AI for cancer diagnosis in resource deprived areas

Dr Yuchun Ding

Founder

Researcher

~~AI~~ for cancer diagnosis in resource deprived areas

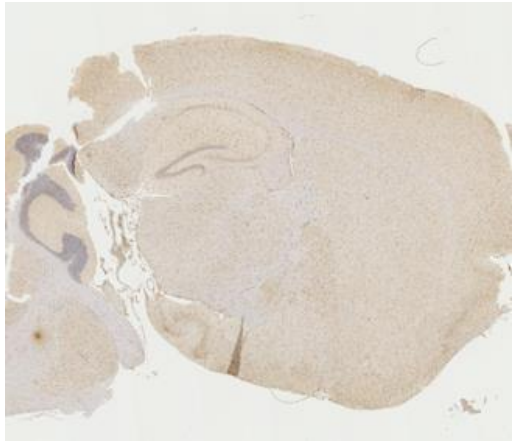
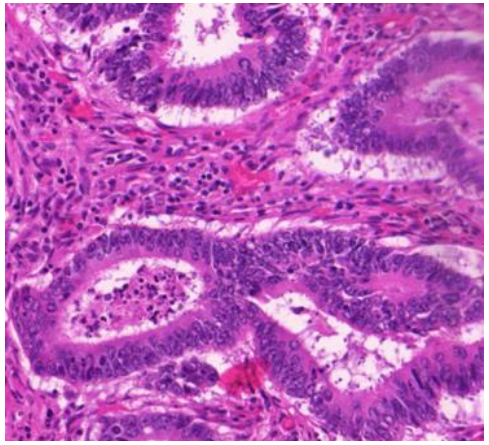
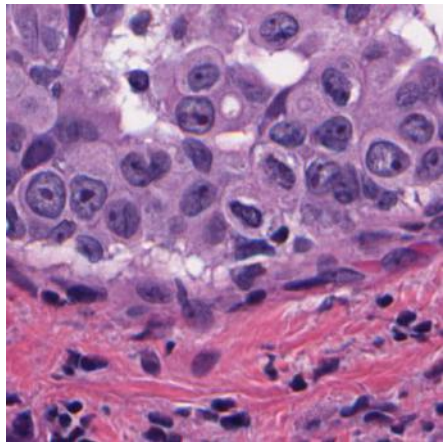
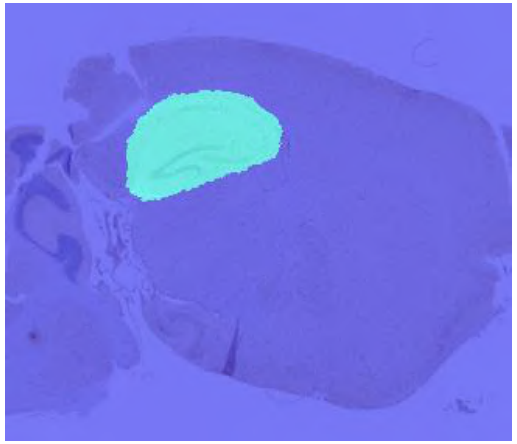
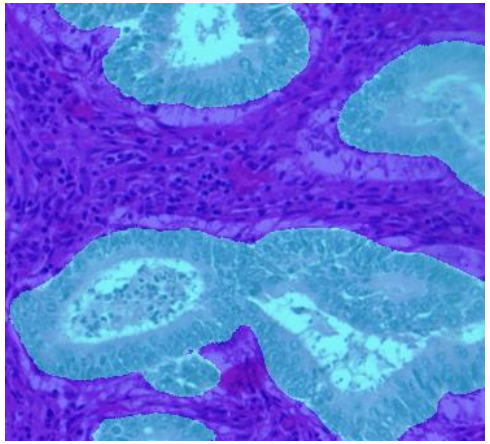
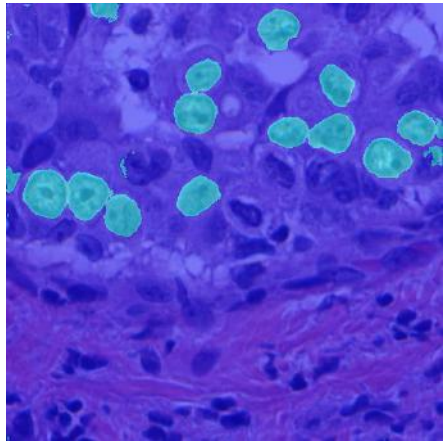
The missing tech

Dr Yuchun Ding

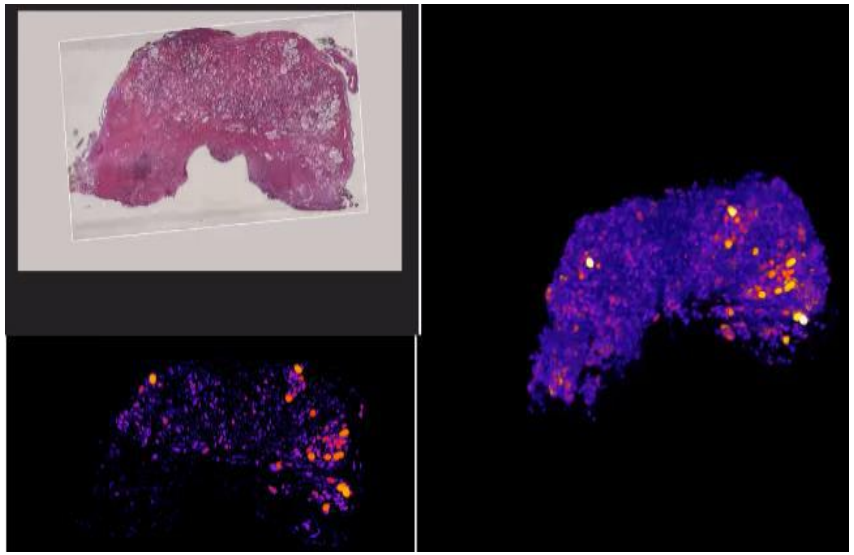
Founder

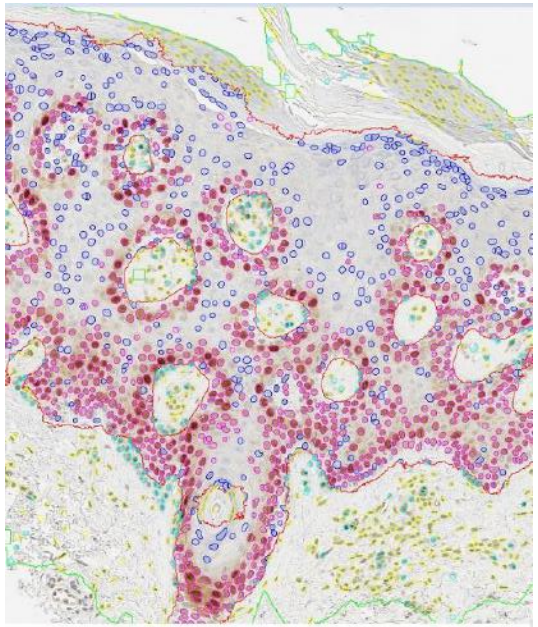
Researcher

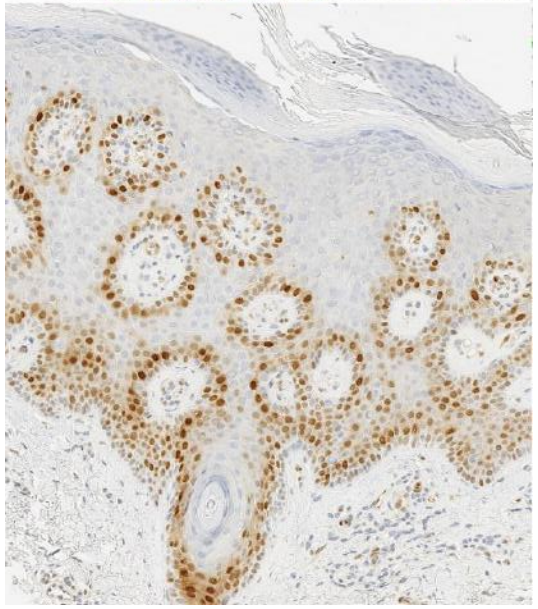
What do I do during the day

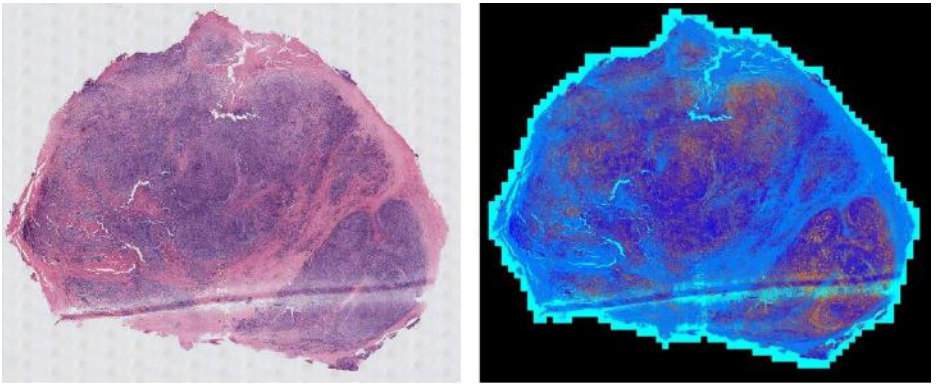
AI-assisted 3D tumour/tissue reconstruction



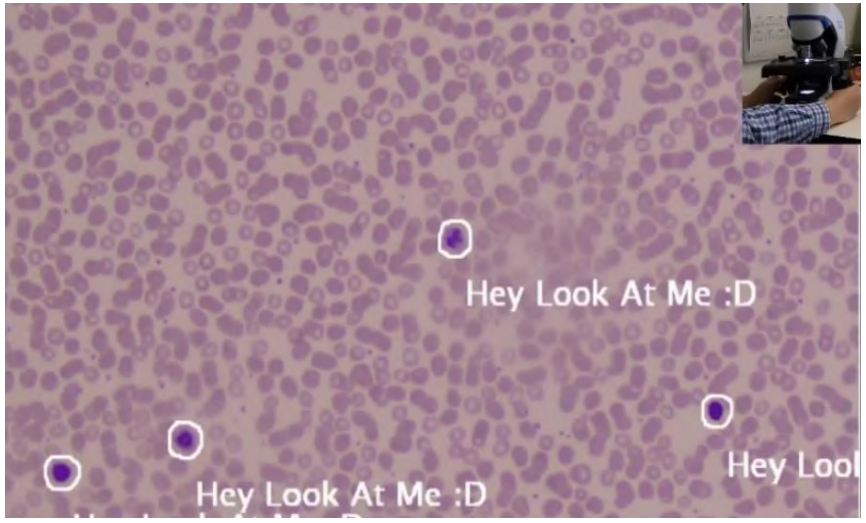




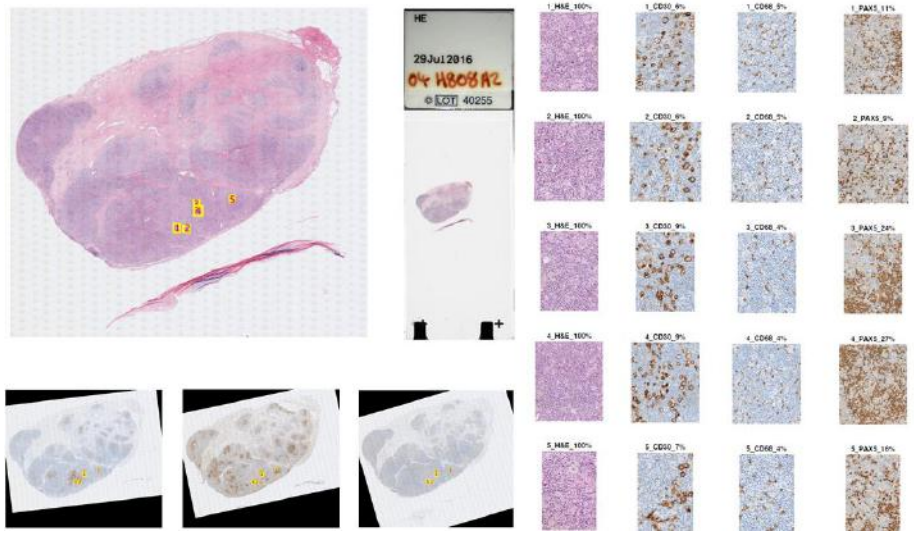
Annotation-Free Data Generation For training AI



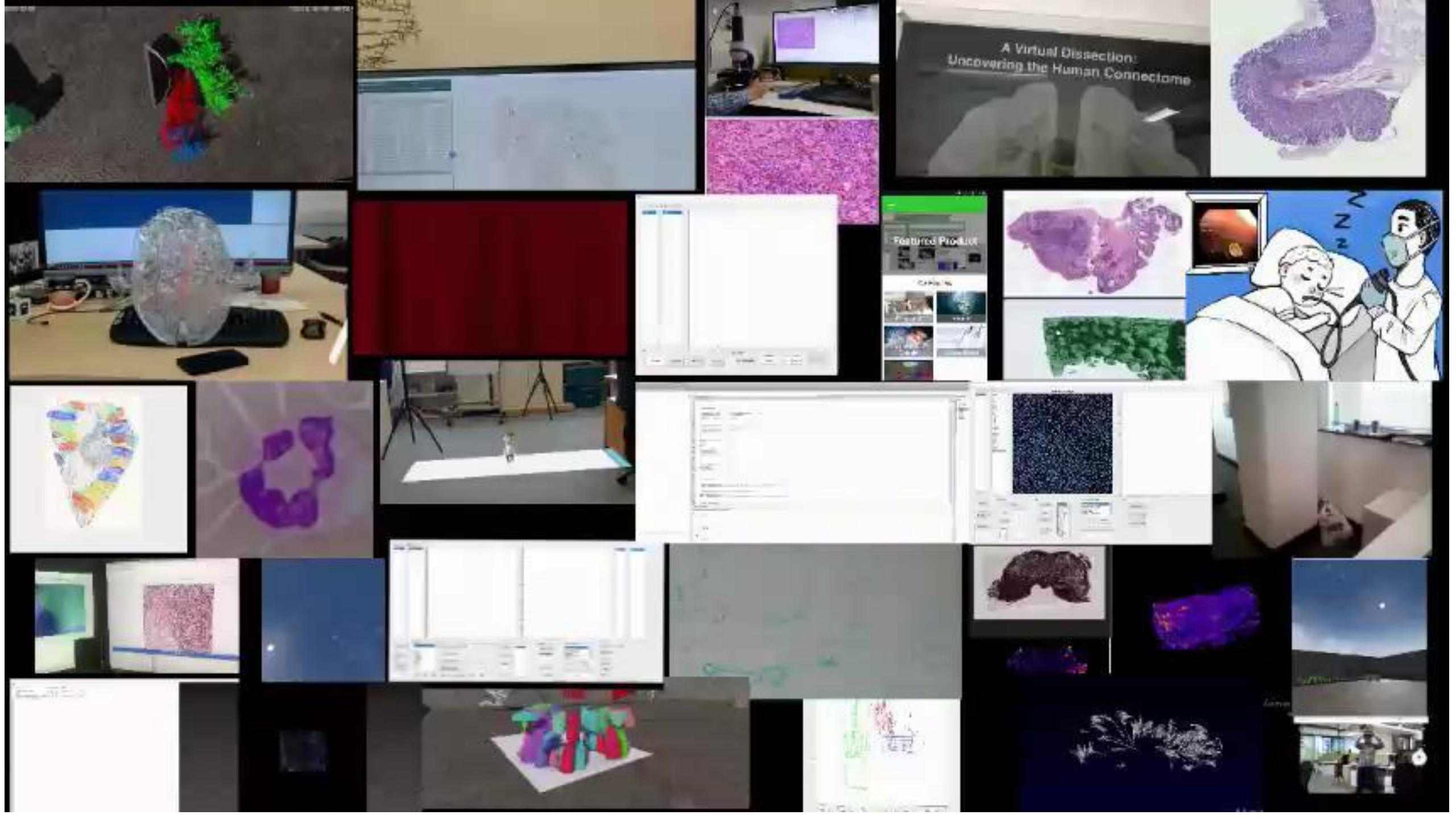
AI-augmented Real Time Microscope



Co-location Analysis



Automate high-throughput IHC quantitative analysis


A Virtual Dissection:
Uncovering the Human Connectome

Have I done something that has made a real difference in healthcare?

No

Suddenly, I realized:

Knowhows without added-values for pathologists is useless:

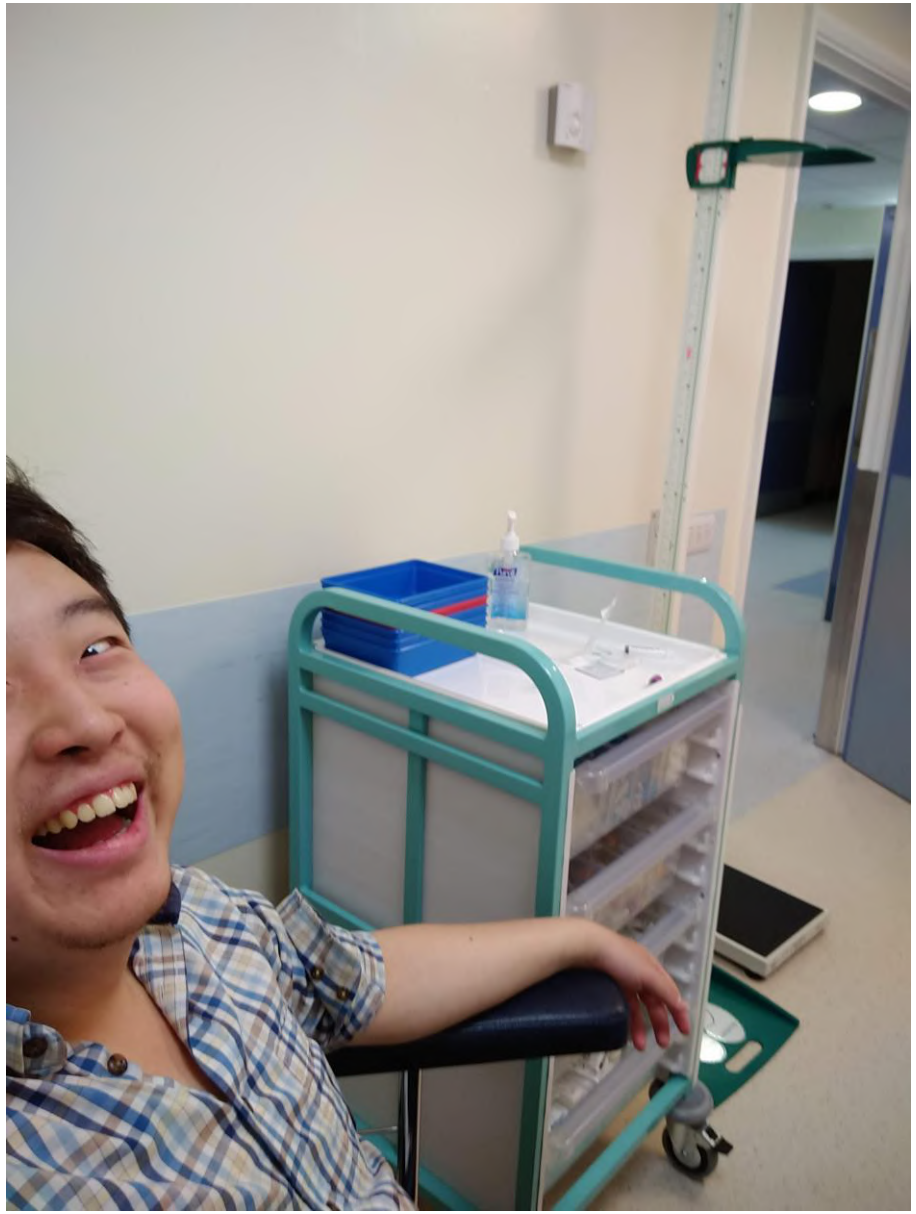
Rookie mistake for tech people.

Here is the first thing I did to start changing..

Forget computer science

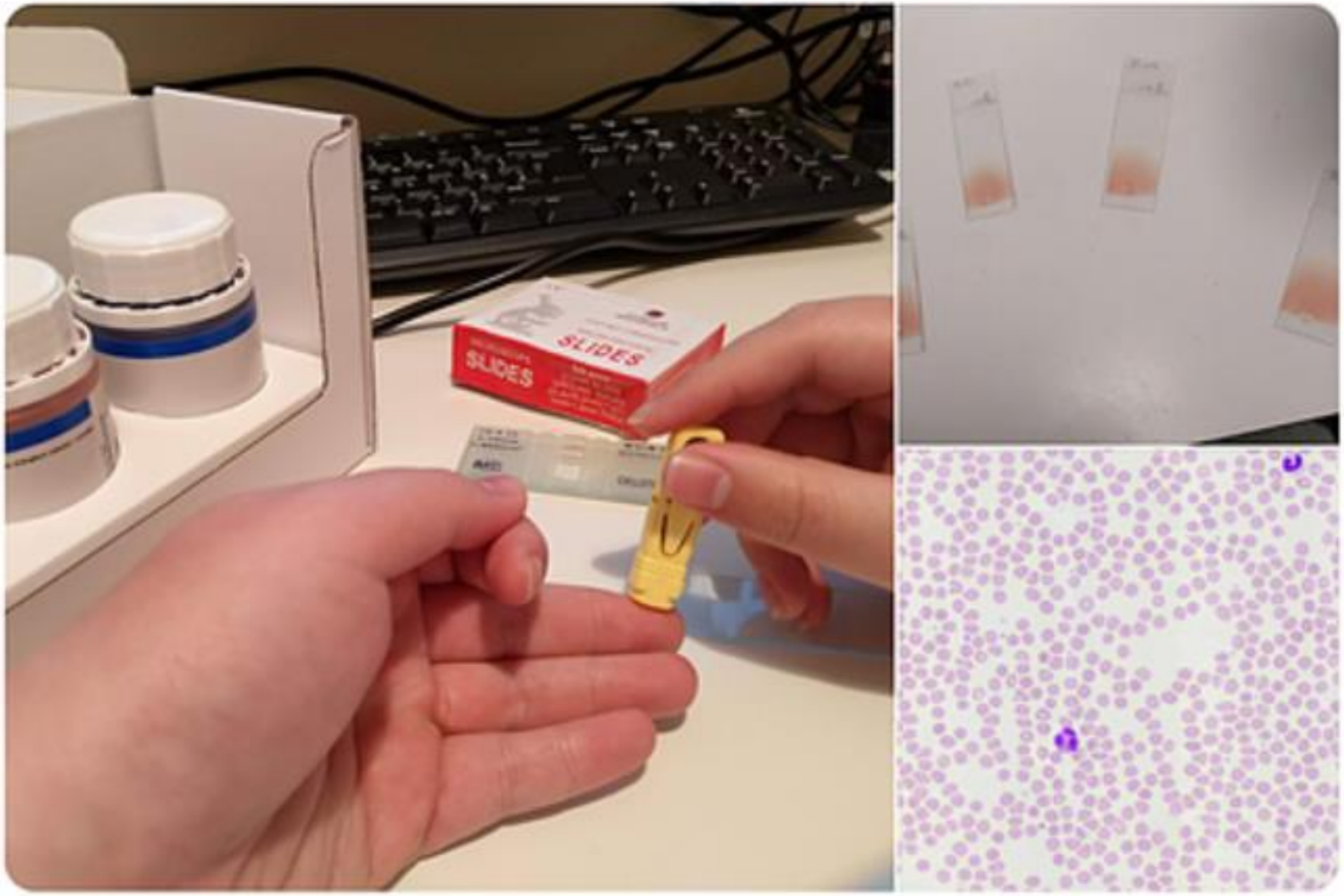
And lean what pathologists do

Visit the haematology lab:



Go shopping….

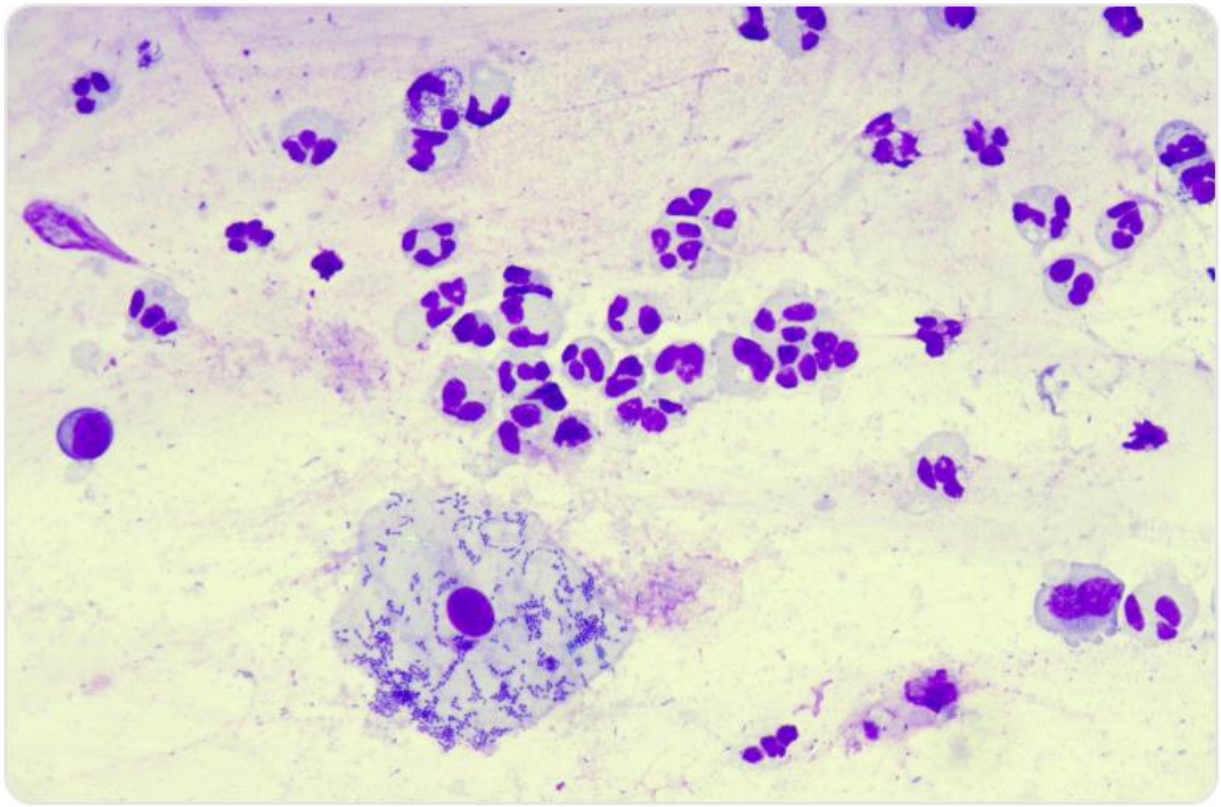
‘hand-on’ experience, start with the basic…



Tweet like a pathologist, not exactly

Ding @Dingdingading · Apr 3

Fun fact: if you sniff really hard, have the boogers go into your throat, and spit it out of your mouth, you will get lymphocytes, neutrophils, cheek cells, bacteria in one sample.



6 12 64 IMG⇩

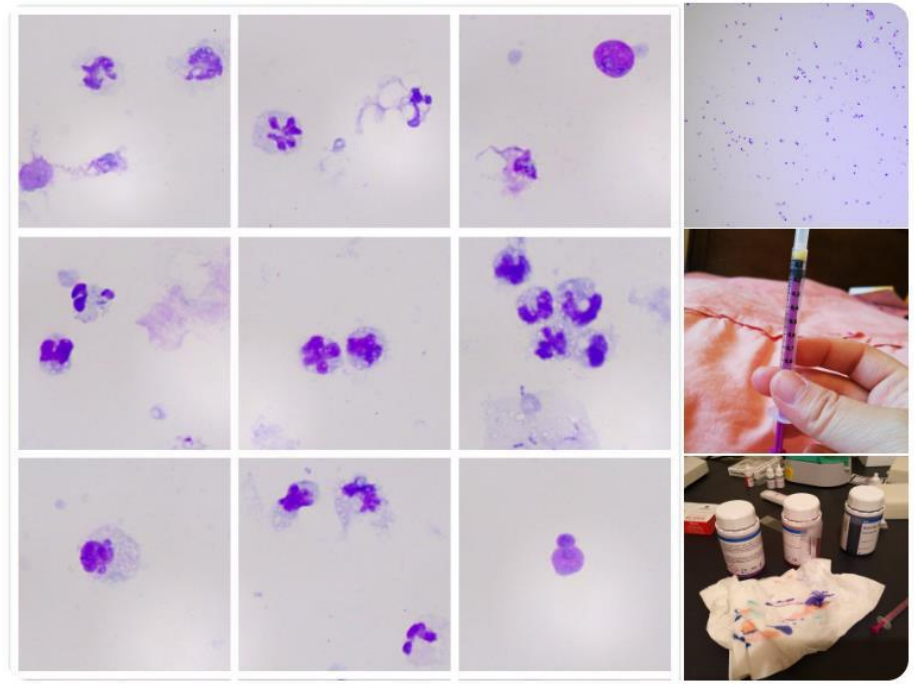
Ding @Dingdingading · Jan 28

4 days after our 2nd son was born my crazy scientific spirit is back

This time I borrowed a drop of colostrum from my wife and made a 'colostrum smear'

You will be surprised to see the amount of leukocytes in it (boost newborn's immune system)

so #breastfeeding if you can! 🤱 👍



X-WOW!

6 18 89 IMG⇩

Challenges of Digital Pathological Diagnosis in LMIC

Out-dated, non-functioning microscopes

Low-end camera, lack of image quality and field of view

Extremely source-limited

Extremely slow internet speed

Extremely short staffed

I decided to start with one country - Malawi

Deploying Digital Pathology in Resource Challenged Countries. The Malawi Experience

Paediatric Oncology, Queen Elizabeth Central Hospital

Paediatric Oncology
Queen Elizabeth Central Hospital

- Main focus has been on Burkitts lymphoma

- Thanks to Prof Elizabeth Molyneux, who opened a separate 17 bedded ward in 1997,

- Partnership with Peter Carey, Simon Bailey, Steve O'Brien

from Newcastle

Remote Cancer Diagnosis Consultation

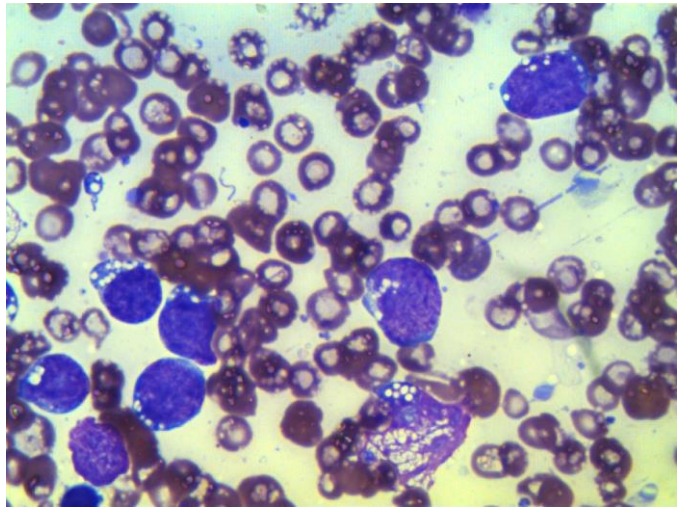
2500 patients e-mailed to Newcastle in 3 years

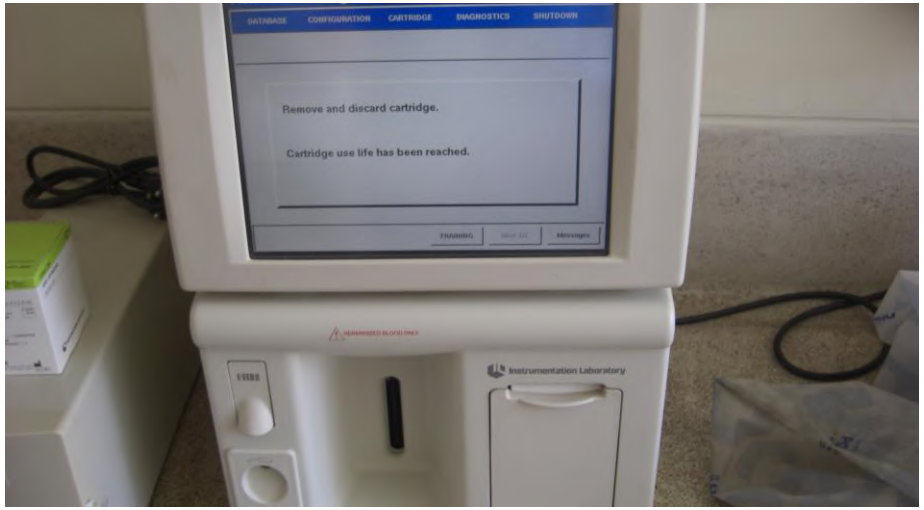
– 50 % diagnosed

Short report

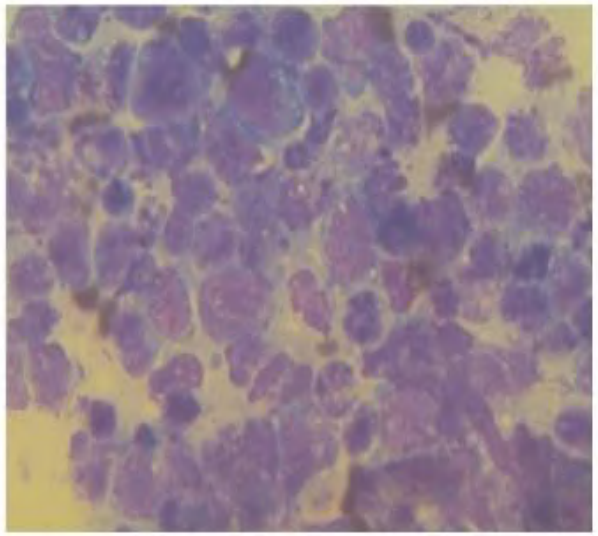
Remote and rapid pathological diagnosis in a resource challenged unit

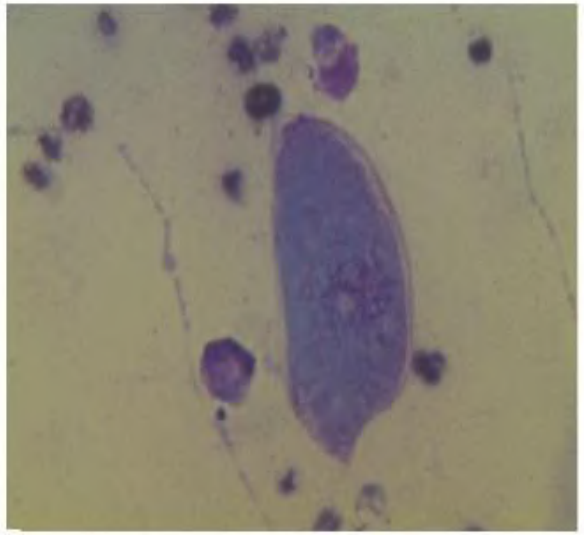
P Carey,[1] R Fudzulani,[2] D Scholfield,[3] G Chagaluka,[2] T Tomoka,[4] G Liombe,[4] K Banda,[2] V Wadehra,[5] S Samarasinghe,[1] E M Molyneux,[2] S Bailey[6]

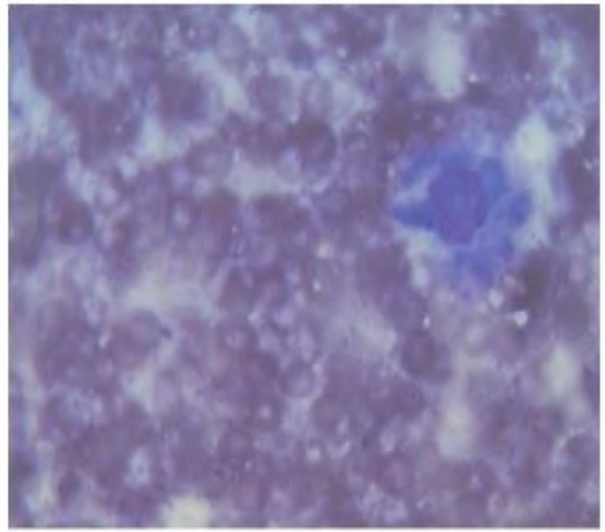


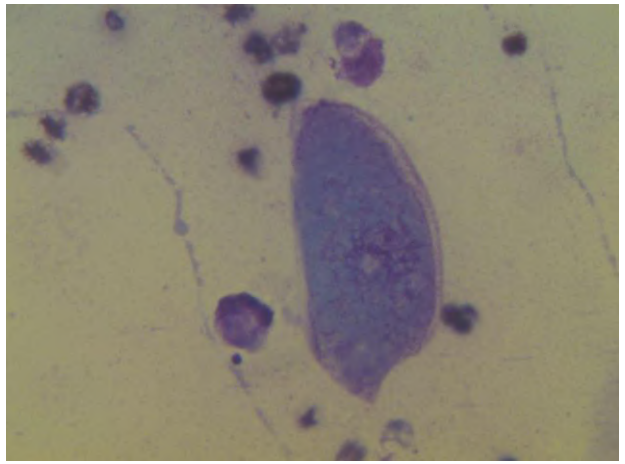


Main Cause
Poor Image quality

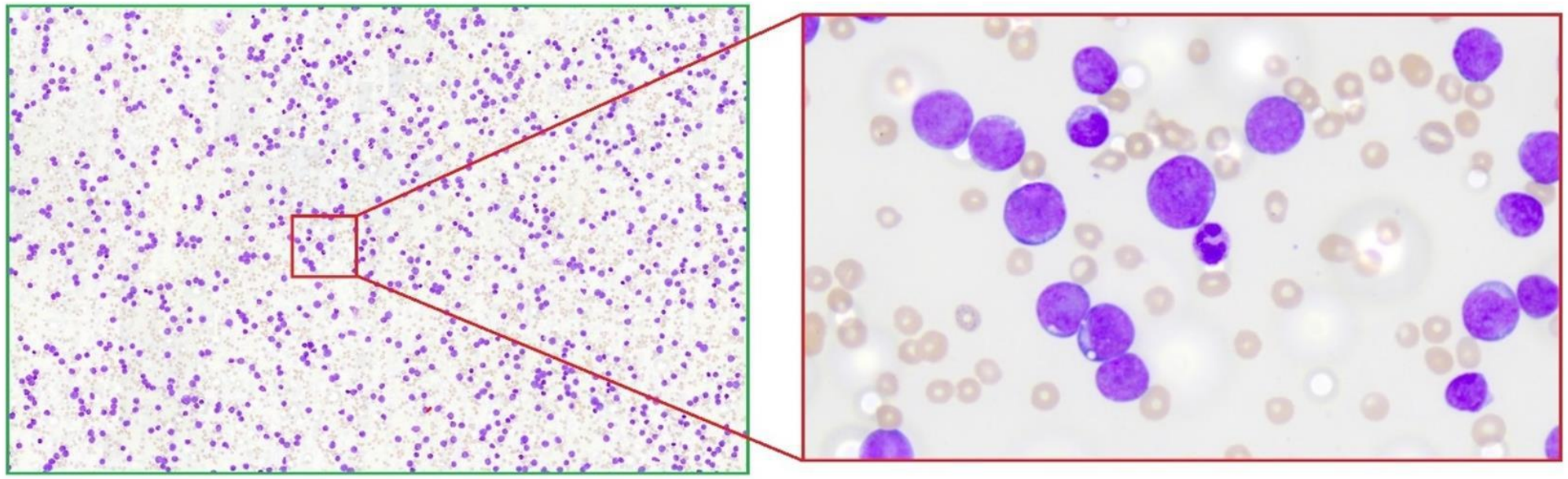








“Easy” Solution
Whole Slide Imaging



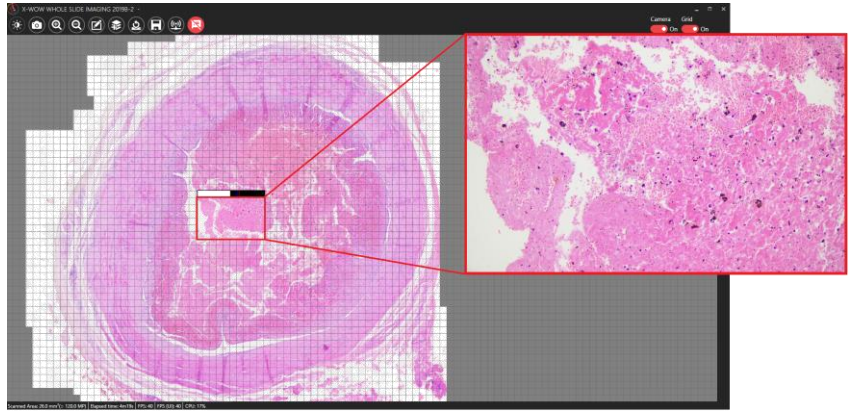
Requirement

Cheap To buy

Portable

High Magnification: blood smear, bone marrow
60x/100x oil

Solution: Turn Microscope into Whole Slide Scanner



Portable: small camera piece

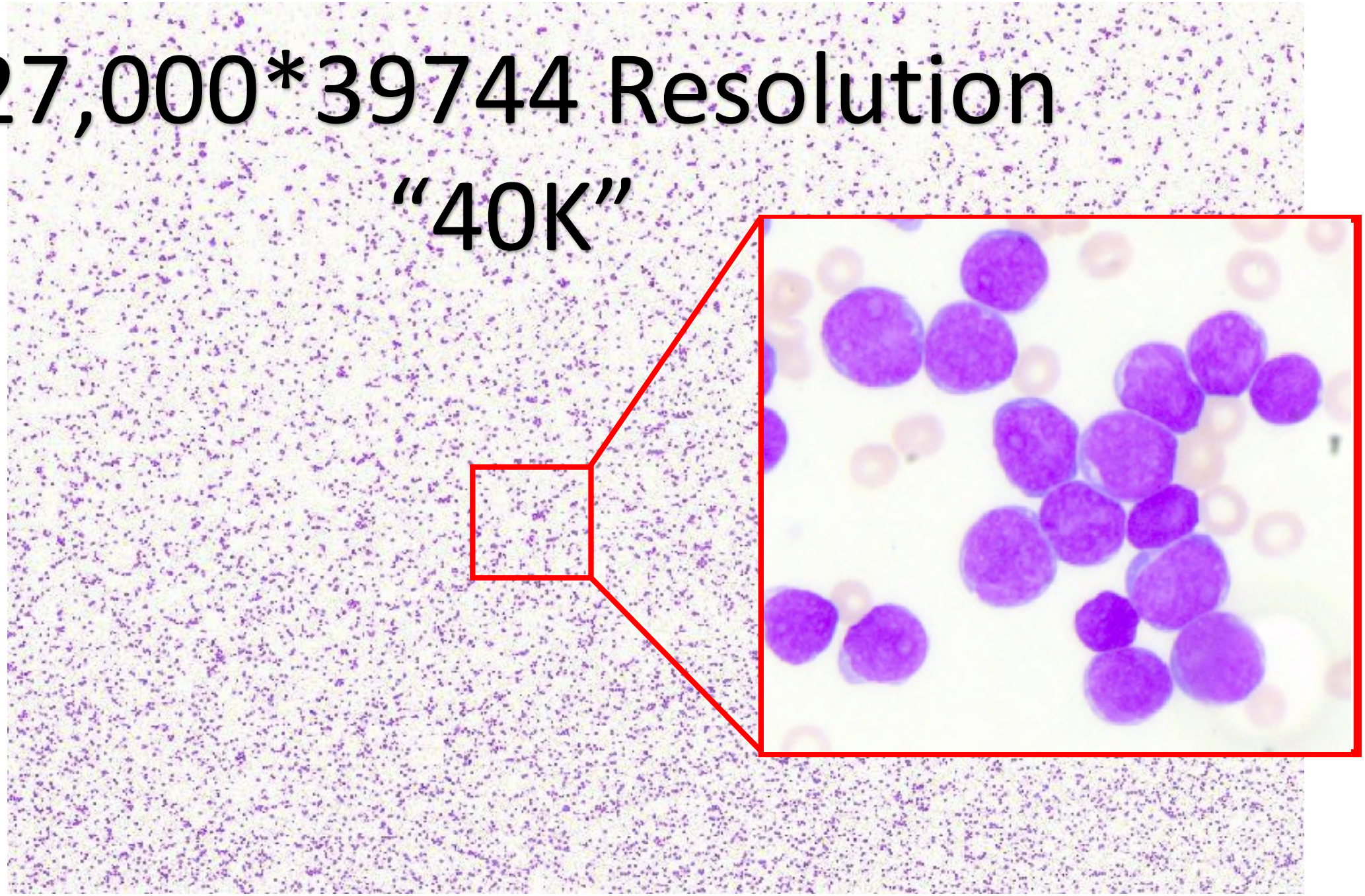
Magnification: up to 100x oil, Gigabyte image

Slow: manual method

X-wow.com/wsi

27,000*39744 Resolution

“40K”



https://www.x-wow.com/demowsi

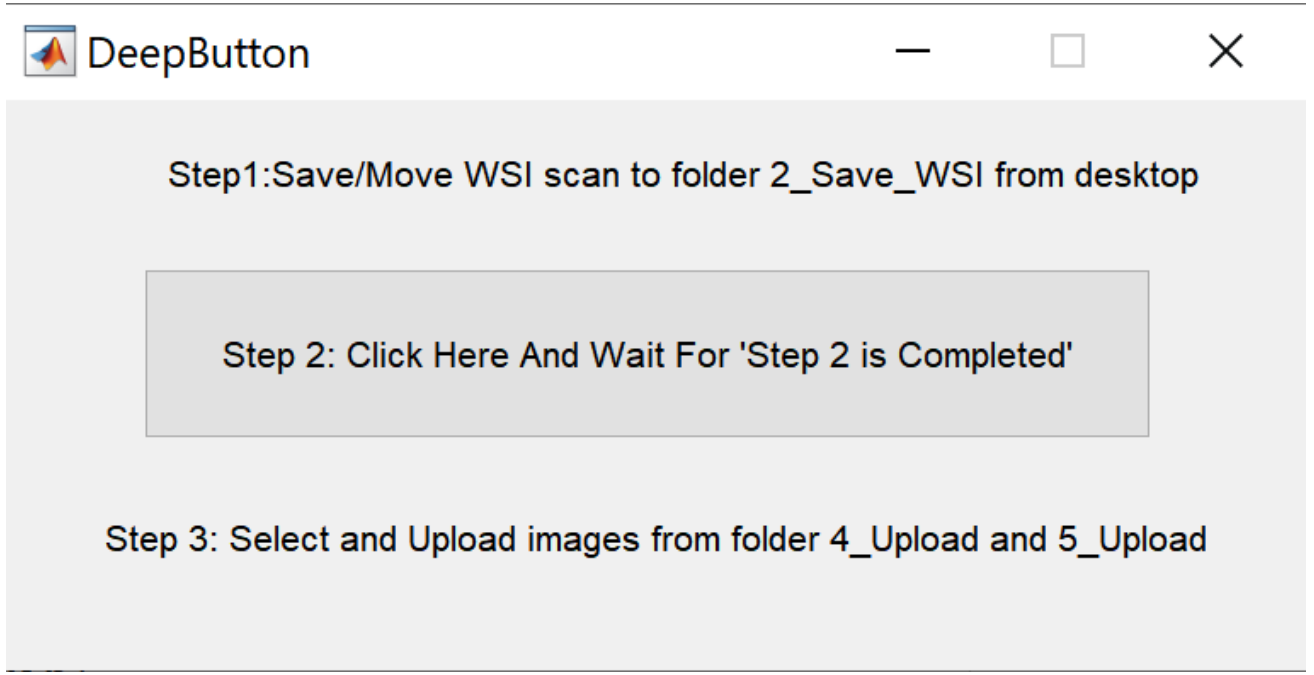
Challenge 2:
Transferring Gigabyte files

Solution: Build AI Whole Slide Scanner

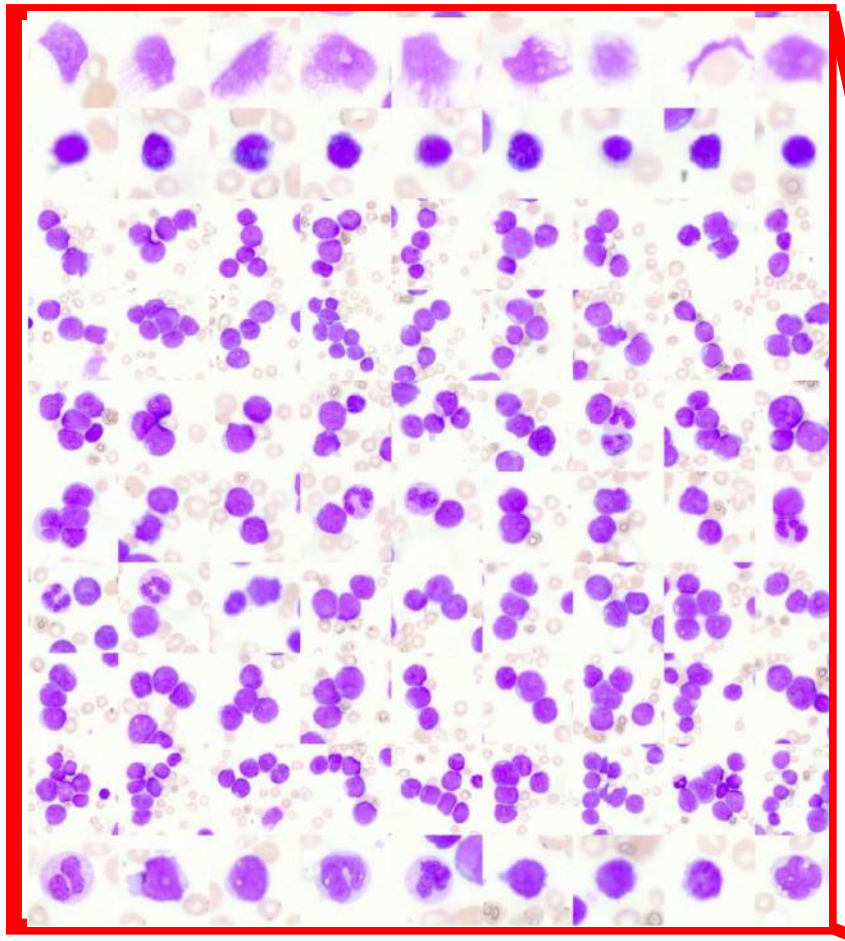
- Extract, classify and organise, intelligently (AI)

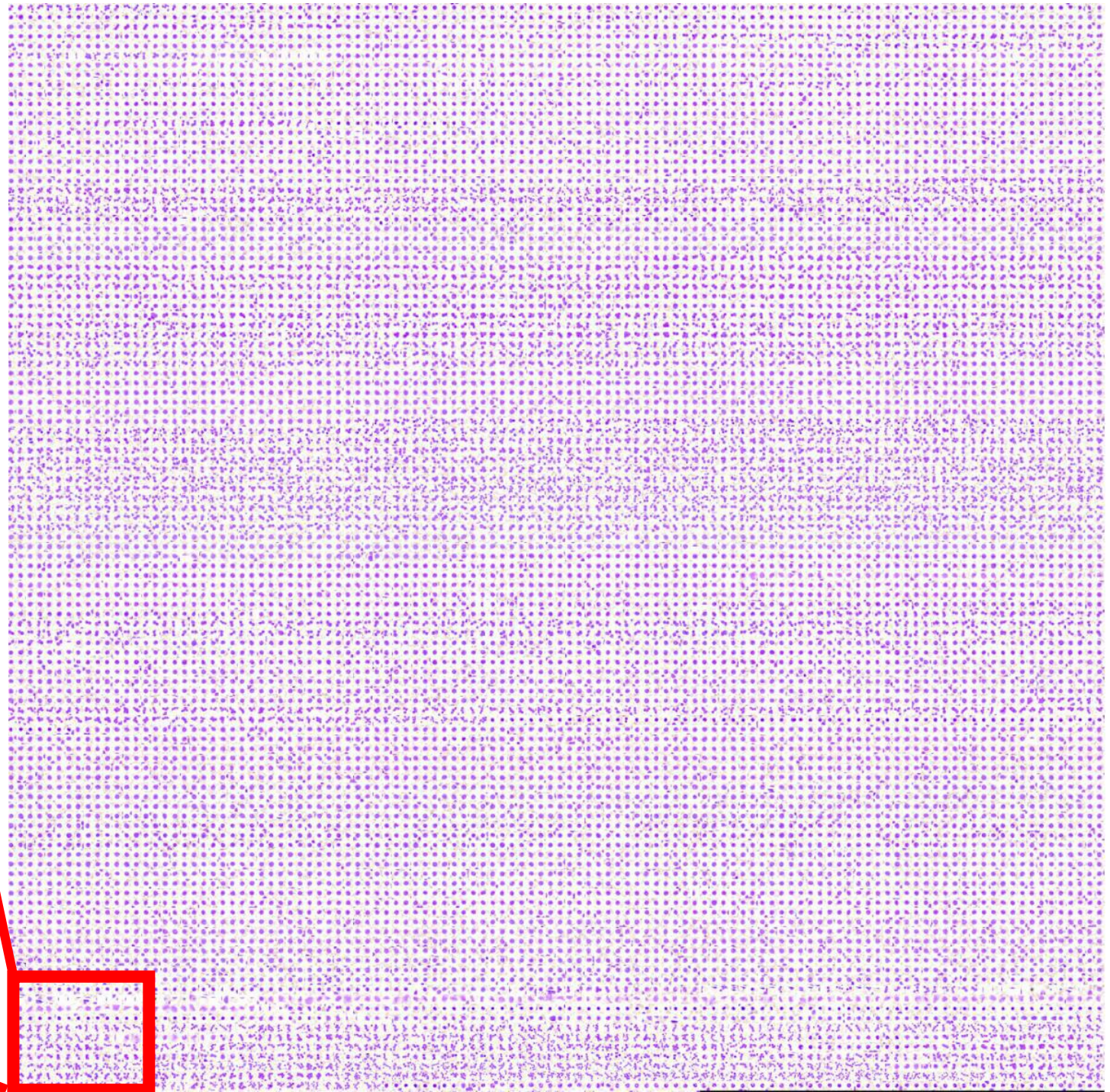
- single touch of a button

- Very simple solution



13,000 Cells
16MB









The Park
Newcastle

WE'LL BE
LESS ACTIVE
IF YOU'LL BE
LESS SUIT



Good
Space
Welcome

Police Officer
NAME: Fiorella Attick
AGE: 7 Years



TISSUE IMAG
ANALYTICS LAB
Cancer Grading




Orbis


Celebration?

No

I assumed….

- I could change healthcare and improve cancer diagnosis by simply sending the state of the art technology in digital pathology and AI.

It’s not that simple

Challenge 4….

Often neglected by scientists

Remote Training (Customer Education)

Attempts

- User Manual
- Video Tutorial
- Zoom Meeting
- Flying to Malawi

Attempts

- ~~User Manual~~ Too technical
- ~~Video Tutorial~~ Too technical
- ~~Zoom Video Meeting~~ Insufficient internet speed
- ~~Flying to Malawi~~ Expensive flight ticket

Exciting Progress

- Meeting Dr Amelia Taylor and Thanda Joshua Mtegha, Computer Science and AI experts from the University of Malawi

- Exchanging emails, explaining the installation, arranging the visit.

- Successful first digitisation: “He has used it and felt it was good”

But….

Challenge 5….

- Digitise whole slides, implement AI require extra time and human resources which is not available in resource limited hospitals

- Not easy to arrange frequent meeting for multidisciplinary team, due to:

  Hospital duty

  University work

  Local demonstration

Other things to consider

- Understaffing
- Limited laboratory and diagnostic support, lack of equipment
- Young children arriving late in the disease and travelling a long way to get to hospital.
- IT infrastracture

2nd attempt: deploying digital pathology in the Caribbean

More challenges

- Delays due to Hospital IT system get hacked
- Interruption due to coronavirus

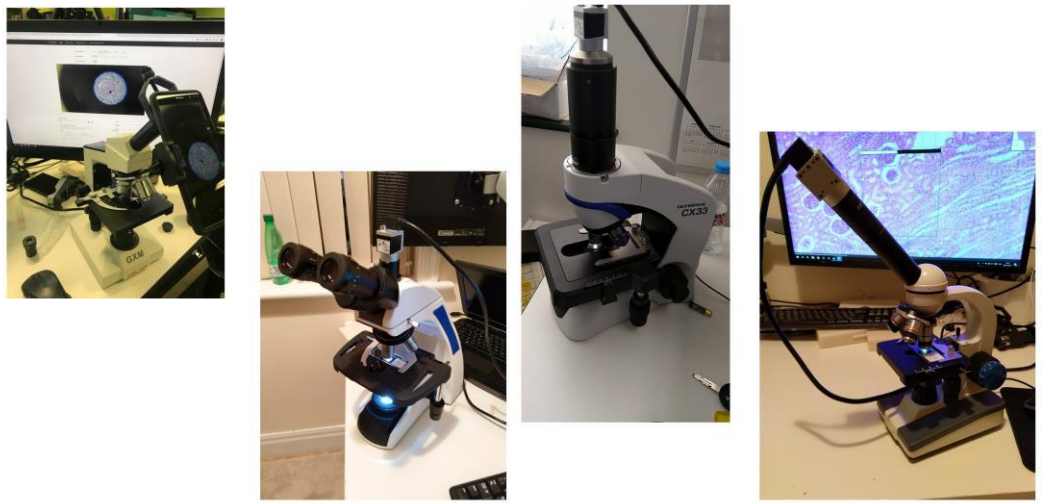
Changed of plan

- Make further improvement to the AI-powered whole slide scanner, focus on usability ‘plug and play’.

- Take another step back and started to think what’s really needed to support cancer diagnosis in deprived areas

Cruel Fact

monocular, binocular, trinocular, whole slide imaging….



I own 4 brand new microscopes for fun twitter posts.

Pathologists in deprived areas share a single old microscope to diagnose diseases

Change of plan:

~~AI for cancer diagnosis in resource deprived areas~~

Training next generation pathologists

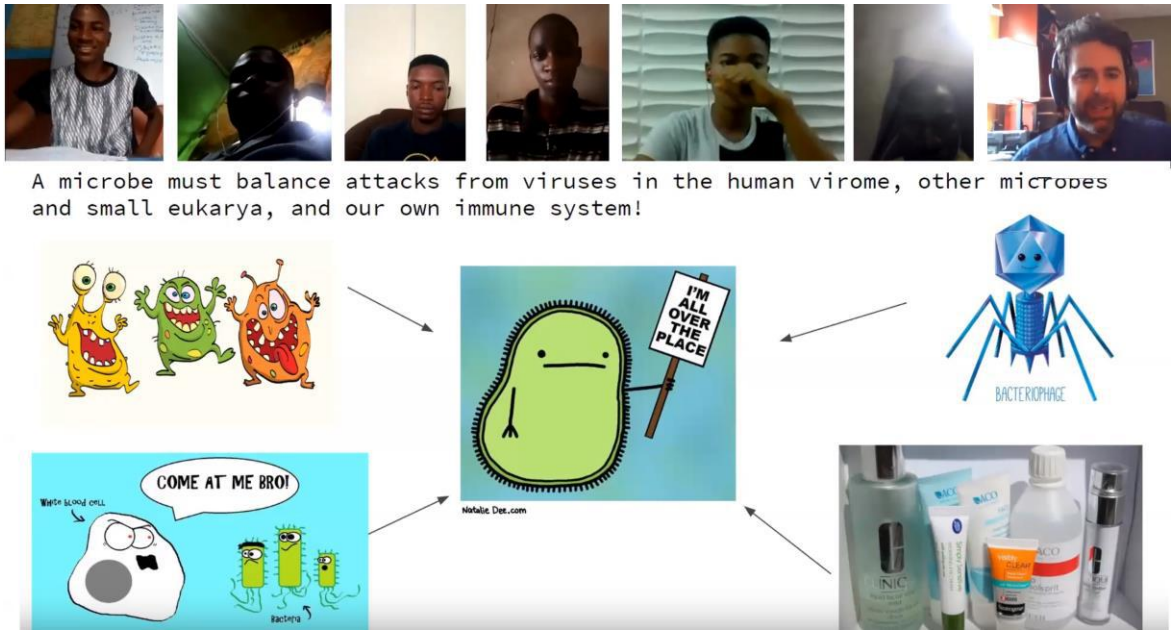
Make microscopes and imaging equipment easier to access

To improve cancer diagnosis in resource deprived areas

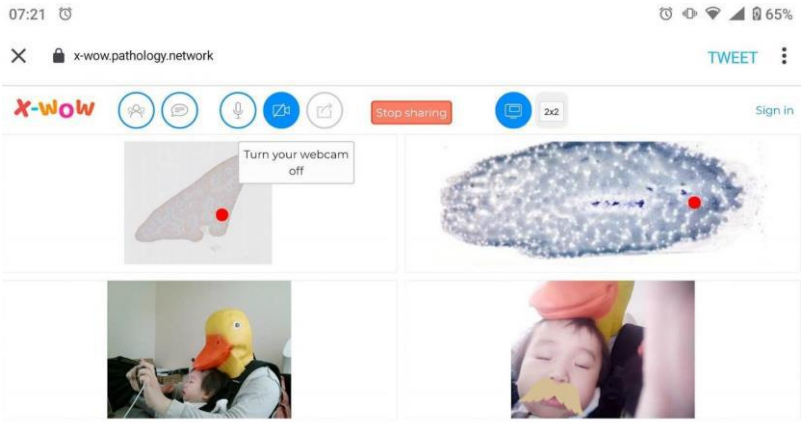
X-WOW's Microscope/scanner donation program

- We rehome 'retired microscopes' to deprived countries where they are desperately needed. Thanks to Lisa Stephens from Cleveland Clinic and Zbigniew Mikulski from La Jolla Institute for Immunology and Aleksandra Żuraw who donated them.

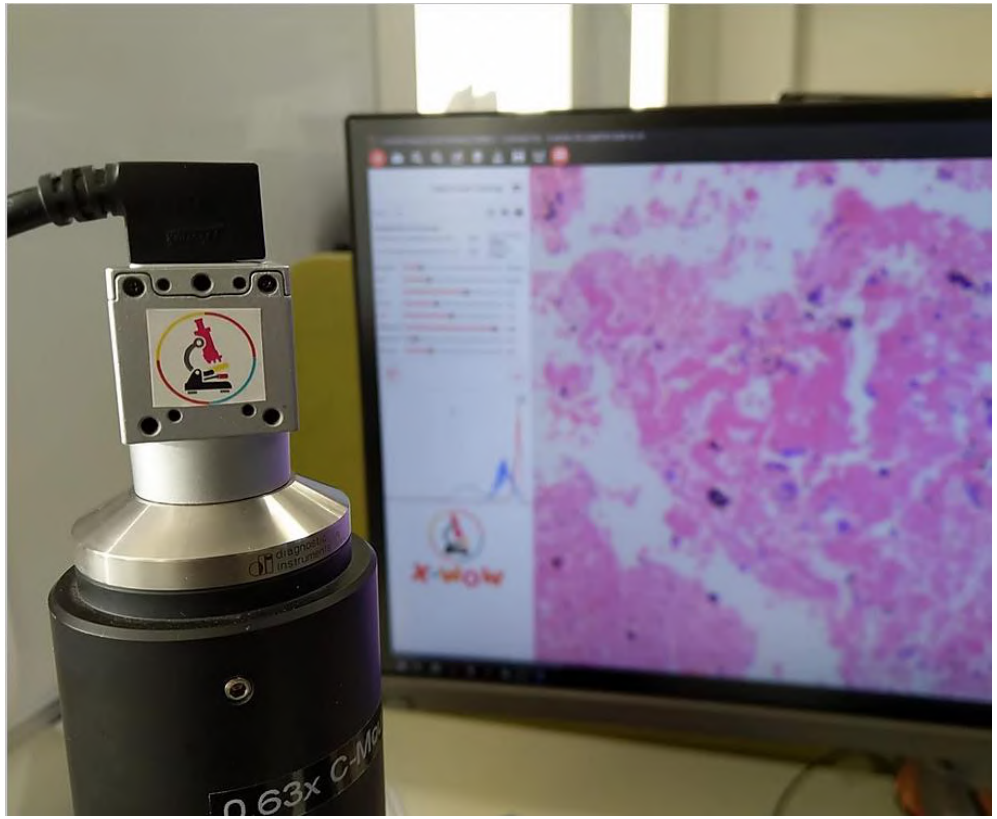
https://www.x-wow.com/donateoldequipment



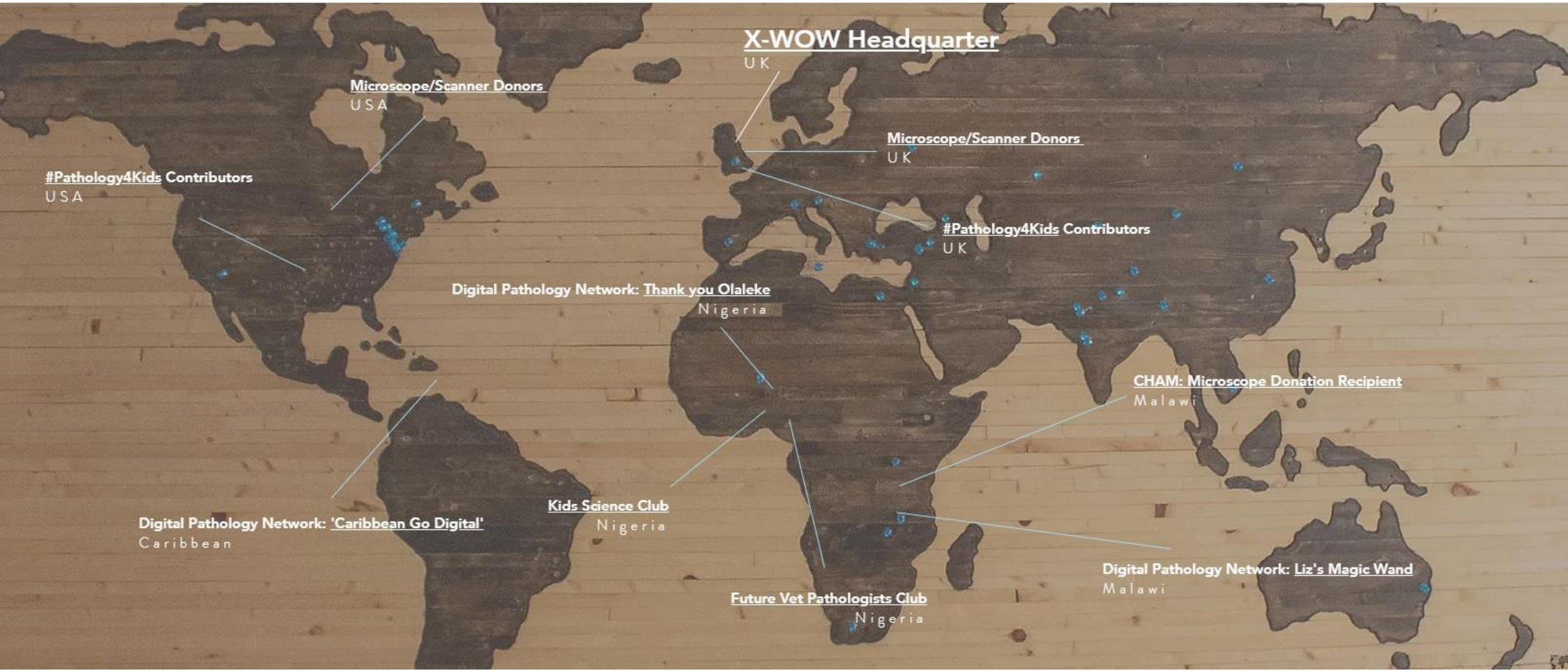
X-WOW's educational activities



X-WOW's cost-effective digital pathology collection: Slides, whole slide scanners/services, cloud solution



A good start: x-wow.com



It is my dream to establish a digital diagnostic network to help pathologists making decisions together

THERE IS

NEVER

NOTHING

WE CAN DO

Prof E Molyneux

Acknowledge

- Professor Simon Bailey, Professor Stephen O'Brien, Dr Chris Carey, Dr Peter Carey from Newcastle Hospitals,
- Professor Natalio Krasnogor from Newcastle University,
- Professor Elizabeth Molyneux, Dr George Chagaluka from Queen Elizabeth Central Hospital.
- Dr Amelia Taylor and Thanda Joshua Mtegha, Computer Science, University of Malawi
- Medical Research Council (MRC) grants (MR/N005872/1, RES/0248/7783/047).
- And finally, the 27 lovely donors on GoFundMe.

"As privileged professionals what is our response should we concentrate solely on our own system or as part of our responsibility help those in greater need as well." Simon