Target Product Profile: AI-based Automated Visual Evaluation (AVE) for detection of cervical precancer

Automated Visual Evaluation: Background and Rationale

Ninety percent of the annual 300,000 cervical cancer deaths now occur in LMICs, where access to preventive services is limited. In 2020, 194 WHO member states adopted a global strategy to eliminate cervical cancer as a public health problem – the first time in history an elimination goal has been set for a cancer.

The Clinton Health Access Initiative (with support from Unitaid) and Global Health Labs have developed and validated a novel AI model to detect precancerous cervical lesions so that they can be treated before they develop into cancer. The model has been trained to analyze a smartphone picture of the cervix, captured during a standard gynecological exam, in less than one minute without the need for internet connectivity. Women screening positive can then be offered treatment to prevent lesions from developing into invasive cervical cancer.

Operating on a smartphone app, the model – Automated Visual Evaluation (AVE) - has outperformed current standard of care – naked-eye visual inspection of the cervix with acetic acid (VIA) - across settings and studies. AVE is intended to provide an inexpensive, simple, and accurate cervical screening method as a triage test for women who have screened positive for HPV, or as a primary screening when HPV testing is not available.

Once finalized and scaled, AVE could enable programs to affordably screen more women with a more sensitive test – detecting more true cases of precancer – than current practice, thus accelerating progress toward the cervical cancer elimination agenda. It has generated tremendous interest among national programs, health providers, and women themselves.

The developing partners are now identifying pathways to finish AVE's productization, secure regulatory approvals, and facilitate market entry at affordable pricing. This document is the Target Product Profile for the final version(s) of AVE.

Target Product Profile: Definitions and Context

This Target Product Profile (TPP) lays out requirements for an AI-enabled device for cervical image capture and precancer diagnostic decision support for use in low-resource settings.

- Characteristic – refers to a specific requirement or specification that is measurable.
- Minimal – for a specific characteristic refers to the lowest acceptable output for that characteristic. Solutions must meet the 'Minimal' characteristic in order to be acceptable.
- Optimal – for a specific characteristic provides the ideal output for that characteristic. Meeting the 'Optimal' characteristics provides the greatest differentiation and the greatest impact for the end users (clinicians) and clients. Developers would ideally design and develop their solutions to meet the 'Optimal' characteristic in all cases.

Characteristic	Minimal	Optimal
Overview & use case		
Goal of tool	Commercially available non-invasive imaging software that captures a quality cervical image and can apply a machine learning algorithm to support image interpretation and provide a positive or negative result, indicating likely presence or likely absence of precancerous lesions.	
Target Population	Women eligible for cervical cancer screening per national guidelines. This is typically women age 30-49, with some variation in screening frequency and age eligibility based on HIV status, HPV status, and local context.	
Intended Use	AVE is intended to provide an inexpensive, simple, and accurate cervical screening method as a triage test for women who have screened positive for HPV, or as a primary screening when HPV testing is not available.	
Target User	Health worker cadre(s) responsible for routinely performing VIA in each setting. This is typically clinical staff such as nurses, nurse midwives, and/or clinical officers. Tool should be simple enough for those with minimal experience with smartphones.	
Setting (health system level)	Primary health center and up	
Software characteristics		
Software capabilities	'Vertical solution': - Embed AVE within a proprietary software – either custom-built to house the AVE model alone or through an app with other functionalities offered by the same vendor. Must: - Integrate with the hardware's camera and take quality pictures - Run an image quality checker - Run AVE diagnostic model - Be remotely updateable over limited bandwidth connections - NOT require internet connectivity to run	'Embedded solution': - Embed AVE within existing offline digital tools (EMRs or community health worker apps), or offer as an API to be integrated into any digital health software, such as EMRs, decision support systems, or chat Apps such as WhatsApp.
Maintenance/ calibration	Remote maintenance and calibration options (for software updates to device)	No updates or calibration required
Data export (for Quality Assurance)	Images and patient data can be synced to remote servers or the cloud using Wi-Fi or mobile data for future research purposes and/or quality assurance.	
Data storage	The relevant Ministry of Health or local authority administering the product should be able to determine or agree to the storage location of the device data without affecting the support and optimal use of the device.	
Hardware characteristics		
Hardware	AVE product is validated to work on a limited number of pre-specified hardware devices (potentially smartphone or tablet models).	AVE product is downloadable by the end-user (or national program focal person) and can run on any smartphone or tablet.

Characteristic	Minimal	Optimal
	Target hardware device must be able to be hand-held by an able-bodied adult. Target hardware device must be battery powered; 110/220V AC power source for battery re-charge.	
Performance & regulatory		
Sensitivity	≥70%	≥85%
Specificity	≥70%	≥85%
Image quantity and quality	One quality digital image of the cervix Adjustable magnification (zoom functionality) so the health worker can better visualize the cervix and any suspected lesions on the device >90% of images accepted by software rated high quality by colposcopists/VIA experts	
Regulatory requirements	Device and software must meet appropriate international quality standards. Depending on final product this could include IEC 62304, ISO 13485, and/or ISO 14971.	
User experience and interface		
Steps to use (total hands-on steps to use the product and obtain a result)	1. Healthcare worker (HCW) conducts VIA as usual. (Includes: speculum insertion, removal of excess mucus, application of acetic acid and one minute waiting period, and visual inspection of the cervix for acetowhite changes.) 2. HCW opens app and takes photo 3. HCW looks at photo to confirm appropriate subject and clicks to run algorithm 4. HCW receives confirmation that photo was accepted, reviewed and result is ready. 5. Healthcare worker removes speculum. This can be completed within ~3 minutes. AVE should require no complex steps, no manually timed steps, and no additional instrumentation beyond phone or tablet. Ideally, a quality image is captured in a single acetic acid application but multiple acetic acid applications may be performed until quality image is captured.	
Time-to-result	Quality image capture: < 2 minutes Interpretation of result: < 2 minutes Total time added to VIA exam: < 4 minutes	Quality image capture: under 30 seconds Interpretation of result: under 30 seconds Total time added to VIA exam: ~ 1 minute
Result capturing, documentation, data display	"Negative" OR "Positive"	
Training and education	1 day for cervical cancer screening providers and ability to take high quality pictures within 5 practice exams, on average	<1 day for cervical cancer screening providers and ability to take high quality pictures within 3 practice exams, on average
Language	One main language (ie. official or de facto national language) should be used, plus any language mandated by	Main language plus additional languages that might be in use by residents or users of the product

Characteristic	Minimal	Optimal
	local regulatory or trade compliance requirements	