Invited ACTs Investigator Oral Presentations

Point of Care Detection and Diagnosis of Oral Cancer using a Low Cost Imaging Module enabled by AI

Fiona Ginty (GE Healthcare), Narayana Subramaniam (Aster International Institute of Oncology)

The overall vision of the project is to to develop and deploy an affordable automated point-of-care (POC) telecytology platform for oral cancer screening that will reliably establish a diagnosis of oral cancer in the community setting and establish an immediate referral care pathway. Oral cancer is a significant public health problem in India; 77,000 new cases and 52,000 deaths are reported annually, which is approximately one-fourth of global incidences. Approximately 70% of cases present at an advanced stage, when the probability of cure is very low, and a five-year survival rate is around 20%. It has been estimated that early diagnosis, with timely and proper treatment, could improve the survival rate up to 90%. The current 'gold standard' of oral cancer screening is visual inspection of the mouth by trained individuals, followed by biopsy of suspicious lesions.

However, in India there is a delay of nine months from the onset of symptoms to diagnosis. Of this, seven months are attributed to the delays within the medical pathway The majority of the population lives in a rural environment, where access to pathology services and expertise is very limited. Without definitive proof of cancer, patients are not eligible for state-run insurance programs for treatment. Our proposed approach comprises a portable system for scanning brush biopsy cytology slides with cloud connectivity for transmission of images to pathologists and/or automated diagnosis via a validated algorithm for identification of atypical cells. After standard visual triaging of patients during routine screening, those identified with higher risk lesions will immediately be directed to undergo brush biopsies on the same day. Samples will be placed on a glass slide, stained with routine toluidine blue (average time is <4 minutes), and imaged using the portable slide scanner. Initially these images will be relayed via cloud to a remote pathologist who will immediately report them, while subsequent versions of the prototype will have in-built artificial intelligence (AI) algorithms for automated reporting in the field. We believe that this innovative and affordable workflow would successfully expedite diagnosis and provide significantly earlier treatment for oral cancer patients.

A comprehensive platform for low-cost screening and image-guided photodynamic therapy (PDT) of pre-malignant and malignant oral lesions in low resource settings

Jonathan Celli (University of Massachusetts), Tayyaba Hasan (Massachusetts General Hospital), Rongguang Liang (University of Arizona), Mohammad Akram (Aligarh Muslim University), Moni Kuriakose (Karkinos Healthcare)

Oral cancers, although largely preventable, accounts for over 30% of cancer cases reported in India. This is largely attributed to the widespread popularity of chewing carcinogenic tobacco-based mixtures, compounded by lack of infrastructure for nationwide cancer screening. The morbidity and mortality associated with astronomical oral cancer incidence is exacerbated by unavailability of effective intervention which can be offered at the point of care, even when a suspicious lesion is identified. To address this unmet need our U01 project introduces, and validates, low-cost optical technology dubbed the “Screen, Image and Treat Optical System” (SITOS) to enable imaging-based screening and photodynamic therapy (PDT) treatment of oral potentially malignant disorders (OPMD) at the point of care in resource limited settings. The hardware is built on a compact dental camera form factor, coupled to a standard consumer smartphone which provides interface for cloud-based AI-enabled lesion classification, and also integrates a laser light source for image-guided PDT treatment. The fluorescence image guidance and monitoring capabilities of SITOS leverage a well-tolerated oral solution of a theranostic fluorophore/photosensitizer precursor, 5-aminolevulinic acid (ALA), which is provided for this project by pharma partner Photonamic GmbH. This technology development and translation effort combines the expertise of 3 US sites in collaboration with an India-based clinical team, all of whom were participants in previous NCI UH2/UH3 projects focusing on either detection (Liang) or treatment (Celli/Hasan) of oral cancers and pre-cancers. Here we report on SITOS technology development, extensive preclinical validation including investigation of PDT-activated anti-tumor immune response using SITOS, and preparation for clinical validation in India, to launch in summer 2026. We will also briefly discuss reciprocal innovation, whereby technology from this global health project is being adapted to address unmet clinical oral medicine need in the USA.

Reimagining Treatment Response Monitoring in Kaposi Sarcoma - From Unmet Need to AI-Enabled Clinical Trials

Thomas Odeny (Washington University in St. Louis), Thomas Odeny (Washington University in St. Louis), Harriet Adhiambo (Washington University in St. Louis), Dorothy Mangale (Washington University in St. Louis), Philippa Makanga (Infectious Diseases Institute, Makerere University), Beryne Odeny (Washington University in St. Louis), Fred Okuku (Uganda Cancer Institute), Chao Zhou (Washington University in St. Louis), Elvin Geng (Washington University in St. Louis), Joseph Carson (Pensievision), Victor Mudhune (Kenya Medical Research Institute), Elizabeth Bukusi (Kenya Medical Research Institute), Aggrey Semeere (Infectious Diseases Institute, Makerere University)

Background. Kaposi sarcoma (KS) remains among the most common cancers and a leading cause of cancer death among men in East Africa. The current standard for monitoring KS treatment response, manual ruler-based measurement, is imprecise, time-consuming, cannot capture lesion height or volume, and performs poorly on dark skin, making it impractical for routine care. SkinScan3D (SS3D) is a portable, low-cost, AI-enabled device combining liquid-lens imaging with machine learning to produce objective 3D measurements of lesion area, height, volume, and color. Our Precision Imaging to Evaluate Kaposi Sarcoma (PRIME-KS) refines and validates SS3D in Kenya and Uganda.

Methods. Aim 1 (complete): we refined SS3D and usage protocols through end-user engagement, including focus groups, in-depth interviews, discrete choice experiments (DCE), and human-centered design (HCD) workshops. Aim 2 (ongoing): we compare reproducibility (concordance correlation coefficient) and accuracy (R-squared) of SS3D versus ruler-based measurement in 50 participants with 150 lesions. Aim 3 (planned) we will validate clinical workflow, usability, feasibility, and implementation cost in 100 patients across routine care and clinical trial settings.

Results. In Aim 1, we engaged 189 participants in DCEs and 54 in HCD workshops across Kenya and Uganda. End-users prioritized portability, battery operation, reliable function despite inconsistent electricity, accommodation of varied lesion sizes, and integration with facility data systems. Qualitative findings showed acceptability was shaped by trust, prior technology experience, and sociocultural beliefs. These results drove refinements including a visual body-map lesion tracker, additional cup sizes, simplified setup, and user authentication, yielding four refined devices now deployed. Aim 2 enrollment launched in Uganda following ethics approvals, with 6 of 25 participants enrolled; Kenya enrollment awaits final Pharmacy and Poisons Board approval.

Conclusion. User-centered refinement produced a field-ready, acceptable, affordable KS monitoring device now entering accuracy and reproducibility validation. We have submitted a supplement to prepare SS3D for U.S. KS care.

Beyond Accuracy: A Framework for Reliable AI-Assisted Cervical Cancer Screening

Nimmi Ramanujam (Duke University), Mwgan Huchko (Duke University), Jessica deSourza (Duke University), Lillian Ekem (Duke University), Rebecca Farrar (Duke University), Kerry Eller (Duke University)

Cervical cancer remains a leading cause of cancer morbidity and mortality among women globally, despite being largely preventable through early detection and treatment of precancerous lesions. Advances in portable cervical imaging technologies and artificial intelligence (AI) have created new opportunities to expand access to screening, particularly in low-resource and underserved settings where access to colposcopy and specialist expertise is limited. However, a major challenge to the clinical deployment of AI-based screening tools is ensuring that diagnostic predictions are reliable, interpretable, and robust across diverse patients and imaging conditions.

Our work focuses on developing a framework for trustworthy cervical AI that extends beyond conventional measures of diagnostic accuracy to evaluate the stability and reliability of model predictions in real-world clinical settings. By leveraging repeated cervical images acquired during routine examinations, we investigate how prediction variability can be quantified and used as an indicator of deployment risk. We further integrate automated image-quality assessment and multi-image inference strategies to improve prediction consistency and identify cases that may benefit from additional imaging or expert review.

This framework supports a patient-centered approach to AI deployment by providing mechanisms to distinguish reliable predictions from those requiring further evaluation. The resulting methodology has the potential to improve the safety, transparency, and clinical utility of AI-assisted cervical cancer screening while supporting broader implementation in resource-constrained environments. More broadly, this work establishes a foundation for developing trustworthy AI systems that can facilitate equitable access to high-quality cancer prevention and early detection services.

KeyScope: The Key to Cancer Treatment in LMICs

Tamara Fitzgerald (Duke University), Jenna Mueller (University of Maryland), Robert Ssekitoleko (Makerere University)

Laparoscopic surgery is the standard of care for many cancers in the chest and abdomen. By using a tiny camera and instruments manipulated through keyhole incisions, it avoids large incisions, but is generally unavailable in LMICs due to installment costs, lack of maintenance personnel, unreliable electricity and shortage of consumables. Patients in LMICs would benefit from laparoscopic surgery, as advantages include: decreased pain, improved recovery time, fewer wound infections, shorter hospital stays and mitigation of impoverishing health expenditure.

KeyScope and KeyLoop (KeySuite) have been designed for the resources, needs and challenges of LMICs. KeyScope is a laparoscope that can be made for $1500 (cost of goods), plugs into a laptop computer to display images during surgery, exists as a single unit without complicated assembly, and is sterilizable by immersion in Cidex. KeyLoop is a laparoscopic retractor that lifts the abdominal wall during surgery, obviating the need for a constant power supply and medical-grade carbon dioxide. This will enable laparoscopic surgery to be performed in rural hospitals, and increase access in tertiary centers where laparoscopic equipment is rare and expensive.

The KeySuite devices have been constructed in Uganda, first through a Shipping Container Makerspace, and then transitioned to ShiShi International, a Ugandan biomedical manufacturing company. Through capacity building, ShiShi has become the first company in sub-Saharan Africa to be recognized by the Health Industry Business Communications Council (HIBCC) for local manufacturing and labelling of medical devices. Working with the Uganda National Drug Authority, our team is ready to start a First-In-Human study at the Uganda Cancer Institute using KeySuite to perform biopsies of intra-abdominal tumors. Primary outcome will be the ability to perform biopsies laparoscopically without conversion to open surgery. Data from the clinical trial will enable a business model for sustainable manufacturing and distribution within Africa and to other LMICs.

Rapid, slide-free histology advancing diagnostics and research in both high and low-resource settings: examples from Ghana

Richard Levenson (UC Davis Health), Eric Seibel (University of Washington), Farzad Fereidouni (Emory University), Beatrice Wiafe-Addai (Peace and Love Hospitals, Kumasi, Ghana)

MUSE (microscopy with UV surface excitation) and FIBI (fluorescence imitating brightfield imaging) enable near-instantaneous, slide-free histology, transforming tissue assessment and advancing research by streamlining workflows and revealing information not readily accessible with conventional methods. These techniques offer two principal advantages: immediate, accessible diagnostics—particularly significant for lower- and middle-income countries (LMICs)—and the ability to reveal novel tissue features that can drive scientific discovery.

MUSE and FIBI provides rapid, non-destructive imaging of intact tissues using cost-effective optics and sensors. Automated scanning and emerging computer-aided diagnostic tools allow tissue evaluation within seconds to minutes. Validation studies have shown approximately 97% concordance with standard clinical diagnoses across a range of tumor types. While these benefits are notable in high-resource settings, they are especially important in LMICs, where pathology expertise and infrastructure are often limited. In breast cancer care, for example, patients frequently present with advanced disease requiring core-needle biopsies. Existing rapid adequacy and preliminary diagnostics methods, such as rapid onsite evaluation (ROSE), may suggest the presence of appropriate tissue in a biopsy, but lack the full histological context needed for comprehensive characterization. Traditional histology, on the other hand, involves prolonged processing and review, often resulting in diagnostic and treatment delays of weeks or months; molecular testing, if available, adds further waiting time. Here, we report the implementation of FIBI in Ghana, applying it to rapid (minutes) evaluation of breast core needle biopsies.

Both MUSE and FIBI provide additional tissue color contrast beyond that visible with H&E—making readily available features with known diagnostic value. Furthermore, imaging non-thin-sectioned tissue specimens preserves the architecture and distribution of extended structures such as blood vessels. Topological data analysis and other mathematical tools can then be used to characterize such structural information, adding new avenues for diagnostic and prognostic evaluation.

Developing a Portable Breast Cancer Detection Kit

John Scheel (VANDERBILT UNIVERSITY MEDICAL CENTER), Catherine Duggan (Fred Hutch Cancer Center), Nixon Niyonzima (Uganda Cancer Institute), Matthew Burger (Vanderbilt University Medical Center), Qingshan Wei (North Carolina State University), Ashutosh Chilkoti (Duke University)

Breast cancer in Uganda presents a pressing public health challenge, characterized by late-stage diagnoses and high mortality rates, particularly among women residing in rural and semi-urban areas. This proposal addresses this critical issue by optimizing, validating, and deploying a point-of-care diagnostic kit, tailored for primary care clinics in Uganda, where most women access care. The proposed diagnostic kit combines (1) an FDA-cleared automated AI-enabled whole breast ultrasound and (2) a smartphone-enabled AI-powered device that performs brightfield imaging of basic cytology preparations and incorporates a self-contained immunodiagnostic chip to quantify breast tumor biomarkers. We will validate the diagnostic performance of the proposed diagnostic kit in a U.S. clinical setting, comparing it to standard-of-care methods such as ultrasound, mammography, tissue sampling, and pathology. Utilizing quality improvement cycles and feedback from end-users, we will refine the kit's performance and usability. Next, we will validate the kit at the Uganda Cancer Institute, tailoring it to Uganda's healthcare landscape, considering factors like infrastructure, health workers' expertise, and accessibility. Following validation, and guided by a Ugandan Community Advisory Board, we will implement a cluster randomized controlled trial involving eight community health centers (CHCs) across two health districts in Uganda. A mobile breast cancer detection clinic will deliver the diagnostic kit to CHCs during bi-monthly Breast Health Days for N=1000 patients referred for diagnostic evaluation, at 4 CHCs. We will compare the effectiveness of the diagnostic kit with women receiving care at control CHCs, who will be referred for standard-of-care ultrasound at Regional Hospitals (N=1000). By validating and deploying a practical, cost-effective, and user-friendly detection and diagnostic technology, we aim to empower healthcare providers in Uganda and, ultimately, improve patient outcomes. If successful, this innovation stands to enhance access to timely breast cancer detection and diagnosis in resource-constrained settings.

Democratizing Precision Oncology: AI-Based Computational Pathology Tools for Cancer Outcome Prediction and Treatment Selection in Low- and Middle-Income Country Settings

Anant Madabhushi (Emory University), Tanuja Sheth (Tata Medical Center)

Over 70% of global cancer mortality occurs in low- and middle-income countries (LMICs), yet the precision oncology tools most proven to guide treatment decisions — multigene assays, molecular biomarkers, and targeted diagnostics — remain inaccessible in the majority of these settings due to cost, infrastructure requirements, and the absence of validated local reference cohorts.

Our laboratory has developed a suite of artificial intelligence-based computational pathology and radiomics tools that extract clinically actionable prognostic and predictive biomarkers directly from routine H&E whole-slide images and standard-of-care CT scans — without requiring expensive molecular assays, specialized staining, or proprietary platforms. Key tools and results include: (1) IbRiS (Image-based Risk Score), a computational nuclear histomorphometric risk classifier for ER+ breast cancer that provides granular risk stratification within Oncotype DX risk categories (HR=2.94, p=0.02); (2) DeSTIL (Density and Spatial architecture of Tumor-Infiltrating Lymphocytes), which identifies HER2+ breast cancer patients most likely to benefit from trastuzumab from H&E slides alone, validated in the NSABP B-41 randomized clinical trial (HR=0.09, p=0.006); (3) MuTriM, a multiscale deep learning framework integrating DCE-MRI radiomics and whole-slide pathomics that predicts recurrence and adjuvant radiation benefit in breast cancer (C-index=0.75); and (4) DOVER, a deep learning framework that identifies prognostically relevant tumor regions within WSIs, validated across 2,041 patients with NSCLC and oropharyngeal squamous cell carcinomas.

Underpinning these efforts is a principled framework for equitable AI in oncology — one that requires diverse and globally representative training and validation cohorts, attention to performance disparities across race, geography, and socioeconomic context, and a commitment to deploying tools that require only the infrastructure already present in LMIC cancer centers. Our work demonstrates that AI-informed precision oncology, derived from the ubiquitous H&E slide, can be made accessible to the patients who bear the greatest cancer burden — not just those in high-income healthcare systems.

KS-COMPLETE – Rapid Sample-to-Answer Diagnosis of Kaposi's Sarcoma Across Sub-Saharan Africa

David Erickson (Cornell University), Aggrey Smeere (Infectious Diseases Institute, Kampala, Uganda)

In this project, we are developing, manufacturing, and performing a multi-site sub-Saharan African clinical validation of KS-COMPLETE — the first true point-of-care sample-to-answer diagnostic system for Kaposi's sarcoma (KS). Our recent large-scale studies in Africa have shown that KS can be diagnosed through quantification of Kaposi's sarcoma herpesvirus (KSHV) DNA in a skin biopsy with high sensitivity and specificity. These efforts have also resulted in the development of TINY — a robust, easy-to-use, infrastructure-free, point-of-care (PoC) technology for KSHV DNA quantification — which is being currently deployed in a multi-site evaluation. The work has also revealed that the key challenge to widespread adoption of skin biopsy-based PoC systems is the time and manual steps required to extract DNA from a skin biopsy — which can be up to 4 hours.

KS-COMPLETE will be the first "direct-to-LAMP" diagnostic system for skin punch biopsies. Similar direct-to-LAMP methods have greatly simplified PoC diagnostics for other sample matrices but the solid-phase, collagenous nature of skin has made this a challenge for biopsies. KS-COMPLETE will address this issue with our "SLICER" technology that will automatically process a punch biopsy into smaller "micro-cores" on which we can directly perform DNA quantification in TINY through our "direct-to-LAMP" approach. We hope that this approach will reduce the time to result to around 60 minutes, eliminate all the current manual and intensive sample processing steps, and is compatible with cost, robustness, infrastructure, and simplicity requirements for operation in LMICs. Clinical validation of the system is being done through our established network of KS clinical sites in Africa.

In addition to the KS-COMPLETE effort we will also present our most recent efforts on using AI image analysis to interpret LANA, H&E, and clinical images of KS lesions and the success of those models in diagnosing KS.

Development and Validation of a Rapid Automated Point-of-Care Test for Hepatitis C Viral RNA on the DASH® Rapid PCR System

Sally Mc (Northwestern University), Claudia Hawkins (Northwestern University), Edith Okeke (University of Jos, Nigeria)

Hepatitis C virus (HCV) infection is a major public health problem despite the availability of curative direct acting antiviral treatments. Low diagnostic rates, driven by a two-step diagnostic process including molecular confirmation, pose a significant barrier to timely treatment. While detection of anti-HCV is achieved at the point of care (POC) with a whole blood antibody detection assay, HCV RNA detection for active infection confirmation is performed in central laboratories leading to lapses in the care cascade. Consequently, the development of truly rapid, accurate, and user-friendly POC tests could expand access to diagnosis and treatment. In the first 2 years of this project, we developed an HCV detection assay for the DASH® Rapid PCR System, a sample-to-answer POC platform with a result time of 16 minutes. Preliminary studies demonstrated a wide dynamic range, genotype 1-6 detection, a detection limit of 200 IU/mL, and 100.0% positive and negative percent agreement in a study of 97 stored plasma specimens when compared to commercial platforms. In years 3-5, we will evaluate the diagnostic accuracy of the DASH® HCV test versus laboratory-based COBAS® AmpliPrep/COBAS® TaqMan® HCV Test, v2.0 on 400 stored plasma specimens from Nigerian adults with and without HCV leveraging the African HIV/HBV Co¬infection/HBV Clinical Research Network (H2Net), a collaborative research partnership created to address important care gaps in viral hepatitis infection care at five academic centers in East and West Africa (Tanzania, Mali and Nigeria), funded by the Robert J. Havey, MD Institute for Global Health. We will evaluate the diagnostic accuracy of DASH® HCV on fingerstick whole blood among 3000 Nigerian adults at risk for HCV in rural and urban areas of Nigeria and assess the feasibility and acceptability of DASH® HCV testing among participants and DASH® HCV administrators.

POC Diagnosis of Esophageal Squamous Cell Carcinoma in LMICs

Stephen Meltzer (The Johns Hopkins University School of Medicine), Tza-Huei Wang (The Johns Hopkins University School of Engineering)

Our project is developing a low-cost, non-endoscopic point-of-care diagnostic platform for esophageal squamous cell carcinoma (ESCC) in low- and middle-income countries. The platform combines a swallowed, retrievable sponge-capsule for esophageal cell collection with a portable microfluidic chip system for automated sample processing, DNA extraction, bisulfite conversion, and methylation detection.

We continued to make progress in developing a multivariate diagnostic model based on candidate methylation biomarkers. Eleven methylation markers were evaluated in 174 sponge-collected samples obtained using the sponge-capsule device. All 11 markers showed markedly elevated methylation levels in ESCC samples compared with controls. Individual marker performance was strong, with AUCs ranging from 0.646 to 0.921. A LASSO-based classification algorithm was developed in a training set of 104 patients and validated in an independent 70-patient test cohort. The final model retained six markers, achieving an AUC of 0.913 in the training cohort. Predictive performance the independent test cohort achieved an AUC of 0.913.

During this reporting period, we also completed fabrication of the magnetofluidic assay system, which integrates battery-powered sample preparation with automated droplet magnetofluidic methylation analysis. The system includes a portable centrifuge for milliliter-volume cytology samples, an enclosed five-channel thermoplastic assay cartridge, and a point-of-care analytical instrument with automated magnetic bead transfer, heating, and fluorescence imaging. The full workflow is completed in approximately four hours with only two brief manual steps. We implemented cartridge assays for four ESCC methylation biomarkers—C1ORF70, SKOR1, JPH4, and PPFIA3—together with ACTB as a housekeeping control gene. Using sponge-collected esophageal samples from 25 ESCC cases and 25 normal esophagus controls from Mbarara, Uganda, methylation indices measured by the magnetofluidic assay system showed good concordance with a manual benchtop standard assay. Together, these results support the potential of combining minimally invasive sponge-based sampling, methylation biomarkers, and portable automated analysis to enable earlier ESCC diagnosis in low-resource settings.

Comparison of anticancer medication quality in sub-Saharan Africa and in the US gray market

Marya Lieberman (U Notre Dame), Ayenew Ashenef (Addis Ababa University), Ibrahim Chikowe (Kamuzu University of Health Sciences), Hanna Kumwenda (UNC Project Malawi), Yauba Saidu (Clinton Health Access Initiative, Cameroon), Phelix Were (AMPATH Kenya), Sachiko Ozawa (UNC), Timothy Mackey (S3 Research)

The quality of anticancer medications is critical for good patient outcomes. After initial studies in Cameroon, Kenya, Ethiopia, and Malawi found that one in six lots of small-molecule anticancer medications failed quality standards, we wondered whether patients in the US were also exposed to risk from SF anticancer medicines. The US FDA is classified as a stringent regulatory authority, and the domestic regulated supply chain is believed to be relatively safe. However, US patients may attempt to obtain anticancer drugs through non-regulated sources (e.g., the grey market, Internet pharmacies, etc.) in response to high costs, lack of insurance coverage, and self-diagnosis and treatment behavior. This project conducted a systematic search of popular web search results using terms associated with anticancer drug seeking behavior that revealed hundreds of websites offering over 200 types of cancer medications. After preliminary assessment of sellers and anticancer products offered, we identified networks of related sites, stratified according to riskiness of purchase (e.g., websites that offered “no prescription access”), and tested for scams. Covert shoppers then selected over 25 websites in the top search results and attempted to buy essential cancer products without a prescription and ship them to the USA. So far, this has resulted in nearly half of all orders being successful and successful procurement of 14 cancer product treatments (of various dosage and quantity) including oral methotrexate, injectable and oral leucovorin, and even highly cytotoxic drugs like injectable cyclophosphamide, without presenting a prescription. Many of these products failed HPLC assay. Several of the products available through gray market sources in the US were made by the same manufacturers flagged by the earlier study in sub-Saharan African markets.

Advancing cervical cancer screening through an integrated CRISPR and fluorescent nucleic acid approach

Cesar Castro (Mass General Brigham Cancer Institute / Harvard Medical School), Seoyoung Lee (Massachusetts General Hospital), Frank Ssedyabane (Mbarara University of Science and Technology), Joseph Ngonzi (Mbarara University of Science and Technology), Thomas Koney (Kwame Nkrumah University of Science and Technology), Thomas Randall (Columbia University), Hakho Lee (Massachusetts General Hospital)

Cervical cancer remains a leading cause of cancer mortality among women in low- and middle-income countries (LMICs), where conventional HPV testing is constrained by cost, infrastructure, and turnaround time. Our NCI-funded U01 program is developing CODA (CRISPR Optical Detection of Anisotropy), a rapid, low-cost, portable platform for integrated point-of-care cervical cancer screening, deployed through a collaborative network spanning Massachusetts General Hospital, Mbarara University of Science and Technology (Uganda), and Kwame Nkrumah University of Science and Technology (Ghana). This presentation summarizes progress across three fronts. First, on the technology side, we have advanced automated, disc-based sample processing that enables hands-off nucleic acid handling with minimal user intervention—work conceptually aligned with our recently finalized centripetal "lab-on-a-disc" architecture, featured as a cover story in Nature Biomedical Engineering, which demonstrated automated, multiplexed molecular profiling from minimally processed biospecimens. These engineering gains directly inform CODA's evolution toward a true "sample-in, answer-out" workflow for comprehensive HPV diagnostics.

Second, our international partners have achieved substantial implementation milestones, including stakeholder engagement, protocol training, standardized operating procedures across sites, REDCap-based data systems, completion of baseline feasibility and acceptability assessments, and hands-on laboratory capacity-building enabling technical self-sufficiency at African sites.

Third, we are starting to establish a multi-modal diagnostic strategy (CANOPY) that integrates CODA's molecular readouts with machine-learning–augmented visual inspection to enhance diagnostic yield in real-world "screen-and-treat" settings. Collectively, this program illustrates how co-developed diagnostic engineering, rigorous clinical validation, and genuine LMIC partnership can converge toward scalable, equity-

focused cancer screening. We will discuss current results, implementation efforts, and the current path toward field deployment.

Development of a Near Point of Care HPV Self-Sampling: Diagnostic Accuracy in Lagos, Nigeria

Chika ONWUAMAH (Nigerian Institute of Medical Research), Yie-Hwa CHANG (Saint Louis University, St. Louis, Missouri), Nkiruka OBODOECHINA (Washington University in St. Louis, St. Louis), Olufunto OLUSANYA (Washington University in St. Louis, St. Louis), Temitope OJO (Washington University in St. Louis, St. Louis), Folahanmi AKINSOLU (Nigerian Institute of Medical Research, Lagos, Nigeria), Goodness OKEKE (Nigerian Institute of Medical Research, Lagos, Nigeria), Kofoworola ABIFARIN (Nigerian Institute of Medical Research, Lagos, Nigeria), Ucheoma NWAOZURU (Wake Forest School of Medicine, Winston-Salem, NC), Hong XIAN (Saint Louis University, St. Louis, Missouri), Kayode AJENIFUJA (Obafemi Awolowo University, Ile-Ife, Osun State, Nigeria), Jennifer SMITH (University of North Carolina at Chapel Hill, Chapel Hill, NC), Joseph TUCKER (University of North Carolina at Chapel Hill, Chapel Hill, NC; London School of Hygiene and Tropical Medicine, London, United Kingdom), Oliver EZECHI (Nigerian Institute of Medical Research, Lagos, Nigeria), Juliet IWELUNMOR (Washington University in St. Louis, St. Louis)

Background: HPV self-sampling has yet to be scaled up in many high-burden regions. This project aims to develop and implement an affordable, rapid, and user-friendly HPV DNA point-of-care testing assay in Nigeria. The goal is to expand access to screening through self-collection and decentralized testing, enabling early detection and treatment while reducing cervical cancer morbidity and mortality among women of reproductive age.

Methods: An innovative loop-mediated isothermal amplification (LAMP)-based assay was developed to detect high-risk HPV genotypes and designed for point-of-care use. Initial targets was the five most prevalent genotypes. However, assay targets was expanded based on a scoping review identifying HPV types associated with invasive cervical cancer in Nigeria. A parallel analysis examined opportunities and barriers to HPV self-testing implementation in Africa. Field evaluations were conducted in Lagos, Nigeria using clinical samples characterized with two Sansure Biotech assays (S3027E and S3057E), under conditions simulating real-world testing workflows. Ongoing work includes optimization for sample self-collection combined with testing at point-of-care settings across geographic regions.

Results: 112 well characterized and genotyped samples have been used to evaluate different versions of the assay. A multiplex colorimetric LAMP assay improved to detect nine high-risk HPV genotypes (strains 16/18/31/33/35/45/52/56/58) was developed. Three assay iterations were evaluated using clinical samples. Initial performance showed 74% sensitivity and 92.3% specificity, which improved to 89% sensitivity and 93.7% specificity following primer redesign and assay optimization. The limit of detection is five copies per reaction for most genotypes. Direct sample lysis methods compatible with field use have been established and being evaluated. Stakeholder engagement included focus groups, a women's advisory board, and steering committee input to guide implementation.

Conclusion: The assay provides sample-to-result detection within one hour at an estimated reagent cost below $2-5 per test. This platform supports expanded field validation and scalable HPV screening in low-resource settings.

Low-Cost CRISPR-on-Paper for Cervical Cancer Screening at the Point of Care

Authors: Changchun Liu (University of Connecticut Health Center), Poornima Hegde (University of Connecticut Health Center), Hui Zhao (University of Nevada, Las Vegas), Albert Manasyan (Centre for Infectious Disease Research in Zambia)

HPV-associated cervical cancer is a leading cause of cancer-related mortality among women worldwide, particularly in low- and middle-income countries (LMICs). Recently, CRISPR-Cas systems have been repurposed as programmable platforms for nucleic acid detection. In this talk, I will describe how we leverage CRISPR technology and microfluidics to enable rapid, affordable, and accessible HPV DNA testing for cervical cancer screening. First, I will present our development of sensitive and highly specific CRISPR assays for HPV DNA detection. Second, I will describe our efforts to integrate CRISPR assays with microfluidic technologies, including paper-based microfluidics, to create simple, sensitive, and programmable diagnostic platforms, such as CRISPR-on-paper devices, for visual detection of HPV DNA. Third, I will discuss the development of integrated CRISPR diagnostic systems, including a handwarmer-powered incubation platform, that enable cervical cancer screening at the point of care.

Overall, by combining the simplicity and sensitivity of CRISPR-based assays with the integration capabilities of microfluidics, we aim to develop next-generation, low-cost diagnostic tools for HPV-associated cervical cancer screening, particularly in resource-limited settings.

One-hour extraction-free loop-mediated isothermal amplification HPV DNA assay for point-of-care testing in low-resource settings

Rebecca Richards-Kortum (Rice University), Rebecca Richards-Kortum (Rice University), Maria Barra (Rice University), Kathleen Schmeler (The UT MD Anderson Cancer Center), Cesaltina Lorenznoi (Universidade Eduardo Mondlane)

Human papillomavirus (HPV) is responsible for nearly all cases of cervical cancer. Affordable point-of-care DNA testing is needed for cervical cancer screening in low-and middle-income countries, where most cervical cancer cases occur. HPV DNA testing typically requires complex lab infrastructure and trained personnel. We are developing a loop-mediated isothermal amplification (LAMP)-based HPV DNA test, which targets eight high risk HPV types and a cellular control. This talk will describe early results for assays that detect the three most oncogenic types as well as multiplex strategies for eight types. Our extraction-free sample preparation strategy permits adding sample lysate directly to the LAMP reaction. We utilize a low-cost benchtop heater/fluorimeter, delivering results in less than one hour. We evaluated our three-type assay with clinical samples in Houston, Texas (n = 38) and Maputo, Mozambique (n = 191). Results show 100% and 93% concordance, respectively, with a reference test widely used in low-resource settings. This sensitive and specific four-step assay can potentially expand cervical cancer screening in resource-limited settings.