GENIUS – Feasibility and workflow study

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BACKGROUND

- Representatives from the 8 English laboratories invited by Hologic to a ‘Genius roundtable meeting’ May 2023
- Well attended, open and frank discussion about the stability, challenges facing CSP and whether digital reporting within gynae cytology could help address these potential concerns
- All the laboratories agreed a need for some English based studies to gather data

BACKGROUND – Where to start

- Potential of Digital
  - Ability to train staff remotely
  - Increase productivity and hence improve TAT
  - Strategic solution to backlogs
  - Manage increase in workloads (Self-sampling)
  - Maintain workforce should there be any further centralisation
  - Increase / maintain abnormal cell detection if prevalence drops due to vaccination
  - Standardise the Invasive Cancer Audit?
- A need to agree where to start - the first phase

Proposal – Initial phase to look at the workflow and compare timings between Manual screening and using the Genius system

- Agree a title
- Agree a protocol
- Avoid the requirement for ethical approval initially

A multi-centre feasibility and workflow study to evaluate the performance of cervical cancer screening utilising the Hologic Genius digital cytology system

- 2 sites – A and B
- HSL – Test = Imager stained slides reviewed via Genius. Control = Imager stained slides reviewed manually
- RDH – Test = Imager stained slides reviewed via Genius. Control = Pap stained slides reviewed manually

Case criteria

- Borderline: 100 cases (max.)
- Low Grade: 130 cases (max.)
- HG – Moderate: 130 cases (max.)
- HG – Severe: 130 cases (max.)
- Negative: 500 cases
- ?Glandular neoplasia: 5 cases (max.)
- Severe - ?InvasiveSCC: 5 cases (max.)

Laboratory Participants

- Principle Investigator
- Study Coordinator
- Primary Screeners – 4
- Consultant BMS - 2

Challenges

- How to pull samples to ensure we got the correct ratio of abnormals and negatives without requiring ethics approval Would parallel processing and reporting have helped this?
- How to decide which staff would participate in the study Need a balance – Good to have 'for' and 'against'
- How to record our findings and keep everyone's results blind to the other staff involved
  Lucky to have 2 x BMS to manage the data
- How do we find the time?
  Now, this was a struggle

Protocol

2 identical teams consisting of 2 x Primary screeners and

2 x CBMS. Both teams to participate equally in Manual Process and Genius review

1 x Primary screener left to relocate

1 x Primary screener had period of sickness

Fortunately, laboratory manager also undertook training so was able to step in

Protocol

	Retrieval of vials/slides*	
Group 1 – Set A 500 cases equal split Neg/Abn	All 1000 slides scanned on Genius scanner	Group 2 – Set B 500 cases equal split Neg/Abn
Genius – S1- Week 1 Primary screen 40 cases QC 40 cases (Review tiles only)	Stopwatch – Time per case for both arms	Manual – S3 – Week1 Primary screen 20 cases QC 20 cases
Genius – S2 - Week 1 Primary screen 40 cases QC 40 cases (Review tiles only)	Stopwatch – Time per case for both arms	Manual – S4 – Week1 Primary screen 20 cases QC 20 cases
Manual – S1 & S2 – Week 2 Follow same principle as Week 1	Stopwatch – Time per case for both arms	Genius – S3 & S4 – Week 2 Follow same principle as Week 1

Protocol cont.

Group 1 – Cytopathologist / Consultant BMS – Review of potential abnormal cases	Final Report	Group 2 – Cytopathologist / Consultant BMS – Review of potential abnormal cases

MANUAL ARM

- Primary screen
- Rapid review

Abnormals pulled out and passed to CBMS for manual screen (No dots added)

In retrospect should have mirrored routine screening and dotted the slides

GENIUS ARM

- Primary screener – Review all tiles presented by the Genius
- Rapid reviewer – Duplicate the Primary screener process

Any cases called abnormal were reviewed by CBMS (Again, no images of concern were marked and no comments were added)

In retrospect – Should we have ‘marked’ the tiles of concern?

EQUIPMENT

HOLOGIC

Engineered for Cytology. Optimized for Clinical Laboratories.

A complete digital cytology system, designed to increase workflow efficiencies, improve collaboration, and drive more actionable insights — **for enhanced patient care.**[2]

Genius™ Digital Imager[2]

Capture

Advanced volumetric imaging technology quickly captures digital images with exceptional image clarity.

Genius™ Cervical AI[2]

Detect

Deep learning-based artificial intelligence (AI) – designed to accurately detect pre-cancerous lesions and cervical cancer cells – enabling targeted and efficient slide review.

Genius™ Image Management Server (IMS)[3]

Store

Securely store digital images. Radically transform workflow with digital case movement, promoting enhanced efficiency.

Genius™ Review Station[1]

Review

Seamless and dynamic collaboration with remote digital case review.

1 Genius Review Station Operator's Manual MAN-08802-001. Rev 003. Hologic, Inc; 2023.
2. Genius Digital Imager Operator's Manual MAN-08801-001. Rev 002. Hologic, Inc; 2023.
3. Genius Image Management Server Dashboard User's Manual MAN-08800-001. Rev. 002. Hologic, Inc; 2023

*Genius Digital Diagnostics is CE-marked for diagnostic use in Europe. May not be available in all markets. Contact your local Hologic representative for availability in your country.

Genius™ Digital Diagnostics

Scanner

Capacity – 400 slides – Continuous loading

Scan time per slide – 2 minutes

Scanner – Feedback from User - General

Very easy to use overall

Simple user interface with easy navigation of menu and options

Easy to load slide racks into the holders – Has a system that highlights if racks are in the incorrect orientation

Clearly shows progress and highlights any errors

Slides with errors can be easily identified for reprocessing

Scanner – Feedback from User - Considerations

- Slides need to be mounted and dried thoroughly before scanning
- Need to manually check that no slides were stuck together in the racks before scanning
- 9 of the 1000 cases had an image error and could not be scanned – Thick preparations with a mucoid background

Logistics / Practicalities

- 4 review stations sited on Cytoscreener/BMS desks
- Availability of a workstation was a problem for the 2 CBMS. Review stations had to fit around the staff Screener/BMS team participating - Early morning or late in the day

TRAINING - 2 day programme

DAY 1

Presentation – Digital Overview

Review of known ‘normal’ cases – 20 cases

Review of known ‘abnormal’ cases – 25 cases

Competency assessment + Review – 20 cases

Evaluation sets 1 & 2 + Reviews – 2 x 20 cases

TRAINING

DAY 2

Review of day 1 – Q+A

Evaluation sets 3 & 4 + Reviews – 2 x 15 cases

Final competency assessment + Review – 20 cases

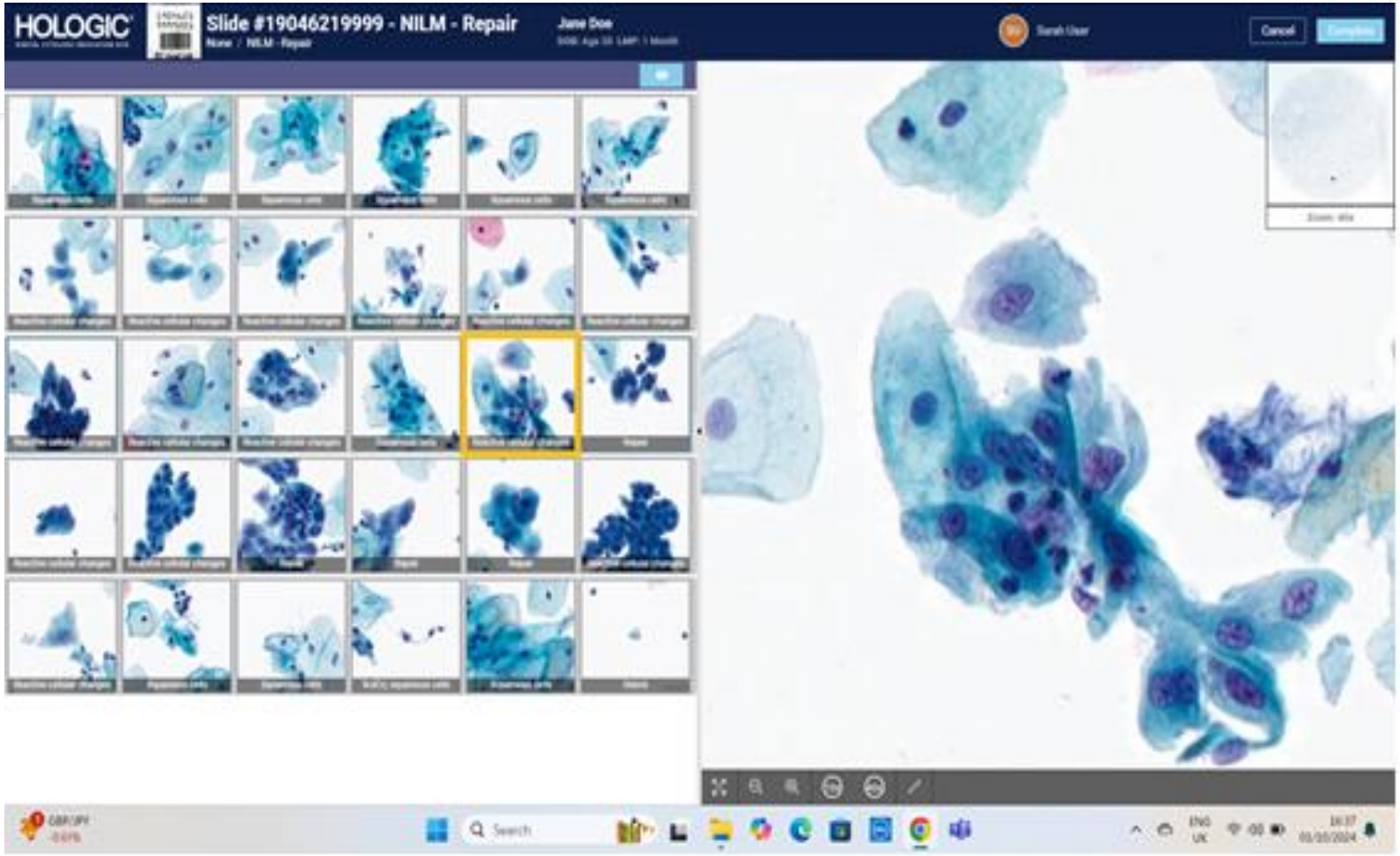
155 cases in total

Training – Staff feedback

- Continual learning / review essential
- Delay between training and study commencement impacted on confidence
- Use education website to re-set yourself – Time!!
- Definite learning curve – Especially with regard to metaplastic groups

EQUIPMENT – Image Review Screen

- 30 initial tiles
- Additional 30 available to view
- Ability to move around the circle
- Zoom in/out



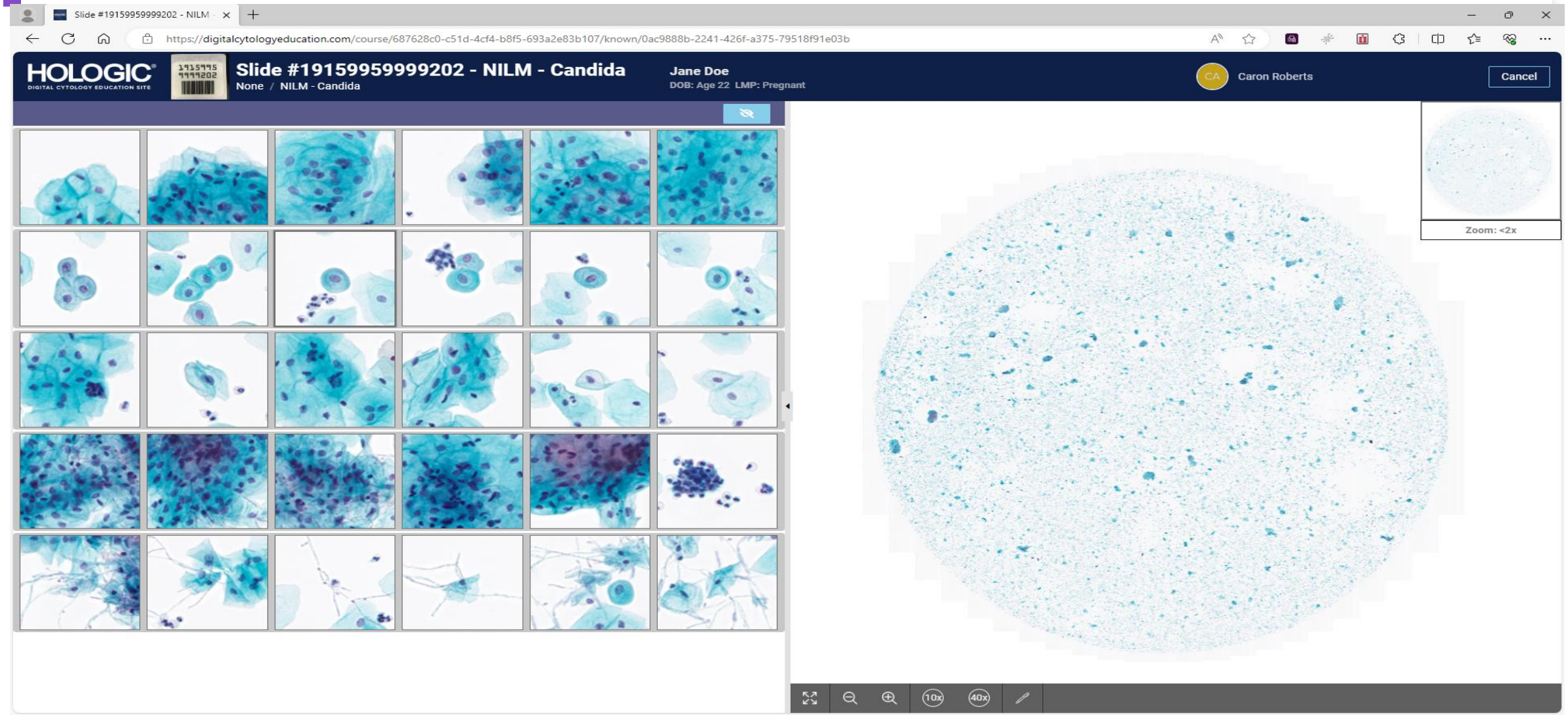
Rows of Tiles

- Row 1 – Low grade changes (BNC / Low grade dyskaryosis)
- Row 2 – High grade changes (Moderate / Severe dyskaryosis at least)
- Row 3 – ‘Bizarre’ cell types
- Row 4 – Glandular cells
- Row 5 - Infections

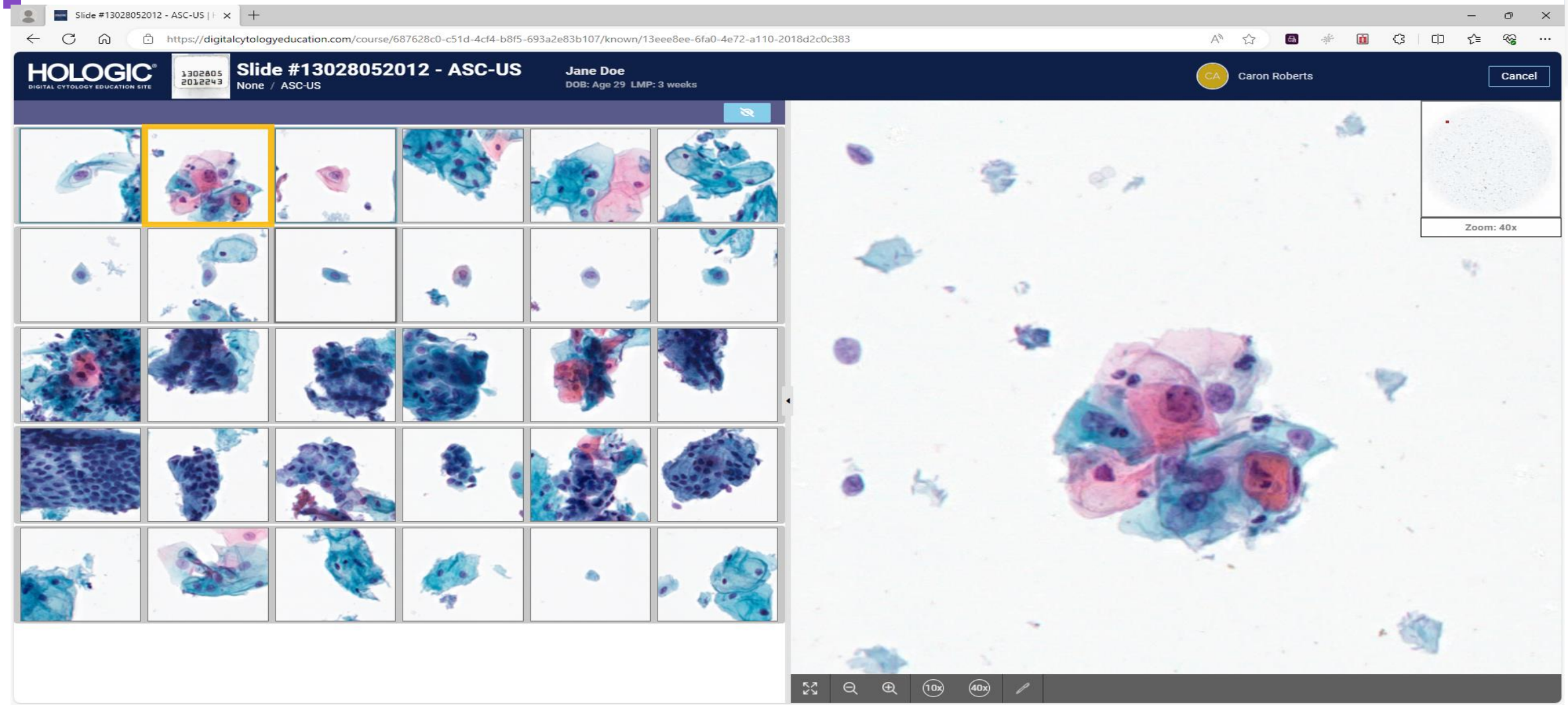
IMAGES

- All courtesy of –
- Digitalcytologyeducation.com
- Currently uses Bethesda classification

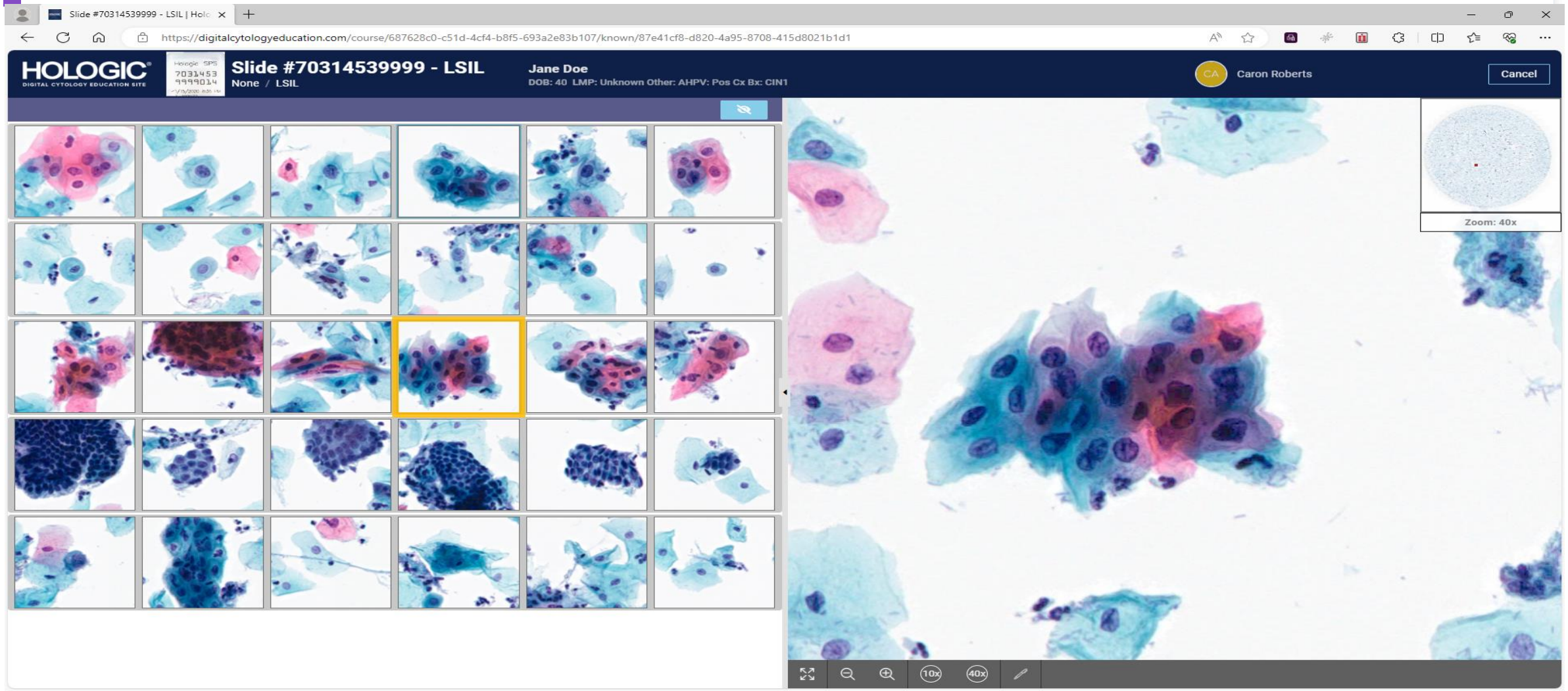
IMAGES – Negative + Candida



IMAGES – ASC-US



IMAGES - LSIL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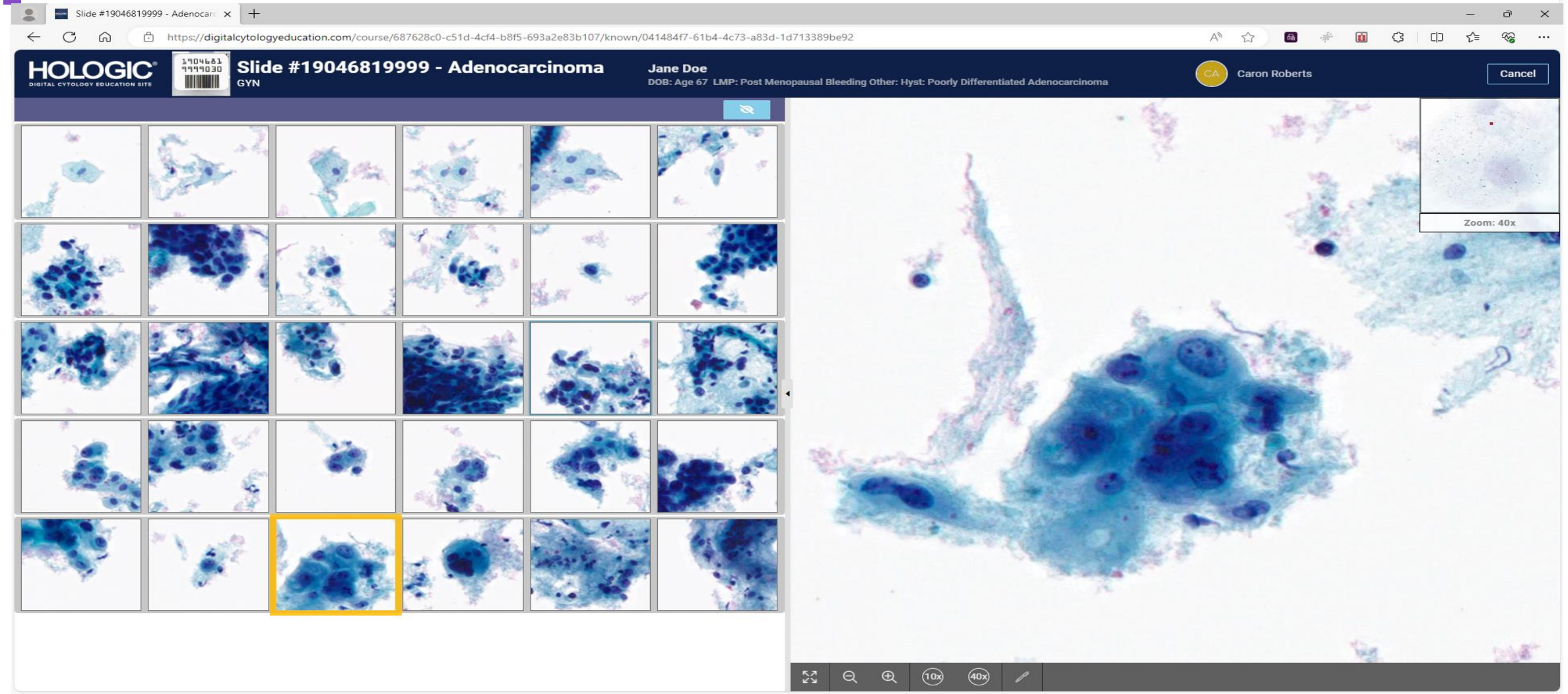
HOLOGIC
DIGITAL CYTOLOGY EDUCATION SITE
Slide #70314539999 - LSIL
None / LSIL
Jane Doe
DOB: 40 LMP: Unknown Other: AHPV: Pos Cx Bx: CIN1
CA
Caron Roberts
Cancel
Zoom: 40x
10x
40x

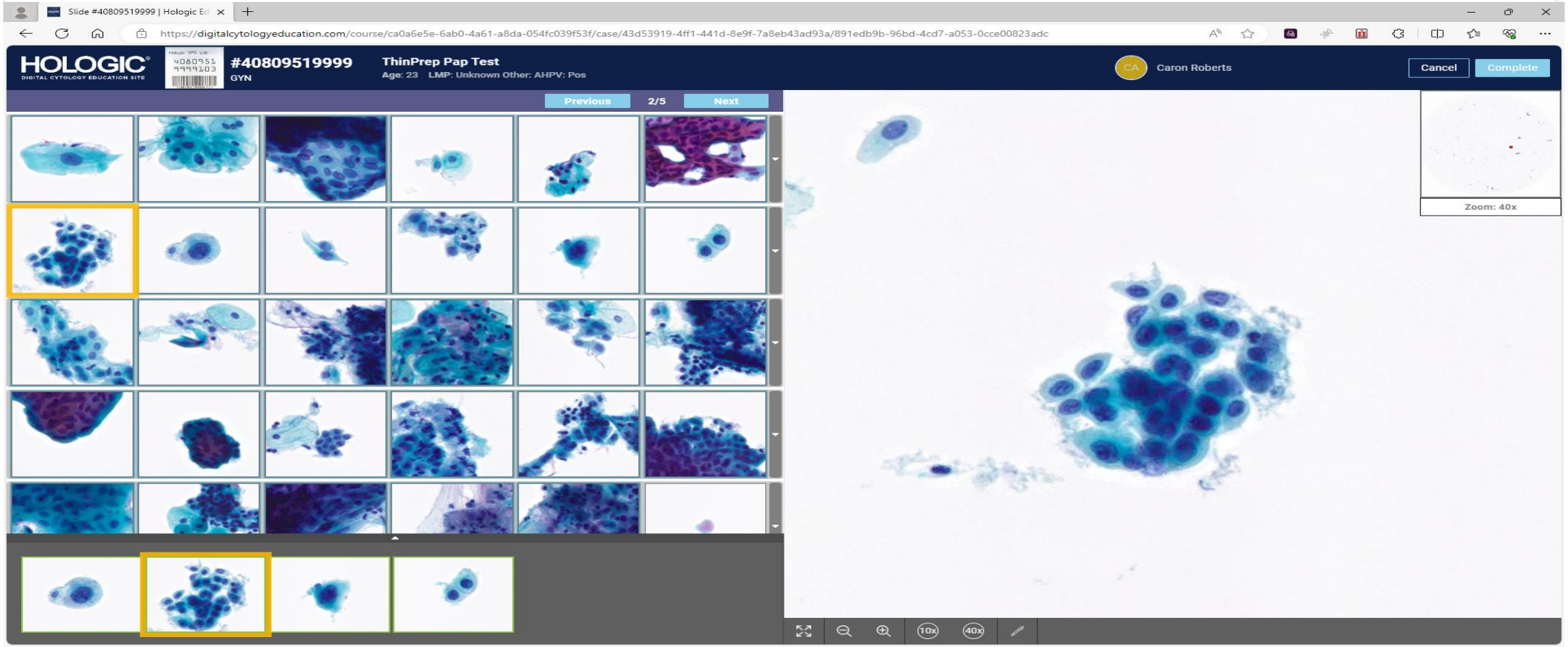
IMAGES - HSIL


Slide #70313799999 - HSIL | Hol
https://digitalcytologyeducation.com/course/687628c0-c51d-4cf4-b8f5-693a2e83b107/known/0c7ce5f3-8225-427a-8be4-64e53ccfad03
HOLOGIC
DIGITAL CYTOLOGY EDUCATION SITE
Slide #70313799999 - HSIL
None / HSIL
Jane Doe
DOB: Age 30 LMP: Unknown Other: AHPV: Pos Cx Bx: CIN 3
CA
Caron Roberts
Cancel
Approximate Cell Count: 41200
Zoom: 40x
10x
40x

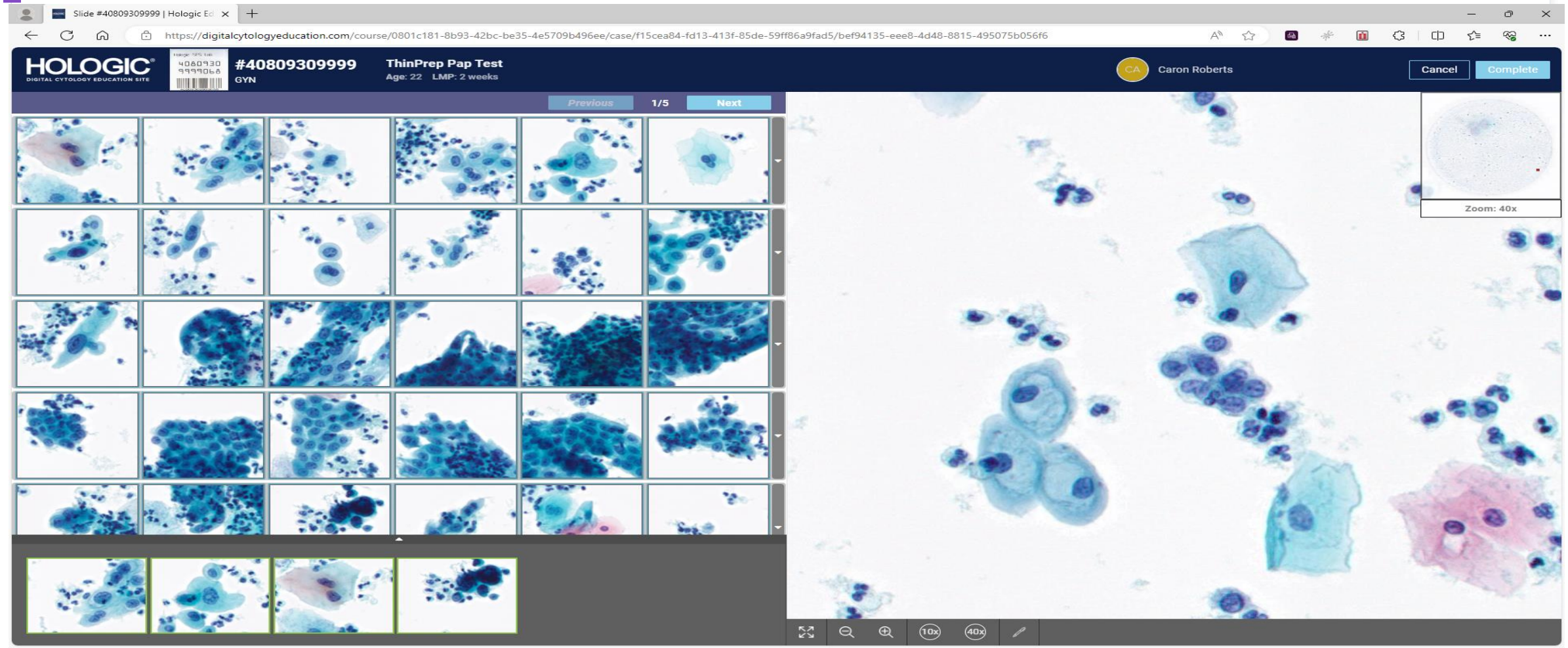
IMAGES – Poorly diff.adenocarcinoma



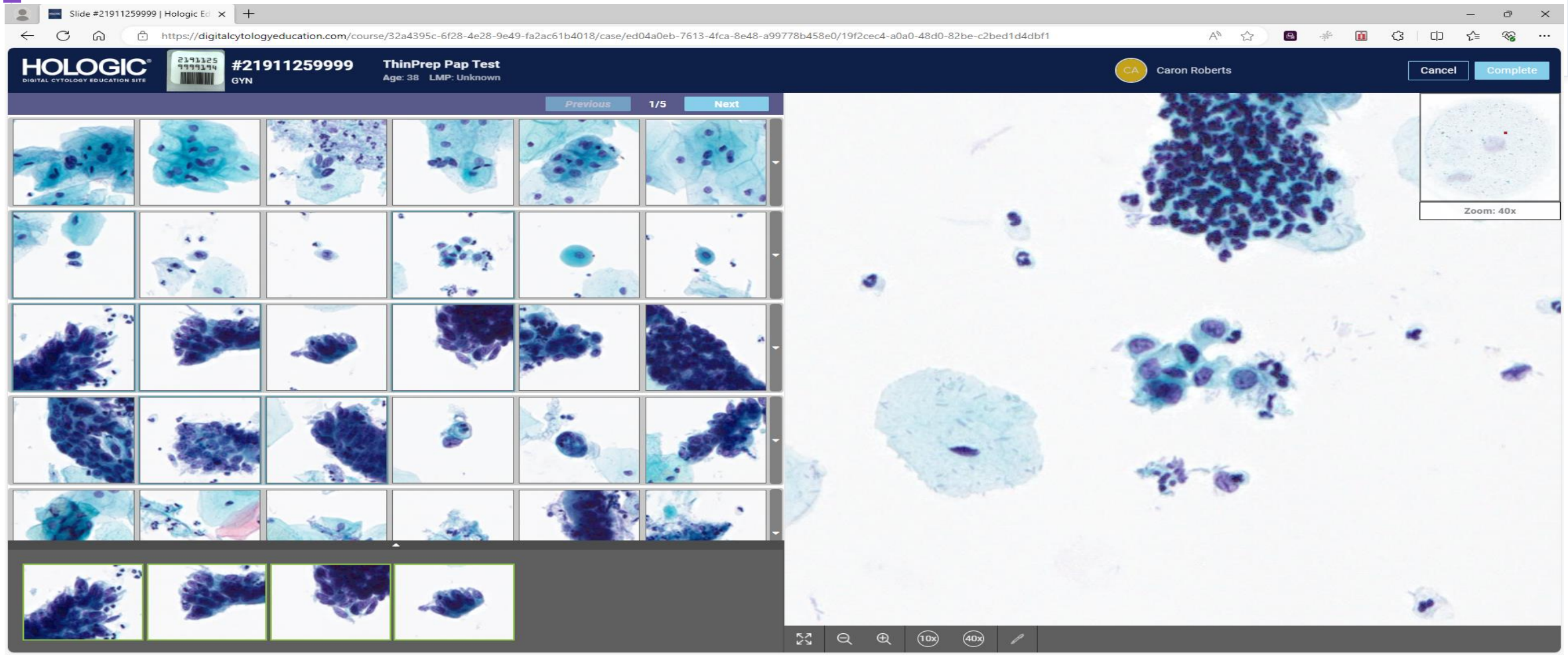
IMAGES – Negative? ASC-H



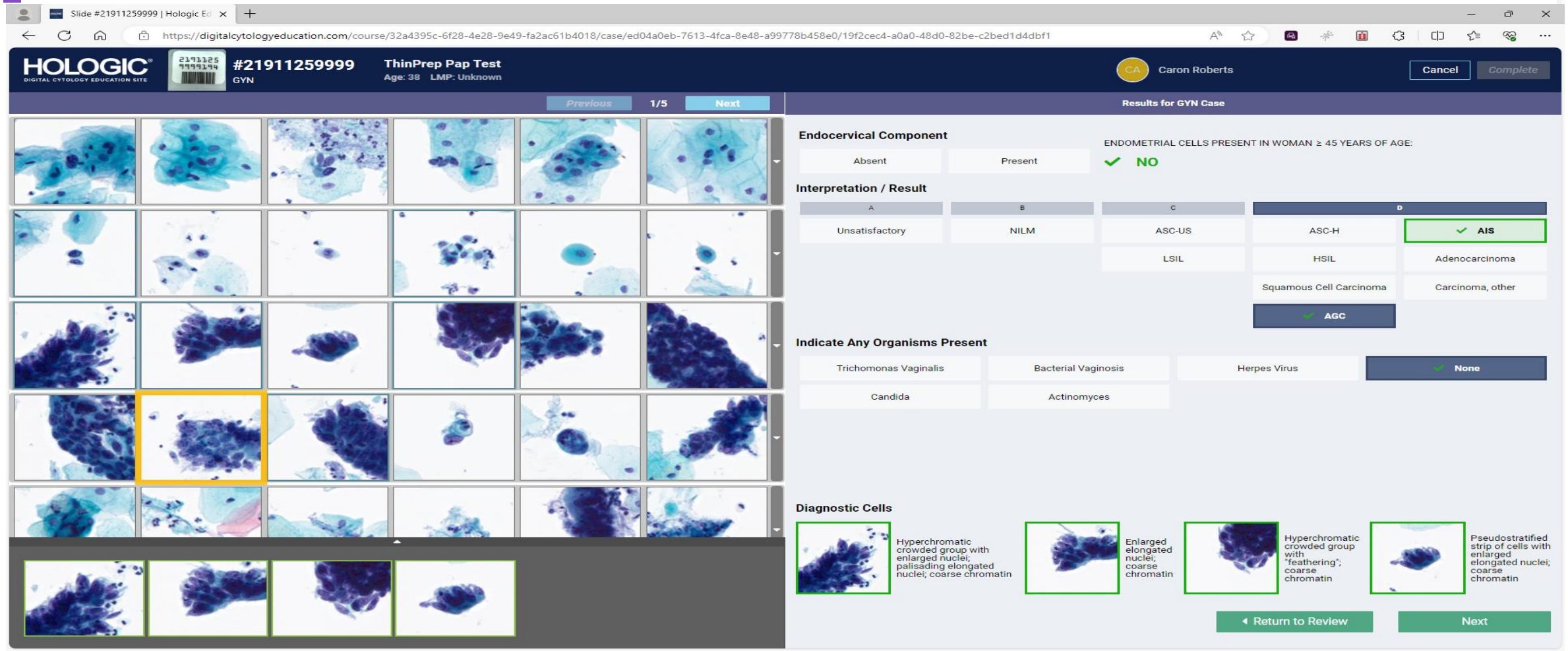
IMAGES – HSIL? LSIL



IMAGES – Don’t make a decision too early



IMAGES – AGC


Slide #21911259999 | Hologic Ed
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HOLOGIC
DIGITAL CYTOLOGY EDUCATION SITE
#21911259999
GYN
ThinPrep Pap Test
Age: 38 LMP: Unknown
CA
Caron Roberts
Cancel
Complete
Previous
1/5
Next
Results for GYN Case
Endocervical Component
Absent
Present
ENDOMETRIAL CELLS PRESENT IN WOMAN ≥ 45 YEARS OF AGE:
NO
Interpretation / Result
A
B
C
D
Unsatisfactory
NILM
ASC-US
ASC-H
AIS
LSIL
HSIL
Adenocarcinoma
Squamous Cell Carcinoma
Carcinoma, other
AGC
Indicate Any Organisms Present
Trichomonas Vaginalis
Bacterial Vaginosis
Herpes Virus
None
Candida
Actinomyces
Diagnostic Cells
Hyperchromatic crowded group with enlarged nuclei; palisading elongated nuclei; coarse chromatin
Enlarged elongated nuclei; coarse chromatin
Hyperchromatic crowded group with "feathering"; coarse chromatin
Pseudostratified strip of cells with enlarged elongated nuclei; coarse chromatin
Return to Review
Next

DATA - Timings comparisons

Manual Arm

- Primary – 3.6 minutes
- 2nd Review (Rapid) – 1.8m
- CBMS – 4m
- **Total = 9.4mins. per case**

Manual - Ranges

- Primary = 3.25m – 4.2m
- 2nd Review = 1.6 – 2.2m
- CBMS = 3.4m – 4.7m

DATA - Timings comparisons

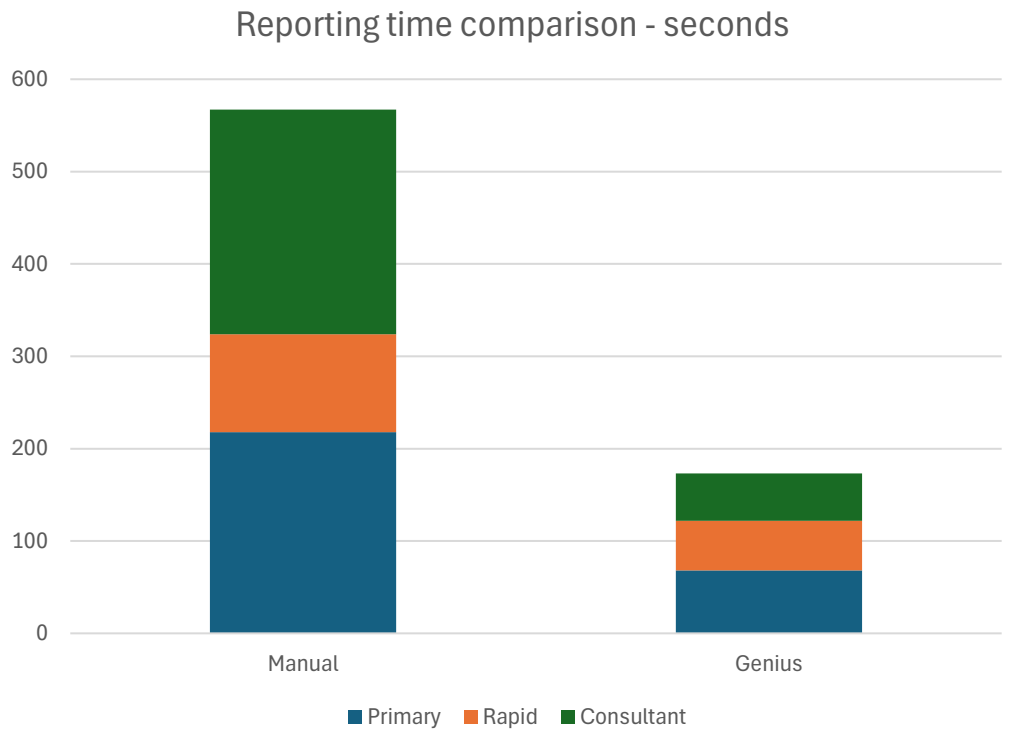
Genius Arm

- 1st Review – 1.1m
- 2nd Review (Rapid) – 0.9m
- CBMS – 0.85
- **Total = 2.85mins per case**

Genius - Ranges

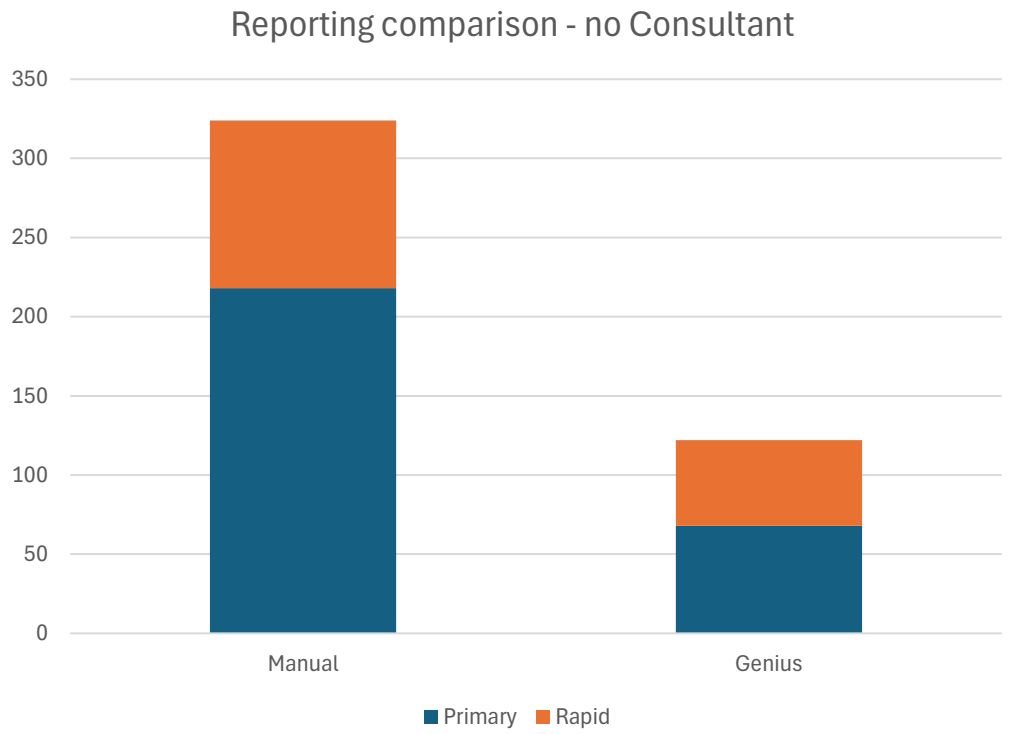
- 1st Review = 0.65m – 1.6m
- 2nd Review = 0.4m -1.3m
- CBMS = 0.6m – 1.1m

DATA – Total review time comparison



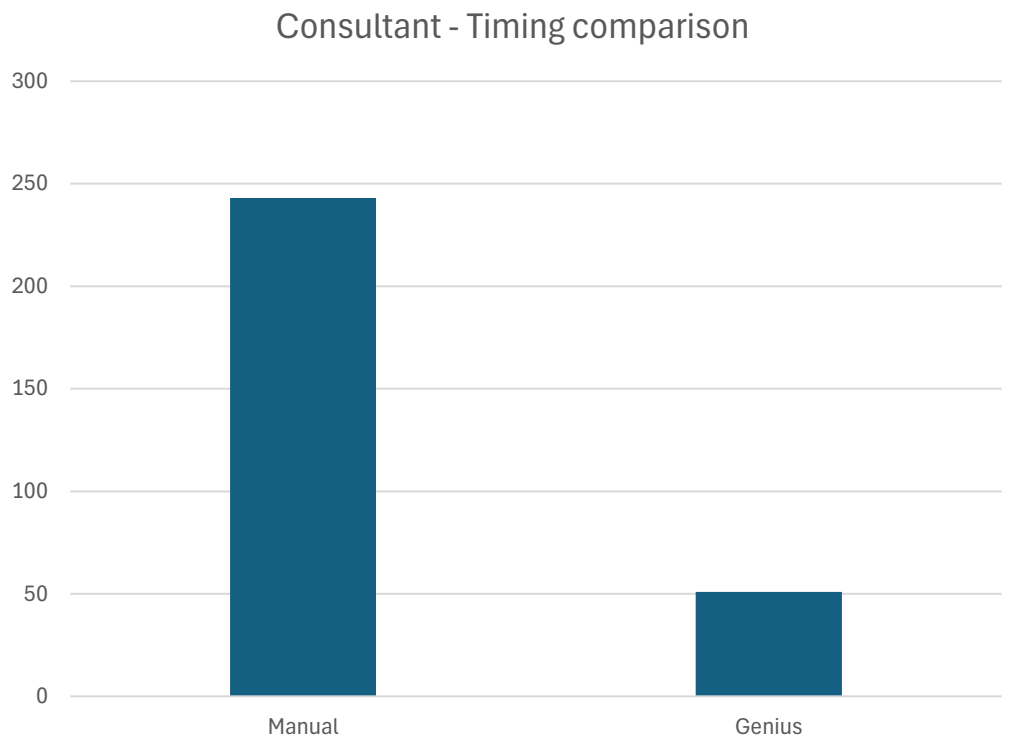
- Genius potentially 3x faster?
- *(Primary, rapid review, reporting – Not true protocol as potential abn. would go for check)*

DATA – Total review time comparison



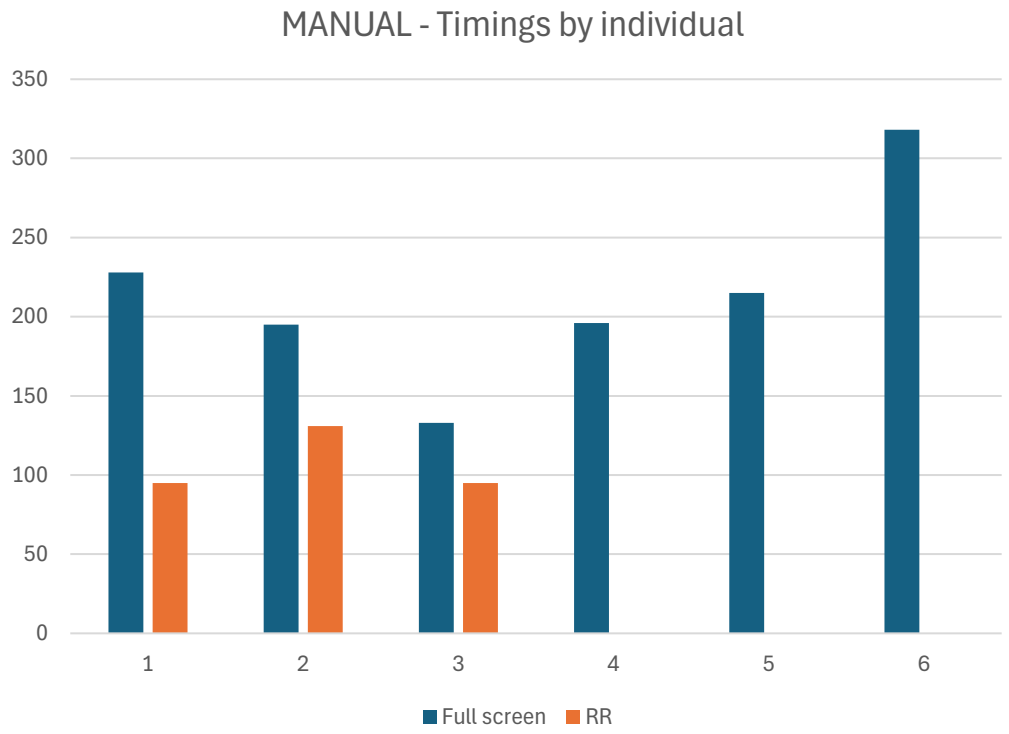
- Genius potentially 2x faster? Primary + Rapid

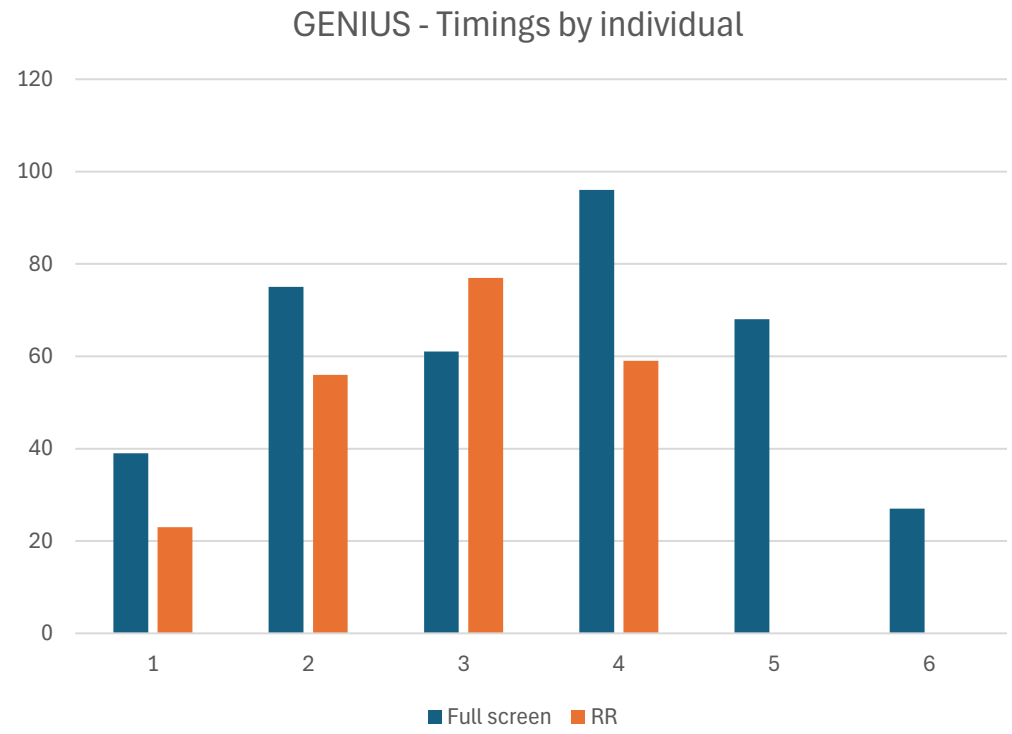
DATA – Total review time comparison



- Genius potentially 4x faster? Consultant reporting

DATA – Variation between individuals





The Study – Feedback from staff

- Genius easy to navigate – Agreed by all staff
- Genius images very clear although it is 'strange' not fine focussing through sheets/groups of cells – Comments from most of the team made regarding the inability to fine focus
- Ergonomically a couple of staff members liked the fact that they could adjust their seating position when using the Genius compared with the fixed position for microscopy – No one struggled with ergonomics of using the system

The Study – Feedback from staff

- Some participants are concerned that they are overcalling – Screeners and CBMS level
- All participants used the 'more like' facility frequently (Review of 60 tiles)
- BUT – There was a delay between training and the study starting. All participants felt that this was detrimental to their confidence – Once review complete, there was a range of confidence levels

The Study – Feedback from staff

- You need to open the tiles and not rely on the cells seen in the gallery
- Be aware of ‘mind set’
- Majority of team trusted the algorithm
- Image – Metaplastics can be difficult with ‘smudgy’ chromatin

Points of note for further study

- Under pressure when you know there's a stopwatch running
- Too easy to focus on LG – Need to remember there may be HG too
- Overcalling – Those groups of metaplastics can be discerning
- Undercalling – Are they metaplastics, are those endocervicals ok?

Points of note for further study

- What to do with major discrepancies? We didn't include in the protocol
- Data passed to Hologic for analysis – they have looked at concordance
- Our data cannot be used for sensitivity/specificity calculations as outcomes are not known due to the 'blind' selection of samples!

Points of note for further study

- Need to mimic current process?
  - Dot manual slides
  - Mark Genius tiles of interest
  - Provide patient age and clinical details
- Staff need to trust the algorithm
- Do not underestimate the ‘threat’ perceived by staff that they won’t be needed in the future
- Requires both a training and mind set change
- What to do with cases that cannot be scanned??

Next steps nationally – How do we decide?

- No. of cases per day?
  - Wide variation of opinions – 50-100
- No. of hours per day?
  - Wide variation of opinions –
    - 1-2 hours
    - 5-6 hours

Next steps – How do we decide?

- Need to design a robust training programme – Use the experience of other countries currently using Genius?
- Need to design a strict protocol
  - Do we do 2 x screen of the 60 tiles instead of Rapid + Primary
  - Is it the same process as above for checking? 2 x screen of 60 tiles instead of Primary + Check

THANK YOU

University Hospitals of Derby and Burton NHS Foundation Trust

- To the Cytology team in supporting the study
- Hologic for their support with the study
- Hologic for supplying images used in the presentation and for their advice