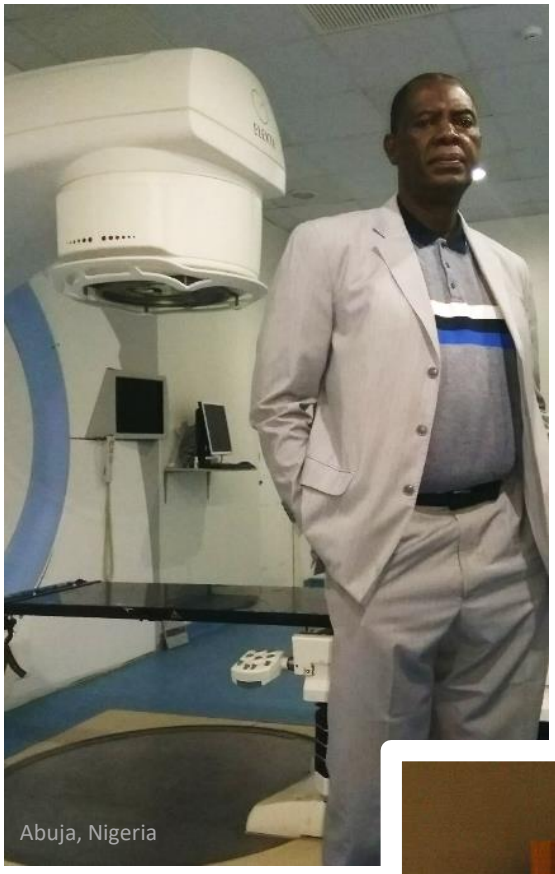
Project STELLA

On the Frontier of Cancer Care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DISPARITIES IN CANCER CARE: AN URGENT GLOBAL NEED

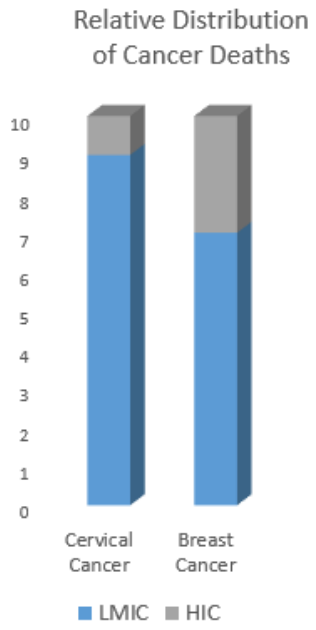
When it is detected early and treated effectively, cervical cancer—the fourth most common cancer in women—is one of the most highly curable cancers. In the United States (U.S.), the rate of infection and death from cervical cancer has decreased significantly in the past 40 years, due to increased screening, including for the human papillomavirus (HPV), which causes the cancer; the HPV vaccine; and access to radiation therapy—which is the foundation for curative treatment for advanced cancers.

In low- and middle-income countries (LMICs), where access to radiation therapy is scarce or non-existent, the story is starkly different. For a young woman in Tanzania or Ethiopia, for example, a diagnosis of cervical cancer is likely to be a death sentence. Left untreated, she will suffer a long and painful illness. She can lose bladder and bowel function and be ostracized from her family and community—sent away to die alone.

The impact of her death is devastating in other ways: since cervical cancer is most often diagnosed in women under 50, children of these women are often left as orphans and neglected resulting in additional needless deaths.

> Women are especially impacted by the lack of radiotherapy access. When a woman dies from cancer, her young children often die from neglect, and the death toll rises.

In LMICs, successfully treating breast cancer also depends on the availability of radiation therapy. The BBC reported last summer from Zimbabwe on 44-year-old Tendayi, who began a course of radiation therapy after undergoing breast conserving surgery and chemotherapy for stage III breast cancer. When the machine broke down, she was told the only way to fix it was to fly in an engineer from South Africa and this took months. Without timely radiation treatment, her oncologist told her that she should start thinking about having a mastectomy as her only remaining option.



Unfortunately, Tendayi's story is all too common among women in LMICs where radiation therapy technology breakdowns and long servicing delays are the norm or where it is not available at all. The lack of access to cancer care contributes to staggering outcomes, with nine of 10 cervical cancer deaths and seven of 10 breast cancer deaths occurring in LMICs. Overall, LMICs bear the burden of 70 percent of cancer deaths.

With more than 18 million new diagnoses of cancer worldwide in 2018 and more than nine million cancer deaths, and with new cancer cases expected to reach 27 million by 2040, the need to improve access to treatment, especially radiation therapy, that can extend and save millions of lives has never been more critical.

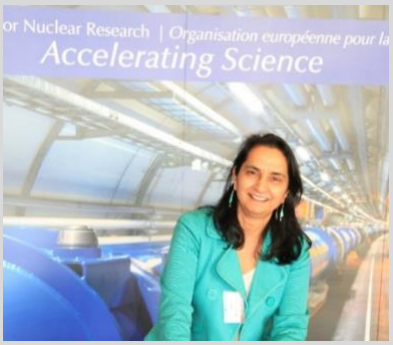
A UNIQUE COLLABORATION, A SINGLE GOAL

To address the need for better, more accessible cancer care in LMICs, a group of experts from different professional backgrounds, cultures, and countries formed an alliance. The group—radiation oncologists, physicists, biomedical researchers, healthcare executives, and advanced computing experts—had one goal in common: they were determined to increase access to high-quality cancer treatment and care for underserved populations across the globe.

> A group of radiation oncologists, physicists, and biomedical researchers from over 15 countries have come together with a goal to shift the paradigm in cancer care in LMICs.

Their innovative project, Project STELLA (Smart Technologies to Extend Lives with Linear Accelerators), was conceived as a public/private partnership established by the Washington D.C.-based International Cancer Expert Corps (ICEC) with the European Organization for Nuclear Research (CERN) and the UK's Science and Technology Facilities Council and its Daresbury Laboratory and Hartree Centre, and Lancaster University. This effort builds upon ICEC's mission of improving cancer outcomes through its training and mentoring programs in LMICs.

Recognizing that access to quality cancer treatment in LMICs depends on the availability of radiation therapy, the group focused on increasing the availability of and access to cancer care and its essential radiation treatment in LMICs by developing a novel, state-of-the-art radiation therapy treatment system with an extensive mentoring program. According to C. Norman Coleman MD, Scientific Advisor to ICEC and its founder and the early leader of this initiative, the group was driven by the idea that "we can solve this problem," by developing a transformative radiation therapy system that will cost less to acquire, operate, and maintain.



Manjit Dosanjh, PhD

"This remarkable group of dedicated scientists, physicians, and computer experts joined together around a mission of using their expertise to improve cancer care and save lives in underserved populations," said Dr. Dosanjh, Project Leader for STELLA and former Senior Advisor for medical applications at CERN and professor at Oxford University. *"Project STELLA addresses this challenge and meets the need for cancer treatment that will save lives."*

BETTER RADIATION TREATMENT, AT LOWER COST

As an essential component of cancer care, radiation therapy – targeted beams of radiation delivered by a radiation therapy machine – is the standard of care for 50 percent of cancer patients for cure or through critical palliation. Linear accelerators, or LINACs, offer more accurate treatment with less damage to normal tissues than treatment delivered with machines that utilize cobalt-60 radioactive sources that also pose security and environmental risks. LINAC technology, though, is both more costly and difficult to acquire and maintain, making access to LINAC-based radiation therapy in LMICs particularly scarce. Nigeria, for example, has seven LINACs for its population of 206 million, or 29.4 million people per LINAC, and Ethiopia, just one, for 115 million people. In contrast, high-income countries (HICs) such as the U.S. has 3,827 LINACs for a population of 331 million or 87,000 people per LINAC, and the state of Rhode Island alone, has 12 LINACs for a population of one million.

Globally, there are only 13,000 LINACs. With Project STELLA, ICEC and its partners are developing a new, technologically disruptive more affordable and easier to maintain LINAC-based radiation therapy system, with the goal of contributing significantly to overcoming the projected global shortage of 12,000 additional linear accelerators between now and 2040 to provide this life-saving treatment.

A team of experts has defined a new technological approach to LINAC design, offering hope of increased access to radiotherapy for LMICs and underserved populations in HICs.

While the project's primary goal is to address the challenges of access to radiation therapy in LMICs, it will also contribute to reducing healthcare costs globally by providing high-quality, lower cost treatment, and also benefit HICs seeking to reduce costs and improve access, as they face financial pressures and access challenges in more rural areas.

Initial funding of $1.3 million has been provided by the partners, including the UK government through its Global Challenges Research Fund and the Science and Technology and Facilities Council, to support the design of a prototype LINAC. ICEC has contributed over $1 million in time and financial support. In parallel with the LINAC development effort, ICEC continues to offer training and mentoring for radiation therapy healthcare professionals in LMICs. This mentoring program will be part of the new Project STELLA system. In order to ensure the project's sustainability and scalability, the intellectual property developed by the collaboration will be licensed to a third-party entity that will manufacture the technology for sale in LMICs and in HICs. The IP licensing revenue stream will support training and mentoring in LMICs, significantly expanding the current programs provided by ICEC.

Project STELLA is far more than breakthrough LINAC design. It includes integrated systems that utilize AI and provides access to expert healthcare mentors.

DISRUPTIVE TECHNOLOGY DRIVING A SOLUTION

Drawing on its collective world-class expertise in accelerator and medical physics, engineering design, artificial intelligence (AI) and machine learning (ML), and cloud technology, and drawing on significant user input from healthcare professionals in LMICs and HICs, Project STELLA has substantially completed the design phase for a new LINAC.
The system will deliver high-quality treatment to cancer patients similar to that provided by existing technology, but with its technical complexity "buried" to make it simpler and less labor intensive to operate. The new LINAC will be more robust and significantly less costly.

These innovations are integral to Project STELLA:

- The new technologically advanced LINAC will be significantly less expensive to purchase, operationally more robust to withstand infrastructure variables such as power and clean water supplies, and, in time, 40 percent to 60 percent less expensive to operate, service, and maintain than currently available medical LINACs.

- The end-to-end highly integrated operating system will utilize cloud-based technology and feature high-performance big data computing while supporting local access and functionality. The AI/ML-centric software, with remote and early fault/failure alerts, will improve patient outcomes and safety while significantly reducing operating costs through increased automation that scales back the need for technical support. Advanced diagnostic imaging technology will be an essential component that will be seamlessly integrated into the system.

- To ensure safe and efficient quality cancer care, robust education, training, and mentoring programs to support radiation therapy colleagues in LMICs will be developed by experts in ICEC Hubs - cancer programs in universities and private practices in HICs. A key goal of ICEC and Project STELLA is to develop capacity and capability for local champions in LMICs to provide high quality cancer care that will achieve world class credibility as part of a global network.

Dr. Taofeeq Ige

"The scourge of cancer can be 'tamed' with the concerted commitments and efforts of all involved in this STELLA collaboration" according to Taofeeq Ige, PhD, chief consultant physicist at National Hospital Abuja, Nigeria, and president of the Federation of African Medical Physics Organizations.

EXPANDING LIFESAVING CANCER CARE: A FUNDING OPPORTUNITY

Funding required to complete Project STELLA is estimated at $25 million over the 36-month timetable for the project. The funding will support:

- Building and testing the LINAC prototype hardware and software in the U.K. Daresbury Lab
- Developing the architecture for the cloud-based operating system
- Expanding the current ICEC training and mentoring programs in LMICs

The ICEC and its partners are seeking immediate financial support to develop the LINAC prototype, the associated software systems and the training and mentoring programs. With this financial support, Project STELLA will be advancing its goal of expanding access to cancer care to people in countries that need it most, extending and saving the lives of millions and setting a healthier course for the future.

Project STELLA, led by the International Cancer Expert Corps, is a collaborative effort among the International Cancer Expert Corps (ICEC), the European Organization for Nuclear Research (CERN), the Science and Technology Facilities Council (STFC) UK, Lancaster University University of Oxford.

ACCELERATING THE FUTURE:

Designing a Robust and Affordable Radiation Therapy TREATMENT SYSTEM for Challenging Environments
Fourth Design Workshop Gaborone, Botswana March 2019

ABOUT ICEC

The International Cancer Expert Corps (ICEC), a U.S.-based 501c3 organization, strives to reduce mortality and improve the quality of life for people with cancer in low- and middle-income countries, as well as the indigenous and geographically underserved populations in upper-income countries and regions worldwide. The ICEC addresses this mission through a mentoring network of cancer professionals who work with local and regional in-country groups to develop and sustain expertise for better cancer care and by addressing technology and other barriers to access to care. ICEC recognizes that cancer care must be an integral component of the healthcare system, in that addressing the spectrum of cancer care - prevention, screening, diagnosis, treatment and follow-up – enhance the health and wellbeing of individuals, societies and the global community.

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