

HPV Prevention and Control Board
Virtual Conference 17th April 2021

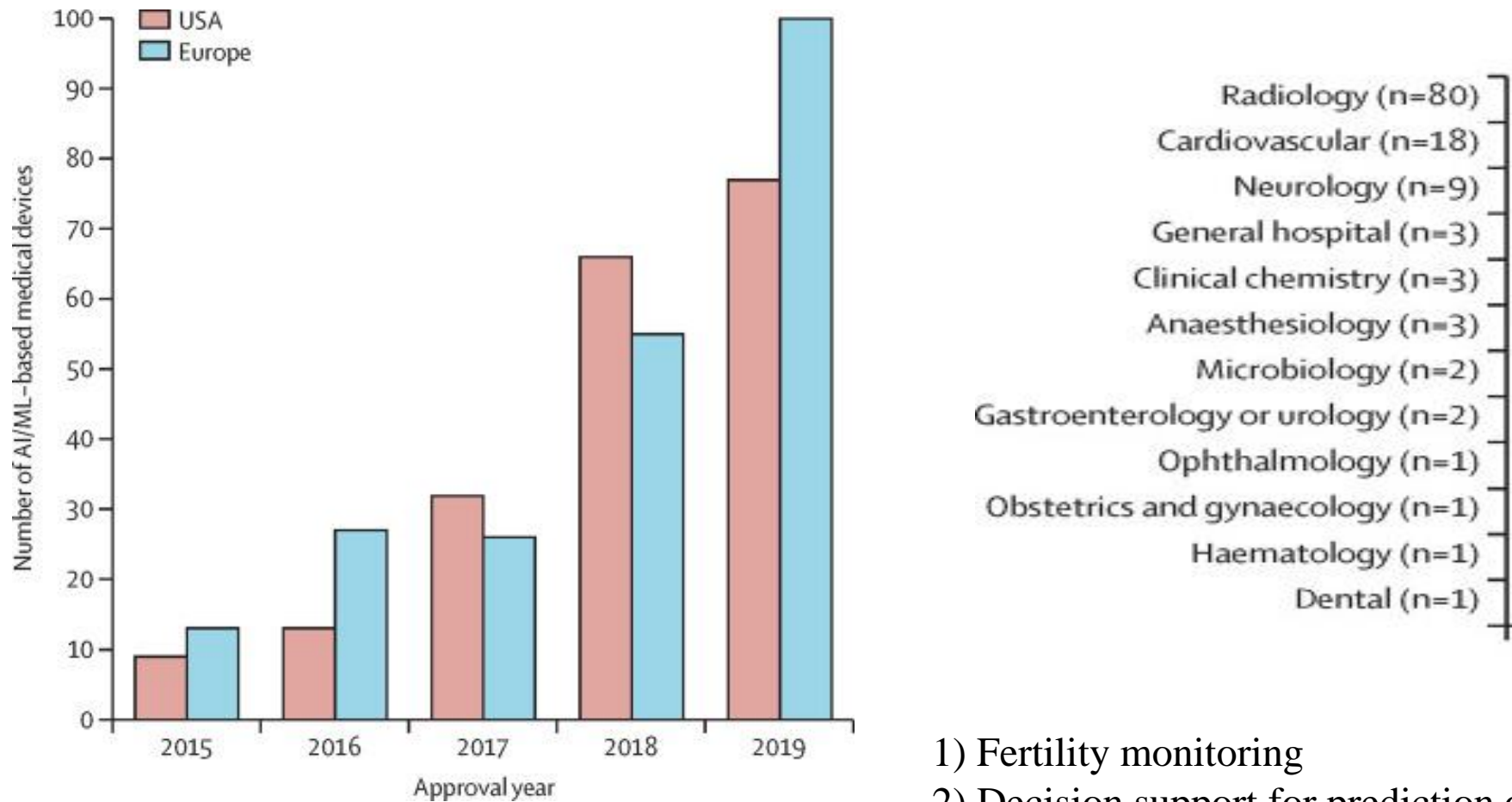
AI applied to cervical cancer screening

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NCI- AVE working team

In discussions with Murat Gultekin

I do not have COI to declare

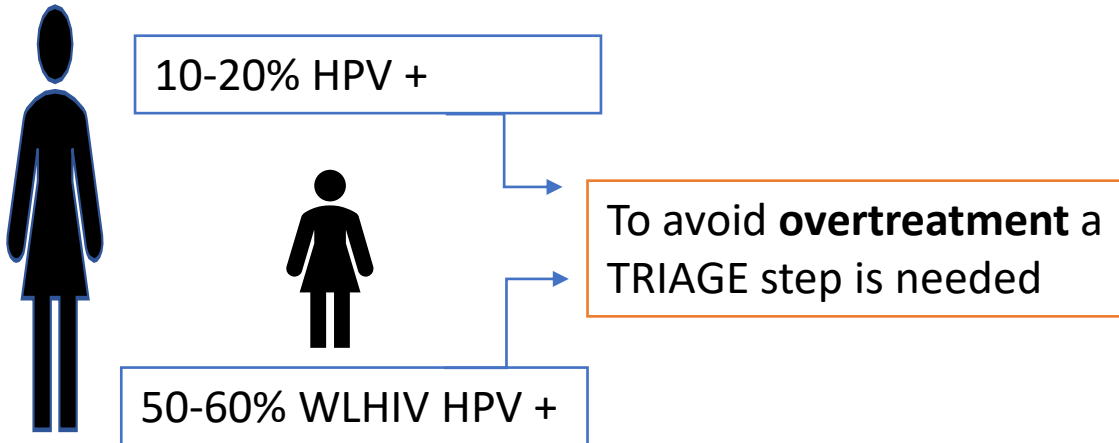
AI and FDA/EC approvals of medical devices



- 1) Fertility monitoring
- 2) Decision support for prediction of likelihood of embryos developing to the blastocyst stage by scoring them according to their statistical viability

How AI on imaging can assist cervical cancer prevention?

- A major worldwide target is to screen at least 70% of the women twice in their lifetime with HPV test.



LOW COST APPROACHES

- Visual inspection after AA **Poor accuracy and reproducibility**
 - Enhanced visual inspection (with digital images) **Unclear benefit**
-
- **Visual inspection after AA with automated reading AI-based**
Promising results



Colposcopist sees



Computer sees

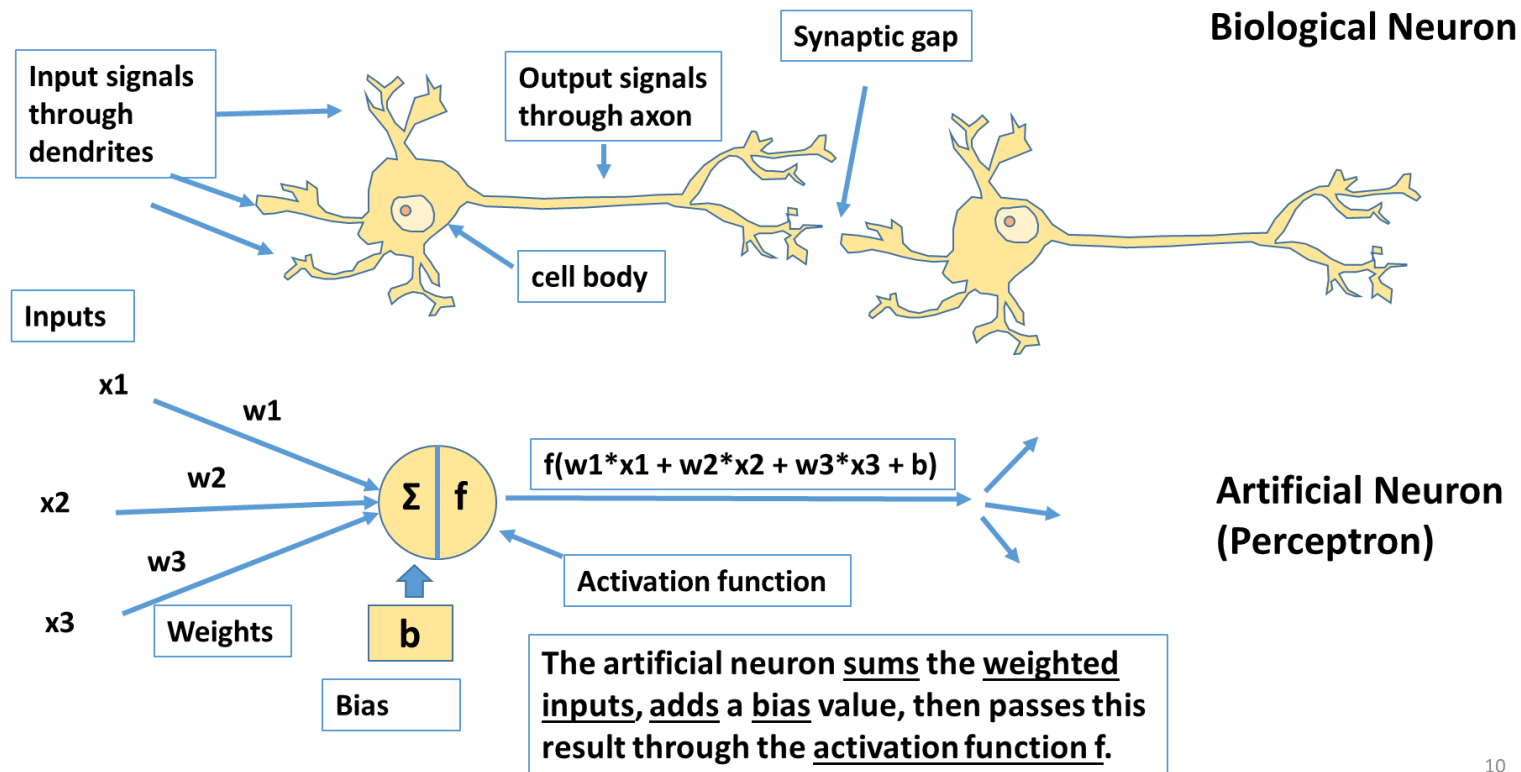
AW region edge

Other edges seen by Canny edge detector

103	104	111	108	112	113	113	108	114	114	113	104	105	99	88	103	111	107	122	115	114	123	114	117	118	112	114	114	115	113	114	112	104	90	93	99	94	92	91	92	86	94	92	94	
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What does it mean to run an AI model?

- Complex analytical process (regression models using multiple weights)/Define the input and output of interest

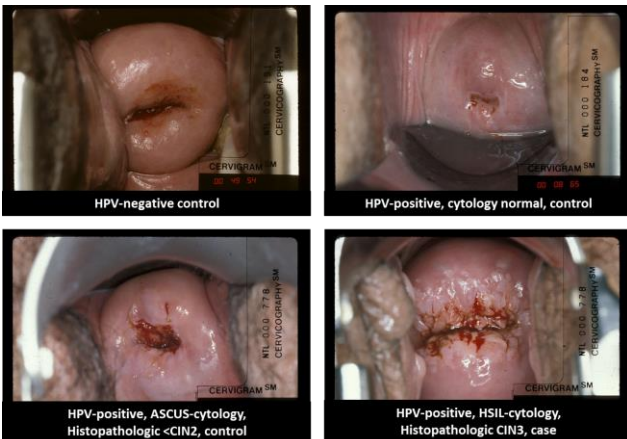


General basic approach (supervised)

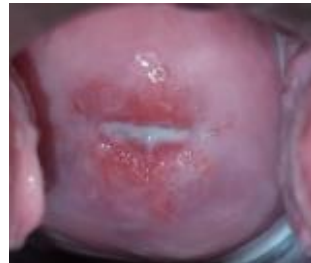
Labeling images (ground truth)

Ex.

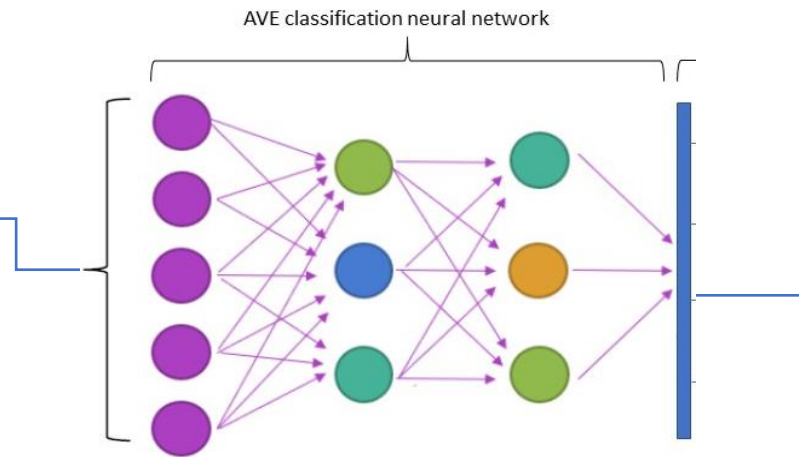
- Histology to verify CIN2+
- Image expert review to confirm normal and low grade



Input image

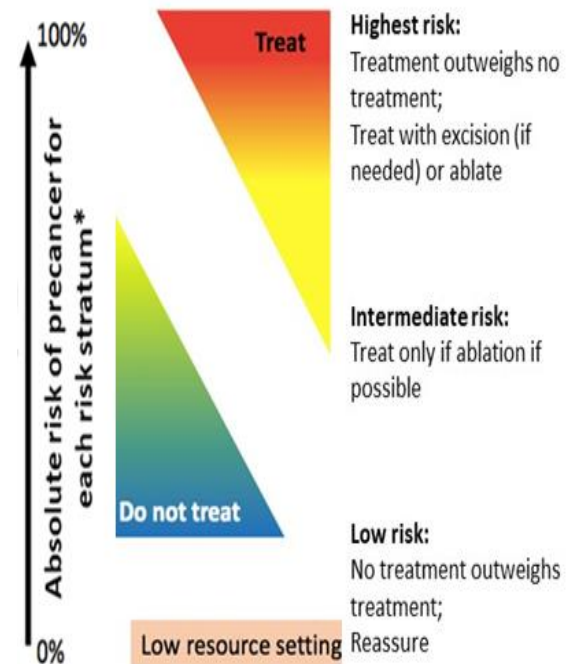


Algorithm



OUTPUT

CLINICAL TEST



DEVICES

- Cervigrams
- Colposcopes
- Mobile colposcopes
- Digital cameras
- Designated devices
- Smartphones

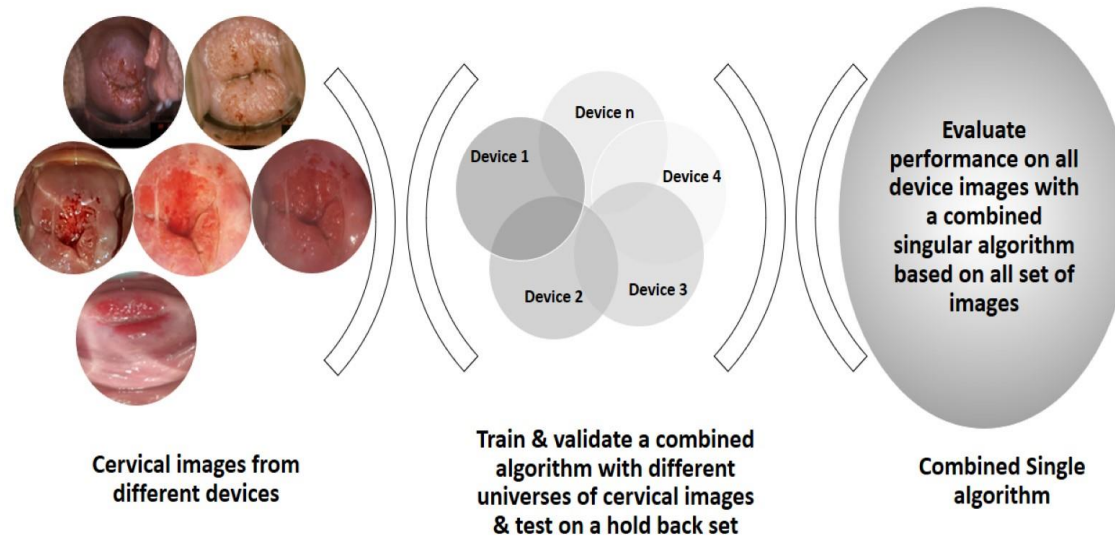


Smartphone: Under evaluation



In preparation to generate an algorithm

- The building of an algorithm requires that the set of images are divided in 3 groups: training, validation and test
- It is important to evaluate the 'portability' from one device to another

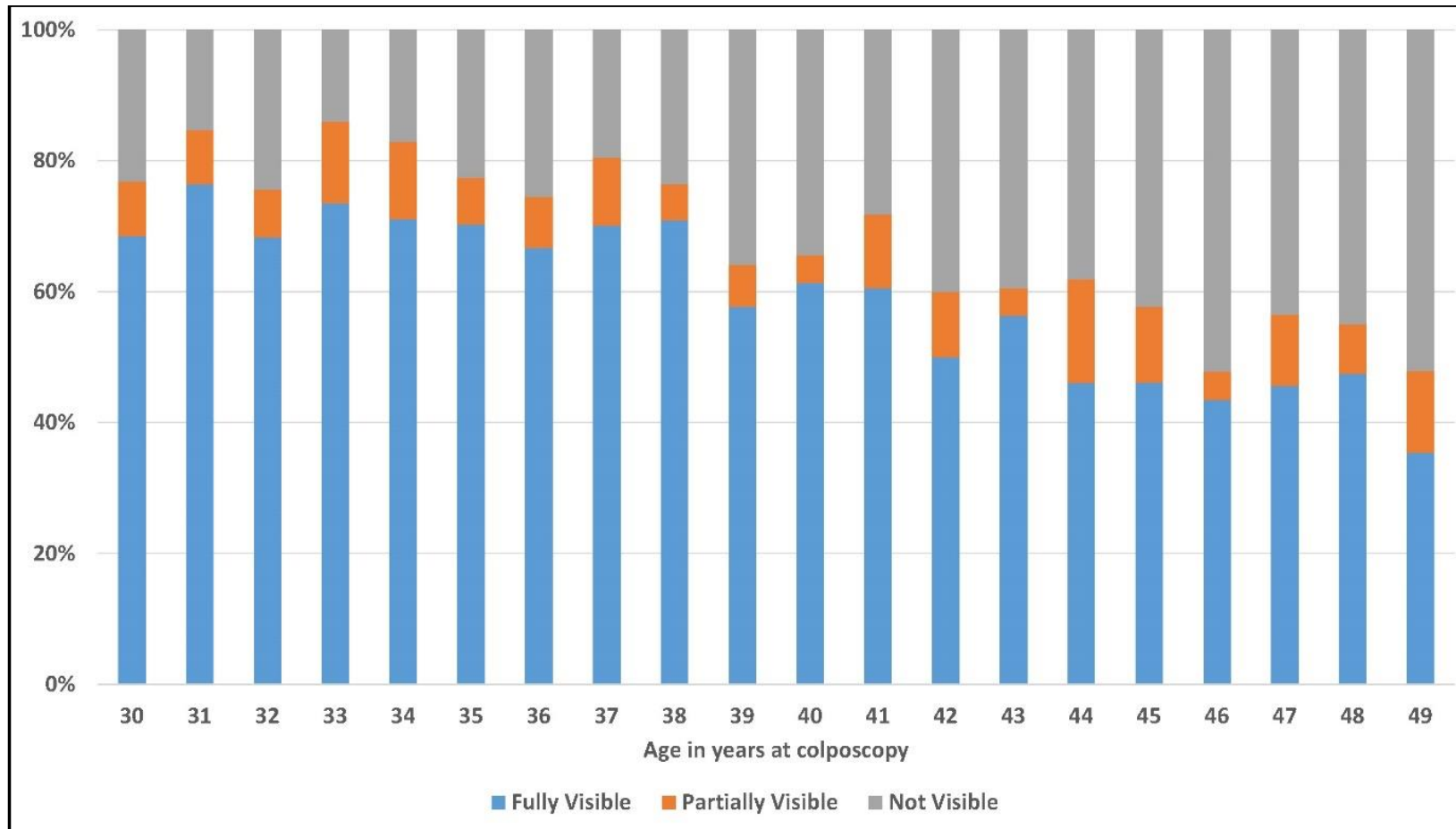


Further...

- Need to evaluate the impact of confounders or effect modifiers: Ectropion, Vaginitis, HIV, Schistosoma,...
- Quality of the image : Blur, light, shadows...
- Color and contrast: Impact of filter/ iodine

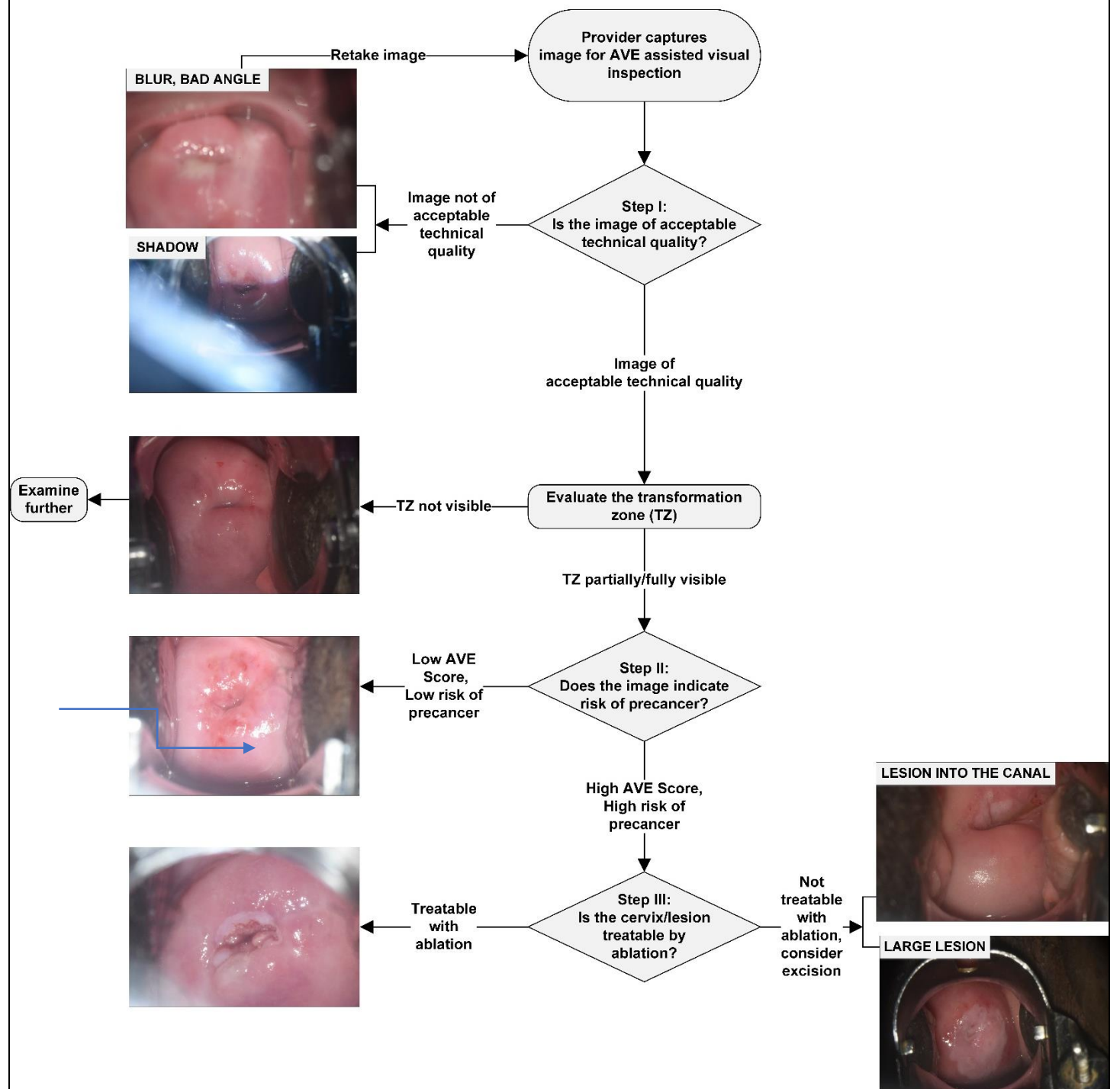


Visibility of SCJ by age, Nigeria (n=1393)

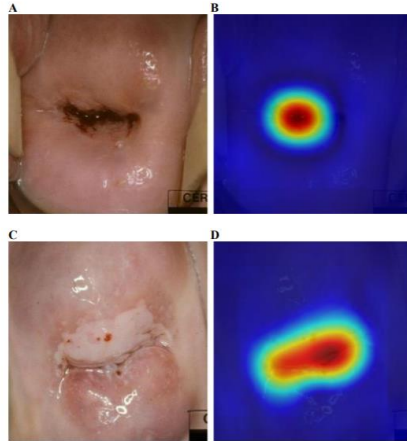


Potential algorithms

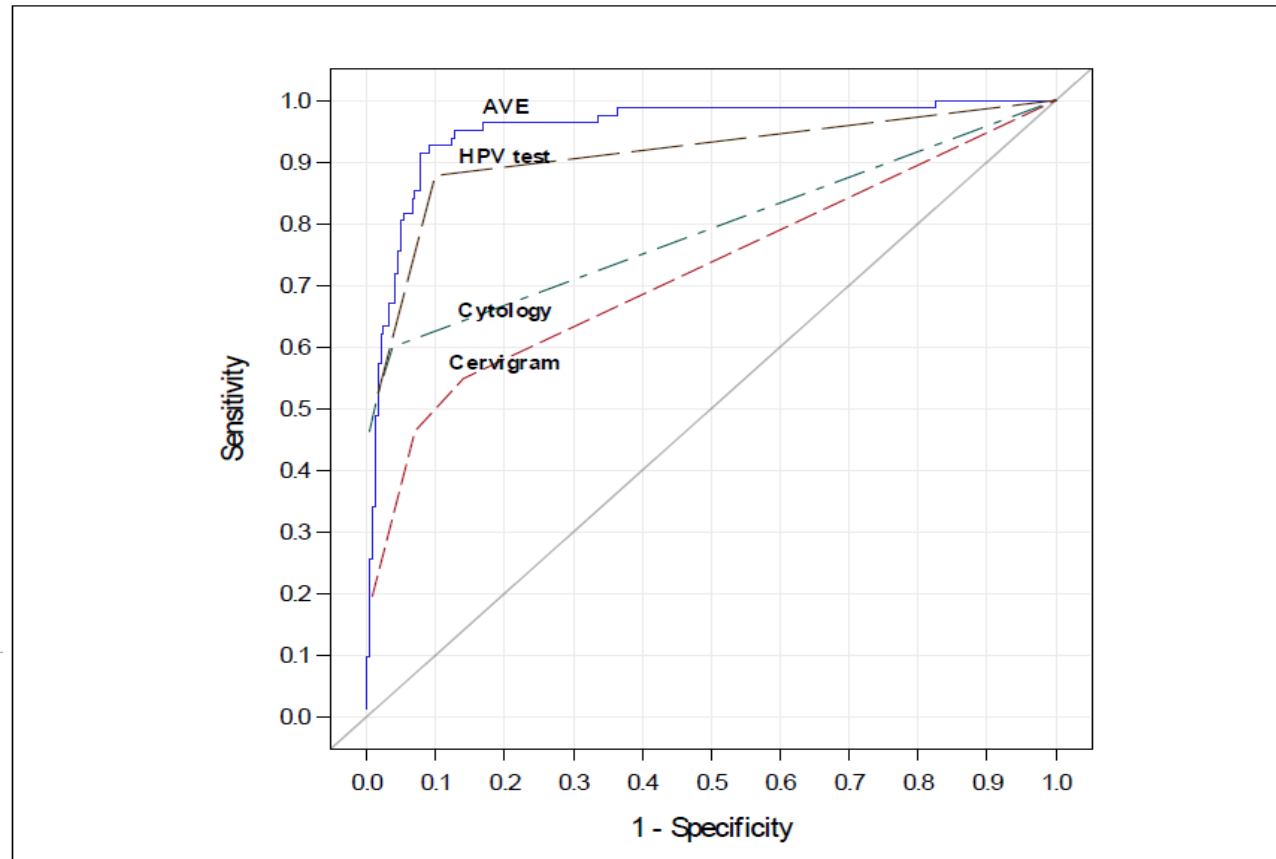
- **Quality of the image:** Is it good? If not take a new one
- **Diagnosis:** Interpretable score
- **Treatability :** Can the women be managed with ablation or should be referred for LLETZ+



- The Guanacaste study on natural history.
- Data from cervigrams (N=9,402)



Supplementary Figure 4. True positive cervigram images and heat maps. (A) and (C) are two abnormal cervigram images that were correctly classified. (B) and (D) are their corresponding heat maps, respectively.

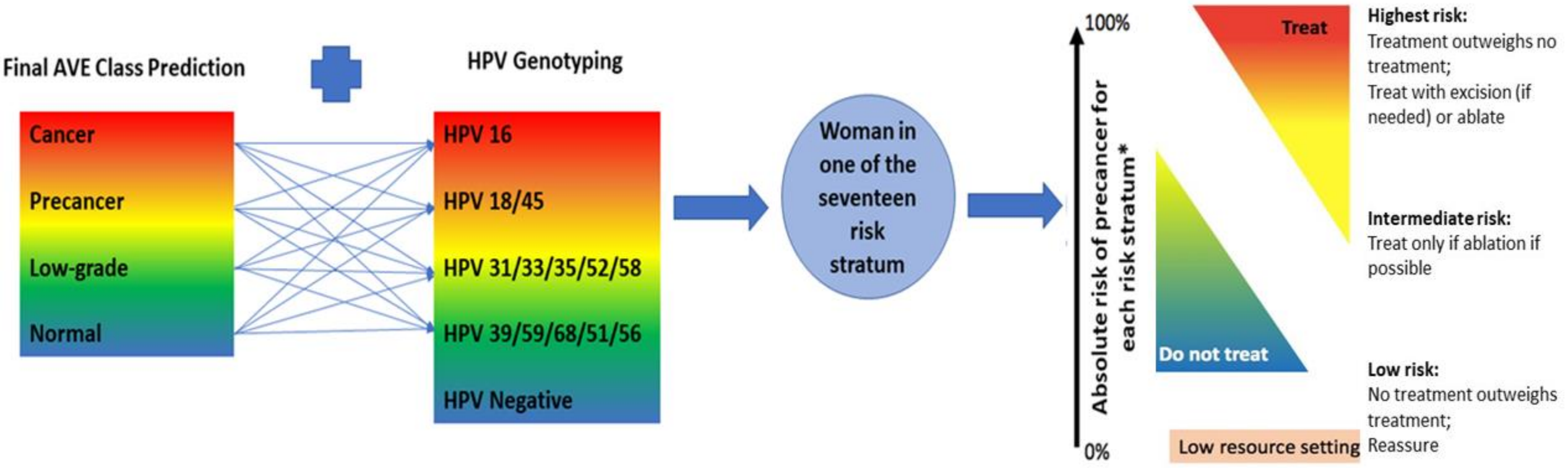


Hu et al. JNCI 2019

As proof of concept

STEP 2)

The best performance of screening approach may be reached combining AVE with HPV genotype data



*=Number of women with precancer in each stratum / Total number of women in each stratum

To be continued...

- Before an AI based test is approved for clinical use:
 - Fulfill requirements as any other diagnostic test (validation, and reproducibility)
 - Improvement from standard of care
 - Stratified analysis by effect modifiers to understand extension of generalizability