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ORIGINAL RESEARCH

# Joint Research Mentoring Through the Community of Young Research Peers: A Case for a Unifying Model for Research Mentorship at Higher Learning Institutions

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**Background:** Mentorship is pivotal for sustainability of a successful research culture at higher learning institutions. Various models have been proposed for provision of research mentorship in health sciences but are challenged by utilizing predominantly hierarchical mentoring, as well as being centred on one discipline or one institution. This paper describes the approach and successes of an inclusive mentorship model employed in a resource-limited setting in sub-Saharan Africa.

**Methods:** Through the NIH-funded Transforming Health Professions Education in Tanzania (THET) project, a consortium of three prominent health sciences higher learning institutions in Tanzania (MUHAS, CUHAS and KCMUCo) and two collaborating US institutions (UCSF and Duke University) was formed. Within THET, the Community of Young Research Peers (CYRP) was constituted, comprised two cohorts of undergraduate students and young faculty (fellows), and senior scientists. Besides mentorship and research training, fellows received funded research awards and in turn mentored undergraduate students.

**Results:** By the first quarter of project year four, the number of fellows and mentored undergraduate students had increased from 12 to 24 and from 41 to 67, respectively. Fellows in the second cohort (junior fellows) included medical doctors, nurses, dentist, biomedical scientist, sociologist and education psychologist. In fostering peer-to-peer mentoring, the cross-institutional pairs of fellows from the first cohort (senior fellows) were assigned to reciprocal pairs of junior fellow mentees and took a leading role in research training. Furthermore, the senior fellows had made significant strides, including eight enrolled in PhD programmes, eight publications from mentored research projects, and six small to medium-size research grants won.

**Conclusion:** The unifying model of research mentorship employed by the CYRP has been demonstrated as an effective model for joint research mentorship of the diverse group of young investigators from collaborating higher learning institutions in Tanzania. This model is recommended for scale-up, particularly in sub-Saharan Africa.

**Keywords:** health research, cross-institutional, inter-disciplinary, young faculty, mentorship, undergraduate

## Introduction

Globally, research evidence is essential to socio-economic development as it informs policies, programmes and practices.[1–4] As such, universities are expected to be well grounded in research in order to generate knowledge for

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development.[5,6] Research excellence at higher learning institutions requires a facilitative environment including opportunities for training, research funding, adequate infrastructure, and research incentives.[7] Nevertheless, in most African countries, research excellence is hampered by several challenges including lack of research mentorship for young faculty and students, limited research funding, and lack of motivation, as well as heavy teaching loads.[7–10]

The problem of a lack of research mentorship for young faculty and students is particularly concerning and often too common among universities in Africa.[7–10] It follows that strengthening of research mentorship in universities is key to Africa's future.[7] Toward this goal, innovative approaches are required to foster acquisition of both research proficiency as well as research leadership skills.[7,11] Several models have been proposed to promote research mentorship in health sciences. These include the near-peer research mentorship model for pharmacy students, the point-of-care research training programme for nurses, the undergraduate research fellowship programme for nurses, the group mentorship model for PhD students, the Condensed Heuristic Academic Research Model (CHARM) for nurses, and Advanced Research Institute (ARI) model for mental health professionals.[12–17] However, most of these models are limited by either providing mentorship to only a single rank of trainees (undergraduate vs master vs PhD-level), placing less emphasis on peer-to-peer as compared to hierarchical mentoring, lacking a multi-disciplinary approach to research mentoring, or being focused on a single institution.[12–17] Since success in health research, particularly for complex health problems, requires inter-disciplinary and cross-institutional collaborations,[18,19] it is vital that these principles are fostered among the future generation of investigators early on.

We previously described the Transforming Health Professions Education in Tanzania (THET), an NIH-funded collaborative project between three leading health sciences higher learning institutions in Tanzania, namely the Muhimbili University of Health and Allied Sciences (MUHAS), Kilimanjaro Christian Medical University College (KCMUCo), and Catholic University of Health and Allied Sciences (CUHAS); and two partnering US institutions, the University of California, San Francisco (UCSF) and Duke University, aiming to transform health education in Tanzania through the use of innovative educational strategies.[20] Through THET, the inter-disciplinary and cross-institutional Community of Young Research Peers (CYRP) was formed that combines hierarchical and peer-to-peer mentoring as a way to groom the next generation of investigators in health sciences in Tanzania.[20] Here, we describe how the CYRP has expanded and diversified, how the senior fellows have transitioned into mentors and trainers of others as well as progressed in their own research careers, including enrolment into PhD programmes, publishing of scientific articles and securing independent research funding. Further, we propose adoption of this unifying model as the model approach to research mentorship of the young researchers at higher learning institutions in countries sharing similar landscapes.

# Materials and Methods

## Recruitment of the Second Cohort of Young Research Peers

During project year 1, the CYRP had recruited the first cohort of young research peers comprised 12 young faculty from the three partnering Tanzanian institutions (now referred to as senior fellows), collectively mentoring 41 undergraduate students, and co-opted 10 members of the Medical Education Partnership Initiative-Junior faculty (MEPI-JF) project. Top mentorship was provided by a group of 10 Senior Leaders including faculty at the level of senior lecturer or above from the three partnering Tanzanian institutions and Duke University who had expertise in HIV/AIDS research, basic sciences, implementation research, socio-behavioral sciences, quantitative research methodology or data analysis.[20] Likewise, selection of the second cohort of young faculty (now referred to as junior fellows) was a competitive process. An advert with accompanying application form was posted for a month on the websites of each of the three partner institutions in Tanzania toward the end of project year 3. Eligibility criteria included being employed as faculty in one of the three partnering institutions (particularly but not limited to the Schools of Medicine and Nursing), academic rank of lecturer or below, age 40 years or below and track record or interest in conducting HIV or education research. Applications were received, and these were scrutinized, and four young faculty were shortlisted and recommended from each institution. Subsequently, the lists of all applicants including the shortlisted ones were submitted to consortium-level management for final approval and announcement.

# Mentorship Process

## Assignment of Mentors

Peer-to-peer mentoring was fostered in the expanding CYRP. The senior fellows were asked to take the lead in pairing each junior fellow with two primary senior fellow mentors. A 2 by 2 Sandwich Mentorship Framework was developed. This was implemented by *sandwiching* junior fellows by pairing each to one senior fellow from their parent institution and another senior fellow from a different institution. Likewise, each senior fellow was assigned to two junior fellows, one from the parent institution and another from a different institution (thus, *2 by 2*). Each team of junior and senior fellows was assigned one Senior Leader as an overall mentor while other Senior Leaders remained available for consultation. Schematic presentation of the 2 by 2 approach to assigning mentors is depicted in Figure 1.

## Physical Meetings

During project years 1–3, the CYRP met at least once during the annual CYRP meetings held at the three partnering Tanzanian institutions (on a rotational basis) as well as the annual MUHAS Scientific Conference. During these meetings, the young peers discussed progress of their mentored research projects, common challenges and strategies in research, including ways of fostering inter-professional research across institutions and potential solutions to challenges encountered. Such meetings are also planned in project years 4 and 5.

## Scientific Meetings Through Videoconferences

The group organized to meet virtually to discuss research questions, research methods, publishing with peer review of draft manuscripts, competing for research support with peer review of draft applications, and training opportunities. The meetings initially took place through videoconference facilities available at each institution but later transitioned to online platforms such as *Zoom* and *GoToMeeting* at the onset of COVID-19. The frequency of meetings has also evolved from once every two weeks to once every week due to the increase in number of peers and demand for hands-on training in research areas such as quantitative (and recently qualitative) data analysis.

## Mentorship of Undergraduate Students

In order to ensure the young peers acquire hands-on experience in mentoring, as well as maintain the chain of mentored future researchers, each senior fellow was instructed to involve at least one undergraduate student in their mentored research projects. In total, 41 undergraduate students were mentored by the senior fellows. Similarly, each junior fellow has involved at least one undergraduate student in mentored research projects.

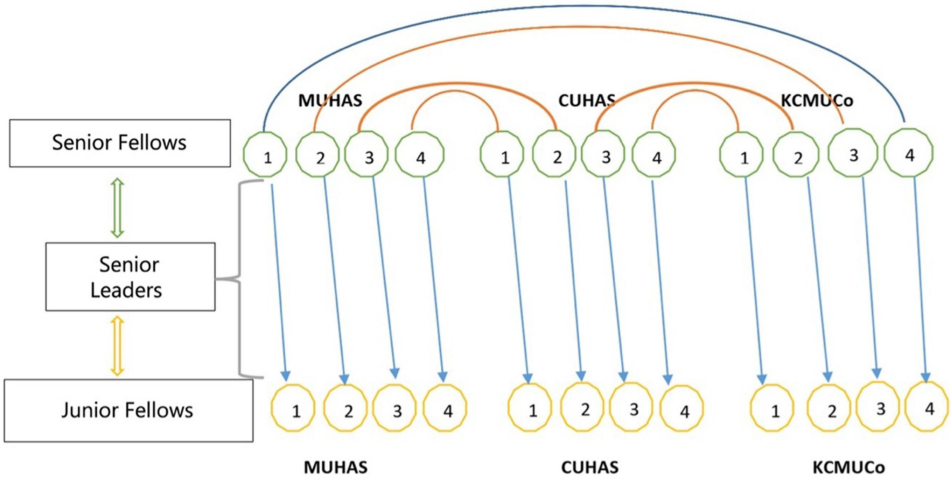


**Figure 1** The 2×2 Sandwich Mentorship Framework. Currently each of the 3 institutions has eight fellows; junior fellows (four) and senior fellows (four). The framework was effectively used to assign cross-institutional pairs of senior fellow mentors to cross-institutional pairs of junior fellow mentees. Example; Senior fellow mentor number 1 from MUHAS was paired with senior fellow mentor number 4 from KCMUCo. The pair was assigned to junior fellow mentee number 1 from MUHAS and junior fellow mentee number 4 from KCMUCo. The Senior Leaders provided overall mentorship to both senior fellow mentors and junior fellow mentees.

**Abbreviations**: 2X2, Two by two; MUHAS, Muhimbili University of Health and Allied Sciences; CUHAS, Catholic University of Health and Allied Sciences; KCMUCo, Kilimanjaro Christian Medical University College.

## Research Training

### Opportunities Within CYRP

The junior and senior fellows were each supported by THET to undertake advanced courses in personally identified gaps in research ethics, research methods, biostatistics and scientific writing. Thematic trainings for senior fellows were conducted once per year and included mentoring workshop (year 1), secondary data analysis (year 2) and education research (year 3). These trainings will be offered to the junior fellows in project years 4 and 5 under facilitation of the senior fellows. One Senior Leader who is an expert in quantitative data analysis volunteered to train fellows on the use of STATA data analysis software during weekly videoconference sessions. As was the case for the first cohort, the Senior Leaders and invited senior faculty will provide training to the junior fellows via videoconferences in areas such as financial compliance, ethical conduct of research, reference management and citation, scientific presentations and soliciting grant funding.

### Opportunities Through Externally Funded Research and Training Programmes

The Senior Leaders actively sought for external fellowship opportunities outside THET, communicated these to the young peers and encouraged applications. These ranged from research training short courses, practical attachments, and PhD scholarships to research grants writing.

## Mentored Research Awards

Similar to the senior fellows, the junior fellow will also receive funding to support the mentored research projects in the areas of HIV or education research. In improving their mentorship, each junior fellow will receive direct peer mentorship from two senior fellows, overseen by the assigned Senior Leader mentor. The senior fellow and Senior Leader mentors will assist the junior fellow in developing the research proposal which will be submitted to the local Institutional Review Boards (IRBs) for ethical clearance. Once ethical clearance is obtained, the junior fellows will have access to research funding amounting USD 10,000 each, half of which will be disbursed in project year 4 and the remaining half in project year 5. The senior fellow and Senior Leader mentors will continue working with the junior fellows throughout implementation of the mentored research projects and will encourage presentation of the output in scientific conferences, publication in peer-reviewed journals and submission of grant applications for extramural funding. The junior fellows will also be encouraged to enroll in PhD programmes.

## Developing the Unifying Model for Research Mentorship at Higher Learning Institutions

We developed the unifying model for research mentoring of the young researchers at health sciences higher learning institutions based on experiences from the 3 years of the THET-CYRP. The model features the human resources (undergraduate students, young research peers and senior leaders) as well as other resources and settings (enabling environment, mentorship, research training, research funding, career development pathways, cross-institutional and inter-disciplinary collaborations) required for successful and inclusive mentoring of the diverse group of young researchers through a combination of hierarchical and peer-to-peer mentoring strategies.

## Data Collection and Analysis

At the end of each quarter, a progress report for the CYRP is prepared and submitted to the THET Project Coordinator. Data reported on this manuscript is based on the progress reports collected. Data has been analysed descriptively and is presented in tables and figure. All methods were carried out in accordance with the relevant regulations and guidelines.

# Results

## Expansion of the Community of Young Research Peers

We selected young faculty from available academic staff at the three partnering institutions to constitute the second cohort of young research peers (junior fellows). The total number of full-time academic staff at the institutions were 313,

144 and 184, serving student populations of 4230, 2300 and 1815 (staff-to-student ratios of 1:14, 1:16 and 1:10) at MUHAS, CUHAS and KCMUCo, respectively. The total number of faculty in the ranks of lecturer and below were 239, 107 and 139 at MUHAS, CUHAS and KCMUCo, respectively. In contrast to the first cohort where 20 applications were received, we received 31 applications for the second cohort of young peers. All the 12 selected junior fellows (38.7% of the 31 applicants; 2.5% of the 485 faculty in the ranks of lecturer and below) had Bachelor and Master's degrees. Most of the selected fellows were in the age group ≤35 years as was the case in the first cohort. Although the overall male: female ratio of academic staff at the 3 institutions was approximately 2:1, the male: female ratio of the selected fellows was close to 1:1 (Table 1). In line with the main goal to provide research mentorship primarily to young faculty in medicine and nursing, most of the junior fellows belonged to these two disciplines. However, deliberate efforts were made to increase selection of young faculty from other disciplines from one among the senior fellows (bioethics) to four among the junior fellows (dentistry, biomedical sciences, sociology and education psychology). Diversity was further ensured in the range of the second degrees of the selected fellows in medicine and nursing which included specialists in urology, radiology, pathology, anatomy, microbiology and midwifery. The number of mentored undergraduate students had increased from 41 to 67 following addition of 26 new undergraduate students who are mentored by the junior fellows.

Soon after selection, the junior fellows were initiated into the CYRP through a physical meeting held at MUHAS in Dar-es-salaam that was attended by the senior fellows, representative of the MEPI-JF fellows, Senior Leaders and THET administrators. A few who were unable to attend physically participated online. During this meeting, the junior fellows were formally welcomed, oriented to the CYRP, and received a mentoring session on research in academia, including anecdotes from senior fellows, MEPI-JF fellow and Senior Leaders. The junior fellows were also given the opportunity to present and received feedback on their proposed research concepts for mentored research awards. Additionally, the larger group of 24 young peers was given the opportunity to elect their new leadership comprising President, Vice President and Secretary via a democratic process.

## Diversity of Mentored Research Projects

With guidance by the senior fellow and Senior Leader mentors, all junior fellows were able to refine their research concepts that were presented again once during the videoconference sessions and received additional feedback from fellow peers as well as Senior Leaders. In line with the diversity in composition of the junior fellows, the research concepts proposed varied widely and included topics such as information seeking behaviour and oral health in people living with HIV. A complete list of research topics proposed by the junior peers and the number of mentored undergraduate students is presented in Table 2.

## Evolution of Mentoring and Research Training

At the beginning of the project, the Senior Leaders took a more active role in providing research training and mentorship to the senior fellows through vertical (hierarchical) mentoring. The peer-to-peer (horizontal) component of mentoring also occurred through mentoring of the senior fellows by the MEPI-JF fellows. After three years of intense mentorship, the senior fellows had acquired substantial expertise and experiences and were ready to undertake a more active role in mentoring of the junior fellows while the Senior Leaders transitioned towards a more supervisory role. One of the highlights was the assignment of teams of two senior fellow mentors to two junior fellow mentees, one institutional and another cross-institutional, through a 2 by 2 sandwich mentorship framework. In turn, the junior fellows will mentor the undergraduate students who are part of their research projects.

Besides mentoring of junior fellows, the senior fellows have also transitioned to a more active role in providing research training. Particularly, expertise had been accumulated among senior fellows on the use of STATA following training sessions conducted by one of the Senior Leaders during the third year of the project. Four of the twelve senior fellows who are most conversant with STATA undertook the responsibility of providing STATA training to the junior fellows on alternating basis during videoconference sessions while the expert Senior Leader took the responsibility to oversee the training sessions. These training sessions have necessitated an increase in the frequency of videoconference sessions from biweekly to weekly and are planned to be opened to the broader audience of the young and senior faculty at health sciences institutions in Tanzania, including those not directly affiliated with the CYRP. Other research training

**Table 1** Composition of the First and Second Cohorts of the Young Research Peers

| S/N | Attribute | | All Academic Staff at Institutions by September 2020 | | | First Cohort of the Cyrp | | | Second Cohort of the Cyrp | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | MUHAS (n=313) | CUHAS (n=144) | KCMUCo (n=184) | MUHAS (n=4) | CUHAS (n=4) | KCMUCo (n=4) | MUHAS (n=4) | CUHAS (n=4) | KCMUCo (n=4) |
| 1 | Age | ≤35 years n, (%) | 124 (40) | 25 (17) | 37 (20) | 3 (75) | 3 (75) | 1 (25) | 3 (75) | 3 (75) | 3 (75) |
| | | 36–50 years n, (%) | 129 (41) | 91 (63) | 94 (51) | 1 (25) | 1 (25) | 3 (75) | 1 (25) | 1 (25) | 1 (25) |
| | | >50 years n, (%) | 60 (19) | 28 (19) | 53 (29) | – | – | – | – | – | – |
| 2 | Gender | Male n, (%) | 197 (63) | 99 (69) | 108 (59) | 2 (50) | 2 (50) | 3 (75) | 1 (25) | 2 (50) | 2 (50) |
| | | Female n, (%) | 116 (37) | 45 (31) | 76 (41) | 2 (50) | 2 (50) | 1 (25) | 3 (75) | 2 (50) | 2 (50) |
| 3 | Discipline | Medicine n, (%) | 127 (41) | 111 (77) | 112 (61) | 2 (50) | 3 (75) | 3 (75) | 1 (25) | 2 (50) | 2 (50) |
| | | Nursing n, (%) | 24 (8) | 11 (8) | 19 (10) | 1 (25) | 1 (25) | 1 (25) | – | 2 (50) | 1 (25) |
| | | Others n, (%) | 162 (52) | 11 (8) | 53 (29) | 1 (25) | – | – | 3 (75) | – | 1 (25) |
| 4 | Academic rank | Tutorial Assistant n, (%) | 92 (29) | 15 (10) | 23 (13) | – | – | – | 2 (50) | – | – |
| | | Assistant Lecturer n, (%) | 70 (22) | 18 (13) | 50 (27) | 4 (100) | 2 (50) | 1 (25) | 2 (50) | 2 (50) | 1 (25) |
| | | Lecturer n, (%) | 77 (25) | 74 (51) | 66 (36) | – | 2 (50) | 3 (75) | – | 2 (50) | 3 (75) |
| | | Senior Lecturer n, (%) | 51 (16) | 19 (13) | 24 (13) | – | – | – | – | – | – |
| | | Associate Professor n, (%) | 16 (5) | 11 (8) | 11 (6) | – | – | – | – | – | – |
| | | Professor n, (%) | 7 (2) | 7 (5) | 10 (5) | – | – | – | – | – | – |

**Abbreviations**: S/N, Serial number; n, number; ≤, less or equal to; >, greater than; %, percentage; MUHAS, Muhimbili University of Health and Allied Sciences; CUHAS, Catholic University of Health and Allied Sciences; KCMUCo, Kilimanjaro Christian Medical University College; CYRP, Community of Young Research Peers.


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**Table 2** Research Topics Proposed by the Second Cohort of Young Peers and Number of Mentored Undergraduate Students

| S/N | Research Area | Number of Mentored Undergraduate Students |
|---|---|---|
| FROM MUHAS | | |
| 1 | Sexual and Reproductive Health Information Seeking Behavior among People Living with HIV in Selected Public Hospitals in Southern Highlands, Tanzania | 2 |
| 2 | The Use of Echocardiography in the Screening for HIV-associated Cardiac Abnormalities at Muhimbili National Hospital, Tanzania | 2 |
| 3 | Acceptability, Experiences and Adherence to Pre-Exposure Prophylaxis among Young Adolescents in Tanzania. | 2 |
| 4 | The Burden of Intestinal Parasitic Infections among HIV-infected Patients in Africa: Systematic Review and Meta-analysis | 2 |
| FROM CUHAS | | |
| 1 | Utility of Auramine Stain and GeneXpert in Diagnosis of Tuberculosis in Lymph Node Aspirates among HIV Patients at Bugando Medical Centre | 1 |
| 2 | Investigating the Determinants of Students Attendance among Selected Medical Universities in Tanzania | 2 |
| 3 | Prevalence and Clinical-pathological Features of Colorectal Cancer among People Living with HIV Lake Zone, Tanzania | 2 |
| 4 | Seroprevalence and Factors Associated with Severe Acute Respiratory Syndrome Corona Virus 2 among People Living with HIV Attending Care and Treatment Clinics in Mwanza, Tanzania. | 2 |
| FROM KCMUCo | | |
| 1 | Effectiveness of Phone Tracing in Scaling Up Male Attendance and HIV Testing at Antenatal Clinics in Kilimanjaro, Tanzania | 2 |
| 2 | Magnitude and Determinants of Erectile Dysfunction among HIV Infected Adult Males Attending Care and Treatment Clinics in Northern Tanzania | 4 |
| 3 | Oral Health Status and Treatment Needs Among People Living with HIV/AIDS Attending Care and Treatment Clinic at KCMC, Northern Tanzania | 4 |
| 4 | Breast Cancer and HIV/AIDS: A Clinico-pathological Study at a Tertiary Hospital in Tanzania | 1 |

**Abbreviations**: S/N, Serial number; HIV, Human Immunodeficiency Virus; AIDS, Acquired Immunodeficiency Syndrome; MUHAS, Muhimbili University of Health and Allied Sciences; CUHAS, Catholic University of Health and Allied Sciences; KCMUCo, Kilimanjaro Christian Medical University College; KCMC, Kilimanjaro Christian Medical Centre.

areas where the senior fellows are expected to play a more active role in project years 4 and 5 include facilitation of the secondary data analysis and education research sessions as well as critique of research conducted by the junior fellows.

## Progress Made by the Senior Peers

We reported three papers to have been published by the senior fellows by the end of second year from the mentored research projects.[20] By the first quarter of the fourth year, five more papers were published by the senior fellows,[21–25] and five manuscripts were submitted to peer reviewed journals. Undergraduate students who are part of the respective mentored research projects were included in the authorship. The number of senior fellows enrolled into PhD programmes during their time in the CYRP had increased from six to eight. Four of the senior fellows have received prestigious research fellowships including two Harvard Medical School Global Clinical Scholar Research Training Fellowships, one Fogarty International Center Fellowship through Harvard T.H. Chan School of Public Health HIV Implementation Science Research Training

Programme and one HIV Research Trust Fellowship. In 2021, the senior fellows presented their research findings at nine scientific conferences both national and international, including The 9th MUHAS Scientific Conference, The 3rd Tanzania National Non-Communicable Diseases Conference, The World AIDS Day National HIV Symposium, The 8th East Africa Health and Scientific Conference, The African Organisation for Research and Training in Cancer (AORTIC) Conference, International Workshop on HIV and Adolescents and 25th Annual Conference of The Union – North America. One of the senior fellows won the Inter-Academic Partnership (IAP) Young Physician Leaders Award, being recognized as one of the twenty-four outstanding young physicians from across the world in 2021.[26] Notably, the senior fellows collaborated as lead investigators in nine small to medium size grant applications, six of which were funded. The grants included supplements to the CYRP mentored research awards, funding for PhD studies and other independent studies. In response to the COVID-19 pandemic, the senior fellows submitted three grant applications for COVID-19-related research, two of which were funded. A complete list of submitted and awarded grants is presented in Table 3.

## The Unifying Model for Research Mentorship at Health Sciences Universities

Our experiences provide support for the unifying model of research mentorship that focuses on concurrent delivery of the various elements required for mentorship of diverse groups of young investigators at health sciences higher learning institutions. Research groups are encouraged to have members from across the hierarchies, from undergraduate students to top senior researchers, with each advanced rank offering vertical mentorship to the rank below while fostering peer-to-peer mentoring and training within ranks. Involvement of undergraduate students is pivotal in order to ensure that the most junior members of research institutions are interested and mentored in research from early on. As much as possible, cross-institutional and inter-disciplinary collaborations should be emphasized as a way to foster competencies required to undertake research on complex phenomena in health sciences as well as promote joint capacity building and prevent academic inbreeding. Seed funding should be part of the mentored research programmes coupled with concerted efforts to solicit small and medium size independent funding that will enable the young researchers to continue with their research careers after completion of fellowships. All of these must occur in an enabling environment encompassing harmonious relationships, protected time for research and tenable pathways for career development that encourages long-term investment in research. Figure 2 summarizes the various facets recommended in the model.

# Discussion

Research mentorship for junior investigators is pivotal for sustainability of successful research culture at higher learning institutions. However, optimal research mentorship is often lacking at academic institutions, especially in sub-Saharan Africa. The CYRP in Tanzania, employing the unifying model of research mentorship, has succeeded in uniting health sciences higher learning institutions with diverse backgrounds to offer joint mentorship to the multi-disciplinary group of young faculty and undergraduate students through a combination of hierarchical (vertical) and peer-to-peer (horizontal) mentoring strategies. The model has started to yield impressive results with senior fellows producing research output, including publications in peer-reviewed journals and acquiring external research funding. This model is highly recommended as a pragmatic and sustainable approach to offer research mentorship at higher learning institutions of health sciences.

It is widely recognized that lack of mentorship is a major bottleneck to sustainability of research culture at higher learning institutions in sub-Saharan Africa.[7–10] Various mentorship models have been proposed to address this need in health sciences. Some of the described models include the near-peer research mentorship model for pharmacy students, the point-of-care research training programme for nurses, the undergraduate research fellowship programme for nurses, the group mentorship model for PhD students, the Condensed Heuristic Academic Research Model (CHARM) for nurses, and Advanced Research Institute (ARI) model for mental health professionals.[12–17] However, most of these models are limited by either providing mentorship to only a single rank of trainees (undergraduate vs master vs PhD-level), placing less emphasis on peer-to-peer as compared to hierarchical mentoring, lacking a multi-disciplinary approach to research mentoring, or being focused on a single institution.[12–17] To our knowledge, our approach is the first to combine all these elements into a unifying mentorship model. Thus, the uniqueness of the unifying model of the CYRP includes diversity of its members in terms of institutional affiliations, gender, disciplines,

**Table 3** Grants Submitted and Awarded to Senior Fellows

| S/N | Title | Agency | Nature of Grant | Status | Funding Level ($-Equivalent) |
|---|---|---|---|---|---|
| FROM MUHAS | | | | | |
| 1 | Serial IGRA testing of Tanzanian adolescents to detect TB in household contacts (R21) | US National Institute of Allergy and Infectious Diseases (NIAID) | Independent study | Submitted | N/A |
| 2 | Effect of aspirin on viral load among HIV patients initiating on antiretroviral therapy in Tanzania | MUHAS through Swedish International Development Cooperation Agency (Sida) | Supplement to mentored research award to support PhD | Awarded | 8575 |
| 3 | Bone mineral density and serum bone mineral biomarkers among patients with end-stage renal disease at Muhimbili National Hospital | MUHAS through Swedish International Development Cooperation Agency (Sida) | Independent study | Awarded | 5000 |
| 4 | COVID-19 vaccine acceptability and associated factors among healthcare workers in Tanzania | United Nations Children's Fund (UNICEF) | Independent study | Awarded | 47,000 |
| 5 | Assessment of COVID-19 vaccines uptake and its associated predictors among adult community in Tanzania | Tanzania Ministry of Health | Independent study | Awarded | 107,296 |
| 6 | Access to information on COVID-19 in hard-to-reach areas in Tanzania | MUHAS through Amne Salim Foundation | Independent study | Submitted | N/A |
| FROM CUHAS | | | | | |
| 7 | Gut microbiome diversity and multidrug resistance neonatal sepsis among neonates admitted at Bugando Medical Centre, Mwanza Tanzania | Else Korner Foundation (EKF) | PhD funding | Awarded | 101,859 |
| 8 | Role of incretin hormones in diabetic patients and HIV patients with enteropathy in Tanzania | Fogarty Global Health Fellowship | Independent study | Submitted | N/A |
| FROM KCMUCo | | | | | |
| 9 | Prostate cancer awareness, barriers associated with screening and correlation with prostate-specific antigen (PSA) among men in Northern Tanzania | Pfizer | Independent study | Awarded | 149,500 |

**Abbreviations**: S/N, Serial number; N/A, Not applicable; HIV, Human Immunodeficiency Virus; US, United States; NIAIDS, National Institute of Allergy and Infectious Diseases; Sida, Swedish International Development Cooperation Agency; UNICEF, United Nations Children's Fund; EKF, Else Korner Foundation; PSA, Prostate Specific Antigen; IGRA, Interferon Gamma Release Assay; R21, United States National Institutes of Health (NIH) Exploratory/Developmental Research Grant Award; PhD, Doctor of Philosophy; COVID-19, Coronavirus Disease 2019; $, United States Dollar; MUHAS, Muhimbili University of Health and Allied Sciences; CUHAS, Catholic University of Health and Allied Sciences; KCMUCo, Kilimanjaro Christian Medical University College.

academic ranks and nature of research projects, all contributing to the vibrant environment. The hierarchical component has started lower down at the level of undergraduate students which has considerably improved their mentorship and interest in research, similar to observations made by other groups.[12–17] Besides hierarchical mentoring, we have fortified peer-to-peer mentoring through a 2 by 2 sandwich framework which promotes cross-institutional mentorship of the junior fellows by the more experienced senior fellows, thus fostering an inter-institutional culture of collaboration, joint growth of research expertise, joint growth of identity as researchers across the partnering institutions and mitigation of academic inbreeding.[27,28] Furthermore, the cross-institutional and inter-disciplinary collaborations are emphasized in fostering growth of competencies required to undertake complex collaborative research in health sciences.[18,19] We also emphasize provision of enabling environments, protected time for research,

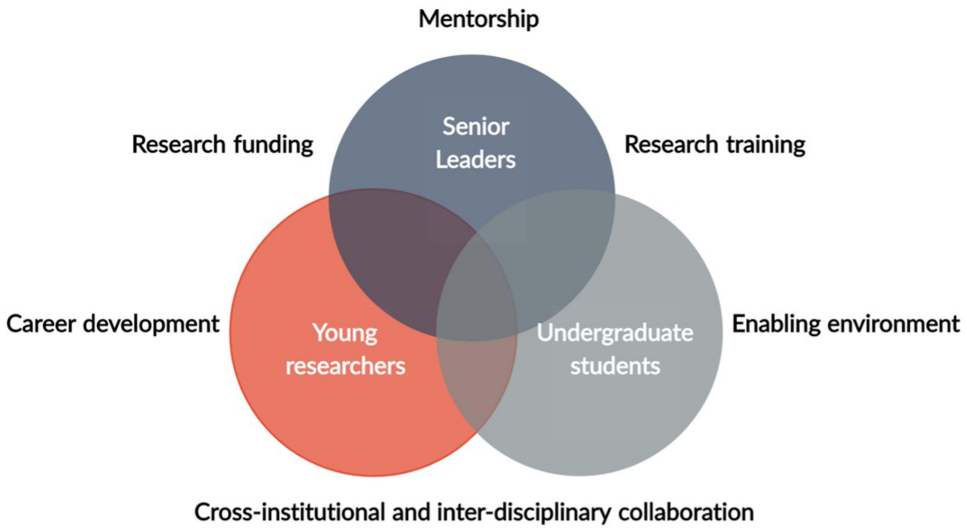


**Figure 2** The unifying model for research mentorship at higher learning institutions. A tripartite community comprised of senior leading researchers, young faculty researchers and students in an enabling environment that fosters collaboration, training, resource mobilization, career growth and mentorship is envisioned as a basic requirement for sustainable research excellency at higher learning institutions.

seed funding, concerted efforts to solicit external and internal funding and pathways for career development as important components for a successful mentorship programme. These components have been similarly highlighted by other investigators.[7–10] Besides research training and mentorship, the unifying model of the CYRP has the added benefit of providing a platform for mutual support, sharing of inspiration and exchange of ideas. Furthermore, a transition of the weekly mentoring sessions to fully online at the onset of COVID-19 was advantageous as it improved attendance to sessions since participants had the flexibility to join using mobile devices wherever they were. Experiences of the CYRP, inclusive of private and public institutions, indicate that this model is acceptable at higher learning institutions of diverse backgrounds.

As a testament to the success of our mentorship model, the senior fellows have registered substantial progress after three years of mentorship. This has included presenting at national and international scientific conferences, publishing eight articles from mentored research projects in peer-reviewed international scientific journals, enrolling into PhD programmes and winning external research fellowships and research grants which are indicators of successful future careers in research.[29] Equally important, the senior fellows have transitioned into mentors and trainers of others. These attributes indicate a high likelihood for the sustainability of research mentorship at the partnering institutions.[7]

Our work was not without limitations. Firstly, the expansion in number of fellows has been limited by the current level of funding. We were only able to accept a very small proportion of eligible young faculty at the universities into the programme. We have addressed this by allowing access to some research mentoring and training activities offered by the CYRP, such as the online training on STATA, to members of faculty who are not directly affiliated with the programme. To address the long-term need for sustainability of the programme, and given the high demand for research mentorship among the young faculty at the participating institutions, the partnering institutions plan to continue to collaborate beyond the current funding period. The team plans to apply for additional funds to support continuation of the CYRP and its expansion to more health sciences institutions in the country where an increased number of young faculty from more diverse disciplines and research interests can be supported. Likewise, institutional dialogues are ongoing to discuss the allocation of internal sources of funds as seed funds for research to young faculty. Secondly, securing protected time for research remains a major challenge at the partnering institutions in Tanzania, as experienced at other higher learning institutions in sub-Saharan Africa.[30] To address this challenge, the CYRP conducts most mentoring and training sessions, including videoconference sessions, after work hours. Furthermore, we encourage our fellows to enroll into doctorate programmes as an interim measure to secure protected

time for research during studentship. Efforts are ongoing at institutional levels to increase the number of academic staff and engage part-time staff as a way of mitigating staff shortages and free up time for research.

## Conclusion

The unifying model for research mentorship by the CYRP has proven to be successful in offering joint health research mentorship to the inter-disciplinary and cross-institutional group of young researchers in Tanzania. Besides young faculty, this approach has substantially improved the mentorship and interest in research among the undergraduate students. This model is recommended for scale-up at institutions of higher learning, particularly in sub-Saharan Africa.

## Abbreviations

2X2, Two by two; AIDS, Acquired Immunodeficiency Syndrome; AORTIC, African Organisation for Research and Training in Cancer; COVID-19, Coronavirus Disease 2019; CUHAS, Catholic University of Health and Allied Sciences; CYRP, Community of Young Research Peers; EKF, Else Korner Foundation; FIC, Fogarty International Center; HIV, Human Immunodeficiency Virus; IAP, Inter-Academic Partnership; IGRA, Interferon Gamma Release Assay; IRB, Institutional Review Board; KCMC, Kilimanjaro Christian Medical Centre; KCMUCo, Kilimanjaro Christian Medical University College; MEPI-JF, Medical Education Partnership Initiative-Junior Faculty; MUHAS, Muhimbili University of Health and Allied Sciences; NIAID, National Institute of Allergy and Infectious Diseases; NIH, National Institutes of Health; Sida, Swedish International Development Cooperation Agency; PhD, Doctor of Philosophy; PSA, Prostate Specific Antigen; THET, Transforming Health Professions Education in Tanzania; UCSF, University of California at San Francisco; UNICEF, United Nations Children's Fund; US, United States; USA, United States of America.

## Data Sharing Statement

Data used in the current study are available from the corresponding author on reasonable request.

## Ethics Approval and Informed Consent

The study received waiver of ethical clearance and waiver of informed consent from MUHAS Research and Ethics Committee (No. DA. 282/298/01.C/) as well as Duke University Health System Institutional Review Board (Pro00107296-INIT-1.0).

## Consent for Publication

All the young peers are aware of the content of the manuscript and have given permission for publication.

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## Disclosure

The authors report no conflicts of interest in this work.

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