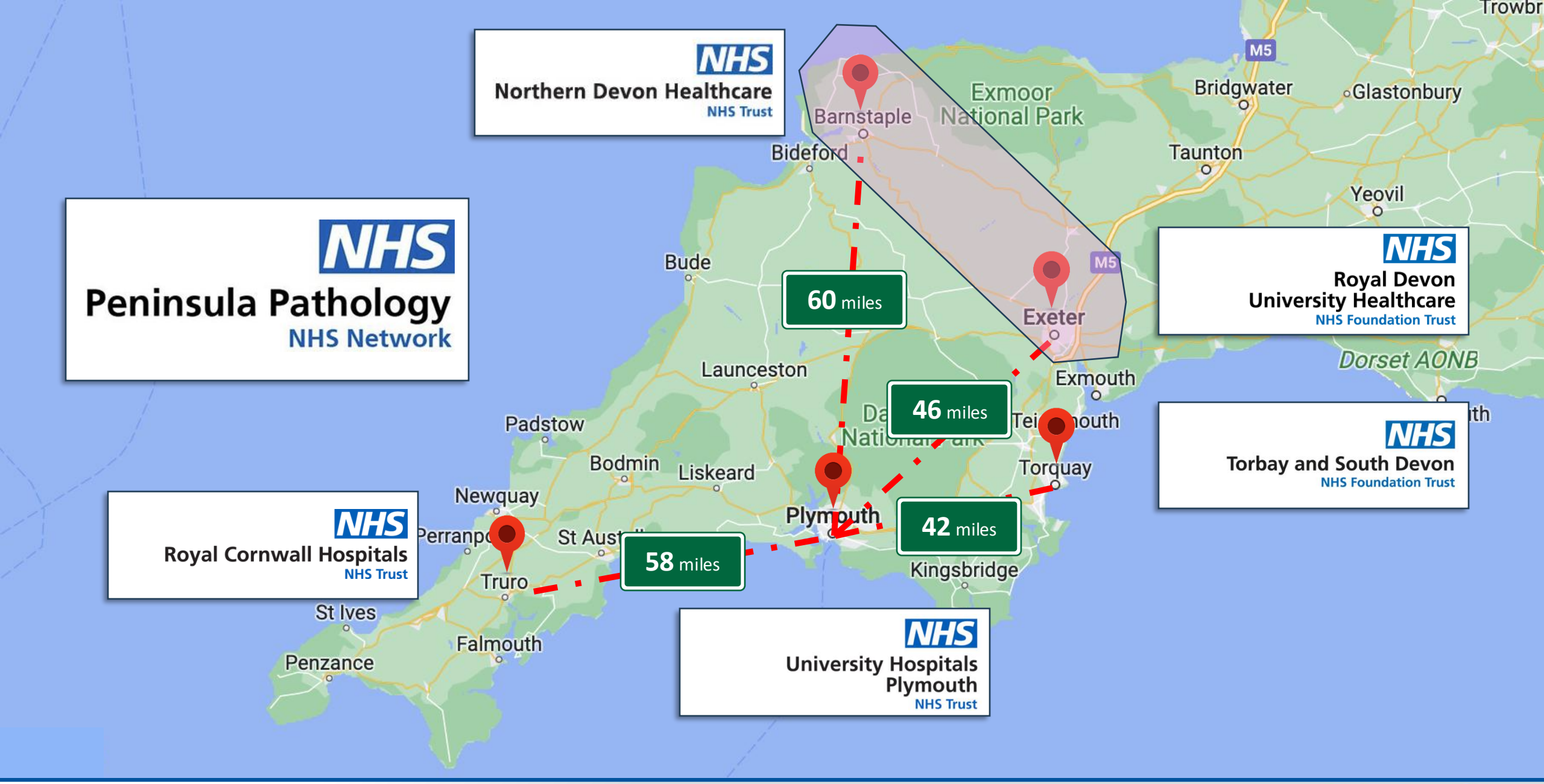


15 years ago. The early days of digital pathology

Royal Cornwall Hospitals NHS Trust

Devon and Cornwall SW Peninsula

Outstanding Care for One+All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Northern Devon Healthcare
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NHS
Royal Cornwall Hospitals
NHS Trust
NHS
University Hospitals
Plymouth
NHS Trust
60 miles
46 miles
42 miles
58 miles
Barnstaple
Bideford
Exmoor
National Park
Bridgwater
Glastonbury
Taunton
Yeovil
Exeter
M5
Bude
Launceston
Exmouth
Dorset AONB
Padstow
Bodmin
Liskeard
Newquay
Plymouth
Torquay
Truro
St Ives
Falmouth
Penzance
Kingsbridge

Specialist Team

The Plymouth Oesophago-Gastric Centre has a large team of specialists dedicated to providing first class care to patients with diseases of the oesophagus and stomach.

The team includes:

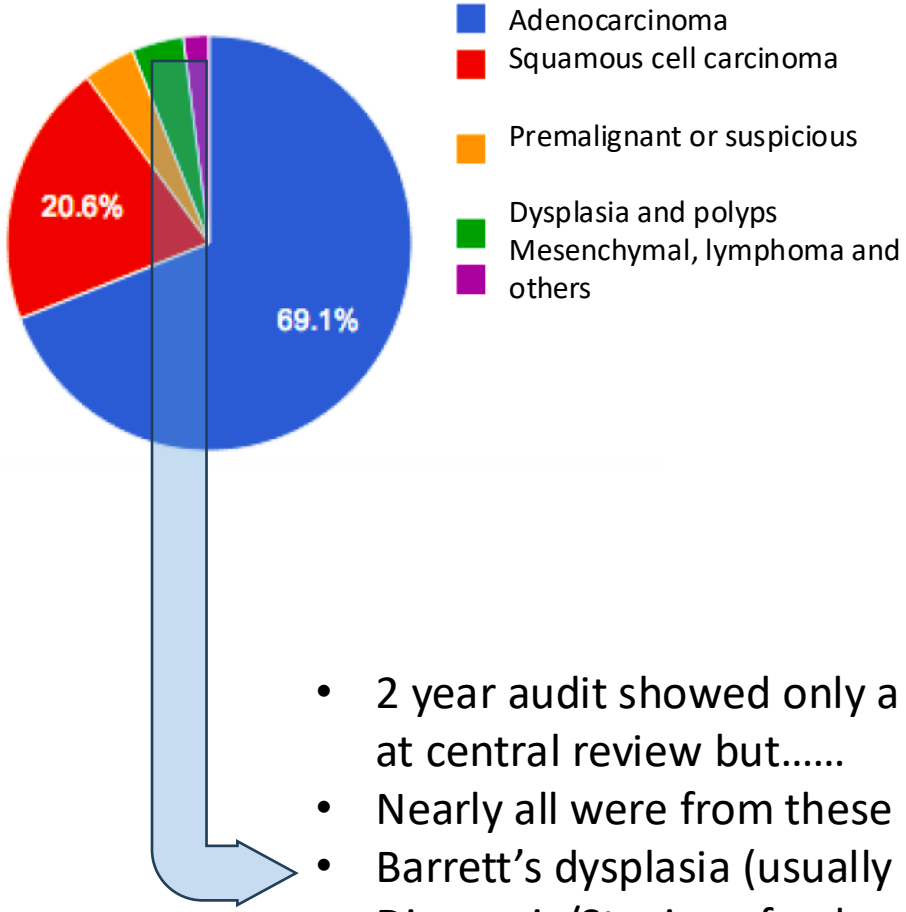
- Surgeons
- Oncologists
- Clinical Nurse Specialists
- Radiologists
- Histopathologists
- Anaesthetists
- Gastroenterologists
- Nurse Endoscopists
- MDT co-ordinators
- Dieticians
- Palliative care physicians

You can access some further information about these specialists by clicking on the links above.

UHP specialist services

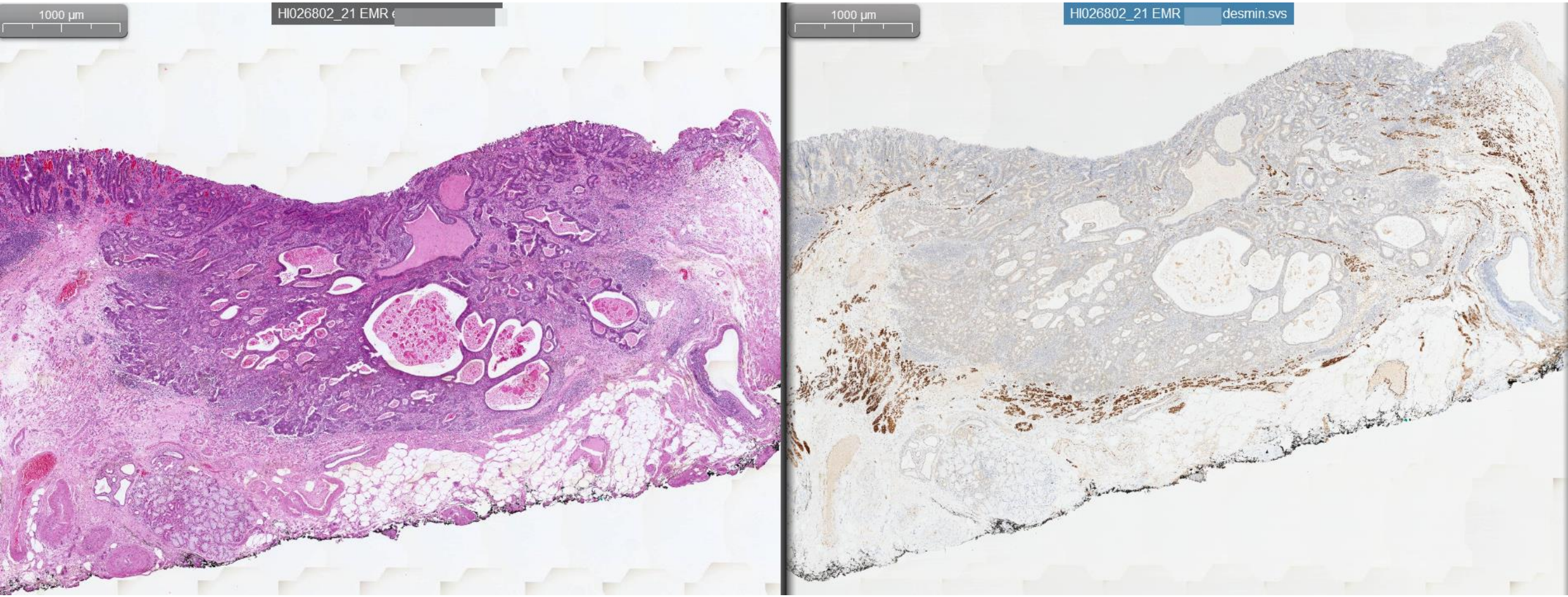
Upper GI
Liver and pancreas
Lung
Neurosurgery

Range of pathology encountered on biopsy

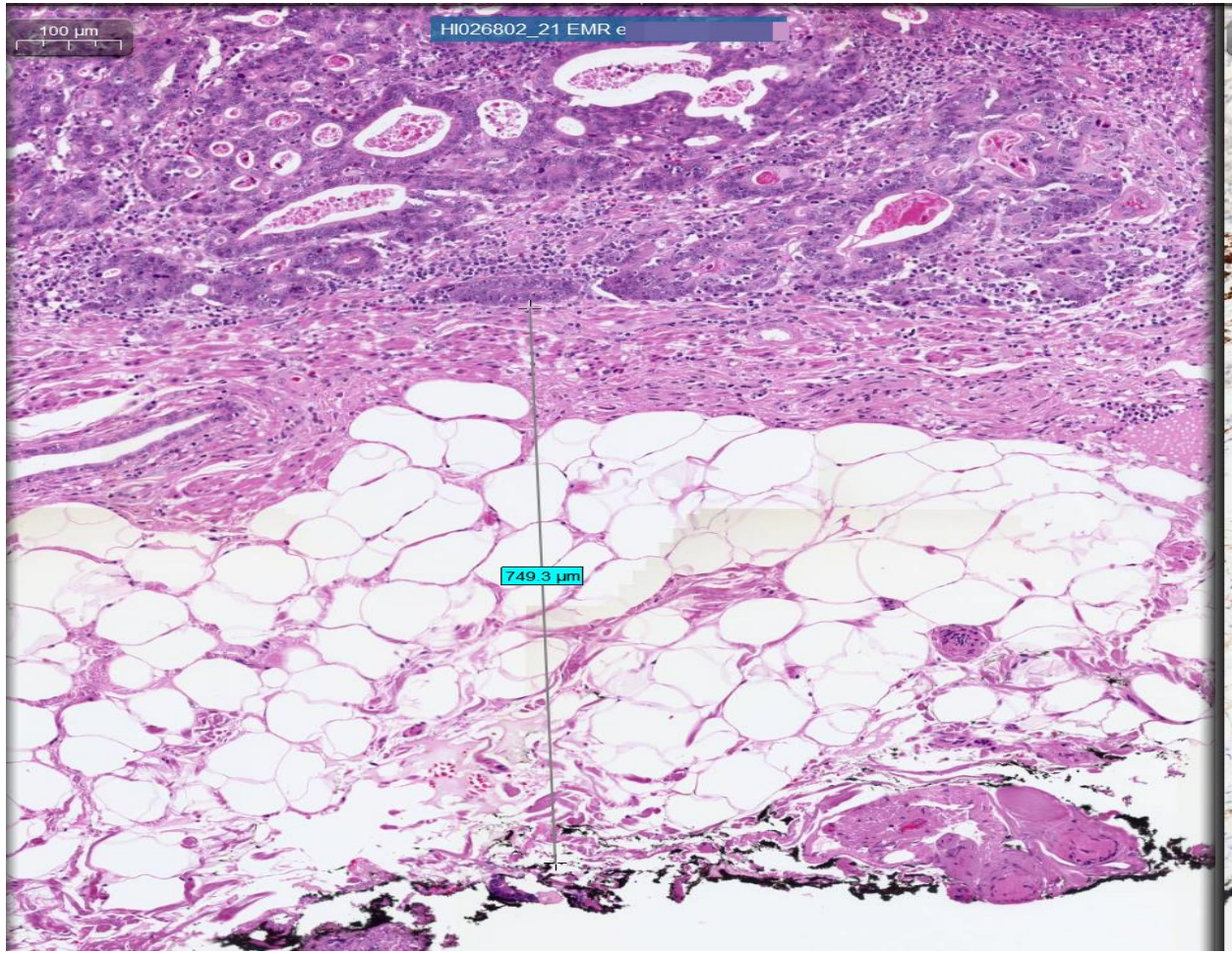


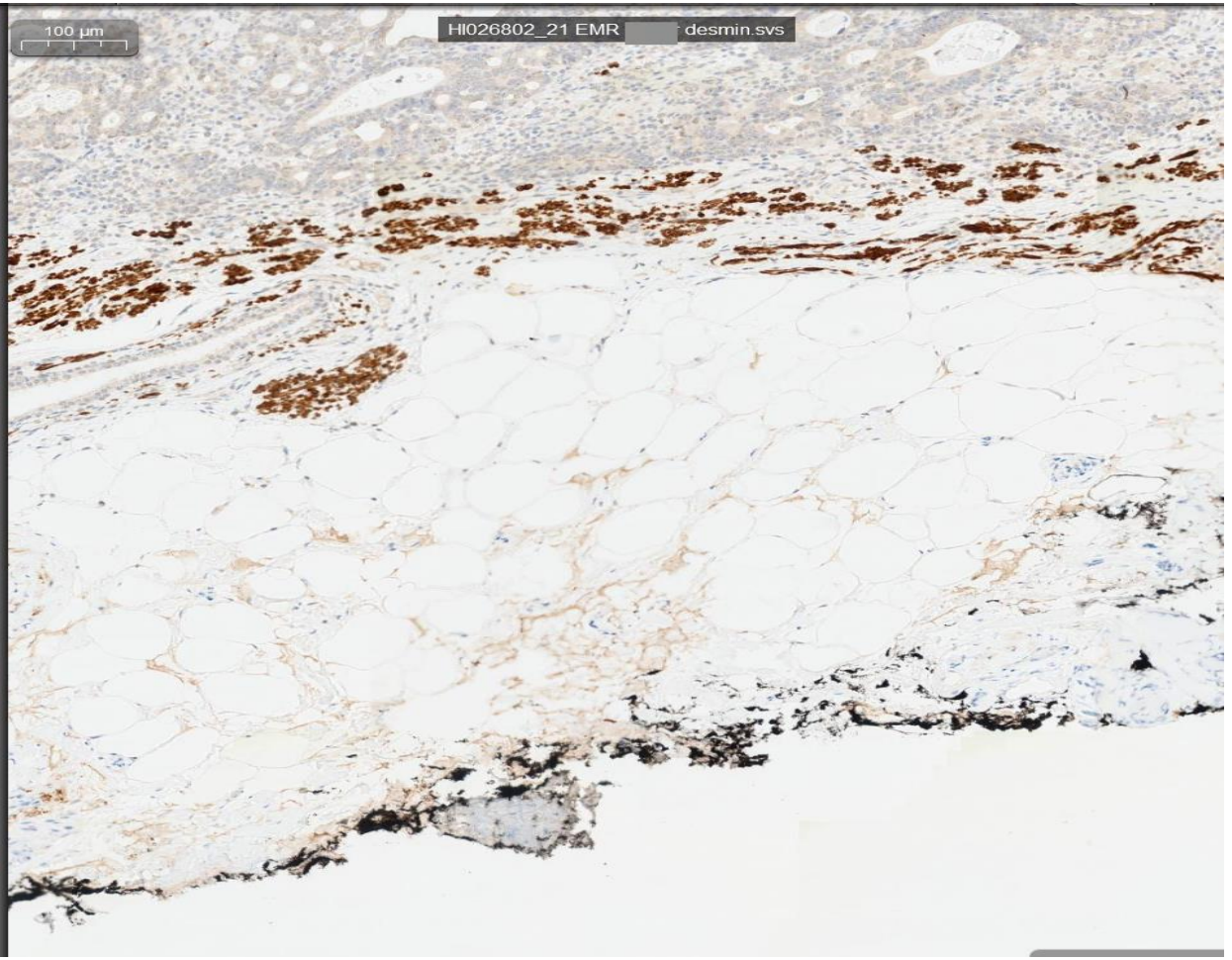
- 2 year audit showed only a 6% discordance at central review but……
- Nearly all were from these categories
- Barrett's dysplasia (usually downgraded)
- Diagnosis/Staging of polyps and early cancer
- Mesenchymal and Neuroendocrine lesions

EMR oesophageal adenocarcinoma

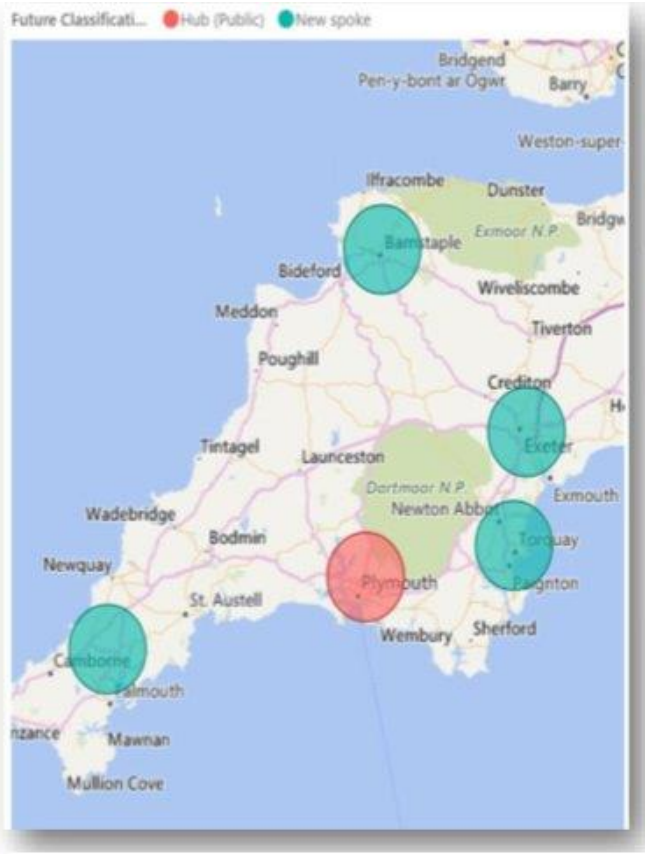


EMR reviewed and stage altered from T1b to T1a





2016: Sustainability transformation plans



TrustName	TrustCode	Status
PLYMOUTH HOSPITALS NHS TRUST	RK9	Hub (Public)
ROYAL DEVON AND EXETER NHS FOUNDATION TRUST	RH8	New spoke
ROYAL CORNWALL HOSPITALS NHS TRUST	REF	New spoke
NORTHERN DEVON HEALTHCARE NHS TRUST	RBZ	New spoke
TORBAY AND SOUTH DEVON NHS FOUNDATION TRUST	RA9	New spoke

TrustName	Future Cla...	Sites 24/7	Total Cost	Total FTE	Total Tests
PLYMOUTH HOSPITALS NHS TRUST	Hub (Public)	1.00	£18,376,247.00	220	7,449,690.00
ROYAL CORNWALL HOSPITALS NHS TRUST	New spoke	1.00	£18,435,861.80	183	6,973,304.00
TORBAY AND SOUTH DEVON NHS FOUNDATION TRU...	New spoke		£9,497,000.00	84	6,403,656.00
ROYAL DEVON AND EXETER NHS FOUNDATION TRUST	New spoke	1.00	£20,002,089.30	214	6,318,501.00
NORTHERN DEVON HEALTHCARE NHS TRUST	New spoke	1.00	£6,702,764.00	75	5,353,434.00
Total		**4.00**	**£73,013,962.10**	**776**	**32,498,585.00**

TrustName	Cost of Current Ops	Cost of Hub Future	Cost of Referrals to Hub	Cost of Spoke Labs	Cost of Consolidated Service	Consolidation Saving
PLYMOUTH HOSPITALS NHS TRUST	11,274,118.00	10,639,290.00			10,639,290.00	634,828.00
NORTHERN DEVON HEALTHCARE NHS TRUST	4,213,964.00		2,376,396.94	1,350,541.62	3,726,938.55	487,025.45
ROYAL CORNWALL HOSPITALS NHS TRUST	9,279,709.00		6,175,481.03	1,655,531.39	7,831,012.43	1,448,696.57
ROYAL DEVON AND EXETER NHS FOUNDATION TRUST	12,381,037.90		7,993,219.06	1,740,639.29	9,733,858.35	2,647,179.56
TORBAY AND SOUTH DEVON NHS FOUNDATION TRUST	5,764,000.00		3,604,429.27	930,721.57	4,535,150.84	1,228,849.16
Total	**42,912,828.90**	**10,639,290.00**	**20,149,526.29**	**5,677,433.87**	**36,466,250.16**	**6,446,578.74**

Summer 2017: NHS Improvement proposed pathology networks

Digital Pathology and AI are the Icing on the cake

2017: We were offered a managed DP system ….. Which never materialised!

“The money always appears at times of crisis (*and scandal!*)”
Dr MEF Smith Consultant Pathologist MD PhD (retired 2020)

2018…..more trouble on the horizon?

No not COVID (yet)…..but the unexpected arrival of this guy meant Bracey senior had to relocate to Cornwall!

Losing staff freed up some money

Glissando slide scanner procured for liver service

UHP to RCHT link

Tuesday afternoon - in person
UGI and H&N support
Thursday - remote OGSMDT

The Nomadic Digital Pathologist (Bracey, 2022)

•The use of a simple slide scanner with remote viewing software to enable continuation of a specialist role (OGSMDT) after relocating within the Southwest UK Peninsula cancer network.

Key Findings:

•Digital pathology (DP) was used to report or review 44 cases (10% of annual OGSMDT workload) remotely, maintaining diagnostic confidence equivalent to traditional glass slide methods.

•No significant discrepancies were identified between digital and glass slide diagnoses.

•**Advantages:**

•Enabled continued specialist participation despite relocation.

•Improved efficiency in case review and reporting.

•Demonstrated feasibility of integrating DP into existing workflows with minimal infrastructure.

•**Challenges:**

•Lack of automation and integration with LIMS.

•Variations in slide staining and section thickness across different hospitals required adaptation.

•Limited lab staff capacity for scanning cases on demand

•System only worked on hospital grounds

•IT security teams did not allow slide labels to be viewable

Contents lists available at ScienceDirect

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The Nomadic Digital Pathologist. Validation of a simple, dual slide scanner with remote reporting for a regional upper gastrointestinal specialist multidisciplinary meeting

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ARTICLE INFO

Keywords:
Cancer multidisciplinary team
Remote diagnosis
Digital pathology
Whole Slide Imaging
UK cancer networks
NHS
Esophagus
Stomach
Cancer
Histopathology
Cell biology
Dysplasia
Carcinoma
Specialist
COVID19

ABSTRACT

Background: This article describes how a simple slide scanner with remote viewing software enabled a remote "nomadic" pathologist to continue his role as specialist lead for a regional gastrointestinal multidisciplinary team meeting (MDTM) after relocating to another site in the 5 hospital Southwest UK Peninsula cancer network just prior to the COVID-19 pandemic.

Materials and methods: The author used digital pathology (DP) to supplement a conventional workflow as a way of minimising delay in reporting and reviewing slides for a regional specialist Oesophagogastric MDTM (the OGSMDT). The specialist centre at University Hospital Plymouth (UHP) is 58 miles from the author's new workplace at Royal Cornwall Hospital (RCHT). Slides from the 44 cases (10% of this specialist annual workload) in this validation study were reported or reviewed digitally using the slide scanner. All were listed for the OGSMDT due to being clinically suspicious for upper gastrointestinal malignancy, having been processed at UHP, or one of the other hospitals in the cancer network.

Results: The scanner allowed the author who was only on site at UHP 1 day per week to prevent delays in reporting/reviewing glass slides, using remote DP. Confidence in digital diagnosis was assessed using the Royal College of Pathologists recommendations. The author was the primary pathologist signing out 31, and second opinion for the remaining 13 cases. These comprised a mixture of biopsies as well as endoscopic and surgical excision specimens. The DP system enabled the author to report the cases digitally with an equivalent degree of confidence to glass slides and no significant discrepancies were identified between the author's digital and final glass slide diagnosis.

Conclusions: The scanner was found to be safe and effective for remote reporting and review for OGSMDT cases. It was recognised that DP was advantageous to enable this role to continue remotely but that a fully integrated digital reporting system capable of high-capacity scanning would be preferable to the simple system used.

Introduction

Digital pathology (DP) is the general term used for the scanning of glass slides to produce high quality digital images in histopathology.[1] Previous international studies have demonstrated non-inferiority of DP whole slide images (WSI) compared with a conventional workflow,[2,3] but widespread adoption of this technology in the UK has been slow despite advantages demonstrated by early adopters.[4,5] Expensive equipment, ongoing subscription, and digital storage costs may be difficult to justify in DP business cases, but since home and remote working has become more commonplace, the argument for implementation of this technology is more persuasive.

The OGSMDT takes place at University Hospital Plymouth (UHP) each Thursday, and involves discussion of the clinical, endoscopic, pathology, and imaging findings relating to patients from the 5 South West England Peninsula hospitals (UHP, RCHT, Exeter, North Devon in Barnstaple, and South Devon in Torbay). The other 4 hospitals have their own local MDTs, listing their suspected or confirmed oesophageal and gastric cancer patients for the OGSMDT once basic diagnostic workup is complete. While most of the diagnostic workup is performed locally at the peripheral hospital, tissue diagnoses and pre-treatment staging are expected to be finalised at the OGSMDT prior to definitive oncological and or surgical management. All radical surgery is performed at UHP, and there is consequently considerable time pressure to prepare and transport the relevant material and information from the peripheral hospitals (situated between 42 and 61 miles away; at least 50- to 95-min drive without traffic) to enable prompt MDT discussion and surgical planning (see Fig. 1).

The author had been the regional pathology lead for OGSMDT since 2011 while working full time at UHP. On relocating to Royal Cornwall

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Feasibility of Multisite Networked Digital Pathology in England (Mayall et al, 2022)

•*Evaluated remote digital pathology reporting across South West NHS sites during the COVID-19 pandemic.*

•Utilized the FreeDPath platform to enable pathologists to report a range of mainly routine cases remotely on digital slides.

Key Findings:

•Even Pathologists with minimal prior digital experience achieved good diagnostic accuracy and allowed for easy second opinions on more challenging cases.

•Talking Point copied reports from FDP into the TST LIMS

Challenges:

- Some perceived DP as slower than glass slide reporting.
- Despite payment incentives difficult to find pathologists with available time for remote digital reporting.
- Firewalls and VPN access required changing platform during the project….

- Despite challenges, all pathologists developed a positive perception of digital pathology and expressed a desire to continue its use.

NHS Peninsula Cancer Alliance supported the project and funded more scanners

A Feasibility Study of Multisite Networked Digital Pathology Reporting in England

Frederick George Mayall[1], Hanne-Brit Smethurst[2], Leonid Semkin[3], Trupti Mandalia[3], Muhammed Sohail[4], Rob Hadden[5], Leigh Biddlestone[6]

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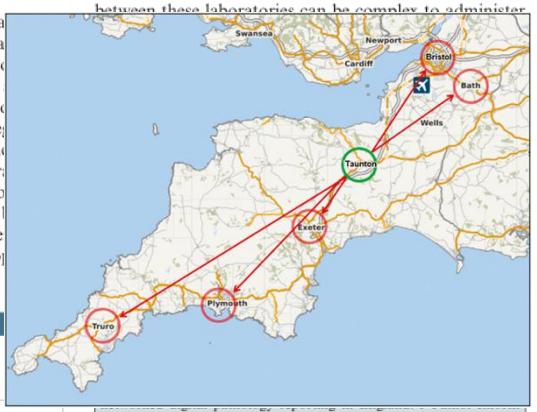
Abstract

Background: The objective of the project was to evaluate the feasibility of introducing a single-networked digital histopathology reporting platform in the Southwest Peninsula region of England by allowing pathologists to experience the technology and recording their perceptions. This information was then used in planning future service development. The project was funded by the National Health Service (NHS) Peninsula Cancer Alliance and took place in 2020 during the COVID-19 pandemic. **Materials and Methods:** Digital slides of 500 cases from Taunton were reported remotely in Truro, Plymouth, Exeter, Bristol, or Bath by using a single remote reporting platform located on the secure Health and Social Care Network (HSCN) that links NHS sites. These were mainly small gastrointestinal, skin, and gynecological specimens. The digital diagnoses were compared with the diagnoses issued on reporting the glass slides. At the end of the project, the pathologists completed a Google Forms questionnaire of their perceptions of digital pathology. The results were presented at a meeting with the funder and discussed. **Results:** From the 500 cases there were nine cases of significant diagnostic discrepancy, seven of which involved the misrecognition of *Helicobacter pylori* in gastric biopsies. The questionnaire at the end of the project showed that there was a general agreement that the platform was easy to use, and the image quality was acceptable. It was agreed that extra work, such as deeper levels, was easy to request on the software platform. Most pathologists did not agree that digital reporting was quicker than glass slide reporting. Some were less confident in their digital diagnoses than glass diagnoses. They agreed that some types of specimens cannot easily be reported digitally. All users indicated that they would like to report at least half of their work digitally in the future if they could, and all strongly agreed that digital pathology would improve access to expert opinions, teaching, and multidisciplinary meetings. It was difficult to find pathologists with time to undertake remote digital reporting, in addition to their existing commitments. **Conclusions:** Overall, the pathologists developed a positive perception of digital pathology and wished to continue using it.

Keywords: Cancer diagnosis, digital pathology, information technology, software

Background

In the United Kingdom, most cellular pa
laboratories are run by the state-owned NHS, usua
NHS hospital site. The legal entity that owns and
these laboratories is usually an NHS trust. This is
sector body with responsibility for the provision
funded health care in a particular geographic re
occasionally a highly specialist area of care. Typi
NHS trust will operate only one pathology labor
support its health-care activities. Despite these labo
all being state-owned and funded, sharing work
them is difficult as they are managed indepe
usually with no shared staff. In addition, they o
wide variety of different laboratory information
that are not interconnected. Transportation of glass slides
between these laboratories can be complex to administer



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2022:13:4.
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x1

https://ibex-ai.com/resource/dr-tim-bracey-the-coastal-path-to-artificial-intelligence-in-digital-pathology/

2024 audit / pilot study at RCHT comparison of glass vs digital external opinion referrals

- In one calendar year 81 cases were sent away (57 glass, 24 digital). Anonymous *Pathomation* links via NHS email
- Similar mix of cases in both groups with some very rare and difficult subspeciality cases in both groups
- Many of the same experts were approached for glass and digital so TAT differences can't be explained by carefully choosing rapidly replying experts for digital cases
- More than 20 day improved TAT using the digital method

Table 1: List of cases including tissue type, turnaround times and expert locations

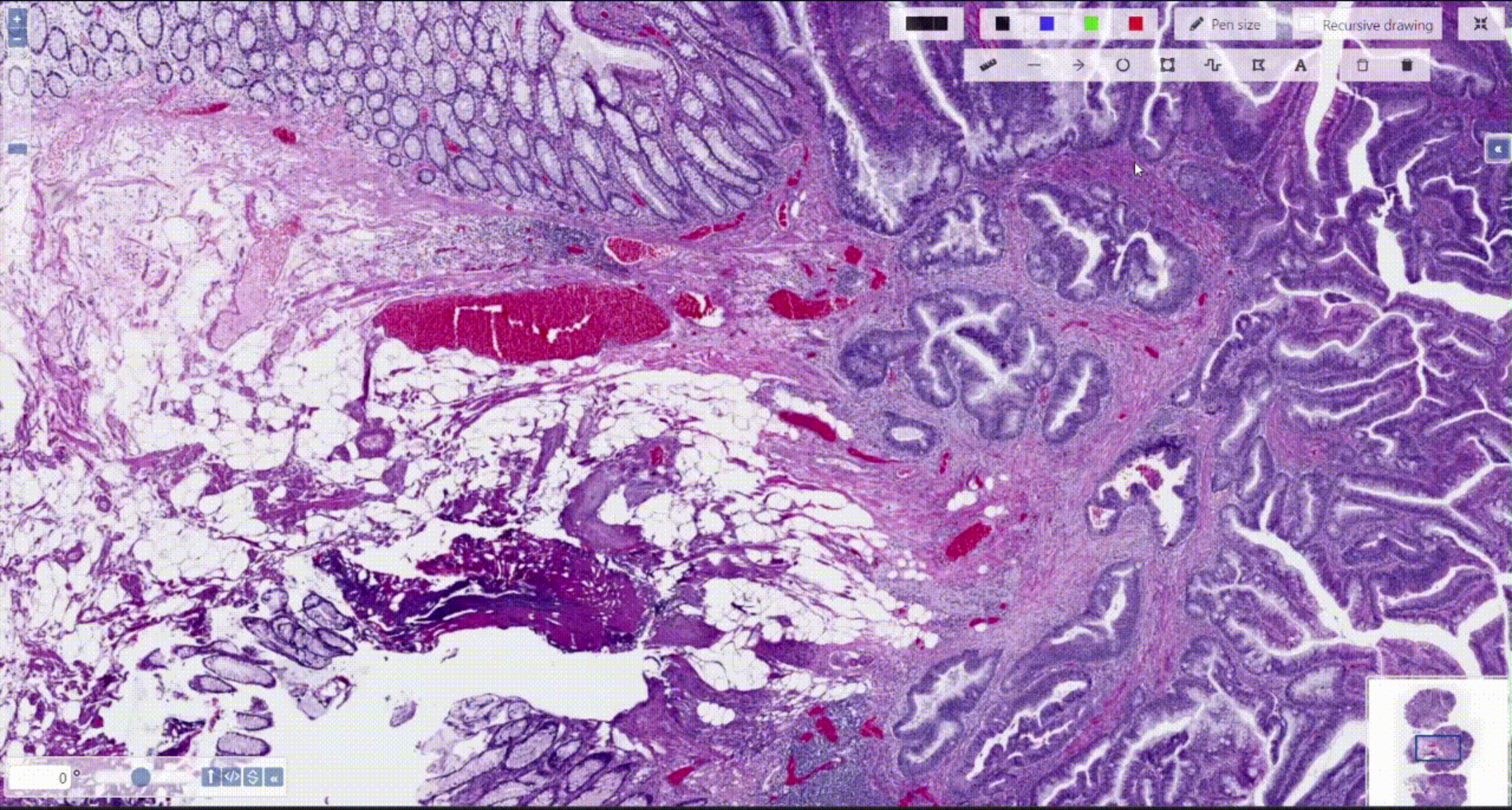
Subspeciality/ tissue type	Cases (glass)	Cases (digital)	Locations (Glass)	Locations (Digital)
Soft tissue & osteoarticular	19	4	Plymouth, Bristol, London, Oxford	London, Sheffield, Bristol
Skin	16	1	London	Sheffield
Gynaecological	7	3	Birmingham, Exeter	Birmingham, Exeter
Gastrointestinal inc. HPB	5	7	Southampton, London, Plymouth	Southampton, Bristol, Cheltenham
Head and neck	4	7	London, Sheffield	London, Sheffield
Lymphoreticular	3	1	London	Oxford
Endocrine	3	1	Portsmouth	North Tees
Average TAT days (range min to max)	24 (5-71)	3 (1-12)		

Table 2: Perceived advantages and disadvantages of digital vs glass expert opinions

Advantages of Digital Second Opinion	Disadvantages c/w Glass Slide Method
• Rapid turnaround time critical particularly for malignant diagnoses. • Referrer and expert can view slides simultaneously in different locations allowing an interactive learning experience. • Additional experts can see the same slides at different locations allowing multiple expert consensus. • Physical slides do not leave the referrer's department so there is no risk of loss or damage so no delay to local MDT review. • Remote mentoring to enable development of local expertise. • Remote expert can rapidly respond to communicate unavailability or unwillingness to give a digital opinion if necessary.	• Additional time investment for the referring pathologist. • May be less acceptable to some remote experts who do not know the referrer. • Referral may want a more "formally documented opinion". • Remote experts may be less familiar and not confident with digital slide technology. • Remote experts may not have a mechanism for recording and justifying the DCC time dedicated to digital opinions. • Additional costs of high quality equipment and digital slide storage. • Technical hurdles include ring-fenced NHS IT infrastructure and tendency of NHS to choose "on prem" solutions. • Current lack of a national NHS full interconnected digital pathology system.

Comments from remote experts

increasingly passionate about using digital pathology for external second opinions, and several of the remote experts have made it clear they also prefer this method, stating reasons like "*avoiding desk clutter*", discussing the case in context with the local team while the "*details are fresher in our minds*", and "*not having to wait for glass slides*" to arrive. Another expert colleague said "*when glass slides arrive for second opinions, I just cannot bring myself to open the damn boxes, arrange them on my desk in order, match the IHC, etc. There's too much payload in the prep before seeing the case. With digital, the case can be opened with just a click of the link, there's no desk clutter and hence there's no brain clutter. It's all so straightforward.*"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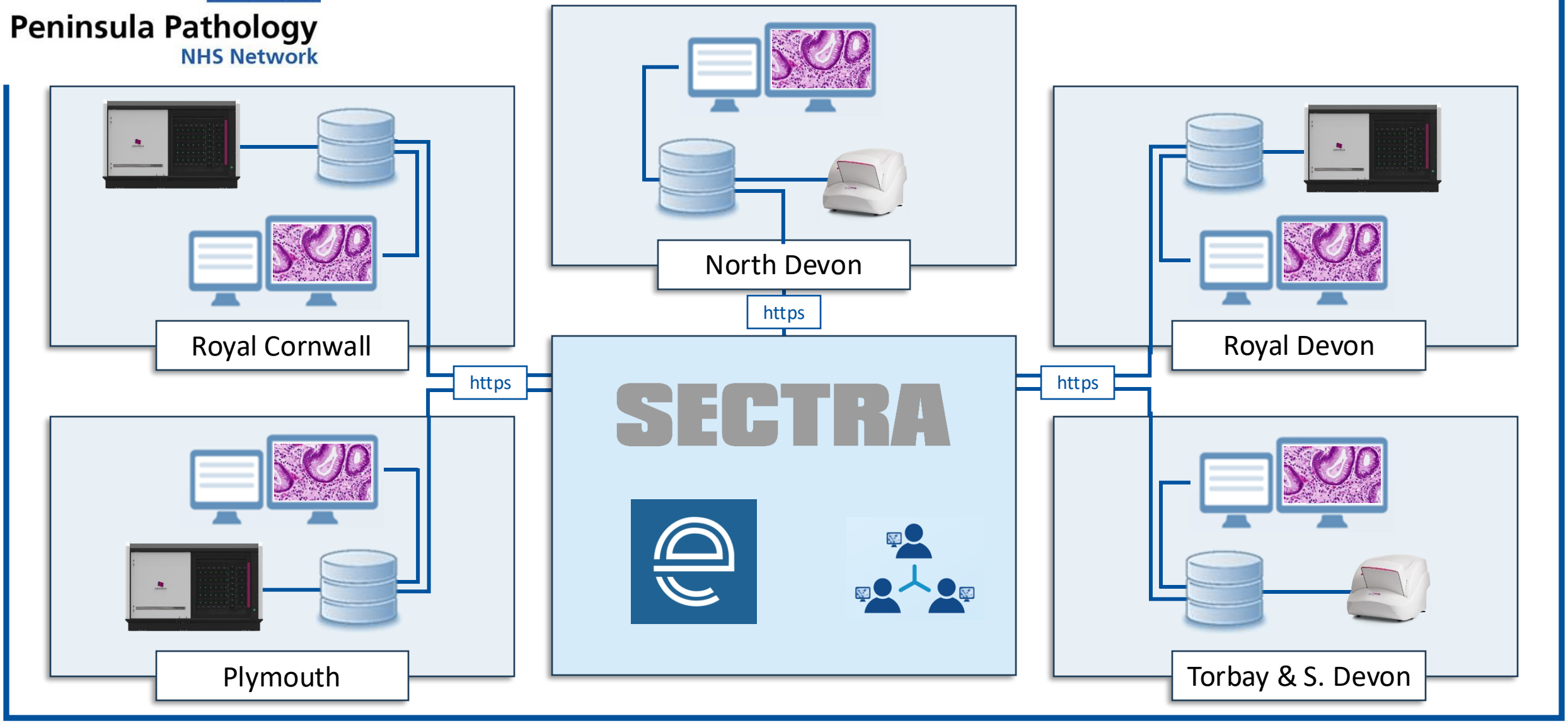
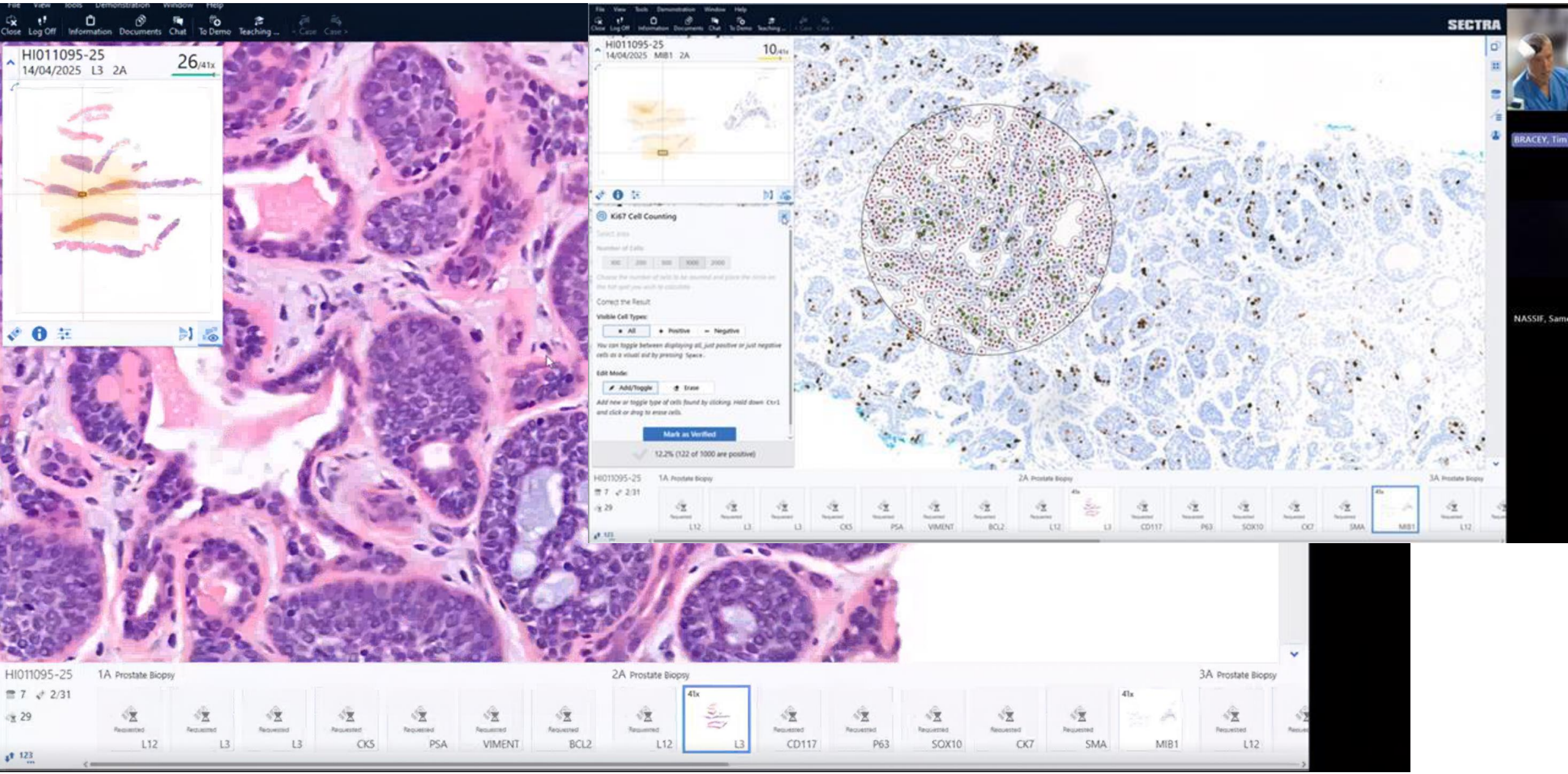
PERFECTION

NHS
Peninsula Pathology
NHS Network

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14/04/2025 L3 2A
26/41x
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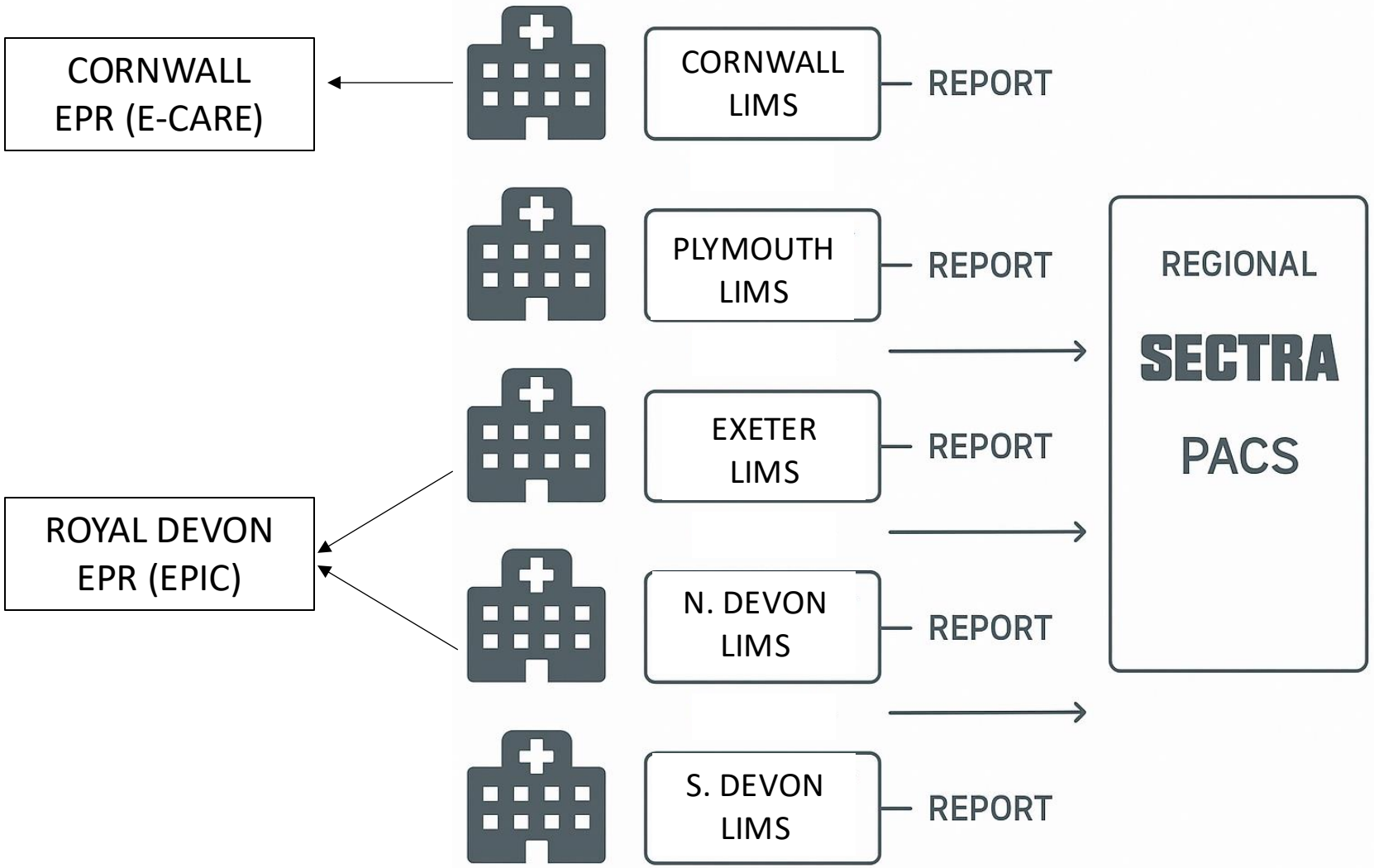
14/04/2025 MIB1 2A
10/41x
SECTRA
Ki67 Cell Counting
Correct the Result
Visible Cell Types:
All
Positive
Negative
Edit Mode:
Add/Toggle
Erase
Mark as Verified
12.2% (122 of 1000 are positive)
BRACEY, Tim
NASSIF, Sam
HI011095-25
1A Prostate Biopsy
2A Prostate Biopsy
3A Prostate Biopsy
7
2/31
29
L12
L3
L3
CK5
PSA
VIMENT
BCL2
L12
L3
CD117
P63
SOX10
CK7
SMA
MIB1
L12

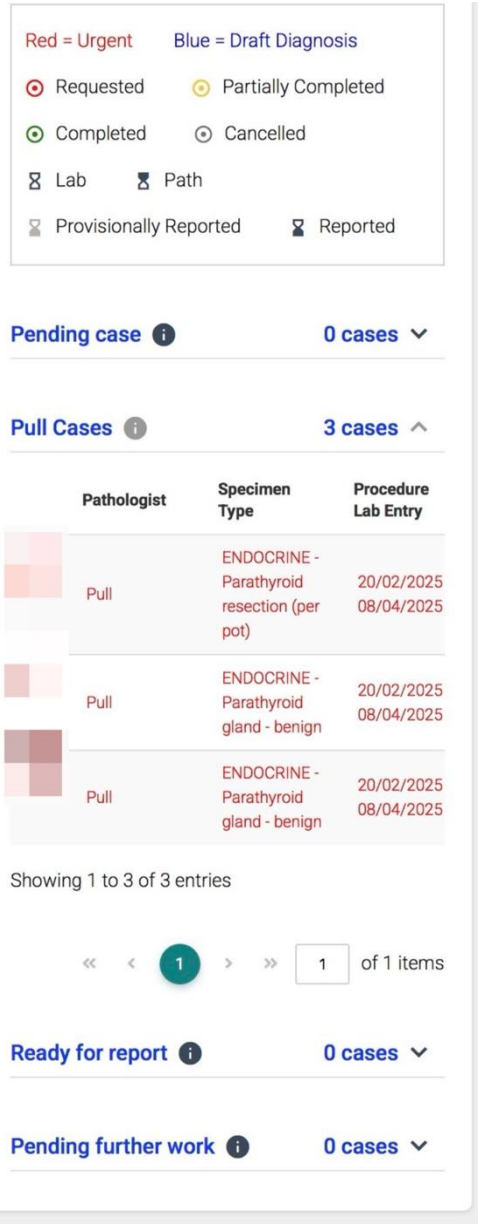
....getting close!

LIMS and EPR integration is the next challenge!



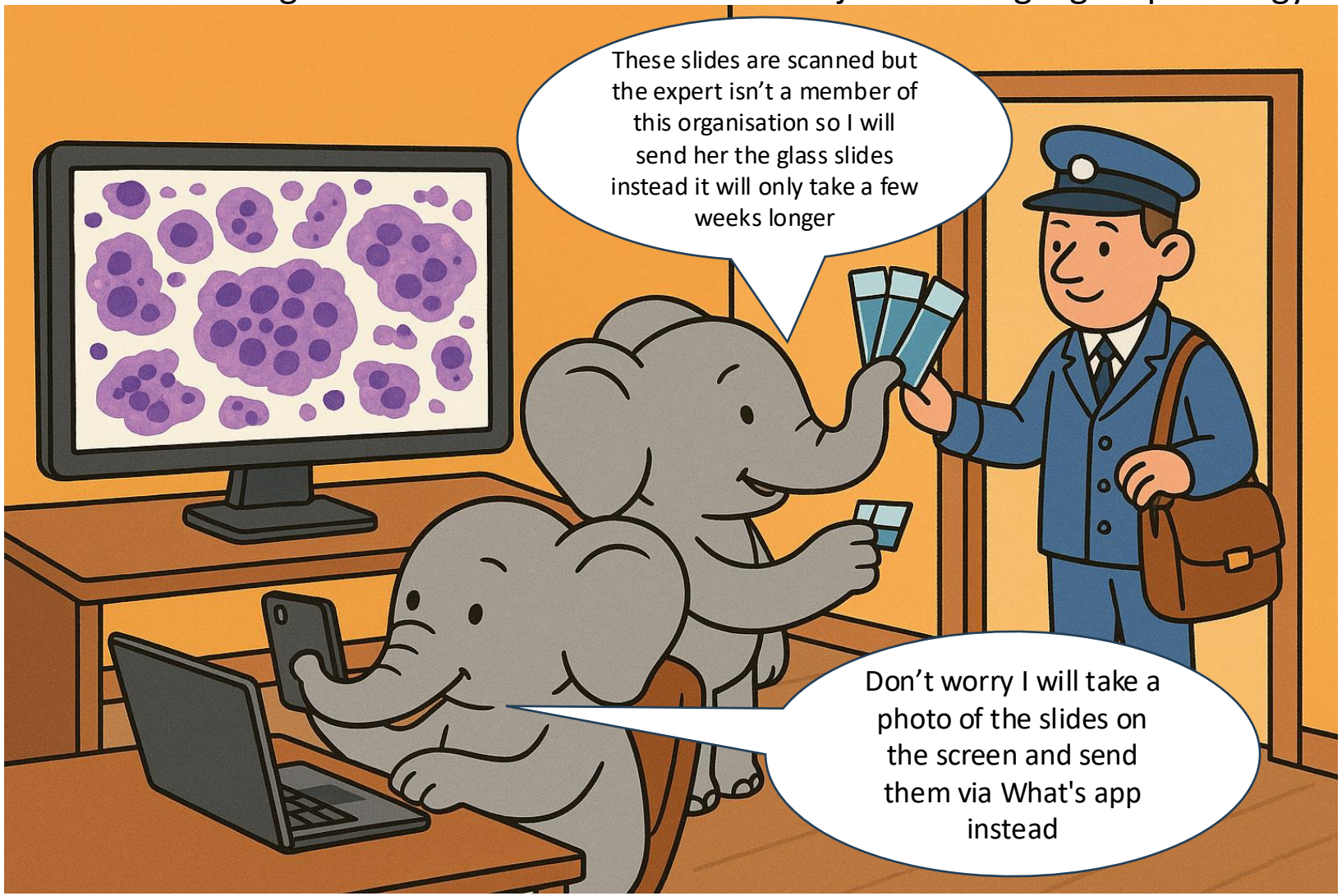
Batching vs pulling?

- We all value our free time and don't all want to be overwhelmed with large batches of cases at the weekend
- A dynamic digital pull system allows large batches of cases to be reported more rapidly
- 100 pathologists reporting a few cases each is much more efficient than a few pathologists being given hundreds of cases
- Speciality specific case availability
- Other details hidden to avoid "cherry picking"
- If a case is not reported, extra work or second opinion requested in a few hours it's returned to the pull list



Elephants in the room:

Unless the receiving pathologist is a member of the same organisation it is often impossible to send them digital slides. Does this defeat the object of using digital pathology??



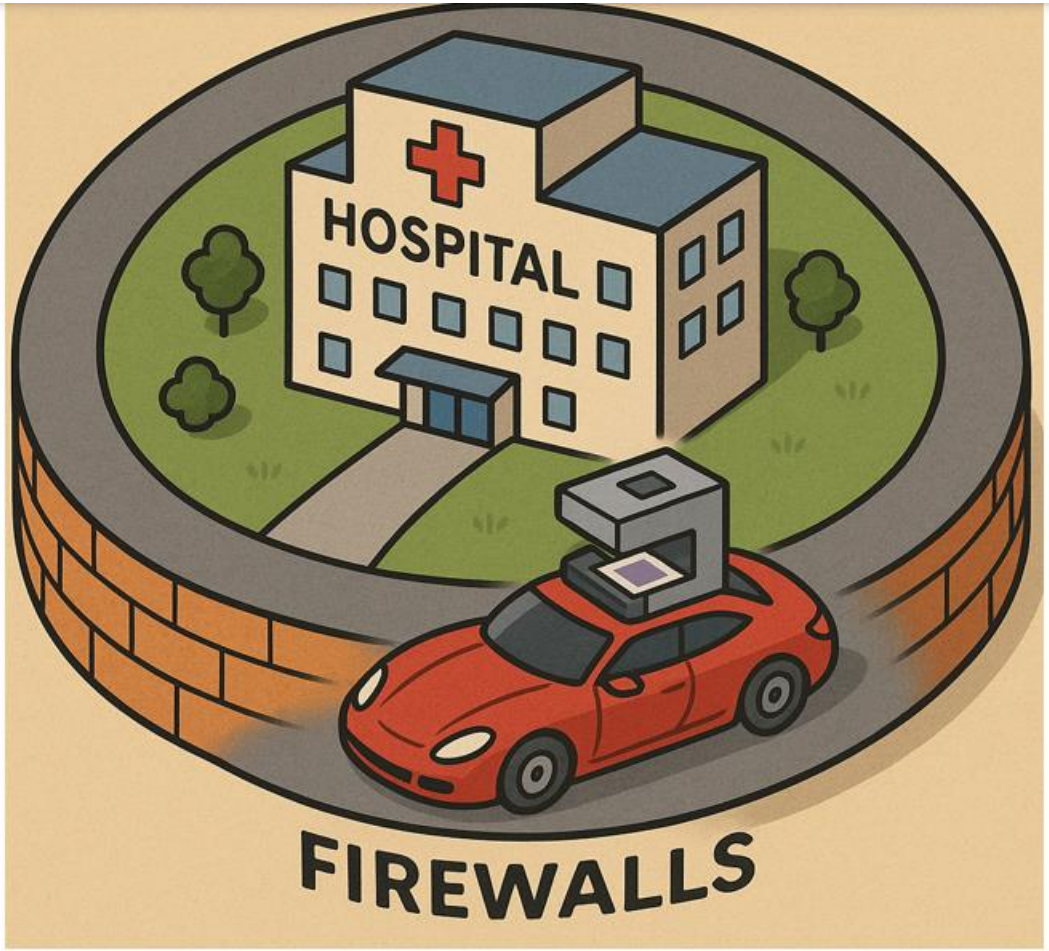
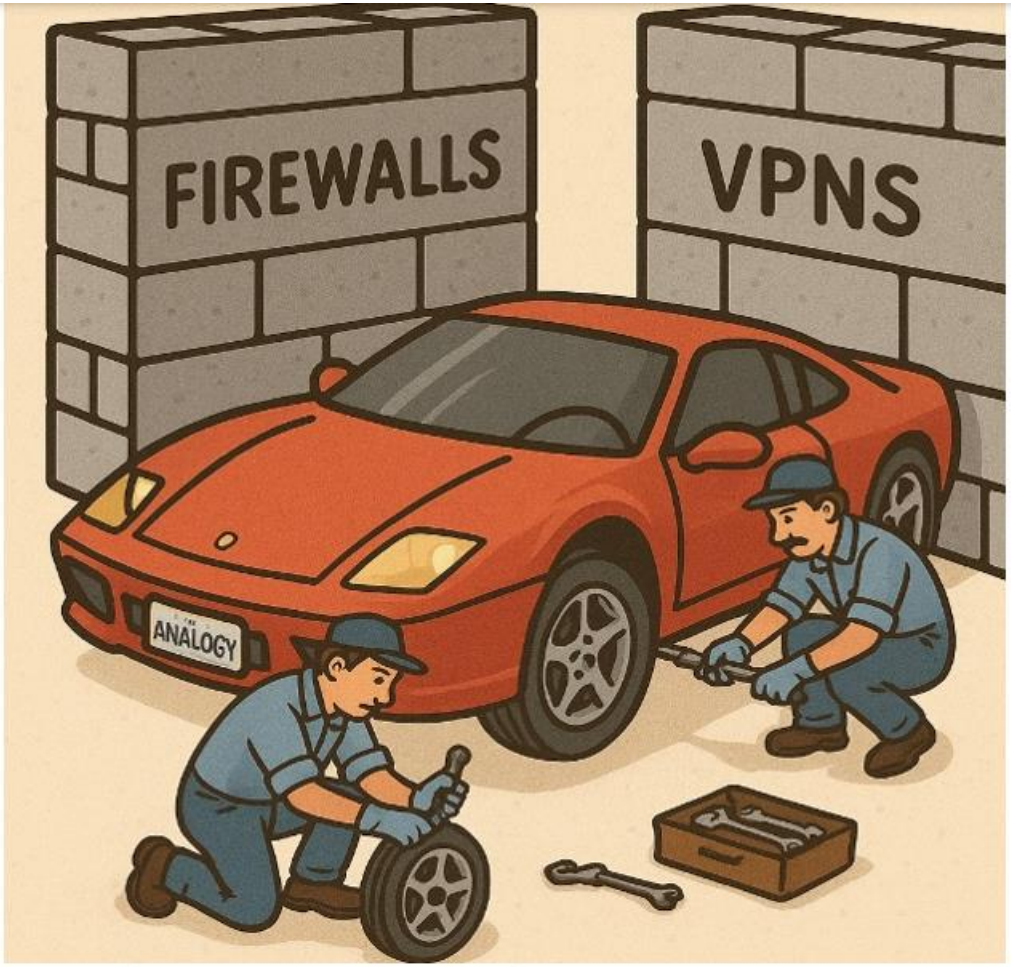


Figure 4: I often use car analogies to talk about DP. Just dropping an expensive scanner off at your hospital is like having a sports car which you can only use in your own garden.



An entire team are needed ideally to make sure your lab process is prepared for digital pathology (your expensive vehicle) and to ensure the equipment is serviced, optimised and maintained

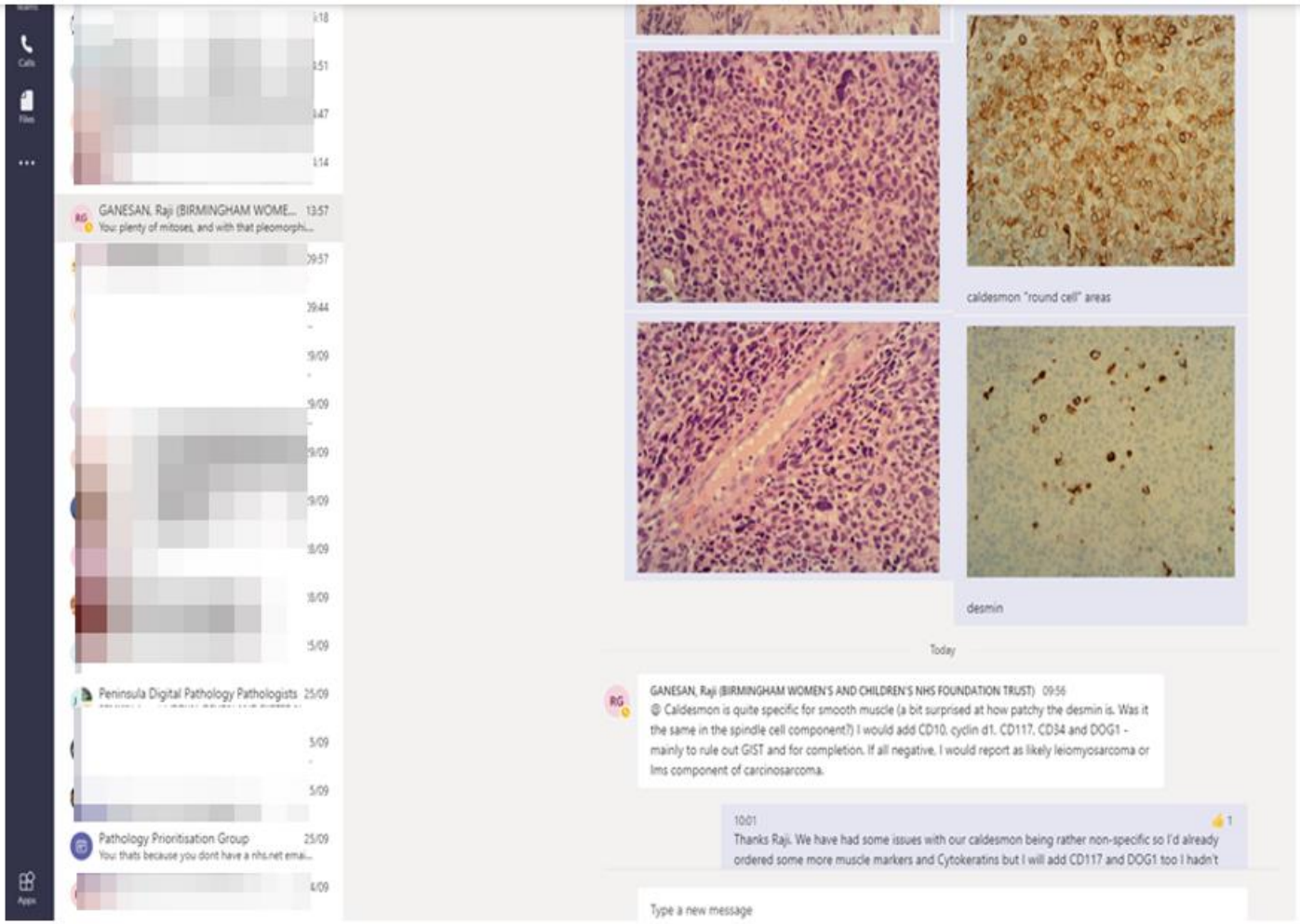


Figure 1: Microsoft teams is great way to share snapshots of a case and dynamically collaborate on a case with a remote expert particularly if you are both part of the nhs.net national network

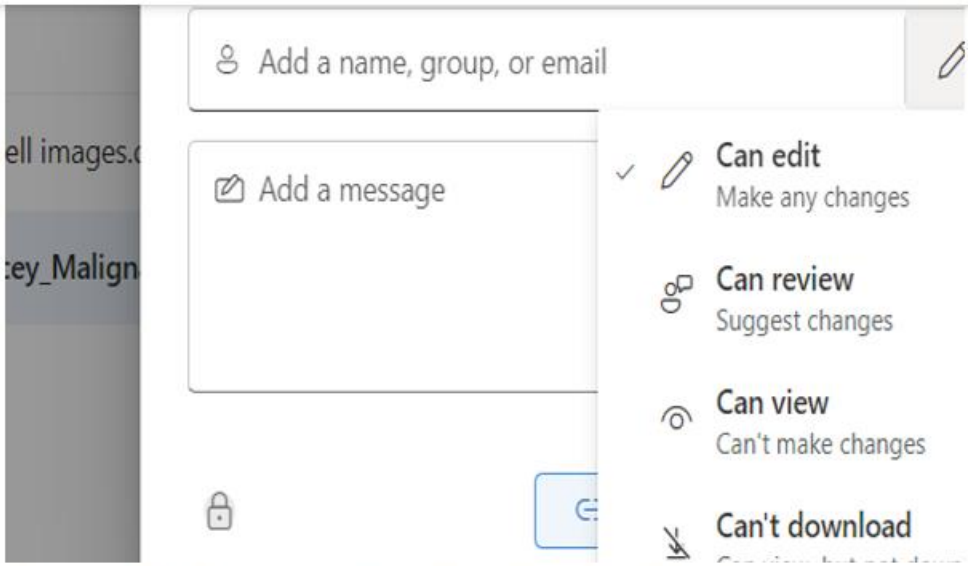


Figure 2: Even without digital pathology, we can now collaborate with colleagues using teleconferencing and teams chats and articles can be shared with individual authors to dynamically collaborate and edit manuscripts rather than sending attachments back and forward and having to incorporate changes made by different authors in different copies of the same document at different times.

Digital pathology should not be limited by geographical barriers

- Abolish fragmented procurements with glacial timescales
- End to end service not just equipment and software (intelligent private partnerships?)
- Use Vendor-Neutral, Interoperable Cloud Platforms
- Big data projects require intelligent storage plans
- Centralised Identity and Access Management with inbuilt security that does not limit useability
- Sophisticated tests and AI algorithms should be available nationally

In our pursuit of

we might find excellence!

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Matt Coles, Katy Valentine, Amy Leeming, Suzie Hazeldine, Mary Jones

Regional colleagues

Steve Blunden, Alec McLean, Samer Nassif, Leonid Semkin, Trupti Mandalia, Sarah Saunders, Fred Mayall, Ade Oriolowo, Naomi Carson

National colleagues

Marco Novelli, Adrian Bateman, Sonali Natu, Gillian Hall, Ali Khurram, Khin Thway, Raji Ganesan, Iskander Chaudhry, Adelina Baltan *and too many others to name!*