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

**Smartphone 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

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

Devices will fully automate testing and analysis or display of results

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

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.

Universities
NGO
Industry

Community Groups
Charities
Hospitals

Local Low Resource Area
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:

<table>
<thead>
<tr>
<th>Year</th>
<th>Cost 1st set of awards in millions (6 awards, $500K each)</th>
<th>Cost 2nd set of awards in millions (6 awards, $500K each)</th>
<th>Cost 3rd set of awards in millions (6 awards, $500K each)</th>
<th>Total Dollar Amount per year in millions</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>(UH2) $3M</td>
<td>(UH2) $3M</td>
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<td>2</td>
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<tr>
<td>4</td>
<td>(UH3) $3M (3 awards phase II, $1M each)</td>
<td>(UH3) $3M (3 awards phase II, $1M each)</td>
<td>(UH2) $3M</td>
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<td>5</td>
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## Funding Opportunity Summary

<table>
<thead>
<tr>
<th>Mechanism</th>
<th>UH2/UH3 Cooperative Agreement</th>
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<tbody>
<tr>
<td>Number of awards</td>
<td>18 awards</td>
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<tr>
<td>Length of the awards</td>
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<td>Set Aside for first year</td>
<td>$3 million total cost</td>
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<tr>
<td>Total cost</td>
<td>$45 million</td>
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</tbody>
</table>

### 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.