The Coastal Path to Artificial Intelligence in Digital Pathology.

Digesting the experience of a South West UK Specialist GI "Path" vs the Ibex Gastric AI

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NHS
Royal Cornwall Hospitals
NHS Trust

NHS
Peninsula Pathology
NHS Network

Declaration of Competing Interest

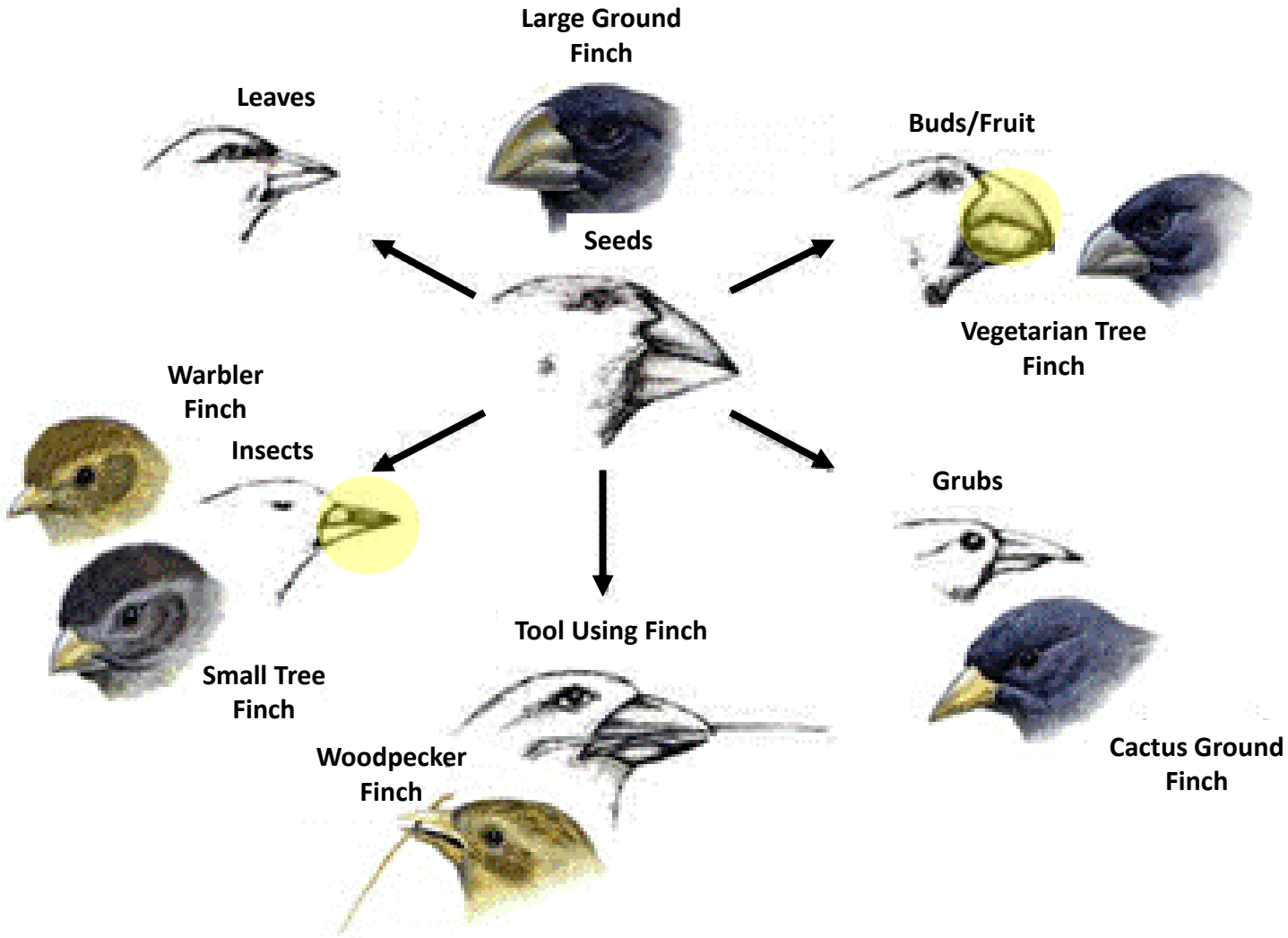
I have no competing financial interests or personal relationships that could influence the work reported in this presentation

The Coastal Path to AI in Digital Pathology

- A bit about me and my curious career path!
- How digital pathology enabled my “nomadic” regional upper GI role
- Digital pathology in the Peninsula Cancer Network
- Some classical and unusual gastric pathology cases
- How could adding AI into the workflow benefit patients and Pathology departments?
- Do we need to worry about AI replacing us?

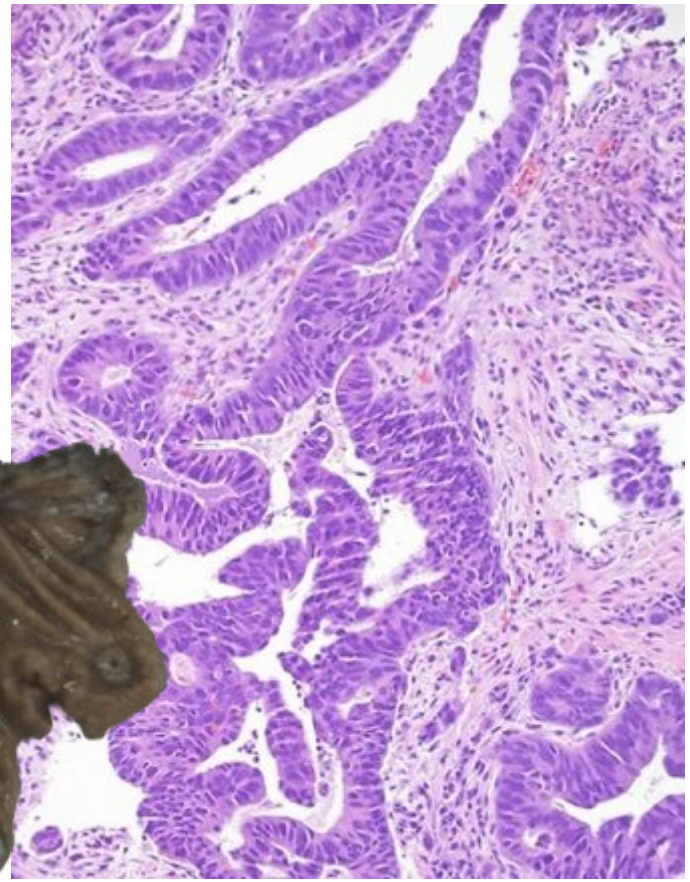
Curious
Nature Nerd
▼
Biologist
▼
Cancer cell
Biology PhD
▼
Surgeon
▼
Pathologist

Predicting Behaviour by Morphology

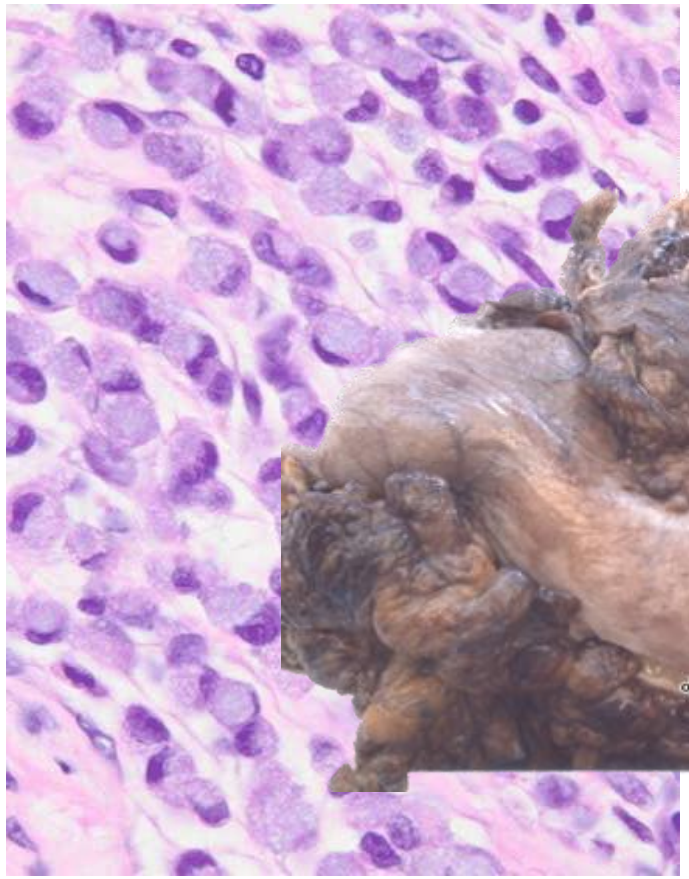


Predicting Behaviour by Morphology

Pekka Laurén (1965)



Intestinal-type



Diffuse-type

Signet ring

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.

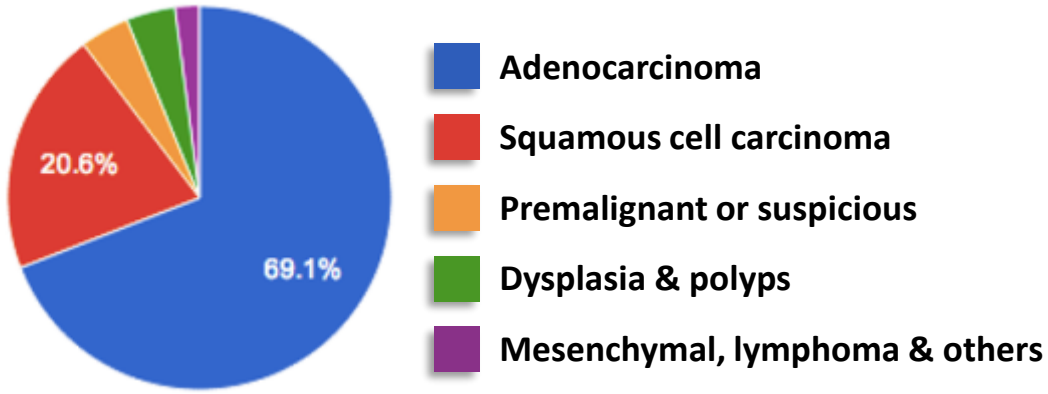
The team includes:

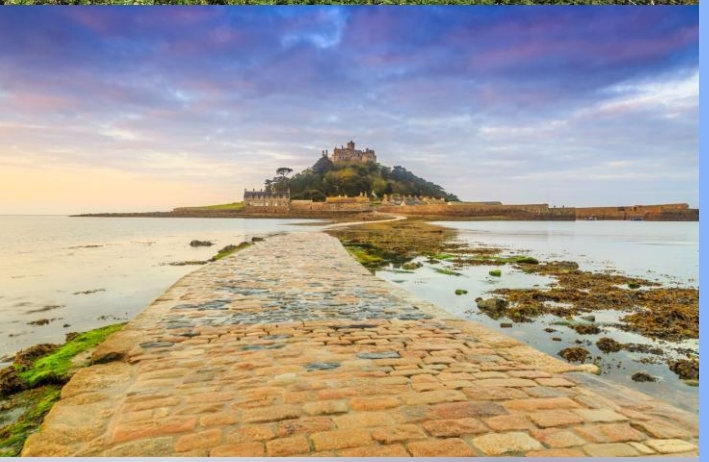
- Surgeons
- Oncologists
- Clinical Nurse Specialists
- Radiologists
- Histopathologists
- Anaesthetists
- Gastroenterologists
- Nurse Endoscopists
- MDT co-ordinators
- Dieticians
- Palliative care physicians

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

- I joined as Pathology Lead in 2011
- >100 major resections per year from 5 Trusts
- 7 Surgeons
- ~500-600 biopsy case reviews from 5 Trusts
  - 90% time spent on 10% of the cases!
  - *Subjectivity, extra work, second opinions*
- 6% major discordance on central review

Range of pathology encountered on biopsy






Stavanger
Gothenburg
North Sea
Edinburgh
Copenhagen
Denmark
United Kingdom
Isle of Man
Manchester
Hamburg
Dublin
Ireland
Birmingham
Amsterdam
Berlin
Netherlands
London
Germany
Belgium
Prague
Luxembourg
Paris
SW Peninsula

NHS
Northern Devon Healthcare
NHS Trust

NHS
Peninsula Pathology
NHS Network

NHS
Royal Devon
University Healthcare
NHS Foundation Trust

NHS
Torbay and South Devon
NHS Foundation Trust

NHS
Royal Cornwall Hospitals
NHS Trust

NHS
University Hospitals
Plymouth
NHS Trust

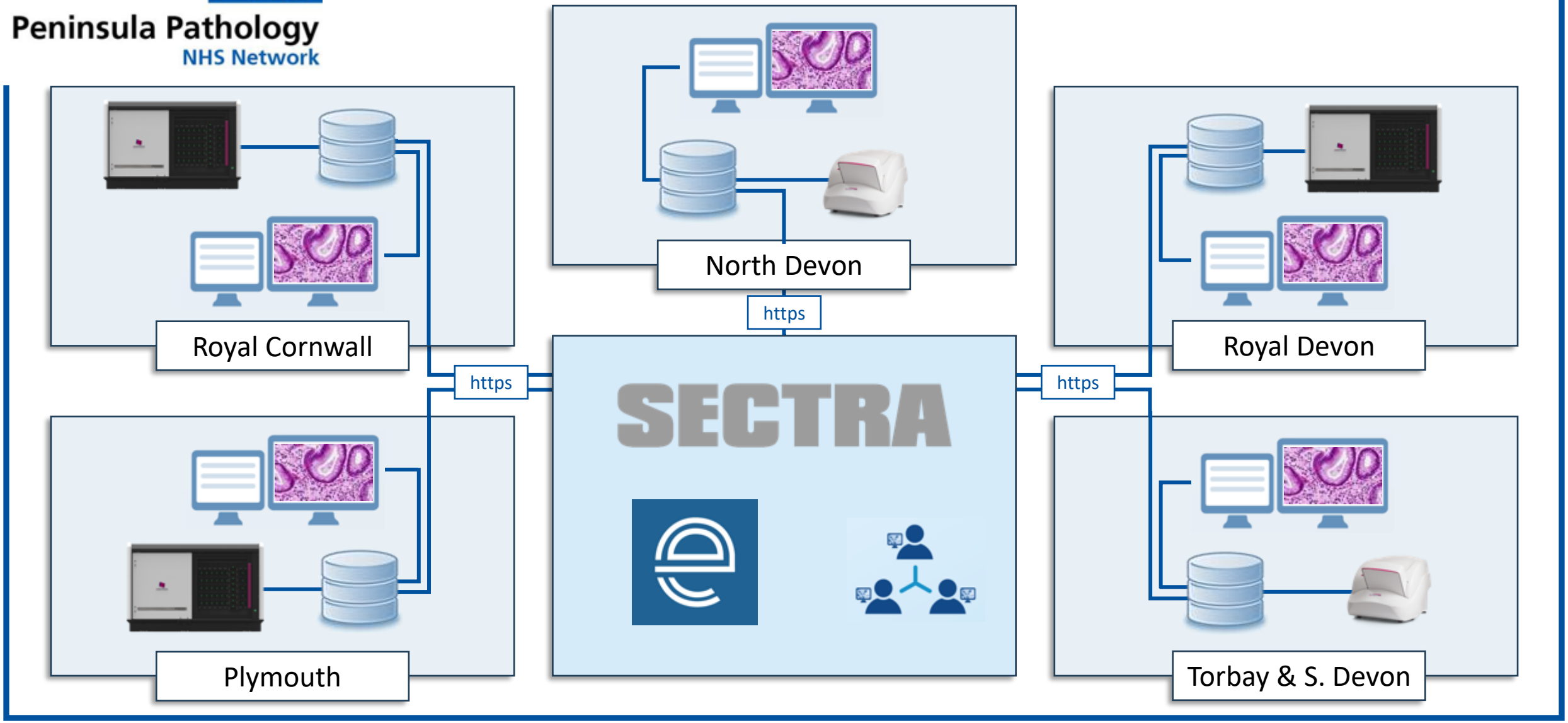
60 miles

46 miles

42 miles

58 miles

NHS
Peninsula Pathology
NHS Network



In 2018 I moved from Plymouth to the North Coast of Cornwall

NHS Northern Devon Healthcare NHS Trust

NHS Peninsula Pathology NHS Network

NHS Royal Cornwall Hospitals NHS Trust

NHS University Hospitals Plymouth NHS Trust

Barnstaple
Bideford
Bude
Launceston
Padstow
Bodmin
Liskeard
Newquay
Truro
Plymouth
St Ives
Falmouth
Penzance
60 miles
58 miles
46 m
42

Journal of Pathology Informatics (2022)

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

Tim S Bracey, MBChB, PhD, FRCPath

Royal Cornwall Hospital, Treliske, Truro TR1 3LJ, UK

Objective Imaging

As a result I had a range of gastric pathology digital slides available to test with AI

Contents lists available at ScienceDirect

Journal of Pathology Informatics

journal homepage: www.elsevier.com/locate/jpi

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

Tim S Bracey, MBChB, PhD, FRCPath *

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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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Digital Pathology & AI Landscape

IBEX

Products

- Prostate, Breast (H&E), Breast (IHC), Gastric

Clearance & Certification

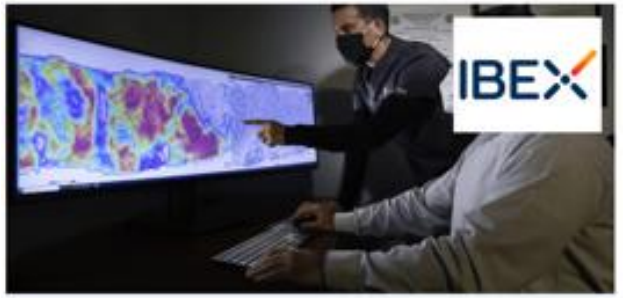
- CE-IVDR (Prostate, Breast & Gastric)
- HMRA, Cyber Essentials+

Key Publications

- Prostate (The Lancet)
- Breast (Nature NPJ)

Awards

- NHSx AI Award: Prostate (2021)
- NHSx AI Award: Breast (2023)



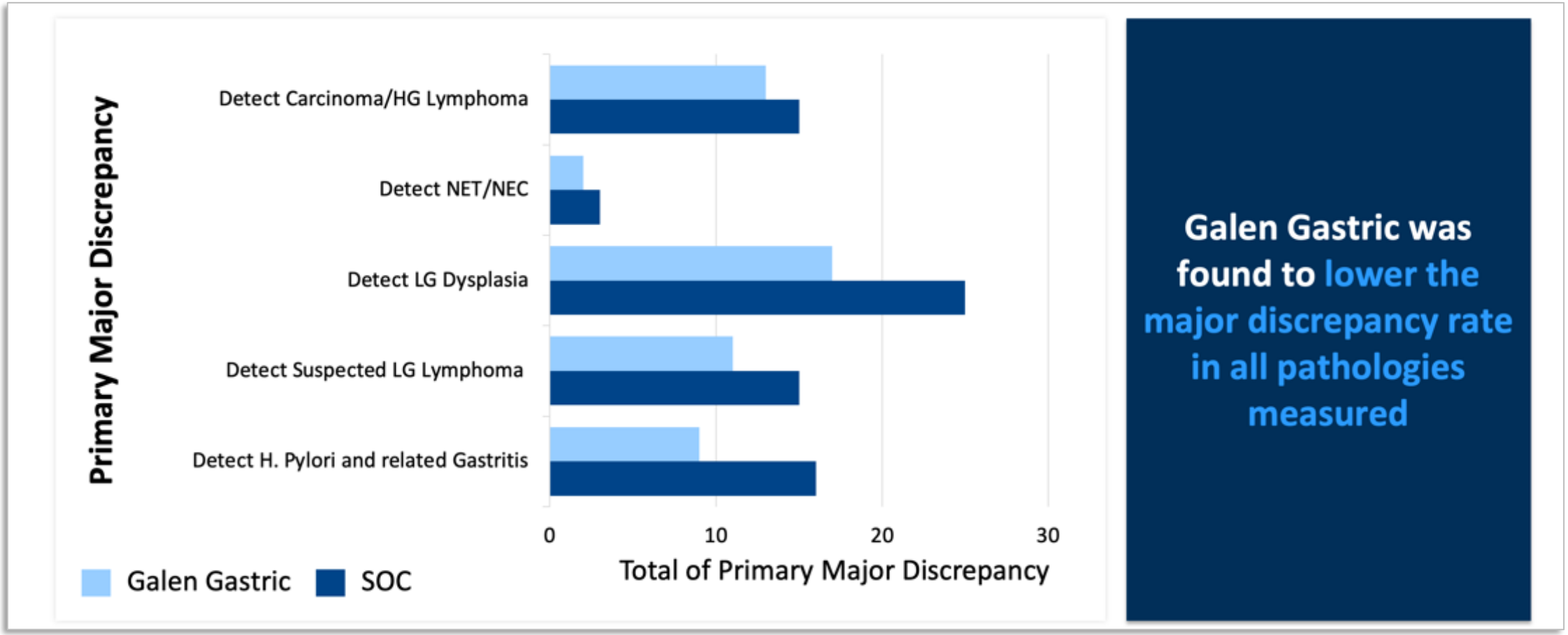
» The Galen™ Platform

CE | H&E

Galen is a clinically proven, AI-powered platform for supporting pathologists during routine cancer diagnosis. The platform helps pathologists improve the accuracy of diagnosis, enhance lab efficiency and implement 100% quality control.

Multi-Site Validation of AI-assisted gastric biopsy diagnosis

Manuel Rodriguez-Justo at University College London, UK



Galen Gastric was found to lower the major discrepancy rate in all pathologies measured

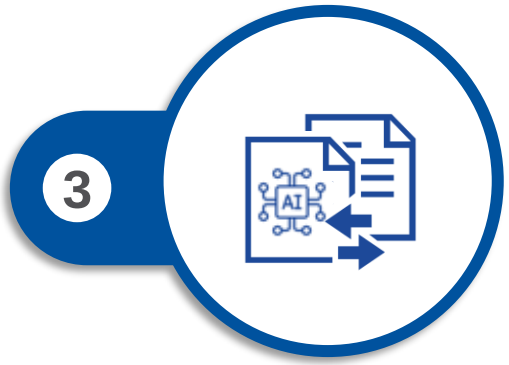
Simple Evaluation Design

Select

Select **interesting & challenging cases** from the archive

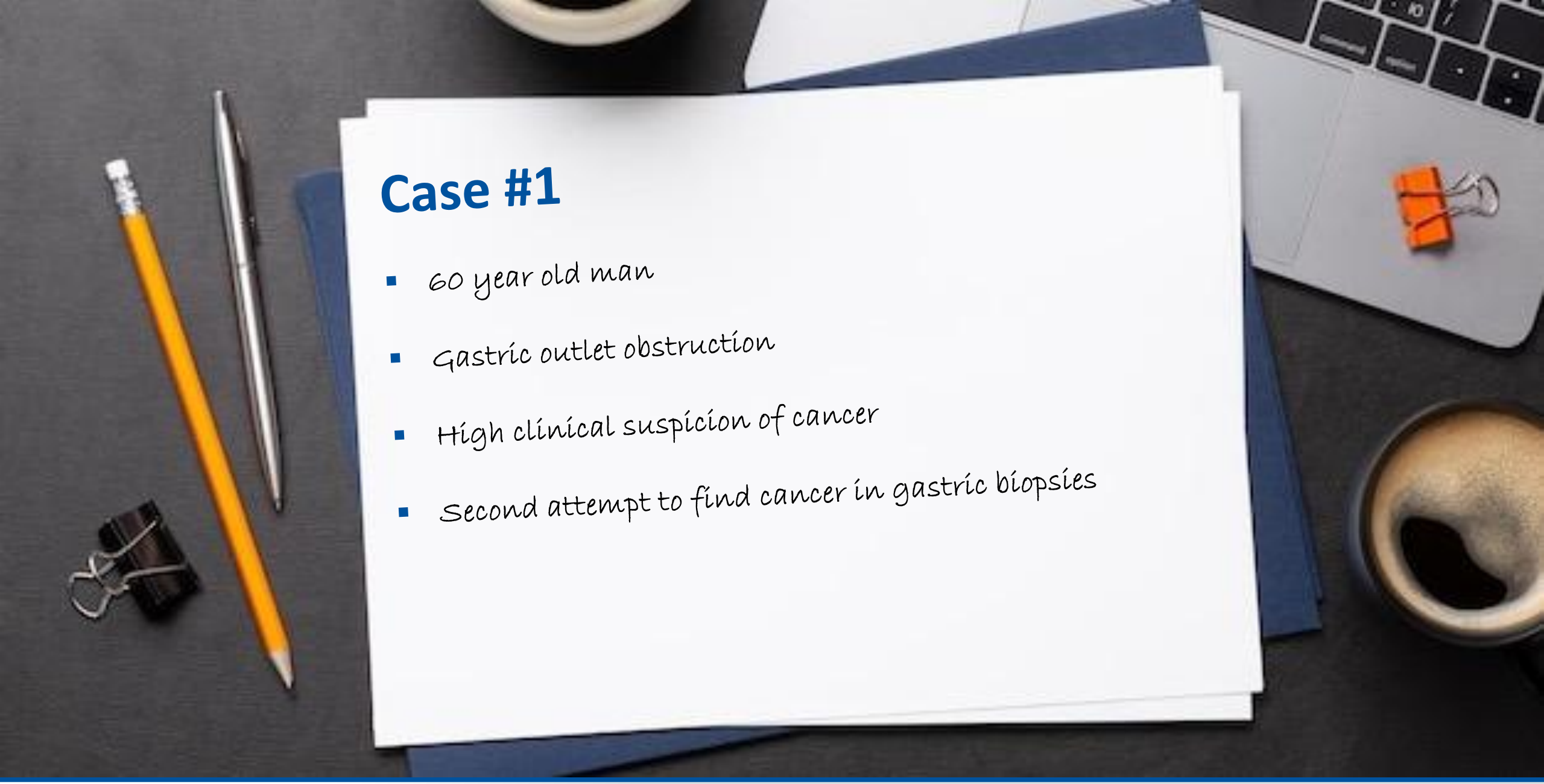
Anonymize

Anonymize & upload to **Ibex AI Platform**



Compare

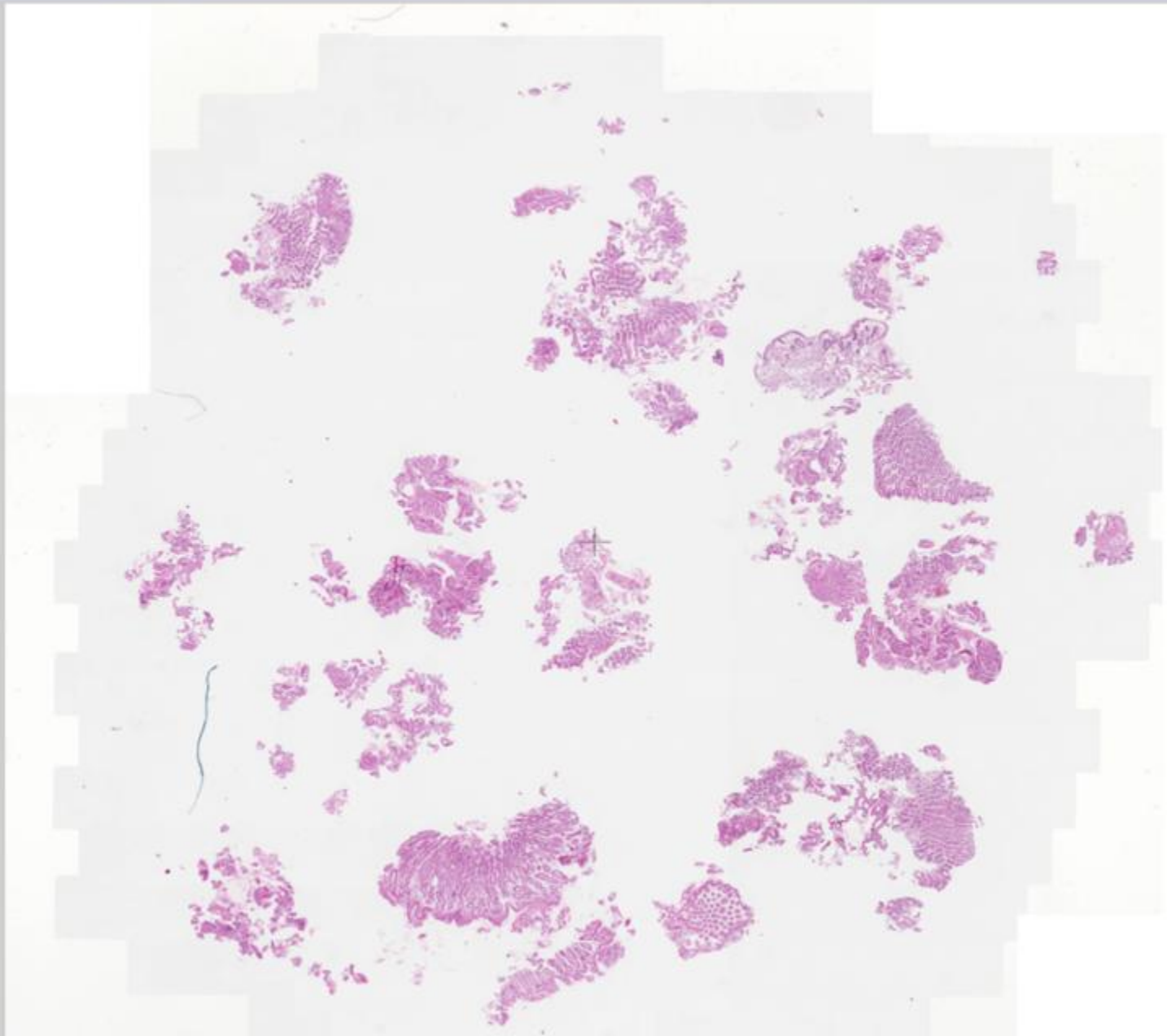
Compare results & assess **performance**
Can I beat it?



Case #1

- 60 year old man
- Gastric outlet obstruction
- High clinical suspicion of cancer
- Second attempt to find cancer in gastric biopsies

Heatmaps

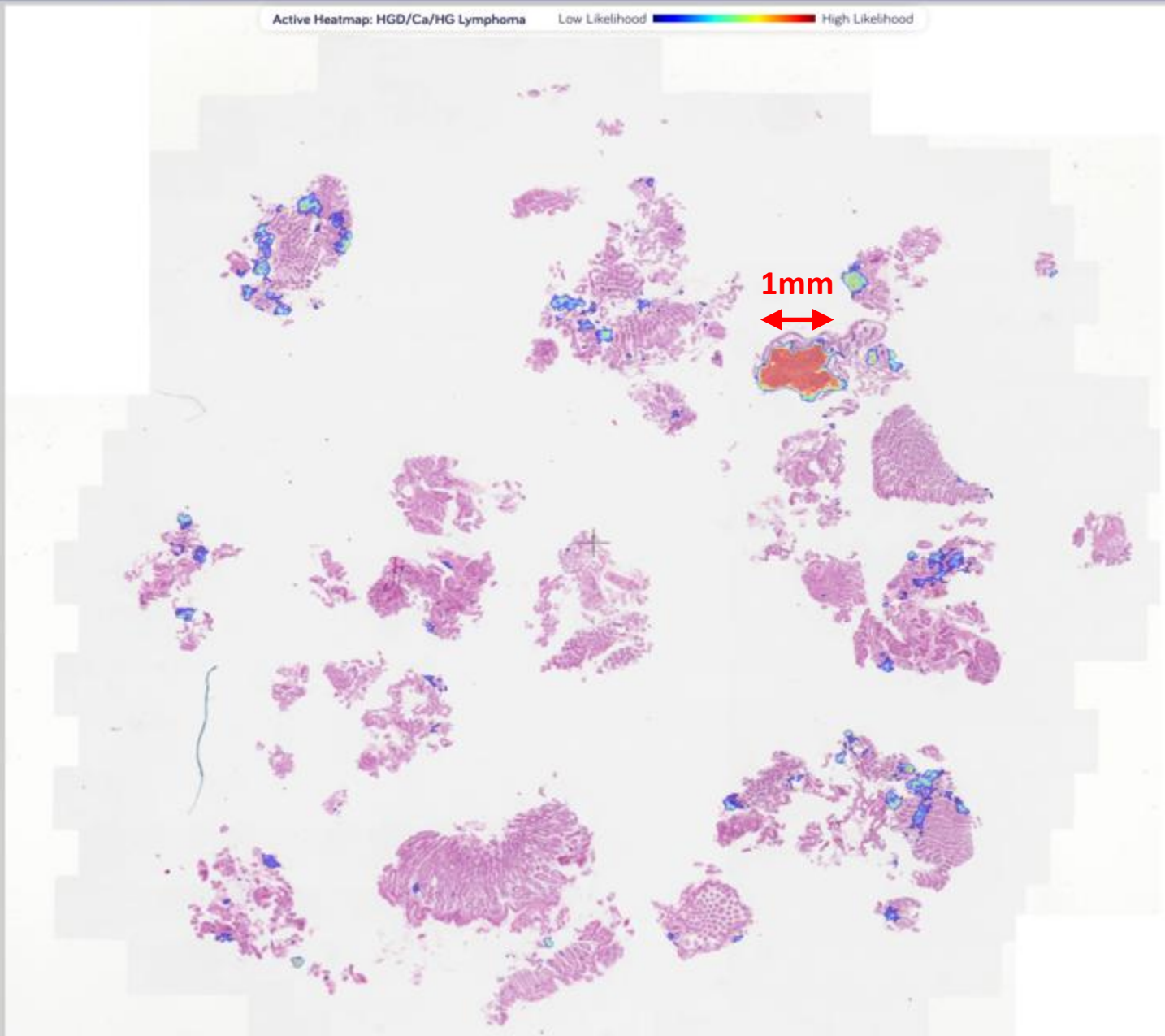


Case #1

60 year old man

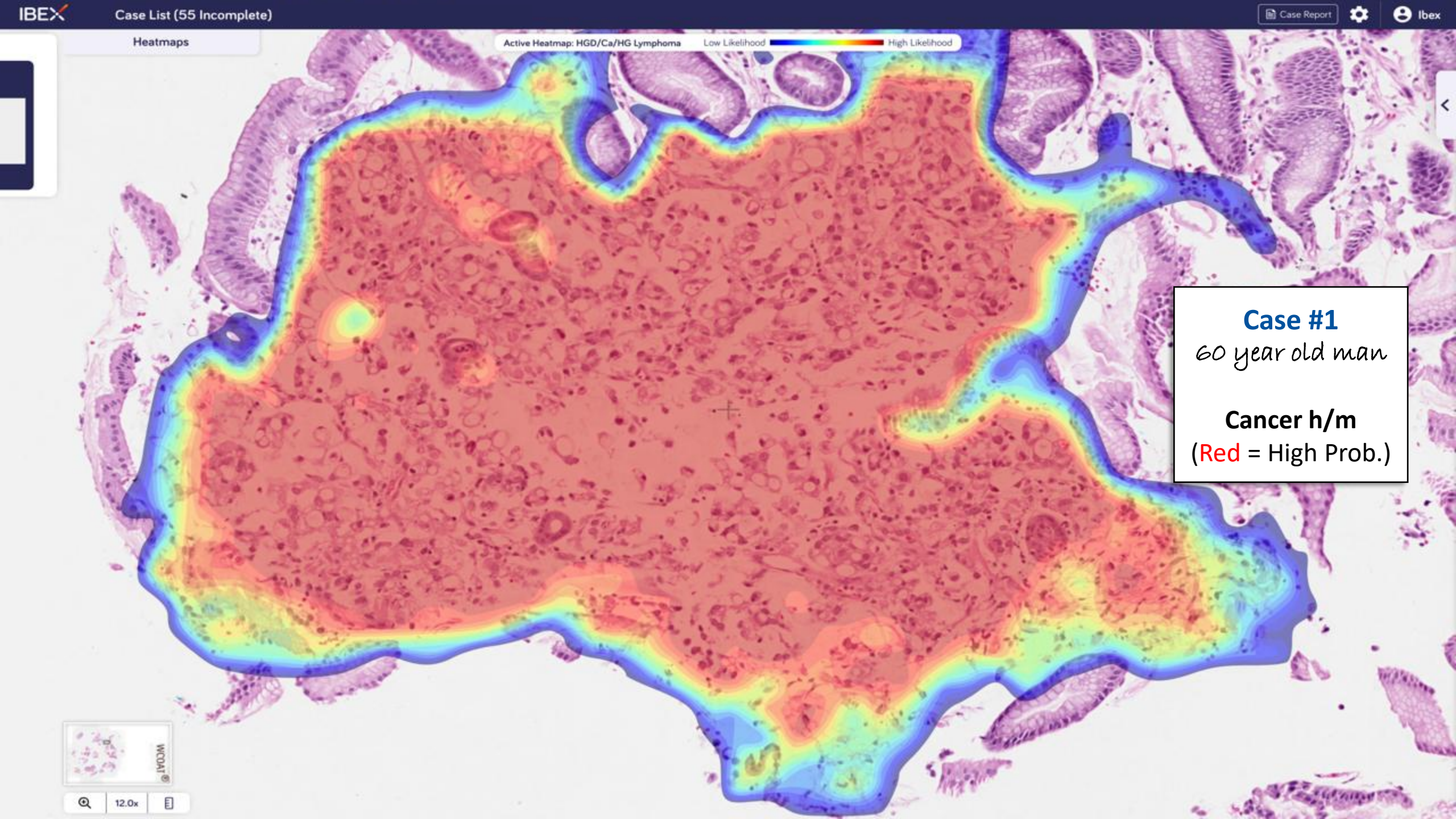
H&E

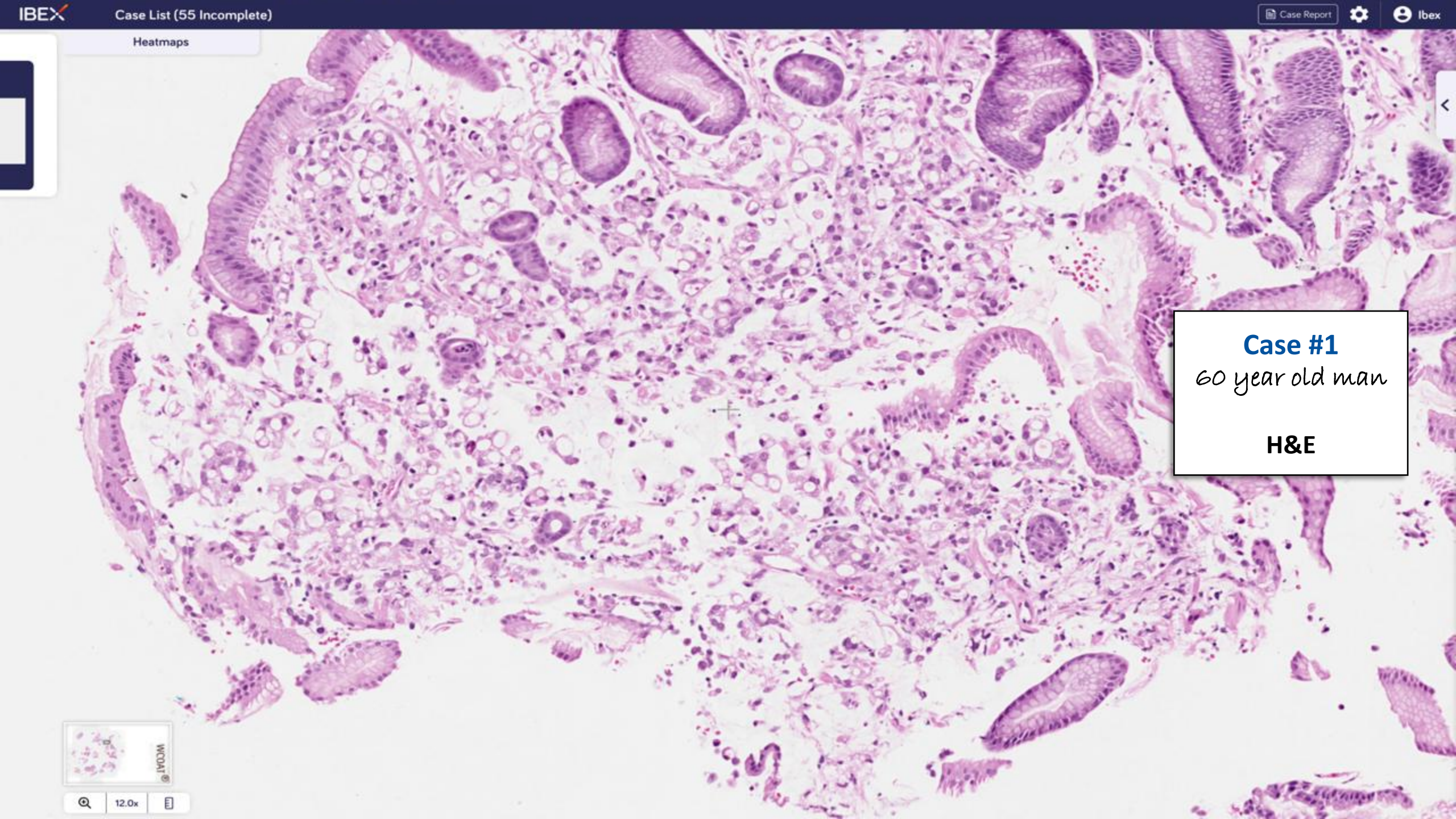
Heatmaps

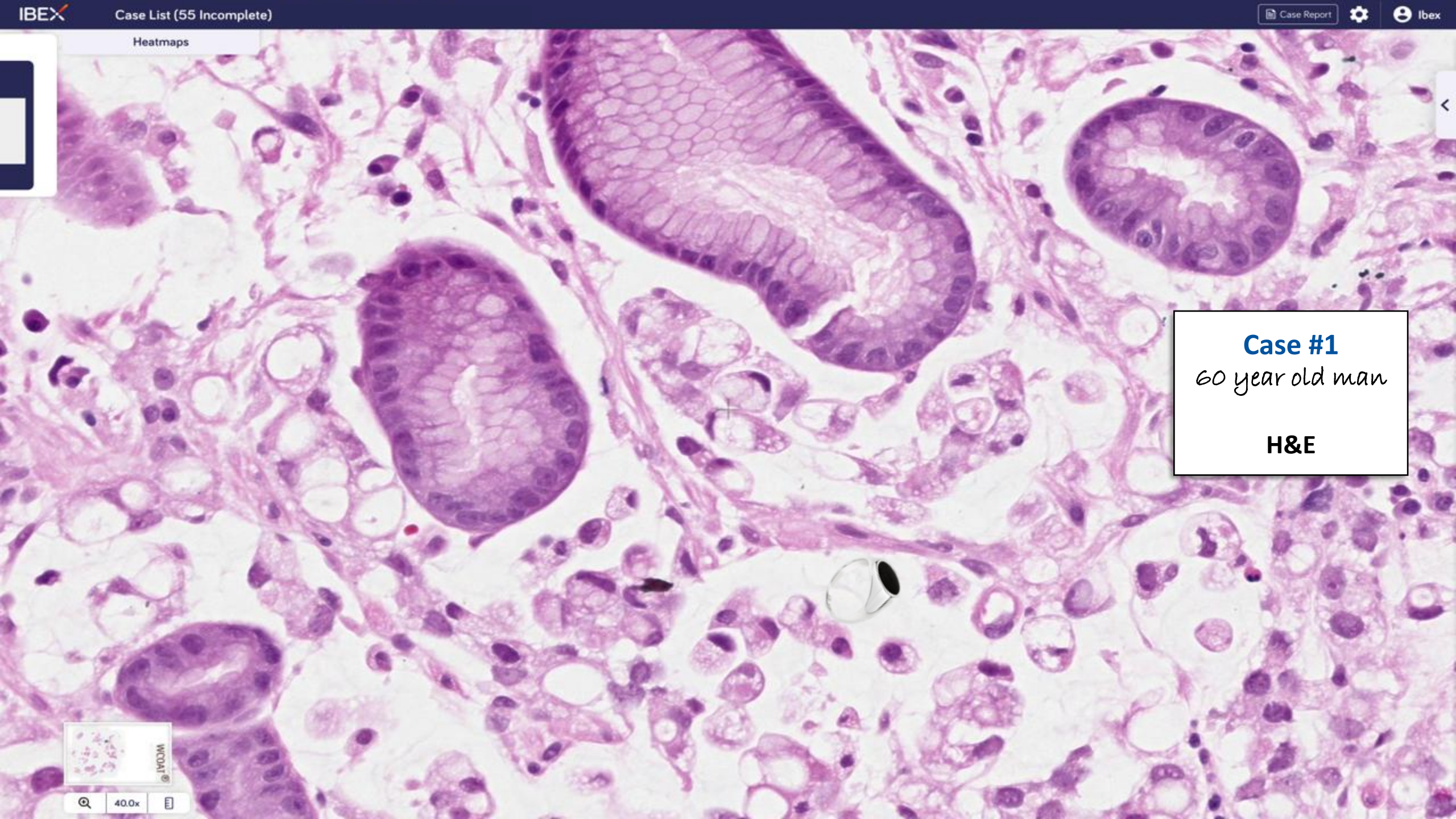


Case #1
60 year old man

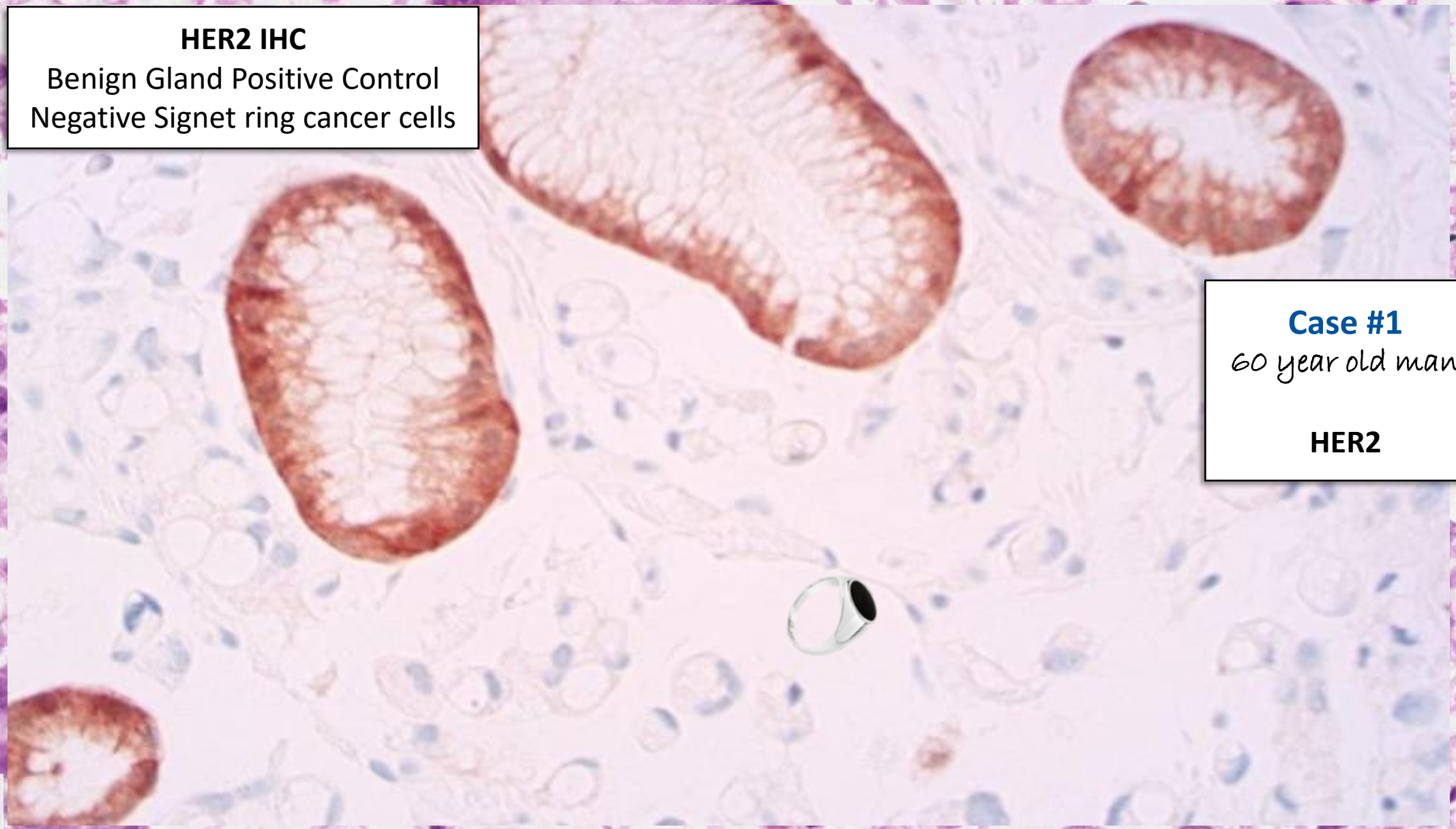
Cancer h/m
(Red = High Prob.)


IBEX
Case List (55 Incomplete)
Case Report
Ibex
Heatmaps
Active Heatmap: HGD/Ca/HG Lymphoma
Low Likelihood
High Likelihood
Case #1
60 year old man
Cancer h/m
(Red = High Prob.)
WCOAT
12.0x


IBEX
Case List (55 Incomplete)
Case Report
Ibex
Heatmaps
Case #1
60 year old man
H&E
WCOAT
12.0x


IBEX
Case List (55 Incomplete)
Case Report
Ibex
Heatmaps
Case #1
60 year old man
H&E
40.0x

HER2 IHC
Benign Gland Positive Control
Negative Signet ring cancer cells



Case #1
60 year old man

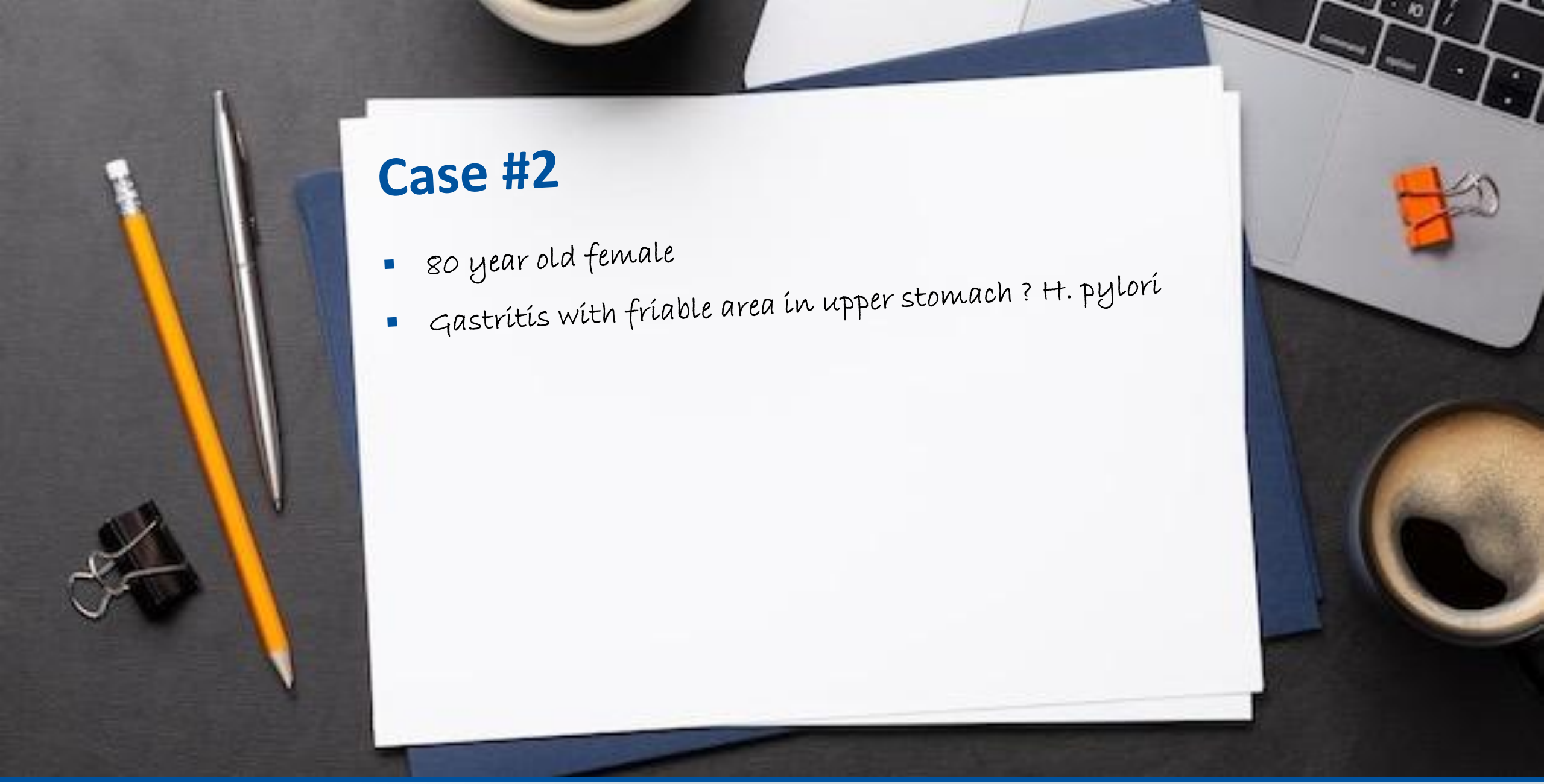
HER2

Case #1

Summary & learning points

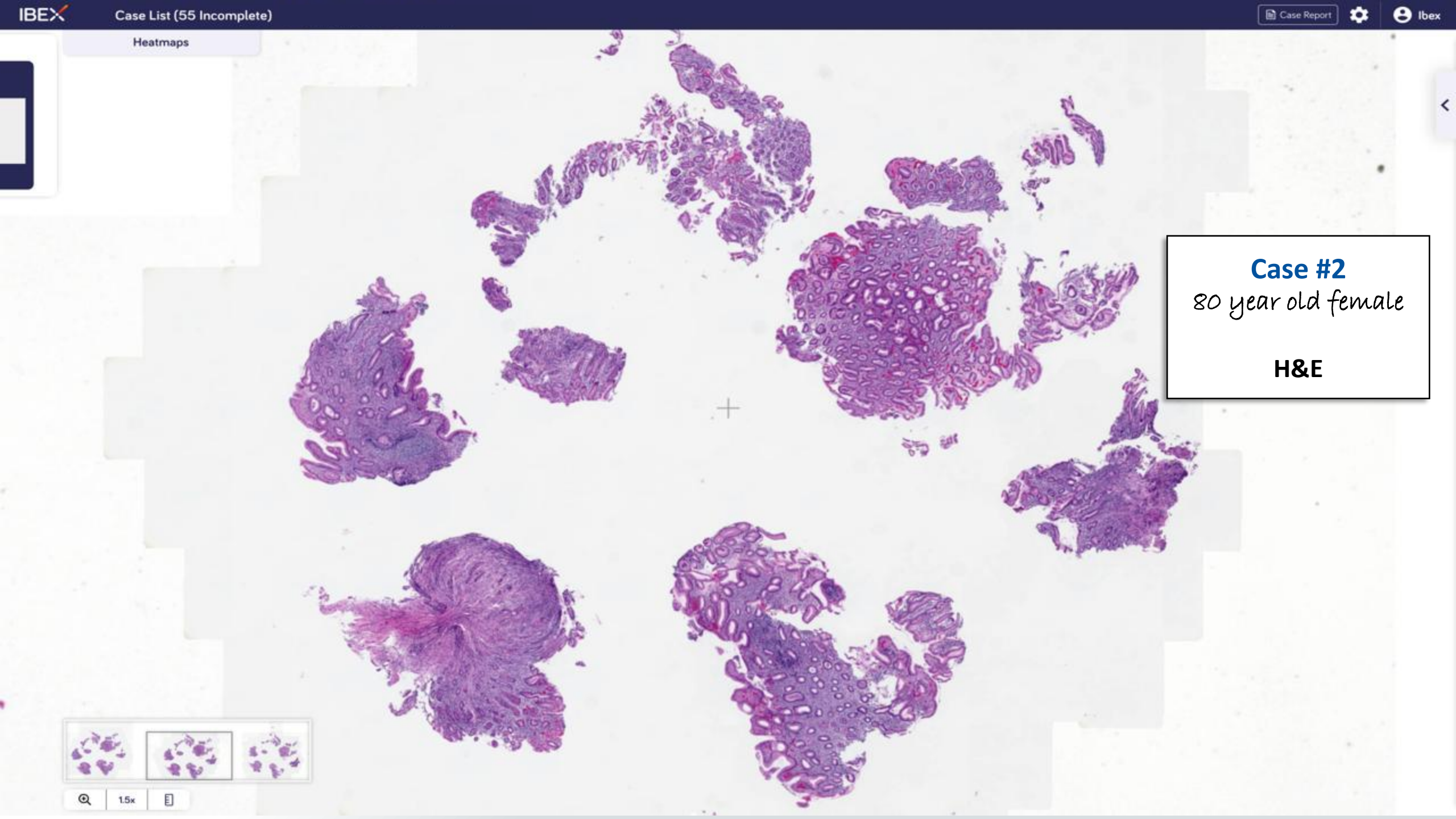
- 60 year old man
- Even clinically extensive gastric carcinoma can be difficult to confirm in biopsy material
- Even a less than 1mm focus of cancer can be sufficient for surgical management but many predictive tests can require at least 500 tumour cells

Ibex AI is very sensitive for detecting tiny foci of cancer easily overlooked by a busy pathologist



Case #2

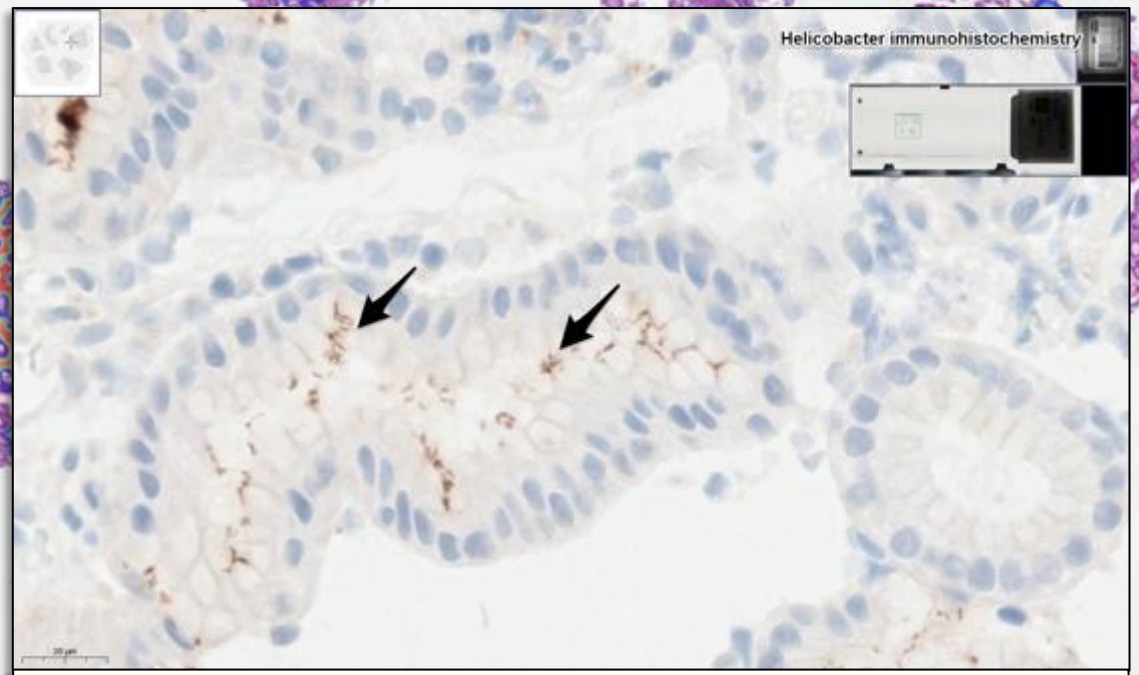
- 80 year old female
- Gastritis with friable area in upper stomach ? H. pylori


IBEX
Case List (55 Incomplete)
Case Report
Ibex
Heatmaps
Case #2
80 year old female
H&E
1.5x

IBEX Case List (55 Incomplete) Case Report Ibex

Heatmaps

Active Heatmap: H. pylori-related gastritis Low Likelihood High Likelihood



H.Pylori confirmed by IHC

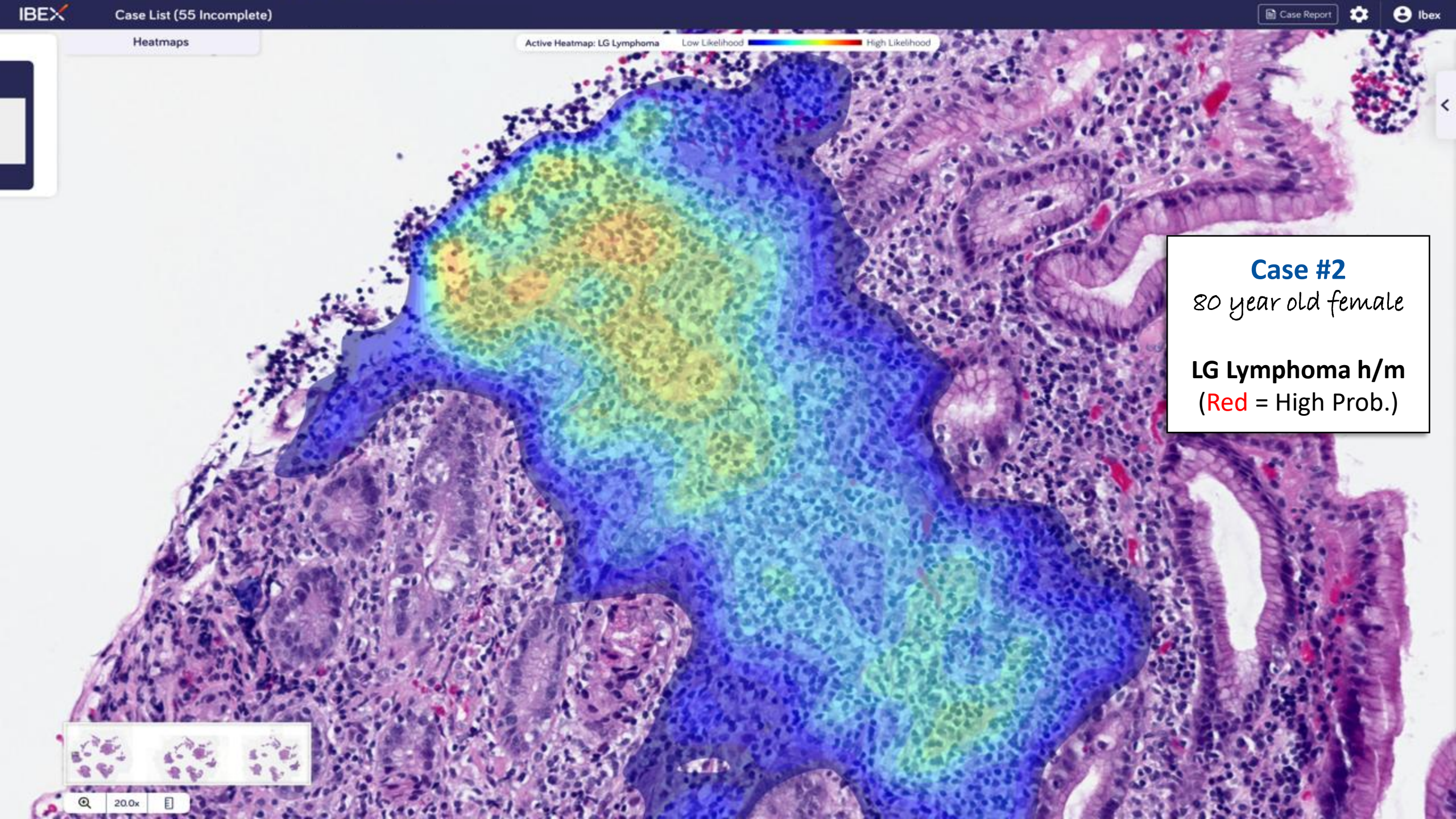
Case #2

80 year old female

H.Pylori gastritis h/m

(Red = High Prob.)

1.5x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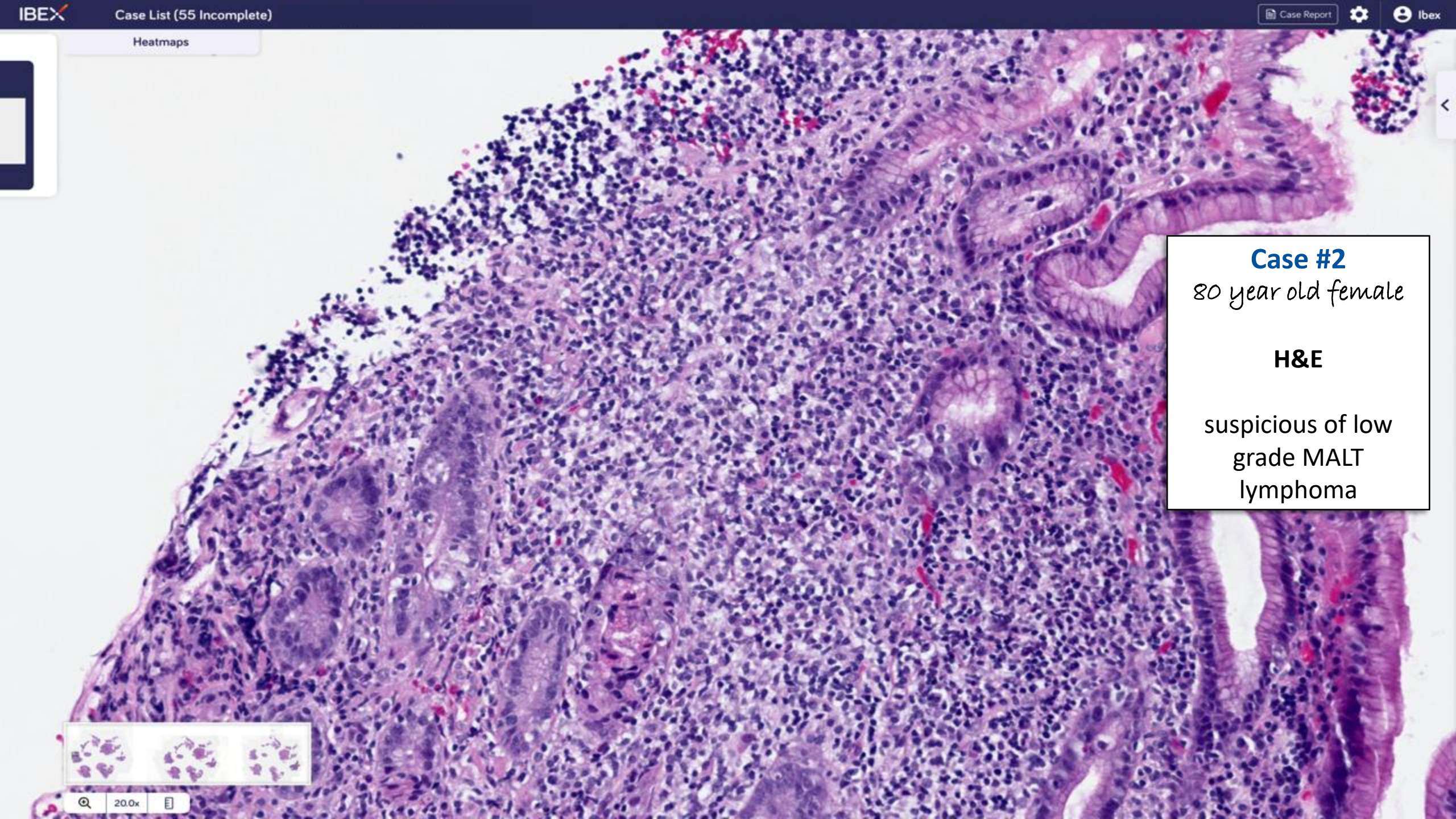
Case List (55 Incomplete)
Case Report
Ibex
Heatmaps
Active Heatmap: LG Lymphoma
Low Likelihood
High Likelihood
Case #2
80 year old female
LG Lymphoma h/m
(Red = High Prob.)
20.0x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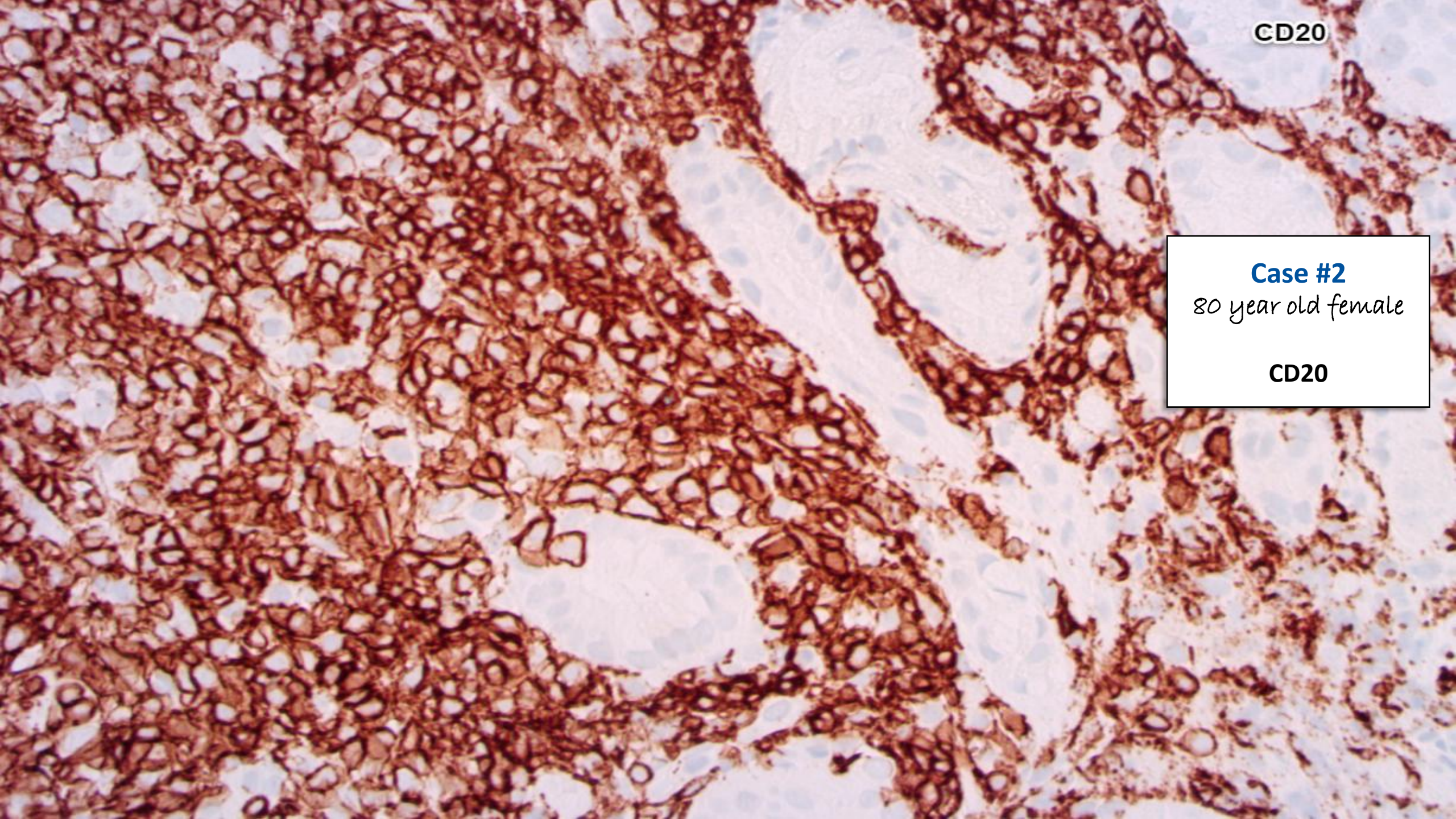
Case List (55 Incomplete)
Case Report
Ibex
Heatmaps
Case #2
80 year old female
H&E
suspicious of low grade MALT lymphoma
20.0x



Case #2

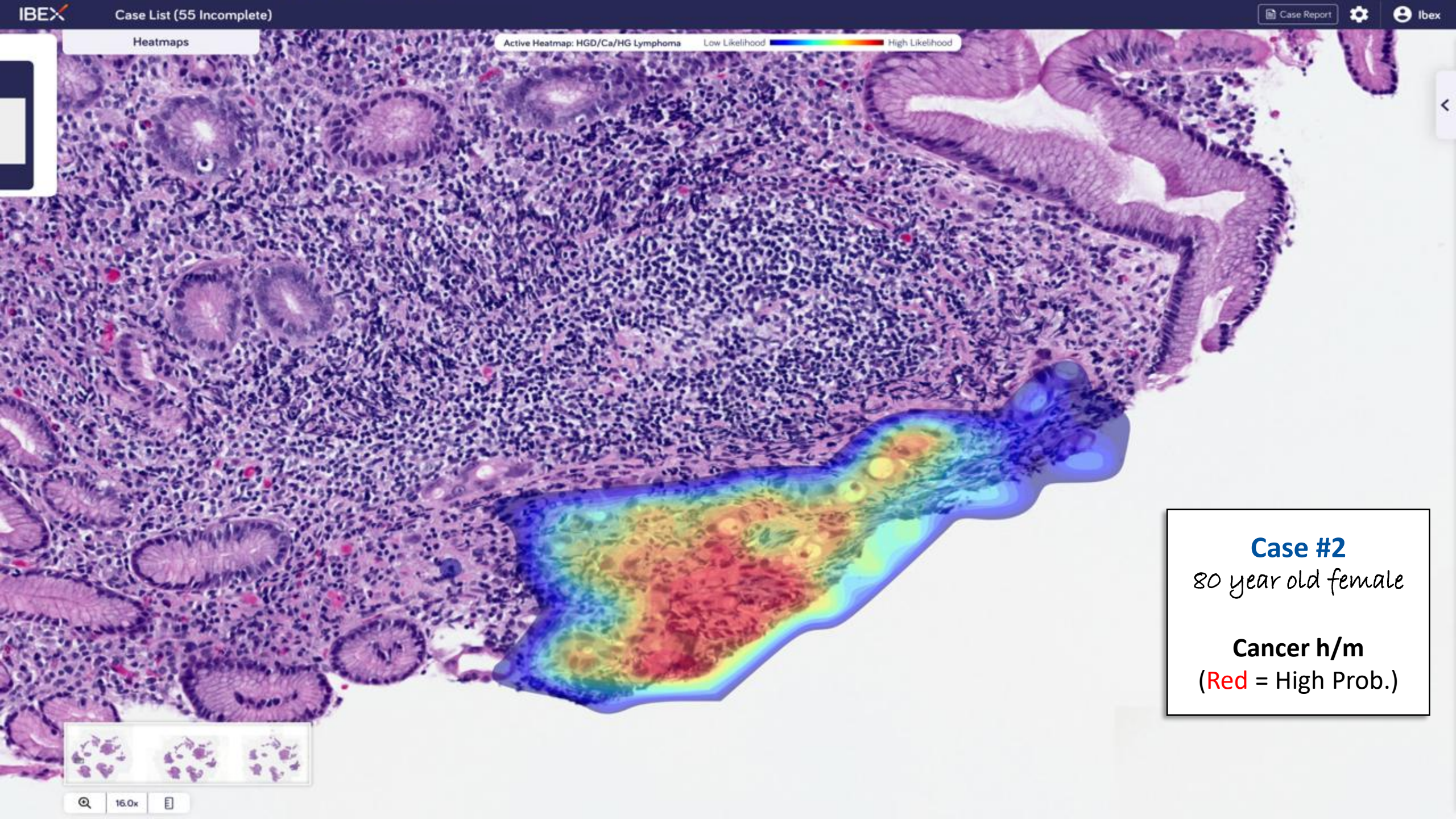
80 year old female

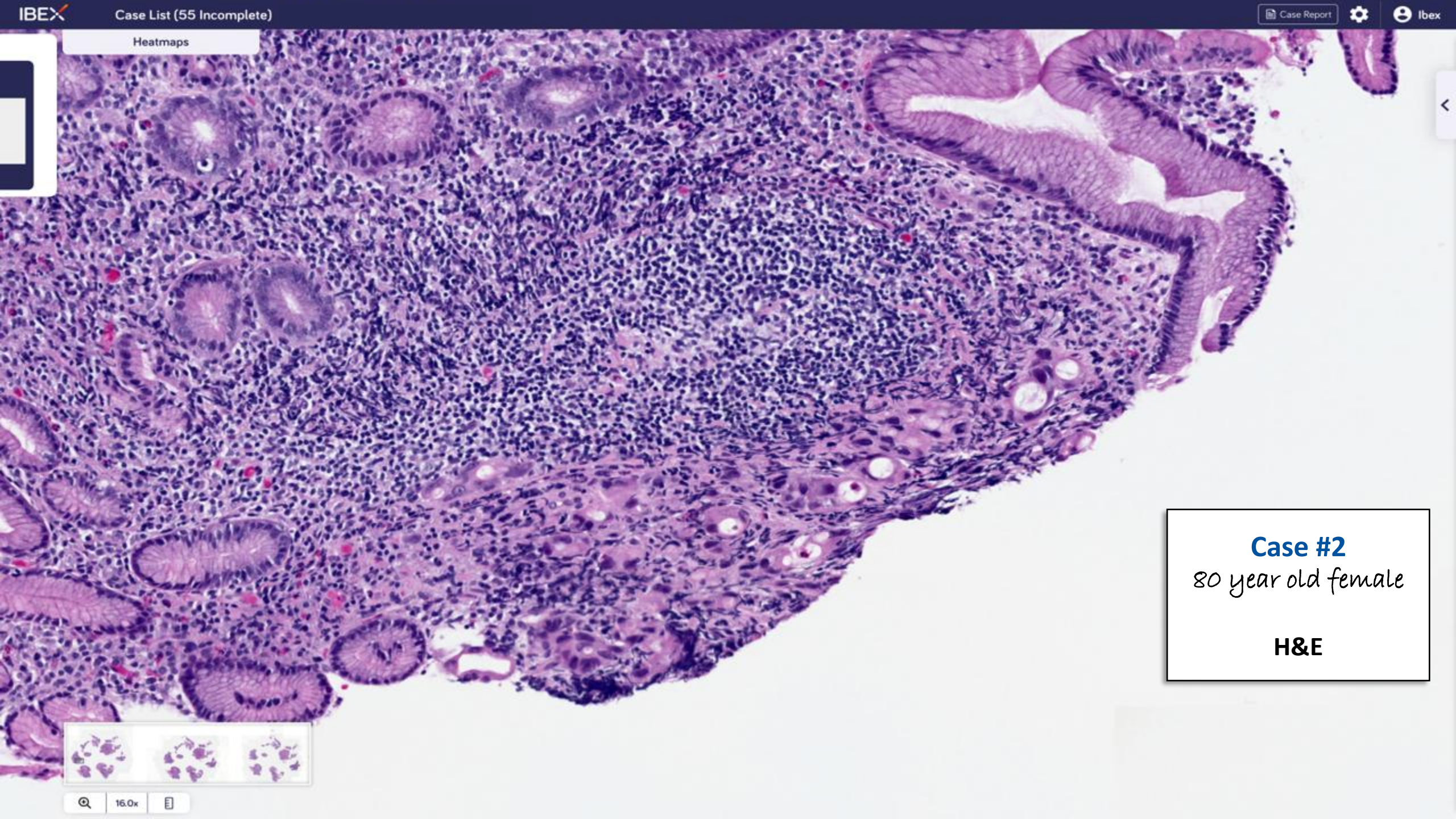
CD20

Case #2

80 year old female

Cytokeratin AE1/3


IBEX
Case List (55 Incomplete)
Case Report
Ibex
Heatmaps
Active Heatmap: HGD/Ca/HG Lymphoma
Low Likelihood
High Likelihood
16.0x
Case #2
80 year old female
Cancer h/m
(Red = High Prob.)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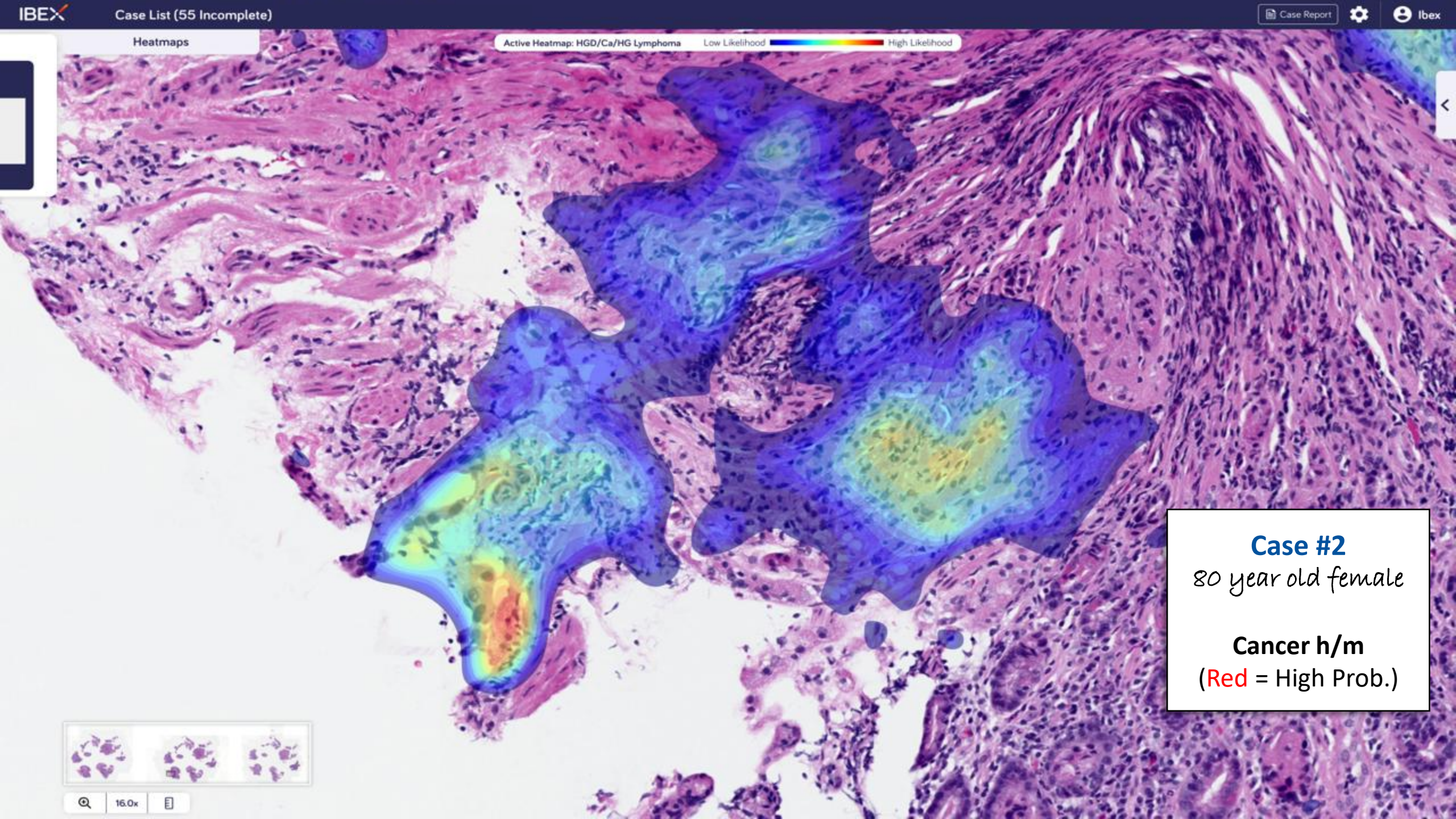
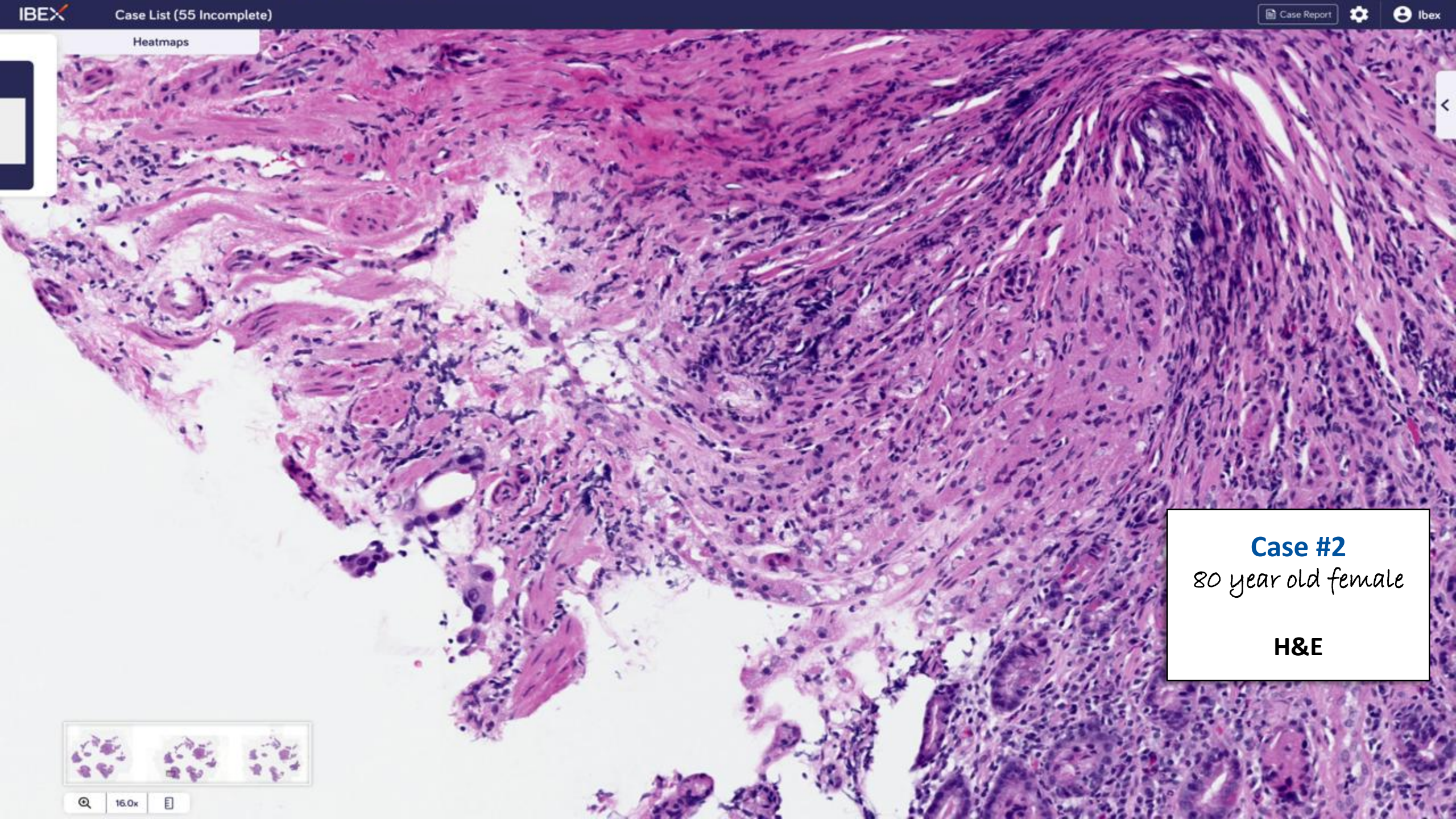
Case List (55 Incomplete)
Case Report
Ibex
Heatmaps
16.0x
Case #2
80 year old female
H&E


IBEX
Case List (55 Incomplete)
Case Report
Ibex
Heatmaps
Active Heatmap: HGD/Ca/HG Lymphoma
Low Likelihood
High Likelihood
16.0x
Case #2
80 year old female
Cancer h/m
(Red = High Prob.)


IBEX
Case List (55 Incomplete)
Case Report
Ibex
Heatmaps
16.0x
Case #2
80 year old female
H&E

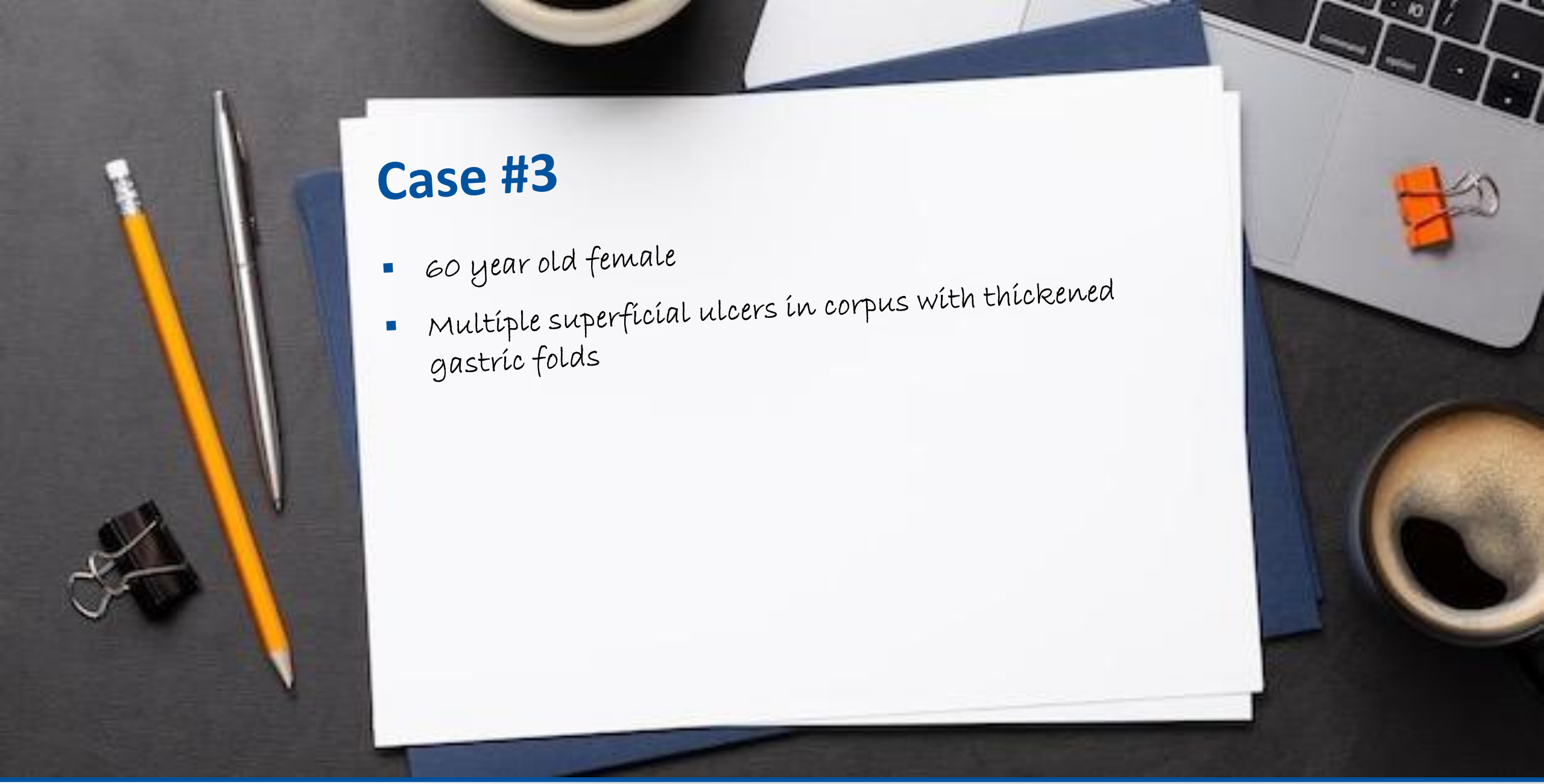
Case #2

Summary and learning points

- 80 year old female
- Helicobacter pylori gastritis
- Low grade MALT lymphoma with synchronous adenocarcinoma
- H. pylori eradication can be effective treatment f… stage MALT lymphoma

Ibex AI sensitive for H. pylori gastritis, lymphoma & small foci of adenocarcinoma

Ibex AI seems particularly good at finding cancer, even in crush artefact



Case #3

- 60 year old female
- Multiple superficial ulcers in corpus with thickened gastric folds

Heatmaps

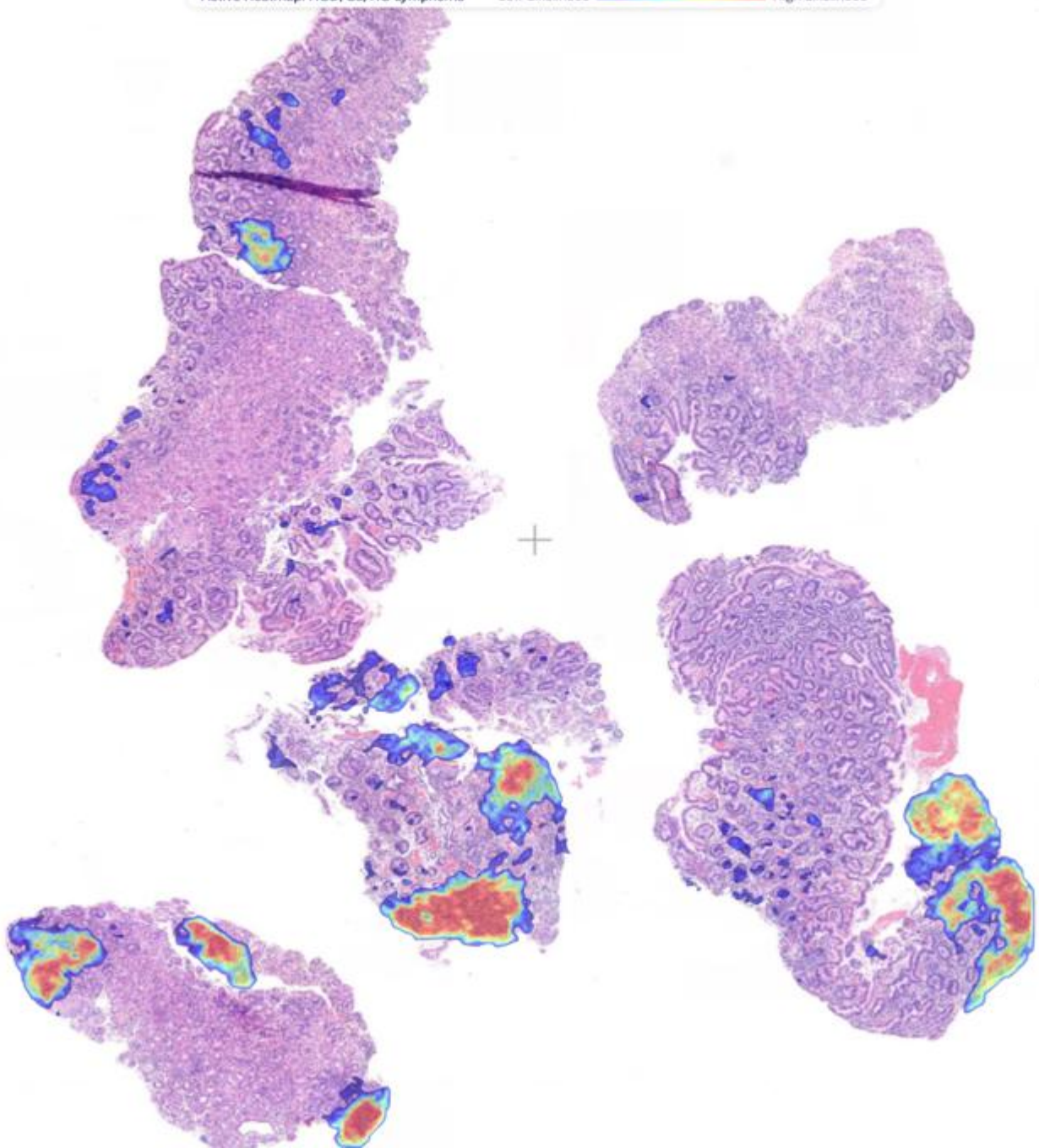
Active Heatmap: HGD/Ca/HG Lymphoma Low Likelihood High Likelihood

Case #3

60 year old female

Cancer h/m

(Red = High Prob.)



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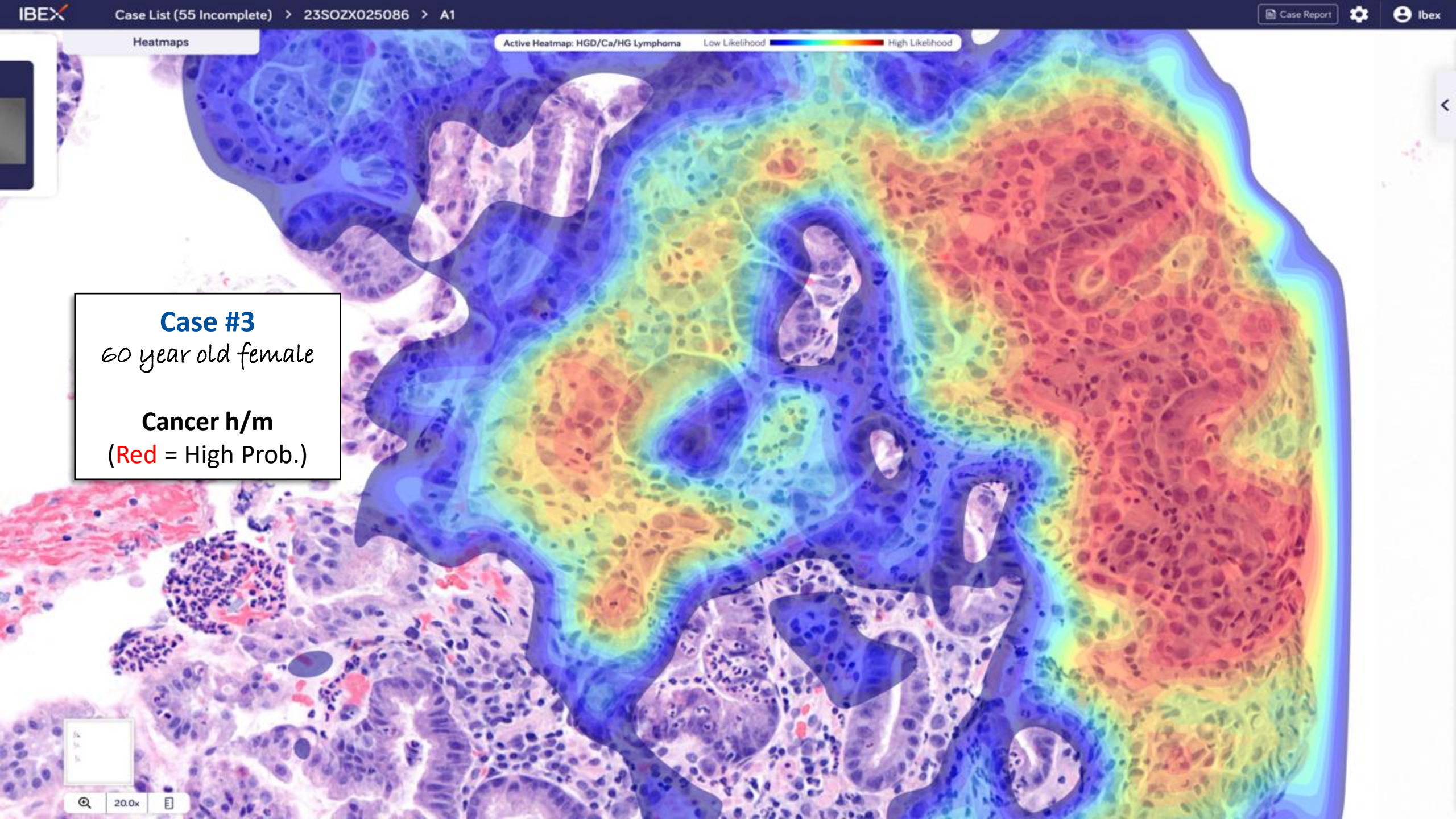
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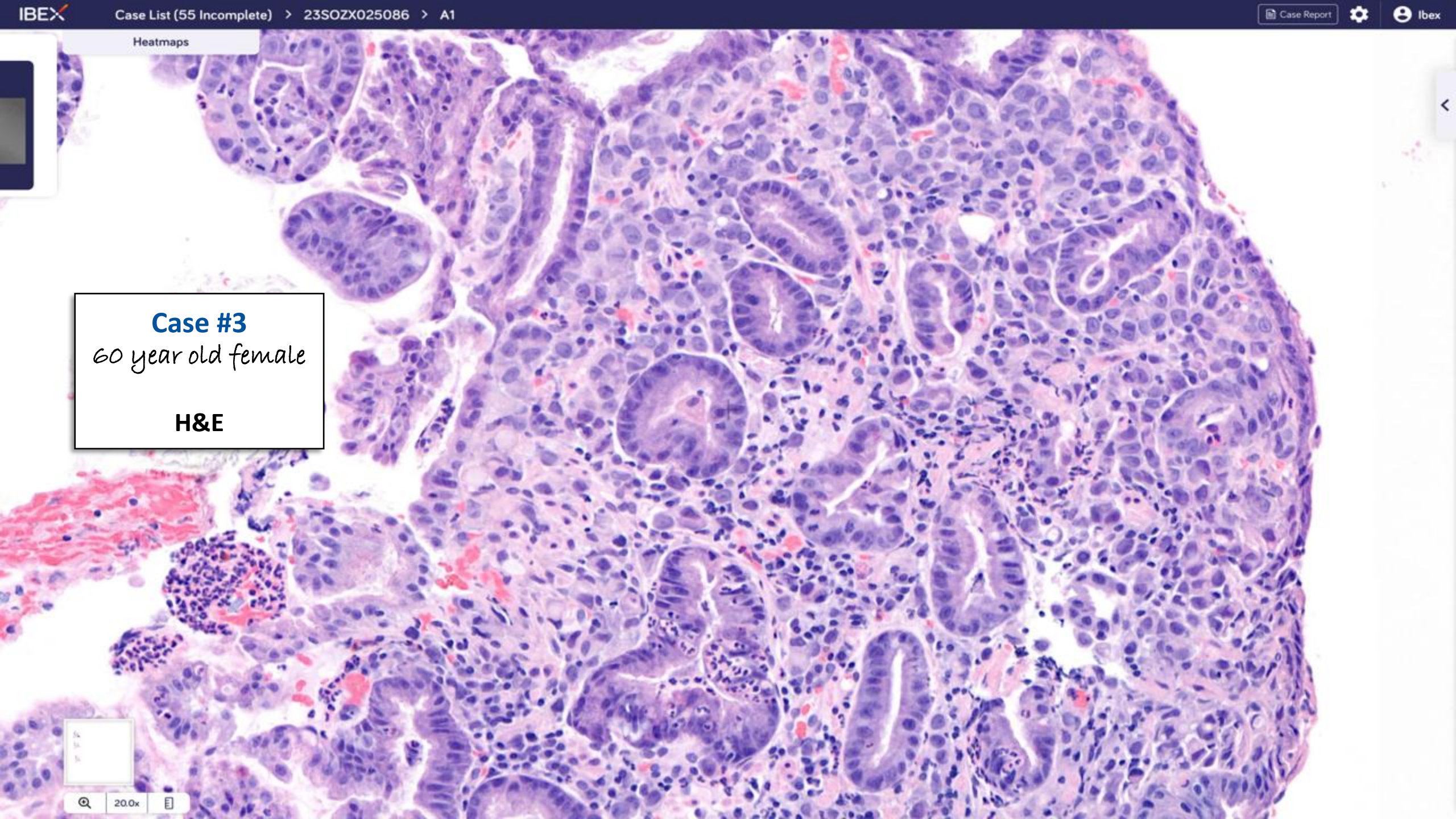
Case Report
Ibex
Heatmaps
Active Heatmap: HGD/Ca/HG Lymphoma
Low Likelihood
High Likelihood
Case #3
60 year old female
Cancer h/m
(Red = High Prob.)
20.0x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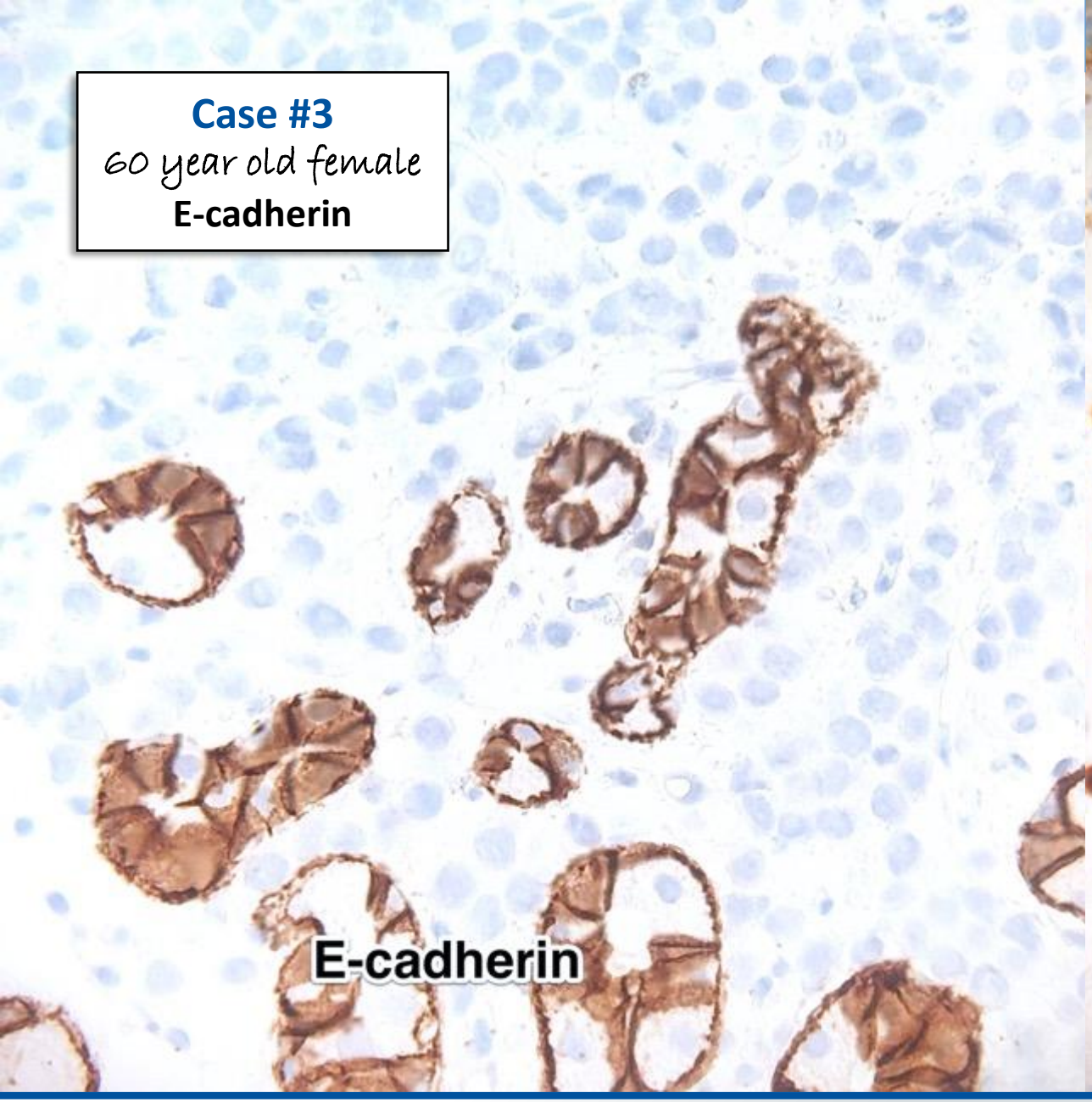
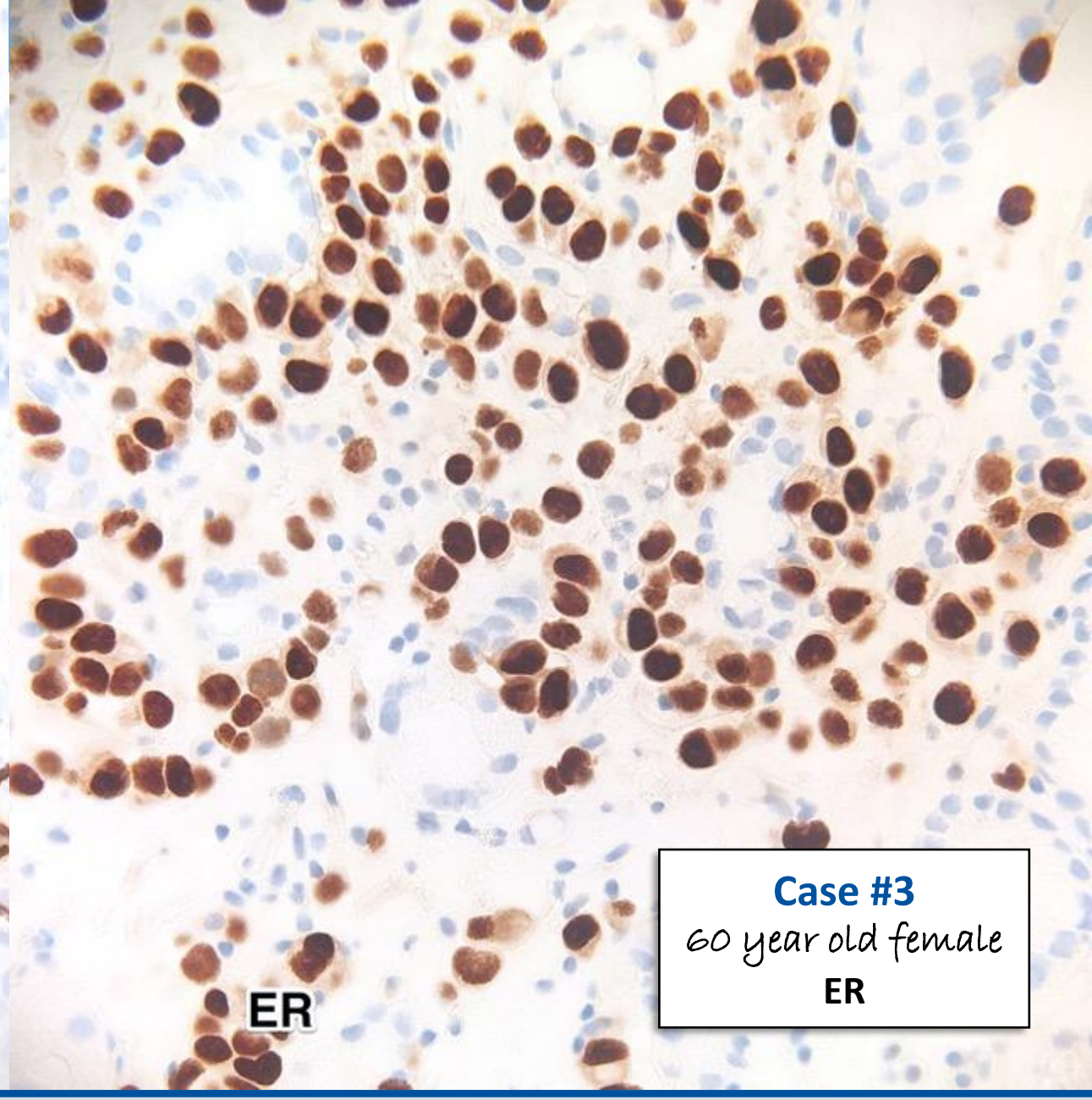
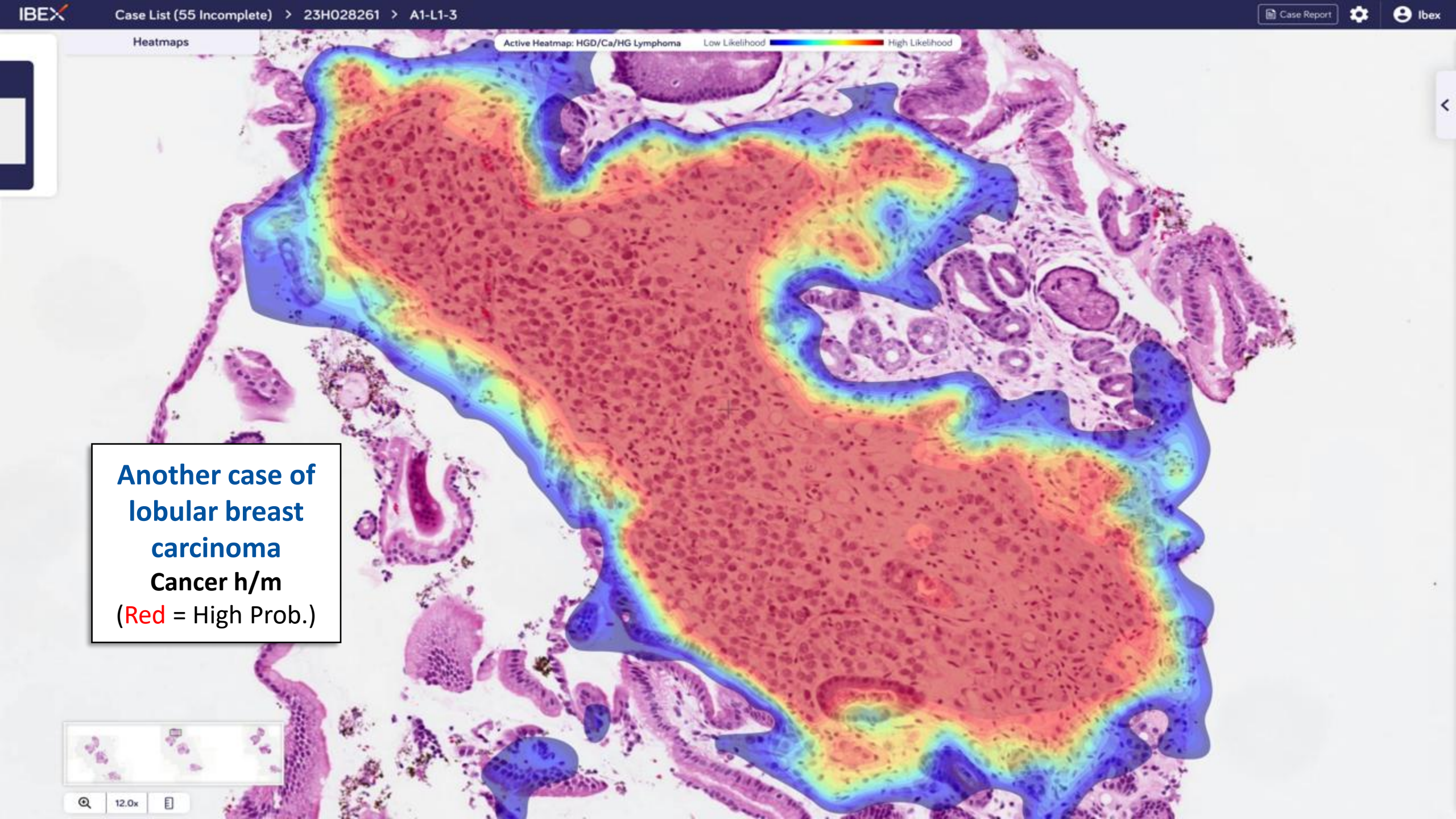
Case List (55 Incomplete) > 23SOZX025086 > A1
Case Report
Ibex
Heatmaps
Case #3
60 year old female
H&E
20.0x

Case #3
60 year old female
E-cadherin





Case #3
60 year old female
ER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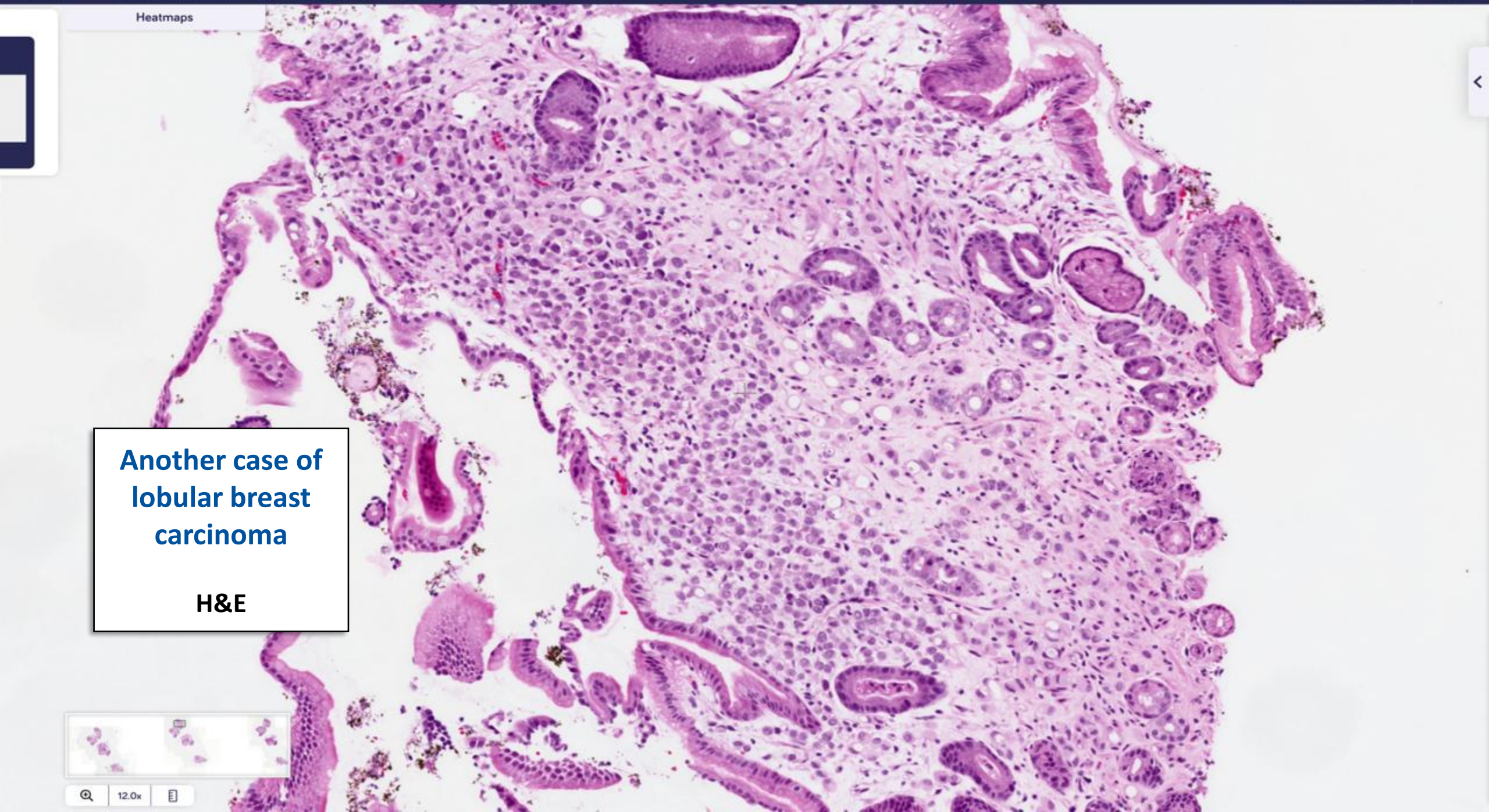
Case Report
Ibex
Heatmaps
Active Heatmap: HGD/Ca/HG Lymphoma
Low Likelihood
High Likelihood
Another case of lobular breast carcinoma
Cancer h/m
(Red = High Prob.)
12.0x


Heatmaps
Another case of lobular breast carcinoma
H&E
12.0x


IBEX
Case List (55 Incomplete) > 23H028261 > A1-L1-3
Case Report
Ibex
Heatmaps
Another case of lobular breast carcinoma
H&E
Classical signet ring cells
64.0x

Case #3

Summary and learning points

- 60 year old female
- Metastatic Lobular Breast Carcinoma mimicking diffuse gastric cancer
- May not be suspected clinically and can also mimic primary gastric cancer on scans (linitis plastica)
- Pathologists must be aware of this to help avoid unnecessary surgery
- Although rare, direct spread / metastasis of other cancer types to the stomach does occur and may be difficult to identify in biopsy material

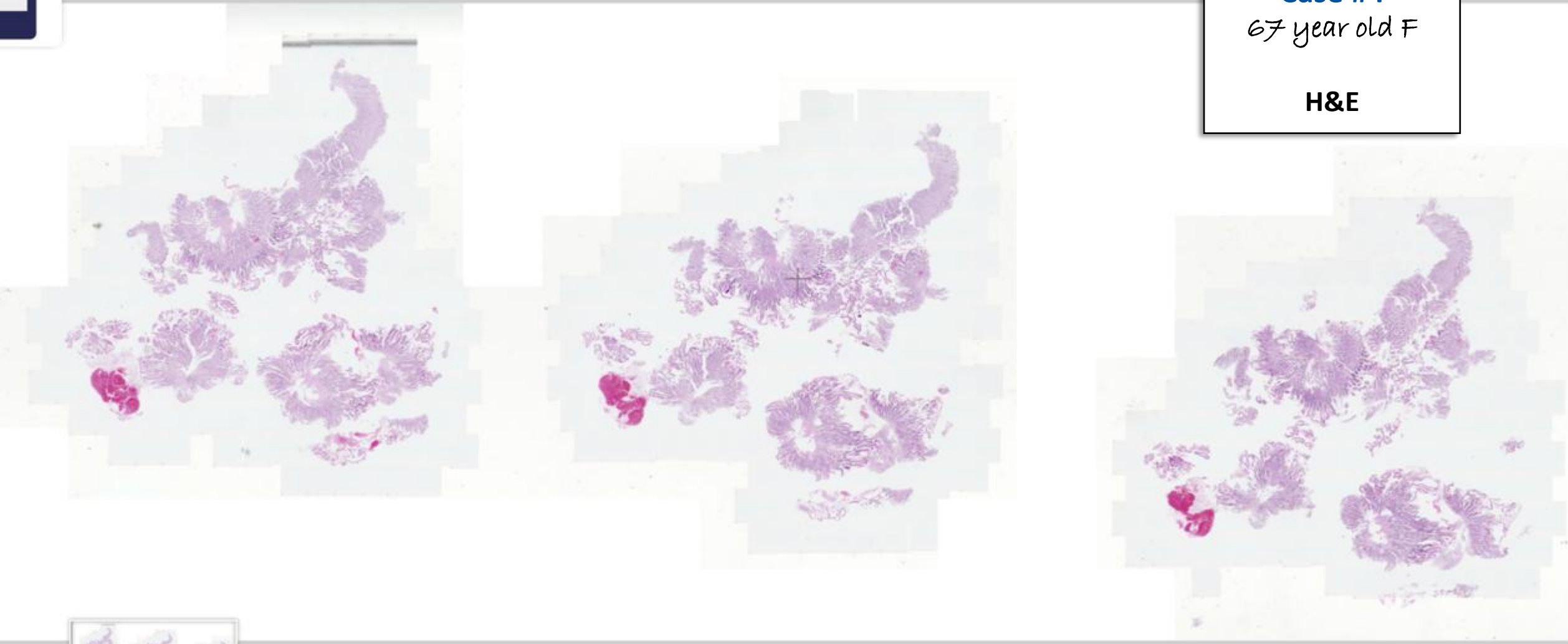
Ibex AI is able to recognise metastatic breast cancer

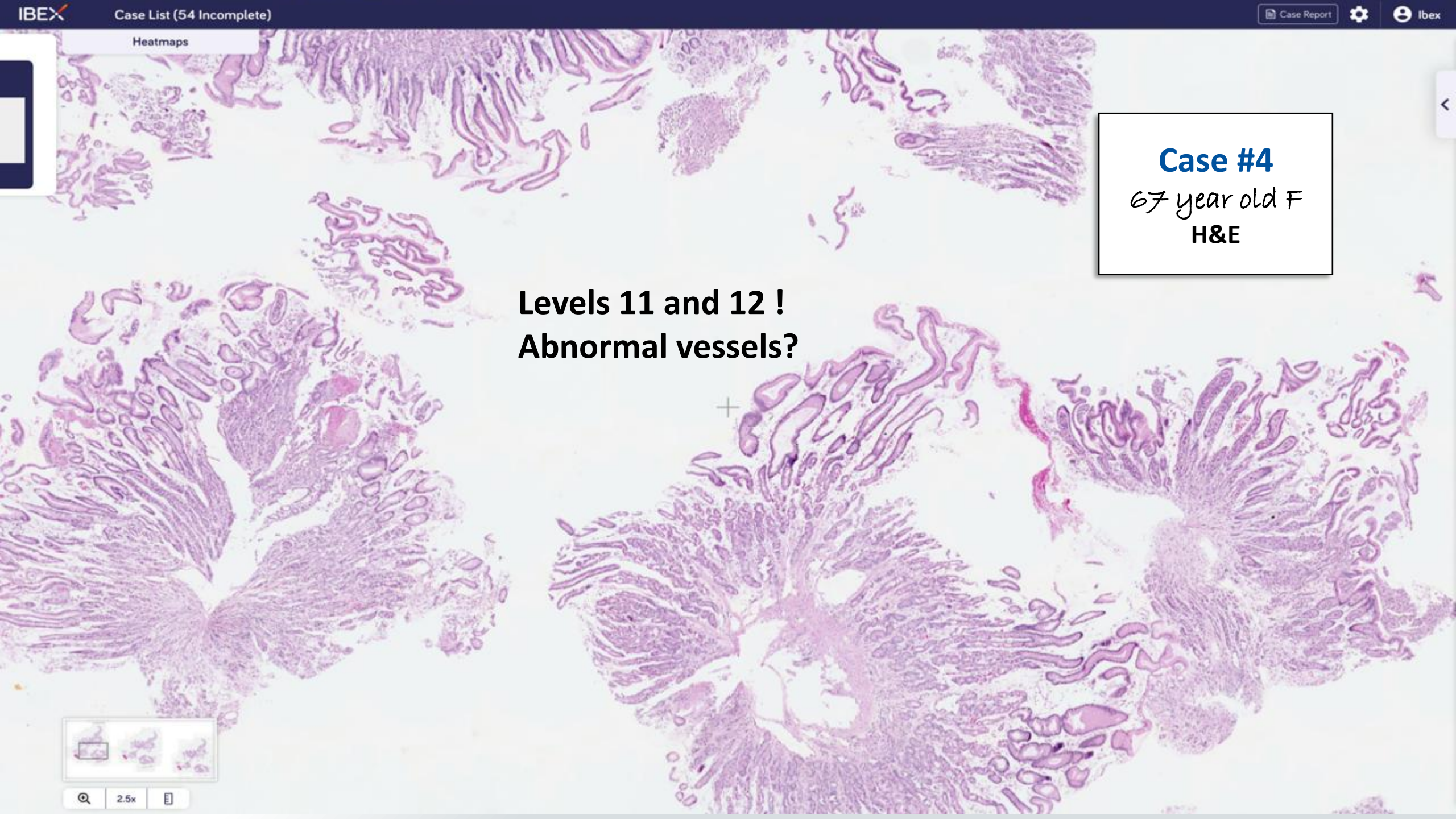
Case #4

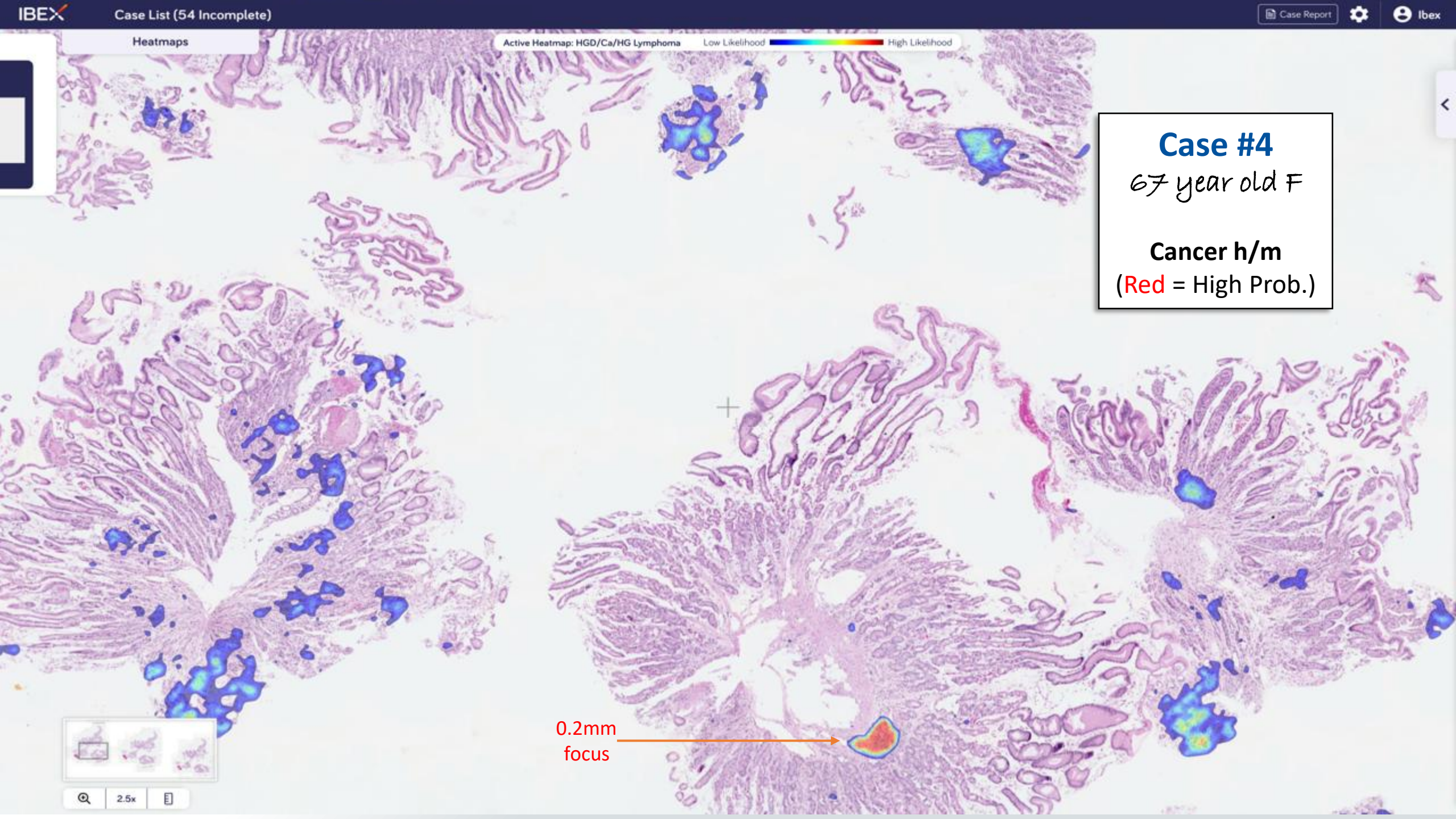
- 67 year old female
- Suspected primary gastric cancer
- Linitis plastica features on CT

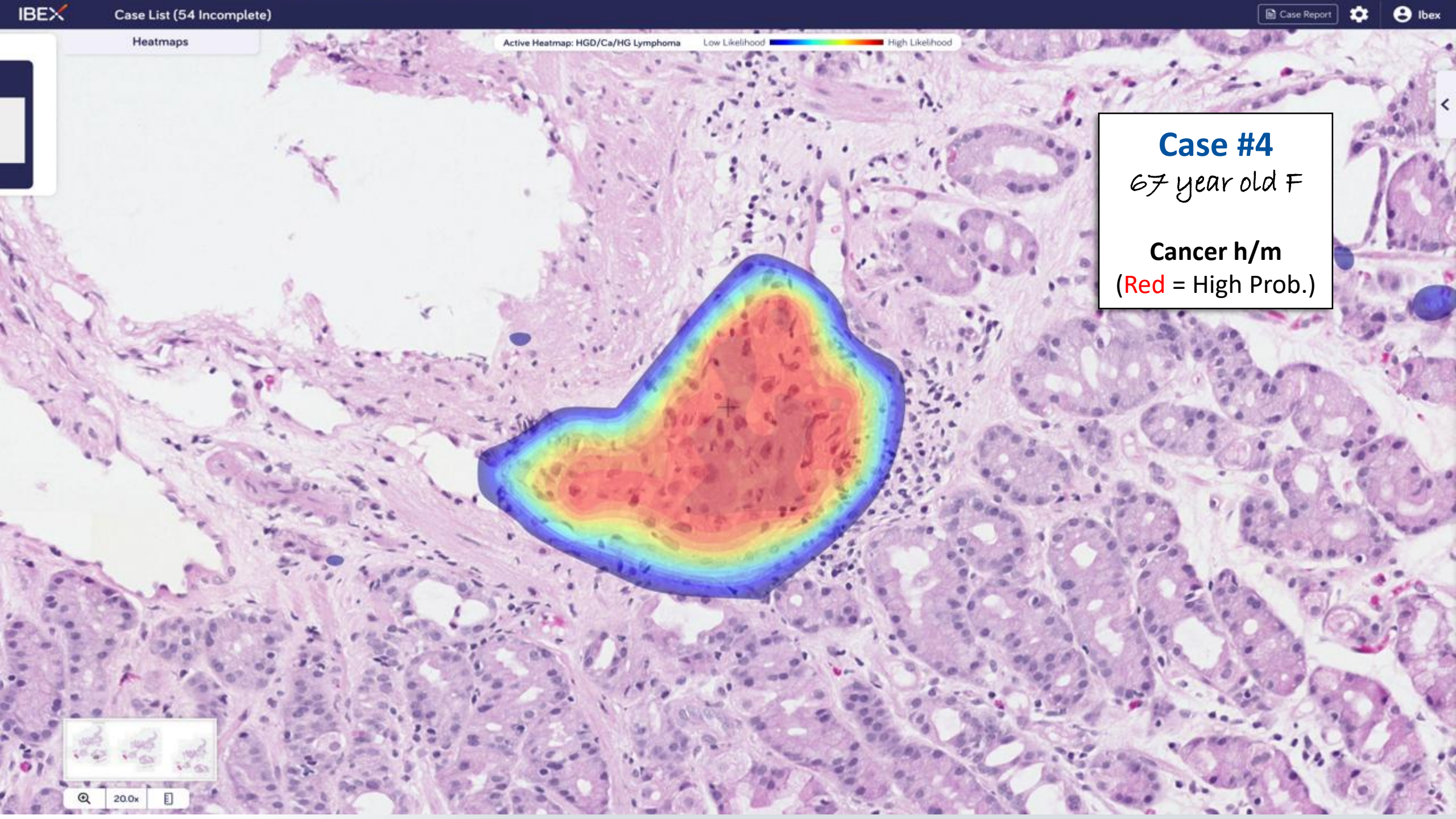
Case #4
67 year old F

H&E

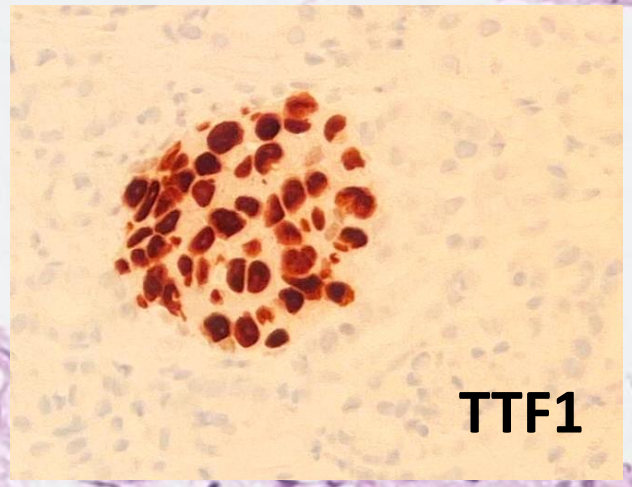



IBEX
Case List (54 Incomplete)
Case Report
Ibex
Heatmaps
Case #4
67 year old F
H&E
Levels 11 and 12 !
Abnormal vessels?
2.5x


IBEX
Case List (54 Incomplete)
Case Report
Ibex
Heatmaps
Active Heatmap: HGD/Ca/HG Lymphoma
Low Likelihood
High Likelihood
Case #4
67 year old F
Cancer h/m
(Red = High Prob.)
0.2mm
focus
2.5x


IBEX
Case List (54 Incomplete)
Case Report
Ibex
Heatmaps
Active Heatmap: HGD/Ca/HG Lymphoma
Low Likelihood
High Likelihood
Case #4
67 year old F
Cancer h/m
(Red = High Prob.)
20.0x

Heatmaps



Case #4

67 year old F

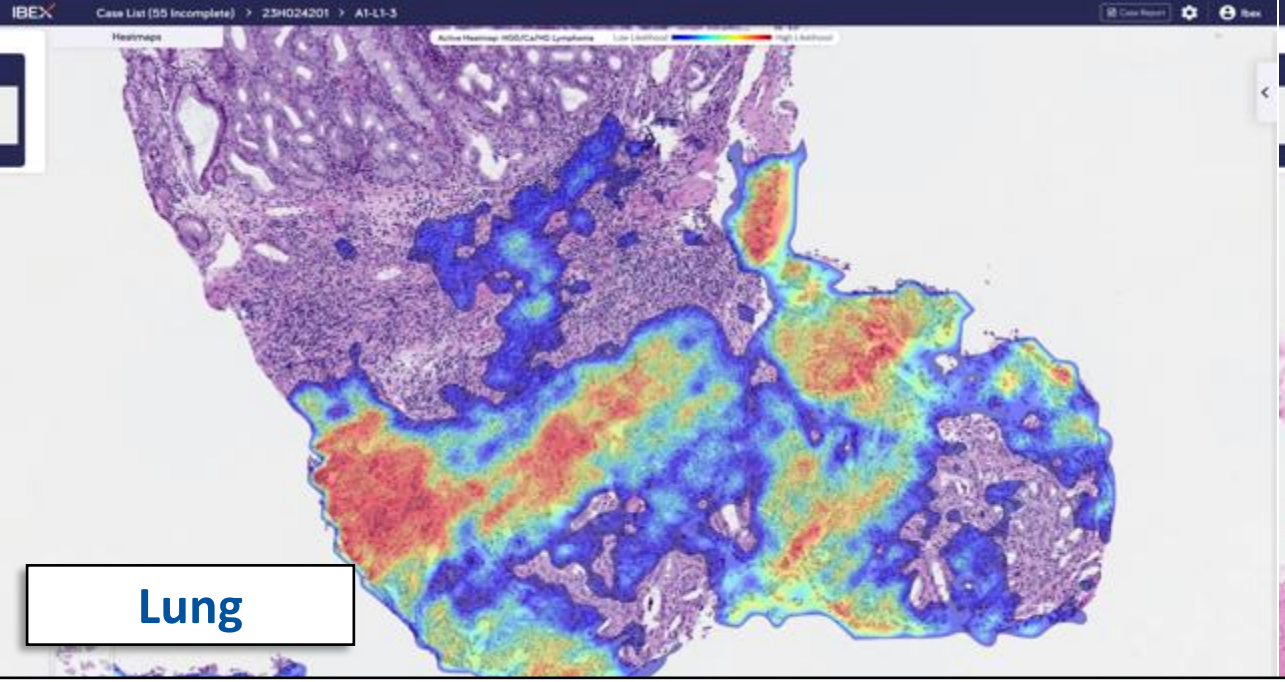
H&E

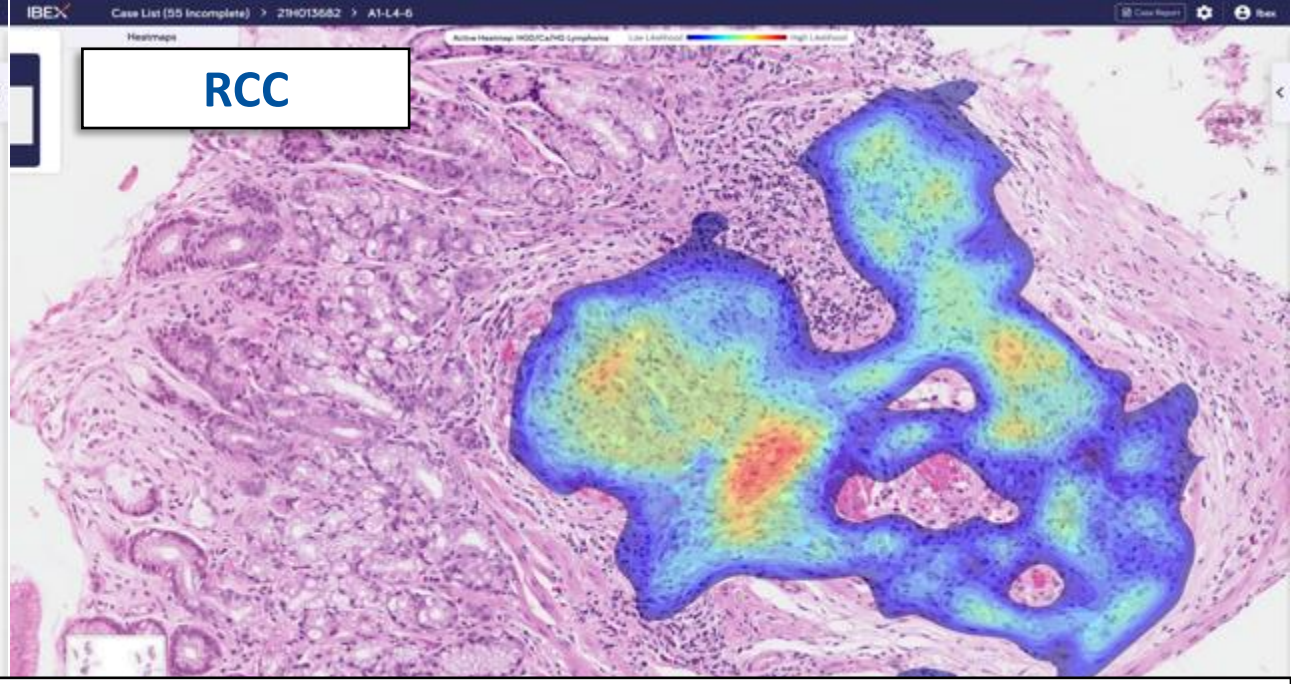
Case #4

Summary & learning points

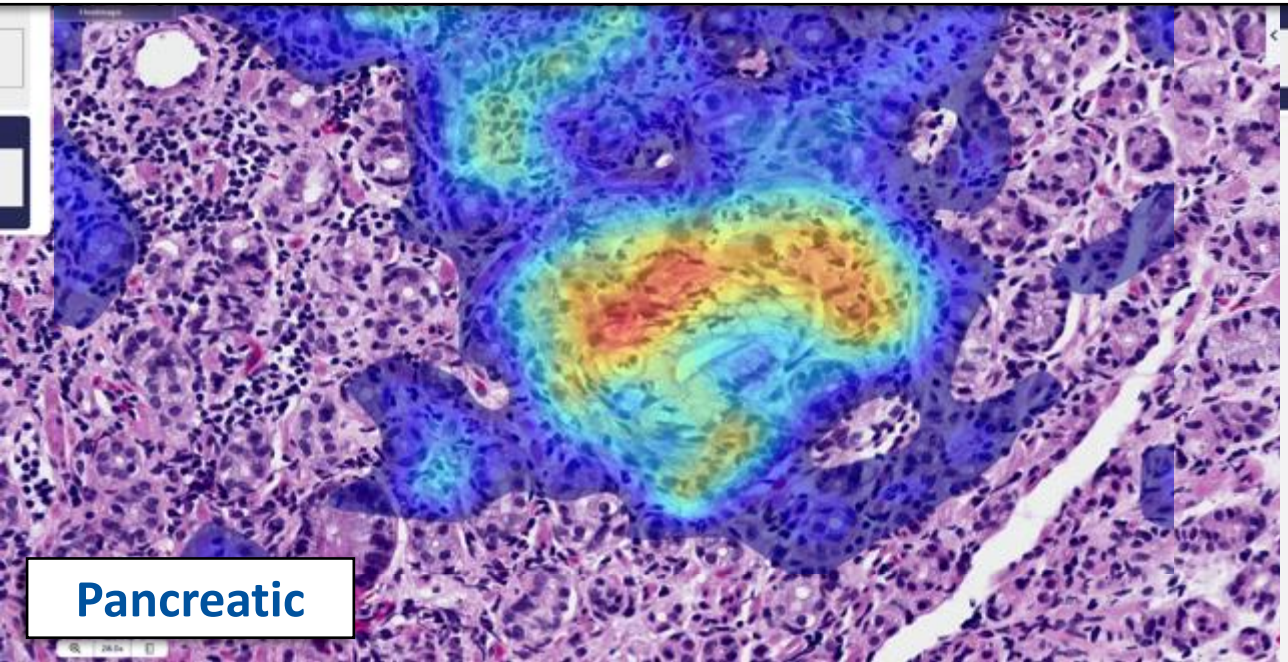
- 67 year female
- Suspected primary gastric cancer
- Metastatic lung cancer (entirely intravascular) mimicking linitis plastica primary gastric cancer!
- Previous lung cancer resection "up the road"!

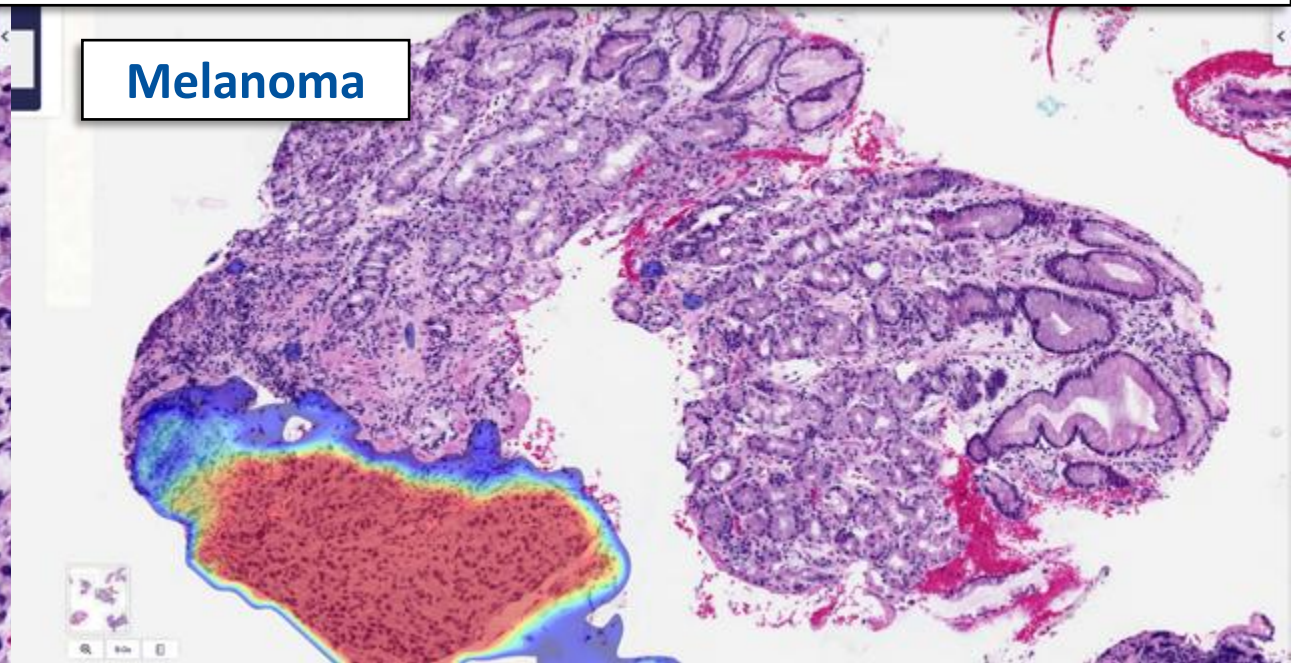
Ibex AI is very sensitive for detecting tiny foci of cancer easily overlooked by a busy pathologist



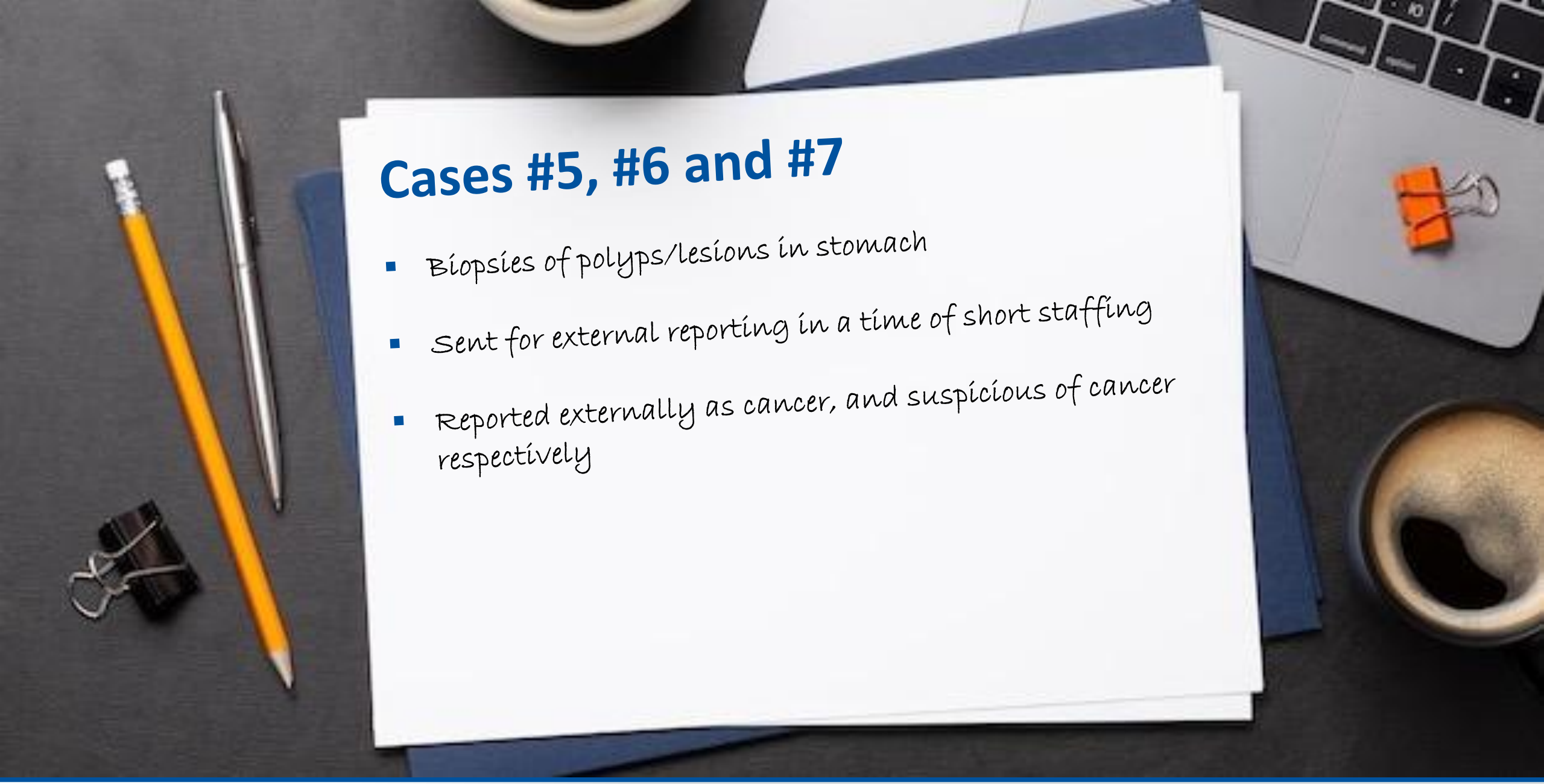


Metastatic spread of other cancer types to the stomach **Cancer h/m** (Red = High Prob.)





Could AI be *too sensitive* and call everything cancer?

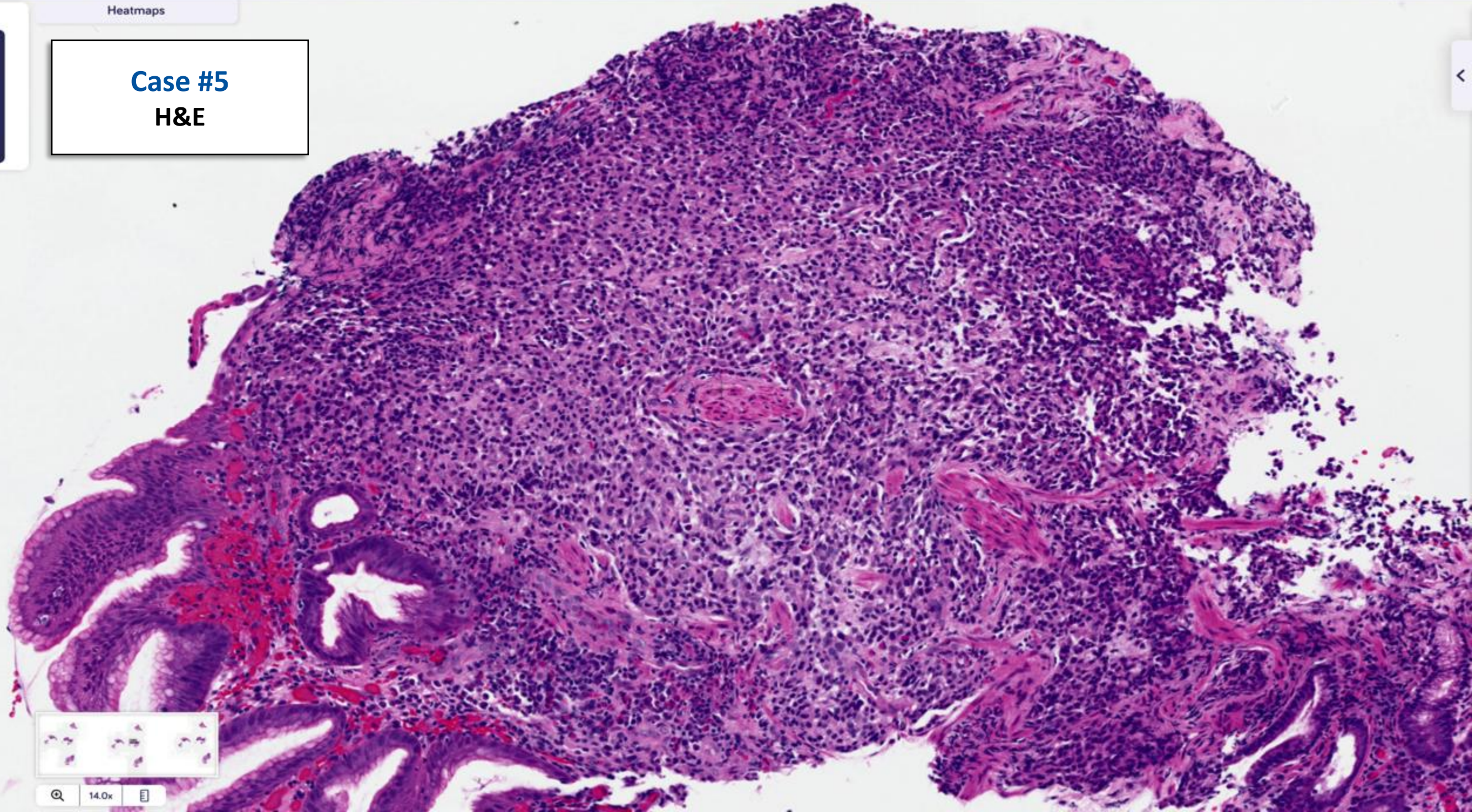


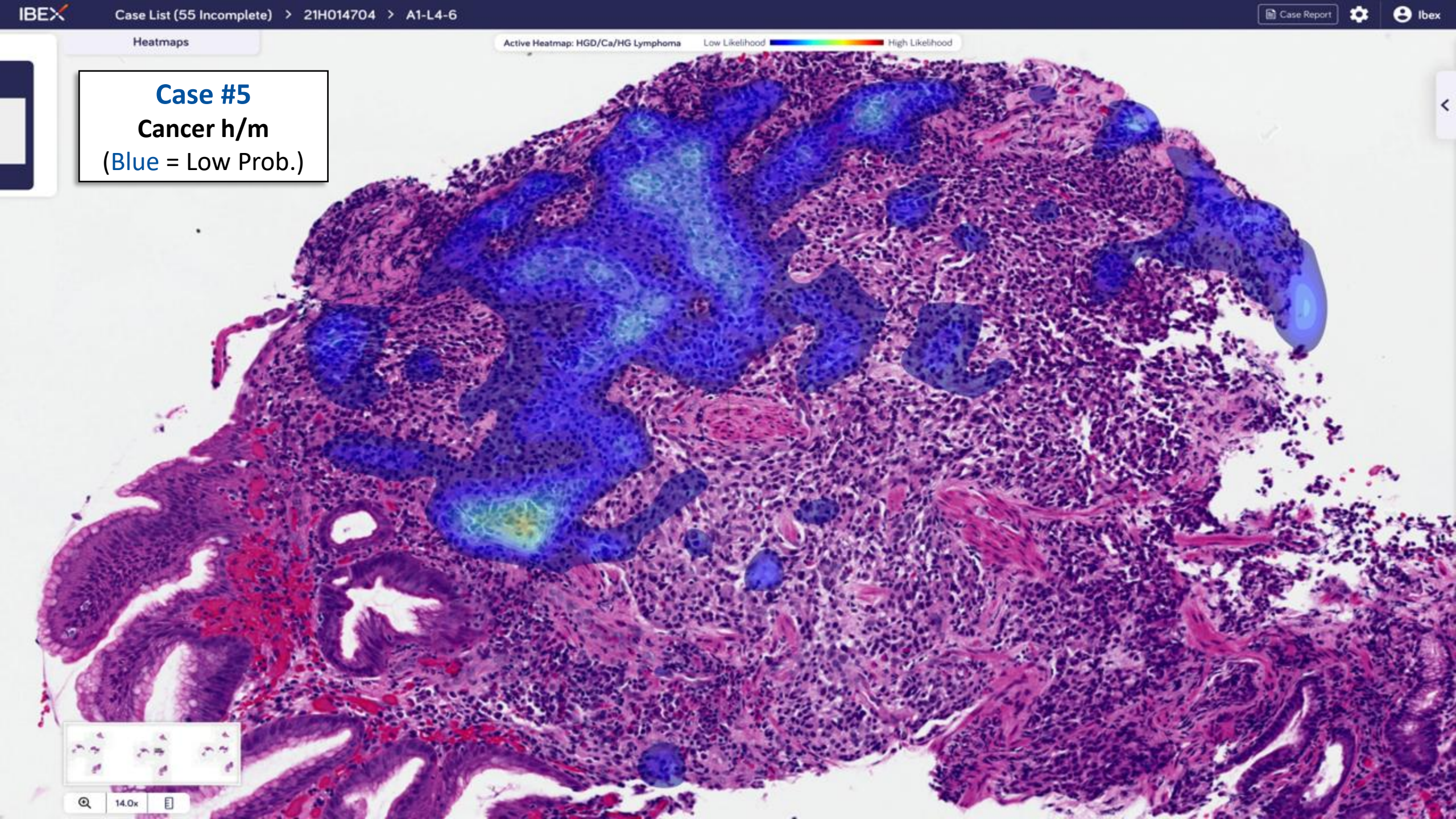
Cases #5, #6 and #7

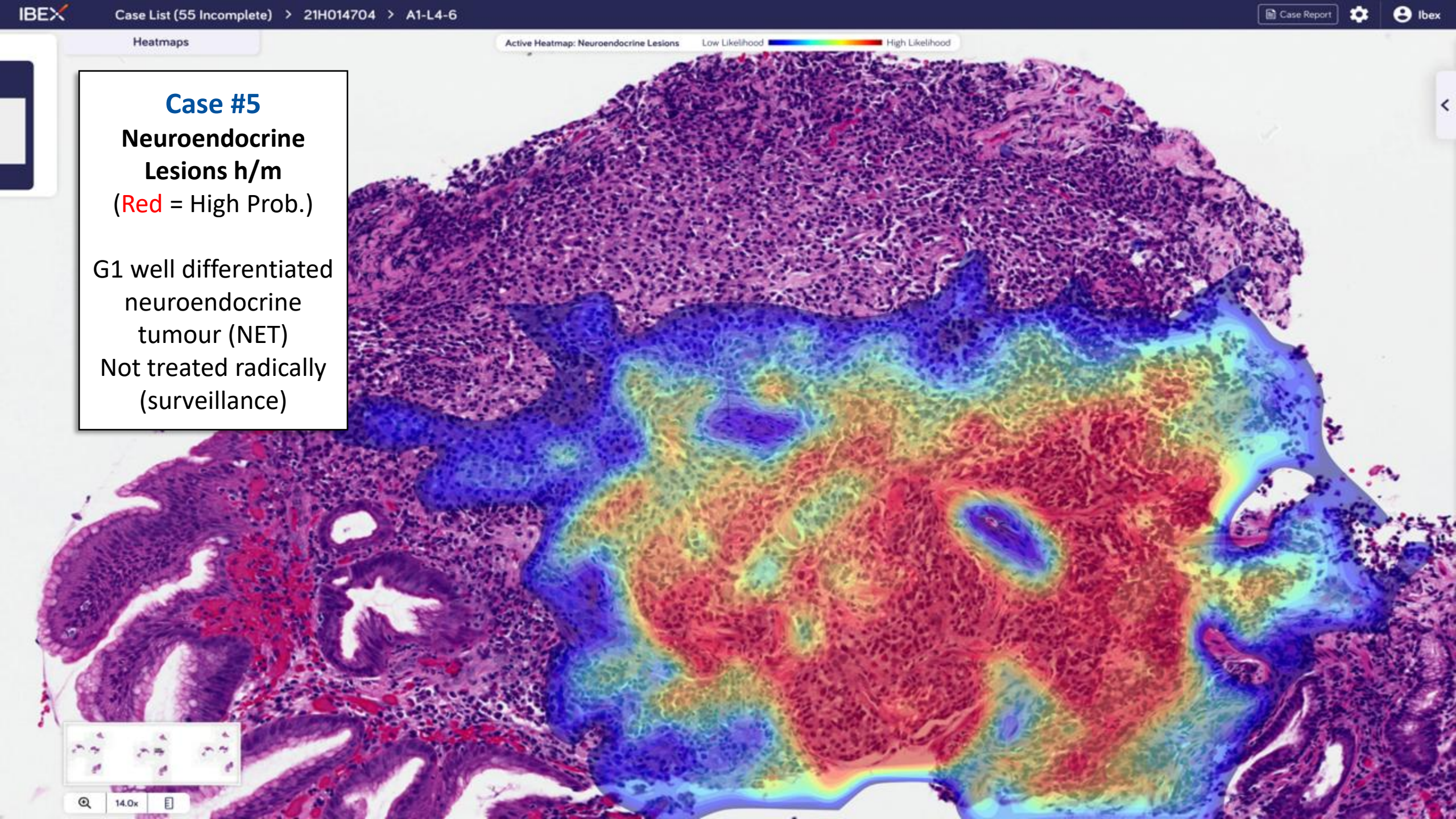
- Biopsies of polyps/lesions in stomach
- Sent for external reporting in a time of short staffing
- Reported externally as cancer, and suspicious of cancer respectively

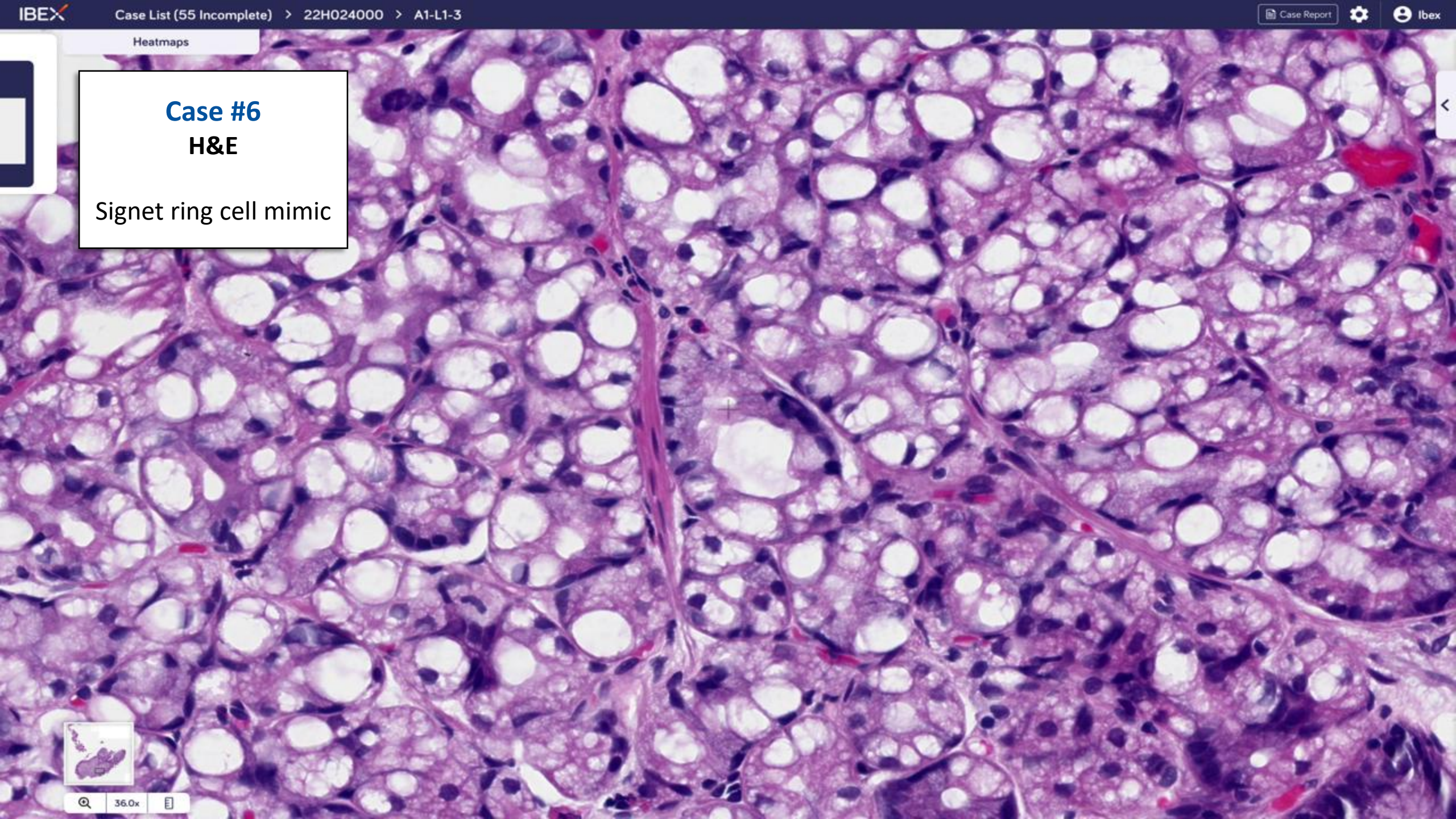
Heatmaps

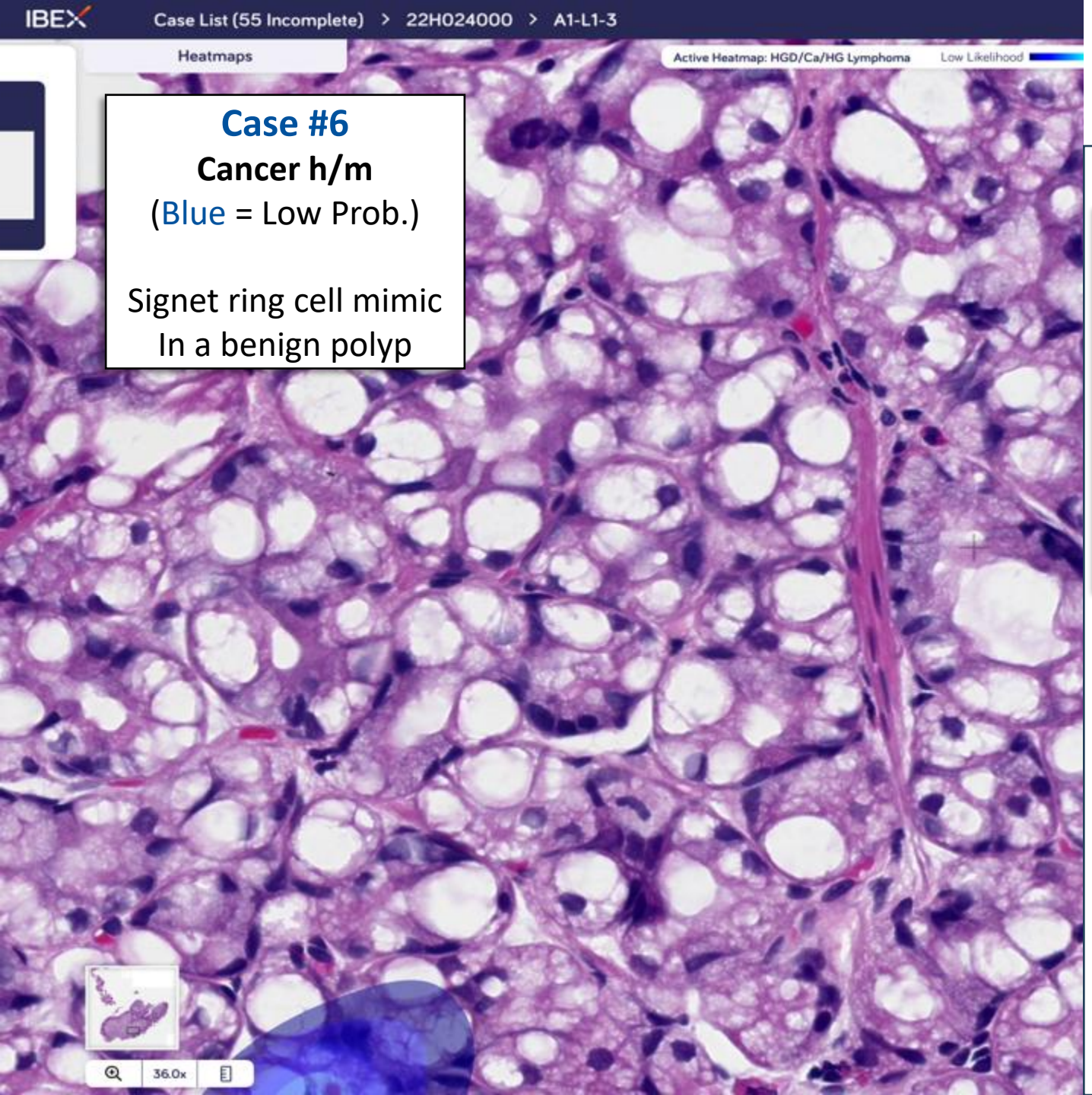
Case #5
H&E




IBEX
Case List (55 Incomplete) > 21H014704 > A1-L4-6
Case Report
Ibex
Heatmaps
Active Heatmap: HGD/Ca/HG Lymphoma
Low Likelihood
High Likelihood
Case #5
Cancer h/m
(Blue = Low Prob.)
14.0x


IBEX
Case List (55 Incomplete) > 21H014704 > A1-L4-6
Case Report
Ibex
Heatmaps
Active Heatmap: Neuroendocrine Lesions
Low Likelihood
High Likelihood
Case #5
Neuroendocrine Lesions h/m
(Red = High Prob.)
G1 well differentiated neuroendocrine tumour (NET)
Not treated radically (surveillance)
14.0x


IBEX
Case List (55 Incomplete) > 22H024000 > A1-L1-3
Case Report
Ibex
Heatmaps
Case #6
H&E
Signet ring cell mimic
36.0x



Histopathology

Histopathology 2013, 63, 735–737. DOI: 10.1111/his.12217

I concur that this clear cell change is an important diagnostic pitfall that pathologists should be aware of as part of the histological spectrum of proton pump inhibitor-induced change.

Runjan Chetty

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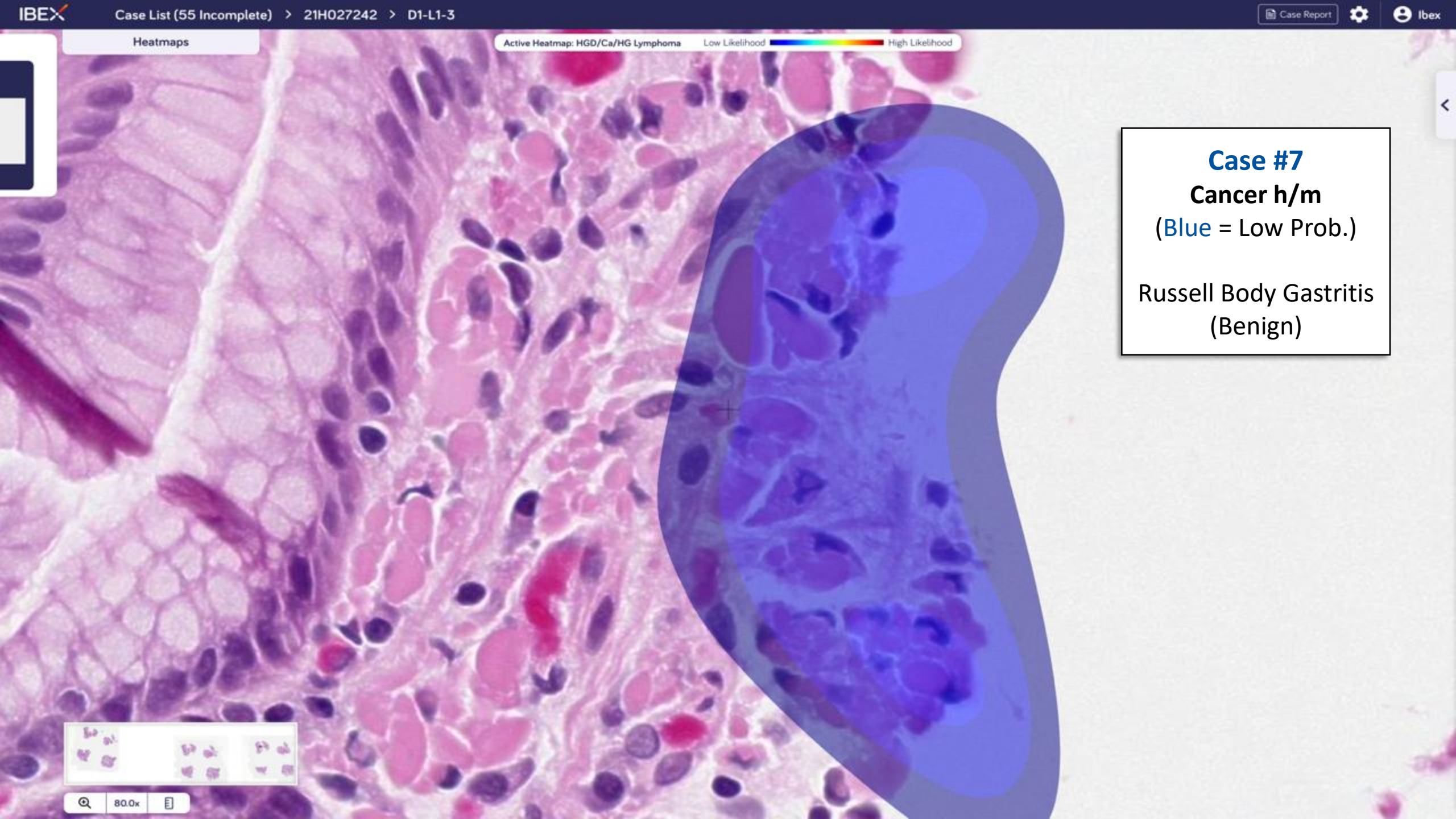
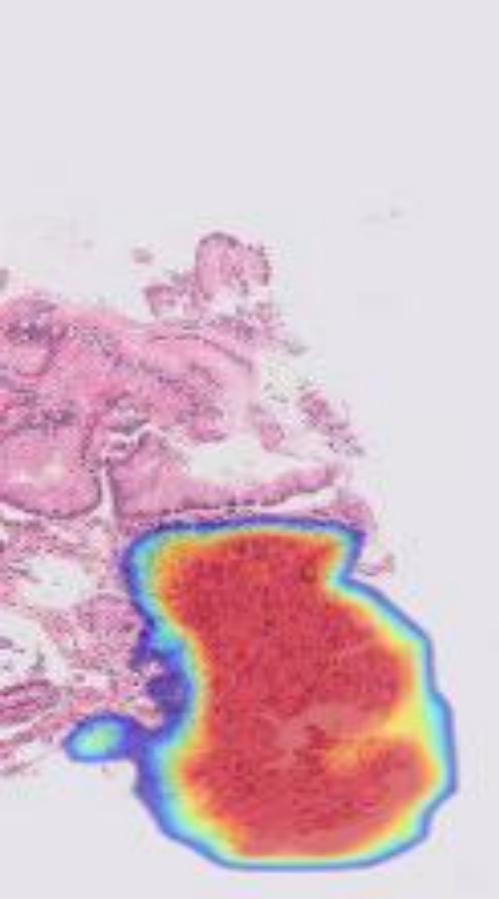
Endoscopic biopsies of the upper gastrointestinal tract account for a significant amount of workload for general and specialist histopathologists. The most common indications for gastric biopsy include diagnosis of various types of gastritis, peptic ulcer disease, confirmation of the presence of *Helicobacter pylori*, and neoplastic lesions. Histological recognition of subtle gastric mucosal infiltration by diffuse-type (signet-ring) adenocarcinoma is a well-recognized area of diagnostic difficulty. We present two examples of marked cytoplasmic vacuolation of parietal cells mimicking signet ring cell carcinoma.


IBEX
Case List (55 Incomplete) > 21H027242 > D1-L1-3
Case Report
Ibex
Heatmaps
Case #7
H&E
Russell Body Gastritis
(Benign)
80.0x

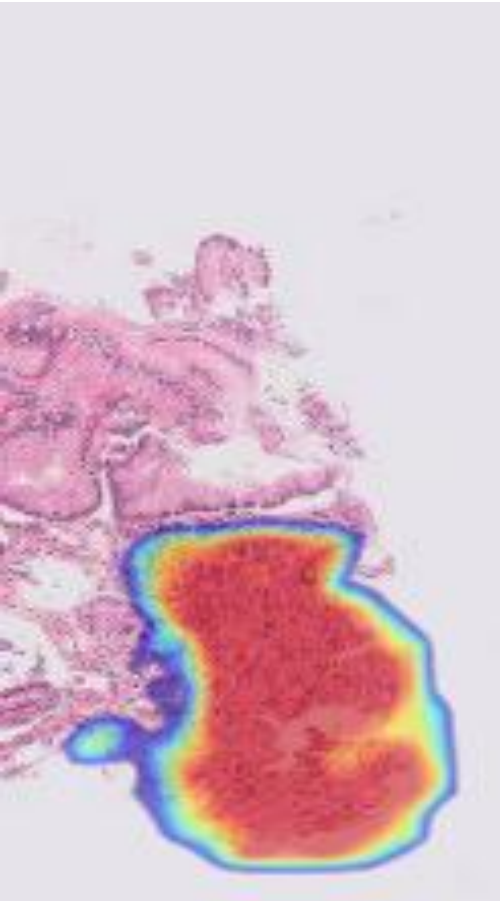

IBEX
Case List (55 Incomplete) > 21H027242 > D1-L1-3
Case Report
Ibex
Heatmaps
Active Heatmap: HGD/Ca/HG Lymphoma
Low Likelihood
High Likelihood
80.0x
Case #7
Cancer h/m
(Blue = Low Prob.)
Russell Body Gastritis
(Benign)

My experience of where the Ibex AI adds value for Gastric Biopsies



1) **Small focus** of signet ring diffuse gastric cancer
   - Identify, locate & quantify using the heatmap
2) **Complex pathology** (H.pylori gastritis, MALT lymphoma & adenocarcinoma) in same biopsy
   - Helps pathologist not overlook additional findings
3) **Malignancy of non-gastric origin** (e.g. breast cancer)
   - Lung, RCC, pancreatic & melanoma also detected
4) Well differentiated **Neuroendocrine tumour**
   - Could be misinterpreted as poorly differentiated carcinoma but usually treated conservatively
5) **Mimics**: Benign & drug induced changes mimicking signet ring cells
   - Galen Gastric AI can be trained to recognise or ignore artefacts

How could Ibex AI benefit patients in South West Peninsula?



1) **Screening** batches of slides to detect cancer
2) Rapidly identifying & directing pathologists' **attention to benign & malignant features**
3) Enabling the generalist to **work as a specialist**
4) O**esophageal dysplasia**
   - "Expert" review is a limited and "retiring" resource
5) Morphological subtyping & **quantification**
6) Predicting **molecular phenotype from morphology**

Take Home Message

AI is a very powerful tool

"Guiding the Pathologist's eye"... and more?

Pathologist + AI

=

Best Possible Outcomes for Patients

Acknowledgements

Plymouth colleagues

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Daniel Ignatov
Sebastiaan Vroomen

Questions?