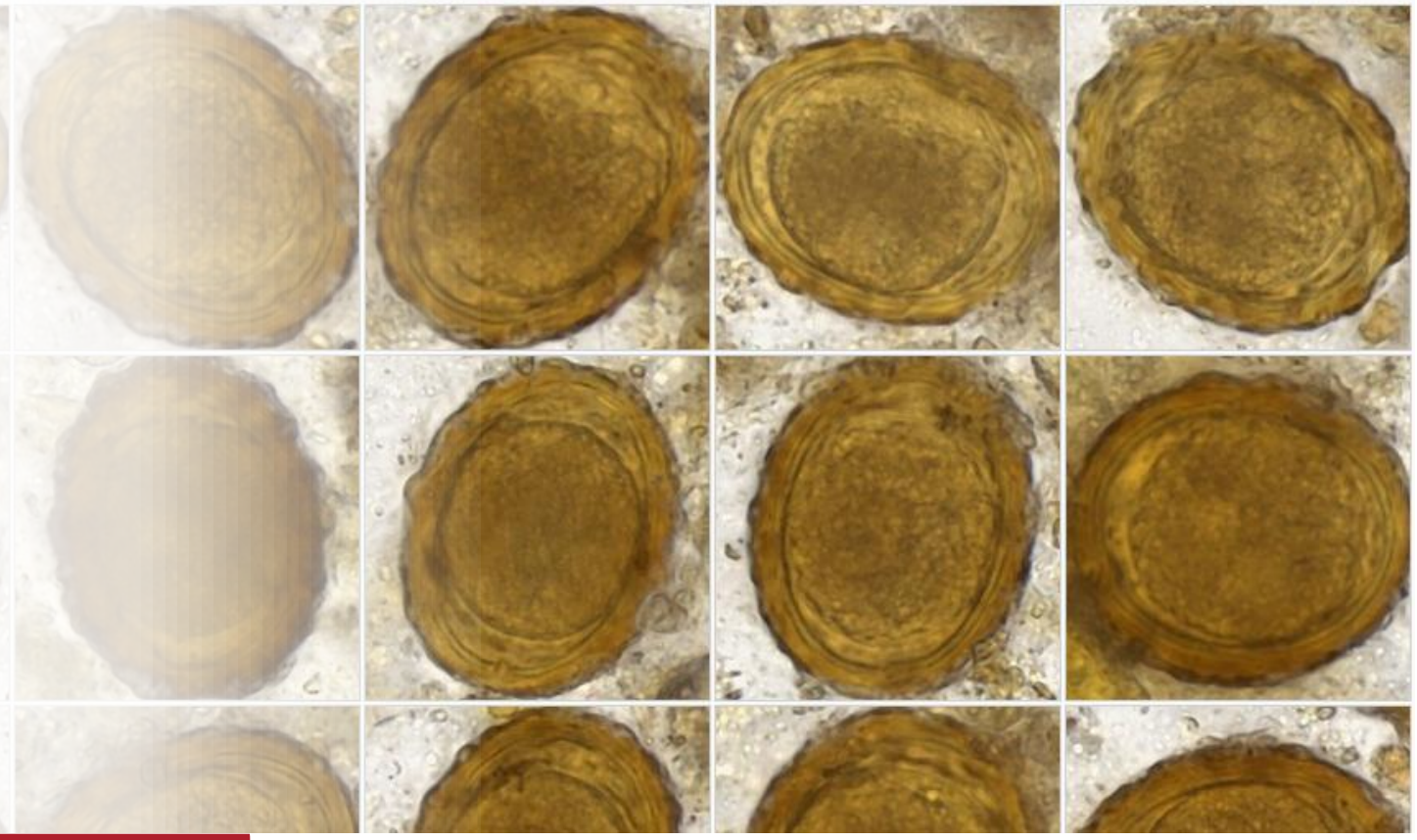
Applications for AI in the Clinical Parasitology Lab



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ARUP LABORATORIES | HEALTH UNIVERSITY OF UTAH

NOVEMBER 2025

Disclosures in the Past Year

- Disclosures Related to this Talk:
  - Techcyte Inc. (collaborator)
- Other Professional Disclosures:
  - American Society for Microbiology (Editorial Board, *Journal of Clinical Microbiology;* Editorial Board, *ASM Case Reports*; honoraria and travel support)
  - College of American Pathologists (Microbiology Committee Member, 2024-present)
  - Illinois Society for Microbiology (travel support; honorarium)
  - University of Minnesota (travel support)
  - Association of Public Health Labs (travel support)
  - Mayo Clinic (travel support)
  - Southwestern Association for Clinical Microbiology (travel support)
  - Elsevier (publication honorarium)

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Learning Objectives

Review the Morphologic Identification of Intestinal Parasites

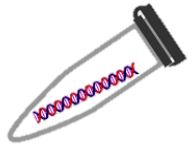
Describe Potential Workflow Changes when Adopting AI for Parasitology

Discuss Proficiency, Competency, and Quality Control as it Pertains to AI

Review: Laboratory Diagnosis of Intestinal Parasites

A Brief History of Laboratory Identification of Intestinal Parasites

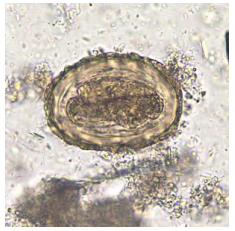
- Microscopy
- Antigen Detection
- Molecular Detection
- Artificial Intelligence

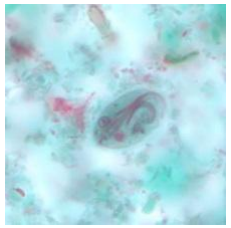


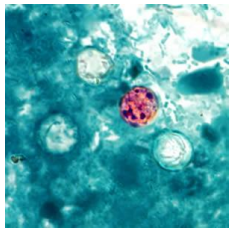
Paramount Pictures

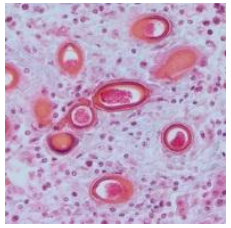
Review: Morphologic Identification of Intestinal Parasites

- Wet Mount (direct or concentrate)
- Trichrome/Iron Hematoxylin Smear
- Modified Acid-fast/Safranin
- Histopathology
- Gross Examination



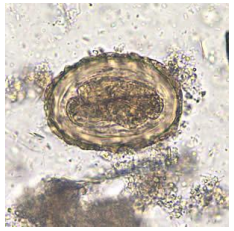


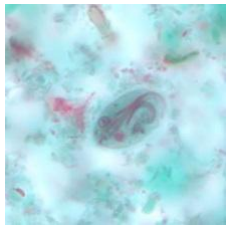


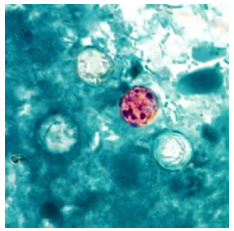


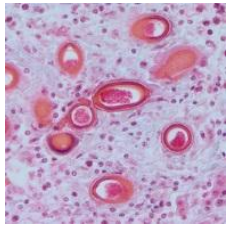
Review: Morphologic Identification of Intestinal Parasites

- **Wet Mount (direct or concentrate)**
- **Trichrome/Iron Hematoxylin Smear**
- **Modified Acid-fast/Safranin**
- Histopathology
- Gross Examination









AI: Benefits, Challenges, and Practical Application

Basic Concepts of the Application of AI

- First and most important, this is a screening tool, not a definitive parasite identification tool.
  - » Models were designed for sensitivity over specificity
- The application of the AI does not diminish the need for parasitology expertise, competency, and proficiency
- An experienced technologist must still evaluate images
- The goal is to reduce the number of manual reads for likely negative specimens
  - » ‘**negative screening tool**’

Potential Benefits to Adopting AI

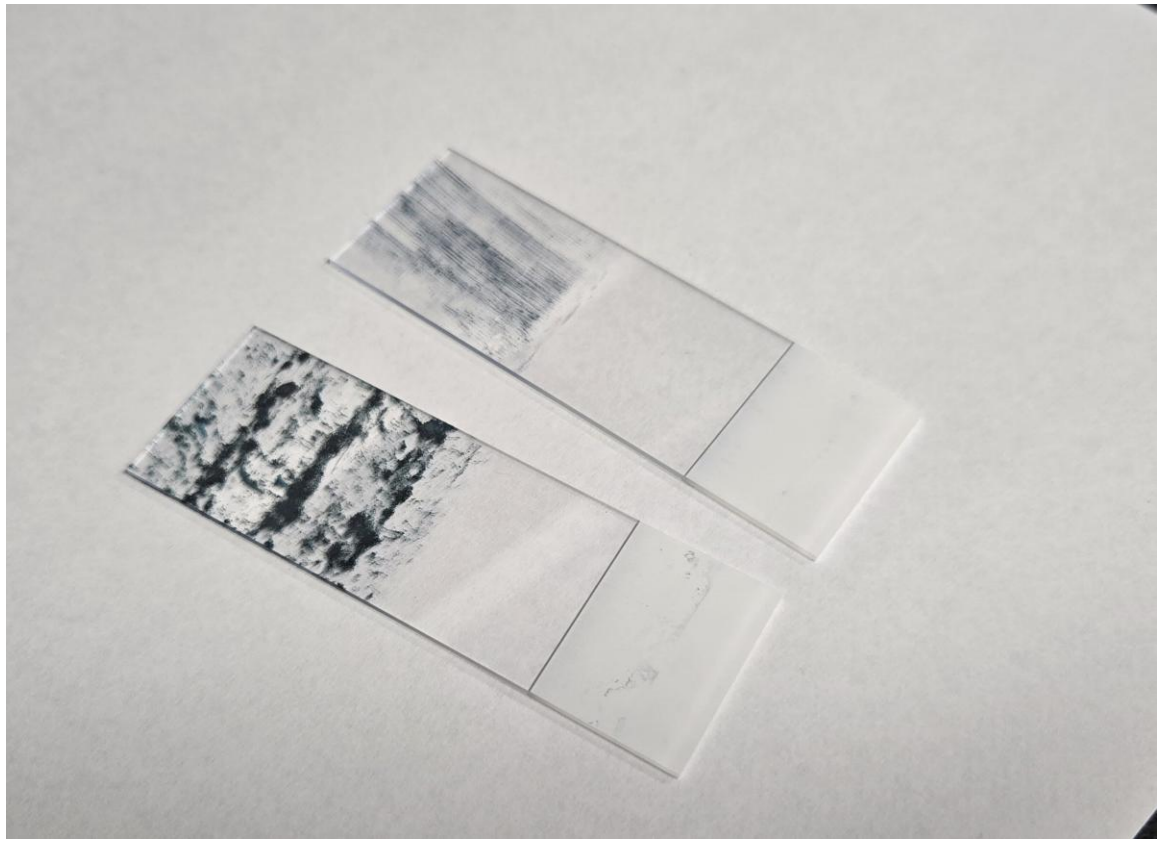
- Less time spent manually reading negative specimens
  - » In our lab, the negative percent for O&P is 92-95%
- More time devoted to scrutinizing positive or putative positive specimens
  - » Improves diagnostic skills and competence and confidence in parasite identification
- Increased sensitivity
- Less physical stressors and ergonomic issues
  - » Eye strain (microscopy), hand strain (microscope adjustment), poor posture
- Possibly more engaging for an increasingly younger workforce
- Potential for remote analysis
  - » CAUTION: could be constraints on where clinical specimens can be formally evaluated

Workflow Challenges to Consider

- Slide preparation for both trichrome/MAF and wet mount
  - » Hills and valleys vs. homogenous smears (permanent smears)
  - » Coverslipping of permanent smears
  - » Wet mount preps to prevent drying and movement
- Labeling slides
- Choosing a scanner for volume and workflow
- Acquisition of specimens for validation
- Possible reorganization of workforce
  - » Technicians vs. technologists
- Quality control (upcoming section)
- Having back-up plans when there is failure at any step
  - » Scanner malfunctions
  - » Coverslipper breaks
  - » AI/upload issues

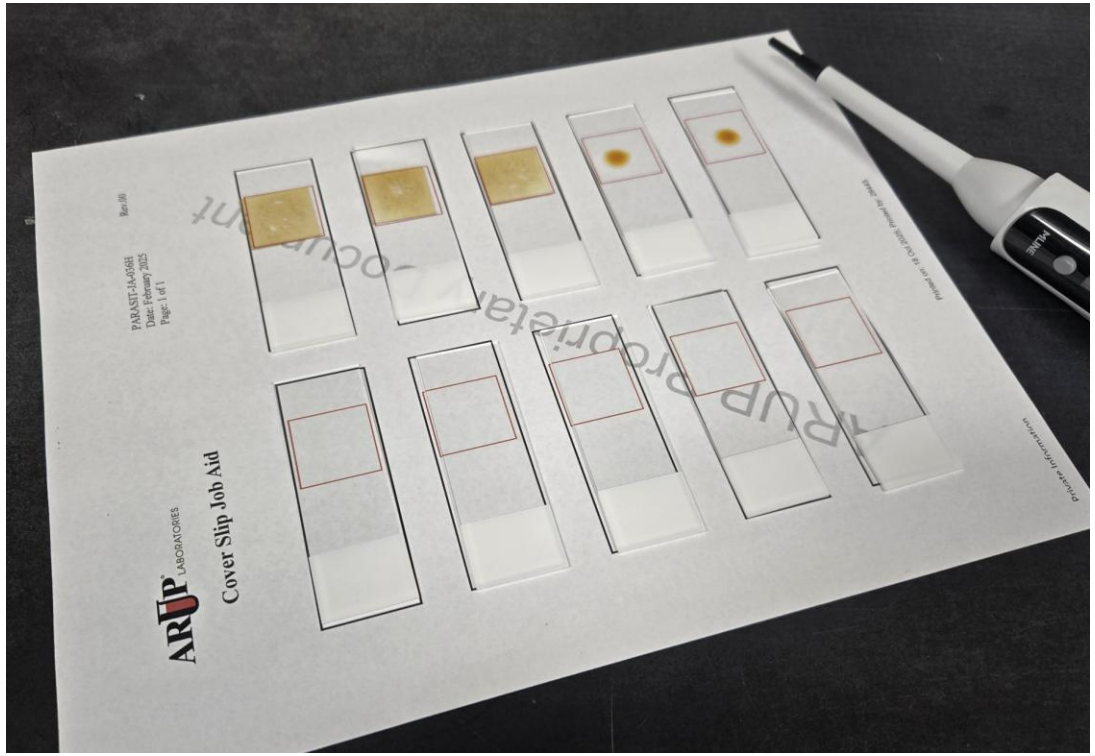
Changes to Permanent Smear Processes

- Permanent smears (trichrome, MAF, SAF) will have to be prepared with a thin monolayer
  - » No more ‘hills and valleys’
- Slides will need to be coverslipped prior to scanning
  - » Automated vs. manual coverslipping
- Slides will need a label with a barcode/QR code for reading by instrument



Changes to Wet Mount Preps

- Precise measurements of stool and mounting medium (iodine solution) are required
  - » 20 µL 50% Lugol's iodine + 50% 10% glycerol in PBS
  - » 15 µL stool specimen
- Use of a template to make sure the stool is in the designated scan area
- Slides will need a bar code/QR code for reading
- The preparation of smears will have to be carefully timed to prevent drying
- Make sure there are no air bubbles or parts of the coverslip devoid of stool/mounting medium
- Challenging specimens may not be scannable and will have to be manually read per normal
  - » Grainy, excess mucus, 'interfering substances'



Selecting a Scanner

Pramana SpectralHT2

Pramana SpectralM-Pro

Hamamatsu
NanoZoomer 360

Grundium Ocus40

NOTE: This slide is not an endorsement or renouncement of shown products

Quality Control, Proficiency, Competency

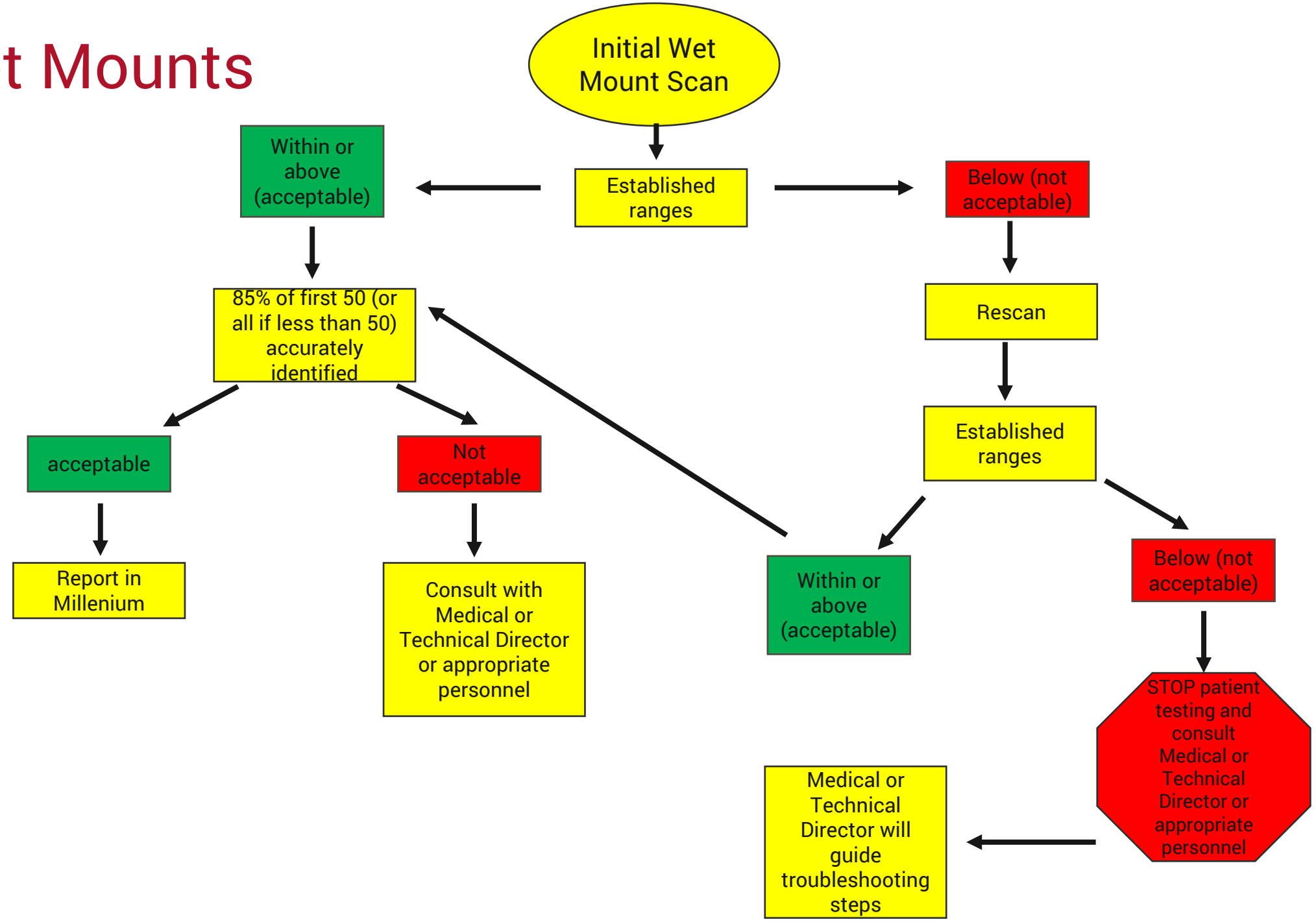
Competency and Proficiency

- Competency = tests the individual's skill set
  - » In our lab, an employee must be competent on traditional microscopic identification of the parasites prior to learning AI
  - » After initial training new employees get unknowns consisting of a mix of positive and negative scans
    - If organisms are missed, scans are reviewed with Education Coordinator
    - If several organisms are missed, a second (different) test is given
  - » In our lab, we have quarterly competency testing both traditional parasite ID and recognition of parasites via AI
- Proficiency = tests the workflow
  - » Technically, proficiency specimens should be handled in the same manner of clinical specimens
  - » For proficiency specimens to be scanned, scan area must be correlated with premade proficiency specimens (e.g., trichrome)

Quality Control – Permanent Smears

- QC is performed daily on trichome slides.
  - » QC slide for scanning is not the same for the stain itself
- For the scanning QC slides, both positive and negative slides are processed; a lot for the positive smear is made from a specimen containing at least one protozoan.
- Ranges are established with each **slide** (not lot) and counted boxes (identified by the software)
  - » If total counted boxes for a given organism are outside of ±3 SD range, the slide is rescanned
  - » If after rescanning the total counted boxes are outside of the ±3 SD range, the QC is acceptable **if** the first 50 boxed organisms are correct **and** >80% of the prevalence regions are valid (in focus)
- Slides are retired after six months to prevent bleaching from scanner light

Wet Mounts


Initial Wet Mount Scan
Established ranges
Within or above (acceptable)
Below (not acceptable)
85% of first 50 (or all if less than 50) accurately identified
acceptable
Report in Millenium
Not acceptable
Consult with Medical or Technical Director or appropriate personnel
Rescan
Established ranges
Within or above (acceptable)
Below (not acceptable)
STOP patient testing and consult Medical or Technical Director or appropriate personnel
Medical or Technical Director will guide troubleshooting steps

Case Examples – How does it Work?

What can the AI detect? Permanent Smears

Trichrome

- *Giardia duodenalis* – cysts and trophozoites
- *Entamoeba* sp. non-*hartmanni* - trophozoites
- *Entamoeba hartmanni* - trophozoites
- *Dientamoeba fragilis*, *Iodamoeba buetschlii*, *E. nana* – trophozoites
- *Blastocystis* species
- *Chilomastix mesnili* – trophozoites
- *Cyclospora* species – trophozoites
- White Blood Cells
- Red Blood Cells

Modified Acid-Fast

- *Cryptosporidium* species
- *Cyclospora* species

Yeast was trained as an anti-class and available for those that report yeast in OPs

What can the AI detect? Wet Mounts

Protozoans

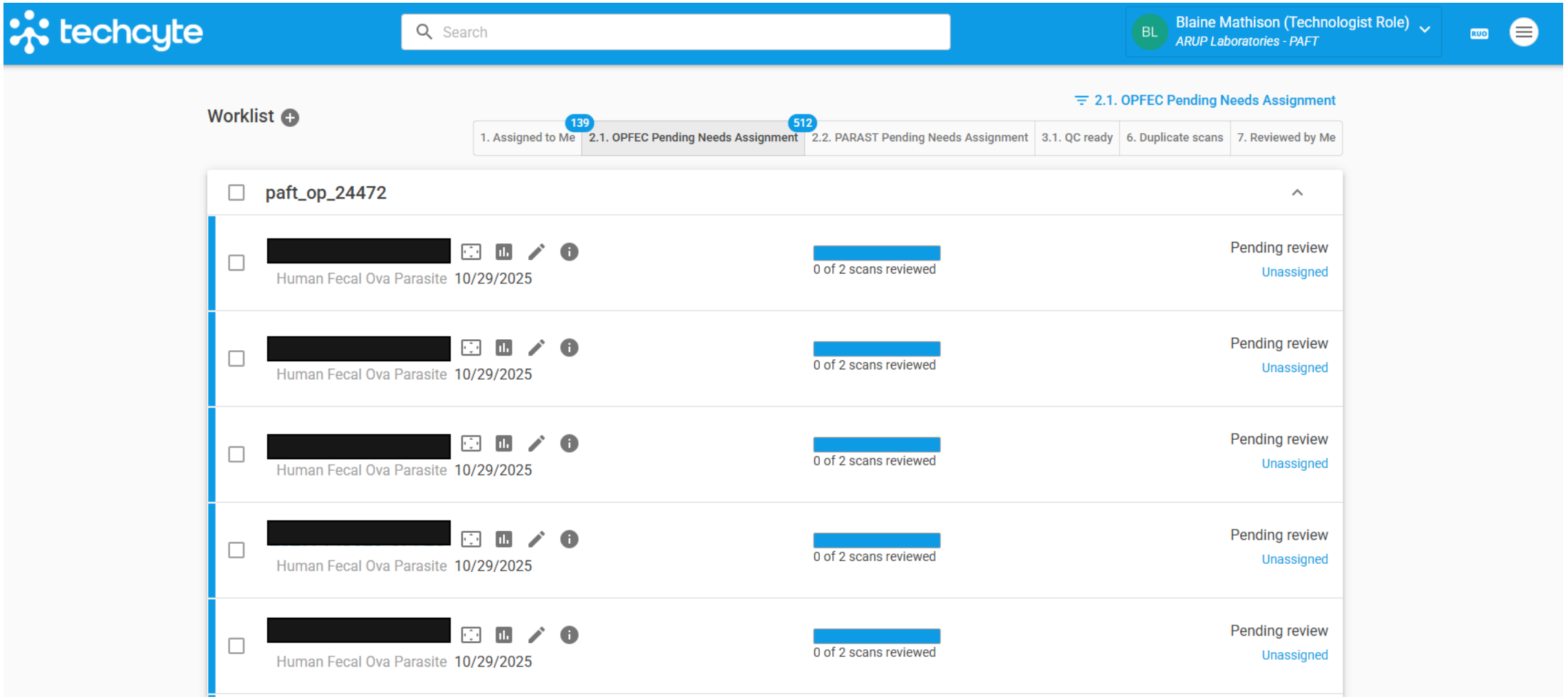
- *Giardia duodenalis* – cysts and trophozoites
- *Entamoeba* sp. non-*hartmanni* – cysts and trophozoites
- *Blastocystis* species
- *Chilomastix mesnili* – cysts
- *Cyclospora* species – oocysts
- *Cystoisospora belli* - oocysts
- *Balantioides coli* – cysts and trophozoites
- *Endolimax nana* – cysts
- *Iodamoeba buetschlii* – cysts
- Misc. Small Protozoans*

**Iodamoeba buetschlii*, *Dientamoeba fragilis*, *Endolimax nana*, *Chilomastix mesnili*, and *Entamoeba hartmanni* trophozoites; *E. hartmanni* cysts

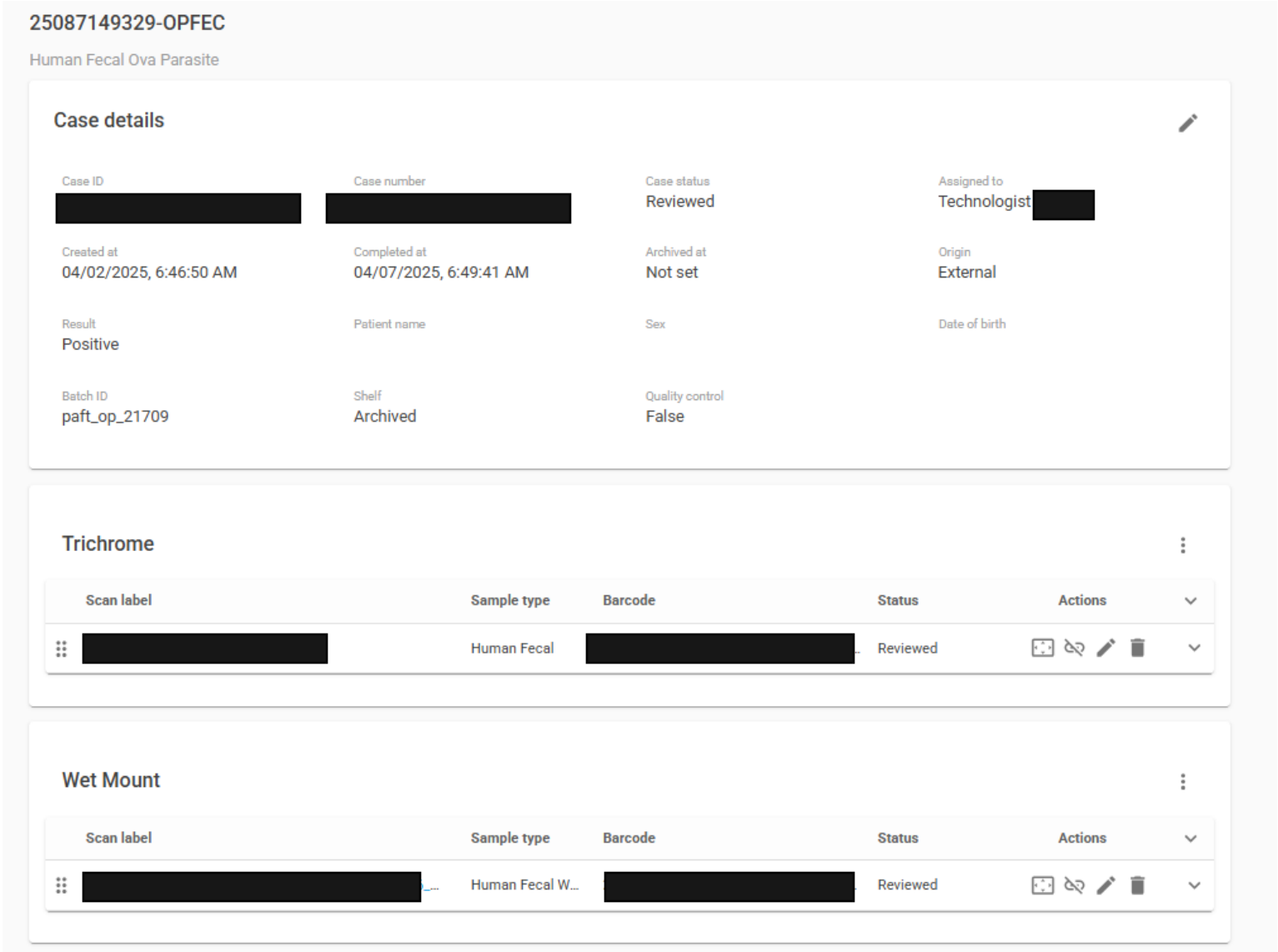
Helminths

- *Enterobius vermicularis*
- *Ascaris lumbricoides*
- *Trichuris trichiura*
- Hookworm/*Trichostrongylus*
- *Strongyloides* species – L1 larvae
- *Paracapillaria philippinensis*
- *Taenia* species
- Fish Tapeworm (*Diphyllobothrium*-complex)
- *Rodentolepis nana*
- *Hymenolepis diminuta*
- *Schistosoma mansoni*
- *Schistosoma japonicum*
- *Fasciola hepatica*/*Fasciolopsis buski*
- *Clonorchis*/*Opisthorchis* species
- *Paragonimus* species

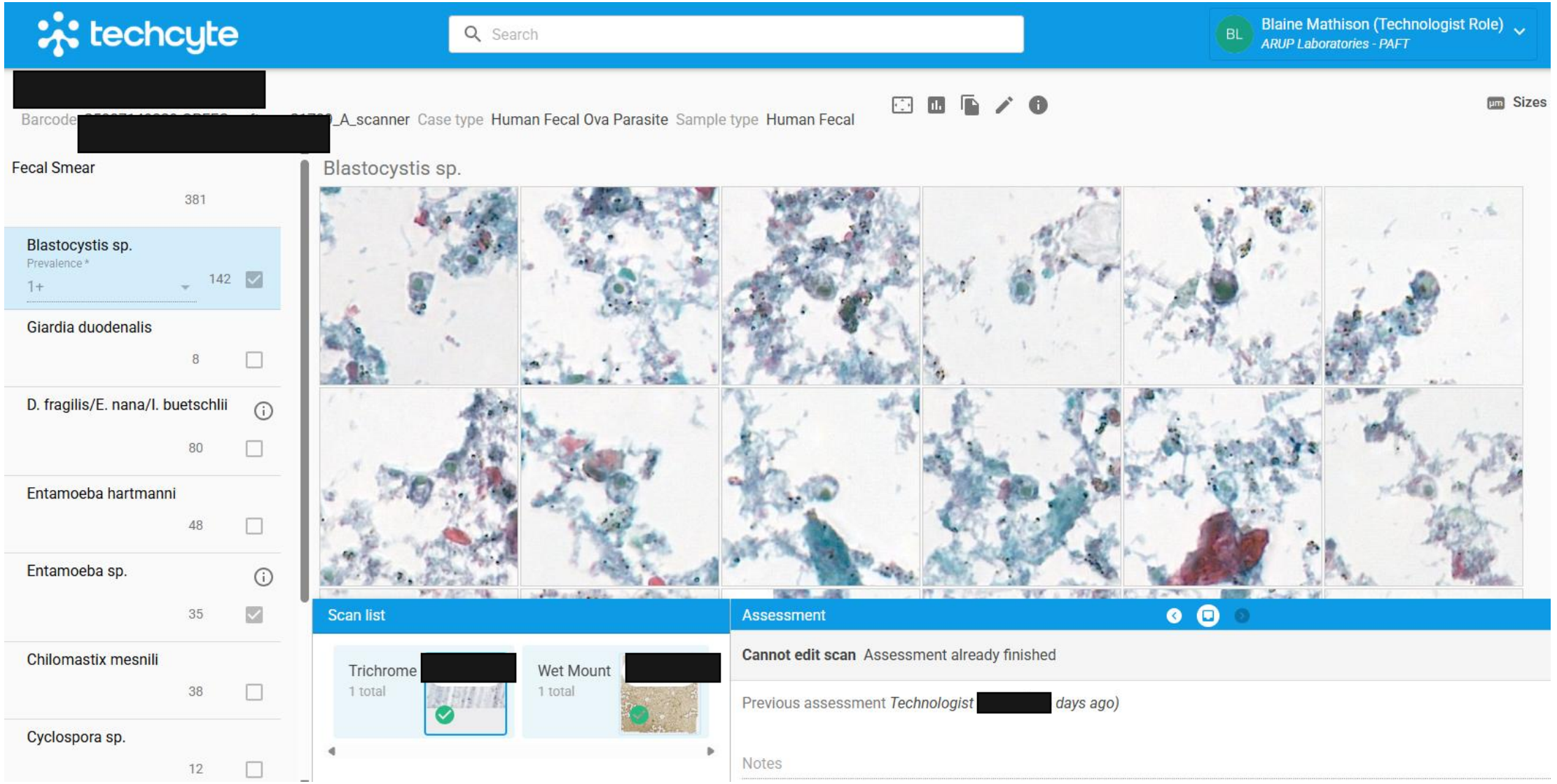
Using the AI interface



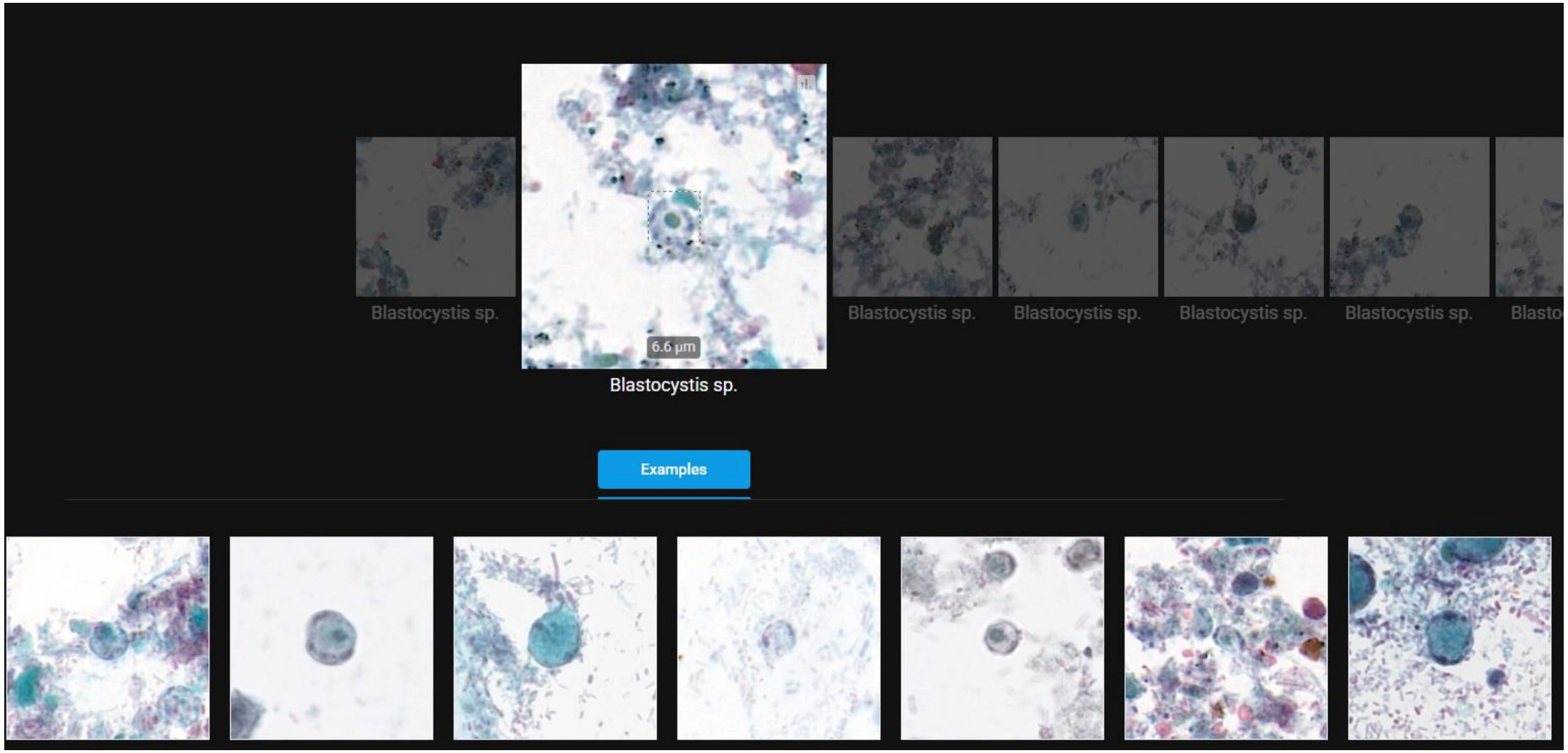
Using the Interface



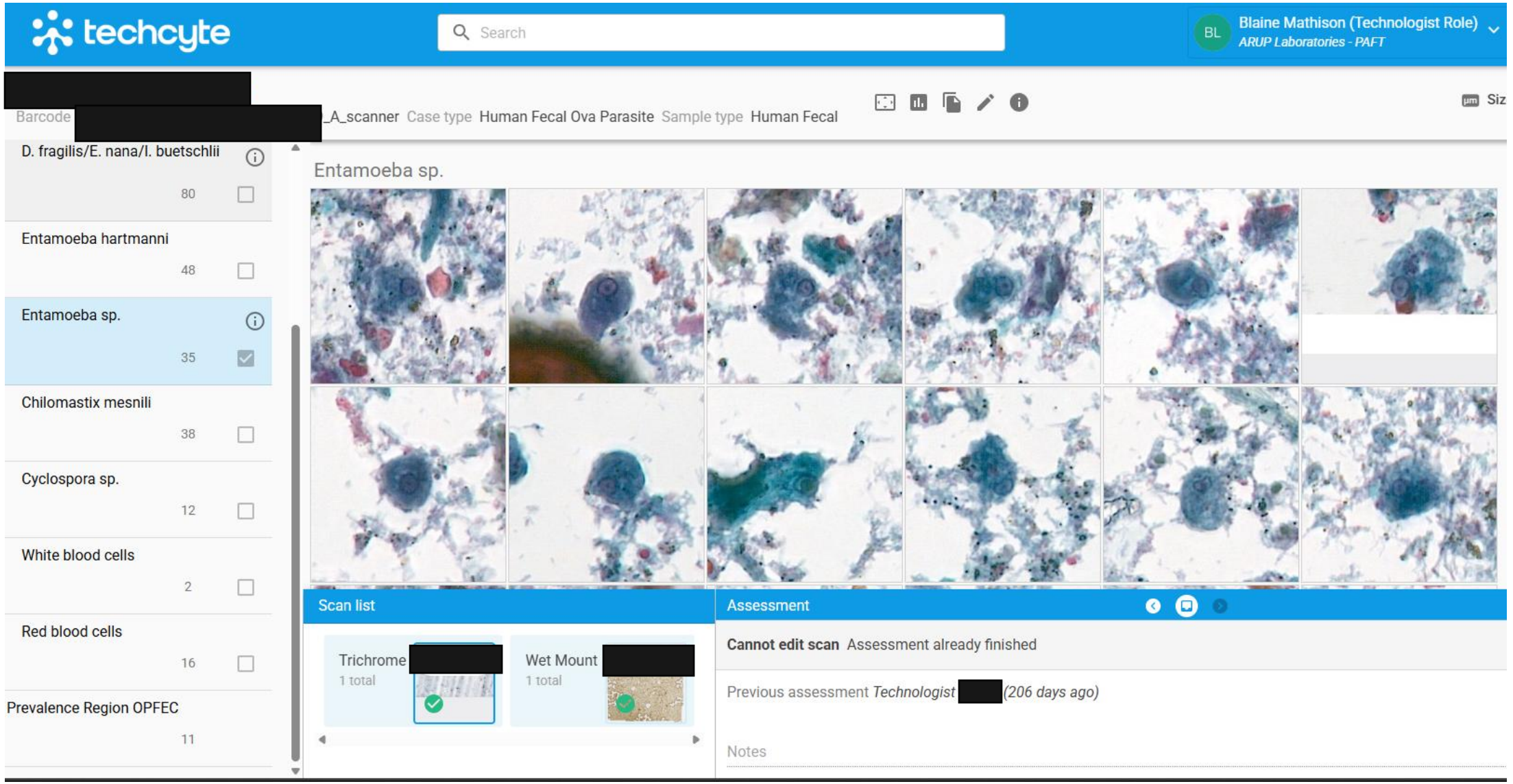
Trichrome smear



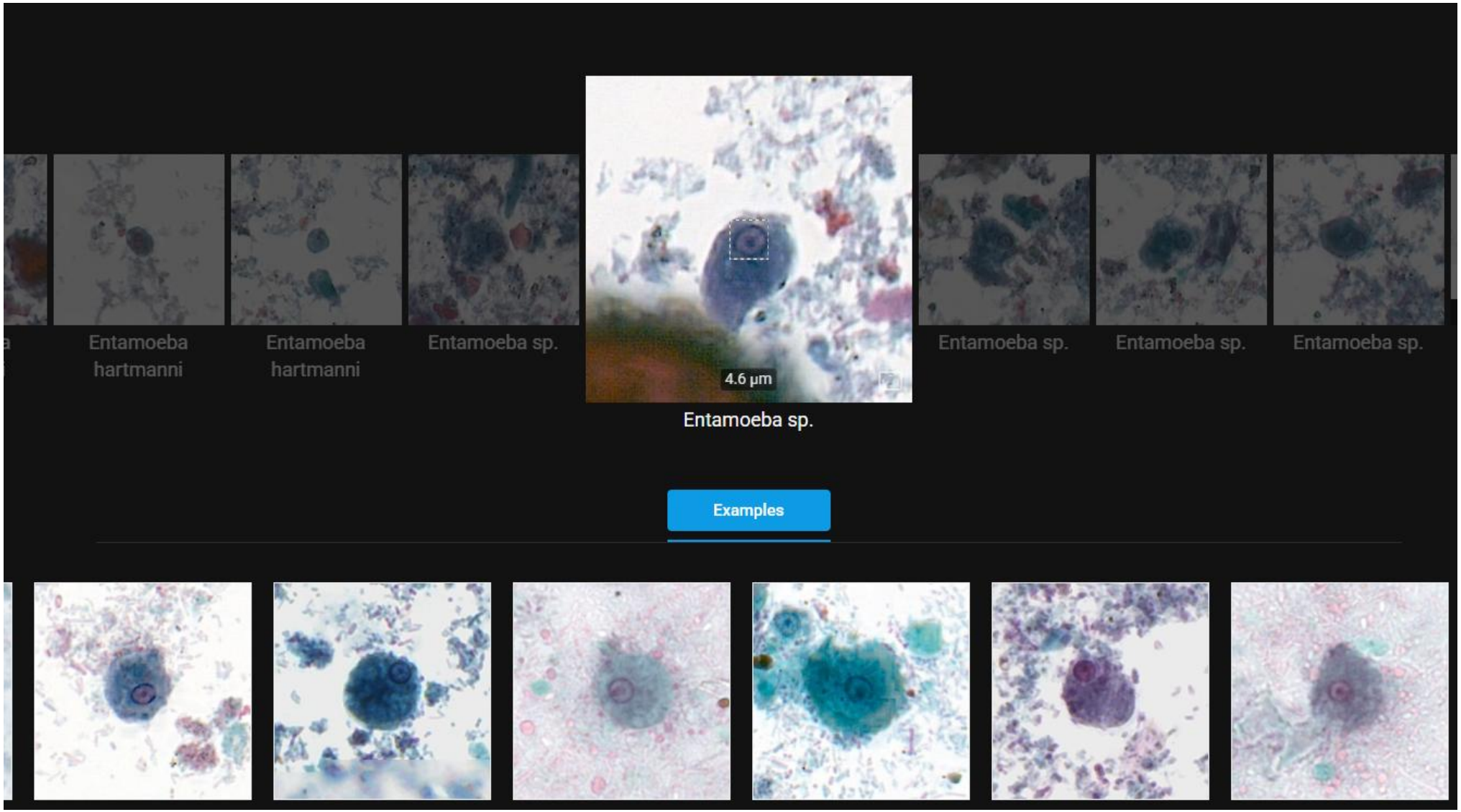
Example: *Blastocystis* sp.



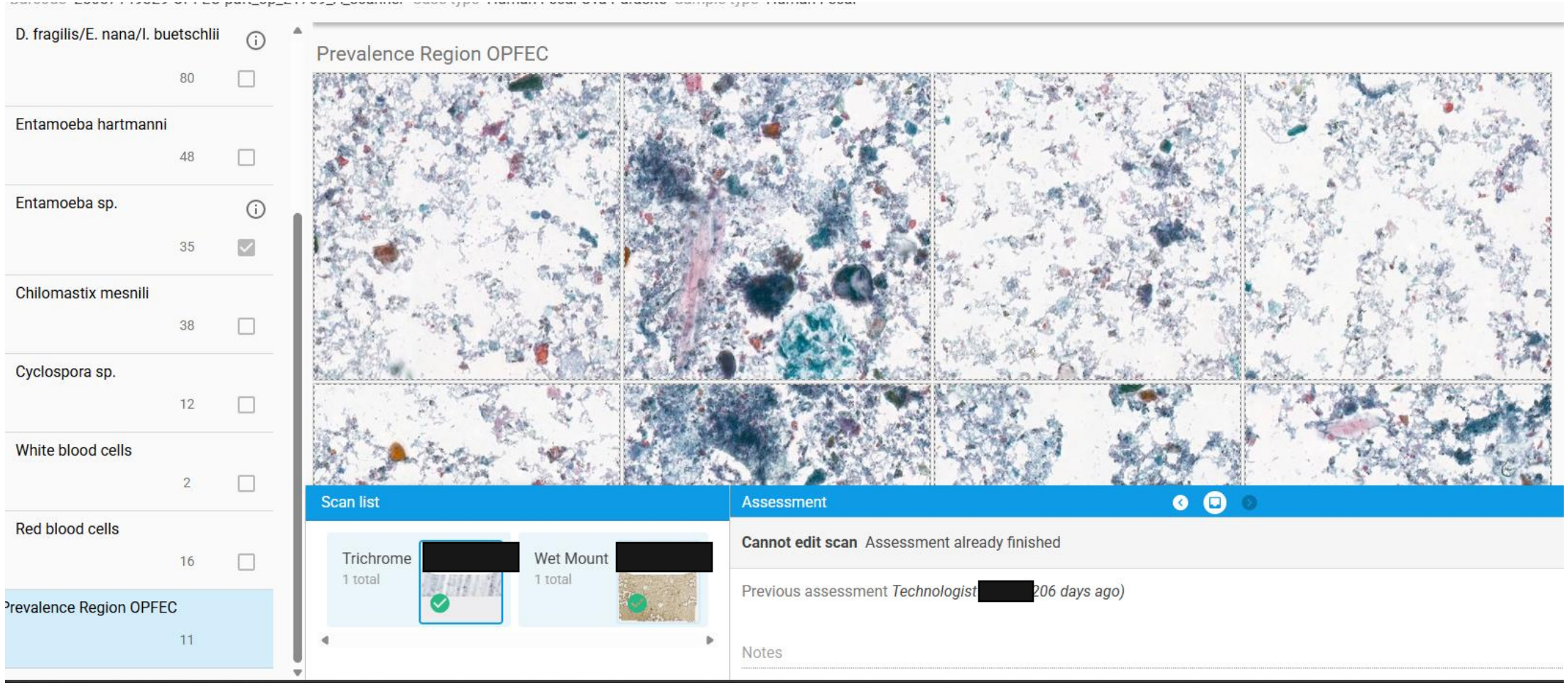
Trichrome smear



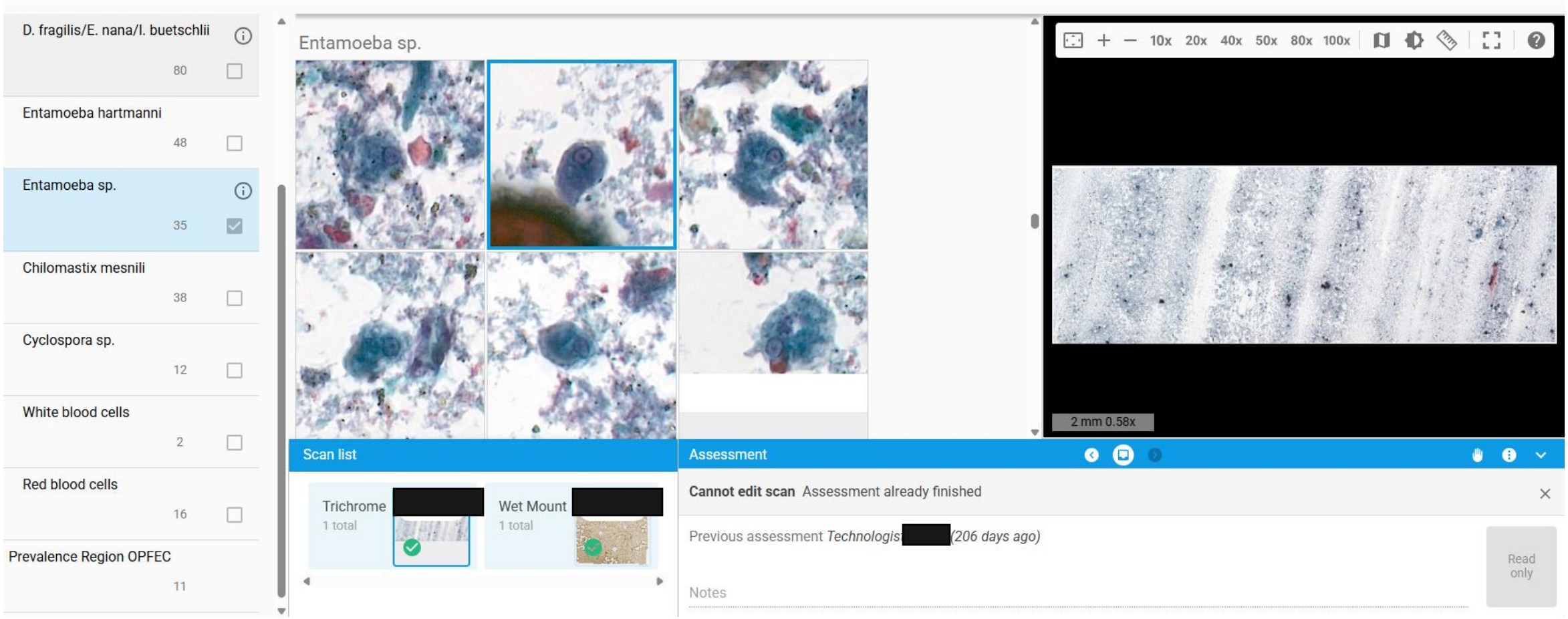
Example: *Entamoeba* sp.



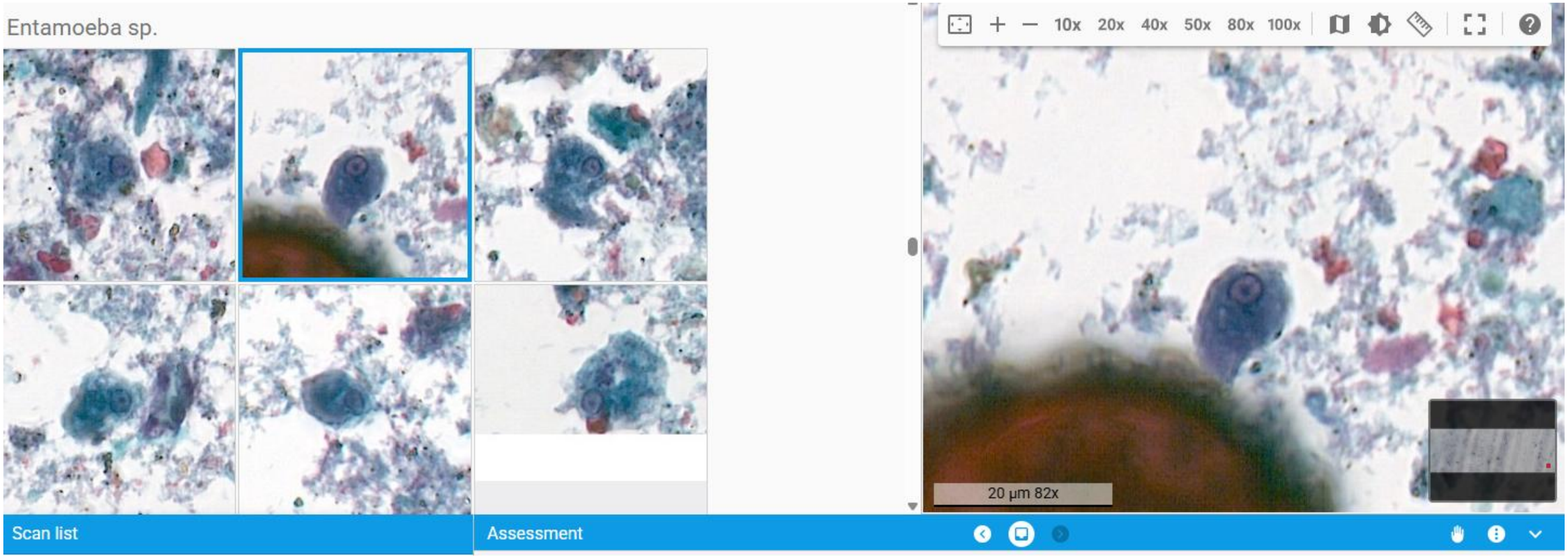
Trichrome – Prevalence Regions



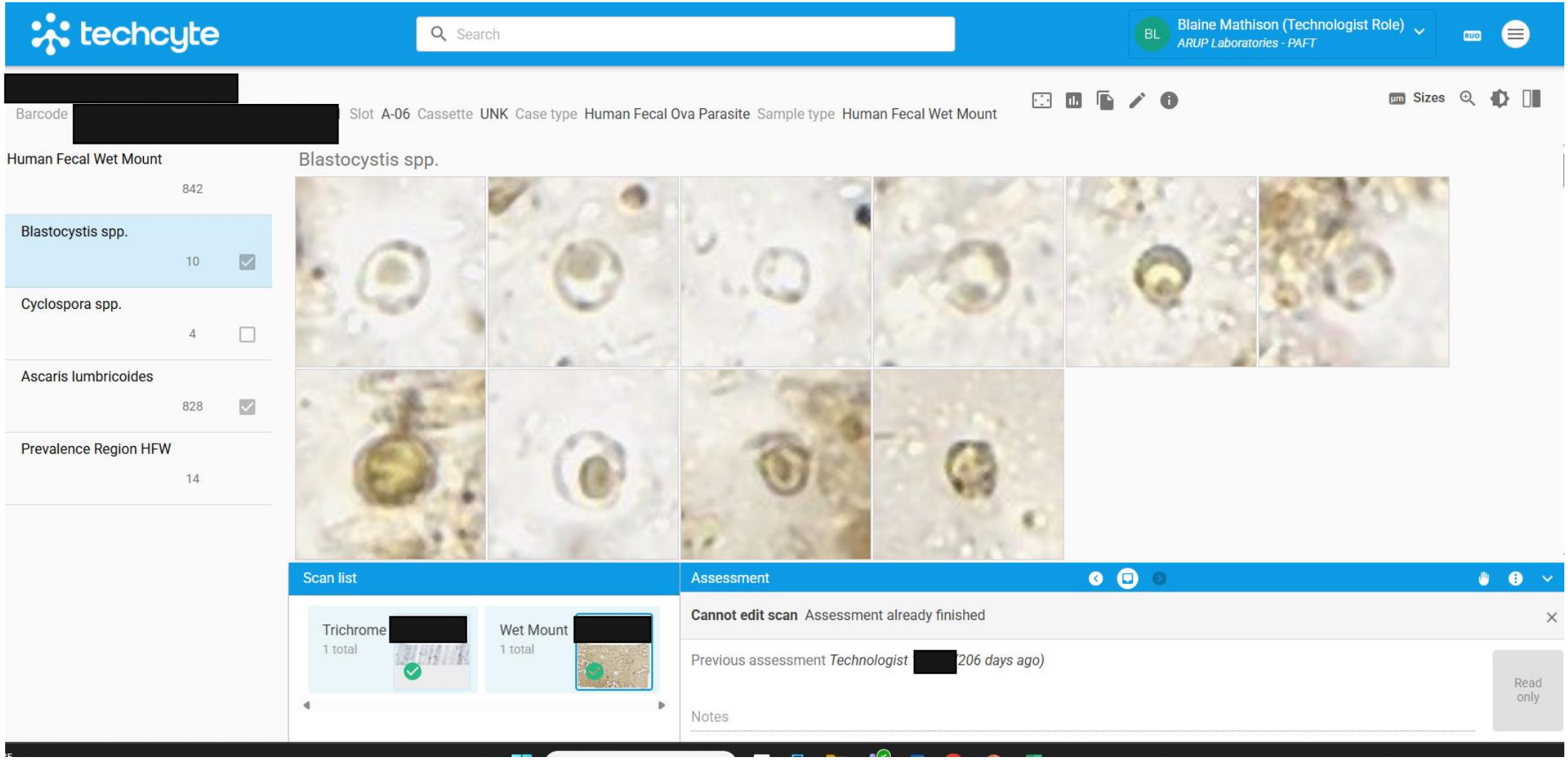
Slide View


D. fragilis/E. nana/I. buetschlii
80
Entamoeba hartmanni
48
Entamoeba sp.
35
Chilomastix mesnili
38
Cyclospora sp.
12
White blood cells
2
Red blood cells
16
Prevalence Region OPFEC
11
Entamoeba sp.
10x 20x 40x 50x 80x 100x
2 mm 0.58x
Scan list
Trichrome
1 total
Wet Mount
1 total
Assessment
Cannot edit scan Assessment already finished
Previous assessment Technologis[redacted] (206 days ago)
Notes
Read only

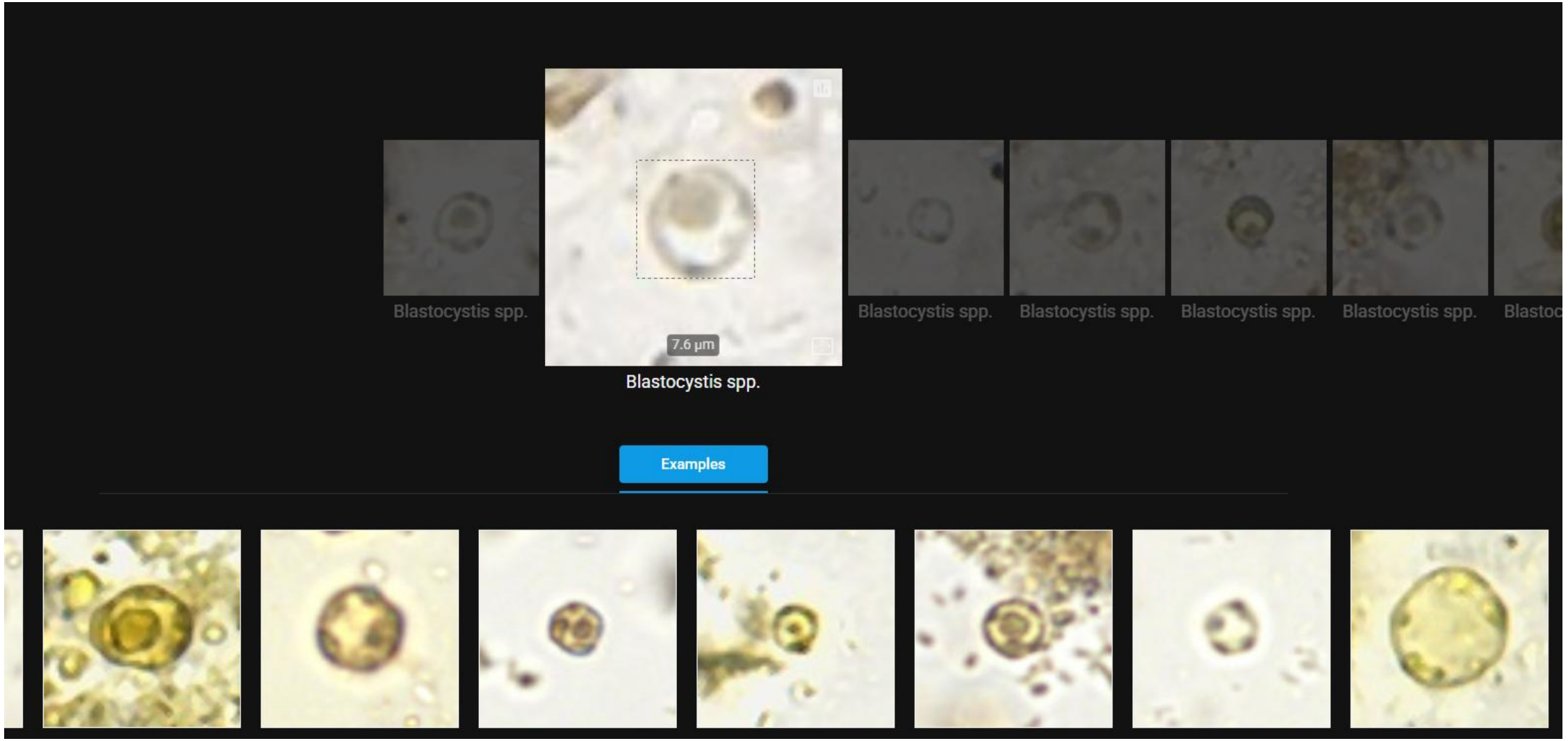
Slide View


Entamoeba sp.
10x
20x
40x
50x
80x
100x
20 µm 82x
Scan list
Assessment

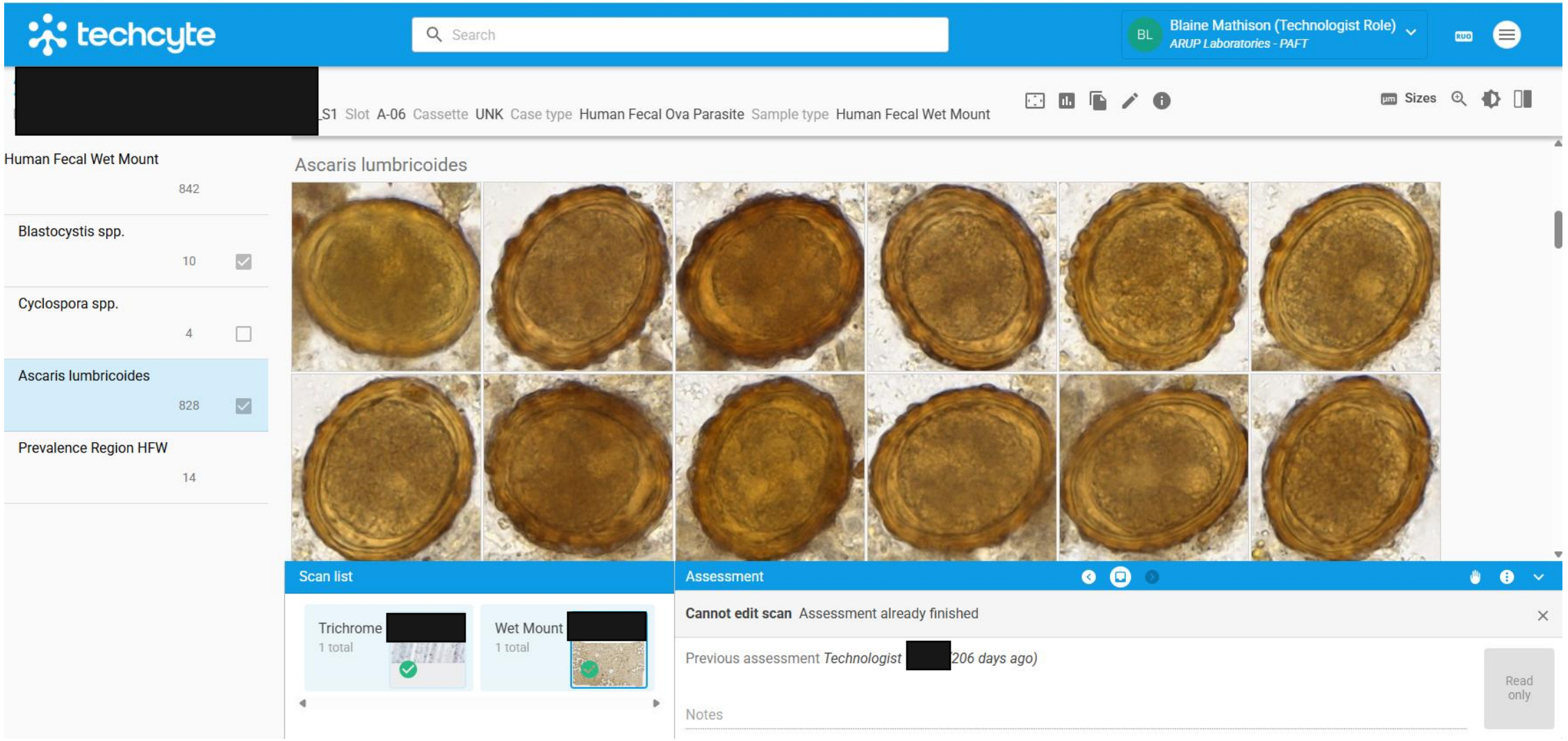
Wet Mount


techcyte
Search
Blaine Mathison (Technologist Role)
ARUP Laboratories - PAFT
[redacted]
Barcode [redacted] Slot A-06 Cassette UNK Case type Human Fecal Ova Parasite Sample type Human Fecal Wet Mount
Sizes
Human Fecal Wet Mount
842
Blastocystis spp.
10
Cyclospora spp.
4
Ascaris lumbricoides
828
Prevalence Region HFW
14
Blastocystis spp.
Scan list
Trichrome [redacted]
1 total
Wet Mount [redacted]
1 total
Assessment
Cannot edit scan Assessment already finished
Previous assessment Technologist [redacted] (206 days ago)
Read only
Notes

Example: *Blastocystis* sp.



Wet mount


techcyte
Search
Blaine Mathison (Technologist Role)
ARUP Laboratories - PAFT
[redacted]_S1 Slot A-06 Cassette UNK Case type Human Fecal Ova Parasite Sample type Human Fecal Wet Mount
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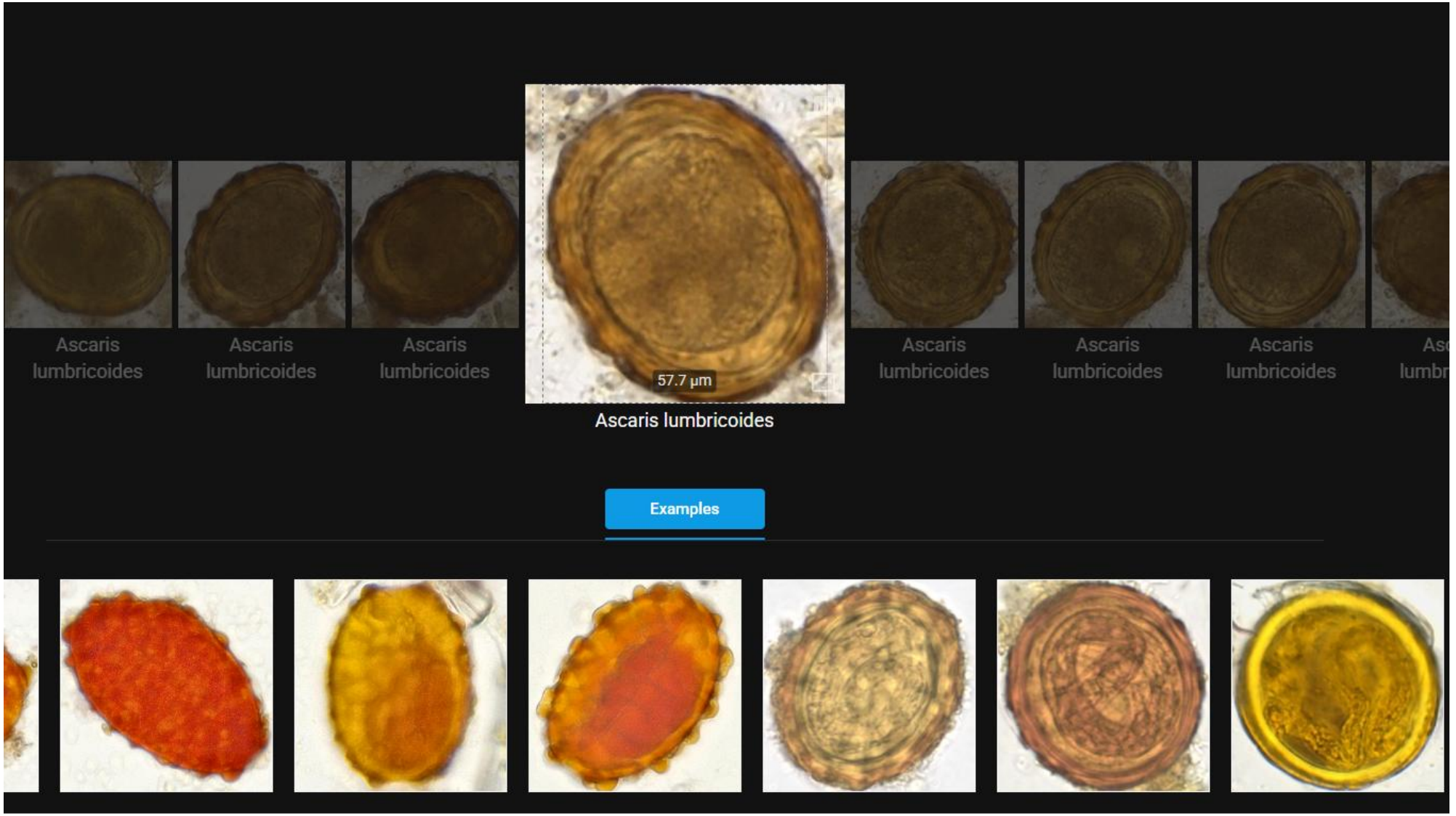
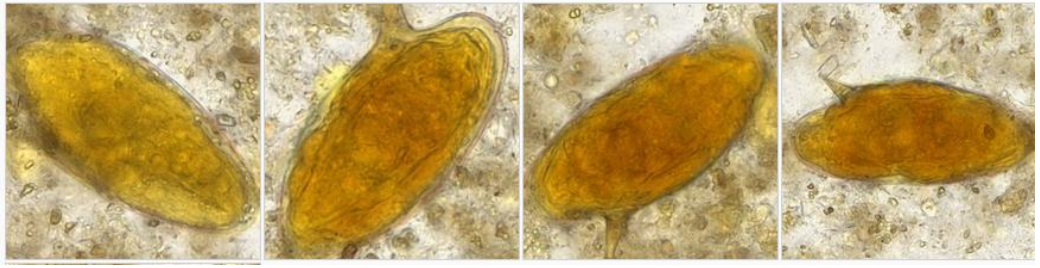
828
Prevalence Region HFW
14
Ascaris lumbricoides
Scan list
Trichrome [redacted]
1 total
Wet Mount [redacted]
1 total
Assessment
Cannot edit scan Assessment already finished
Previous assessment Technologist [redacted] (206 days ago)
Notes
Read only

Example: *Ascaris lumbricoides*

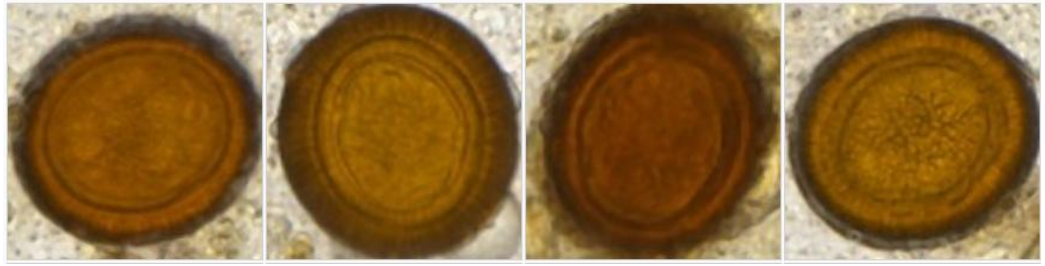


Some fun examples since going live with wet mount:

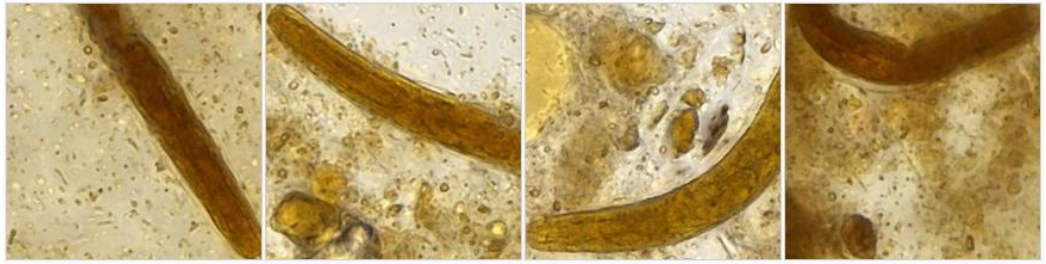
Schistosoma mansoni



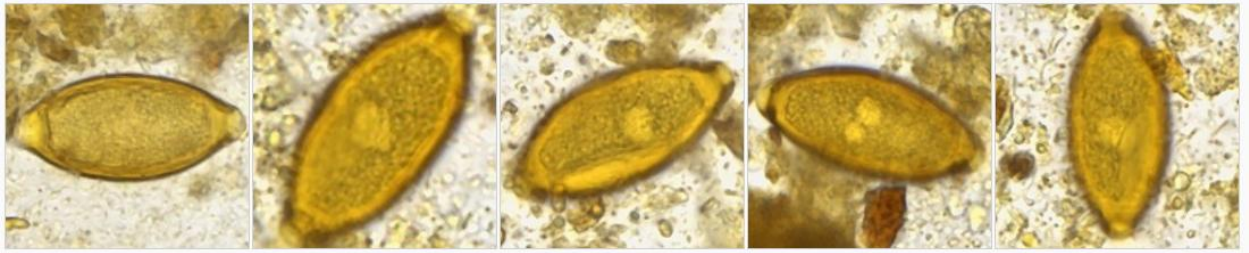
Taenia spp.



Strongyloides spp.

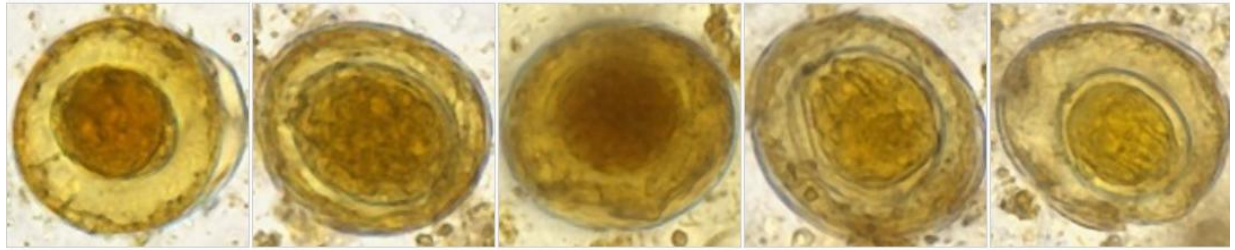


Trichuris trichiura

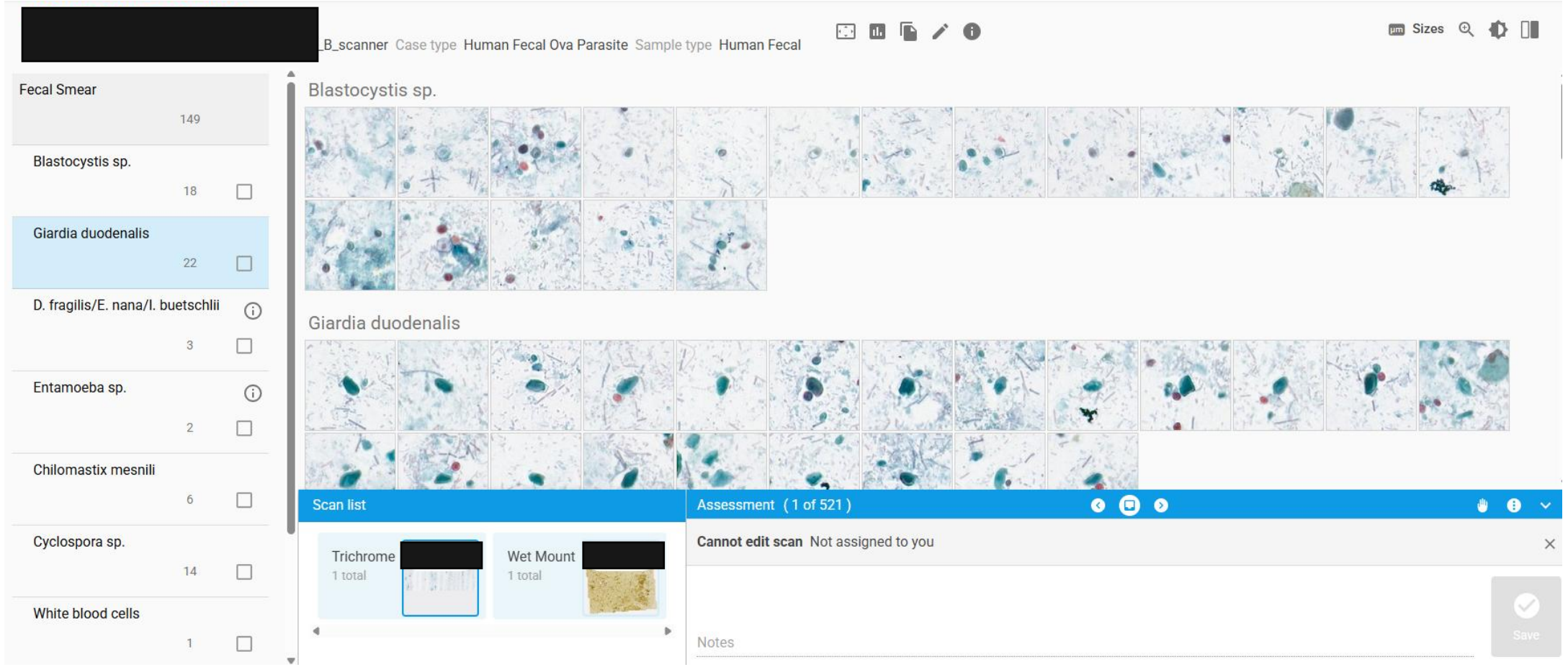


Enterobius vermicularis

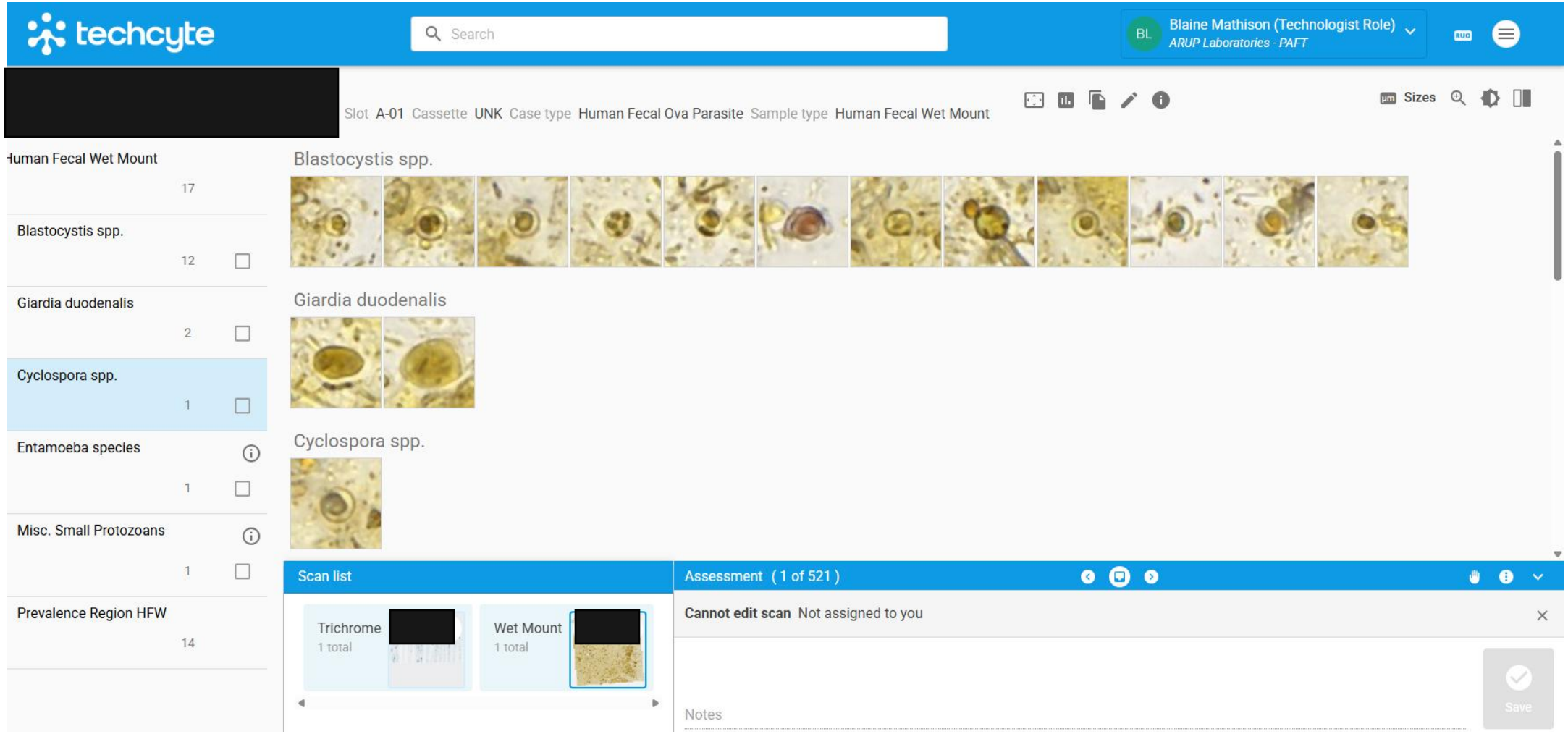
Rodentolepis nana



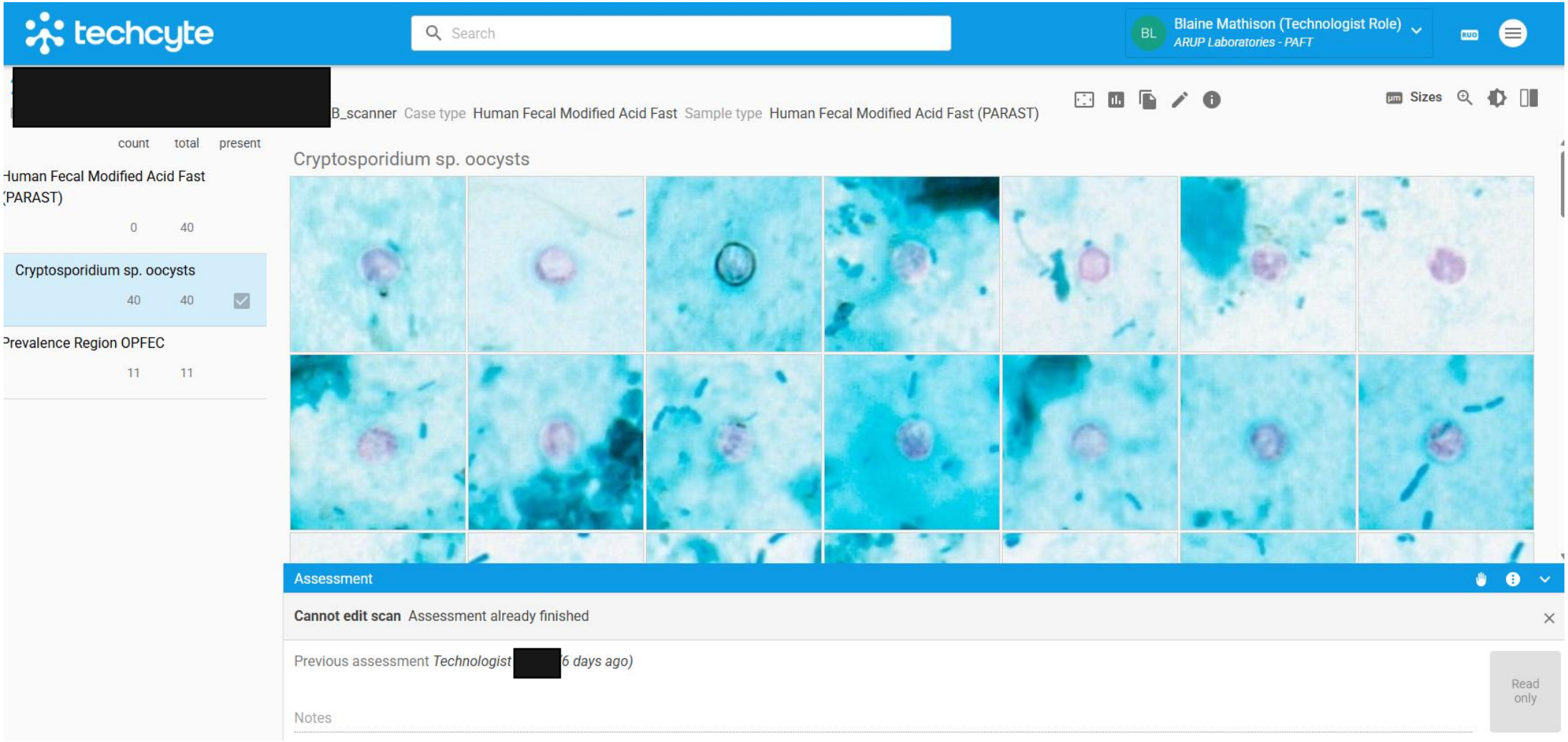
A clean negative…



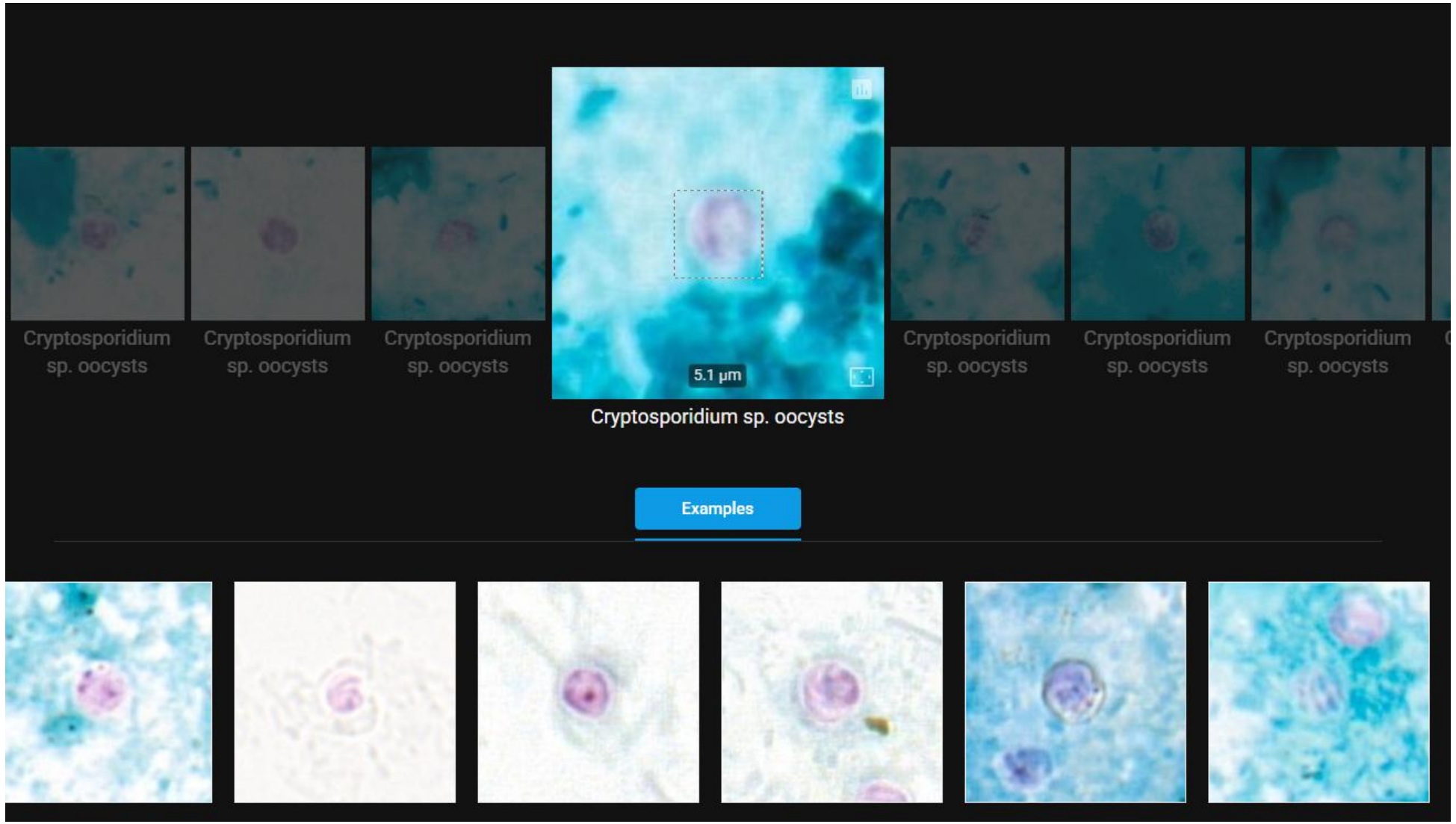
And its corresponding wet mount…



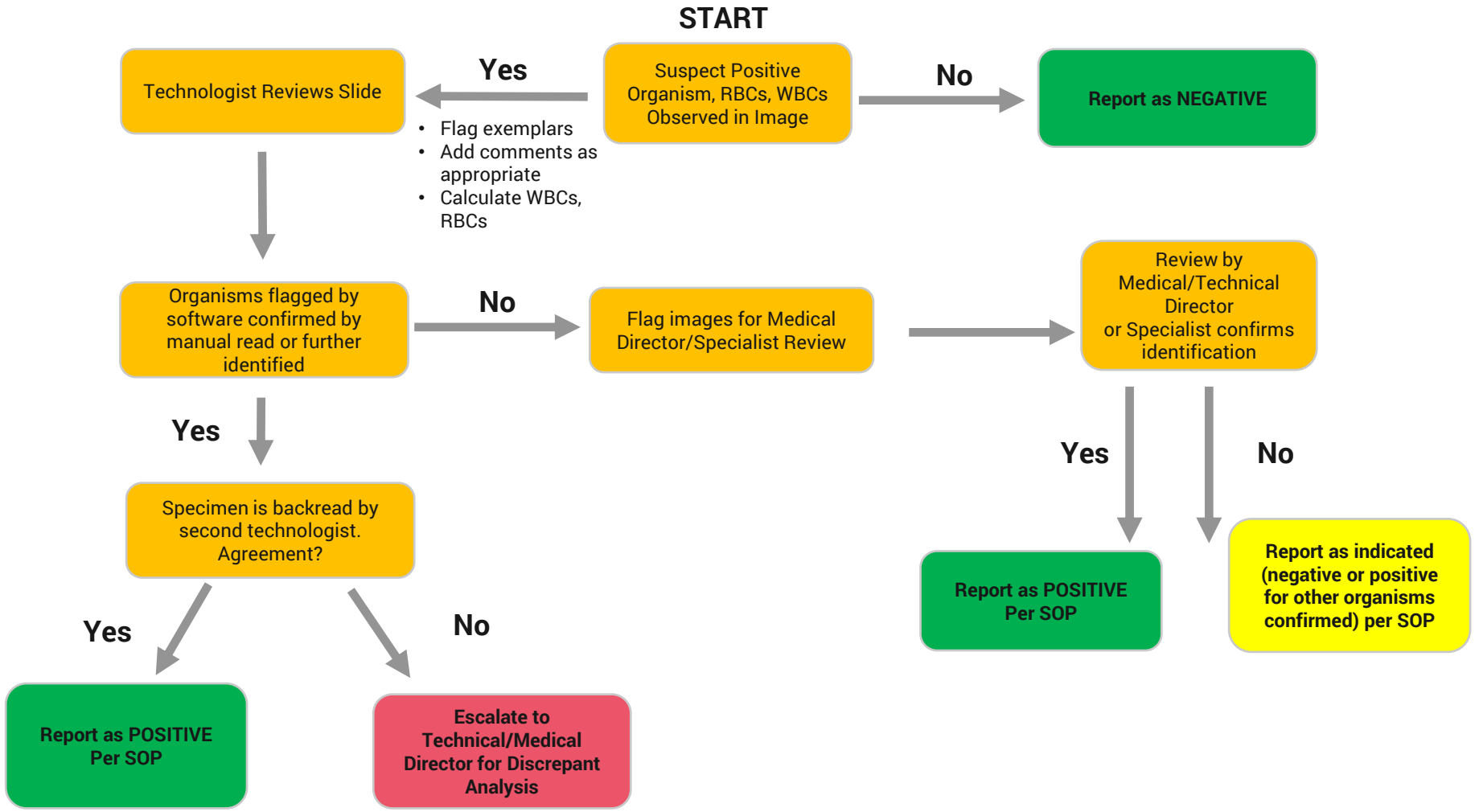
Kinyoun’s Modified Acid-fast Stain



Example: *Cryptosporidium* sp.



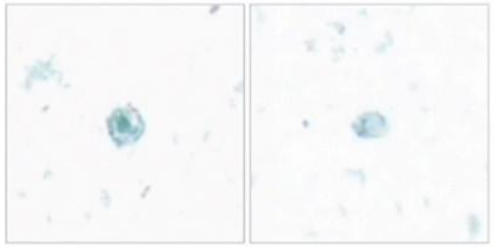
Lab Workflow



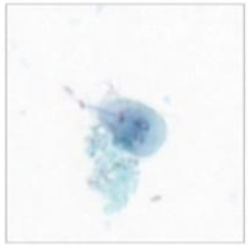
Would the lab have missed this?

	count	total	present
Fecal Smear	0	42	
Blastocystis sp.	2		☐
Giardia duodenalis	0	1	
Giardia Troph	1		☐
Entamoeba sp.	0	2	
Entamoeba Troph	2		☐
White blood cells	4		☐
Red blood cells	33		☐
Prevalence Region OPFEC	11		

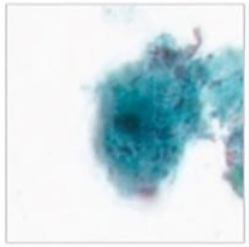
Blastocystis sp.

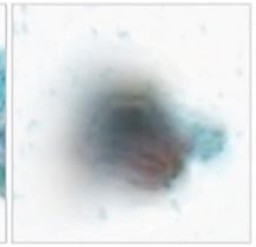


Giardia Troph



Entamoeba Troph





Or what about this one?

Human Fecal Wet Mount

14

Giardia duodenalis

11

Entamoeba species

1

Iodamoeba buetschlii

1

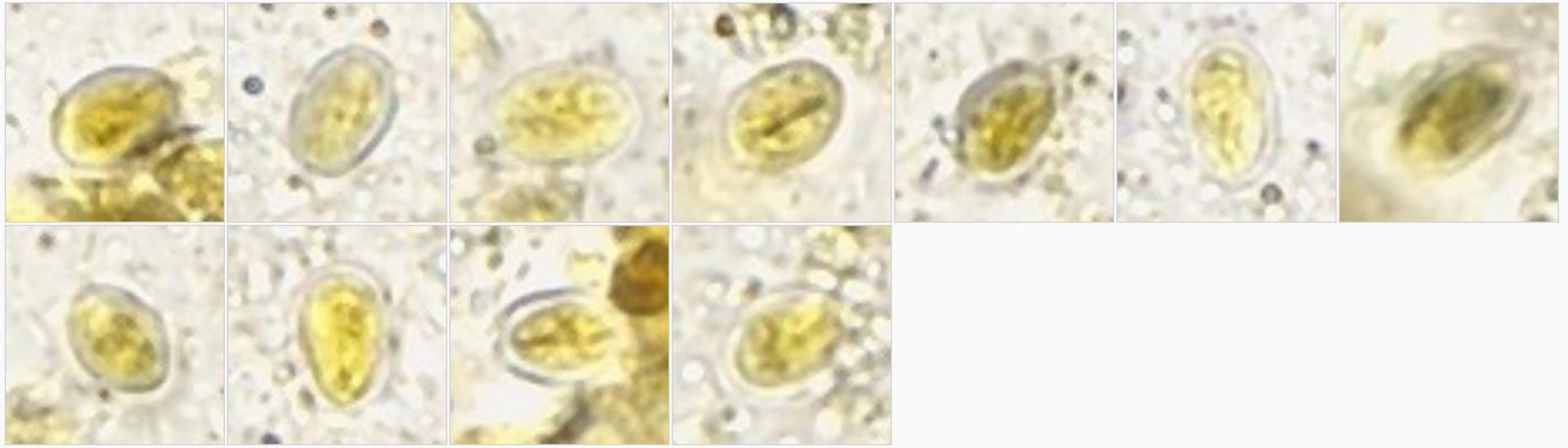
Trichuris trichiura

1

Prevalence Region HFW

14

Giardia duodenalis



Entamoeba species

Assessment

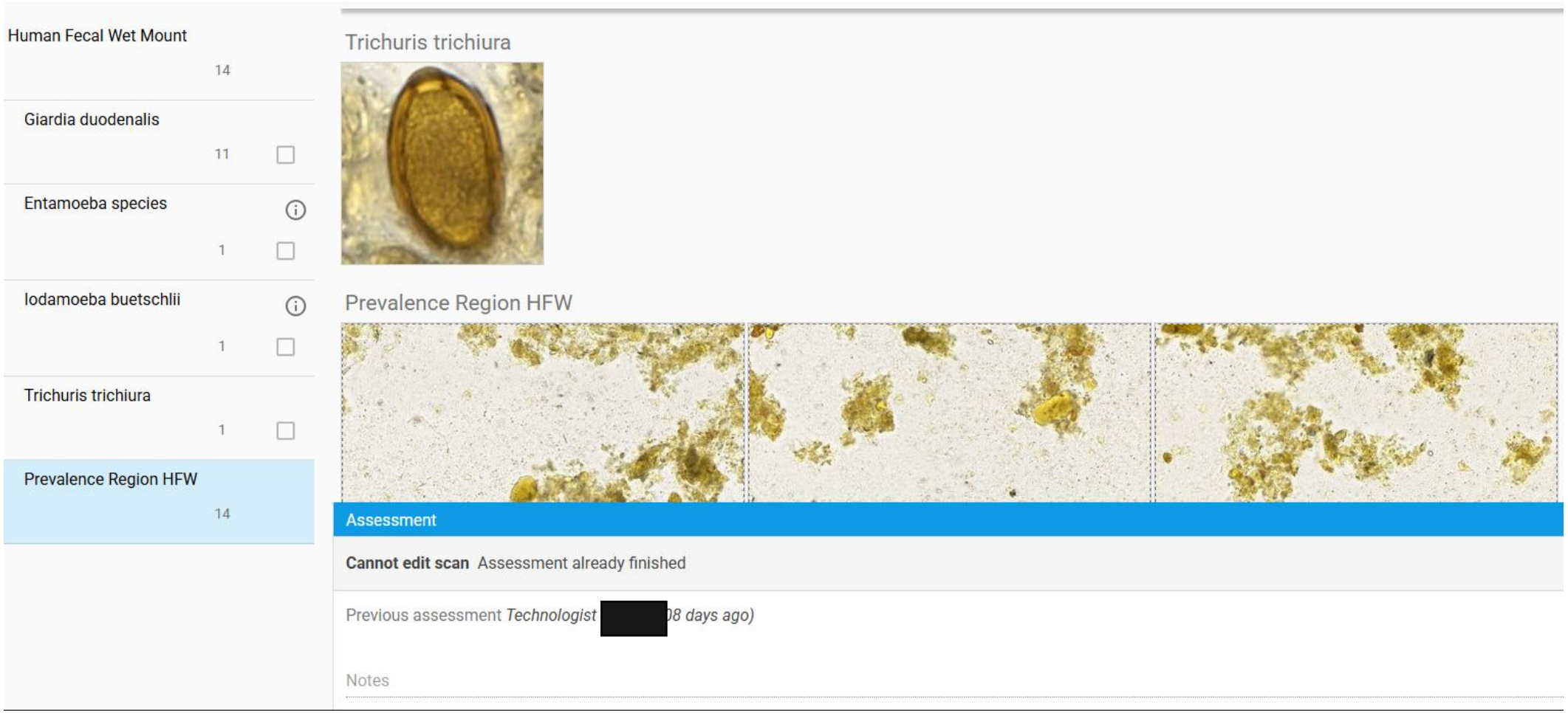
Cannot edit scan Assessment already finished

Previous assessment *Technologist* [redacted] *08 days ago)*

Notes

Read only

But wait, there's more!



And another challenging case…

Human Fecal Wet Mount

8

Blastocystis spp. 3 ☐

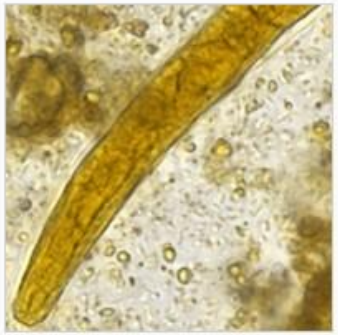
Cyclospora spp. 1 ☐

Entamoeba species ⓘ 3 ☐

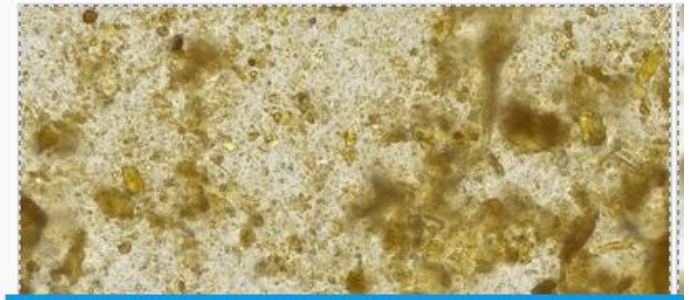
Strongyloides spp. 1 ☐

Prevalence Region HFW 14

Strongyloides spp.

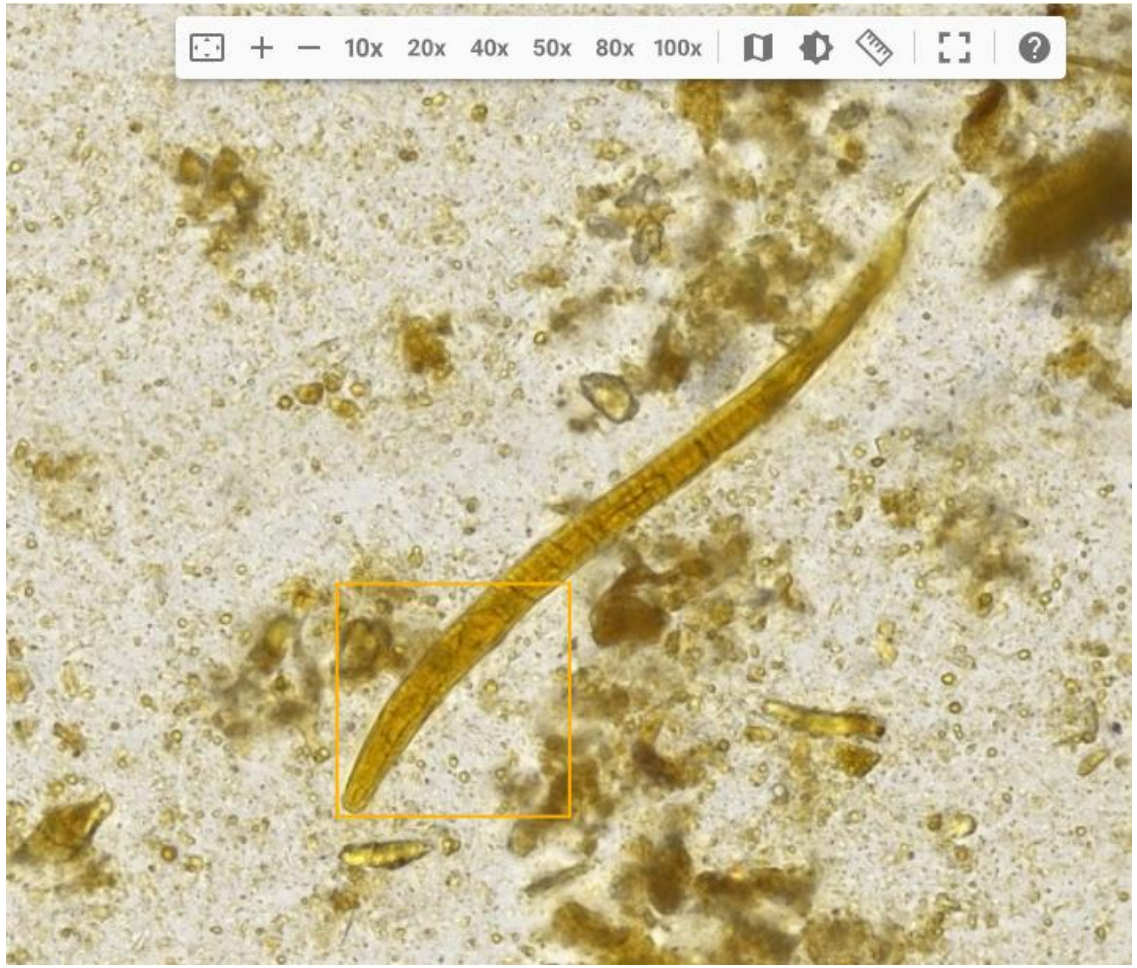


Prevalence Region HFW



Assessment

Cannot edit scan Not assigned to you



In Closing…

In Closing. AI can improve the workflow in a parasitology lab by….

- Improving turnaround time (reducing the time needed to manually read negative specimens)
- Screening out negative specimens
- Reduce ergonomic injuries associated with prolonged microscopy
- Improve employee satisfactions (spending more time reading and confirming positive slides)
- Increased competence and confidence in parasite identification
- More engaging for an increasingly younger workforce

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