

Cancer Detection, Diagnostic and Treatment Technologies for Global Health

Main Goal

Stimulate technology development and adaptation for low-cost use to detect, evaluate, diagnose and treat cancer in low resource settings.

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Background

Two thirds of cancer deaths occur in low- and middle-income countries (LMICs) due to:

- Limited access to health care.
- Need for early detection and diagnosis
- Lack of treatment options
- Poor prognosis and outcomes.

Technologies for detection, diagnosis and treatment can help address challenges in LMICs through:

- Portability
- Low cost
- Training adapted to low-resource settings
- Ease of use by local providers
- Minimal invasiveness

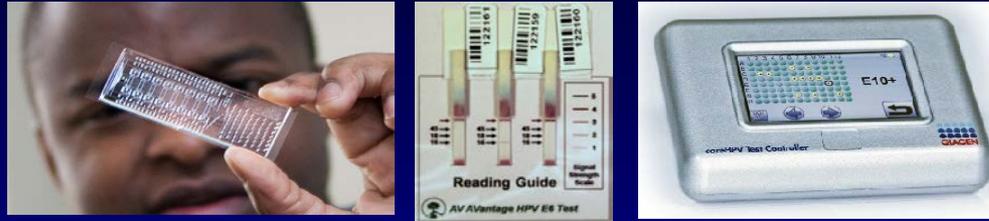
Concept Aim: Produce low-cost devices for cancer detection, diagnosis and treatment in low resource settings



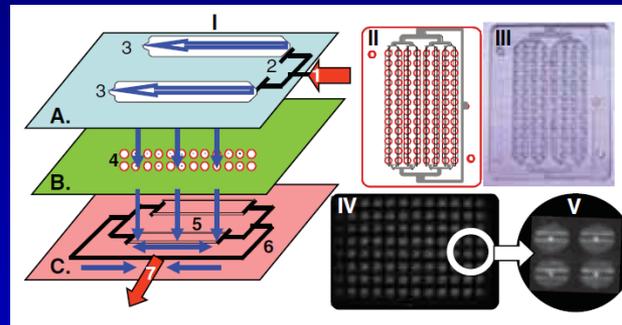
Technologies Adaptable to Low Resource Settings

Microfluidics—Lab-on-Chip:

Cervical cancer: From Vinegar To Lab-on-Chip: A Vantage, careHPV (China).



ELISA—Lab-on-Chip



Lab-on-Paper (George M. Whitesides, Harvard):

Paper printed with hydrophobic polymer using a solid wax printer.
Quantitative detection can be done using a cell phone.



Technologies Adaptable to Low Resource Settings

DermLite (marketed world wide):

Low cost dermatological illuminator-microscope;
iPhone interface for distant diagnosis and records.



Smart Phone Technology /Smart Phone App:

Remote retinoblastoma
diagnosis by automated
leukocoria detection



Smartphone based
fluorescent detector

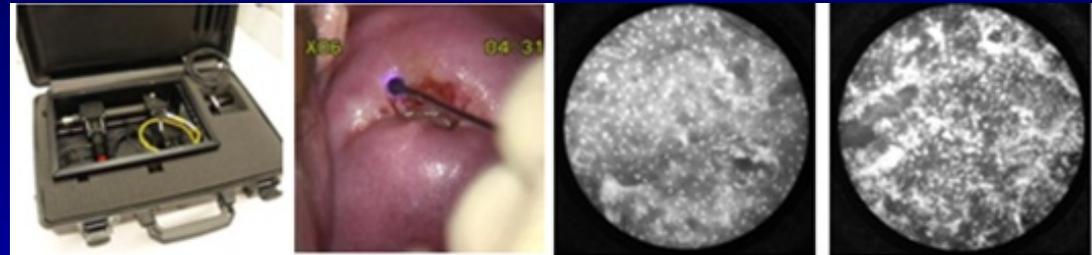


Technologies for Low Resource Settings

Spectrometer (Haiti):
Cervical Intraepithelial Neoplasia



Endoscope-Microscope
+ molecular imaging agents (China).



Cryotherapy for Cervical Cancer Treatment (WHO specs)



Hand Held Ultrasound (marketed world wide): Triage for cysts, effusions, palpable masses.



Point-of-Care and Global Health

A First generation of POC diagnostic testing

Typical samples
 Oral fluid
 Urine
 Capillary blood

Common test formats
 Lateral-flow test
 Vertical-flow test

Automated reading
 Manually read cartridge-based strips
 Manually read dipsticks

Detection targets
 Antibodies
 Antigens
 Simple biochemical reactions

Examples
 Rapid test strips and dipsticks (HIV antibody and antigen, malaria antigen, urine biochemistry, and pregnancy tests)
 Simple instruments (glucometers and hemoglobin meters)

B Second generation of POC diagnostic testing

Test cartridges
 Sample (e.g., capillary blood, oral fluid, or urine) is inserted into disposable test cartridge

Small instruments process and read results

Detection targets
 Whole cells
 DNA or RNA using PCR or other nucleic acid detection method

Examples
 CD4-cell count
 HIV viral load
 Tuberculosis diagnosis and potential drug resistance

C Next generation of POC diagnostic testing

Samples
 Capillary blood, oral fluid, urine, breath, and other samples

Multiple test formats
 Handheld lab-on-a-chip devices
 Disposable tests (no instruments)
 Doctor's office desk-based devices

Transmission of results
 Devices are likely to have wireless connectivity to transmit result data

Potential detection targets
 Nucleic acid sequencing
 Advanced protein analysis (proteomics)

Examples
 Antiviral and antibiotic drug-resistance screening
 Differential diagnosis (e.g., viral rash and fever, childhood diseases, antenatal tests)
 Home-based self-testing

Technology Development Pipeline

Discovery **Prototype** Multi-Site Validation in GH **Commercialization** Global Health Deployment



Academia/Small business

Pharma

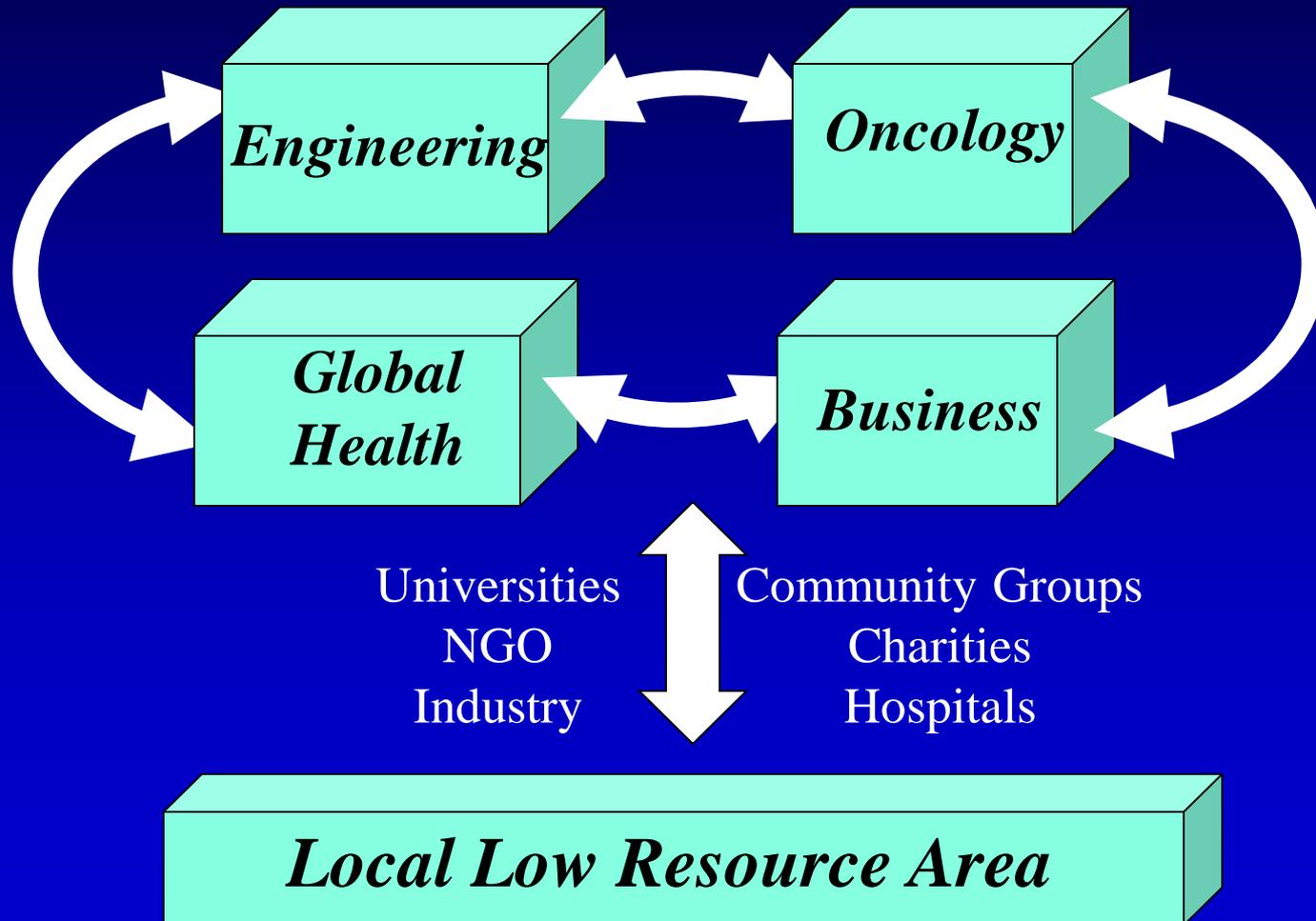
NGOs
Health Providers

IMAT →
SBIR →
BRG →
BRP →

NCI effort

Approach

This approach establishes a strategic alliance between engineers/developers, cancer care professionals, experts in global health delivery, and business. They must assemble a critical mass of expertise to accomplish what they cannot readily do separately.



Funding Opportunity Overview

Two-phase cooperative agreement (UH2/UH3). RFA reissued yearly over three years.

Phase I (UH2), two years:

- Demonstrate clinical potential in a global health setting
- \$500K per grant per year
- 18 grants funded over three years

Phase II (UH3), three years:

- Validate device in global health setting
- \$1M per grant per year
- 50% of Phase I grants advance to Phase II (9 grants)

Progression from UH2 to UH3:

- Grantee must meet specified milestones
- Milestones reviewed by NCI program staff.

Deliverables for Phase I (UH2)

- Prototype adapted to specifications appropriate to low-resource settings
- Must demonstrate working relationship with local site(s)
- Update business plan based on phase I experience
- Update validation study design and leverage with ongoing clinical research/care at chosen site(s)
- Identify clinical research network to validate trial; priority use of existing US government networks (NIH, CDC, PEPFAR etc.)
- Provide evidence of progress toward regulatory approval for Phase II validation study

Deliverables for Phase II (UH3)

- Regulatory approval for deployment and use of device
- Adequate accrual for validation study, with real-time review of QC and endpoint data; modifications of protocol as needed
- Updating of business plan for commercialization if validation is confirmed
- Confirm commercial partners for production and marketing
- Develop education plan for use in health care delivery; assure progression toward clinical utility and benefit from validated technology

Budget anticipating 50% of Phase I awards advancing to Phase II

The RFA is issued over three years, with six Phase I awards anticipated each year; \$500K total cost per award per year. The budget profiles are as follows:

Year	Cost 1 st set of awards in millions (6 awards, \$500K each)	Cost 2 nd set of awards in millions (6 awards, \$500K each)	Cost 3 rd set of awards in millions (6 awards, \$500K each)	Total Dollar Amount per year in millions
1	(UH2) \$3M			3
2	(UH2) \$3M	(UH2) \$3M		6
3	(UH3) \$3M (3 awards phase II, \$1M each)	(UH2) \$3M	(UH2) \$3M	9
4	(UH3) \$3M	(UH3) \$3M (3 awards phase II, \$1M each)	(UH2) \$3M	9
5	(UH3) \$3M	(UH3) \$3M	(UH3) \$3M (3 awards phase II, \$1M each)	9
6		(UH3) \$3M	(UH3) \$3M	6
7			(UH3) \$3M	3

Funding Opportunity Summary

Mechanism	UH2/UH3 Cooperative Agreement
Number of awards	18 awards
Length of the awards	5 years
Set Aside for first year	\$3 million total cost
Total cost	\$45 million

Project Organization and Management

- RFA with central coordination by Center for Global Health.
- UH2/UH3: Program oversight for effective project coordination.
- Steering Committee of Principal Investigators and NCI personnel.
- DOC program directors manage individual awards.