TREATMENT, NOT TERROR. A UNIQUE CANCER TREATMENT PARADIGM FOR DEVELOPING NOVEL LINEAR ACCELERATORS FOR RESOURCE- LIMITED SETTINGS.

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Introduction: **The confluence of problems being addressed:** Over the last decade, two major socioeconomic challenges have been recognized that led to the development of a novel linear accelerator (LINAC) as a solution. With data over decades indicating the rising burden of noncommunicable diseases (NCDs) [predominantly cardiovascular, oncologic, respiratory and metabolic diseases] the United Nations General Assembly formally recognized this as a global problem in 2011. The terrorism concerns from the Office of Radiological Security, US Department of Energy, National Nuclear Security Agency from poorly controlled high-activity resources led to initiatives to develop "Alternative Technology" (Alt Tech).[1] Resulting from an international meeting on these topics that recognized the importance of Cobalt-60 for cancer care particularly in poor-security regions, Pomper and Delnoki-Veress created the paradigm of "Treatment, not Terror" for simultaneously addressing cancer and security. The International Cancer Expert Corps (ICEC) [3], a global NGO, recognized the need for novel technology for challenging environments [4] and the essential requirement for expertise to manage the patients and facilities. ICEC has since entered into partnership with LINAC experts to develop a novel LINAC with progress as follows.

Building Collaborations and taking action: ICEC set out to define, understand and address the challenges faced by the health professionals at the grass-roots in low- middle income countries (LMICs) who treat cancer patients with radiotherapy (RT). A number of workshops were held from 2016 - 2020 involving medical and technical experts from CERN, the ICEC and its global membership and, since 2017, the UK Science and Technology Facilities Council (STFC). ICEC especially involded representatives from LMICs and Official Development Assistance (ODA) countries to understand the challenges and develop effective, innovative solutions, especially for our partners across Africa.

Technology challenges: Current RT LINAC technology requires a large number of expert professional staff (including radiation oncologists, medical physicists, dosimetrists, service engineers and radiation therapy technologists) to treat patients and to maintain the equipment. In most LMICs there is both a shortage of machines and frequent breakdowns and too few engineers to keep the machines working.

Data: Obtaining RT data from the ODA countries was an essential step thus we obtained specific information from grass-roots practitioners from workshops and from a specific questionaire from all 28 African countries that offer LINAC treatment. From our analysis (data to be presented) technology development is needed to produce a modular, robust machine suited for the challenging environmental conditions and poorer infrastructures while requiring fewer qualified experts. The RT system should be user- and patient-centered and incorporate artificial intelligence (AI) and machine learning (ML)

throughout all processes to help reduce both clinician effort and the need for costly and scarce technical support personnel. The use of modular design in conjunction with remote monitoring and fault analysis, will expedite maintenance and repairs, lessening the need for specialized personnel and shortening down times.

Expertise-healthcare: The essence of the ICEC solution for global cancer care is a sustained mentorship program having the necessary, sustainable onsite expertise built from local champions and local and/or country-based investment.[5] The expertise includes medical care delivery, oncologic science, and supporting care. Critical are proper education and training and the ability to remain up to date in a world of rapidly advancing science.[6]

Socioeconomic impact: That having RT as an essential component of effective cancer care will have a broad impact on a country. The enabling LINAC technology - that encompasses the machine, the AI/ML assistance in machine capability and enhancing medical expertise - can through a global trusted network fill the current shortfall of >5,000 LINACs worldwide. An innovative healthcare system model has the potential for the necessary exponential growth in cancer care capacity.

References:

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