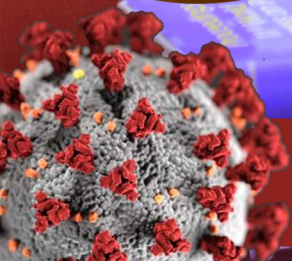




MMJ



# MAKERERE MEDICAL JOURNAL



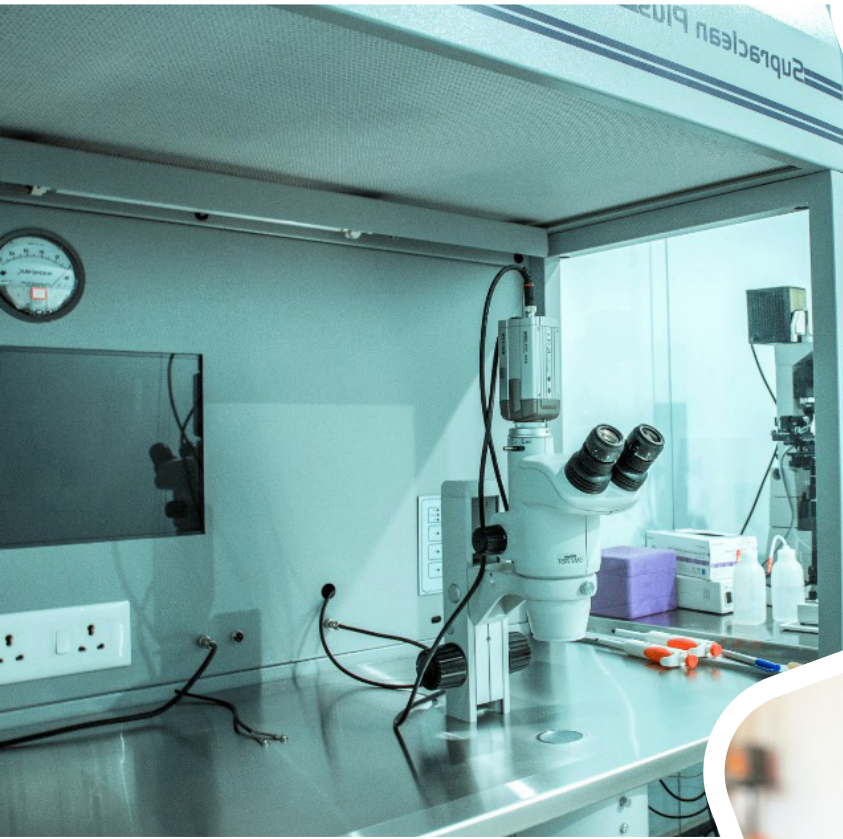
BROUGHT TO YOU BY  
RESEARCH AND WRITERS CLUB MakCHS





# NEOGENESIS FERTILITY CENTRE

*Your Fertility, Our Passion*



## SERVICES

- Fertility Treatment
- In Vitro Fertilization (IVF)
- Fertility Preservation
- General Gynaecology
- Gamete Storage
- Intrauterine Insemination (IUI)
- Embryo/Egg Freezing
- Intracytoplasmic Sperm Injection (ICSI)
- Fertility Assessment
- 3D/4D Scan
- Cycle Monitoring
- Donor treatments
- Endometriosis & PCOS
- Antenatal • Counselling

120-122 Bukoto Street,  
Kamwokya, Kampala

0394 853532 / 0782 429586

[info@neogenesisfertility.com](mailto:info@neogenesisfertility.com)

[www.neogenesisfertility.com](http://www.neogenesisfertility.com)





**MAKERERE UNIVERSITY**

Leveraging 100 years of Excellence  
in Building a Transformed Society



## MAKERERE UNIVERSITY COLLEGE OF HEALTH SCIENCES RESEARCH AND WRITERS CLUB

### ABOUT US

The Makerere Medical Journal (MMJ) is a prime student-run journal of research and related activities. MMJ is a fountain publication of the Makerere University College of Health Sciences (MakCHS). Since 1972, the journal has always published undergraduate scholarly articles. This 2022 publication marks (50 years) Golden Jubilee celebrations.

### CORE VALUES

Capacity building

Career development

Mentorship in research to promote  
research among undergraduate students at  
Makerere University

## MMJ@50 YEARS OF PUBLISHING

### VISION

To be a fountain for African generation that prides in research and publishing scientific resources

### MISSION

To improve on the competence of tomorrow's medical undergraduates through research and scientific writing.

MMJ is an annual publication accepting submissions from undergraduate medical students at Makerere University. Submissions are reviewed by an editorial board composed of undergraduate students MakCHS

### FUTURE PLANS

To transition to a fully digital journal.

To be an indexed, quick publishing one peer reviewed academic journal





# IN THIS ISSUE



Foreword	5-6
The Golden Jubilee of MMJ	7
Editorials	9-14
World Health Summit Students' conference	15
Sir Albert cook Library	17
Interview with Dr. Deborah Thompson	19
Student Projects	23
Abstracts	27
Manuscripts	30
Articles	101



Design/Layout  
Timothy Nkwasiwe  
+256 704 842 991  
[@timodegreat@gmail.com](mailto:@timodegreat@gmail.com)





LINDA ATULINDA,  
MBChB IV

Editor-in-Chief,  
Research and Writers'  
Club 2021-2022

Contact

+256701464895

[lindaatulinda@gmail.com](mailto:lindaatulinda@gmail.com)

It's with great pleasure that I welcome you to the Golden Jubilee edition of this phenomenal journal. Yes, The Makerere Medical Journal marks 50 years of publication with this year's edition and all this has been made possible by the endless efforts and contributions of the Makerere University College of Health Sciences Staff and students because without your research submissions and financial support, the journal wouldn't have made it this far. To you reading this, thank you for contributing to the sustainability of this great project, year in year out.

Here's a quote to ponder on as you delve into this year's well-crafted articles and it's by Zora Hurston (1891-1960), "Research is formalized curiosity. It is poking and prying with a purpose." And doesn't that just define our purpose as researchers?!

This edition's articles cover pertinent topics ranging from Antimicrobial Stewardship, COVID-19 interventions, Oral Health amongst others. It also features student projects, write-ups on student-led organizations and societies that are making a difference in the life of a health sciences' student and many more interesting writings. Featured in this issue are international manuscripts from countries like Nigeria and we were also honored to work with other universities within the country and feature some of their students' articles.

I would like to extend my most sincere gratitude to my team of editors that engaged in a rigorous peer review process to ensure that the articles published are up to standard. As the editorial team, we are quite pleased to see the number of undergraduates involved in research steadily increasing and all the efforts that have been put in by the different stakeholders to see this happen are commendable.

With that said, I hope you enjoy every second of your read!!!

celebrating  
50<sup>th</sup>  
Edition





ASASIRA IGNATIUS

MBChB IV

President Makerere University  
College of Health Sciences  
(MakCHS) Research and Writers'  
Club 2020/2021.

Contact

+256775285425

ignatiusasasira3@gmail.com

The journey of medicine and the health care training at MakCHS has over the years been integrated with the aspect of inclusive undergraduate research. LADIES AND GENTLEMEN, am greatly honored and exceedingly humbled to welcome you to the GOLDEN JUBILEE Edition of the Makerere Medical Journal (MMJ). It brings heartfelt warmth to find undergraduate medical students greatly participating in clinical and non-clinical research with some of our members having over 20 publications on platforms like PubMed and Google scholar. What is more relieving is the impact the research and writing skills of students at MAKCHS in this club have immensely improved communities and the society we live in.

This year, our mother institution Makerere University will be celebrating 100 YEARS of existence and MMJ is releasing its 50th Edition. We proudly associate our selves with Innovation, Research and writing in a bid to improve the academia and to inform policy for the betterment of the health care in our great nation. In the last one year, the COVID-19 pandemic has greatly impacted activities across the globe and we were equally challenged. I thank the team I worked with under the Patronage of Dr Sabrina B. Kitaaka as we were able to achieve a lot even in the middle of uncertain times and the new collaborations established with Busitema Research Association and with the Rotaract Club of Mulago should be propagated.

Lastly, and I quote Benjamin Franklin "Either write something worth reading or do something worth writing." God bless you and enjoy the voyage as you decipher the amazing writings of the medical students at Makerere University.

Great readers are great writers!

celebrating  
50<sup>th</sup>  
Edition



# Golden Jubilee of the Makerere Medical Journal (MMJ publication)



It is an absolute pleasure and honor to join the Makerere University College of Health Sciences alumni and current students as we celebrate the Golden Jubilee of the Makerere Medical Journal. The MMJ was first published as a Newsletter in 1971, to communicate to the medical students and faculty of then Makerere Medical School. Today the MMJ communicates to a much wider readership, as a result of the more refined publications including cutting edge original research; interesting case reports; scientifically driven medical opinions in global health; and excerpts from international scientific conferences. The journal has served its purpose of communicating medical knowledge and practice to medical students and health practitioners through the publication of local and international research findings. The contents of the journal have covered many relevant health issues and reflected the epidemiological transition seen in the public health landscape currently manifested in the double burden of disease. Over the last 50 years, we have seen a significant change in the epidemiology infectious diseases including the rise of global pandemics like HIV, Ebola and most recently SARS-COV-2. There has also been a significant increase in non-communicable diseases caused by poor lifestyle choices. This phenomenon has been termed the “double-burden” of disease, requiring societies to adapt rapidly to the challenge of coping with a heavy and growing case-load of communicable and non-communicable disease simultaneously.

The burden of mental disorders continues to grow with significant impacts on health and major social, human rights and economic consequences in all countries of the world. For college students, the rise in mental health disorders may be driven by the abuse of drugs and alcohol, requiring specific interventions led by students and faculty. The best approach is prevention; as we have constantly been reminded more than ever before during this covid-19 pandemic. The public health measures and social interventions towards preventing disease may be less costly than the cure. It is therefore important to follow all the standard operating procedures for this double burden.

This Golden Jubilee Edition will show case excerpts from the first ever World Health Summit in Africa which was hosted by the Makerere University College of Health Sciences. The publication which is driven mostly by the student leaders at the College of Health and has undergone various transitions based on the epidemiological changes and technological advancements. The MMJ now has an online format which is published on the Makerere University College of Health Sciences (MakCHS) official website, [www.makchs.ac.ug](http://www.makchs.ac.ug).

We thank all the contributors to all the publications gone by; it takes hard work and dedication to become a prolific writer. I wish to congratulate all the past and present editors and sub-editors of the 50 editions of the MMJ which have been published, and to say ‘Aluta continua!’, we build for the future!



Dr. Sabrina Bakeera-Kitaka

Patron,

Makerere University College of Health  
Sciences (MakCHS) Research and  
Writers' Club







Prof. Damalie Nakanjako

(MBChB, MMED, PhD)

Professor of Medicine and Principal

Makerere University College of Health Sciences

With great pleasure I welcome you to read the Silver Jubilee edition of the Makerere Medical Journal (MMJ), that has been produced by medical students at Makerere University since 1971.

The Makerere University College of Health Sciences (MakCHS), formerly named the Faculty of Medicine, aims to develop life-long learners through its student-centered learning approaches to promote problem-based learning, competence-based training and interprofessional education, in order to release graduates that are well-equipped to lead and respond to the various challenges facing health in our communities.

MakCHS learners are exposed to invaluable experiences in the community they will work serve through the community-based education, research and service (COBERS) program. COBERS allows the students to interface with the health system and communities in different parts of Uganda, to develop both technical and soft skills that are relevant to medical practice. Similarly, students at MakCHS have several opportunities for elective placements globally through the many training partnerships that have been established between MakCHS and other local, regional and internationally recognized academic institutions. The MMJ provides an institutional platform for students and faculty to disseminate their respective academic scholarly activities.

This Jubilee edition of the MMJ presents articles that cover a large spectrum of students' experiences through engagement in various projects in communities in Kampala, Mbale, and Kotido districts. You will also read about contributions to scientific conferences that include among others; the World health Summit and the East, Central and Southern Africa (COSECSA) scientific conference. In addition, you will read about advances in medical care and training including laparoscopic surgery and telemedicine by faculty at MakCHS.

I wish to congratulate MakCHS staff and students upon the resilience exhibited through the COVI-19 pandemic and emerging stronger, with various approaches to blended learning to complement the clinical/practical training approaches.

Being a medical student at Makerere University is one of the best gifts I have received from the government of Uganda and I treasure it and use to build for the future by training the next generation. It is my prayer that all the students at MakCHS value all the opportunities that were carefully designed into the wholistic curricular offered at the college.

Best wishes

celebrating  
50<sup>th</sup>  
Edition



# Editorial Team



Beliza Chemutai,  
MBChB IV,  
Editor



Kiyingi Kizito Tonny,  
MBChB V,  
Editor



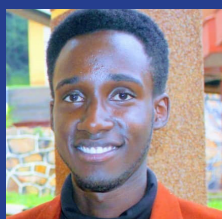
Otolia Isaac,  
MBChB,  
Editor



Kanyesigye Alan Karegyesa,  
MBChB IV,  
Head of Publicity



Senyonga Sidwell Kyeyune,  
MBChB V,  
Editor



Othieno Jacob Michael,  
BSB,  
Editor



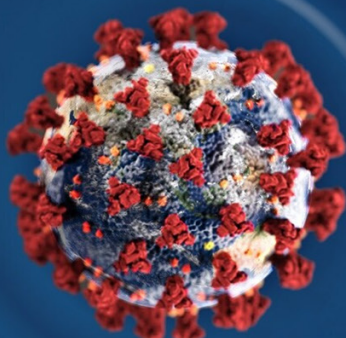
Kibone Winnie,  
MBChB V,  
Editor



Jameela Nsubuga,  
MBChB,  
Editor







# COVID-19 Experience in Uganda



Dr. Ombeva O. Malande  
Vaccinologist and Senior  
Consultant (Paediatric Infectious  
Diseases)  
Lecturer, Makerere and Egerton  
University  
Research Associate, Sefako Makgatho  
Health Sciences University, South Africa  
Director, East Africa Centre for  
Vaccines and Immunization (ECAVI)

Email address: [ombevaom@gmail.com](mailto:ombevaom@gmail.com) / [ombevaom@yahoo.com](mailto:ombevaom@yahoo.com) / [ombevaom@e-cavi.com](mailto:ombevaom@e-cavi.com)

Since the start of the COVID-19 pandemic, over 227 million cases and over 4.7 million deaths have been confirmed in over 200 countries globally (1). Many countries have adopted various

restrictions as part of the measures to contain the pandemic – including say-at-home/work from home orders. There has been general drop in the uptake of vaccines in many countries, with the risk of parallel outbreaks of both COVID-19 waves, new variants, and other vaccine-preventable diseases (2-7). The need to better support health workers and build capacity of healthcare facilities to handle severe COVID-19 patients without compromising ongoing services is urgent. The various containment measures have proved key as life-saving interventions, and helped reduce exponential increase in infections across the world (2-7). These lockdowns have had a negative effect on routine childhood immunisation and health care provision globally, with more than

half of the

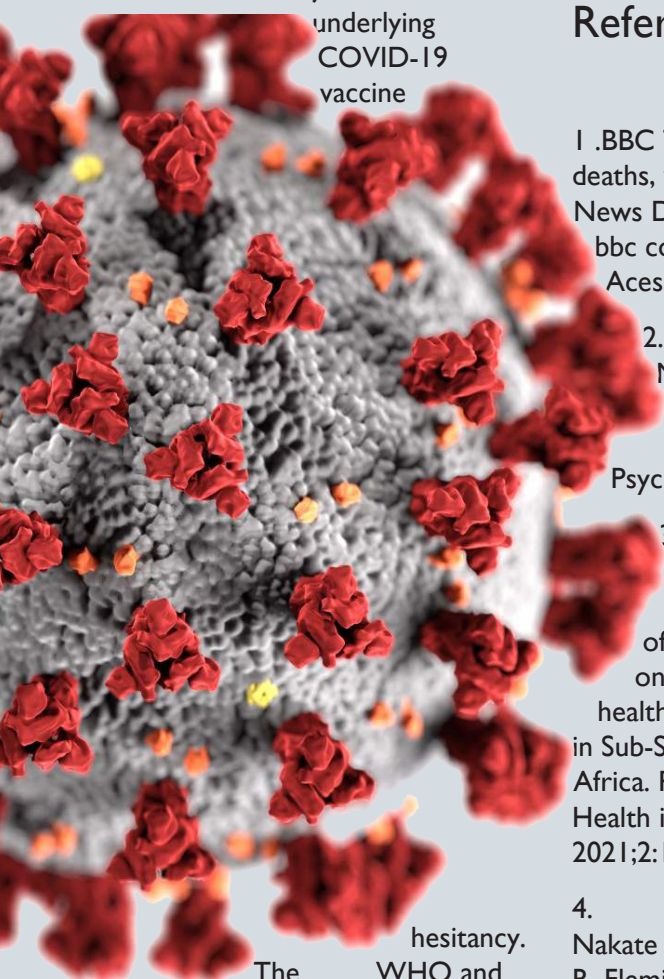
countries where data was available reporting moderate-to-severe disruptions, or in some cases, a total suspension of vaccination services especially during March-April 2020 (8). The spread of the pandemic has heightened concerns about reversal of gains with polio control, the resurgence of measles, and delay in the introduction of new vaccines. The impact of the March World Health Organization (WHO) 2020 guidance on operating routine immunization programs during the COVID-19 pandemic calling for “temporary suspension of mass immunization campaigns in order to prevent clustering of individuals and propagation of community spread of COVID-19” was seen later in a June 2020 WHO, UNICEF and GAVI poll that found that 73% participating countries had experienced declines in the demand for immunization services. This same survey further found that over 85% of respondents indicated that the average level of vaccination was found to be lower in May 2020 than in January or February 2020 (2-7). In the USA, a May 2020 - U.S. Centers for Disease Control and Prevention study revealed





significant decreases in quantities of orders for the ACIP-recommended vaccines especially noninfluenza childhood vaccines in the immediate period after the implementation of containment measures. These disruptions, coupled with difficulty in accessing vaccines, complacency, and vaccine refusal or low confidence in vaccines are major reasons

underlying  
COVID-19  
vaccine

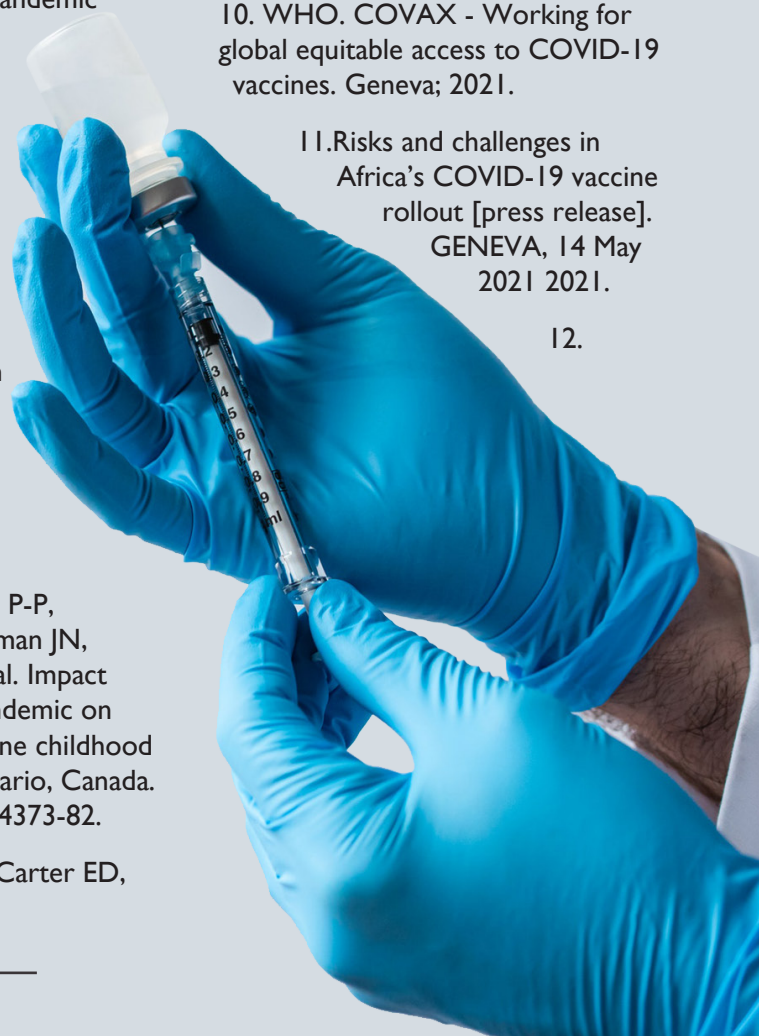


hesitancy. The WHO and UNICEF subsequently warned that disruption to immunisation programmes by the COVID-19 pandemic threatens to unwind decades of progress against VPDs like measles, and also poses the risk of exchanging one deadly outbreak for another (2-7, 9-12). The result was a call to action by the WHO for “all countries to make a joint effort to deliver routine immunisations as an essential service during the pandemic, and to plan and develop a strategy to increase acceptance and demand for vaccination” (8). This 50<sup>th</sup> edition

of the Makerere Medical Journal (MMJ) focuses on the impact of the COVID-19 pandemic in Uganda, its effect on the ministry of health strategy to combat the pandemic; and individuals (especially health workers on the forefront of fighting this pandemic). We hope you enjoy reading this edition.

## References

1. BBC T. Coronavirus cases, deaths, vaccinations by country. BBC News Disponível em: <https://www.bbc.com/news/world-51235105> Acesso em. 2021;2.
2. Morgan C, Rose N. Multidisciplinary research priorities for the COVID-19 pandemic. The Lancet Psychiatry. 2020;7(7):e33.
3. Ogunkola IO, Adebisi YA, Imo UF, Odey GO, Esu E, Lucero-Prisno III DE. Impact of COVID-19 pandemic on antenatal healthcare services in Sub-Saharan Africa. Public Health in Practice. 2021;2:100076.
4. Pallangyo E, Nakate MG, Maina R, Fleming V. The impact of covid-19 on midwives' practice in Kenya, Uganda and Tanzania: a reflective account. Midwifery. 2020;89:102775.
5. Piché-Renaud P-P, Ji C, Farrar DS, Friedman JN, Science M, Kitai I, et al. Impact of the COVID-19 pandemic on the provision of routine childhood immunizations in Ontario, Canada. Vaccine. 2021;39(31):4373-82.
6. Robertson T, Carter ED, Chou VB, Stegmuller AR, Jackson BD, Tam Y, et al. Early estimates of the indirect effects of the COVID-19 pandemic on maternal and child mortality in low-income and middle-income countries: a modelling study. The Lancet Global Health. 2020;8(7):e901-e8.
7. Schwarzing M, Luchini S. Addressing COVID-19 vaccine hesitancy: is official communication the key? The Lancet Public Health. 2021;6(6):e353-e4.
8. Organization WH. At least 80 million children under one at risk of diseases such as diphtheria, measles and polio as COVID-19 disrupts routine vaccination efforts, warn Gavi, WHO and UNICEF. Geneva. . WHO Bulletin. 2020.
9. Lu X, Zhang L, Du H, Zhang J, Li YY, Qu J, et al. SARS-CoV-2 infection in children. New England Journal of Medicine. 2020;382(17):1663-5.
10. WHO. COVAX - Working for global equitable access to COVID-19 vaccines. Geneva; 2021.
11. Risks and challenges in Africa's COVID-19 vaccine rollout [press release]. GENEVA, 14 May 2021 2021.
- 12.





# One Health Approach:



**Professor William Bazeyo**

**C.E.O AFROHUN**

Africa One Health University Network

The rapidly increasing global population has resulted in increased human-domestic animal-wildlife interactions. Global trends indicate that economies are increasingly becoming consumer driven, populations more urban and regions more inter-connected. With international, cross-border travel and trade, diseases can spread around the world very quickly. Disruptions in environmental conditions and habitats, climate change and changes in land use and farming systems create opportunities conducive for diseases to cross from animals to man and vice versa. The factors that make these trends possible, also dictate the importance of interdisciplinary interventions to achieve any meaningful results. Ebola and Avian Influenza outbreaks, and the prevailing COVID-19 pandemic have demonstrated the importance of the One Health approaches in supporting and managing global health efforts and ensuring global health security.

One Health is a concept as well as an approach. The US Centers for Disease Control provides a very good definition of One Health. It states, thus, 'One Health is a collaborative, multisectoral, and transdisciplinary approach – working at the local, regional, national, and global levels – with the goal of achieving optimal health outcomes recognizing the interconnection between people, animals, plants and their shared environment'. The One Health approach is gaining more prominence in the recent years, when the world is witnessing an increase in emerging and re-emerging pandemic threats.

One Health enables us break down disciplinary silos and barriers, primarily between animal, human health and environmental sectors so that disease outbreaks and other complex health challenges can be addressed in a

# “ Embrace the One Health Approach ”

comprehensive and wholesome manner. As a public health approach, it emphasizes the interconnectedness of disease occurrences and such other health challenges. Some of the key issues of importance to One Health are zoonotic diseases, environmental issues like air pollution, climate change, food security, antimicrobial resistance (AMR) and other infectious disease threats, and complex health hazards.

The components of One Health include human health, environmental health and animal health, while its foundations are coordination, collaboration and communication, amongst professionals in the key sectors in the triad.

No one single person, sector or discipline can address health challenges at the animal-environment-human interface given their complex nature, so the One Health approach provides the opportunity to promote and enhance the collaboration needed to address these challenges. OH improves collaboration, coordination and communication at the interface as professionals work together to address disease threats and other health challenges and supports the attainment of optimal health for people, animals (wild, domestic, livestock) and the environment.

Currently, the world is experiencing major economic, health, social and political upheavals arising from the COVID-19 pandemic. Caused by a novel coronavirus, i.e., the SARS-CoV-2, the pandemic has demonstrated – in a manner that perhaps no other disease outbreak has hence the dire need to operationalize the One Health approach.

The past two decades have seen many efforts put into groundbreaking One Health innovations in research, capacity building and practice. The current discourse revolves around what we are learning in terms of impact and sustainability of the One Health approach in harnessing global health security. I have witnessed universities under the Africa One Health University Network (AFROHUN) repositioning to build a field-ready One Health workforce and the people who have undergone some of the training programs, at the forefront of response to major disease events and they bring on board the much-needed One Health competencies.

Finally, I personally appeal to the education sector to embrace the One health approach and start on offering teaching and learning materials in OH as early as possible in the training institutions. The in-service need refresher training if we as professionals are going to make any meaningful change or impact on our communities as diseases and health challenges continue to surround us.



# Laparoscopic Surgery in Uganda



**Prof Moses Galukande**

Department of Surgery , School of  
Medicine, College of Health Sciences,  
Makerere University

Email: [moses.galukande@mak.ac.ug](mailto:moses.galukande@mak.ac.ug)

## Introduction:

Whereas the first Laparoscopic cholecystectomy was performed more than three decades ago (1987) in Europe and the practice caught on for even other surgeries<sup>1</sup>. It only arrived in Uganda in the early 2000s. However, the first diagnostic laparoscopic cases in Uganda were done in mid nineties without video camera technology but using a single viewer analog system . A decade later enough interest and modest resources had been mobilized.

## Pioneer work:

This pioneering work was done mostly at three facilities including Mulago Hospital, International Hospital Kampala and Case hospital. Right now, it is practiced with amazing consistence in a dozen hospitals in Kampala mostly private. Mulago and Makerere University as the leading training institutions are not left out on these innovative and cutting-edge ways of doing surgery.

## Feasibility:

Whereas the general thinking was and may still be that keyhole surgery is expensive and impractical for developing country low resource settings there are counter arguments, the benefits of short stay, reduced morbidity and good cosmetic outcomes<sup>2,3,4</sup> would still hold for patients in the developing world. Keyhole surgery mitigates the trauma of negative laparotomy and provide accurate information for staging in oncological conditions like gastric cancer.

## Barriers:

The challenges encountered include; funding (the costs for set up is high), consumables (reliable supplies), maintenance of equipment and troubleshooting in case of equipment failure. The other challenge is securing training without leaving ones workstation (on site), access to local experienced trainers.

## Mitigation:

Skills transfer can be done in multiple ways <sup>5,6,7</sup> one on one apprenticeship in country, and this is ongoing, the association of laparoscopic surgeons' members do that. Out of the country training opportunities abound in Asia, Europe, America and Africa, though it comes at a cost Innovative cost containment technique are required to lower cost and improve access to this service.

## Conclusion:

Laparoscopic surgery has taken off in Uganda. Short low cost repeated well supervised hands on training courses are a workable skills transfer strategy for training qualified surgeons in practice and without leaving their workstations as well as surgical trainees . Cost containment but safe techniques need to be continually looked for to tackle the sustainability issue in low resourced countries.

## References

- Fitzgibons RJ, Salerno GM. *Historical Review: Diagnostic Laparoscopy to Laparoscopic cholecystectomy and beyond*. In Zucker KA, Bailey RW, editors. *Surgical Laparoscopy*. Quality Publishing, St Louis. 1991:41-6.2.
- Grace P, Quereshi A, Darzi A, McEntee G, Leahy A, Osborne H, et al. *Laparoscopic cholecystectomy: a hundred consecutive cases*. *Ir Med J*. 1991; 84:17-14.3.
- Rutherford J, Stowasser M, Tunny T, Klemm S, Gordon R. *Laparoscopic adrenalectomy*. *World J Surgery*. 1996; 20: 758-761.4.
- Gagner M, Pomp A, Heniford BT, Pharand D, Lacroix A. *Laparoscopic adrenalectomy: Lesions learned from 100 consecutive procedures*. *Ann Surg*. 1997; 226:238-246.5.
- Ozgediz D, Galukande M, Mabweijano J, Kijjambu S, Mijumbi C, Dubowitz G, Kaggwa S, Luboga S. *The neglect of Global Workforce: Experience and Evidence from Uganda*. *World Journal of Surgery*. DOI 10.1007/s00268-008-9473-412.
- Galukande, Moses and J Jombwe. "Feasibility of Laparoscopic Surgery in a Resource Limited Setting: Cost Containment, Skills Transfer and Outcomes." *East and Central African Journal of Surgery* 16 (2011): 112-117.
- Wilkinson E, Aruparayil N, Gnanaraj J, Brown J, Jayne D. *Barriers to training in laparoscopic surgery in low- and middle-income countries: A systematic review*. *Tropical Doctor*. 2021;51(3):408-414. doi:10.1177/0049475521998186





WORLD  
HEALTH  
SUMMIT



# Students' Event



Racheal Ndaada Nangobi.

Chairperson Organising Committee  
Students' pre-event.

For the first time, the World Health Summit was hosted in Africa proudly by Uganda's Makerere University. This event is always preceded by a students' event where all students all over the world gather to discuss various aspects in health.

## What is World Health Summit (WHS)?

The world health summit is the world's leading strategic forum for global health. It was founded in 2009 on the occasion of the 300th anniversary of the Berlins Charite hospital and is traditionally held under the patronage of the



German chancellor, the president of France, the president of the European commission and the director general of World Health Organization (WHO). In addition to the WHS held in berlin, there are annual regional meetings and regular expert meetings around the world, these are organized by M8 Alliance the academic backbone of the world health summit.

The M8 Alliance is a network of 25 outstanding universities,

research institutes and academias from 6 continents committed to improve global health. As Makerere university, we're so very much proud to be part of this network, to us it shows we're and will still be academic giants and giants focused to improve health in the regions we belong to, Uganda at large and worldwide.

## Why the students event?

M8 assembly during their last meeting 13 October 2018 in berlin Germany unanimously approved the establishment of the M8 Alliance Students Network, a platform to Empower Future Global Health Leaders. The first students event was hosted by TUMS (Tehran University of Medical Sciences) in Iran where I happened to represent Makerere university, lots of discussions among students were conducted and I believe these have been put to use.



Makerere university hosted the 2nd event, a virtual event that aimed at Harnessing the potential of next generation leaders to empower health care, the event was attended by all students all over the world.





Break away sessions, you choose the topic of interest and you join that room for further discussion on that topic.

Certificate of attendance to every participant that will attend at least 80% of the event will be availed in soft copy on their emails.

These opportunities for us students are rare, therefore when given the opportunity, we should use it to the maximum. We seized the opportunity and took advantage of it. Having this event in the Pearl of Africa was a blessing, I appreciate all the responsible parties that gave us this opportunity including the College of Health Sciences; Makerere University.

During the event, various stake holders from all over the world attended and had discussions with the students. Topics of emphasis were; climate change, Covid 19 pandemic, and Mental health.

The opening ceremony chaired by the Principal college of health sciences ; Prof.Damalie Nakanjako and Chair organizing committee; Ms.Racheal Ndaada gave an opportunity to most of the stake holders to address the students. The event was opened by Prof. Ibingira; WHS International President 2020. The Guild President and Vice Chancellor of Makerere University welcomed the audience to the university and gave a brief history of the university. The guest of honour Prof.Yonas focused on achievement of sustainable developmental goals.

The event gave the attendants many achievements including;

Various topics to be discussed from, various speakers giving a platform for all of us to be mentored and also learn.

We shall also give an opportunity to all interested participants to ask questions and also share their ideas or their life experience in relation to the subjects.

A dialogue on covid 19 tell us what you think about the virus, how has it affected your well-being socially, mentally, academically etc.







Alison Annet Kinengyere, PhD  
Sir Albert Cook Library  
Makerere University

# SIR ALBERT COOK

## and his contribution to the establishment of the medical library at Makerere University

The development of medical education in Uganda is credited to the early Church Missionary Society and the work of one of its missionaries, Dr. Sir Albert Ruskin Cook (referred to as the Father of Modern Medicine in Uganda), who established Mengo Hospital in 1897. He was born on 2 March 1870 in England. His father H.W Cook, a general practitioner in Hampstead, his grandfather Edward Bickersteth, a hardworking clergyman, and his uncle who was a Bishop at Exeter jointly influenced his life as Christian and a medical practitioner who later saved many lives. He arrived in Uganda on 22 February 1870, and immediately began his work (1). He later married Lady Catherine Cook, first matron and founder of Mengo Hospital Training School (2)

In 1924, Dr. Cook established the current Albert Cook Medical Library. Later when the Faculty of Medicine was established. In 1946, this library started catering for medical education.

It was the first health library in Uganda and today it houses the archives of Sir Albert Cook's original hand-written patient records, personal letters and photographs dating back to 1900. In 1965, the medical library was named after its founder, hence its official name 'Sir Albert Cook Memorial Library'. It is a branch of Makerere University Library Services and Uganda's major biomedical/health sciences library (2).

He died in 1951, and later his cremated remains brought back to

Uganda, and are currently housed in the Library.

Nevertheless, his legacy still lives on as represented by the continuous existence

and development of the library, currently headed by Dr. Alison Annet Kinengyere since 2013.

*Albert R Cook  
Uganda*





More information about the library at: <https://chs.mak.ac.ug/acook/>

Chemistry as applied to medicine. One of the first simple but useful tests, boiling urine in a spoon over candle flame. John Bright (1789-1858) celebrated in Bright's Disease was the first to employ this test.



Joseph Jackson Lister, 1786-1869, a distinguished amateur physicist and microscopist. The microscope became that invaluable instrument of precision with his introduction of the compound microscope. His son Baron Joseph Lister, 1827-1912, was the most outstanding surgeon of his day. His attention was directed to the work of Louis Pasteur whose principles he applied to the prevention of suppuration. He was the founder of the "antiseptic principle" in Surgery and also the father of the "aseptic principle" which was a logical development of his first work. The panel shows the early compound microscope, the human eye, and the bacteria which through the medium of the microscope is revealed.



Some of the staff members of the Medical School Library

## References

1. Foster, W.D. (1978). The life of Sir Albert Cook, K.C.M.G 1870-1951
2. Billington WR. Albert Cook 1870-1951: Uganda pioneer. *British medical journal*. 1970 Dec 19;4(5737):738.
3. The Albert Cook Library website: <https://chs.mak.ac.ug/acook/> .
4. Makerere University Annual Report, 2015 (<https://sph.mak.ac.ug/sites/default/files/2019-10/Makerere-PDD-Annual-report-MAY-2016.pdf>).



# AN INTERVIEW OF DR. DEBORAH THOMSON

With Linda Atulinda

**LINDA:** Good evening, Dr. Deborah Thomson! My name is Linda Atulinda, a fourth-year medical student, from Makerere University, Kampala-Uganda, and we are so glad to have you here. I am coordinating this interview today as the Editor-in-Chief of the Makerere Medical Journal (50<sup>th</sup> Edition).

**DR. THOMSON:** It's a pleasure! Thank you for the kind invitation!

**Q LINDA:** Let's start off with the first question, we would like to know who Dr. Deborah Thomson is, how her life has been, her career and future prospects?

**DR. THOMSON:** Oh, where do I start? I've always been a curious person and I absolutely love to travel and meet people from different cultures. I've lived in Canada, the United States, Nepal, Tanzania, and Thailand. For my professional life, I am a veterinarian with a background in teaching adults as well as children. I was already in my mid-twenties when I first heard the term 'One Health'. Honestly, my mind was blown. I personally define **One Health** in two different ways to avoid any confusion. **The One Health concept is the interconnection between our health, the health of the environment, animals and plants. The One Health approach is teamwork of people of various disciplines, backgrounds, strengths and we come together to prevent and solve complicated problems.** So, in my personal opinion, One Health is both an approach and a concept. While working as a clinical veterinarian in animal hospitals during the day, I was creating One Health lessons for children at night. On my days off, I would go into schools and teach these lessons

and I found this volunteer work to be very rewarding. Kids are like sponges- they are curious and they like to laugh, to play, and to have fun. I saw that by educating kids, and their teachers who are listening in to my lesson, communities can be educated about the importance of One Health. Fast forward a few years and I was working in One Health policy and then One Health Lessons really took off.

**Q LINDA:** Wow, that is really fascinating! I can see you have a lot of passion in what you do! I think teaching children is really phenomenal and innovative because movers and shakers typically target adults but adults are harder to



convince. In my opinion, if something is to stay for a longer time, then it should pass through the children. That is truly amazing!

**DR. THOMSON:** Thank you and that's all sustainable!

**Q LINDA:** The next question is; what is the "One Health Lessons"?

**DR. THOMSON:** One Health Lessons is an organization that aims to inspire every child and adult on this planet to value One Health. The website affiliated with One Health Lessons is OneHealthLessons.com. There are 7 different age-appropriate lessons focused on COVID-19 on the site. These lessons alleviate anxiety of the pandemic through promotion of understanding. They highlight; (1) where the virus likely came from, (2) how to protect ourselves today, (3) how different scientists of so many different backgrounds are all coming together and solving complicated problems, (4) what vaccines are and why they are important and (5) what mutations are. I want the students to focus on the interactive activities, and also learn at the same time. For example, when we talk about point mutations, we do tongue twisters and make it into a contest. Who has the least amount of mutations after saying this sentence 5 times fast? I designed these lessons to be taught both online and offline so that this high quality material is accessible to anybody irrespective of one's ability to access the constant electricity. One can have these lessons printed out and then teach them under a tree.

**Q LINDA:** I like the fact that you are zealous about education, which makes it easy for you to connect with the children and teach them these lessons. This makes me wonder, "Why this particular organization?", "Why did you feel the need to start One Health Lessons?"

**DR. THOMSON:** Honestly, One Health Lessons is a dream come true! For many years I was just doing my own thing. After my 12 hour hospital shifts, I'd go home and create these lessons for fun to help educate my community. I had a To-Do list just like everybody else, where developing a website remained at the bottom. It wasn't until a friend asked me in January

2020 to share my website link that I thought, "Okay, now is the time. Just do it." Another close friend, a web developer, was going into classrooms with me to teach the One Health lessons back in 2019! With his help, OneHealthLessons.com was launched on the 1st May, 2020. By that point, I had already created seven different age-appropriate COVID-19 lessons. After making an announcement to my personal network, I took to social media. I posted a request on LinkedIn; something like, "if there's anybody out there interested in translating a COVID-19 lesson, please let me know". I was honestly expecting one or two new languages and that would have been mind-blowing. However in the last nine months, the lessons have been translated into over 80 different languages by phenomenal volunteers all over the world.

**Q LINDA:** Why are the children the target audience? Can you elaborate more on this point?

**DR. THOMSON:** First, I have a question for you, how old were you when you wanted to become a physician?

**LINDA:** I think at about eight years.

**Dr. THOMSON:** And that's the exact reason why we are talking to children! Most scientists say that they decided on their career by the age of 13. So, that means that if we can show a child that despite wanting to go into one field, like human medicine, you can have a larger impact if you worked with a team of people from different backgrounds. Therefore, the more friends you have from various backgrounds, the stronger your message, because One Health is all about teamwork. Our health is relying on the health of the environment, animals and plants. A sick environment can result into sick people, so, it's a nice way to open the minds of children before they decide on their particular profession later on. It is easier to teach children about One Health than adults.

**Q LINDA:** Definitely it did answer my question, and I liked your definition of the One Health approach. I have attended so many competitions and conferences where they emphasize that One Health should involve everyone, from every background and profession because, whether you are an engineer, a teacher or whatever job you do, this is something that affects your health at the end of the day.

**DR. THOMSON:** Thank you! Multi-sectorial, multi-disciplinary, there are many large words involved, but when you are explaining this to a 6-year-old, the best way to simplify it is "teamwork".



**Q** LINDA: Very true. What modes of delivery are being used to help the children understand the concept, and in what way are the classes conducted?

DR. THOMPSON: Right now, the lessons of COVID-19 that are up online are in PowerPoint form, which means that you can teach it virtually by screen sharing. On the YouTube channel you'll find walk through instructions on how to print out these lessons. When printed out, you can use them to teach in person. I have seen photographs of people around the world teaching with these printed versions of the lessons. My most recent picture was from Ethiopia, but the first was here in Africa, actually Uganda! There was a community event in Uganda in October 2020, where we partnered with a local non-profit organization in Kampala, and several One Health Lessons interns from Makerere University. We taught the community during that one-day event and was phenomenal!

**Q** LINDA: That's amazing! I would like to ask; how best can adults get involved in these lessons, both in terms of helping out, and learning? Because, children may be taught and may influence their parents. How about those who don't live with children, how exactly can they get these lessons?

DR. THOMPSON: Such an important question! There are so many ways to go about this. You can tell a local teacher that there is something called a Lesson Leaders' Program with One Health Lessons, and/or you can be a part of this Program. So, let me explain that a little bit! The Lesson Leaders' Program is a portion of One Health Lessons that is designed to have adults learn how to teach these lessons. This program improves ones' communication skills, and it's at the same time a community outreach. The process of training in this Program is a total 4 hour period for each individual. The first step is an orientation session, to learn how to speak to children of different age groups. The second is to observe a recorded lesson on our YouTube channel which has videos of me teaching 7 different lessons to different age groups. You can then take a quiz after watching one of the lessons. Next, you watch a live lesson being taught, after which, you teach a virtual lesson yourself and at that point, you become a Certified Lesson Leader. As a Certified Lesson Leader, you can reach out to your primary school educator or connect to the principal of your former school, and see whether you could be a tutor guest for one hour with the students. As long as

you teach five lessons in your own community, in your own first language, (keeping in mind that we have 81 languages, including Luganda), you can become a One Health Ambassador. From there you can teach others how to teach this lesson in your native language! That's how adults can get involved, by becoming Lesson Leaders. They can also become translators because ultimately, I want each child and adult on this planet to care about One Health, and that can be achieved through education.

**Q** LINDA: I loved how you have elaborately put the steps, and one leads to the other and more. Why did you choose to use translators (the volunteers) and not Google Translate?

DR. THOMPSON: Yeah! Google Translate, would have been so much easier but wouldn't work for this because, we need cultural sensitivity! We need to have people who are in the community to translate not only the words, but also the right meaning. Beautifully, they are doing this voluntarily.

**Q** LINDA: The bit of the cultural sensitivity is really important.

DR. THOMPSON: That's teamwork! I rely on the experts since I don't speak these languages. These language teams help me understand and I have learned so much. It is wonderful because these teams have started to create One Health activities in their own areas around the world.

**Q** LINDA: You are really creating lasting partnerships and corporations! What is your judgment of the public response/attitude towards taking on these lessons so far?

DR. THOMPSON: Very positive! The other day, there's an organization called KRIOLA and a subsector of it called Crayloa Educator. Crayloa, in North America is a really large art supplier and is very involved in the childhood education space. They interviewed me along with 2 other educators. One of them spoke about March, 2020 where he taught the COVID-19 lesson to students. Crazy thing is that 10 months later, the kids remembered the one-hour lesson and that is one of so many different examples. The lessons are really landing how I dreamt they would.

**Q** LINDA: That's really nice, and I feel like your theme; alleviating anxiety through promotion of understanding really describes how the entire process goes. Your goal at the end of the day is to help people understand what is going on, but with so much ease and

hoping for the future. So, I think it's one of the reasons why it's being taken positively! Doctor, are there any challenges that you have encountered so far regarding these lessons?

**DR. THOMPSON:** At the very start, people were having trouble printing out the lessons and that's why I put on the YouTube channel with the instruction video. Besides that, sometimes we need more translations for various areas of the world. For the 18+ lesson, the lesson that's meant for adults, some people felt like it was too simple for their students. It's designed in a very simple language and the reason for that is because I want to make sure adults know how to then explain it to children. It helps with science communication, and I have been in many meetings for 3 hours of what the definition of One Health is.

**LINDA:** Wow, that is amazing! About the internship, what does it take to be an intern with the organization, and what are the benefits of this particular internship?

**DR. THOMPSON:** Right, the internship program with the One Health lessons is pretty competitive because I am particularly looking for leadership skills, creativity and open mindedness. Each internship position is different and has it's own title and responsibilities. In return, I personally mentor them to improve their communication, leadership and networking skills. On my YouTube channel you will see the several different interviews of interns, both current and past that speak about their experiences.

**LINDA:** Wonderful experience! Indeed, for anyone to get anywhere, they should have a mentor to take them through the basic life skills, thank you for that. What is your take on the current COVID-19 pandemic? Do you think One Health can help in its mitigation, or One Health is more of a pick a lesson from this pandemic and apply it to the future to make sure we don't go through it again?

**DR. THOMPSON:** Just the other day, the General Secretary of the WHO at a particular conference, mentioned in his opening statement that the One Health approach is no longer a concept, we have to act on it. That was really encouraging. One Health advocates have been expecting disease X to come and it was a matter of time, but how can we start to prepare and prevent the disease from even becoming bigger! The One Health approach is our future. Right now, powerful people and organizations are talking about it and we should also have that open mindset to listen to their perspective. One Health should be expanded, and I think the future is bright as long as work through the One Health approach.

**LINDA:** Indeed, learning never stops! Every time One health is discussed, we learn something new. This leads us to the next question, "Where do you see the concept of One Health in the next years?"

**DR. THOMPSON:** If I could dream the biggest dreams, my dream will be to have One Health as a standard in education throughout primary and secondary schools. For tertiary level or university level, credited bodies should help make sure that learning One Health is maintained and advanced over time. So, I really find it a stretch to get One Health in the curriculum all over the world, and that's where I hope to see the future of One Health.

**LINDA:** True, I believe it's something that can be integrated. The One health lessons have been adopted and taught to children. When introducing a new lesson in the curriculum, people usually ask; how will the lessons be conducted? Is it feasible? etc. but with your website One Health lessons is a feasible plan.

**DR. THOMPSON:** Figures crossed! I hope it comes to life.

**LINDA:** As we conclude, what message would you love to leave for the medical students about the organization and One Health in general?

**Dr. THOMPSON:** What I can say to the medical students is, I understand what you are going through, medical school like veterinary school, it is a lot of work, but remind yourself why you joined this profession, and why did you want to help others, and beautiful thing with medicine is that, it's always changing, and we are always learning based on biomedical research. So, I would love to invite, and encourage you to stay curious, and keep an open mind, because there are so many wonderful things we can learn, as long as we keep an open mind, and start to see the world as connected. With this kind of mindset, it's extra appealing to speak with people from different backgrounds. always wanting to make your community and world safer, healthier and happier, and we can do that all together.

**LINDA:** That's a lovely concluding message! Thank you so much, Dr. Deborah. Thanks, for your time and letting us in to your work with One Health Lessons. I request everyone listening or reading, to subscribe to the One Health Lessons YouTube channel! Get involved, learn and help out in your community. I hope to work with you in the nearby future.

**DR. THOMPSON:** It's a pleasure, and Thank you so much for this opportunity. I look forward to future conversations.



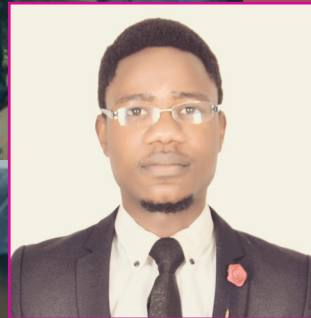
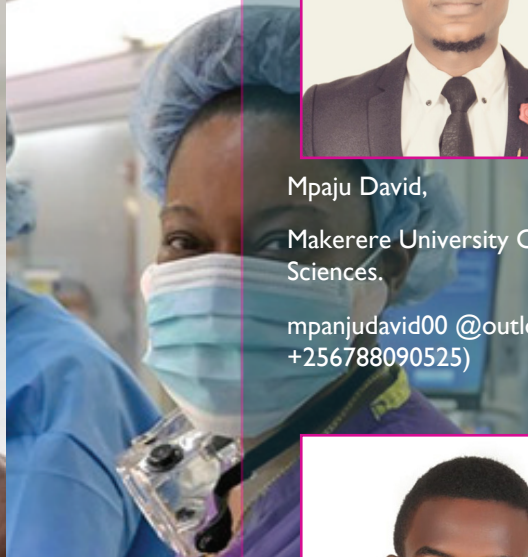
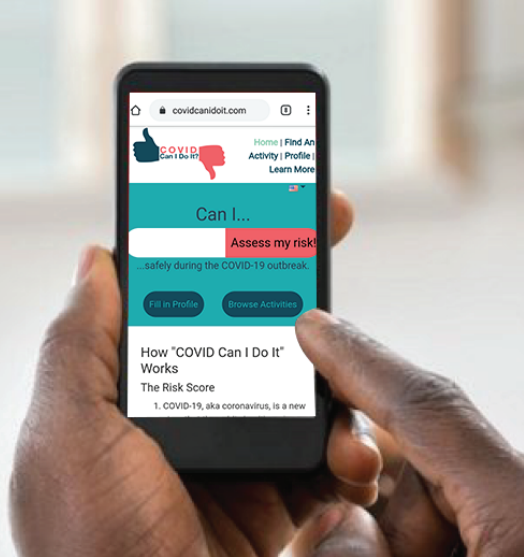


# COVID



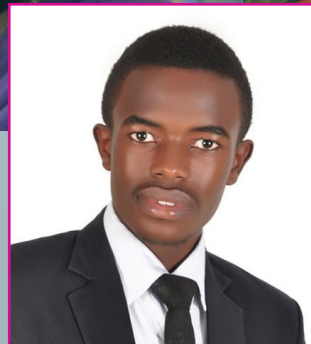
## Can I do it?

“Enjoying a less risky environment”



Mpaju David,  
Makerere University College of Health  
Sciences.

[mpanjudauid00@outlook.com](mailto:mpanjudauid00@outlook.com),  
+256788090525)



Byamugisha Joseph,  
Makerere University College of Health  
Sciences.

[jbyamugisha12@gmail.com](mailto:jbyamugisha12@gmail.com),  
+256706387332



# COVIDCanIDolt:

## A COVID-19 Daily Activity Risk Assessment Tool for Uganda

### Executive Summary

By 22nd September 2020, COVID-19 had caused over twelve million infections and over 550,000 reported deaths globally. In Uganda, deaths had been limited by proactive measures that had been put in place by the government. As a novel infectious disease with high transmission rates, drastic measures had been taken to limit new infections and prevent overwhelming Ugandan health care systems. However, lockdowns had forced Ugandans to severely limit their daily life and work. While lockdowns and stay-at-home orders had kept people physically distant, there was no clear guidance on how they could make informed decisions on preventing the transmission of COVID-19.

Developed in March 2020, COVIDCanIDolt is an online,

mobile-friendly tool that helps users make informed decisions to reduce the risk of transmission, from not engaging in certain activities to recommendations for mitigating transmission and preventing the further spread of COVID-19. Over 700 users have used the tool during the, 660 being from Kampala and the rest from other parts of Uganda. 68% of the users are for Mobile phones while 31.2% are for Desktop computers and 0.8% is for Tablets.

While lockdowns and stay-at-home orders have kept people physically distant, people have been left without clear guidance on how they can make informed decisions on preventing the transmission of COVID-19. COVIDCanIDolt is an online tool that helps users make informed decisions to reduce the risk of transmission, from not engaging in certain activities to ways to mitigate transmission, to help prevent further COVID-19 transmission.

Recommendations are based on both scientific literature and the current epidemiologic data of their locality. With such information, populations can be empowered to make informed choices of when to engage in activities, helping us all reduce transmission and put an end to the COVID-19 pandemic.

that has both the Ugandan and the USA context of activities. In Uganda, the tool was launched by the Vice-chancellor Makerere University on 20th May for the feasibility phase and had over 686 users as of 09th July 2020. The feasibility phase was supported by Makerere University under MakRIF.

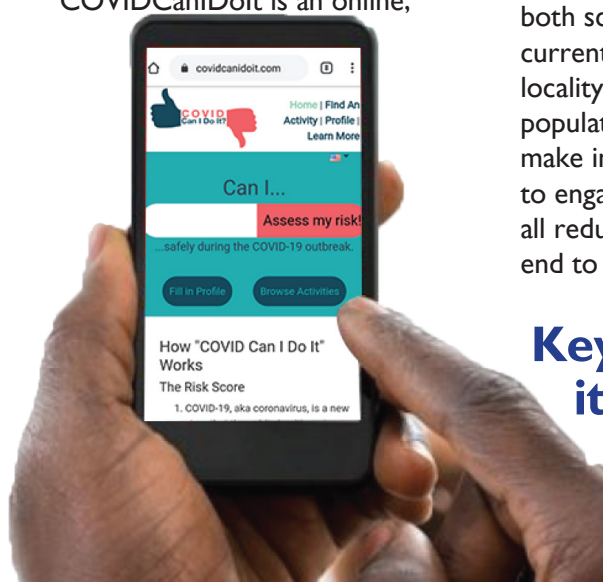
The tool was presented to the ICT and Innovations pillar of the COVID 19 at the Ministry of Health on Tuesday 2nd June 2020 and its recommended was that "The solution is worth deploying because lockdown has been eased. It will be a great tool to deploy for the population to be able to identify and avoid the risk areas or put measures in place to curb any associated risks. It is a web-based tool, and does not capture any personal related information."

### Deliverables

- I. National Alert system through Risk communication.
- II. Risk Stratification and modification.
- III. Communicating generic guidance around high-risk activities.
- IV. Identification of key intervention areas by place and activity.
- V. Mapping out high-risk areas by case numbers.
- VI. Evaluation and Monitoring of the Tool Usage by google analytics.

### Key progress items

The tool, COVIDCanIDolt runs as web-based tool

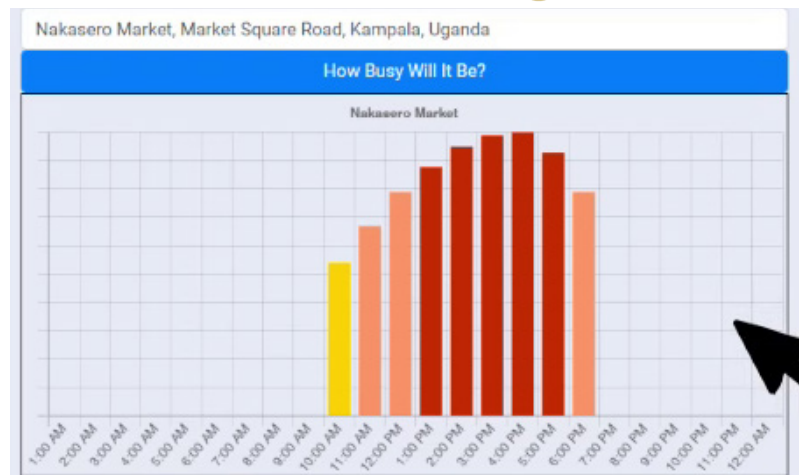




## Key Results on User Engagement.

CCIDI uses google analytics to monitor activity by the number of users, location, user behavior, device, page search over a given time range. The analytics also provide real-time usage by blue dotting on the google map embedded.

A total of 698 users had used the tool as of 01st Aug 2020, 663 being from Kampala, and the rest from other parts of Uganda. 60.9% of the users are for mobile phones while 37.7% are for desktop computers and 1.4% were for tablets computers.



*Tool results showing which hours of the day are busier and crowded, and which hours are safer to move.*

should consider deploying digital technologies and online solutions especially in this COVID 19 pandemic given there is limited need for human to human interaction.

CovidCanIDolt-a web-based activity risk assessment tool developed in March 2019, is an indispensable solution to facilitate the mitigation of spread and contraction of COVID 19 infection amongst its population.

## Acknowledgment

We record thanks to Mr. Jarjeh Fang and Ms. Gayatri Sanku from Columbia University, New York, and Georgetown University, Washington respectively for the collaboration.

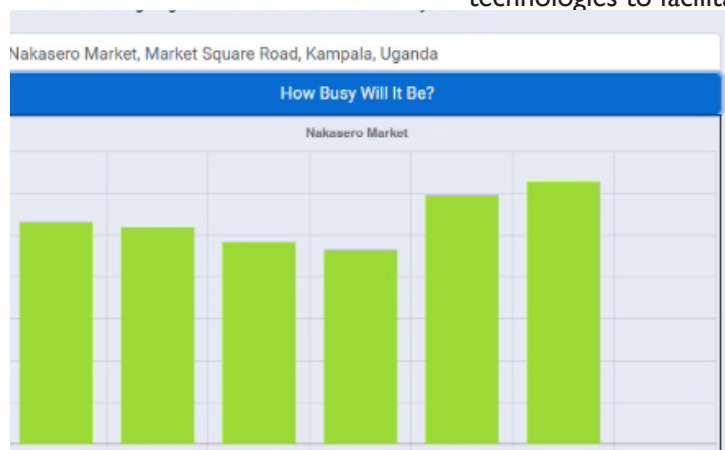
We would like to express our gratitude to Makerere University for supporting the feasibility phase of this tool.

low mortality rates. In the race to contain the spread of a highly transmissible virus, countries that have quickly deployed digital technologies to facilitate planning, surveillance, testing, contact tracing, quarantine, and clinical

management have remained front-runners in managing disease burden. The comprehensive responses of countries that have been successful at containment and mitigation can provide insight into other countries that are still facing a surge of cases.

To effectively implement digital technology on a national scale, interventions should be tailored to the target regions; broadband access requires government and private sector investment in technology and infrastructure.

The government of Uganda through its stakeholders such as the Ministry of Health, Ministry of Science, Technology, and Innovations



*Tool results showing which days crowding would peak and how busy the place would be*

## IMPLICATIONS AND RECOMMENDATIONS FROM THE FINDINGS OF THE PROJECT

The integration of digital technology into pandemic policy and response could be one of several characteristic features of countries that have flattened their COVID-19 incidence curves and maintained

# "Hope lives here"



We're not saying it is okay now, we're saying it will get better soon.

Haven Mental Health Foundation Uganda is a youth led Non-government organization that is changing the narrative on Mental Health.

Transition into adulthood is a challenging process, often faced with different pressures ranging from establishing an independent identity to making interpersonal relationships. All these have major long term effects on our mental health as young people. For that matter, we cannot stress enough or overlook the importance of having someone with whom to celebrate wins, but also hold your hand through the blues, cheering you on when it's hard to keep going!

Birtherd on the 1<sup>st</sup> of May, 2020 at the peak of the Covid-19 pandemic, Haven Mental Health Foundation

took on a journey of Mental Health awareness among young people. This entailed a 30days' awareness campaign on all social media platforms, counselling and linkage of young people with mental health challenges to professional health care and therapy, through youth friendly channels.

Since then, we have been able to counsel over 100 people and link 30 of these to youth friendly mental health services.

Throughout the last year, we held a series of webinars, reaching out to about 500 people. As a result, we realized the need for a comfortable safe space, where one is able to share personal mental health issues devoid of insecurity and stigma, hence normalizing conversations about Mental health.

Haven Uganda also organizes peer support group discussions where young people share experiences of mental health challenges they've faced before and how they were able to overcome them with those going through similar challenges, helping them open up and navigate the rough waters together.

Healing is a process that gets easier with the right support system! We at Haven Uganda aim at being that Support System that will walk the healing journey with you, every step of the way through counselling and linkage to professional health care at a subsidized cost.

Haven Uganda has partnered with organisations such as Thrive Uganda, The Mind Lab Uganda, The Sanctuary and different mental health practitioners to join the fight in creating mental health awareness amongst the masses, highlighting the fact that mental illness is just like any other illness that can be treated, the different mental disorders and how they can be identified, when and where to seek help.

Through our social media campaigns and webinars, we've been able to reach out to about 20,000 people and are hoping to capitalize on different niches such as the marginalized groups including but not limited to young people living with HIV, widows and orphans.

Our goal is to equip as many young people as possible with knowledge on mental health, creating public awareness and counselling skills. We strive to see a world where young people with mental health disorders can freely speak about their illness and seek treatment without stigma; a world where the onus is on each and every one of us to improve mental health, where governments and policy makers prioritize and consider mental health as a public health concern.

"There's always light, but only if we are brave enough to see it and be it!"

*Haven Mental Health Foundation, Hope lives here...*





# PROMOTING HAND WASHING PRACTICES WITHIN HOUSEHOLDS IN KAPILAN BAR WEST VILLAGE, KAABONG DISTRICT.

Blaise Kiyimba,

Arnold Atuhaire,

Teddy Onyait,

Margaret Najjemba,

Rosette Kyokunzire (MBChB IV).

Dr. Charity Oneko.

## ABSTRACT.

**Background:** Hand washing with soap is a strong pillar of international development and public health. It improves health, nutrition, education, economic development, and equity. However, the hand washing behavior among people in Kapilan bar west village-Kaabong district was still poor according to our community diagnosis results.

**Objective:** To promote hand washing practices among people in Kapilan bar west village.

**Method:** We held 3 two-hours hand hygiene education sessions on three consecutive days, each consisting of about 35 people in three different places within Kapilan bar west village with the help of 2 translators, 2 VHTs, one town agent, one LCI and one LCII chairmen for mobilization and organization. In each session emphasis was on the relevance and standard steps of hand washing, demonstration of tippy tap construction, its use and maintenance, giving out construction materials to six active participants, and concluded by construction of 10 tippy taps in ten different households. We used observation checklists and questionnaires for pre and post project evaluation.

**Results:** The knowledge about poor hygiene-related diseases increased as follows: diarrhea from 83.3% to 100%, dysentery from 3.3% to 83.3 %, cholera from 33.3% to 100%, hepatitis A& E from 6.6% to 66.6%, .The knowledge about the standard time and steps of hand washing increased from 0% to 97% and from 0% to 100% respectively. The knowledge about tippy tap construction increased from 40% to 100%, and the prevalence of tippy taps in the village increased from 00 to 23%.

**Conclusion** There was an improvement in the knowledge, handwashing practices, and total number of tippy taps in the village.

**Recommendations:** More WASH-related health education outreaches in villages should be scheduled by the DHO's office, the VHTs and health education workers should continuously encourage tippy tap construction and maintenance in the village . Provision of tippy tap construction materials by any other future going health promoting teams to motivate more house holds to construct.



**AUTHORS:** MWACHAN PATRICIA, RUTAREMWA KENNETH, NKURUNZIZA EMMANUEL

**INTRODUCTION:** Mycobacterial Growth Indicator Tube (MGIT) is the gold standard and most sensitive method for liquid culture and sensitivity testing for *M. tuberculosis*. Sample contamination compromises the ability to isolate *Mycobacterium tuberculosis* due to competition by overgrowth of contaminating organisms hence delaying the diagnosis, and treatment of tuberculosis.

**OBJECTIVE:** To identify and characterize contaminants isolated from samples processed for tuberculosis diagnosis at the Mycobacteriology (BSL-3) laboratory, Makerere University.

**METHOD:** The study was a cross sectional study that was carried out at the mycobacteriology (BSL-3) and clinical microbiology laboratories at Makerere University. 150 samples that were contaminated from the MGIT liquid culture were included in this study to identify both bacterial and fungal contaminants. The proportion of the organisms from the different sample type and site of sample collection was also determined.

**RESULTS:** Most of the contaminating agents were Gram positive bacteria, specifically, *Staphylococcus epidermidis* (31.93%), *Staphylococcus aureus* (16.81%), and *Bacillus species* (14.29%). We also observed Gram negative bacteria of which *Pseudomonas aeruginosa* was the predominant (3.36%), followed by *Enterobacter species* (0.84%). Among the different sample types, spot sputum method had the highest rate of contaminants (76.5%) followed by early morning/ overnight/pooled sputum method with a 9.2% rate of contamination. Induced sputum method also had a 9.2% rate of contamination. Nasopharyngeal aspirate method had the least rate of contamination (5.0%). There was also a higher rate of contamination from sites that were far the laboratory than those that were near the laboratory.

**CONCLUSION:** Contamination of samples for the diagnosis of *M. tuberculosis* is mainly from normal floras of the upper respiratory tract that are collected during expectoration of sputum. These organisms are of significant clinical importance, therefore they could cause co-infections, especially in immunocompromised patients.



# Reducing malaria burden through increasing household ownership and proper use of ITNs in Entebbe village, Kotido Municipality.

## Background

### Authors:

Kyomurungi Rollands

Otolia Isaac

Jurua Micheal

Ndegemu Evelyn

Alinetu Raymond

Namayanja Rathia

Ngabirano Derek

Onyait Stephen.

Despite the reduction in malaria related deaths over the past years, it still remains a global burden with Uganda contributing 5% of the global cases. In spite of the government's intervention of periodic distribution of Insecticide treated nets (ITNs) countrywide, ITN ownership in Karamoja only stands at 55% with Entebbe village at 66% all below the national average of 78%.

**Objective.** To reduce the malaria burden through increasing household ownership of ITNs and promoting their proper use.

**Method.** A simple random sampling method was used to select 78 households out of 97. Project resources were mobilized from CHS and Kotido HC IV while VHTs and LC I guided in Community mobilization. Pre and post intervention quantitative data was obtained using interviewer administered questionnaire and observation checklist. Intervention activities included demonstration, health education sessions and distribution of ITNs.

**Results.** Knowledge of ITN use in malaria prevention increased from 78.2% (61) to 100%. 94.7% (74) knew that use of torn ITNs increased their risk of malaria infection, an increment of 36.9%, from 58% (45) pre intervention. post intervention, a large number 88.5% (69) reportedly learnt that ITNs should be used all year round. 64.1% (50) respondents cited alternative use of ITNs this markedly improved post intervention to 96.2% (75) participants reporting no other alternative use. There was a marked increase from 69.2% (54) to 94.9% (74) in household ownership of at least one ITN.

**Conclusion.** The project was successful and achieved 94.9% household ownership of ITNs with significant increase in knowledge on proper ITN use and care.

**Recommendations.** There should be continuous health education and community mobilization by local leaders to sustain ownership and proper use of ITN coupled to continued periodic distribution of ITNs.

**Key words:** Insecticide Treated Mosquito nets (ITNs), Malaria, and Mortality



# INTENTION FOR POSTGRADUATE STUDY AMONG BACHELORS' PREPARED NURSES AT HEALTH FACILITIES IN KAMPALA

## ABSTRACT

**Introduction:** Uganda has severe shortage of human resources for health despite the heavy disease burden. The current nurse: patient ratio of 1:11000 is inadequate and this is further constrained by trained workers leaving the country while others abandon the health sector. The shortage of graduate-level prepared nurses is reaching critical levels. Combined with an anticipated wave of faculty retirements, a relatively older graduate student body, and an insufficient number of graduates at the Masters' and doctoral levels, the recruitment of more and younger students into graduate programs in nursing has become a priority for the profession. Current understanding of why graduate nursing students choose to pursue graduate studies in nursing remains vague.

**Aim:** The study aimed at assessing the intention of graduate nurses at health facilities in Kampala, to advance their nursing career.

**Methods:** This study employed a quantitative cross-sectional design. Samples of 195 graduate nurses (those without post graduate qualification) were recruited into the study using consecutive sampling procedure in 10 hospitals around Kampala. A structured questionnaire was used to collect data on intention for post graduate study and associated factors. Binary logistic regression was used to determine association between factors and intention for post graduate study and data was analysed using SPSS version 23.

**Major findings:** A cross-sectional study was carried out among 195 graduate nurses at Kampala health facilities. 142(72.8%) nurses had intention for post graduate study, 92.8% (181) of participants said post graduate study is valuable, friends influence post graduate study also at 87.2% (170) also 73.3% (143) agreed to family support in post graduate study, those who agreed to better job opportunities were 90.3% (176) and finally nurses who attached post-graduate study to success were 92.3% (180)

**Conclusion:** Majority of nurses intend to advance their nursing career, however, there are limited fields to advance in, friends and family have a lot of influence on intention for post graduate study, no scope of practice and there are no institutional policies to support post graduate study.



## INTRODUCTION

The Bachelor of Nursing Science (BSN) degree in Uganda started in 1993 at Makerere University, with the aim of providing students with a more in-depth study of the Physical and Social Sciences, Nursing Research, Nursing Leadership and Management, Community and Public Health Nursing and Humanities (Kiguli et al., 2011).

It was envisaged that introduction of higher education level in nursing, would create more developmental ideologies in nursing academia especially in the field of nursing, with nurses developing professionally in their career (McCowan, 2017). Unfortunately, many graduate nurses have continually diverted to other medical fields other than nursing. This is evidenced in the intakes made for students in Makerere University College of Health Sciences, where students join Bachelors of Medicine and Surgery in third year after four years of Nursing and Internship (Kiguli-Malwade et al., 2006). Additionally, other nurses have opted to join other professions including business and farming while others have transitioned into management.

However, there is limited evidence on the intentions of graduate nurses to advance their nursing career to be better suited for the various roles and demands of the dynamic nursing profession.

The World Health Organization (WHO, 2015), asserts that human resources are the most important of the health system's resource inputs.

The performance of health care systems ultimately depends on the knowledge, skills and motivation of the people responsible for delivering services.

A study was conducted by (WHO, 2017) which described the correspondents to the median score of SDG tracer indicator attainment (25%). This value has been used for needs-based estimates and it was used to estimate a threshold of minimum requirements for health workforce availability. Globally, the needs-based shortage of health-care workers in 2013 was estimated to be about 17.4 million, of which almost 2.6 million were doctors, over 9 million were nurses and midwives, and the remainder represented all other health worker cadres. This model examined different aspects of human resource requirements and qualities set by local policies and considering education as key.

The available literature is not directly focused on the nurse's intentions to advance their career and hence there is no reliable information to acknowledge what their choices direct them to do. In recent years due to the health advancement and recognition of specialization globally, there is need for focused trends in education where an individual should have a direct path in career advancement and many real world instances where people are liable of compromising their interests (Lent, Brown, & Hackett, 2002).

This study therefore sought

information about what nurses intend to do and what other alternatives they would like to incorporate into the system to favour their interests.

## METHODS

A cross-sectional descriptive study was conducted to obtain data on intentions for post graduate study among bachelors prepared nurses. The study was conducted in 10 health facilities around Kampala, they comprised both public and private facilities.

The sample size was determined by Cochran, 1977 equation to yield a representative sample.

Data was collected using a semi-structured self-administered questionnaire having a likert scale with five choices to choose from, that is Strongly agree, Agree, Undecided/Neutral, Disagree and Strongly disagree of which the value of positivity about the research question ranged from 5 to 1, 5 being the highest level of acceptance and 1 being the lowest.

## RESULTS

### Attitudinal factors and intention to pursue post graduate study

The results indicated that graduate nurses who thought that post graduate study is worthless were 2.4 times less likely to have intentions for post graduate study, depicted by (OR=1.340; 95% CI; 1.04-1.728; P=0.024<0.05)

The study results revealed that graduate nurses with a positive attitude towards post graduate study were five times more likely to have an intention to advance their nursing career (OR =5.549; 95% CI; 2.727-11.20; P=0.001<0.05).

Additionally, graduate nurses who believed that post graduate study brings success were twelve times more likely to have the intention to pursue post graduate study evidenced by OR= 12.588; CI; 5.970-26.543; P=0.001<0.05)

The study results further revealed that graduate nurses with an attitude that post graduate study provides better job opportunities were eleven times more likely to have intention of career advancement. This is highlighted by OR= 11.584; 95% CI; 5.523-24.396; P= 0.001<0.05.

The study further revealed that graduate nurses who had family support for post graduate study were three times more likely to have intentions for post graduate study in nursing as shown by (OR=3.255, 95% CI; 1.605-6.601; P=0.001<0.05).

Furthermore, nurses who wished to pursue post graduate study, were thirty one times more likely to advance in nursing career, (OR=31.618, 95% CI; 13.453-74.308; P=0.001<0.05).

## DISCUSSION

### 5.0 Introduction

The major finding from the study was attitudinal factors that are: post

graduate study is valuable, leads to success and better employment opportunities. Physical factors that were significant included; family support for post graduate study, every nurse wish to advance career and friends influencing post graduate study.

### 5.1 Attitudinal factors influencing early or delayed post graduate study in nursing among bachelors prepared nurses.

The existing literature is in support with post graduate study and it shows the benefits of career advancement in connection to being a mandate in the profession, it's connected to success, many career opportunities among other factors.

#### 5.1.1 There is worth in post graduate study

In nursing professionalization, the "professional self" is one of the most important attitudinal elements. Professional identity is a secret knowledge that shows the continuation of a profession. Professional attitude is a sense of experiences that makes up a professional identity. Professional self-concept is the result of the university system, skills training, and professional development. Finally, we can say professionalization is a framework for identifying a career in a social context, which emphasizes on attitudinal dimension of professionalization showing the importance of attitude within a profession and its professionals (Ghadirian, Salsali, & Cheraghi, 2014).



Nurses globally hold unit/ward managerial positions, for better practice and attachment nurse managers/ward in-charges should be given a special training in the wards of attachment this will make them feel more comfortable and competent to work as managers.

Our study suggests that there is worth in post graduate study, all nurses should embrace the professional worth and stand out to represent the professional image at all levels of practice and every nurse should take pride in the profession, this will escalate many changes in the nursing profession because the image in the society will automatically change.

### **5.1.2 Post graduate study is valuable.**

The study results revealed that majority of the respondents 82.1% saw worth in post graduate study, 92.8% agreed that post graduate study is valuable. This is supported in a study by Rognstad, who talks about initial motives for post graduate study like human contact, helping others, job security was important, and 92% had a wish for further education. Career preferences were often midwifery, public health and nursing practice in high tech areas. Towards the end of the bachelor course, there was more ambiguity in the helping motives. On one hand, the students wanted to be altruistic but on the other hand, they wanted gratitude in return when giving help to patients. 75% of the students had plans for further education within a period of about 2 years after graduation. Midwifery, public health work and high tech

practice were still preferred. Findings from 2003 indicated only 16% had started or finished further education 2<sup>1</sup>/<sub>2</sub> years after graduation (Rognstad & Aasland, 2007).

Similarly, (Cheetham & Chivers, 2005) stressed the importance of continuous professional development, when they stated that few professionals can remain unaffected by the rapid pace of change which has influenced the professions over the past decade especially medical professionals. They added that the concept of continuing professional development is not new, but that it is simply part of good professional practice. What is new, however, is the greater importance and relevance of continuing professional development to professional success. This is consistent with the present study where 93% of the participants saw value in career advancement.

It is suggested in this study that nurses attach value to post graduate study and it is considered as a transitional norm for every nurse, policy makers should influence the system to make post graduate study in nursing more affordable and accessible to those who wish to advance their career, its therefore every nurses role to show the need of achieving the value attached to post graduate study to help nurse representatives lobby for more opportunities.

### **5.1.3 Better employment opportunities after post graduate study**

On the contrary (Vawda & Variawa, 2012) whose study in among South

African nurses revealed that they carry the burden staff shortages, a growing HIV/AIDS pandemic and under-resourced public health facilities which result in stressful working conditions. It is difficult to see beyond these harsh conditions to how attaining a higher nursing qualification will ease the burden of care and attract increased monetary reward.

In the present day nurses believe that even though the working conditions are harsh today and the patient's numbers are overwhelming, with post graduate study there is reduced work load because of specialization which relieves them from multitasking and the fact that majority of nurses want managerial positions, which they believed it lifts some weight off their shoulders from hard work. Fortunately some specialty nursing practice like critical care nursing have been included into the public service scheme and attached a salary scale. Therefore the government should use that as the basis to incorporate more specialties into the public service scheme.

Since professional identity is a secret knowledge that shows the continuation of a profession, specialty nursing has continued to emerge in various disciplines like the famous critical care nursing profession, where nurses are optimally dominant and are taking on the mantle to even train other health care workers like Doctors and Physicians, this shows the asset behind career advancement and specialization, this should awaken the Uganda's health sector to identify

other areas of need for specialty nursing in healthcare provision.

Ugandan policy for career advancement recommends at least two years of experience to advance your career after two years of practice, however advancing is not a mandatory recommendation it always depend on some one's attitude and the value attached to career advancement like being successful, getting better job opportunities and engaging in nursing leadership like at the in-charge/nursing manager level or Principal nursing officers in the health institutions. Despite of the motivation and years of experience limitation, nurses have continuously ignored career advancement and most of them have no opinion if asked about career advancement, which has brought in knowledge decay and loss of value at the places of work because there is no renewal of knowledge and skills.

Therefore the nursing council should look for ways of following up on the CPD progress for nurses and employ supervisory means and if possible attach CPD points to years of experience as a requirement for every nurse who makes those years in practice.

Our study suggests that nurses attach better employment opportunities to life after post graduate study and these acts as a motivation for all nurses, therefore it is to the policy makers to avail the better employment opportunities and also source for nurses in all medical and non-medical employment choices.

## **5.2 Physical factors affecting early or delayed post graduate study among bachelors prepared nurses in Kampala health facilities**

### **5.2.1 Family support for post graduate study**

The study revealed that majority of the respondents 73.3% had family support for post graduate study. This agrees with findings from Blustein that, what was inherent in all the responses is the idea that family influences on career development are multifaceted and should not be simplistically viewed in terms of cause and effect (Blustein, Schultheiss, & Flum, 2004). As in Whiston and Keller who concluded that 'as most of us know from our own lives, family relationships are a complex mosaic of emotional tugs, psychologically subtle balances, and elusive family mores that are difficult to isolate and fully comprehend (Whiston & Keller, 2004), this study discussed various factors that showed that career development can be influenced basing on the social class of the family, age of the person and the tribe or ethnic back ground of a person.

A study done in SA focused on family and community influences in tertiary educational career decision-making with special reference to black South African students' context of historical disadvantage. Family and community variables, such as socio-economic status, culture, parental influence, family composition and support, were investigated. Thematic analysis indicated strong links between family socio-economic status and student

career decisions. Familial support further emerged as an important factor when students make career decisions (Mhlongo & O'Neill, 2013).

Family influence and support in terms of finances, family background of medical personnel, others get family support in aspects of staying with their children while at school for those who have children. However, some are hindered by old age, chronic illnesses, and marriage and cannot leave a young family. In other words family support plays a significant role in regard to intention for post graduate study. In most cases those who advance continuously have either not started a family yet or have other factors like long distance relationships that enables them time to concentrate on studies.

Our study suggests that family support is key to post graduate study and at the same time it can hinder post graduate study outcomes in cases of married nurses most especially the females, so nurses through their professional bodies should show the need for consideration and also second ideas for recommendation. Therefore policy makers should stand out to implement favourable changes that favour post graduate study and family maintenance, for example education institutions should put facilities like on-line learning, reduce contact class days in a week for learners, this can reduce the fear of living the family for studies and the stress of daily travel and class attendance.

### **5.2.2 Every nurse wishes for post graduate study**



The study revealed by 79.5% of respondents that it is every nurse's wish to pursue post graduate study. This is consistent with a study by Rognstad and Aasland with stated that the bachelor programme was regarded as a basis for further education, but preferences related to job values regarding a prospective job reveal a decrease in the importance of human contact and an increase in the importance of a high salary and job security from 2001 to 2003. (Rognstad & Aasland, 2007).

Furthermore Parker & Ohly (2008) revealed that graduate nurses who undertake a program of continuing formal education is self-motivated and eager to satisfy the desire for self-esteem by achieving credentials such as registration of an additional qualification. In this study most of the participants preferred the managerial role when they advance because they believe that with enough knowledge, a unit manager can contribute to maintaining the momentum of motivation through understanding his or her own and the employee's needs, motivators and job satisfiers; being aware of the stressors which make them frustrated and dissatisfied; and seeking out opportunities for achievement of career goals.

Nurses are motivated to specialize or advance their career, for an increase in salary which is connected to being successful, and also to have a fixed role for medical provision, do managerial programs, reduce on clinical workload and to be better placed for advocacy.

Since it's evident that every nurse

would wish to advance career, our study findings suggest that employing institutions and organisations should provide study leave period and scholarships for every worker who wishes to advance career. Policy makers also should help influence the right for study leave for every employee and also teach employees about their rights and jurisdiction.

### 5.2.3 Friends/peers influence post graduate study

In this study 87% of the participants agreed that their friends influence them to advance their career, and this was connected to the success stories that their friends have told them and also the simplicity of working in a health setting with an advanced qualification and also the respect earned considering the health sector hierarchy plus the pressure not to feel inferior to a friend who has achieved a qualification a head of you. So the struggles to remain in the comfort of the social circles, nurses have been influenced by friends to go back to school. This is consistent with a study by Grusec who proposes that socialization involves three specific outcomes: the development of self-regulation of emotion, thinking, and behaviour; the acquisition of a culture's standards, attitudes, and values, including a willingness to accept the authority of others; and the development of role-taking skills, strategies for resolving conflicts, and ways of viewing relationships (Grusec, 2002).

Success stories told by friends, the simplicity of working in a health setting with an advanced

qualification and also the respect earned considering the health sector hierarchy plus the pressure not to feel inferior to a friend who has achieved a qualification a head of you. So the struggle to remain in the comfort of the social circles, nurses have been influenced by friends to go back to school in order not to be out of the friendship circle and also aspirations of being successful like others.

Our findings highlight the need for nurses to form a social platform where views and challenges in nursing are discussed, career guidance discussions from prominent people in the nursing profession who have attained higher qualifications in the profession, this can help to motivate nurses who would wish to advance career. This can be done through annual conferences, international collaboration with other nursing groups at regional and beyond regional levels; this can stimulate faster growth of the nursing sector by exploring opportunities elsewhere.

Other attitudinal factors related to social experiences that came up from the verbal interaction with nurses were brain drain in nursing sector where every nurse who qualifies wants to work from outside Uganda, factors were attributed to poor pay and poor working standards which is contrary to European countries with better standards. This is consistent with a study showing intent to migrate among nurses which reported that 70% of the participants in his study would like to work outside Uganda, and said it was likely that within five years they would be working in the

U.S. 59% or the U.K. 49% (Nguyen et al., 2008). More so there are a few career choices to choose from hence a limited career base which in the end is competitive, the governance gaps and disunity among nurse leaders cause attitudinal bias and hate for the profession.

In addition to that physical factors like lack of scheme of practice, no independence at work that is a nurse always has to work under a doctor and also report to the doctors in case of any decisions made, nurses want to also have an optimum decision where they can work independently and be accountable for their decisions (Dambisya & Matinhure, 2012)

Institutional factors also depended on the institutional experiences that nurses have witnessed during their period of practice in nursing like nurses at the same cadre have different years of training taking an example of extending students from universities like Makerere the nursing course is for four years which is inconsistent with other Universities like Mbarara, Aga Khan where Bachelors of science in nursing course is 3 and 2 years respectively. Furthermore Uganda's system has not recognizes specialization in nursing and general nursing /multitasking is the main stay in Uganda, in that regard post graduate study does not make a lot of meaning to the majority. This is consistent with Pergert et al, who says that lack of prioritization, or even neglect, of protective measures for nurses and others has been evident. We must promote standards,

identify incentives, and provide a solid rationale to institutions and governments to prioritize access to PPE for all those handling hazardous drugs, and, in parallel, advance specialized nursing roles and education to develop proficiency in paediatric oncology nursing care and optimize patient outcomes (Pergert et al., 2020). Still under institutional factor, participants suggested that the Uganda Nurses and Midwives Council members should be voted into service like the Uganda Medical Association. This was because many participants regarded the council as incompetent and not helping them in one way or another, other than collecting money for certificates and updating licensure. If the council is voted maybe policies and some reforms in nursing will be established within the term of service stipulated by the executive committee.

Also work scheme should be designed to help guide nurses at different levels of qualification into better practice for example a certificate nurse, diploma nurse, and a degree nurse all perform the same nursing duties yet have different qualification and levels of knowledge/skills.

Our study findings suggest that nurses should stand out to identify their competencies at different levels of qualification for better work out put, liaise with policy makers to be acknowledged to perform those duties at a certain level of qualification, like the medical clinical officers and medical officers all being under allied health professionals with demarcated

medical roles.

## CONCLUSION

The study findings showed nurses see value in post graduate study that is 93% of the participants, more so nurses engaged in post graduate study because they connect it to success and leads to better job opportunities that are well paying and have favourable remunerations.

The major physical factors in this study that were significant included family support at 73%, every nurses wish to advance at 80%, and friends influence intention for post graduate study at 87%. Among institutional factors the parameters considered were not statistically significant, however the institutions acted as barriers to post graduate study from the verbal responses and percentile cumulative.

The major reasons for which graduate nurses in this study would undertake continuing formal education programmes were peer influence, family support and intention to advance not being pointless.



# NON-INVASIVE MONITORING OF BLOOD GLUCOSE AMONG THE DIABETICS IN UGANDA USING NEAR INFRARED (NIR) SENSOR

*Ssebuliba Reagan Arshavin*



## Abstract

Diabetes is a non-communicable global chronic health condition which occurs among individuals with pancreatic disorders that is failure of the pancreas to produce adequate insulin hormone from the  $\beta$ -cells of Islets of Langerhans as required by the liver to physiologically lower glucose concentration in blood, a condition particularly known as diabetes mellitus. (1) Rare cases of diabetes Insipidus are cited among individuals whose posterior lobe of the pituitary gland is incapable of secreting adequate Anti Diuretic Hormone (ADH) which exerts a significant effect of enhancing water permeability of collecting duct endothelial cells thereby increasing selective reabsorption of water. As a health threat, diabetes displays no vivid cure but controlled treatment through regular blood glucose concentration monitoring by either invasive or noninvasive diagnostic approach. The former diagnostic approach is more often costly, painful, life threatening and inconveniencing since it involves puncturing the skin for blood sample to determine if someone is diabetic or not. (2) It is most commonly cited among low and middle income countries in addition to sub-Saharan Africa forexample Uganda et al. For a non-diabetic, the blood glucose concentration is expected to be around (80-120) mg/dL depending on the time of day and their last time of meal. Individuals with blood glucose concentrations out of the latter range are reported as hypoglycemic and hyperglycemic respectively. This paper reviews the research progress of non-invasive diagnosis of diabetes using Near Infrared (NIR) spectroscopy since glucose has specific absorbance spectrum in the NIR range, 850nm - 2500nm.

**Keywords:** Non-communicable, Insulin, Anti Diuretic Hormone, noninvasive, hypoglycemic, hyperglycemic, Near Infrared.

## Introduction

Over 463 million people have diabetes, roughly 9% of the world's population and around 1.6 million deaths are directly attributed to diabetes according to the latest 2019 data from the International Diabetes Federation (IDF). According to the IDF statistics, every seven seconds someone is estimated to die from diabetes or its complications, with 50% of those deaths (4 million in total per year) occurring under the age of 60 years.

The prevalence is expected to further increase to 9.9% that is more than 700 million victims by the year 2045. Global numbers of diabetes prevalence have continuously risen from 151 million in 2000, when the IDF Diabetes Atlas first was launched, to 285 million in 2009, to 382 million in 2013 and to over 463 million in 2019. (3)

Rates of diabetes have overwhelmingly doubled over the past three decades as more developing countries experience increased urbanization and adopt western lifestyle that is eating habits (2). Disturbingly in this context, over 50% of all individuals with type 2 diabetes-mellitus in developing and middle-income countries are never aware of their hyperglycemic status (undiagnosed), due to the less efficient, costly, inconveniencing and painful invasive handheld diagnostic devices for diabetes. Although these handheld devices are becoming more readily available worldwide, their application is still considered manual and unfit for continuous monitoring of diabetics due to its tedious process, long detection time and large amounts of venous blood extraction. In addition, the invasive tests can be readily affected by several environmental factors such as humidity, temperature et al therefore failure to avail accurate measurements under

overly all conditions. This makes regular/daily monitoring of diabetics' blood glucose concentrations nearly impossible hence appropriate treatment that is adjustments in diet, prescription of appropriate insulin consumption, and other medicines can't be effectively met. In the long run, the African society risks to lose lives of quite a big population leading reduction in the labor force of various economic sectors.

Looking at the sub-Saharan region, Uganda in particular, medical companies and all health facilities have entirely embarked onto only "manufacturing", importing, application and implementation of invasive diagnostic kits for diabetes regardless of their clear-cut weaknesses and limitations in monitoring blood glucose concentration. With my impeccable research therefore, the development and design of an inexpensive, comfortable non-invasive approach will improve on the quality of healthcare among the several diabetics through efficient continuous glucose monitoring (CGM) without inflicting any pain and reduce their exposure to the known risks of diabetes in the country.

Worldwide, the diabetics are deprived of several great life experiences such as yummy dishes and fizzy drinks, high probability of failure to undergo successful surgical procedures like bone grafts, cannot participate in fancy sports activities such as football et al. Overtime, diabetes can also lead to;

- Heart damage through sudden heart attacks and strokes
- Neuropathy (nerve damage) in the feet which increases chances of foot ulcers and eventual amputation of lower limbs
- Diabetic retinopathy which attributes to blindness among several diabetics
- Glycosuria that is glucose

excretion in urine when its concentration in blood reaches a critical level

- Kidney failure et al increasing the risk of dying prematurely among diabetics. (1)

With effective regular monitoring of their blood glucose concentrations using the non-invasive approach, their lives can always be rehabilitated and restored to access full great life experiences as the rest of non-diabetics. Various studies on non-invasive blood glucose measurement have been performed since the early 90s with various methods that is sensing electromagnet, ultrasound technology, infrared spectroscopy, etc. (4), (5). Noninvasive method used for this development is Near Infrared Spectroscopy. This method is chosen since glucose absorbance spectrum in this range is good enough and relatively comparable to water absorbance spectrum. Water absorbance consideration is important since 70% of human tissue content is water. In addition, the provision of tools and sensors such as LED and photodiode at these wavelengths is relatively easy and affordable compared to other methods.

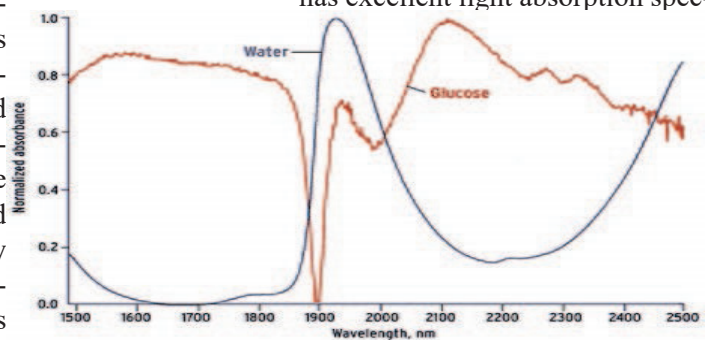
This paper contains draft interface circuit for near infrared sensor. Infrared ray must be able to penetrate the tissue. At the other side, transmitted light is detected by a photodiode. As the measurement sites, earlobe is chosen since it is thin. It has thinner stratum corneum than other body part so that scatter fewer rays. (6). This circuit is then implemented and tested. First test is performed on variations of glucose solution, 50mg/dl – 2g/dl. Second

test is performed directly in earlobe and the result will be correlated using invasive glucose meter.

## THEORY

### A. Glucose NIR absorbance spectrum

Each substance has a unique light absorption spectrum. These properties can be utilized to identify a substance by using light. Glucose has excellent light absorption spec-



trum at Near Infrared (NIR) range. Figure 1 shows normalized absorbance value of glucose and water. For efficient comparison, maximum absorbance values for each must be known.

Fig. 1. Water and Glucose Solution Absorbance spectra  $\lambda = 1500\text{nm} -$

2500nm. (10)

From figure 1, glucose absorbance value is higher than water at a wavelength of 1500nm – 1800nm, especially at 1660nm when water absorbance is zero. The light source for wavelength above 1550nm being relatively expensive, light alternative below 1550nm with good glucose correlation is taken. This paper hence experiments blood glucose level detection using near infrared light, at 1300nm, 1450nm (8), and 1550 nm (9).

### B. NIR Irradiation Effect on hu-



### man Skin.

NIR irradiation on skin tissue is scattered due to human body structure. In order to extract information about substance concentration, light must reach blood vessel in dermis (12). However, some rays will be reflected by outermost skin surface. Some is diffused reflected by substance in the tissue and some is transmitted to the other side. In order to minimize scattering and to make light reach dermis easier, thin tissue is needed. Regarding the requirements, earlobe is the appropriate measurement site for this experiment (6).

In practice, there's two measurement method for light: transmittance and reflectance. Reflectance measures reflected light which is scattered diffusely from skin surface (diffuse reflectance). Transmittance measures scattered light which go through other side of the tissue. Amount of obtained light depend on tissue thickness and contained substance. Referring to the experiments, transmittance is chosen as measurement method (9).

### C. Photodiode and Interface Circuit

Photodiodes detect light by converting light to electric current due to absorption of photons in material's PN junction. Produced current is proportional to the optical power and expressed as responsivity in ampere per watts. Indium Gallium Arsenide (InGaAs) is sensitive and has good responsivity to NIR light ( $\lambda = 800\text{nm} - 1700\text{nm}$ ).

Photodiode current is converted to voltage using transimpedance amplifier (TIA) circuit. Photodiode can be configured photoconductive or photovoltaic, such as in fig.3. in my experiment I opted for photovoltaic configuration due to its capacity to check noise alterations

Photodiode and its connection to the circuit is prone to noise and signal

leakage. The entire system must produce very little noise. Operational amplifier will minimize input bias current so that photodiode current is not disturbed. In order to control noise gain amplifier effect, capacitor is placed parallel with resistor in transimpedance circuit. (Check Figure 3).

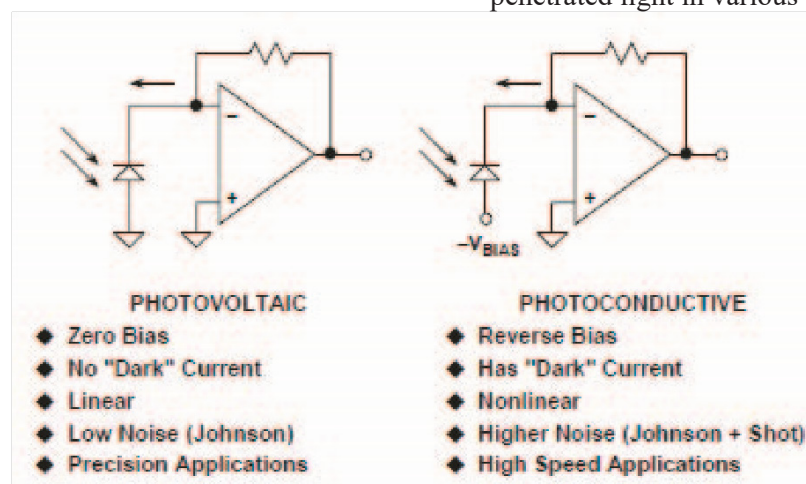


Fig. 3. Transimpedance Circuit (14)

### D. Beer Lambert Law

$$A = \log(I/I_0) = \epsilon \cdot I \cdot C \cdot (l)$$

When a light irradiates a substance, it can be absorbed or transmitted. In glucose solution, there's only two substances to absorb the light: glucose and water. According to Beer Lambert, the one that has higher absorbance in a specific wavelength shall be identified by this simple spectroscopy method. Again, a lot of parameter should be taken when applying spectroscopy method in human tissue such as effective pathway length, pigment, etc.

## METHODOLOGY AND DESIGN

Glucose has specific absorbance spectrum in NIR range,  $850\text{nm} - 2500\text{nm}$ . LED is utilized as incoherent infrared source to irradiate body surface in wavelength  $1550\text{nm}$ . Penetrated light is then detected by InGaAs photodiode, sen-

sitive for wavelength  $850 - 1700\text{nm}$ . As the measurement sites, earlobe is chosen since it is thin. Photodiode's current is converted into voltage using transimpedance amplifier circuit. In order to minimize high frequency noise, low pass filter is applied consecutively. Early testing is conducted by measuring penetrated light in various concentration of glucose solution with wavelength

$1300\text{nm}$ ,  $1450\text{nm}$ , and  $1550\text{nm}$ . Measurement indicates correlation between voltage and glucose concentration. In earlobe testing, light can penetrate tissue with detected voltage,  $300\text{mV} - 4\text{V}$  depend on the wavelength. Linear approximation and two point equation is applied to the data. This two approach extracts formula that can estimate blood glucose concentration with maximum 30% error. By using two point equation, a specific formula for each person can be obtained.

### A. Electronic Component Selection

All the components were obtained from Innovex limited. NIR LED from is used, with  $\lambda = 1300\text{nm}$ ,  $1450\text{nm}$ , and  $1550\text{nm}$ , InGaAs Photodiodes with sensitivity in  $\lambda = 850\text{nm} - 1700\text{nm}$ . Responsivity varies for each wavelength from 0.65 to 0.9 A/W. CA3130 is chosen as operational amplifier due to its specific application as photodiode amplifier and relatively cheap.

### B. Sensor Circuit Design

Transistor is used to enhance and

stabilize LED bias current. When using microcontroller (Arduino UNO) to control the lighting, maximum output current from pins is 40mA (ATmega 256). Optical power needed is around 2.5-3mW which can be obtained by forward-biasing 60mA to LED (see Figure 4).

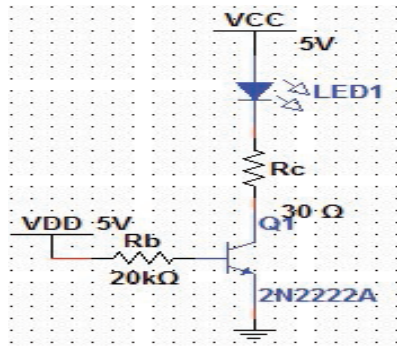


Fig. 4. LED Biasing Circuit using Transistor 2N2222A

Photodiode is interfaced using transimpedance amplifier with photovoltaic configuration as seen before. Feedback resistance,  $R_5$ , is designed as big as possible to compensate small photodiode current. Feedback capacitor, 100 pF, is chosen to minimize noise gain but keeps responsiveness. TIA circuit is followed by RC passive filter to reduce high frequency noise. As anticipation from small voltage output from TIA, noninverting amplifier is added with  $2 V_o/V_i$  amplification (see Figure 5).

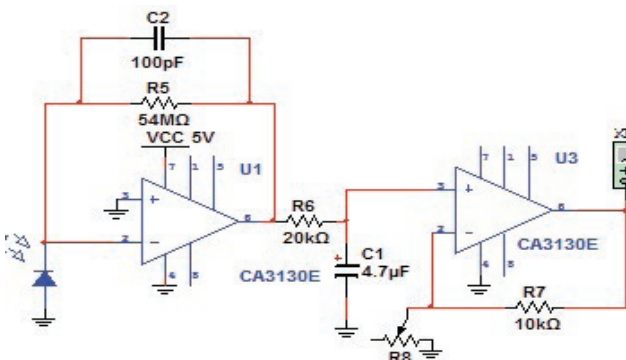


Fig. 5. Photodiode Circuit Design

### C. The design of sensor casing prototype

In the prototype, LED and photodiode are mounted on either side of the casing so that the measurement site, earlobe can be placed in between the components. Casing needs to cover the photodiode from unwanted light to minimize alterations in the output and increase reproducibility, stability and accuracy. According to bioinstrumentation fundamentals, aspects of safety, comfort, and ease of use should be considered which affect the clamp shapes. Clamp's pressure should be maintained so that the blood can flow normally. Four holes is created as places for two LED and two photodiodes.

### D. Sensor testing on Glucose solution and Earlobe

Sensor sensitivity is tested on various concentration of glucose solution. Glucose solution, 50 mg/dl – 2 g/dl, is made from dextrose powder ( $C_6H_{12}O_6 \cdot nH_2O$ ) that is naturally calorie dense by dissolving it in distilled water. Solution is poured in test tube. Test tube is irradiated by NIR light in a simple designed box. LED and photodiode is mounted in the side of the box, facing each other. Photodiode will detect the transmitted light from the tube. Experiment is conducted with three wavelengths:  $\lambda = 1300nm, 1450nm, 1550nm$ .

Sensor is also tested in earlobe by clamping it to the earlobe. Photodiode voltage is measured as indicator whether the light transmitted through the earlobe.

### E. Correlation between Voltage and Glucose Concentration

Photodiode voltage is proportional to near infrared light transmittance. It is then correlated with blood glucose concentration. Correlation is

intended to find blood glucose concentration as a function of photodiode voltage. Two experiments are conducted to get data of blood glucose versus photodiode voltage. At first experiments, ten volunteers, 5 men and 5 women, are involved with variety of age 20-22 years. Earlobe voltage and blood glucose concentration are randomly measured without any precondition. Photodiode voltage is measured three times for every volunteer.

At second experiment, we examine glucose concentration for one person to remove various factors which influence blood glucose concentration, such as skin color, gender, tissue thickness, earlobe size, etc. Volunteer is asked to fast to get their minimum glucose concentration. After that we also keep tracking blood glucose concentration for 15', 30', 60' and 120' after break fasting. This procedure is repeated on the next day. Photodiode voltage in earlobe and blood glucose measurement are measured. A distinct equation is obtained using this experiment.

Two approach is used to get blood glucose concentration formula from these data. First data is correlated linearly and linear blood glucose concentration function of photodiode voltage is obtained. Linear approach is applied based on beer lambert law (1). Light transmittance is calculated using logarithmic function. Meanwhile, for variation of human blood glucose concentration, short variation of photodiode voltage will be obtained. Because of little variation of transmittance ( $I/I_0$ ), we can approximate logarithmic function as linear

This approach is also applied for second data. Another approach is applied using two-point equation. Still based on linear approximation of beer lambert equation, equation is formulated using two point from



two condition: fasting and 15' after break fasting. This points is substituted into (2).

$$(Y-y1)/(y2-y1) = (x-x1)/(x2-x1) \quad (2)$$

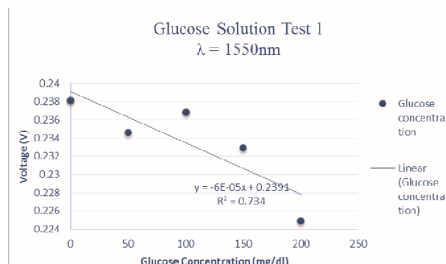
After getting the equation, the approximation blood glucose concentration is calculated. The difference between actual and approximate blood glucose concentration can lead to sensor accuracy.

## TESTING

### A. Sensor testing on Glucose solution

Sensor is tested by a various concentrations of glucose solution. Figure 7 – 9 show graphic of glucose concentration versus photodiode voltage for  $\lambda = 1300$  nm, 1450 nm, and 1550 respectively

Fig. 7. Glucose concentration and the voltage at  $\lambda = 1550$ nm



From figure 7, it can be concluded generally that there is an inversely proportional relation from photodiode voltage and glucose concentration. By analyzing this result, we can get glucose sensitivity for the sensor. For each 50 mg/dl increasing of glucose concentration, there is a 3 mV decrease in photodiode voltage. This is pretty good if we directly compared with blood glucose measurement range. For normal people, it will be around 50 – 250 mg/dl. The latter wavelength enables measurements in the millivolts range.

From figure 8 and figure 9 it can be concluded that there is a positive correlation between photodiode voltage and glucose concentration. Results for  $\lambda = 1450$ nm is similar to tests in (13) which shows an increasing concentration leads to increasing photodiode voltage. Results for  $\lambda = 1300$ nm show that concentrated glucose solutions transmit more light than pure water. Variation of glucose solution used is different from previous test because short variation (0 – 200mg/dl) can't be detected well so that greater concentration (0 – 14g/dl) is used.

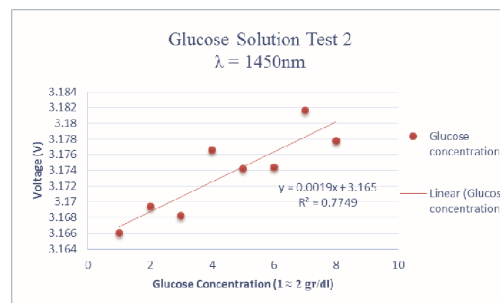
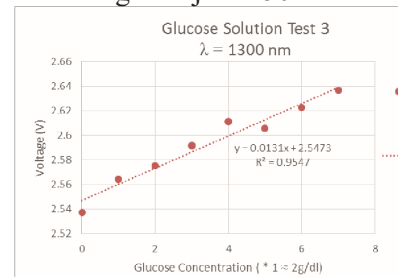


Fig. 8. Glucose concentration and the voltage at  $\lambda = 1450$ nm



On further analysis, you notice that for both wavelength, every increase in glucose concentration results in a voltage increase. It means more NIR light is detected and consequently less is absorbed by the glucose solution and according to Beer Lambert, for increasing glucose concentration in solution, water is never detected since its fraction is reduced by the latter. Therefore, its only glucose detection that occurs. This trend shows for this two wavelength the main absorbent is water instead of glucose. The sensitivity over glucose concentration is 700mg/dl

for 1 mV (1450nm) increasing and 300mg/dl for 1 mV (1300nm).

### B. Sensor testing on measurement site (ear lobe)

Table I shows the sensor test result in earlobe. This result is very promising since the light successfully penetrates the earlobe. Detected voltage is in hundreds mV for 1550nm and around 3V for 1300nm and 1450nm.

TABLE I. PHOTODIODE VOLTAGE ON EARLOBE

Wavelength (nm)	Fasting (V)	Break Fasting (V)
1300	3.014	2.961
1450	2.809	2.818
1550	0.676	0.510
Blood Glucose Concentration (mg/dl)	106	166

This value varies when the sensor position on the earlobe moved. The movement of the lobe affects the stability of the voltage produced. Since the test results from glucose solution and earlobes showing 1550nm as the best wavelength for detecting glucose, 1550nm is chosen for the correlation test. A successful work, (9), supports this wavelength usage.

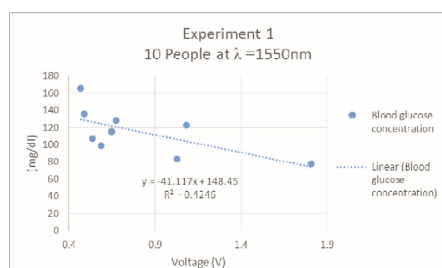
### C. Correlation

Data from first experiment is shown by figure 10. By doing linear approximation towards the data, a blood glucose concentration formula is obtained. Reverse proportional relation of glucose concentration and voltage is shown. When using this formula to approximate the blood glucose concentration, 15% error is visited. Applying this formula to other case will result 25 – 30% error. However, this approach is not valid enough since there are a lot of variable not counted. Every person has

different parameter that will affect infrared radiation through the skin tissue such as pigment, the effective path length, the body temperature, and skin structure. This experiment just tries to generalize all relevant factors affecting IR radiation, but in order to do that we have to collect more samples and adding another sensor to the device. It is also possible if another technique of correlation becomes more equivalent.

Fig. 10. First Experiment, Linear Correlation Method at  $\lambda = 1550\text{nm}$

Since only one parameter is measured, another experiment is conducted by looking for a specific formula for one person. Procedure of this experiment has been explained previously. Five data is obtained from each day. Two approaches are used to get blood glucose concentration formula: linear correlation and two-point equation. By doing linear approximation, a formula (3) is obtained. This formula is checked using the same data to approximate



blood glucose concentration. 30% error still can be found.

$$y = -211.36x + 263.34 \quad (3)$$

Two-point equation is obtained by inserting two points, the lowest and the highest by fasting and break fasting, as mentioned in table I. This formula is created by assuming linear relationship between blood glucose concentration and light

detected. Another parameter which affect blood glucose concentration calculation is assumed as static parameter. By using this equation, we can approximate glucose concentration with 28% error.

$$y = -348.35x + 343.52 \quad (4)$$

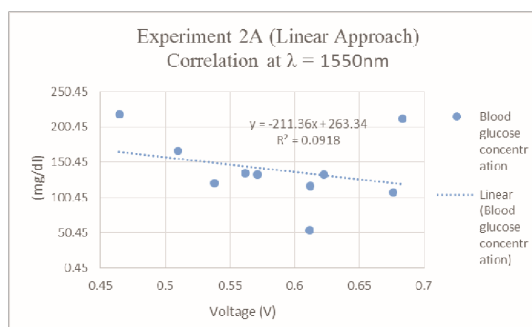


Fig. 11. Second Experiment, Linear Correlation Method at  $\lambda = 1550\text{nm}$ .

### Future prospects

Inconsistency in different parts of a given measurement site must be looked at and catered for in future

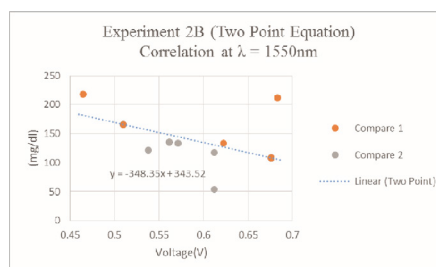


Fig. 12. Second Experiment, Two Points Equation Method at  $\lambda = 1550\text{nm}$

Sensor's position has influence in amount of penetrated light. Different position produce different result. There might be different component structure in every part of the earlobe. Because of that, consistency of measurement sites should be designed in future works.

prototyping works. This is because movement of the NIR sensor along a measurement site alters the output voltage values from the TIA circuit

## Conclusion

NIR spectroscopy has potential as a window to look at the concentration of blood sugar in vitro. Three wavelengths tested show an impeccable detection of glucose

concentration by using NIR light. All of them also can penetrate earlobe by current design. Light at 1550nm showing the best glucose detection so that this design can be used for data collection and correlation of blood glucose concentration. However, it is very difficult to extract linear correlation since we only use one parameter and ignore others which may have influence in determining blood glucose concentration. Equation obtained by linear approximation and two-point method can estimate blood glucose concentration. This estimation still has error about 30%.

### References

- (1)-<https://www.who.int/news-room/fact-sheets/detail/diabetes>
- (2)-Non-Invasive Diabetes Diagnosis and Monitoring (azom.com)
- (3)-<https://www.escardio.org/Education/Diabetes-and-CVD/Recommended-Reading/global-statistics-on-diabetes>
- (4)- K.-S. C. T. K. W. J. W. C. Chi-Fuk So, Recent advances in noninvasive glucose monitoring, Dove Press Journal, 2012.
- (5)- J. L. Smith, The Pursuit of Non-invasive Glucose: "Hunting the Deceitful Turkey", Third Edition: Revised and Expanded, 2013.
- (6)- D. Z. X. M. Z. M. K. X. Jingying Jiang, "Investigation on how to choose measurement sites for non-invasive near-infrared blood glucose sensing," in Dynamics and Fluctuations in Biomedical Photonics IX, Tianjin, 2012.
- (7)- Y. J. a. J. Hwang, Near-infrared studies of glucose and sucrose in aqueous solutions: water displacement effect and red shift in



water absorption from water-solute interaction, *Optical Society of America*, 2013.

(8) D. Sia, "Glucose Concentration Measurements," *Department of Electrical and Computer Engineering McMaster University, Hamilton, Ontario, Canada*, 2010.

(9)- A. K. Masab AhmadAwais Kamboh, "EDN Network," 16 Oktober 2013. [Online]. Available: [5] <http://edn.com/design/medical/4422840/Non-invasive-blood-glucose-monitoring-using-near-infraredspectroscopy>. [Accessed 8 Oktober 2014].

(10)- M. J. T. Janet A. Tamada, "spectrum.ieee.org," 01 April 2012. [Online]. Available:

<http://spectrum.ieee.org/biomedical/devices/keepingwatch-on-glucose>. [Accessed 02 December 2014].

(11)- P. D. I. Beckers, "andor.com," [Online]. Available: <http://www.andor.com/learning-academy/spectralresponse-of-glucose-spectral-response-within-opticalwindow-of-tissue>. [Accessed 18 Mei 2015].

(12)- e. a. Kenji Iino, "Monte Carlo Silmulation of Near Reflectance Spectroscopy in the Wavelength Range from 1000 nml to 1900 nm," *OPTICAL REVIEW*, Vols. 10, No. 6, pp. 600-606, 2003.

(13 )- P. Rako, "Photodiode Amplifiers," *National Semiconductor*, 2004.

(14)- W. Jung, *Op Amp Applications Handbook*, Burlington: Elsevier, 2005.



# PROMOTING KNOWLEGDE AND PREVENTION PRACTICES REGARDING URINARY TRACT INFECTION(UTI) AMONG SECONDARY SCHOOL GIRLS IN CENTRAL PARISH, NTUNGAMO MUNICIPALITY.

## Authors:

1. Agwang Elizabeth

---

2. Kimbugwe Moses

---

3. Musosa Nancy Joy

---

4. Nankinga Brenda

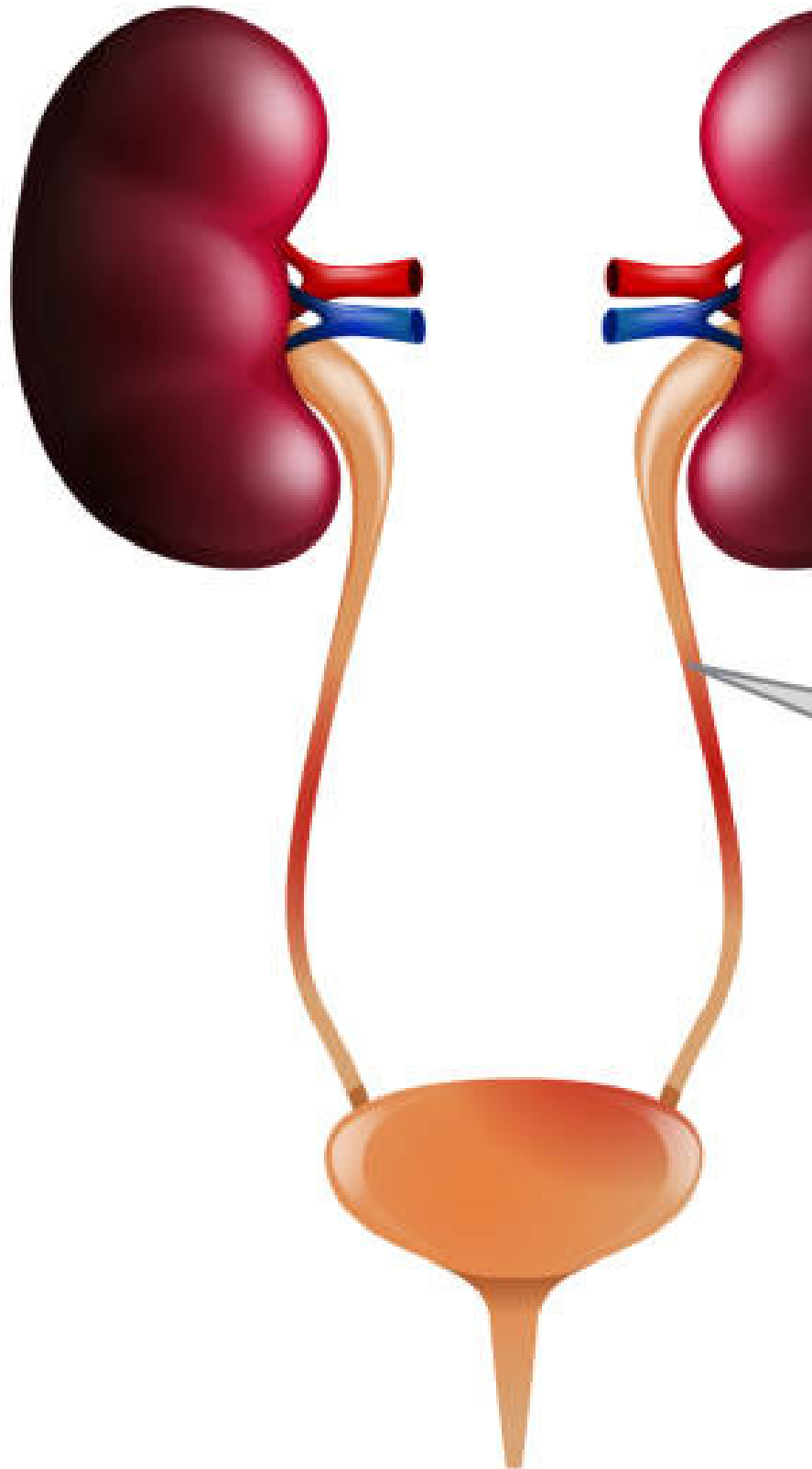
---

5.Noah Ramadhan

---

6. Senono Kizito Allan

---



**Site tutor:** Ms. Ankunda Afia

**Site supervisor:** Dr. Onyango Tadeo Jude



## ABSTRACT

**Introduction:** UTI are inflammatory disorders of the urinary tract caused by infiltration and abnormal growth of pathogens mostly *E. coli*. They present with fever, dysuria and lower abdominal pain. They can be asymptomatic, acute, subacute, chronic, complicated or uncomplicated. They are a major cause of morbidity, they can reduce the quality of life and if left untreated can lead to serious life threatening complications. They are more prevalent in females than males which is attributed to the short urethra in females and the close proximity of the urethral meatus to the vagina and anal opening. Adolescents and young females are significantly at risk of UTI with some of the risk factors among the population being poor menstrual hygiene, poor personal hygiene and sexual activity. In Uganda they account for 2.2% of the OPD attendances, putting them as the third leading cause of ill health for all ages. From our community diagnosis, UTI had a point prevalence of 14% and were the second leading cause for OPD attendance at Ntungamo Health Centre IV. Therefore, a good health education program on UTI is important to convey accurate information to the society

**Objective:** The project was intended to promote knowledge and prevention practices with regards to UTI among secondary school girls in Central Parish, Ntungamo Municipality

**Methods:** An interventional pre- and post- test study was carried out in two secondary schools selected by convenience sampling in Central parish Ntungamo Municipality. 146 Female students of age 15-24 years were enrolled for the project. A structured health education was

delivered under the themes of definition, signs and symptoms, risk factors and prevention practices with particular emphasis put on personal hygiene, Menstrual hygiene and voiding habits. Data was collected through administration of pre- and post-test questionnaires and from responses obtained during the discussion. A student's t-test was used to compare the pre- and post- intervention level of knowledge

**Results:** Out of the 146 respondents, 103(70.55%) reported to have prior knowledge about UTI and 59(40.41%) reported to have had an episode of a UTI in the previous one year. From the pretest assessment respondents had moderate knowledge about UTI with a mean score of 42.93%. Factors that increase the risk of the population to UTI were identified which included inadequate water intake (79%), poor menstrual hygiene (48.83%), poor voiding habits (48.28%), and inadequate personal hygiene. From the post-test assessment most of the respondents demonstrated high levels of knowledge with a mean score of 76.89%, and an average learning gain of 57.26%. Further comparison of the pre-and post-test scores with a paired t- test showed statistically significant improvement of knowledge ( $t_{(145)} = 15.35251, p < 0.001$ )

**Conclusion:** The project achieved prompt result in improving the knowledge of the participants through structured health education and promotion

## Recommendations

- A more detailed study should be carried out to assess for hygiene practices and measure behavioral change after the intervention
- Regular health education programs should be implemented

## 1.0 INTRODUCTION

### 1.1 Background

Micturition (also called urination) is a process by which urine is expelled from the bladder, hence emptying the urinary bladder through the urethra to the outside of the body (K. Sembulingam, 2012). The urinary tract is formed from the kidneys, ureters, the urinary bladder and also the urethra. The urinary framework of healthy people is meant to keep the urine from backing up to the ureters and thereafter the kidneys from the urinary bladder and therefore the stream of the urine from the bladder normally keeps washing away any microorganisms (Van Meter KC, 2010). However, factors like poor hygiene (Gondim R, 2018), poor voiding habits or sexual intercourse would cause the organisms to travel up the urethra and will likewise contaminate the urinary bladder (Engelkirk Paul G., 2011)

Urinary tract infection (UTI) are the inflammatory disorders of the urinary tract caused by the microbial infiltration of the otherwise sterile tract, with the most common causative organisms being *Escherichia coli*, *Staphylococcus aureus*, *Klebsiella pneumonia* among others (Odoki, et al., 2019). UTI may be asymptomatic, acute, chronic and complicated or uncomplicated, and the clinical manifestation of UTIs depend on the portion of the urinary tract involved, the etiological organisms, the severity of the infection and the patient's ability to mount an immune response to it (Odoki, et al., 2019). UTI is known to cause

short-term morbidity with relatively vague signs and symptoms such fever, pain on urination, frequency, urgency, lower abdominal pain, lower backache among others (Neni Wildiasomoro Selamat, 2020). If left untreated, UTI are capable of resulting in serious complications like permanent kidney damage due to acute or chronic pyelonephritis, in pregnant women, increased risk of delivering low birth weight or premature babies, Urethral narrowing in men, sepsis among others (Mayo Clinic, 2020)

A study by (Walter E. Stamm, 2001) revealed that approximately 150 million people suffer from UTIs each year, globally which results in greater than 6 billion dollars ( $\approx$  22.4 trillion Uganda shillings) in direct health care. In Uganda UTIs were found to have a prevalence of 54/139 (38.8%), and age, female gender, and married individuals had statistical significant relations with the disease among adults attending the assessment center, Mulago Hospital (Kabugo, Kizito, Ashok, & et al, 2015). However, a study in Bushenyi district of Uganda by (Odoki, et al., 2019), reported a comparatively lower prevalence of 67/300 (22.33%) among patients attending Hospitals in Bushenyi District. UTI is therefore a common disease affecting all populations from new born to adulthood. Despite occurring in any respect ages, the prevalence is significantly high in females especially in their adolescence stage. Up to 60% of ladies have a minimum of one symptomatic UTI during their lifetime. A short urethra in women is mostly responsible for the high incidence of UTI among them (Stammer W

E, 1999). The prevalence of UTIs in men is significantly lower than in women occurring primarily in men with urological structural abnormalities and in older adult men (Helen S. Lee, 2018).

From our community diagnosis done from 15<sup>th</sup> June – 13<sup>th</sup> July 2019, UTIs were the second most commonly diagnosed condition at Ntungamo Health Centre IV with a point prevalence of 14%. To date there is no detailed data from Ntungamo that outlines the interventions put in place to address the issue. Therefore, this project is intended to assess knowledge, perceptions and practices regarding UTIs as well as promoting prevention practices among secondary school girls in Central Parish, Ntungamo Municipality.

### 1.2 Problem statement

To ensure healthy lives and promote well-being for all at all ages is the third SDG in the United Nations' 2030 Agenda for sustainable development. Most of the global disease burden remains preventable through vaccination, lifestyle changes, screening programs among others.

Over 75% of Uganda's disease burden is considered preventable as it is caused by poor hygiene. (Ministry of Health, Government of Uganda). Despite this knowledge, poor sanitation and hygiene are at unacceptable levels. Up to 65% Of Ugandans are not practicing improved hygiene behavior which further predisposes them to diseases like UTI.



According to (Ministry of Health, 2019) Urinary Tract Infections are the third leading cause of illness for all ages in Uganda accounting for 2.2% of all OPD attendances. However, from our community diagnosis made from 15<sup>th</sup> June – 13<sup>th</sup> July 2019, UTI was the second leading cause of ill health accounting for 14% of OPD attendances at Ntungamo Health Centre IV and more than 50% of the patients reported a history of being treated for UTI (Community diagnosis, 2019). This finding was indicative of a potential knowledge gap about the modifiable risk factors that predispose these patients to UTI.

This project is designed to address the knowledge gap and poor hygiene practices through conveying accurate information in form of health education and demonstration of good personal and menstrual hygiene practices to secondary school girls within selected schools in Ntungamo Municipality.

### 1.3 Justification

Although not thought to cause significant mortality, UTIs pose a serious threat to public health care, hence reducing the quality of life, resulting into school and work absenteeism, increasing costs of care among other things. (Odoki, et al., 2019). If left untreated or undertreated, UTIs have serious life threatening complications such as pyelonephritis leading to renal scarring, sepsis among other things

From our Community diagnosis done from 15<sup>th</sup> June – 13<sup>th</sup> July 2019, UTI was the second leading cause of ill health accounting for 14% of OPD attendances

at Ntungamo Health Centre IV with more than 50% of the patients presenting with signs and symptoms of UTI self-reporting to have been treated for the same.

UTIs also rank as the number one infection that leads to an antibiotic prescription after a physician's visit (Abbo & Hooton, 2014). However, with the increasing prevalence in drug resistant bacteria in adults with CA-UTIs (Kabugo, Kizito, Ashok, & et al, 2015), it is not enough managing CA-UTI with antibiotics without revising hygiene practices that modify its pathogenesis.

This Health promotion and disease prevention project is meant to deliver accurate health information on easy yet vital prevention practices that will inform behavioral changes among the people. Behavioral modifications are generally easy, low risk and low-cost maneuvers and yet significantly effective in disease prevention (Mona M. Sedrack, 2010)

The intervention will therefore reduce the incidence of the UTIs and hence improve the quality of life of girls and women, reduce school and work absenteeism due to acute illnesses like UTI and the lower costs of medical care. The intervention will also contribute a step in antimicrobial stewardship, as less medicines will be prescribed in the reduced cases and preventative measures emphasized. The increase in Knowledge about UTIs will also enhance the people's response to the illness and there by improve their health seeking behavior.

Young, sexually active women 18 – 24 years of age have the highest incidence of UTIs (Sobel & Kaye, 2014) with sexual activity standing out as one of the significant risk factors for UTIs. In Uganda, the median age for sexual debut is 16.7 years for women (Macro, July 2002). The project targeted girls and women whose ages range from 15–24 years, in this case standing out as the population at highest risk.

## 2.0 OBJECTIVES

### 2.0.1 General Objective

1. To promote knowledge and prevention practices of UTIs among secondary school girls in Central Parish, Ntungamo Municipality.

### 2.0.2 Specific Objectives

1. To increase awareness and knowledge about UTIs among Secondary school girls in Central Parish, Ntungamo Municipality.
2. To demonstrate good personal hygiene practices vital in the prevention of UTI to secondary school girls in Central Parish, Ntungamo Municipality.
3. To influence Secondary school girls' perception of UTI positively, in Central Parish, Ntungamo Municipality.

## 2.1 METHODS

### 2.1.1 Project design

An Interventional pre-post study

design involving both quantitative and qualitative methods was used. We carried out a pre-intervention assessment to gain baseline data about the study participants. The intervention was carried out through health talks, discussion with the participants, demonstrations, a question/answer session and a short quiz. A post interventional assessment was carried out with in the same group to evaluate the impact of the intervention.

### 2.1.2 Project Area

The project was conducted in two secondary schools i.e. St. Charles Secondary School and Ntungamo High school in Central Parish, Ntungamo sub county, Ntungamo Municipality, Ntungamo district.

The schools were randomly picked by convenience sampling.

### 2.1.3 Target Population

Our target population was all girls in the candidate classes (i.e.

Senior 4 and Senior 6) in the selected secondary schools in Central parish. The total number of female students (in candidate classes) in the schools was 211 girls according to the schools' registers provided by the school administrators (i.e. 43 in St. Charles Secondary School, 168 in Ntungamo high school)

Out of the 211 girls in the two schools the group managed to collect data and implement the project with 146 girls, representing 69% of the total number of female students

#### Inclusion Criteria

All secondary school girls with a sound mind and within the age range 15-24yrs were included in the study as long as they consented to take part.

#### Exclusion Criteria

All secondary school girls ab-

sent at the time of implementing the project due to other school activities taking place concurrently were not considered.

All those who did not consent to the study were not included in the study results.

### 2.1.4 Project Duration

19<sup>th</sup> October to 13<sup>th</sup> November 2020

### 2.1.5 Materials

Flip charts, Face masks, plain manila paper, markers and sell tape

### 2.1.6 Project tools

Health education talks and demonstrations

- Questionnaires

Standardized Knowledge, Attitudes and Practice (KAP) survey multiple choice questionnaires were adopted from (World Health Organisation, 2008) and modified for the study. The questionnaires were prepared in simple English and reviewed with enumerators during training for purposes of increasing measurement accuracy and for field work purpose. Pre and Post-test questionnaires were given tracking numbers to ensure that the same respondent answered the questionnaires bearing the same number in order to accurately measure the learning gain. • Teaching Aids

We designed the IEC material in simple language and with illustrations to make easy the teaching and understanding of the information delivered.

### 2.1.7 Project activities

Community entry; Introduction of the group to the local authorities like the LC1 chairperson and administration of Ntungamo Health Centre IV.

We briefed the site tutor about the project to be implemented and obtained information about potential sites, that is schools in which the project could be implemented.

Initiation visits to the project sites were carried out, to seek permission to carry out the project from the administrators of the secondary schools and to also ensure safety and readiness of the sites for the project.

A group meeting among the COBERS team members was made to plan for the activities of the project and design the necessary IEC materials and teaching aids for carrying out the project.

Activities in the target population were carried out in 3 sessions, all taking a total of 3hrs, on the same day;

- **Session 1:** - Introductions and Pre-intervention assessment of the students' awareness, knowledge and perception about UTIs as well as their personal hygiene practices that are important in the prevention of UTIs. Self-administered pre-test Questionnaires with multiple choice questions were used. The questionnaire had 4 sections that is,

Demographic characteristics, Knowledge, Perceptions and Practices. Respondents were required to tick the correct responses or as saw fit the question. This process took place for 10 minutes

- **Session 2:** - Structured health education on UTIs carried out by the project implementers with the par-



ticipation of the students. An activated Heath education model was employed which is based on principles of; i) active involvement of participants in intervention process, ii) awareness of the positive and negative influences of behavior to health and iii) personal responsibility for managing health behavior. The information delivered was under 4 themes that is, *Definition, Signs and symptoms, Risk factors and prevention practices* with regards to UTI. Information delivered was through selfdesigned teaching aids, with illustrations to enhance learning. The teaching aids were designed after extensive literature review about UTI from related publications, WHO and CDC articles. The Risk factors and prevention practices were organized with focus on personal hygiene practices, Menstrual hygiene practices and sex education. Demonstration of different personal hygiene practices was done with the active participation of the students. The students who demonstrated high knowledge and good personal hygiene practices with regards to prevention of UTI were awarded with Face masks embroidered with a Makerere University Logo.

The session was followed by a short Question and Answer session to address the myths about different behavioral practices, UTI and other health concerns.

- **Session 3:** - Assessment of the students' knowledge

after the intervention using the selfadministered Post-Test Questionnaire. The questionnaires contained two sections that is, one assessing knowledge and the other perceptions about UTI. Careful attention was taken to track the change in knowledge per individual student by using tracking numbers, so that a one student fills both the pre- and post-test questionnaires with the same tracking number.

The intervention in the two schools was done over two weekends 1 week apart. This was to enable ample time to reevaluate delivery methods, improve on the health education and delivery strategies to enable maximum gain by the participants from the intervention.

All group members carried out these Health Education activities with the assistance of the school Nurses and the senior-woman teacher in the schools

During the education sessions, volunteers from the audience were asked questions about UTI and the reasons why they adopted different personal hygiene and menstrual hygiene practices. This information was recorded as part of the qualitative data.

Other activities carried out include patient care and management at the Health Facility and screening for risk factors and health education to patients who presented with signs and symptoms suggestive of a UTI at the Health Facility

### 2.1.8 Evaluation of the

Evaluating the success of our project was through the achievement of the following; Impacts and Outcomes

- Increased awareness about UTI among the secondary school girls
- Increased knowledge about UTI, risk factors and prevention practices, demonstrating a learning gain of at least 50%
- Increased practice of proper hygiene vital in the prevention of UTI and other diseases Processes
- Cooperation from the students to turn up in big numbers for the health education and promotion exercise.
- Cooperation from the school administrators and staff to ensure maximum mobilization and attendance of the students for the exercise
- Maximum participation of all team members on schedule and by their roles
- Accomplishment of all proposed tasks successfully.

### 2.1.8 Data Collection Procedures

We administered Pre-intervention questionnaire to obtain baseline data. The questionnaires were made up of 3 sections to capture;

- i) The demographic characteristics of the participants
- ii) The knowledge of the participants regarding the signs and symptoms, risk factors and preven-

- tion practices with regards to UTI
- iii) The participant's perception about UTI

We administered Post-intervention questions to obtain data after the intervention. Tracking numbers were used to make sure a participant answered the questionnaires (pre- and post-) with the same tracking number in order to accurately determine the change in knowledge after the intervention.

We allowed open discussion with the participants during which we expected them to express their thoughts about different hygiene practices and misconceptions about UTI.

### 2.1.9 Data Management

The Data from the questionnaires was coded by tallying and direct counting, entered into a Microsoft Access Database file. The data was then exported and analyzed using Microsoft Excel. Descriptive data was summarized and organized in tables, pie charts and bar graphs. A student's t test was used to compare the results from the Pre- and post- intervention assessment. Qualitative data was transcribed and analyzed thematically.

### 2.1.10 Ethical consideration

Community entry was observed by introducing ourselves, seeking support and permission from the Local Government administration i.e.; Chief Administrative Officer (CAO), District Health Officer (who doubles as the head of the district COVID19 Task Force) and Local Council(LC) 1 chairpersons to allow us perform our project activities within the municipality and particular villages.

We also sought permission

from the Head teachers of St. Charles Secondary school and Ntungamo High school to allow us perform our activities in their particular schools. We sought verbal and written consent from the students, explained to them the purpose of the project, benefits and reassured them of their safety and confidentiality of our shared interaction

## 3.0 FINDINGS

The study was done over a period of 4 weeks from 19<sup>th</sup> October to 14 November 2020.

### 3.1 Section I. Demographic Characteristics

We implemented our project in two schools and reached a total population of 146 girls. Ma-

jority of the girls were between 18 to 20 years accounting for approximately 59%(n=83) of the population with the average age for the population being 18.02years.

98.73% (n=144) of the respondents were Christians with the majority (n=83, 53.85%) belonging to the Anglican religion. In contrast, only 2 respondents (1.37%) were Muslims.

Majority of the participants (n=124, 86.71%) were Banyankore by tribe and only 13.29%(n=19) of the respondents belonged to other tribes.

Figure 1: Distribution of the respondents by religion

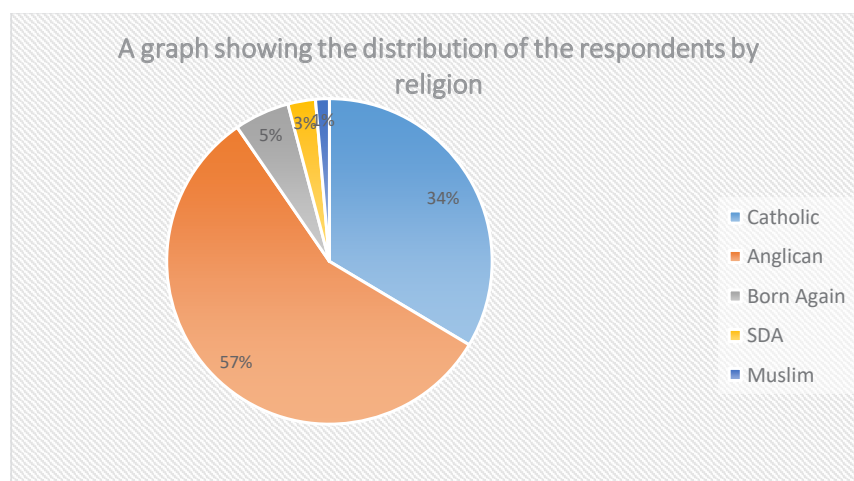
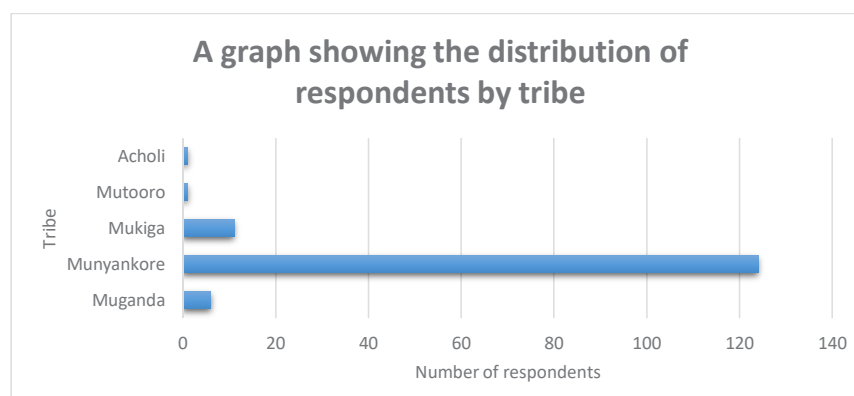


Figure 2: The distribution of the respondents by tribe.





**Table 1:** The demographic characteristics of the participants.

Variables	Categories	Frequency	Percentage (%)
Age	15-17yrs	50	35.71
	18-20yrs	83	59.30
	21-23yrs	7	5.00
Tribe	Muganda	6	4.20
	Munyankore	124	86.71
	Mukiga	11	7.69
	Mutooro	1	0.70
	Acholi	1	0.70
Religion	Catholic	49	33.56
	Anglican	83	53.85
	Born Again	8	5.78
	SDA	4	2.74
	Muslim	2	1.37
Type of Family	Nuclear	114	82.01
	Extended	25	17.99
Class	S.4	94	67.14
	S.6	46	32.86
Section of school	Boarding Section	146	100
	Day Section	0	0.00

### 3.2 Section II. Assessment of results

In the study, a pre- and post- test questionnaire were administered as a track on the level of knowledge of the respondents before the intervention and to approximate the learning gain after the intervention.

In the study, 70.55%(n=103) of the respondents reported to have prior knowledge about UTI and about 40% of the respondents reported having had a previous episode of UTI in the previous one year.

**Table 2:** Frequency and percentage distribution of previous knowledge regarding UTI, previous episode of UTI

Variable	Frequency(f)	Percentage(%)
<b>Previous Episode of UTI</b>		
YES	59	40.41
NO	87	59.59
<b>Previous knowledge regarding UTI</b>		
YES	103	70.55
NO	43	29.45

The knowledge level was assessed using a section in the questionnaire containing multiple choice questions about the signs and symptoms of a UTI, practices that increase risk to getting a UTI and proper prevention practices for UTI. This was assessed before and after the intervention. The score was computed into a percentage using the formula

$$\text{Knowledge score} = \frac{\text{total respondent's score}}{\text{total maximum score}} \times 100\%$$

The scores were further classified as follows;

- 0-40%: Low level of knowledge
- 41-69%: Intermediate/moderate knowledge
- 70-100%: High/Good level of knowledge

**Table 3:** Level of knowledge regarding UTI before and after intervention.

Level of knowledge	PRE-TEST		POST-TEST	
	Frequency(f)	Percentage(%)	Frequency(f)	Percentage(%)
Low level of knowledge(0-40%)	61	41.78	20	13.70
Intermediate level of knowledge (41-69%)	70	47.95	16	10.96
High level of knowledge (70-100%)	15	10.27	110	75.34

Prior to the intervention 70 of the respondents had intermediate level of knowledge accounting for approximately 48% of the group, with the average score of the entire group being 42.93% in the pre-test questionnaires.

In the pre-test questionnaires, most of the respondents (n= 94, 64.38%) answered that **only girls** can get a UTI, and 21% of the respondents responded that UTI cannot be cured.

All respondents cited at least one correct symptom/sign of UTI with Pain on Urination (n=104, 71.23%) and lower abdominal pain (n=79,54.11%) being the most cited symptoms.

Following the intervention 75% of the respondents exhibited high levels of knowledge about UTI. Majority of the respondents (n=76,52.05%) were able to correctly define UTI in their own words and up to 82.88%(n=121) cited at least 3 signs and symptoms of UTI.

**Figure 3:** A graph showing level of knowledge pre- and post- the intervention

On the graph is a trend line showing the change in numbers of respondents with high level of knowledge regarding UTI.

In evaluating the practices observed by the sample population, the study revealed that approximately 79% (n=113) of the respondents drink 3 or less cups of water in a day, 48.83 % only take a bath once during their menstrual periods and, 44.14% and 4.14% void only once and never void at all respectively during school hours.

**Table 4:** Frequency and percentage distribution of respondents based on selected contributing factors to Urinary Tract Infection

Practices		Frequency(f)	Percentage(%)
1)	Consumption of water in a day		
	a) 1-2 cups	80	55.94
	b) 2-3 cups	33	23.08
	c) 3-4 cups	24	16.78
	d) More than 4 cups	6	4.20
2)	Voiding during school hours		

	a) > 3 times	30	20.69
	b) 2-3 times	45	31.03
	c) Once	64	44.14
	d) Never void	6	4.14
3)	Drying under garments after washing		
	a) Under the sun	42	28.77
	b) On a pant peg inside the room	97	66.44
	c) Under another cloth	6	4.11
	d) Under the bed	1	0.07
4.)	Taking a bath during their periods		
	a) Never	3	2.05
	b) Once	71	48.83
	c) Two or more times	72	49.32

During the discussion, respondents were asked to give their reasons for adopting different practices and their responses noted;

About voiding habits;

- **“During school hours I go to urinate two times, at break time and lunch time. Because I don’t want to miss out on what the teacher is teaching, so I hold my urine till lunch break.”** NM (16 years, S.4, St. Charles SSS)
- **“I am used to holding my urine up to evening, so I urinate only once.”** AL (21years, S.6, NHS)
- **“Sometimes Teacher Mpagi (mathematics teacher) does not allow us to go for a short call, so I hold my urine up to break time”** KV (17 years, S.4, NHS)

About Menstrual hygiene;

- **“I usually change my sanitary towels in the morning after bathing, and in the evening after taking a bath. That’s what my mum told me is good for my hygiene.”** T.A (15years, S.4, NHS)
- **“I still bath once even during my periods because that’s what am used to doing.”** B.C (18years, S.4, St. Charles SSS)

### 3.3 Section III: Evaluation of Intervention.

The learning gain for the sample was calculated using the formula;

$$\text{Learning gain} = \frac{\text{Post learning score} - \text{Pre learning score}}{\text{Maximum score} - \text{Pre learning score}} \times 100\%$$



The study revealed that there was, on average, a 57.26% learning gain among the learners following the intervention.

**Table 5: Comparison of pre-test and post-test knowledge by paired t-test**

Tests	Mean	Standard Deviation	Mean Difference	t-statistic
Pre-test	8.158	4.037	7.219	15.35251
Post-test	15.377	4.686		

N=146

The Mean Pre-test knowledge score is 8.158 and the mean post test score is 15.377. A paired ttest was used to compare the pre-test and post test scores. As the calculated t-statistic value 15.35251 is higher than the table value 3.357 at 145 degree of freedom ( $p < 0.001$ ), there is strong evidence that on average, the intervention led to an increase in knowledge.

#### 4.0 DISCUSSION

Our project was aimed at promoting knowledge and prevention practices regarding UTI among Secondary school girls in Ntungamo District. The females of age group 15-24 years, an age group termed as 'youths', were chosen as the target population for the project as UTI are more prevalent among adolescent girls and young females than in males and other age groups. Prevalence studies by (Odoki, et al., 2019) in Bushenyi District and (Kabugo, Kizito, Ashok, & et al, 2015) at Mulago Hospital in Uganda, demonstrated that age  $\leq 19$  and female gender were found to bear statistically significant relationship with UTI.

A total of 146 female students

were reached, with the average age of the group being 18.2 years.

Majority were Anglicans and Banyankore by tribe. Majority of the respondents

(70.55%) reported to have previous knowledge about UTI and 40.41% reported to have had a previous episode of UTI in the past 1 year. These results are comparatively higher than those reported in a similar age group by a study by (Ms. Nimmy Saji, 2018) where 58% (majority) of the respondents reported previous knowledge and 16.66% a previous episode of UTI.

Prior to the intervention majority of the respondents had moderate knowledge with regards to UTI with an average score of 42.93%. However, majority of the respondents reported practices that increase their risk of getting UTI with 79% of the respondents drinking 3 or less cups of water in a day, 48.83% bathing only once during their periods and 48.28% voiding once or not at all during school hours. The voiding habits were found to be greatly influenced by the teachers' permission to get out and the school routine. The menstrual hygiene practices were influenced by norms upheld by members of their communities.

Following the intervention there was a significant increase in the level knowledge, with the majority of the respondents demonstrating high level of

knowledge with the average score being 76.89%. The respondents on average registered a learning gain of 57.26%. Further comparison between the pre- and post- test knowledge using the paired t-test indicated statistically significant improvement in knowledge ( $t_{(145)} = 15.35251$ ,  $p < 0.001$ ). These findings are consistent with those in a study by (Ms. Nimmy Saji, 2018), where a structured teaching program regarding prevention of UTI had significant impact on knowledge of first year nursing students.

#### 4.1 LIMITATIONS

- Most of the responses as regards to practices were assessed based on self-report rather than observation which could have biased the results as some people may have given false information.
- Long term outcomes like behavioral change with regards to hygiene practices could not be assessed because of the time allocated for the project.
- The COVID-19 pandemic limited our access to the schools, where each school only allocated one day for the activities and only a few of the students could attend per session.
- The pandemic also affected the economy of the country leading to an overshoot in the prices and transport fares that had not been accounted for in the budget

#### 5.0 CONCLUSION

Our intervention achieved prompt results in improving the knowledge of the participants

through structured health education and promotion. The study also established that the knowledge of the students as regards to UTI was moderate prior to the intervention. Practices including poor voiding habits, inadequate intake of water, poor menstrual hygiene and inadequate personal hygiene noted in this group increase the students risk of getting UTI. This signifies the need and importance of implementing regular health teaching programs for secondary school girls on various topics as it would help improve their knowledge and follow healthy practices to create a healthier community.

## 5.1 RECOMMENDATIONS

- A more detailed study should be carried out with tools to accurately assess the hygiene practices among Secondary school girls as regards to prevention of Urinary Tract Infection and measure behavioral change following the intervention.
- Regular health education programs about various health concerns should be implemented in schools by the school counsellors, school nurses and VHTs in partnership with Ntungamo Health Centre IV administration and staff to improve the students' knowledge and inform their adoption of behavioral patterns and practices aimed at disease prevention.

## References

1. Abbo, L., & Hotoon, T. (2014). Antimicrobial Stewardship and Urinary Tract Infections. 174-92.
2. Engelkirk Paul G., D.-E. L. (2011). *Burton's Microbiology for the Health Sciences (Internet)* (9th ed.). Philadelphia, Pa: Wolters Kluwer.
3. Gondim R, A. R. (2018, April). Risk factors for urinary tract infections in children with urinary urgency. 44(2), 378-383. Retrieved November 5, 2020
4. Helen S. Lee, J. I. (2018). Urinary Tract Infections. In M. W.-L. John E. Murphy, *Pharmacotherapy Self Assessment Program (PSAP) 2018 Book 1: Infectious Diseases* (6th ed., pp. 7-28). Kansas: American College of Clinical Pharmacy.
5. J, S. (2010). Antimicrobial resistance among producers and non-producers of extended spectrum betalactamases in urinary isolates at a tertiary Hospital in Tanzania. *BMC Research Notes* vol. 3, 348.
6. K. Sembulingam, P. S. (2012). *Essentials of Medical Physiology* (6th ed.). New Dehli: Jaypee Brothers Medical Publishers (P) Ltd.
7. Kabugo, D., Kizito, S., Ashok, D. D., & et al. (2015). Factors associated with community-acquired urinary tract infections among adults attending assessment centre, Mulago Hospital Uganda. *African Health Sciences*, vol. 8, 489-498.
8. Macro, O. (July 2002). *Reproductive Health of Young Adults in Uganda: A Report Based on the 200-2001 Uganda Demographic and Health Survey*. Maryland, USA: Calverton.
9. Mayo Clinic. (2020, October 14th). Urinary Tract Infection (UTI) - symptoms and Causes. Retrieved November 29th, 2020, from [www.mayoclinic.org/diseases-conditions/urinary-tractinfection/symptoms-causes/syc-20353447](http://www.mayoclinic.org/diseases-conditions/urinary-tractinfection/symptoms-causes/syc-20353447)
10. Ministry of Health. (2019). *Annual Health Sector Performance Report, financial year 2018/19*. Kampala: Ministry Of Health.
11. Ministry of Health, Government of Uganda. (n.d.). *HEALTH SECTOR STRATEGIC PLAN III 2010/112014/15*.
12. Mona M. Sedrack, S. M. (2010).
13. Ms. Nimmy Saji, M. A. (2018, July-September). Effectiveness of Structured Teaching Programme on Prevention of UTI among Adolescent Girls. *International Journal of Science and Healthcare Research*, 3(3).
14. Neni Wildiasomoro Selamat, K. P. (2020, January). Awareness, Knowledge & Attitude on Urinary Tract Infection among Government Secondary School Students in Shah Alam, Malaysia. *Malaysia Journal of Medicine and Health Sciences*, 51-57.
15. Odoki, M., Aliero, A. A., Tibyangye, J., Maniga, J. N., Wampande, E., Kato, C. D., . . . Bazira, J. (2019). Prevalence of Bacterial Urinary Tract Infections and Associated Factors Among the Patients Attending Hospitals in Bushenyi District, Uganda. *International Journal of Microbiology*, 2019, 1.
- OECD. (2012). *Development Co-operation Report 2012*.
16. Sobel, J., & Kaye, D. (2014). Urinary Tract Infections. In G. Mandell, & J. Bennet, *Principles and practices of Infectious Diseases* (pp. 886-913). Philadelphia: Elsevier Saunders.
17. Stamm, W. E., & Norrby, S. R. (2001). Urinary Tract Infections: disease panorama and challenges. *Journal of Infectious Diseases*, vol. 183, S1-S4.
18. Stammer W E, H. T. (1999). Management of Urinary Tract infection in adolescents. *NEMG J med*, 329.
19. Van Meter KC, H. R. (2010). *Microbiology for the Healthcare Professional*. Missouri, Maryland Heights: Elsevier Inc.
20. Walter E. Stamm, S. R. (2001). Urinary Tract Infections: Disease Panorama and Challenges. *The Journal of Infectious Diseases*, S1-4.
21. World Health Organisation. (2008). *Advocacy, communication and social mobilisation for TB control: a guide to developing knowledge, attitude and practice surveys*. Geneva, Switzerland: WHO Press.



# Knowledge, Attitude and Practices Towards Contraception and Teenage Pregnancy Among Students in Mbale, Eastern Uganda: An Interventional Cross-sectional Study.

## Authors:

Olum Ronald<sup>1</sup>

Makai Emmanuel<sup>1</sup>

Nsamba Patrick<sup>1</sup>

Okot Joseph<sup>1</sup>

Mutyaba Robert<sup>1</sup>

Gizamba Levi<sup>1</sup>

**Supervisor:** Dr Herbert Muyinda <sup>2</sup>

1. School of Medicine, College of Health Sciences, Makerere University Kampala, Uganda.
2. Department of Child Health & Development Centre, Makerere University



## Introduction

Teenage pregnancy (TP) is a major public health problem. Globally, about one-tenth of all births are to women below 20 years old, and the majority occur in developing countries. In Uganda, 24% of teenagers aged 15-19 have begun childbearing and Eastern Uganda is among regions with the highest prevalence. School-going children are at a great risk of being affected by TP. There is however limited data on their knowledge, attitude and practices towards TP and contraception in Eastern Uganda, necessitating our study.

## Methods

An interventional cross-sectional study was conducted among students in three schools at Bukonde sub-county, Mbale district. An interactive health education session was delivered by a team of medical students, health educators and local leaders on TP and contraception. Materials were designed and adopted from documents by the World Health Organisation and the Ministry of Health, Uganda. Pre- and post- intervention tests were used to assess the impact of the intervention. All analyses were performed using Microsoft Excel, STATA 15 and GraphPad Prism.  $P < 0.05$  was considered statistically significant.

## Results

Data from 316 participants with a mean age of 16 (SD: 2.4, range: 11 to 25) years were analysed. The majority were below 18 years (70.3%,  $n=222$ ), Moslems (72.2%,  $n=228$ ), and Gishu speaking (83.9%,  $n=265$ ). At baseline, only 30.7% ( $n=97$ ) and 50.1% ( $n=174$ ) of the participants had good knowledge on contraception and teenage pregnancy respectively. Attitudes were generally positive towards contraception (mean score: 12/18, SD: 1.9) and teenage pregnancy (mean: 13/18, SD: 2.3). Of the 127 participants (40.2%) who had had a sexual intercourse, 53 (41.7%) and 74 (58.3%) were females and males, respectively. The mean age at sexual debut was 14 years (SD: 3.4, range: 5 to 21 years,  $n=112$ ). Sexual debut was earlier among males (mean: 13.1 years, SD: 3.5, range: 5 to 21) than in females (mean: 15.6 years, SD: 2.5, range: 5 to 20). Some 109 participants (34.5%) had used contraception with 58% ( $n=63$ ) of these had used condoms. After the intervention, the knowledge of contraception (median score: 37.5% vs 50%,  $P < 0.0001$ ) and teenage pregnancy (50% vs 60%,  $P < 0.0001$ ) significantly increased. Although attitudes towards contraception significantly improved (mean score: 12.2 vs 12.8,  $P$ ), there was no difference in the pre- and post- intervention attitudes towards teenage pregnancy (mean score: 13.1 vs 13.0,  $P = 0.476$ ).

## Conclusion

The knowledge of participants on contraception and teenage pregnancy were poor at baseline but improved significantly after the intervention. Attitudes towards contraception also significantly improved. Routine health education on sexual and reproductive health are recommended among students to improve their understanding of teenage pregnancy, hence reducing the burden in the long run.





## INTRODUCTION

Teenage pregnancy, also known as called adolescent pregnancy, is a major public health problem (1), particularly in African countries (2, 3). Teenage pregnancy is defined as the occurrence of pregnancy in girls aged 10–19 (2, 4). Globally, about one-tenth of all births are to women below 20 years old, and the vast majority of these births occur in developing countries (5). In these countries, an estimated 21 million girls aged 15–19 years become pregnant and approximately 12 million of them give birth (6).

Giving birth during teenage is a risk factor for adverse pregnancy outcomes, and also has a negative impact on the mother and the infant (7). These include denying the expecting mothers childhood experiences, reducing their education opportunities, inhibiting personal development and making learning and practicing a profession extremely difficult (8). Teenage mothers face higher risks of eclampsia, puerperal endometritis, and systemic infections than women aged 20 to 24 years, and babies of these mothers face higher risks of low birth weight, preterm delivery and severe neonatal conditions (9). Complications during pregnancy and childbirth are the leading cause of death for 15–19-year-old girls globally (10). Of the estimated 5.6 million abortions that occur each year among adolescent girls aged 15–19 years, 3.9 million are unsafe, contributing to maternal mortality, morbidity and lasting health problems (6). Adolescent pregnancy and child motherhood also have gross implications on Uganda's economy and the country's growth and development (11).

The prevalence of teenage pregnancy in Africa is 18.8% and 19.3% in the Sub-Saharan African region respectively. Rates fall between 16.7% to 21.6% with the highest prevalence in East Africa (21.5%) and lowest in Northern Africa (9.2%) (12). Accord-

ing to Uganda Demographic Health Survey, 24% of adolescents aged 15–19 have begun childbearing (13). Teso sub-region (31.4) has the highest prevalence and Kigezi regions (8.8) have the lowest (13). Factors associated with teenage pregnancy include living in rural areas, childhood marriage, low level of education of parents and the adolescents, bad peer groups, cultural practices and lack of parental guidance on sexual and reproductive health (SRH) issues (12, 14).

The knowledge, attitude and practices of the population at risk on teenage pregnancy and contraception is essential in the prevention of the high rates of teenage pregnancy.

What is known, gap and the purpose statement.

## OBJECTIVES

1. To increase the knowledge of students on teenage pregnancy.
2. To improve the attitudes and practices of school-going children towards risky sexual behaviour and adolescent pregnancy.

## METHODS

### Study Design

We conducted a cross-sectional interventional study using quantitative methods between October and November, 2020.

### Study Setting

The study was conducted in two primary schools (Bumuluya PS and Bulweta PS) and one secondary school (Bukonde SS) located in Bukonde sub-county. Bukonde sub-county is located in the Northern Division (formerly Bungokho North county) of the newly formed Mbale City in Eastern

Uganda. Bagisu are the major tribe in this area and Lugisu is the most commonly spoken language.

### Study Population

Students in final years (primary seven and senior four) were targeted by the study because the rest of the classes were closed due to the COVID-19 pandemic. At the opening of the schools after the COVID-19 lockdown, Bukonde SS had 135 students, Bumuluya SS with 65 pupils and Bulweta with 122 pupils.

### Sample size and sampling

All the 318 students (out of the available 322 students) who were present at the time of our intervention were enrolled after an informed verbal consent.

### Study Intervention and Materials

We conducted interactive health education sessions on teenage pregnancy and contraception among the students. Study materials on teenage pregnancy and contraception were adopted from the World Health Organisation and the Ministry of Health Uganda (15, 16). The intervention was divided into five sessions; pre-test, teenage pregnancy, contraception/family planning, post-test and career guidance.

- a) Teenage pregnancy: we held an interactive session which covered the burden, science, risk factors, complications and prevention of teenage pregnancy.
- b) Contraception: we discussed with the learners the available contraception and family planning methods with an emphasis on abstinence.

The key messages used in the study is provided as a supplementary material.

As part of the intervention, we also

held meetings with the respective school administrators, local leaders, healthcare workers within the catchment area (Bufumbo Health Center Four) and the District Health Office, Mbale.

## Study Evaluation

A pre- and post-intervention assessment was done using a semi-structured questionnaire was designed by the authors. The questionnaire consisted of three parts.

- a) Social and demographic characteristics of the participants including age, sex, school, tribe, the caretaker, the parents' level of education and the parents' occupation.
- b) Contraception: this section had 16 questions on awareness, source of information, definitions, knowledge of contraceptives, usage, source and attitudes towards contraceptives.
- c) Teenage pregnancy: 16 questions on awareness, source of information, knowledge of individuals at risk, complications, prevention methods, attitudes, prior sexual intercourse, age at sexual debut and prior pregnancy or impregnation.
- b) Attitude towards contraception was assessed using six questions with three-point Likert responses (agree, I don't know and disagree). Participants scored 1 point for a negative response, 2 for neutrality and 3 points for a positive response. Points from each question were summed to give an attitude score, ranging from 6 to 18 with higher scores indicating positive attitudes and lower scores indicating negative attitudes.
- c) Knowledge on teenage pregnancy was assessed using four questions and each correct answer scored a point with a maximum of 10 points. A participant who scored 50% and above (5/10 and above) was considered to have good knowledge on teenage pregnancy.
- d) Attitude towards teenage pregnancy was assessed using six questions with three-point Likert responses (agree, I don't know and disagree). Participants scored 1 point for a negative response, 2 for neutrality and 3 points for a positive response. Points from each question were summed to give an attitude score, ranging from 6 to 18 with higher scores indicating positive attitudes and lower scores indicating negative attitudes.

The questionnaire is provided as a supplementary file.

## Measurements

- a) Knowledge on contraception was assessed using three questions on the definition of family planning, definition of contraception and identification of at most six contraceptive methods. Each correct answer was awarded a point with a maximum total of 8 points. A participant who scored 50% and above (4/8 and above) was considered to have good knowledge on contraception.

## Implementation Team

The implementation team consisted of six fourth-year medical students from Makerere University, two health educators, a woman councilor, and supervisors from Makerere University College of Health Sciences.

## Data Management and Analysis

Complete questionnaires from the pre- and post- intervention tests were entered using Epicollect 5 Soft-

ware (Center for Genomic Pathogen Surveillance, Hinxton, England) and exported to Microsoft Excel 2016 for cleaning and coding. All analyses were performed using STATA 15.0 (StataCorp LLC, College Station, Texas, USA) and GraphPad Prism 7.0. Categorical variables are presented as frequencies and percentages whereas numerical variables are presented as median or mean, appropriately. Knowledge on contraception and teenage pregnancy was dichotomised as "good" and "poor" as described in the measurements ( $\geq 50\%$  or  $< 50\%$  respectively). To assess the association of sociodemographic factors with knowledge on contraception and teenage pregnancy, chi-square tests or Fisher's exact tests were performed. Variables with a p-value  $< 0.2$  were fitted into a multivariable logistic regression model to adjust for confounders and presented as adjusted odds ratio (AOR) at 95% confidence intervals (CI). To assess differences in knowledge and attitude scores in the pre- and post-intervention tests, paired student t-test or Wilcoxon Sign Rank test were performed for parametric and non-parametric conditions respectively. A p-value of less than 0.05 was considered statistically significant at all levels of hypothesis testing.

## Dissemination

The findings of this study were availed to the school administrators, local leaders, the local and district health offices (Mbale). The results were also be presented to the Department of Child Health and Development Centre, Makerere University College of Health sciences.

## Ethical Considerations

The study was approved by the Department of Child Health and Development Centre, Makerere University (2020). Additional permissions were requested from the respective school administrators, local leaders and the District Health Office, Mbale district. The study was conducted according



to the *Declaration of Helsinki*. All participants provided an informed verbal consent before participating in the study. The participants were free to withdraw from participation in the study at any time without any negative consequences or punishment.

## RESULTS

### Characteristics of participants

Overall, 318 students were recruited into the study (response rate= 87%). After excluding two incomplete questionnaires, data of 316 participants with a mean age of 16 (SD: 2.4, range: 11 to 25) years were analysed. The majority of the participants were children (70.3%, n=222), Moslems (72.2%, n=228), and Gishu speaking (83.9%, n=265). Only 184 participants (58.2%) were living with both parents at home (father and mother). Table 1 summarizes the demographic characteristics of the participants.

Who do you stay with at home?		
Both parents	184	58.2
Mother	61	19.3
Guardian	41	13.0
Father	30	9.5
Father's level of education		
None	16	5.1
Primary	99	31.3
Secondary	153	48.4
Tertiary	14	4.4
University	31	9.8
I don't know	3	1.0
Mother's level of education		
None	16	5.1
Primary	87	27.5
Secondary	174	55.1
Tertiary	7	2.2
University	26	8.2
I don't know	6	1.9
Father's occupation		
Business person	169	53.5
Farmer	85	26.9
Civil servant	40	12.7
I don't know	13	4.1
Unemployed	9	2.9
Mother's occupation		
Farmer	120	38.0
Business person	114	36.1
Civil servant	37	11.7
Housewife	33	10.4
I don't know	12	3.8

**Table 1. Sociodemographic characteristics of participants**

Demographics	Frequency	%
Age	16	2.4
11 to 17	222	70.3
18 to 25	94	29.8
Sex		
Female	172	54.4
Male	144	45.6
School		
Bukonde SS	131	41.5
Bulweta PS	124	39.2
Bumuluya PS	61	19.3
Religion		
Moslem	228	72.2
Catholic	35	11.1
Pentecostal	30	9.5
Anglican	19	6.0
Other	4	1.3
Tribe		
Gishu	265	83.9
Ganda	22	7.0
Itesot	9	2.9
Luo	4	1.3
Sabiny	2	0.6
Other	14	4.4

## Contraception

**Awareness and practices** Whereas 86.7% (n=274) of the participants had heard about family planning, only 36.4% (n=115) had heard about contraception. The common sources of information on family planning (**Figure 1**) were health centres (40.1%, n= 110) and schools (31.4%, n=86). Some 109 participants (34.5%) admitted ever using a contraceptive method. Self-reported contraceptive methods included condoms (58%), abstinence (50%), safe period (18%), pills (15%), injectables (7%), diaphragm (3%), and implants (3%).

**Figure 1. Source of information on family planning among students at Bukonde sub-county.**

## Knowledge on contraception

The median score for knowledge on contraception was 37.5% and 50.0% during the pre- and post-intervention test respectively. Overall, only 97 participants (30.7%) had good knowledge on contraceptives and family planning at pre-intervention test compared to 160 participants (50.6%) at post-intervention test. The most commonly known contraceptives were condoms, pills, abstinence, and injectables (**Table 2**). At bivariate analysis, knowledge on family planning was significantly associated with religion at both pre-intervention ( $P=0.01$ ) and post-intervention tests ( $P=0.031$ ). Age, sex, and level of education were not significant (**Table 3**). A Wilcoxon Signed-Rank Test indicated that the post-test median knowledge score was significantly higher than the pre-test median knowledge score indicating a significant increase in knowledge (median difference= 12.5%,  $P<0.0001$ , **Figure 2**).

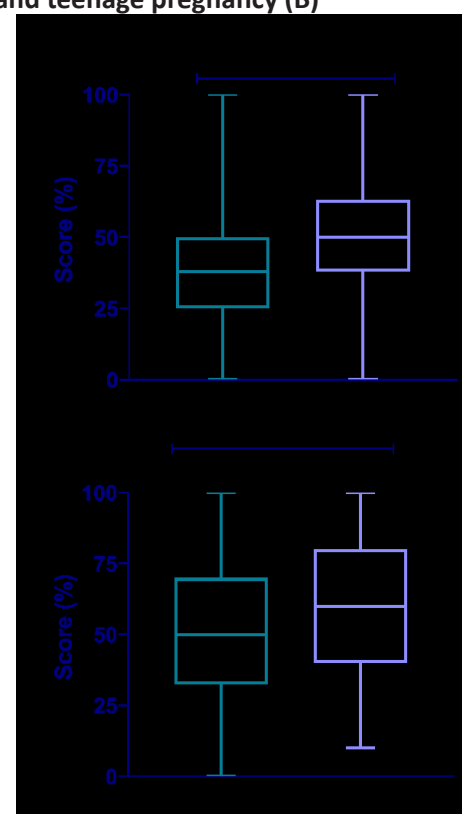
**Figure 2. Mean knowledge scores of participants towards contraception (A) and teenage pregnancy (B)**

**Table 2. Responses to questions on family planning knowledge among participants.**

Family planning / contraception knowledge	Pre-test		Post test	
	n	%	n	%
Family planning is				
Spacing of births	146	46.2	168	53.2
Stopping of births	67	21.2	82	26.0
Limitation of births	35	11.1	36	11.4
I don't know	68	21.5	30	9.5
Contraception is				
Avoiding getting pregnant	160	50.6	260	82.3
Getting pregnant	22	7.0	21	6.7
No idea	134	42.4	35	11.1
The following are contraceptive methods				
Condoms	184	58.2	221	69.9
Pills	98	31.0	150	47.5
Abstinence	101	32.0	190	60.1
Injectables	67	21.2	69	21.8
Withdrawal	44	13.9	53	16.8
Intrauterine device	20	6.3	32	10.1
Implants	25	7.9	52	16.5
Maternal breastfeeding	32	10.1	15	4.7
Diaphragm	6	1.9	9	2.8
Vasectomy	21	6.6	29	9.2
Spermicides	15	4.7	16	5.1

**Table 3. Knowledge of participants on contraception.**

Demographics (N=316)	Pre-test; n (%)			Post-test; n (%)		
	Good	Poor	P	Good	Poor	P
Overall	97 (30.7)	219 (69.3)		160 (50.6)	156 (49.4)	
Age						
11 to 18	62 (27.9)	160 (72.1)	0.101	113 (50.9)	109 (49.1)	0.884





19 to 25	35 (37.2)	59 (62.8)		47 (50)	47 (50)	
<b>Sex</b>						
Female	52 (30.2)	120 (69.8)	0.845	92 (53.5)	80 (46.5)	0.267
Male	45 (31.3)	99 (68.8)		68 (47.2)	76 (52.8)	
<b>School</b>						
Primary	52 (28.1)	133 (71.9)	0.236	91 (49.2)	94 (50.8)	0.542
Secondary	45 (34.4)	86 (65.6)		69 (52.7)	62 (47.3)	
<b>Religion</b>						
Moslem	58 (25.4)	170 (74.6)	0.010	109 (47.8)	119 (52.2)	0.031
Catholic	14 (40)	21 (60)		18 (51.4)	17 (48.6)	
Pentecostal	16 (53.3)	14 (46.7)		23 (76.7)	7 (23.3)	
Anglican	8 (42.1)	11 (57.9)		9 (47.4)	10 (52.6)	
Other	1 (25)	3 (75)		1 (25)	3 (75)	
<b>Tribe</b>						
Gishu	85 (32.1)	180 (67.9)	0.548	142 (53.6)	123 (46.4)	0.072
Ganda	5 (22.7)	17 (77.3)		6 (27.3)	16 (72.7)	
Itesot	4 (44.4)	5 (55.6)		4 (44.4)	5 (55.6)	
Luo	1 (25)	3 (75)		3 (75)	1 (25)	
Sabiny	0 (0)	2 (100)		0 (0)	2 (100)	
Other	2 (14.3)	12 (85.7)		5 (35.7)	9 (64.3)	
<b>Who do you stay with at home?</b>						
Both parents	59 (32.1)	125 (67.9)	0.855	100 (54.3)	84 (45.7)	0.419
Mother	17 (27.9)	44 (72.1)		26 (42.6)	35 (57.4)	
Guardian	11 (26.8)	30 (73.2)		20 (48.8)	21 (51.2)	
Father	10 (33.3)	20 (66.7)		14 (46.7)	16 (53.3)	
<b>Father's level of education</b>						
None	3 (18.8)	13 (81.3)	0.754	4 (25)	12 (75)	0.137
Primary	34 (34.3)	65 (65.7)		54 (54.5)	45 (45.5)	
Secondary	48 (31.4)	105 (68.6)		79 (51.6)	74 (48.4)	
Tertiary	4 (28.6)	10 (71.4)		6 (42.9)	8 (57.1)	
University	7 (22.6)	24 (77.4)		17 (54.8)	14 (45.2)	
I don't know	1 (33.3)	2 (66.7)		0 (0)	3 (100)	
<b>Mother's level of education</b>						
None	4 (25)	12 (75)	0.868	5 (31.3)	11 (68.8)	0.236
Primary	27 (31)	60 (69)		40 (46)	47 (54)	
Secondary	57 (32.8)	117 (67.2)		95 (54.6)	79 (45.4)	
Tertiary	1 (14.3)	6 (85.7)		5 (71.4)	2 (28.6)	
University	6 (23.1)	20 (76.9)		11 (42.3)	15 (57.7)	
I don't know	2 (33.3)	4 (66.7)		4 (66.7)	2 (33.3)	
<b>Father's occupation</b>						
Business person	54 (32)	115 (68)	0.845	88 (52.1)	81 (47.9)	0.481
Farmer	24 (28.2)	61 (71.8)		37 (43.5)	48 (56.5)	
Civil servant	11 (27.5)	29 (72.5)		24 (60)	16 (40)	
I don't know	4 (30.8)	9 (69.2)		7 (53.8)	6 (46.2)	
Unemployed	4 (44.4)	5 (55.6)		4 (44.4)	5 (55.6)	

Mother's occupation						
Farmer	35 (29.2)	85 (70.8)	0.774	56 (46.7)	64 (53.3)	0.628
Business person	37 (32.5)	77 (67.5)		64 (56.1)	50 (43.9)	
Civil servant	9 (24.3)	28 (75.7)		19 (51.4)	18 (48.6)	
Housewife	11 (33.3)	22 (66.7)		16 (48.5)	17 (51.5)	
I don't know	5 (41.7)	7 (58.3)		5 (41.7)	7 (58.3)	

**Table 4. Multivariable logistic regression showing factors associated with knowledge on family planning.**

Demographics	Pre-test		Post test	
	AOR (95% CI)	P	AOR (95% CI)	P
<b>Age</b>				
11 to 18	1.0			
19 to 25	1.5 (0.9 - 2.6)	0.121		
<b>Religion</b>				
Anglican	1.0		1.0	
Catholic	1 (0.3 - 3.2)	0.992	0.4 (0.1 - 1.6)	0.180
Moslem	0.5 (0.2 - 1.3)	0.151	0.4 (0.1 - 1.5)	0.174
Other	0.4 (0 - 5.1)	0.512	0.3 (0 - 3.5)	0.314
Pentecostal	1.6 (0.5 - 5.2)	0.420	0.4 (0.1 - 1.6)	0.184
<b>Tribe</b>				
Ganda			1.0	
Gishu			3.5 (1.4 - 8.9)	0.007
Itesot			4.6 (0.8 - 27.2)	0.091
Luo			0.6 (0.1 - 7.1)	0.690
Sabiny			1.4 (0.3 - 5.6)	0.660
Other			1.5 (0.1 - 28.4)	0.772
<b>Father's level of education</b>				
None			1.0	
Primary			2.4 (0.8 - 7.4)	0.120
Secondary			2.3 (0.8 - 6.7)	0.141
Tertiary			1.8 (0.4 - 8.3)	0.462
University			1.4 (0.4 - 5.2)	0.576
Unknown			2.1 (0.2 - 29)	0.577

## Attitudes towards contraceptives

**Table 5** shows the attitudes of the participants towards contraception. At pre-test, majority had no idea whether contraceptives caused infertility or were for women only. However, 46.8% (n=148) believed that barrier contraceptives like condoms reduced sexual pleasure. The majority believed that contraceptives enable parents to take good care of their children (49.1%) and have provide a healthy living for their children (46.8%).



**Table 5. Attitudes of the participants towards contraceptive usage**

Attitudes	Pre-test		Post Test	
	n	%	n	%
<b>Contraceptives can cause infertility</b>				
Agree	94	29.8	206	65.19
Disagree	53	16.8	54	17.09
I don't know	169	53.5	56	17.72
<b>Contraceptives is for women only</b>				
Agree	99	31.3	132	41.77
Disagree	83	26.3	140	44.3
I don't know	134	42.4	44	13.92
<b>Contraception allows parents to take good care of their children</b>				
Agree	155	49.1	231	73.1
Disagree	32	10.1	41	12.97
I don't know	129	40.8	44	13.92
<b>Contraception is not accepted in my religion or culture</b>				
Agree	110	34.8	138	43.67
Disagree	90	28.5	128	40.51
I don't know	116	36.7	50	15.82
<b>Contraception ensures that the children are healthy</b>				
Agree	148	46.8	205	64.87
Disagree	48	15.2	72	22.78
I don't know	120	38.0	39	12.34
<b>Using a condom during sexual intercourse reduces pleasure.</b>				
Agree	148	46.8	163	51.58
Disagree	58	18.4	93	29.43
I don't know	110	34.8	60	18.99

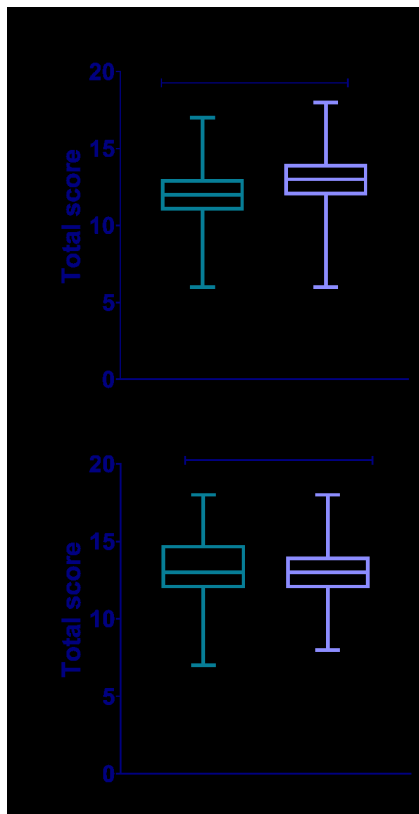
Overall, the mean score for attitudes towards contraception was 12.2 (SD: 1.9, range: 6 to 17) and 12.8 (SD: 2.0, range: 6 to 18) for pre- and post-intervention tests, respectively. A paired t-test showed a statistically significant overall improvement in attitudes towards contraception among the students after the intervention (mean difference= 0.64,  $t(319) = 4.1$ ,  $P < .0001$ , **Figure 3**). At bivariate analysis, attitudes significantly improved regardless of age, sex and school. However, attitude change differed by tribe, religion, parent's level of education, and parent's occupation. Participants who were Gishu speaking, Moslems, whose parents had attained either primary or secondary level of education significantly had improved attitudes compared to their counterparts in the respective categories (**Table 6**). The parents' occupation was also significantly associated with change of attitudes (**Table 6**).

**Table 6. Mean scores on attitudes towards contraceptives.**

Demographics	Pre-test Mean (SD)	Post-test Mean (SD)	Mean Change	t-test P value
<b>Age</b>				
11 to 18	12.1 (1.9)	12.6 (2.1)	0.545	0.004
19 to 25	12.4 (1.8)	13.2 (1.9)	0.872	0.003
<b>Sex</b>				
Female	12.1 (1.8)	12.6 (1.9)	0.424	0.041

Male	12.2 (1.9)	13.1 (2.2)	0.903	0.000
<b>School</b>				
Bukonde SS	12.5 (1.8)	13 (2.2)	0.511	0.047
Bulweta PS	11.9 (1.9)	12.5 (1.9)	0.508	0.029
Bumuluya PS	12 (1.8)	13.2 (2)	1.197	0.002
<b>Religion</b>				
Moslem	12.2 (2)	12.9 (2.1)	0.680	0.001
Catholic	11.9 (1.7)	12.6 (1.8)	0.686	0.090
Pentecostal	12.4 (1.1)	12.9 (2.3)	0.533	0.275
Anglican	12.1 (1.6)	12.5 (2)	0.421	0.419
Other	12.3 (3)	12.3 (1.7)	0.000	1.000
<b>Tribe</b>				
Gishu	12.2 (1.9)	12.9 (2)	0.709	0.000
Ganda	11.8 (1.5)	12 (2.4)	0.132	0.820
Itesot	12.3 (1.7)	12 (2.4)	-0.333	0.740
Luo	11 (1.8)	13.3 (1)	2.250	0.186
Sabiny	15 (1.4)	11.5 (2.1)	-3.500	0.090
Other	12.6 (2.2)	13.6 (2.1)	0.929	0.311
<b>Who do you stay with at home?</b>				
Both parents	12.1 (1.9)	12.9 (2.1)	0.793	0.000
Mother	12.2 (1.8)	12.7 (1.9)	0.475	0.155
Guardian	12.1 (1.8)	12.5 (2.2)	0.341	0.364
Father	12.4 (1.7)	12.9 (1.9)	0.467	0.266
<b>Father's level of education</b>				
None	11.8 (2.1)	12.8 (1.6)	1.000	0.119
Primary	12.1 (1.8)	13.1 (2.1)	0.990	0.000
Secondary	12.3 (1.9)	12.9 (2)	0.600	0.011
Tertiary	12 (1.2)	11.8 (1.4)	-0.214	0.706
University	12.5 (1.9)	12.5 (2.4)	-0.065	0.915
I don't know	9.7 (1.5)	10.3 (0.6)	0.667	0.635
<b>Mother's level of education</b>				
None	11.6 (1.5)	12.6 (1.6)	0.938	0.119
Primary	12.2 (1.9)	12.9 (2.2)	0.713	0.023
Secondary	12.3 (1.9)	12.9 (1.9)	0.615	0.003
Tertiary	12.4 (1.5)	11.6 (2.6)	-0.857	0.439
University	11.5 (1.8)	12.3 (2.3)	0.731	0.251
I don't know	11.7 (1)	12.7 (1.8)	1.000	0.391
<b>Father's occupation</b>				
Business person	12.2 (1.9)	12.9 (2)	0.663	0.002
Farmer	12 (1.8)	12.8 (2.2)	0.835	0.012
Civil servant	12.6 (2)	12.4 (2.1)	-0.275	0.550
I don't know	11.9 (1.4)	13 (1.5)	1.077	0.079
Unemployed	11.4 (1.6)	13.3 (1.9)	1.889	0.023
<b>Mother's occupation</b>				

Farmer	12.2 (1.8)	12.8 (2)	0.583	0.017
Business person	12.1 (1.9)	12.7 (1.9)	0.667	0.011
Civil servant	11.9 (2.2)	12.9 (2.4)	0.973	0.097
Housewife	12.6 (1.9)	13.2 (2)	0.576	0.228
I don't know	12.3 (0.4)	12.4 (1.8)	0.167	0.820



**Figure 3. Mean attitude scores of participants towards contraception (A) and teenage pregnancy (B).**

Teenage pregnancy

## Awareness and practices

Two hundred and fourth eight (78.48%) participants had heard about teenage pregnancy. The most common sources of information on teenage pregnancy were schools, radio or television, and health centres (**Figure 4**). Up to 127 participants (40.2%) reported to have had sexual intercourse. Of these, 53 (41.7%) and 74 (58.3%) were females and males, respectively. The mean age at sexual debut was 14 years (SD: 3.4, range: 5 to 21 years, n=112). Sexual debut was earlier among males (mean: 13.1 years, SD: 3.5, range: 5 to 21) than in females (mean: 15.6 years, SD: 2.5, range: 5 to 20). Of the students who had engaged in sexual intercourse, 3 females reported to have had a pregnancy while 10 males had made a female pregnant before.

**Figure 4. Source of information on teenage pregnancy (N=248).**

## Knowledge on teenage pregnancy

At baseline, the majority of the participants knew that a girl can become pregnant after menarche (71.5%, n=226), (**Table 7**). More than half of the participants identified school dropout, difficulty giving birth and death as possible dangers of teenage pregnancy. After intervention, knowledge increased across all components assessed. The median knowledge score was 50% (range: 0 to 100%) before the intervention and 60% (range: 10% to 100%) after the intervention. A Wilcoxon Signed Rank Test revealed a significant difference in the median knowledge score on teenage pregnancy at pre- and post- intervention (50% vs 60%,  $P<.0001$ , **Figure 2**). The proportion of participants with good knowledge on teenage pregnancy also increased from 50.1% (n= 174) in the pre-test to 63.9% (n= 202) after administering the health education (**Table 8**).

**Table 7. Knowledge on teenage pregnancy**

Knowledge on teenage pregnancy	Pre-test		Post test	
	n	%	n	%
<b>When can a girl become pregnant after having unprotected sex</b>				
At any age	23	7.3	27	8.5
After starting menstruation	226	71.5	269	85.1
I don't know	67	21.2	20	6.3
<b>Teenage pregnancy occurs among women of age</b>				
Less than 10 years	9	2.9	9	2.9
Between 11 to 19	186	58.9	226	71.5
20 years and above	79	25.0	59	18.7
I don't know	42	13.3	22	7.0



The dangers of teenage pregnancy may include				
School dropout	196	62.0	203	64.2
Difficulty while giving birth	189	59.8	209	66.1
Death	171	54.1	213	67.4
Poor quality of life	131	41.5	119	37.7
Complications after giving birth	80	25.3	114	36.1
Social stigma	64	20.3	95	30.1
Teenage pregnancy can be prevented by				
Abstinence	210	66.5	247	78.2
Sleeping under a mosquito net	43	13.6	21	6.6
Using contraception like condoms	140	44.3	108	34.2
Praying	21	6.6	21	6.6

**Table 8** describes the factors associated with knowledge on teenage pregnancy among the participants. At pre-test, knowledge on teenage pregnancy was significantly associated with religion, who the student was staying with at home, and mother's level of education. At post-test, knowledge was associated with participant's level of education, tribe, mother's level of education and who they stayed with at home.

**Table 8. Factors associated with knowledge on teenage pregnancy among students at Bukonde sub-county.**

Demographics (N=316)	Knowledge Pre-test			Knowledge Post-Test		
	Good n (%)	Poor n (%)	P	Good n (%)	Poor n (%)	P
Overall	174 (55.1)	142 (44.9)		202 (63.9)	114 (36.1)	
Age						
11 to 18	119 (53.6)	103 (46.4)	0.423	140 (63.1)	82 (36.9)	0.624
19 to 25	55 (58.5)	39 (41.5)		62 (66)	32 (34)	
Sex						
Female	88 (51.2)	84 (48.8)	0.128	108 (62.8)	64 (37.2)	0.647
Male	86 (59.7)	58 (40.3)		94 (65.3)	50 (34.7)	
School						
Primary	96 (51.9)	89 (48.1)	0.178	109 (58.9)	76 (41.1)	0.028
Secondary	78 (59.5)	53 (40.5)		93 (71)	38 (29)	
Religion						
Anglican	15 (78.9)	4 (21.1)	0.008	16 (84.2)	3 (15.8)	0.339
Catholic	17 (48.6)	18 (51.4)		21 (60)	14 (40)	
Moslem	118 (51.8)	110 (48.2)		145 (63.6)	83 (36.4)	
Other	1 (25)	3 (75)		2 (50)	2 (50)	
Pentecostal	23 (76.7)	7 (23.3)		18 (60)	12 (40)	
Tribe						
Ganda	8 (36.4)	14 (63.6)	0.243	8 (36.4)	14 (63.6)	0.006
Gishu	153 (57.7)	112 (42.3)		180 (67.9)	85 (32.1)	
Itesot	5 (55.6)	4 (44.4)		6 (66.7)	3 (33.3)	
Luo	1 (25)	3 (75)		1 (25)	3 (75)	
Other	6 (42.9)	8 (57.1)		6 (42.9)	8 (57.1)	
Sabiny	1 (50)	1 (50)		1 (50)	1 (50)	

Who do you stay with at home?						
Both parents	115 (62.5)	69 (37.5)	<0.001	132 (71.7)	52 (28.3)	0.000
Father	11 (36.7)	19 (63.3)		16 (53.3)	14 (46.7)	
Guardian	26 (63.4)	15 (36.6)		28 (68.3)	13 (31.7)	
Mother	22 (36.1)	39 (63.9)		26 (42.6)	35 (57.4)	
Father's level of education						
None	7 (43.8)	9 (56.3)	0.582	7 (43.8)	9 (56.3)	0.442
I don't know	2 (66.7)	1 (33.3)		2 (66.7)	1 (33.3)	
Primary	58 (58.6)	41 (41.4)		65 (65.7)	34 (34.3)	
Secondary	87 (56.9)	66 (43.1)		102 (66.7)	51 (33.3)	
Tertiary	6 (42.9)	8 (57.1)		9 (64.3)	5 (35.7)	
University	14 (45.2)	17 (54.8)		17 (54.8)	14 (45.2)	
Mother's level of education						
None	4 (25)	12 (75)	0.030	6 (37.5)	10 (62.5)	0.002
I don't know	3 (50)	3 (50)		2 (33.3)	4 (66.7)	
Primary	52 (59.8)	35 (40.2)		53 (60.9)	34 (39.1)	
Secondary	102 (58.6)	72 (41.4)		124 (71.3)	50 (28.7)	
Tertiary	4 (57.1)	3 (42.9)		6 (85.7)	1 (14.3)	
University	9 (34.6)	17 (65.4)		11 (42.3)	15 (57.7)	
Father's occupation						
Business person	96 (56.8)	73 (43.2)	0.965	111 (65.7)	58 (34.3)	0.734
Civil servant	22 (55)	18 (45)		27 (67.5)	13 (32.5)	
Farmer	44 (51.8)	41 (48.2)		49 (57.6)	36 (42.4)	
I don't know	7 (53.8)	6 (46.2)		9 (69.2)	4 (30.8)	
Unemployed	5 (55.6)	4 (44.4)		6 (66.7)	3 (33.3)	
Mother's occupation						
Business person	68 (59.6)	46 (40.4)	0.547	82 (71.9)	32 (28.1)	0.226
Civil servant	17 (45.9)	20 (54.1)		21 (56.8)	16 (43.2)	
Farmer	63 (52.5)	57 (47.5)		73 (60.8)	47 (39.2)	
Housewife	20 (60.6)	13 (39.4)		20 (60.6)	13 (39.4)	
I don't know	6 (50)	6 (50)		6 (50)	6 (50)	

A multivariable logistic regression was performed for all variables with a  $P < 0.2$  at bivariate analysis to adjust for confounders (**Table 9**). At pre-test, male sex, mother's level of education (primary and secondary) was associated with good knowledge on teenage pregnancy. On the other hand, participants living with only one parent (either father or mother alone) were significantly less likely to have good knowledge than those living with both parents. At post-test, participants who were Gishu speaking (AOR: 2.7, 95% CI:1 to 7.2,  $P: 0.042$ ) and those whose mothers had attained secondary level of education (AOR: 4.2, 95% CI:1.4 to 12.9,  $P: 0.011$ ) significantly had good knowledge than counterparts. Consequently, participants living with their mothers significantly had poor knowledge on teenage pregnancy (AOR: 0.3, 95% CI: 0.2 to 0.6,  $P=0.001$ ).

**Table 9. Multivariable logistic regression showing factors associated with knowledge on teenage pregnancy**

Demographics (N=316)	Pre-test		Post-test	
	AOR (95% CI)	P	AOR (95% CI)	P
<b>Sex</b>				
Female	1			
Male	1.8 (1.1 - 3)	0.026		
<b>School</b>				
Primary	1		1	
Secondary	1 (0.6 - 1.7)	0.871	1.4 (0.8 - 2.3)	0.253
<b>Religion</b>				
Anglican	1			
Catholic	0.3 (0.1 - 1.2)	0.085		
Moslem	0.4 (0.1 - 1.2)	0.090		
Other	0.1 (0 - 1.7)	0.123		
Pentecostal	1 (0.2 - 4.1)	0.972		
<b>Who do you stay at home with?</b>				
Both parents	1		1	
Father	0.3 (0.1 - 0.7)	0.005	0.5 (0.2 - 1.2)	0.139
Guardian	1.2 (0.5 - 2.5)	0.694	0.9 (0.4 - 2)	0.77
Mother	0.3 (0.2 - 0.6)	0.001	0.3 (0.2 - 0.6)	0.001
<b>Mother's level of education</b>				
None	1		1	
Primary	5 (1.4 - 18)	0.013	3 (0.9 - 9.6)	0.066
Secondary	4.1 (1.2 - 13.9)	0.025	4.2 (1.4 - 12.9)	0.011
Tertiary	2.8 (0.4 - 21.1)	0.310	9.6 (0.9 - 108)	0.066
University	1.6 (0.4 - 6.7)	0.556	1.5 (0.4 - 6)	0.529
Unknown	2.8 (0.4 - 21.3)	0.331	0.8 (0.1 - 6.2)	0.837
<b>Tribe</b>				
Ganda			1	
Gishu			2.7 (1 - 7.2)	0.042
Itesot			2.7 (0.5 - 15.3)	0.251
Luo			0.8 (0.1 - 11.6)	0.897
Sabiny			1 (0.2 - 4.4)	0.994
Other			1.5 (0.1 - 30.6)	0.802

### Attitudes Towards Teenage Pregnancy

At baseline (**Table 10**), whereas 207 participants (65.5%) agreed that sex before marriage is bad, 141 (44.6%) students believed abstaining from sex during adolescence is difficult. Over one-third of the participants believed remaining a virgin during adolescence is backward. However, up to 70% of the participants believed teenage pregnancy is risky to both the pregnant mother and the child. Only 186 participants (58.9%) participants believed that students who become pregnant while at school should be allowed to continue with school.

Overall, the mean attitude score was 13.1 (SD: 2.3, range: 7 to 18) at pre-intervention test and 13.0 (SD: 2.3, range: 7 to 18) at post intervention test. A paired t-test showed no statistically significant difference in the attitude scores during the pre- and post- intervention tests (mean difference: 0.1,  $t(315) = 0.7$ ,  $P = 0.476$ , **Figure 3**).



**Table 10. Attitudes towards teenage pregnancy**

Attitudes towards teenage pregnancy	Pre-test		Post Test	
	n	%	n	%
<b>Sex before marriage is bad</b>				
Agree	207	65.51	240	75.95
Disagree	56	17.72	43	13.61
I don't know	53	16.77	33	10.44
<b>A girl/boy who remains a virgin during adolescence is backward</b>				
Agree	120	37.97	140	44.3
Disagree	97	30.7	122	38.61
I don't know	99	31.33	54	17.09
<b>Abstaining from sex during adolescence is difficult</b>				
Agree	141	44.62	157	49.68
Disagree	100	31.65	121	38.29
I don't know	75	23.73	38	12.03
<b>Having a baby at an early age is a sign of maturity</b>				
Agree	138	43.67	157	49.68
Disagree	129	40.82	120	37.97
I don't know	49	15.51	39	12.34
<b>Pregnancy during childhood is risky to both the mother and the child</b>				
Agree	224	70.89	225	71.2
Disagree	38	12.03	56	17.72
I don't know	54	17.09	35	11.08
<b>A child who becomes pregnant at school should be allowed to continue studying</b>				
Agree	186	58.86	167	52.85
Disagree	93	29.43	112	35.44
I don't know	37	11.71	37	11.71

## DISCUSSION

Teenage pregnancy still remains a major public health concern globally. At least 777,000 births occur to teenage girls younger than 15 years in developing countries (17). This has far-reaching impact on the lives of the young girls, their parents, the community and the nation at large. In this study, we set out to assess the impact on sexual and reproductive health education on the knowledge, attitudes and practices of school-going children in Bukonde sub-county, Mbale, on contraception and teenage pregnancy.

### Contraception

In our study knowledge on contraception was low at baseline, with only 30.7% of the participants had good knowledge. This is line with a study by Babatunde and colleagues who reported about 27.8% of the students also had good knowledge on contraception (18). In Tanzania, up to two-thirds of secondary school adolescents had adequate knowledge on family planning services (19). Knowledge on contraception has been reported to be higher among students in developed countries (20). Studies done among adults have also yielded higher results. Condoms, pills and implants were the most known contraceptives in our study which is in corroboration with a study among

university students at Makerere University, Uganda (21). Among university students in the above study however, knowledge of any contraceptive method was very high, at 99% (21). In a survey among pregnant teenagers in China, the majority had limited knowledge on contraception (22). Sexual and reproductive health education in Ugandan schools is still a controversial debate. Cultural and religious institutions, along with some members of the public insist that sex education in schools will lead to an increase in immorality among children (23). Its implementation is also faced with barriers like institutional weakness, lack of coordination between the relevant ministries

and lack of capacity (23). In a survey among pregnant teenagers in China, the majority had limited knowledge on contraception.

Attitudes were generally positive towards contraception in our study (mean score: 12/18, SD: 1.9). In south west Nigeria, 55.3% of female secondary students had positive attitudes towards contraception (24). Attitudes towards contraception is an important factor that influences its uptake. Fear of side effects, level of education, socioeconomic status, religious and social beliefs all influence attitude towards contraception, and hence its uptake (25). At baseline, about one-third of the participants in our study had used contraception, with used condoms being the most used means which concurs with findings among adolescents in Nigeria and India (24). Contraception use could have been affected by knowledge, attitudes, religious and cultural opinions towards the methods. It is not surprising that a good number of the students in our study agreed that contraception is unacceptable in their religion and also perceived that use of condoms during sexual intercourse reduces pleasure.

### Teenage pregnancy

In our study, 78.5% of the students were aware about teenage pregnancy, which is in line with a study in South East Nigeria, which reported awareness at 71.8% (26, 27). This can be attributed to the rampant number of teenage pregnancies reported in Mbale District, and particularly Bukonde subcounty. According to the school administrators, each of the three schools had at least one girl in the candidate class who had become pregnant during the COVID-19 lockdown. Subsequently, school dropout was the most commonly reported danger of teenage pregnancy among the students in our study. Mother's level of education (secondary education) significantly affected knowledge on teenage pregnancy. In many rural communities in Uganda, it is the role of the mother and the aunt (*ssenga*) to train young girls on sexual and re-

productive health. It is during these sessions that girls are educated on sexuality and prepared for future marriages (28). They are therefore important stakeholders in the provision of sex education and programs targeting prevention of teenage pregnancy in Uganda.

Majority of the participants perceived that premarital sex was not negative, coherent with findings by Maly and colleagues in Rakai, Uganda (29). However, in our study, about 40.2% of the participants had had a sexual intercourse. This finding is higher than that reported in Nigeria (24). In a qualitative study by Nyanzi and colleagues in western Uganda, most of the pupils were sexually active while exchange of money and gifts played an important role in the negotiation of sexual relationships (30). In the above study, some pupils opted for sexual relationships with adults to increase benefits (30). In Mbale, the role of culture in sexuality cannot be overlooked. The indigenous *Bamasa-ba* who live here and neighbouring districts hold a cultural ceremony of male circumcision locally known as *imbalu*. During these seasons (usually even years), young boys are initiated into manhood through circumcision and a dance ceremony called *kado-di*. Sexual behaviours of adolescents during and after these ceremonies may expose them to teenage pregnancy.

Nevertheless, the top most cause of deaths among female adolescents globally and in Uganda are those related to complications of pregnancy and childbirths. The factors contributing to teenage pregnancy are multifactorial, ranging from individual-behaviour, traditional, and socio-cultural to religious in nature. Inarguably, low socio-economic status like poverty (31, 32), limited education (33), and early sexual activity (34) can perpetuate teenage pregnancy. Additionally, gaps in the implementation of the Penal Code Act of Uganda, the Uganda National Adolescent Reproductive Health Policy by government institutions could possibly be escalating the situation. Furthermore, in-

creased accessibility to internet and pornographic sharing (35), cross cultural influences such as teenage marriages and decreased supervision by adults, especially concerning sexual and reproductive health issues, have led to early initiation of sexual activity by teenagers (36).

### Strengths and limitations

Our study shows significant importance of sexual and reproductive health education on knowledge attitudes and practices. We were significantly able to improve knowledge on contraception and teenage pregnancy among school-going students in Bukonde sub-county, Mbale. We also significantly improved attitudes towards contraception among the students although attitudes towards teenage pregnancy was not significant. Our study however has some limitations. Firstly, our data collection tool is not standardized however we adopted questions based on information regarding contraception and teenage pregnancy from World Health Organisation and the Ministry of Health, Uganda. The Cronbach alpha scores were also above 0.7, indicating acceptable internal reliability.

### Conclusion and Recommendations

Nearly 40.2% of students have had sexual intercourse with a mean age at debut of who had had a sexual intercourse, 53 (41.7%) years. About one-third have also used contraception, with condoms being the most used. The knowledge of students on contraception and teenage pregnancy were poor at baseline but improved significantly after the intervention. Attitudes towards contraception also significantly improved.

Routine health education on sexual and reproductive health are recommended among students to improve their understanding of teenage pregnancy, hence reducing the burden in the long run. A comprehensive project involving all the stakeholders is ultimately recommended in order to have an overall impact on the burden of teenage pregnancy in the

district. This includes engaging academic institutions, political leaders, cultural leaders, the health sector and non-governmental organisations to act in their capacities to decrease teenage pregnancy and its complications.

### Conflict of interests

The authors declare no conflict of interests.

### Acknowledgement

The authors appreciate the support from the Department of Child Health and Development Center (Makerere University), the administration and staff of Bufumbo Health Center IV, the District Health Officer Mbale District, the local leaders in Bukonde sub-county and the administration team of COBERS program at Makerere University College of Health Sciences.

### References

1. Scally G. Too much too young? Teenage pregnancy is a public health, not a clinical, problem. *International Journal of Epidemiology*. 2002;31(3):554-5.
2. WHO. Adolescent pregnancy. *Issues in Adolescent Health and Development*. Geneva, Switzerland.: World Health Organisation; 2004.
3. WHO. Adolescent Pregnancy: World Health Organisation; 2020 [Available from: <https://www.who.int/news-room/fact-sheets/detail/adolescent-pregnancy>].
4. Ganchimeg T, Ota E, Morisaki N, Laopaiboon M, Lumbiganon P, Zhang J, et al. Pregnancy and childbirth outcomes among adolescent mothers: a World Health Organization multicountry study. *Journal of Obstetrics Gynaecology*. 2014;121:40-8.
5. WHO. Adolescents: Health Risks and Solutions. Geneva: World Health Organization; Geneva. 2017.
6. Darroch JE, Woog V, Bankole A, Ashford LS, Points K. Costs and benefits of meeting the contraceptive needs of adolescents. Guttmacher Institute. 2016.
7. WHO. Adolescent pregnancy: unmet needs and undone deeds. A review of the literature programmes. Geneva, Switzerland: World Health Organisation; 2007.
8. Bantebya GK, Muhanguzi FK, Watson C. Adolescent girls in the balance: Changes and continuity in social norms and practices around marriage and education in Uganda. J Overseas Development Institute: London, UK. 2014.
9. WHO. Global health estimates 2015: deaths by cause, age, sex, by country and by region, 2000-2015. World Health Organization Geneva; 2016.
10. Neal S, Matthews Z, Frost M, Fogstad H, Camacho AV, Laski L. Childbearing in adolescents aged 12–15 years in low resource countries: a neglected issue. New estimates from demographic and household surveys in 42 countries. *Acta obstetrica et gynecologica Scandinavica*. 2012;91(9):1114-8.
11. Sebudde RK, Wodon QT, Mawejje J. Uganda economic update: tenth edition – accelerating Uganda's development: ending child marriage, educating girls (English). Washington, D.C.: World Bank Group. 2017.
12. Kassa GM, Arowojolu A, Oduokogbe A, Yalew AW. Prevalence and determinants of adolescent pregnancy in Africa: a systematic review and meta-analysis. *Journal of Reproductive health*. 2018;15(1):195.
13. UBOS, ICF. Uganda demographic and health survey 2016: key indicators report. UDHS. Kampala, Uganda: Uganda Bureau of Statistics; 2017.
14. Manzi F, Ogwang J, Akankwatsa A, Wokali OC, Obba F, al. e. Factors Associated with Teenage Pregnancy and its Effects in Kibuku Town Council, Kibuku District, Eastern Uganda: A Cross Sectional Study. *Primary Health Care* 2018;8(298).
15. World Health O. Adolescent pregnancy: World Health Organization; 2020 [cited 2020 October 5].
16. The Reproductive Health Division. Adolescent Health Policy Guidelines and Service Standards. Kampala, Uganda.: Department of Community Health, Ministry of Health; 2012.
17. Blum RW, Gates WH. Girlhood, not motherhood: Preventing adolescent pregnancy. United Nations Population Fund (UNFPA). 2015.
18. Babatunde OA, Ibirongbe DO, Omede O, Babatunde OO, Durowade KA, Salaudeen AG, et al. Knowledge and use of emergency contraception among students of public secondary schools in Ilorin, Nigeria. *The Pan African medical journal*. 2016;23:74.
19. Dangat CM, Njau B. Knowledge, attitudes and practices on family planning services among adolescents in secondary schools in Hai District, northern Tanzania. *Tanzania journal of health research*. 2013;15(1).
20. Ottesen S, Narring F, Renteria SC, Michaud PA. Emergency contraception among teenagers in Switzerland: a cross-sectional survey on the sexuality of 16- to 20-year-olds. *The Journal of adolescent health: official publication of the Society for Adolescent Medicine*. 2002;31(1):101-10.
21. Nsubuga H, Sekandi JN, Sempeera H, Makumbi FE. Contraceptive use, knowledge, attitude, perceptions and sexual behavior among female University students in Uganda: a cross-sectional survey. *BMC women's health*. 2015;16(1):6.
22. Wu L. A Survey on the



- Knowledge, Attitude, and Behavior Regarding Contraception Use Among Pregnant Teenagers in Beijing, China. *Clinical Nursing Research*. 2010;19(4):403-15.
23. Ninsiima AB, Coene G, Michielsen K, Najjuka S, Kemigisha E, Ruzaaza GN, et al. Institutional and contextual obstacles to sexuality education policy implementation in Uganda. *Sex education*. 2020;20(1):17-32.
  24. Idowu A, Aremu OA, Fehintola FO, Popoola GO. Knowledge, attitude and practice of contraception by female junior secondary school students in an urban community of Oyo-state, South west, Nigeria. *Int J Reprod Contracept Obstet Gynecol*. 2017;6(4759):2320-1770.
  25. Blackstone SR, Nwaozuru U, Iwelunmor J. Factors influencing contraceptive use in sub-Saharan Africa: a systematic review. *International quarterly of community health education*. 2017;37(2):79-91.
  26. Ibeh CC, Ikechebelu JI. Teenage Pregnancy: Knowledge and Attitude of Adolescents in Southeast Nigeria. *International Journal of Medicine and Health Development*. 2002;7(2):104-7.
  27. Renjhen P, Kumar A, Pattan-shetty S, Sagir A, Samarasinghe CM. A study on knowledge, attitude and practice of contraception among college students in Sikkim, India. *J Turk Ger Gynecol Assoc*. 2010;11(2):78.
  28. Dralega CA. Examining women's customary roles as sex educators through community media in Uganda. *Agenda*. 2008;22(77):91-9.
  29. Maly C, McClendon KA, Baumgartner JN, Nakyanjo N, Ddaaki WG, Serwadda D, et al. Perceptions of adolescent pregnancy among teenage girls in Rakai, Uganda. *Global qualitative nursing research*. 2017;4:2333393617720555.
  30. Nyanzi S, Pool R, Kinsman J. The negotiation of sexual relationships among school pupils in south-western Uganda. *AIDS Care*. 2001;13(1):83-98.
  31. Bonell C, Allen E, Strange V, Copas A, Oakley A, Stephenson J, et al. The effect of dislike of school on risk of teenage pregnancy: Testing of hypotheses using longitudinal data from a randomised trial of sex education. *Journal of epidemiology and community health*. 2005;59:223-30.
  32. Vikat A, Rimpela A, Kosunen E, Rimpelä M. Sociodemographic differences in the occurrence of teenage pregnancies in Finland in 1987-1998: A follow up study. *Journal of epidemiology and community health*. 2002;56:659-68.
  33. Nour N. Health Consequences of Child Marriage in Africa. *Emerging infectious diseases*. 2006;12:1644-9.
  34. Edgardh K. Sexual behaviour and early coitarche in a national sample of 17-year-old Swedish boys. *Acta paediatrica (Oslo, Norway : 1992)*. 2002;91:985-91.
  35. Joesephine P, C. P. Adolescent sexual and reproductive health. *Global Journal for Research Analysis* 2016.
  36. Rachakonda L, Rawate S, Shiradkar S. Teenage pregnancy. *International Journal of Current Medical Applied Sciences*. 2014;4(2):2059-63.

# TELEMEDICINE

A KEY TO IMPROVE HEALTHCARE  
DELIVERY IN REMOTE AREAS IN AFRICA.



Author

**MALIK OLATUNDE ODUOYE**

malikolatunde36@gmail.com

Ahmadu Bello University, Zaria, Nigeria.

TELEPHONE NUMBER: +2349035928801

**“Telemedicine can be either  
asynchronous or synchronous...”.**  
**Maurice Mars.**

It is applicable and achievable in African remote areas  
provided that all necessary implementation strategies are  
put in place.



## INTRODUCTION

Telemedicine generally is truly a key to improve healthcare delivery in both urban and rural areas in the World. But the question is if it is feasible, practicable, and adaptable in African remote areas or not?

In most African Countries, quality and sophisticated healthcare delivery services could not be performed in

2006).

The diagnosis was made via a satellite link using slow-scan television transmission between Swaziland and London(Union, International Telecommunication, 2013).

By 1987, clinical case conferencing took place by satellite audio-conferencing between Canada, Kenya, and Uganda(House M, Keough E, Hillman D, 1987)(House M, 1989).

Electroencephalogram (EEG) was also transmitted from Mulago Hospital in Uganda to the Health Science Centre at St. John's Canada (Mars, 2013).



the remote areas due to the limited and poor usage of telemedicine as compared to the urban settings. The majority of acute and chronic illnesses are left undiagnosed or misdiagnosed due to the poor adoption and poor implementation of telemedicine in African remote areas.

## HISTORICAL PERSPECTIVE

In Africa, the first reported use of modern telemedicine was in 1984(International Telecommunications Union, 2013). It was first used to diagnosed **Crouzon's syndrome**(International Telecommunications Union, 2013). This syndrome is craniosynostosis with a broad forehead, ocular hypertelorism, exophthalmos, beaked nose, and hypoplasia of the maxilla(Lippincott Williams & Wilkins,

## DEFINITIONS

**What is Telemedicine?** Telemedicine can be defined as a health care delivery system where physicians, and other medical personnel can examine patients remotely using information and telecommunication technologies(Bashshur R., Sanders, J., & Shannon, 1997). The American Telemedicine Association, also defined telemedicine as “the use of medical information exchanged from one site to another via electronic communications for the health and education of the patient or healthcare provider and patient care”(‘American Telemedicine Association. What is telemedicine? Accessed 22, June 2013.’, 2013). These electronic communications include videoconference, encrypted emails, telephone

chats, etc.

According to the World Health Organization (WHO), Telemedicine, is a subset of eHealth, which is “the use of information and communication technology (ICT) for health(‘World Health Organisation. eHealth. Accessed 22 June 2013’, 2013)”. It differs from **eHealth** and **mHealth** in the sense that eHealth encompasses all clinical services, hospital information systems, including electronic medical records, education in the health sector, research, and surveillance(Mars, 2013). On the other hand, mHealth, which means **mobile health** focus on the use of the mobile telephone market to explore and navigate eHealth activities in wide-spread coverage(Mars, 2013). Thus, to improve healthcare delivery in remote areas in Africa, there is a need for good adoption and implementation of telemedicine.

## STATUS OF HEALTHCARE DELIVERY IN REMOTE AREAS IN AFRICA

**Remote areas in Africa**, have been defined as those areas that are less developed, and less equipped with highly sophisticated facilities, social amenities, information and communication technologies (ICTs) in various sectors, especially in health, education, economic, and political sectors. Some literature reviewed that most of these areas are otherwise known as rural areas, villages, towns, and confined areas. Prominent examples of these areas in Africa are; **Medupi Power Station, South Africa, Chitokoloki Mission, Zambia, Flatdogs Camp, Zambia, Marymount, Zimbabwe, Sambisa Forest, Nigeria, and Tarbaj, Kenya**. Most of these areas, have low internet penetration or non-existent and are served by VSAT, Liquid Telecom's award-winning internet organization that helps to deliver high-speed internet via



satellite to some of these remote corners of the region(VSAT, 2016).

The majority of the people living in these areas are poor. They include farmers, crafters, petty traders, refugees, and individuals with physical disabilities. They are a less civilized group of people, with little or no formal educational background. They lack good motorable roads, water supply, good housing, and healthcare delivery systems as compared to the urban citizens.

Africa, especially sub-Saharan Africa, is afflicted by acute and chronic health problems, for example, malaria, measles, pneumonia, cholera, hypertension, HIV, meningitis, tuberculosis, onchocerciasis, etc. Most of these health problems are prevalent in the African remote areas, especially, childhood malaria, waterborne diseases like diarrhea, dysentery, typhoid fevers, cholera, trypanosomiasis (sleeping sickness), onchocerciasis (river blindness), need urgent and immediate health interventions.

The Victims afflicted with these health problems in these areas are mostly the under-five children, pregnant women, and elderly persons. Reasons because, they have reduced immunity and antibodies to fight against these diseases, making them more vulnerable and susceptible to them and thus increasing the rate of mortality and morbidity of the diseases in these areas. A menace to remote areas in Africa!

Besides, there is an acute shortage of medical specialists and medical facilities in the African region(Mbarika, Datta and Media, 2006)like most sub-Saharan African countries, is faced with limited specialists and health care services. These services are often concentrated in the urban areas, leaving most of the rural population (about 70% of the coun-

try. Fraser, McGrath, & St. John, reviewed that Sub-Saharan Africa has, on average, fewer than 10 doctors per 100,000 people(Fraser and McGrath, 2000). 14 sub-Saharan African countries do not even have a single radiologist(Mars, 2013).

In Nigeria, for example, on average, a medical doctor attends to over 50 patients in most of the teaching hospitals, while 2-3 nurses would be assigned to manage 5-10 nursing wards and over 100 patients. In most of the sub-Saharan African Countries, current health care needs are hardly met due to inadequate capacity and competence, compounded by the limited number of health care

other things, including developing a long-term strategic plan for developing eHealth services(Committee A., 2005). Telemedicine has the potential to decrease health care costs, and increase access, capacity, and quality of health care in sub-Saharan Africa (Washington, 1994).

According to Maurice Mars, telemedicine is divided into two broad categories. These include:

1. **Asynchronous or store and forward telemedicine** and
2. **Synchronous or real-time telemedicine.**

**The store and forward telemedi-**



specialists who are often concentrated in the urban areas(Mbarika, Datta and Media, 2006)like most sub-Saharan African countries, is faced with limited specialists and health care services. These services are often concentrated in the urban areas, leaving most of the rural population (about 70% of the country.

#### **TELEMEDICINE AS A KEY TO IMPROVE HEALTHCARE DELIVERY IN AFRICAN REMOTE AREAS: ADVANTAGES!**

The promise of eHealth and telemedicine was clearly stated in resolution WHA 58.28 of the 2005 World Health Assembly. The assembly called on member nations to among

**cine** deals with the collection, and gathering of data, sent through electronic means to another health professional for diagnosis or a second opinion at a later date (Mars, 2013). A key example is the attachment of a photograph of a patient's Electrocardiogram (ECG) results or his/her skin lesion to an email, and also containing the patient's relevant clinical history, and findings, and sending an encrypted email to a colleague for a review, or uploading the information to a secure website(Mars, 2013).

On the other hand, **real-time or synchronous telemedicine** involves a live and interactive session. It is done through videoconference, for example through zoom, Google meet, Go to Webinar, WhatsApp

calls, Skype, etc. with audio and visual consultation. This type of telemedicine is augmented by distant examination with the use of peripheral devices such as electronic stethoscopes, video otoscopes(Mars, 2013), etc. in the management of a patient.

Having said this, we can fully understand what exactly telemedicine is all about, and perhaps, we can deduce its importance and how it could be used to improve health care delivery in African remote areas.

**Fig.1. An example of synchronous or real-time telemedicine. ('Could COVID-19 accelerate the use of Telemedicine in Africa?', 2020).**

Similarly, there is what is called **"Home monitoring"**. This is a growing area of telemedicine that involves data acquisition, storage, and interpretation. This area occurs synchronously or asynchronously from remote devices, smart clothes that acquire and transmit physiological data, and smart homes that monitor people's activity(Mars, 2013). There is no doubt that the use of home monitoring as an area of telemedicine is a key to improve healthcare delivery in African remote areas.

Virtually, telemedicine has been used to improve healthcare delivery in African countries, especially in urban settings. It can function in the **Cardiology Unit, Ophthalmology Unit, a Radiology Unit, Psychiatry, Dermatology Unit, Pathology, Obstetrics, Surgery, orthopedic, reconstructive surgery, etc.** For example, In Djibouti, where there are no pediatric orthopedic surgeons a store and forward, email-based service has assisted in diagnosis and altered case management (McMullen E, 2012). Text message reminders sent to patients have improved appointment adherence in Malawi(Mahmud N, Rodriguez J, 2010),

and follow-up in Nigeria(Odigie VI, Yusufu LMD, Dawotola DA, 2012), and the Cameroons(Davey DJ, Hares S, Ponce W, 2012).

Also, telemedicine is been used to make a **diagnosis of HIV/AIDS**. It has been used in the promotion of HIV testing in Uganda, and South Africa, used to provide HIV information, and care in Uganda, and HIV data gathering in South Africa(Chib A, Wilkin H, Ling LX, 2012)(De Tolly K, Skinner D, Nembaware V, 2012)(Lemay NV, Sullivan T, Jumbe B, 2012)(Chang LW, Kagaayi J, Arem H, 2011)(Mukudu A, 2012).

**In the field of cardiology**, which is the study of the heart and its abnormalities, telemedicine has been prov-



(Nikus K, Virtanen N, Sclarovsky S, 2011).

**In the field of radiology, Teleradiology** is an integral part of modern radiology. Through telemedicine, digital images are easily moved via electronic means for reporting within radiology information systems, with digital images stored in electronic picture archiving systems(Mars, 2013). For example, there have been several teleradiology initiatives that involved scanned or photographed X-Ray images sent to academic centers via dedicated connections or the Internet and linking computerized tomography (CT) scanners to academic centers in South Africa(Corr P, 1998)(Corr P, Couper I, Beningfield SJ, 2006)(Gulube SM, 2001).

en to be feasible and effective. The usage of telemedicine in this field is called **Telecardiology**. Telecardiology covers a spectrum of activities, including remote monitoring of implantable cardiovascular devices, continuous home monitoring of patients with heart failure, the transmission of Electrocardiograms (ECGs) by telephone, tele-echocardiography, tele-auscultation, medication compliance monitoring, and patient education and support(Birati EY, 2011)

**Fig.2. A picture showing how teleradiology is done somewhere in Africa ('How space-based systems can improve healthcare delivery in Africa.', 2020).**

**In the field of ophthalmology**, Tele-ophthalmology has been proven to reduce patient transfer by 80%(Mars M., 2007). A Web-based service of teleophthalmology, was established and was used in three African countries, namely; Ghana,

South Africa, and The Gambia (Kennedy C, Bowman R, Fariza N, 2006). Also, in South-Africa, the store and forward form of telemedicine was used to send reports of photographs of the surface of the eye, the anterior chamber, and lens, and was sent to an ophthalmologist by email (Mars, 2013).

Similarly, **in the field of obstetrics**, telemedicine has been used in the diagnosis of cervical cancer through the store and forward digital cervicography (Mars, 2013), in Zambia (Parham GP, Mwanahamuntu MH, Pfaendler KS, 2010). Also, mobile phones have been used to photograph and send images to a physician for distant interpretation or supervision of inexperienced healthcare staff (Quinley KE, Gormley RH, Ratcliffe SJ, 2011).

Furthermore, telemedicine has also been effective **in the field of psychiatry**. A pilot project carried out by Abdi YA, and Ejmi JY in Somaliland proved that telepsychiatry from Somaliland to Somali Diaspora groups in Europe was done via Skype (Abdi YA, 2011). Similar studies showed that telepsychiatry is effective in South Africa, as several studies have led to a video conference-based service, with the development of clinical, operational, and technical guidelines and an administrative model for telepsychiatry in the country (Chippis J, Ramlall S, 2012b). (Ramlall S, Chippis J, 2010) (Chippis J, 2012) (Chippis J, Ramlall S, 2012a) (Chippis J, Ramlall S, Madigoe T, 2012).

Due to the limited numbers of dermatopathologists in Africa, telemedicine has been used in the field of dermatology. According to Maurice Mars, only seven African countries have dermatopathologists (Mars, 2013). Through the help of telemedicine, dermatologists in Africa, have been able to discuss and shared

photographs of skin lesions, patient history, and presentation through a separate telephone connection. The iPath platform has been used in teledermatology (O'Mahony D, Banach L, Mahapa DH, 2002) and more recently, The Africa teledermatology project has set up a Web-based service with educational material available on its site (Kaddu S, Soyer HP, Gabler G, 2009) (Weinberg J, Kaddu S, Gabler G, 2009).

**In the field of pathology**, Pathologists have adopted store and forward telemedicine in viewing, standardizing, and sending staining techniques, including the ability the monitors to calibrate various pathology cells reference colors and positions for the reader (Mars, 2013).

#### LIMITATION OF TELEMEDICINE IN AFRICAN REMOTE AREAS

**Why is telemedicine uptake in African Countries low?** (Mars, 2013). Despite the advantages and the promising usage of telemedicine, its uptake in African Countries especially in remote areas has been limited and unavailable.

As I argued in my introductory paragraphs, there is a shortage of medical personnel to patient ratio in Africa especially in remote areas, not to talk about the lack of high sophisticated ICTs including quality and friendly social amenities in these areas. Thus, introducing telemedicine to these African remote areas might be overstressed the already stressed medical personnel, and consequently limiting the uptake of telemedicine.

Again, telemedicine requires information and communication infrastructure, the ability to use that infrastructure, a relatively stable supply of electricity, and people to maintain and support the infrastructure (Mars, 2013), which are lacking in most of remote areas in Africa. According to

a survey done by the international telecommunications union (ITU) in Geneva, 2013, only 6.7% of households in Africa have Internet access at home, 16.3% of people use the Internet, and fixed broadband penetration is 0.3% (International Telecommunications Union, 2013).

Also, Internet penetration in Africa is half that of Asia and the Pacific. It is the lowest of any developing world region (Mars, 2013). Because of the low and poor internet connection in African remote areas, most medical personnel and physicians in these areas considered telemedicine irrelevant. And also, In these remote communities, people are mostly computer illiterate and few of the over 2000 African languages are available on the Web (Mars, 2013). Use of mobile phones like androids, note pads, etc. in these areas are limited or unavailable, and according to a survey conducted by the International Telecommunication Union, mobile

phone penetration is reported to be 64% (International Telecommunications Union, 2013).

Another report reviewed by the International Telecommunication Union, showed that telecommunication costs in Africa when expressed as a percentage of per capita, the monthly, gross national product is very high and 14 of the 20 most expensive countries are in Africa (Union., 2012). And in rural areas, where telemedicine is needed the most by the poorest of the poor, it is least likely to be provided because of inadequate infrastructure and high connectivity costs (Mars, 2013).

More so, there is limited awareness of telemedicine by healthcare workers and the patient community, including lack of government (Mars, 2013), and political will in most of



the African Countries in adopting and implementing telemedicine in the remote areas. Also, the use of telemedicine in the African remote areas is affected by cultural, religious, ethical beliefs by most of the community members in those areas. Most of them might have a negative belief about its usage or not interested in it. A strong factor to be considered!

Another cause could be the issue of civil unrest in most African Countries. For example, the recent **#ENDSARs protest in Nigeria**, and **#ENDANGLOFRANCOPHONE protest in Cameroon**. This could reduce motivations and interest in adopting and implementing telemedicine in most of the remote areas in Africa.

## THE WAY FORWARD!

It is a usual saying that “education is the key to success, the key to optimal growth and development”. Thus, the single most important tool to improve the use of telemedicine in African communities is through what is called **Tele-education**.

Tele-education is by far the most successful use of ICT in health in Africa(Mars, 2013). This ideology is consistent with reports from Canada, Australia, and the United State, where tele-education reduces the sense of isolation experienced by rural doctors, as reviewed in a study conducted by Ricci MA, Caputo MP, Callas PW, et al, Moffatt JJ, Eley DS, and Gagnon MP, Duplantie J, Fortin J-P, et al.

Through the introduction of tele-education in African remote areas, the healthcare workers, including the community members would be more aware of telemedicine. Their negative beliefs, thoughts, and perceptions would change positively. Tele-education could be also

be achieved in rural areas, through educational initiatives. For example, RAFT, Réseau en Afrique Franco-phone pour la Télémédecine, which started in 2000 between Geneva and Mali(Mars, 2013). Similarly, the rural doctors, and patients, can participate in weekly webcasts using software designed to allow participation at very low bandwidth(Mars, 2013). For example, the Institute of Tropical Medicine in Antwerp has used a hybrid email Web support system with a discussion forum, with the provision of interactive quizzes and policy documents for continuing education in HIV(Zolfo M, Lynen L, Dierckx J, 2006).

Secondly, there should be strong political will by the African government in the provision of basic and high sophisticated social amenities such as stable and constant electricity, reduced internet costs, and an improved internet connection to facilitate videoconferencing, audio, and visual clinical history and examinations of patients, including reducing the tariffs of phone calls, data plans, among the rural healthcare workers and the community members.

Also, the African government should ensure prompt rehabilitation of those dilapidated roads to improved easy access to healthcare facilities in these areas. More so, the cybersecurity systems should be improved to reduce the rate of cybercrimes that could de-encrypt patients' records.

The African Policy-makers should advocate for better policy and implementation strategies that could reduce the ratio and proportion of rural doctors, nurses, and other health workers per the patients seen in a day and also increase the wages and salaries of this medical personnel. This would motivate them to practice, adopt, and implement telemedicine in the promotion and delivery of healthcare delivery services in

remote areas.

## CONCLUSION

Inconclusion, telemedicine has the potential to address the shortage of health professionals in Africa and improve a lot of rural patients living in remote areas. It is applicable and achievable in African remote areas provided that necessary implementation strategies are put in place.

Though there are poor adoption and implementation of telemedicine in most of these rural communities but could be improved through awareness, campaigns, and advocacy programs, seminars including government and political will about the usefulness and importance of telemedicine.

Therefore, all hands must be on the desk to ensure the effectiveness and the implementation of telemedicine in remote areas in Africa as it is a key to improve the healthcare delivery services in these areas.

## REFERENCES

1. Abdi YA, E. J. (2011) 'Internet based telepsychiatry: a pilot case in Somaliland. ', *Med Confl Surviv*, pp. 27:145-150.
2. 'American Telemedicine Association. What is telemedicine? Accessed 22, June 2013.' (2013). Available at: <http://www.american-telemed.org/learn/what-istelemedicine>.
3. Bashshur R., Sanders, J., & Shannon, G. : C. C. T. (1997) 'Telemedicine theory and practice', *Springfield, IL*.
4. Birati EY, R. A. (2011) 'Telecardiology.', *Isr Med Assoc J.*, pp. 498-503.

5. Chang LW, Kagaayi J, Arem H, et al. (2011) 'Impact of a mHealth intervention for peer health workers on AIDS care in rural Uganda: a mixed methods evaluation of a cluster-randomized trial.', *AIDS Behav.*, pp. 1776-1784.
6. Chib A, Wilkin H, Ling LX, et al. (2012) 'You have an important message! Evaluating the effectiveness of a text message HIV/AIDS campaign in Northwest Uganda.', *J Health Commun.*, pp. 17(Suppl 1):146-157.
7. Chipps J, Ramlall S, Madigoe T, et al. (2012) 'Developing telepsychiatry services in KwaZulu-Natal - an action research study', *Afr J Psychiatry.*, pp. 15:255-263.
8. Chipps J, Ramlall S, M. M. (2012a) 'A telepsychiatry model to support psychiatric outreach in the public sector in South Africa.', *Afr J Psychiatry.*, pp. 15:264-270.
9. Chipps J, Ramlall S, M. M. (2012b) 'Practice guidelines for videoconference-based telepsychiatry in South Africa.', *Afr J Psychiatry*, pp. 15:271-282.
10. Chipps J, M. M. (2012) 'Readiness of health-care institutions in KwaZulu-Natal to implement telepsychiatry.', *J Telemed Telecare.*, pp. 18:133-137.
11. Committee A. (2005) 'World Health Assembly eHealth Resolution (WHA58.28).', p. A58/62:4-6.
12. Corr P, Couper I, Beningsfield SJ, et al. (2006) 'A simple telemedicine system using a digital camera.', *J Telemed Telecare.*, pp. 6:233-236.
13. Corr P. (1998) 'Teleradiology in KwaZulu-Natal. A pilot project.', *S Afr Med J*, pp. 88:48-49.
14. 'Could COVID-19 accelerate the use of Telemedicine in Africa?' (2020). Available at: [hcsmsa.co.za](http://hcsmsa.co.za).
15. Davey DJ, Hares S, Ponce W, et al. (2012) 'Evaluating SMS reminders in improving ART and PMTCT adherence in Mozambique: challenges in achieving scale. on Appropriate Healthcare Technologies for Developing Countries.', *7th International Conference*, p. 41.
16. Fraser, H. S. and McGrath, S. J. (2000) 'Information technology and telemedicine in sub-saharan Africa', *BMJ (Clinical research ed.)*. British Medical Journal, 321(7259), pp. 465-466. doi: 10.1136/bmj.321.7259.465.
17. Gulube SM, W. S. (2001) 'Telemedicine in South Africa: success or failure?', *J Telemed Telecare.*, pp. 7:47-49.
18. House M, Keough E, Hillman D, et al. (1987) 'Into Africa: the telemedicine links between Canada, Kenya and Uganda.', *CMAJ*, pp. 136:398-400.
19. House M, K. E. (1989) 'Telemedicine and distance education: the Memorial University of Newfoundland experience. Communications: world prosperity through, communications.', pp. 302-305.
20. 'How space-based systems can improve healthcare delivery in Africa.' (2020). Available at: [africanews.space](http://africanews.space).
21. International Telecommunications Union (2013) 'ICT facts and figures.' Available at: <http://www.itu.int/en/ITU-D/Statistics/Pages/facts/%0Adefault.aspx>. 2013.
22. Kaddu S, Soyer HP, Gabler G, et al. (2009) 'The Africa Teledermatology Project: preliminary experience with a sub-Saharan teledermatology and e-learning program. *Dermatol.*', *J Am Acad*, pp. 61:155-157.
23. Kennedy C, Bowman R, Fariza N, et al. (2006) 'Audit of Web-based telemedicine in ophthalmology.', *J Telemed Telecare.*, pp. 12:88-91.
24. Lemay NV, Sullivan T, Jumbe B, et al. (2012) 'Reaching remote health workers in Malawi: baseline assessment of a pilot mHealth intervention.', *J Health Commun.*, pp. 17(Suppl 1):105-117.
25. Lippincott Williams & Wilkins (2006) *STEDMAN'S MEDICAL DICTIONARY*. 28th edn. Edited by H. John H, Dirckx, Raymond, Lukens, Ellen, Atwood, Vincent, Ercolano, William R. Julie K. Stegman. Available at: [www.stedmans.com](http://www.stedmans.com).
26. Mahmud N, Rodriguez J, N. J. (2010) 'A text message-based intervention to bridge the healthcare communication gap in the rural developing world.', *Technol Health Care.*, pp. 18:137-144.
27. Mars M. (2007) 'Telemedicine in KwaZulu-Natal: from failure to cautious optimism.', *J Telemed Telecare*, pp. 13:57-59.
28. Mars, M. (2013) 'ScienceDirect Telemedicine and Advances in Urban and Rural Healthcare Delivery in Africa', *Progress in Cardiovascular Diseases*. Elsevier Inc., 56(3), pp. 1-10. doi: 10.1016/j.pcad.2013.10.006.
29. Mbarika, V. W. A., Datta, P. and Media, S. (2006) 'Telemedicine in Sub-Saharan Africa : The Case of Teleophthalmology and Eye Care in Ethiopia', (August), pp. 1-12. doi: 10.1002/asi.20448.
30. McMullen E (2012) 'Use of audiovisual equipment (SKYPE) for the treatment of hand injuries for remote consultations.', *Hand Ther.*, pp. 17:42-46.
31. Mukudu A, V. B. J. (2012) 'A case

- study of a successful mHealth application: cell-life's EMIT system.', *Recent progress in DEIT*, . Berlin: Springer-Verlag;, Vol 2, pp. 401-408.
32. Nikus K, Virtanen N, Sclarovsky S, et al. (2011) 'The role of standard 12-lead ECG in a telecardiology consultation service. In: Grashew G, ed. Telemedicine Techniques and Applications.', *Intech: Rijeka*.
33. O'Mahony D, Banach L, Mahapa DH, et al. (2002) 'Teledermatology in a rural family practice.', *S Afr Fam Pract.*, pp. 6:4-8.
34. Odigie VI, Yusufu LMD, Dawotola DA, et al (2012) 'The mobile phone as a tool in improving cancer care in Nigeria.', *Psycho-Oncology.*, pp. 21:332-335.
35. Parham GP, Mwanahamuntu MH, Pfaendler KS, et al. (2010) 'EC3-A modern telecommunications matrix for cervical cancer prevention in Zambia.', *J Low Genit Tract Dis.*, pp. 14:167-173.
36. Quinley KE, Gormley RH, Ratcliffe SJ, et al. (2011) 'Use of mobile telemedicine for cervical cancer screening.', *J Telemed Telecare.*, pp. 17:203-209.
37. Ramlall S, Chipps J, M. M. (2010) 'Impact of the South African Mental Health Care Act No. 17 of 2002 on regional and district hospitals designated for mental health care in KwaZulu-Natal.', *S Afr Med J.*, pp. 10:667-670.
38. De Tolly K, Skinner D, Nembaware V, et al. (2012) 'Investigation into the use of shortmessage services to expand uptake of human immunodeficiency virus testing, and whether content and dosage have impact.', *Telemed J E Health.*, pp. 18:18-23.
39. Union, International Telecommunication, T. D. B. (2013) 'Impact of telecommunications in health-care and other social services.', *Geneva: ITU.*, pp. 2/155(Rev2)-E.
40. Union., I. T. (2012) 'Measuring the information society 2012. Geneva'.
41. VSAT (2016) 'VSAT-Internet delivery to remote areas in African Region.' Available at: <https://www.liquidtelecom.com/insights/innovation-blog/Top-five-most-remote-locations-in-Africa-served-by-VSAT>.
42. Washington, D. (1994) 'Council on Competitiveness (COC). Breaking the barriers to the national information infrastructure.'
43. Weinberg J, Kaddu S, Gabler G, et al. (2009) 'The African Teledermatology Project: providing access to dermatologic care and education in sub-Saharan Africa.', *Pan Afr Med J.*, p. 3:16.
44. 'World Health Organisation. eHealth. Accessed 22 June 2013' (2013). Available at: <http://www.who.int/%0Atopics/ehealth/en/>.
45. Zolfo M, Lynen L, Dierckx J, et al. (2006) 'Remote consultations and HIV/AIDS continuing education in low-resource settings.', *Med Inform. Int J.*, pp. 75:633-637.



# CENTRAL NERVOUS SYSTEM TUMOURS: A THEORY ON THE PATHOGENESIS OF CENTRAL NERVOUS SYSTEM TUMOURS



Dr. Geraldine Owor, MBChB, MD  
(Neuropathology elective)

Lecturer Department of Pathology

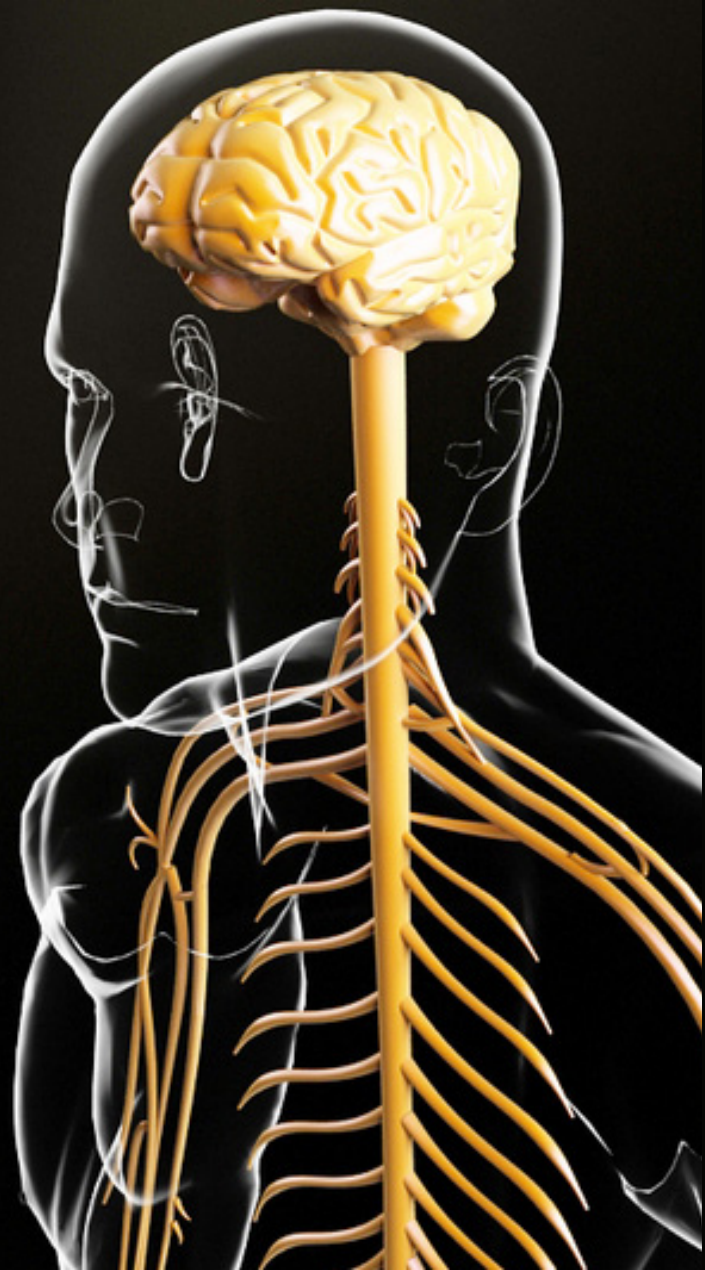
Makerere College of Health Sciences

P.O Box 7072

Kampala

Uganda

Email : [geraldine.owor@gmail.com](mailto:geraldine.owor@gmail.com)



## ABSTRACT

**Introduction/Background:** Epidemiological and biological evidence exists for a common pathway of tumours but no theory on molecular pathogenesis of Central Nervous System Tumours (CNSTs) exists thus multimodal and single treatment are used reflecting the lack of a theory.

**Objectives:** To determine clinicopathological characteristics of CNSTs and prognosis, and their activation pathways and formulate a theory on the pathogenesis of CNSTs.

**Methodology:** A cross-sectional study comparing CNSTs in the Kampala Cancer registry from 1960-1980 and 1991-2011 was carried out. The data were analysed for clinicopathological features and prognosis. STATA version 14, a chi square test (significance levels at  $P = 0.05$  and a 95% confidence interval) and a student t-test were used. Kaplan Meier curve, Univariate and Multivariate analysis using Cox regression model were used. A second study searched several databases for research studies on activation of pathways of tumourigenesis of CNSTs.

### Results:

A multivariate analysis showed no histology to be the only factor associated with the outcome,  $P$  value 0.03. Not significant for prognosis was the histologic type.  $P$  values 0.605 and 0.886. Out of 59 CNSTs, 43 had more than one pathway activated, 6 had one pathway activated but there were no studies available on their other pathways and 1 had one pathway inactivated.

**Conclusion:** In the molecular Pathogenesis of CNSTs the action is in concert albeit unequally such that shared pathways are predeterminants of tumourigenesis

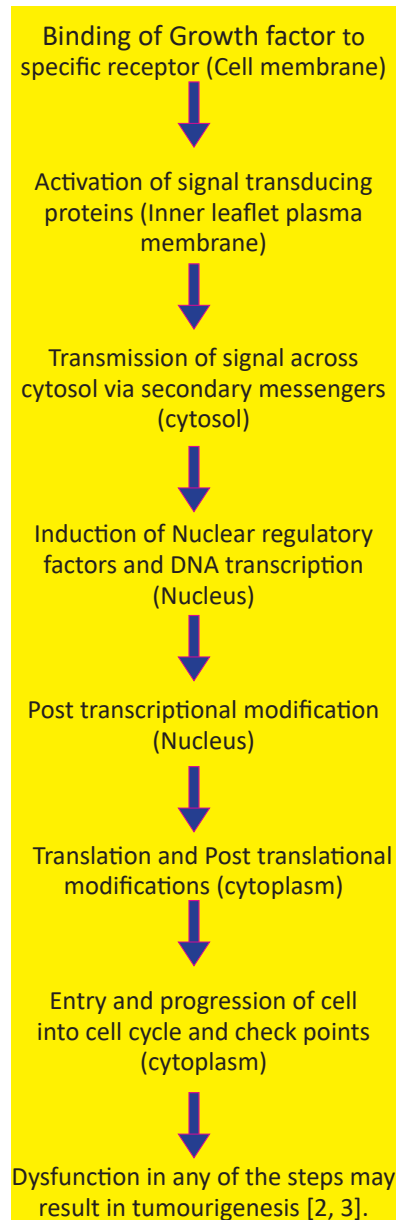
**Recommendation:** A similar study for non CNSTs is recommended to determine whether the theory applies to these tumours as well.

**Declaration:** No conflicts of interest are declared

**Funding:** None

**Introduction:** Epidemiological and biological evidence exists for a common pathway of tumours but no theory on molecular pathogenesis of Brain Tumours (BTs) exists thus multimodal and single treatment are used reflecting the lack of a theory. In the multimodal approach a patient is given Temozolomide, lomustine and antiangiogenic therapy such as bevacizumab while in single treatment Temozolomide is given [1].

The molecular pathogenesis of all tumours has epidemiological and biological evidence supporting a common sequential pathway given below



In step one several growth factors have been described. Mutations of genes that encode growth factors can undergo mutations and become oncogenes such as the protooncogene c-sis which encodes the  $\beta$ -chain of Platelet Derived Growth Factor (PDGF). Astrocytomas are known to produce PDGF and have receptors for it and thus have some autocrine stimulation. However, the more common mechanism is products of other oncogenes such as ras (that lies along the signal transduction pathway) causing overexpression of growth factor genes thus making the tumour cells secrete large amounts of growth factor. Increased proliferation alone does not lead to malignancy and so it is thought that proliferation increases the chances of mutations thus leading to malignancy by the mutant receptors delivering continuous mitogenic signals.

The next step in the sequence is signal transduction. There are several proteins which receive signals from outside the cell and transmit them to the cell nucleus. An example of such a protein is the ras family of Guanine Triphosphate binding proteins. It has an activated state and a quiescent state. The activated state excites the MAP (Mitogen Activated Protein) kinase pathway by recruiting the cytosolic protein raf-1.

The next step is transmission of the signal across the cytosol by secondary messengers. There is removal of GDP and it is replaced by GTP during ras activation. The GTPase activity intrinsic to normal ras proteins is accelerated by GTPase activating Proteins or GAPs which prevent uncontrolled ras activity. In tumours mutant

ras proteins bind GAP and thus their GTPase activity fails and the mutant proteins remain in their activated state causing a pathological activation of the mitogenic signalling pathway.

The next step is DNA Transcription. All the signal transduction pathways such as the MAP kinase pathway enter the nucleus and impact on the genes. The transcription factors in the nucleus contain specific amino acid sequences that allow them to bind DNA. Examples are the helix-loop-helix, leucine zipper, zinc-finger and homeodomain transcription factors which have motifs for dimerization for DNA binding. Many of these protein factors bind DNA at specific sites from which they activate or inhibit transcription at adjacent genes. Transcription of genes into RNA occurs and is rigidly controlled. Mutations affecting genes that encode nuclear transcription factors are associated with malignant transformation. There are several nuclear regulatory factors involved in this process and the common ones are the oncoproteins and products of the myc, myb, jun and fos oncogenes. The myc-max heterodimer binds to specific DNA sequences (termed E-boxes) for example and acts as a potent transcriptional activator thus encouraging cell growth while the mad-max heterodimer functions as a transcriptional repressor thus inhibiting growth.

During this process there may be oncogene activation – Protooncogenes are transformed into oncogenes by changes in structure of the gene resulting in abnormal products such as oncoproteins or by changes in regulation of gene expression resulting in enhanced or inappropriate production of structurally normal growth promoting protein. The changes are brought about by point mutations, or by chromosomal rearrangements such as translocations and inversions or by Gene amplifications.

The next step is posttranscriptional modification. In this process the transcript is modified into mature RNA. The modified transcript has a cap at the 5' end and a poly A tail at the 3' end. Introns of the genes are removed and exons are spliced resulting in a processed nuclear messenger RNA (mRNA).

The next step is translation which occurs in the cytoplasm in which the mRNA is translated into protein. The post translational modifications include methylations and acetylations.

The final step is the entry of the proteins into the cell cycle. Critical target proteins that are required for progression of the cells to the next phase of the cell cycle are phosphorylated by Cyclin dependent kinases (CDK) which bind to another family of proteins the Cyclins. The activated CDK allows the cell to cross the G1/S checkpoint by phosphorylating retinoblastoma (Rb) protein. The transition from G1 to S is an extremely important checkpoint in the cell cycle during which checkpoint molecules bring the cell cycle to a stop for such functions as the repair of DNA damage [2,3].

**Methodology:** A cross-sectional study comparing CNSTs in the Kampala Cancer registry from 1960-1980 and from 1991-2011 was carried out. Data were analysed for clinicopathological features and association with prognosis. Statistical analysis was carried out using STATA version 14, chi square test (significance levels at  $P = 0.05$  and a 95% confidence interval), student t-test for comparison of the two time groups, Kaplan Meier curve analysis for overall survival, Univariate and Multivariate analysis using Cox regression model for multiple variables and a Hazards Ratio (HR) to determine the chance of an event occurring in the two time frames. Trends and associated factors were determined using linear regression analysis.

The Taro Yamane formula was used for sample sizes  $n = N / 1 + N(e)^2$

Where N = Total number of cases seen in registry in 10 years (11 for 1960-1980 and 113 for 1991-2011),  $e = 0.05$  precision and 95% confidence interval. Sample size for 1960-1980 = 10.7 and for 1991-2011 was = 88.1 cases

A second study searched several databases including Google scholar, Google, Pubmed, OVID for research studies on activation of pathways of tumourigenesis of CNSTs.

## RESULTS:

There were 22 cases between 1960-1980 and 227 between 1991-2011

Incidence per 100,000 was 1.7 for Males and 1.8 for females in 1960-1980 and 3.1 for males and 2.8 for females in 1991-2011

The Male : Female ratio was 1:1(11:11) for 1960-1980 and 1:0.9 (120:107) for 1991-2011. The mean age for males was 38.3 years (S.D 41.1) and for females was 26.5 (SD20.6) for 1960-1980 while for males it was 33.4 years (SD 22.2) and for females it was 37.6 (SD25.5) for 1991-2011.

Proportion with histological diagnosis:

Between 1960-1980 7(31.8%) of patients had an autopsy/histology, 0 had clinical only or death certificate while 15(68.2%) had histology of the primary. Between 1991-2011, 157 (69.2%) had clinical only, 8(3.5%) had death certificate only, 1 (0.4%) had histology of metastases and 61 (26.9%) had histology of primary tumour.  $p < 0.001$

Primary site of tumour by age and sex:

Between 1960-1980, 20 (90.9%) involved the cerebrum while 2 (9.09%) the meninges,  $p = 0.476$  while between 1991-2011 15(6.61%) involved the meninges, 196(86.34%) the cerebrum, 9(3.96%) cerebellum



and spinal cord, 4(1.76%) the brainstem and 3 (1.32%) the ventricle.  $p=0.59$ . Of these patients between 1960-1980, all 11 (100%) males had tumour in the cerebrum, while 2 females (18.18%) had tumour in the meninges and 9 (81.82) had tumour in the cerebrum. In 1991-2011, 106 (88.33%) males had tumour in the cerebrum, 8 (6.67%) had tumour in the meninges, 3(2.5%) had tumour in the cerebellum and spinal cord, 2 (1.67%) had tumour in the ventricles and 1 (0.83%) had tumour in the brainstem while 90 (84.11%) females had tumour in the cerebrum, 7(6.54%) had tumour in the meninges, 6(5.61%) had tumour in the cerebellum and spinal cord, 3(2.8%) had tumour in the brain stem and 1 (0.93%) had tumour in the ventricle. Regarding the age between 1960-1980 there were 13 adult tumours out of 22 tumours and 9 paediatric tumours out of 22 tumours and of these 11 (84.62%) of adult tumours were in the cerebrum and 2 (15.38%) were in the meninges and all 9 paediatric tumours were in the cerebrum  $p=0.494$  while between 1991-2011, there were 165 adult tumours out of 227 tumours and 62 paediatric tumours out of 227 tumours. Of these 54 (87.1%) paediatric tumours occurred in the cerebrum, 4(6.45%) occurred in the cerebellum and spinal cord, 2 (3.23%) in the meninges, 1(1.61%) in the brainstem and 1(1.61%) in the ventricle while 142(86.06%) adult tumours occurred in the cerebrum, 13(7.88%) in the meninges, 5(3.03%) in the cerebellum and spinal cord, 3(1.82%) in the brainstem and 2(1.21%) in the ventricles.  $P=0.498$ .

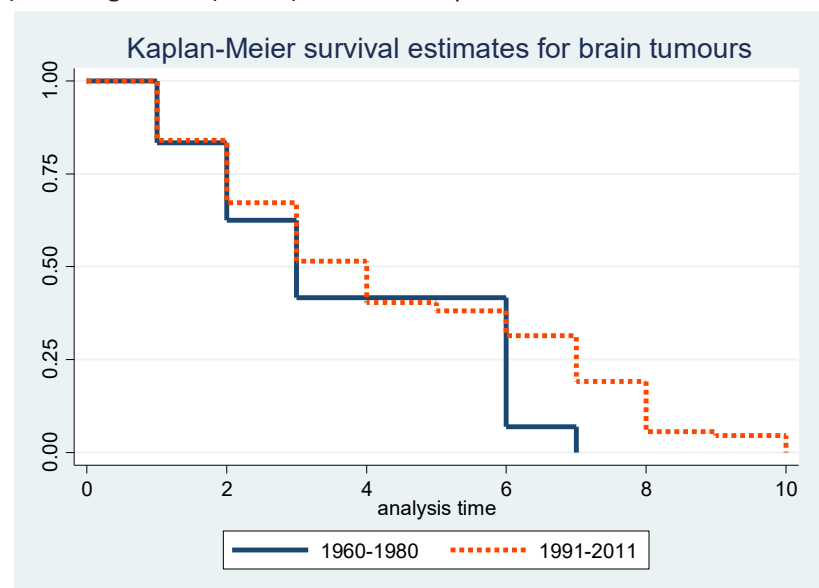
### Clinical Investigations used:

Between 1960-1980, 22 (100%) cases had histology while between 1991-2011, 69 (30.4%) had histology while 157 (69.2%) had clinical only and 1 (0.4%) had an autopsy  $p<0.001$ .

Brain tumour types and frequency by age:

Gliomas were found in 6(66.67%), and medulloblastoma in 3 (33.33%) paediatric patients between 1960-1980  $p=0.311$  while Gliomas were found in 10 (76.92%), meningioma in 2(15.38%) and medulloblastoma in 1(7.69%) adults while between 1991-2011, Gliomas constituted 51 (82.26%), Medulloblastoma 10 (16.13%), Lymphoma 1(1.61%), Meningioma 0 (0%) and metastatic 0 (0%) of paediatric patients while 151 (91.52%) gliomas, metastatic 6 (3.64%), meningioma 5 (3.03%),

Between 1960 and 1980 there was an increase in Paediatric tumours compared to adult tumours while in 1991-2011 there was an increase in adult tumours compared to paediatric tumours. Between 1960 and 1980 there was an increase in female tumours compared to tumours in males while between 1991-2011 there was an increase in male tumours compared to tumours in females. Regarding the incidence of tumours there was an increase in incidence of tumours in females compared to males in both time

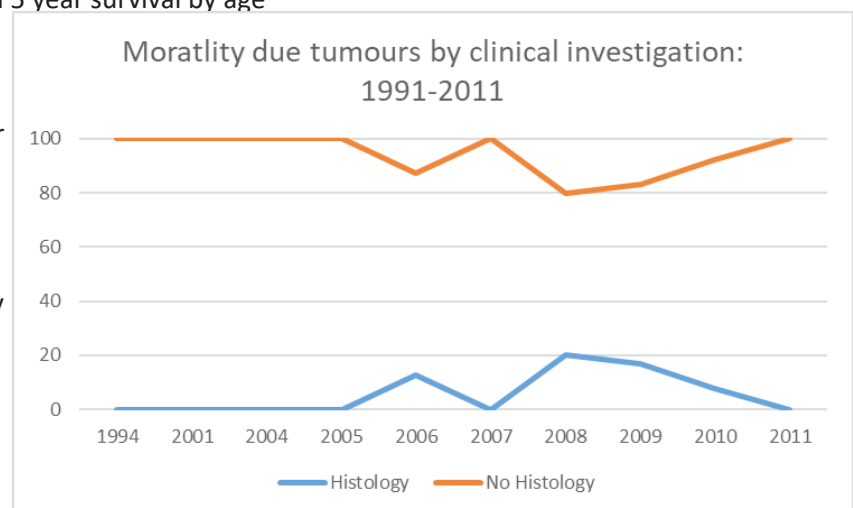


medulloblastoma 2 (1.21%) and Lymphoma 1(0.61%) were found in adults  $p<0.001$ .

### Trends:

The overall 5 year survival by age and sex, showed a decline in survival for both time periods which was not statistically significant (see figure 1) and the

groups. In 1991-2011 there was an increase in mortality in adults compared to paediatric patients while there was no trend between 1960 and 1980. Finally there was an increasing trend in patients with



investigation showed an increase in clinical only (No histology) and had a higher mortality (see figure 2).

no histology compared to histology between 1991-2011 while there was no trend between 1960 and 1980.

A multivariate analysis showed no histology to be the only factor associated with the outcome P value (0.03). The sex, age, period, and tumour site were not associated with prognosis. Also not significant for prognosis was the histologic type. P values 0.605 and 0.886 (see table 1).

Figure 1:

**Log-rank test for equality of survivor functions: p-value= 0.1571**

Figure 2:

Table 1: Multivariate analysis

		Crude HR (95%CI)	p-value
Histology	Histology	1	
	No Histology	1.55(1.04-2.31)	0.03*
tumour type	Glioma	1	
	Meningioma	1.23(0.56-2.68)	0.605
	Medulloblastoma	0.96(0.52-1.76)	0.886
	Metastatic	0.86(0.27-2.74)	0.804
tumour site	Meninges	1	
	Cerebrum	1.92(0.78-4.76)	0.158
	Cerebellum and S_cord	1.93(0.58-6.37)	0.281
	Brain stem	0.99(0.23-4.17)	0.987
	Ventricle	0.77(0.09-6.67)	0.816
Sex	Males	1	
	Females	0.86(0.58-1.26)	0.438
Age group	Paediatrics	1	
	Adults	0.94(0.62-1.41)	0.757
Period	1960-1980	1	
	1991-2011	0.7(0.4-1.22)	0.209

In the second study, out of 59 CNSTs, 43 (72.9%) had more than one pathway activated, 6 (10.2%) had one pathway activated but there were no studies available on their other pathways and 10 (16.9%) had no information on pathways activated. For the 1 tumour which had one was medulloblastoma which had a checkpoint pathway inactivated, (Table 2).

of its pathways inactivated there were other studies with activation of the pathway. These negative findings were included rather than excluded in the face of other studies with positive findings since the negative findings deserve an explanation. Ten tumours the Meningeal melanocytoma, lipoma, Anaplastic Large Cell Lymphoma, MALT Lymphoma of dura, Langerhan's cell histiocytosis, Erdheim Chester disease, Histiocytic sarcoma, CNS seminomas, teratomas and choriocarcinomas did not have any information regarding the activation of their molecular pathways.

The 43 tumours which had more than one pathway reported as activated included Glioblastoma multiforme, Gliosarcoma, Diffuse astrocytoma, Oligodendroglioma, Oligoastrocytoma, Pilocytic astrocytoma, SubEpendymal Glial Astrocytoma, Pleomorphic Xanthoastrocytoma, Ependymoma, Chordoid glioma of the third ventricle, Angiocentric glioma, Astroblastoma, Choroid plexus papilloma, Choroid plexus carcinoma, Dysembryoplastic Neuroectodermal tumour, Gangliocytoma, Ganglioglioma, Glioneuronal tumours, Neurocytoma, Paraganglioma, Pineocytoma, Pineoblastoma, Medulloblastoma, Embryonal tumour with multi-layered rosettes, CNS Neuroblastoma, Atypical Teratoid Rhabdoid tumour, Schwannoma, Neurofibroma, Perineuroma, Malignant Peripheral Nerve Sheath Tumour, Meningiomas, Hemangiopericytoma, Ewing's sarcoma/PNET, Hemangioblastoma, Hemangioma, Primary CNS Lymphomas, Diffuse Large B cell Lymphomas, Embryonal carcinoma, Craniopharyngiomas, Granular cell tumour of the sellar region, Pituicytoma, Spindle cell oncocytoma, and Pituitary adenoma.

The 6 tumours which had one pathway reported as activated included Hemangioendothelioma, Rhabdomyosarcoma, Meningeal melanoma, Germ cell tumours, Yolk sac tumour and Neuromuscular choristoma.

The one tumour which had some inactivated pathways

**Table 2. Common CNSTs and activation of tumourigenesis pathways**

	Cell signaling	Signal transduction	DNA Transcription	Post Transcriptional modification	Translation & Post translational modification	Cell cycle	Check points
GBM	+	+	+	+	+	+	+
Medulloblastoma	+	+	+	+	+	+	-
Diffuse astrocytoma	+	+	+	+	+	+	+
Oligodendroglioma	+	+	+	+	+	+	+
Oligoastrocytoma	+	+	?	+	+	+	+
Pilocytic astrocytoma	+	+	?	+	+	+	+
SEGA	+	+	?	+	+	+	+
PXA	+	+	?	+	+	+	+
Ependymomas	+	+	+	+	+	+	+
Pituitary adenoma	+	+	+	?	+	+	+
Meningioma	+	+	+	+	+	+	+
Primary CNS Lymphomas	+	+	+	?	+	?	?

GBM Glioblastoma multiforme,  
SEGA Subependymal Glial  
Astrocytoma, PXA Pleomorphic  
Xanthoastrocytoma, + evidence  
exists for activation of pathways,  
no information available – evidence  
exists against activation of pathways

### Discussion:

The incidence of brain tumours worldwide is higher in developed than developing countries. In Africa the incidence is 2.81: 100,000 compared to 6.76:100,000 in Europe and may be related to the Human Development Index with the highest incidence rates in Italy, 10.5 per 100,000 persons [4, 5]. The incidence from this study resembles that in Africa [5]. Worldwide the age group most affected is 0-14 years with an incidence of 34.1% compared to 20-34 years 28.3%. [6]. This is different from this study where there is a higher proportion of adult over paediatric tumours

The results from this study suggest a male gender has a slightly higher risk of developing brain tumours which is similar to other findings [7].

Gliomas in this study accounted for up to 82.26% which is similar to the United Kingdom's 86% [8].

### Trends:

Regarding increasing incidence of brain tumours this study found a correlation with radiological investigation (clinical only) and this from previous studies has accounted for the increased incidence of brain tumours due to more sophisticated equipment such as CT scans and MRI resulting in the increased incidence of tumours. There has also been an improved survival related to increased radiological use presumably due to earlier detection of tumours [8] but this study did not find such an association. There was also an increase in tumour subtypes suggesting a change in Neuropathology practice. There

was also an increased mortality in patients without histology suggesting surgery as the main option to improve survival since the histology in brain tumours is mainly operative. These trends have also been found in the United Kingdom and elsewhere [8]. The increased mortality in those without histology can be explained by the closed cranium since the majority of the tumours were located in the cerebrum. The closed compartment does not allow Space Occupying lesions in the cranium leading to compression of the brain stem and many symptoms [9] hence the high mortality observed in the patients without histology in this study. These results suggest surgery as the mainstay of treatment since this reduces the intracranial pressure. However some tumours are located in surgically inaccessible locations such as the brain stem and ventricles as observed in this study. These patients may benefit from targeted therapy with temozolomide and other chemotherapeutic agents. The current targeted therapy may be a single regimen or multiple regimens [1]. This therapy may also decrease the intracranial pressure if there is a response although delivery of the drug is complicated by the Blood Brain Barrier. Lastly with Gene therapy a chimeric molecule created from a Plasmid DNA molecule and the Human DNA insert is created by gene cloning and this is delivered into the genome of the human host cells such as Bone marrow precursor cells or brain progenitor cells. The introduced gene begins to direct the expression of its protein product and this corrects the deficiency in the host cell. The vector uptake thus replaces the missing genes [10].

### Prognosis:

This study found no histology as the only factor associated with a poor outcome. The histologic subtypes, age, sex, tumour site and time period were not associated with prognosis. Although the initial analysis of histologic subtypes by

age showed a statistically significant difference further multivariate analysis did not find this statistical difference or an association with prognosis. This is different from most other studies which found histological subtypes, age and grade of the tumour to be related to the prognosis. However, it was a review article [8] while the study which found a difference in survival between glial and non-glial tumours did not use a multivariate analysis [11]. This piece of epidemiological evidence is the basis of this theory on the molecular pathogenesis of brain tumours which states that CNSTs act in concert albeit unequally. If the tumours did not act in concert and each tumour subtype had an independent predominant pathway one would expect a different epidemiological pattern. The epidemiology would reflect a difference between histological subtypes as most studies have found on initial analysis. However, when you control for confounding factors as was done in this study, and the results show that there is no difference between tumour subtypes, a different pathogenetic mechanism becomes apparent. There already exists evidence of a common pathway however; there is no good theory on how the histological types therefore act. Two scenarios are apparent, a common pathway followed by all tumours with each tumour with an independent predominant pathway or all tumours with a common pathway but with each tumour with pathways acting in concert resulting in one integrated system that all CNS tumours share. The epidemiological evidence from this study supports an integrated system rather than individual predominant mechanisms for each tumour or we would have had tumour subtype being statistically significant. Earlier and recent studies have found cooperation of some pathways. In gene activation phosphorylated 4E binds to the cap enhancing the rate of initiation. Involved in this process



is MAP Kinase pathway, a signal transduction pathway [12]. More recent studies have also shown 'cross talk' between SOX2 involved in DNA transcription responsible for self-renewal and pluripotency and Sonic Hedgehog and Beta-catenin signalling pathways [13]. SOX2 is also involved in the pathogenesis of Glioblastoma multiforme where its aberrant expression is regulated by the TGF- $\beta$ , SHH, EGFR and FGFR signalling pathways [14]. The SHH signalling pathway involved in SOX2 expression in both pituitary adenomas and Glioblastoma multiforme is an example of the action in concert and common pathway shared by different tumours which may be responsible for our findings of no histological difference found on multivariate analysis. Whereas there are individual differences in the signalling pathways our findings suggest that the pathways that are shared may be the predeterminant of tumourigenesis and it is in concert as seen from the interaction between SOX2 and the SHH signalling pathway in both tumours.

The unequal activation of brain tumours follows the second study which was based on a database search for biological evidence. This study found 1 (1.7%) tumour with an inactivated pathway and 43 (72.9%) tumours with activation of all pathways. Regarding checkpoints a study on Paediatric intracranial germ cell tumours found overexpression of genes involved in the DNA damage checkpoint indicating active DNA integrity checkpoints [15]. Human Embryonal Carcinoma cells have also been demonstrated to arrest in the G2 phase and Rad 3 related checkpoint kinase 1 (ATR-CHK1) and p21 pathways might play a role in Ionizing radiation mediated S phase checkpoint in Embryonal Carcinoma cells [16]. In contrast, a study by Vermeulen et al found no PDL-1 immune checkpoints on all their medulloblastoma cases

[17]. However, the study did not examine the Rb pathway and did not study the expression of the genes involved in the PDL-1 checkpoints such as the CD274 gene [18]. As with most studies in the database search not all tumour cells expressed or overexpressed the genes, checkpoint or pathway signalling factors. An example is a study on Glioblastoma where only 38% -61% expressed PD-L1 positive tumour cells. The rest of the cells were negative for PDL-1 and yet the checkpoint was associated with prognosis [19]. The finding that not all tumour cells express the signalling factors or genes suggests that the activation of the pathways is unequal. When the pathway is not activated an explanation is required. In the case of the medulloblastomas which did not express any checkpoints the genes controlling the checkpoints have to be studied. So there are two likely explanations of these negative findings. One is the gene expression is controlled by pRB, the retinoblastoma protein which stops the expression of genes required for progression into the S phase of the cell cycle and thus has tumour suppressor activity [20]. So when pRB is intact it may prevent progression in the cell cycle and stop the gene expression. The RB gene which codes for the pRB protein may not undergo oncogene activation since not all genes in tumours undergo oncogene activation thus remaining intact. It is however, extremely rare since virtually all cancer cells show dysregulation of the G1/S checkpoint due to mutation in one of four genes, RB, CDK4, Cyclin D and P16 which regulate the phosphorylation of pRb [2]. Although Vermeulen et al did not measure the pRB levels it is possible that in these tumours the tumour suppressor activity remained intact and the gene expression stopped hence no detection of PDL-1 and as far as the progression of aberrant cell division is concerned an alternative pathway such as an altered P53 pathway was used [21]. This is considered a less

likely explanation since pRB is almost always altered in tumourigenesis. The second more likely explanation is that the rate of gene expression level may increase only transiently in response to a regulatory signal and may retain basal levels even in continued presence of the signal, also known as response – desensitisation as seen in a Type B response [22]. It is likely that when these tumours were studied the rate of PD-1 gene expression had fallen to a basal level in response to regulatory signals so that the PD-1 checkpoint was not detected in the Vermeulen et al study and that a repeat measurement of the gene and PD-1 checkpoint expression rate when the cell has recovered would detect the PD-1 checkpoint and gene expression. A type A response for hormone and growth factor dependent tumours like meningiomas would result in a similar low level when the stimulus is removed [22]. This means the response is unequal since not all the pathways are activated to the same level even though they are part of an integrated system.

Regarding the heterogeneity of tumour signals some of which have more than one type of signalling pathway such as Glioblastoma which had SHH, EGFR, FGFR signalling pathways, [14] such a tumour may have lower levels of one pathway but have the other pathways activated. So the cell would still progress through these alternative pathways since the tumour has many types of signalling pathways.

Regarding tumours which had only one pathway activated. These cases lacked information. A likely explanation is most studies have a limited number of types of pathways that they can test for and commoner tumours tend to be better studied than uncommon tumours. The assumption therefore from this study is that in time these rare tumours will also be revealed to have more than one pathway activated.

However, the theory still stands since activation is not to similar levels in different tumour cells and there are different types of signals there is unequal activation. This may be responsible for the findings of histological subtype differences in most epidemiological studies before control of confounders. However, as this study found, these differences are not the predeterminant since they are not associated with the prognosis of the patient on multivariate analysis. The predeterminant is therefore more likely the shared pathways.

**Conclusion:** In the molecular Pathogenesis of CNS tumours the molecular action is in concert albeit unequally such that shared pathways are predeterminants of tumourigenesis as opposed to an independent predominant pathway for each tumour. The implications of the theory is multimodal therapy may be preferred to single treatment since the tumours act in concert.

**Recommendation:** A similar study for non CNS tumours is recommended in order to determine whether the theory applies to these tumours as well.

## REFERENCES:

1. van Linde ME, Brahm CJ, deWitt Hammer PC, Reijneveld JC, Bruynzeel AME, Vandertop WP et al. Treatment outcome of patients with recurrent glioblastoma multiforme: a retrospective multicenter analysis. *Journal of Neuro-Oncology*.2017;135(1):183-192
2. Cotran RS, Kumar V, Collins T. *Neoplasia* In: Cotran RS, Kumar V, Collins T. eds *Robbins Pathological Basis of Disease*. 6<sup>th</sup> edition. Philadelphia

, United States:W.B Saunder's Company,1999:279-297

3. Granner DK. *Recombinant DNA Technology* In: Murray KR, Granner DK, Mayes PA, Rodwell VW eds *Harper's Biochemistry*.25<sup>th</sup> edition. New York United States: Appleton & Lange, 2000: 488-504

4. Baldin E, Testoni S, de Pasqua S, Ferro S, Albani F, Baruzzi A, et al PERNO study group. Incidence of Neuroepitheal Primary Brain tumours among adult population of Emilia-Romagna region, Italy. *Neurological Sciences*. 2017;38(2):263

5. Nahed B. Incidence of malignant Brain and spinal tumours varies substantially by world region. *Journal of Clinical Neuroscience*.2019. <https://advances.massgeneral.org/neuro/journal.aspx?id=1493>

6. Merchant TE, Pollack IF, Loeffler JS. Brain tumours across the age spectrum. biology, therapy and late effects. *Seminars in Radiation Oncology*.2010;20(1):58-66

7. McKinley BP, Michalek AM, Fenstermaker RA, Plunkett RJ. The impact of age and gender on the incidence of glial tumours in New York state from 1976-1995. *Journal of Neurosurgery*.2000;93(6):<https://doi.org/10.3171/jns.2000.93.6.0932>

8. McKinney PA. Brain tumours, incidence, survival and aetiology. *Journal of Neurology, Neurosurgery & Psychiatry*.2004;75(2): <http://dx.doi.org/10.1136/jnnp.2004.040741>

9. Lehmann G, Bremond J, Rabaud C, Paillas JE. Space-occupying Lesions of the Occipital Lobe of the cerebral cortex. *Neurochirurgie*.1975;21(1):55-79

10. Daryl K Granner *Recombinant DNA Technology* In: Murray KR, Granner DK, Mayes PA, Rodwell VW eds *Harper's Biochemistry*. 25<sup>th</sup> edition. New York United States. Appleton & Lange.2000: 488-504

11. Crocetti E, Trama A, Stiller C, Caldarella A, Soffietti R, Jaal J et al RARE CARE Working group. Epidemiology of Glial and Non-glial brain tumours in Europe. *European Journal of Cancer*.2012;48(10):1532-1542

12. Granner DK. *Protein synthesis* In: Murray KR, Granner DK, Mayes PA, Rodwell VW eds *Harper's Biochemistry*.25<sup>th</sup> edition. New York United States: Appleton & Lange, 2000: 461

13. Tang J, Chen L, Wang Z, Huang G, Hu X. SOX2 mediates crosstalk between Sonic Hedgehog and the Wnt / $\beta$ -catenin signalling pathway to promote proliferation of pituitary adenoma cells. *Oncology letters*. 2019;18(1):81-86

14. Garros-Regulez L, Garcia I, Carrasco-

Garcia E, Lantero A, Aldaz P, Moreno-Culgnon L et al. Targeting SOX2 as a therapeutic Strategy in Glioblastoma. *Frontiers in Oncology*.2016;6:222

15. Wang H, Wu Y, Hsieh J, Liang M, Chao M, Liu D et al Paediatric primary Central Nervous system germ cell tumours of different prognosis groups show characteristic miRNome traits and chromosome copy number variations. *Biomed Central Genomics*. 2010;11(132):<https://doi.org/10.1186/1471-2164-11-132>

16. Wang X, Lui V, Poon R, Lu P, Poon R. DNA Damage mediated S and G2 checkpoints in Human Embryonal Carcinoma Cells. *Stem Cells*.2009;27(3):568-576

17. Vermeulen JF, Heck WV, Adriaansen EJM, Jansen MK, Bouma RG, Hidalgo J et al. Prognostic relevance of tumour infiltrating lymphocytes and immune checkpoints in paediatric medulloblastoma. *Oncoimmunology*. 2018;7(3):e1398877

18. Du Z, Yan D, Li Z, Gu J, Tian Y, Cao J et al. Genes involved in the PD-L1 pathway might associate with Radiosensitivity of patients with Gastric cancer. *Journal of Oncology*.2020:<https://doi.org/10.1155/2020/7314195>

19. Nduom EK, Wei J, Yaghi NK, Huang N, Kong LY, Gabrusiewicz K et al. PD-L1 expression and prognostic impact in glioblastoma. *Neuro-Oncology* .2016;18(2):195-205

20. Burkhart DL, Sage J. Cellular mechanisms of tumour suppression by the retinoblastoma gene. *Nature Reviews Cancer*.2008;8:671-682

21. Duronio RB, Xiong Y. Signaling Pathways that control cell proliferation. *Cold Spring Harbour Perspectives in Biology* 2013;5(3):a008904

22. Granner DK. *Regulation of Gene Expression* In: Murray KR, Granner DK, Mayes PA, Rodwell VW eds *Harper's Biochemistry*.25<sup>th</sup> edition. New York United States. Appleton & Lange. 2000:468-487





# Research involvement among undergraduate health profession students in a resource-limited setting: awareness, attitude, motivators and barriers

Blaise Kiyimba<sup>1\*</sup>, Linda Atulinda<sup>1</sup>, Racheal Nalunkuma<sup>1</sup>, Ignatius Asasira<sup>1</sup>, Jonathan Kabunga<sup>1</sup>, Davis Banturaki<sup>1</sup>, Anastacia Ssebbowa Nabyonga<sup>1</sup>, Rachel Nakiganda<sup>1</sup>, Racheal Ndyabawe<sup>1</sup>, Jonathan Nkalubo<sup>2</sup>, Nelson Ssewante<sup>1</sup>, Felix Bongomin<sup>3</sup> and Sabrina Ba-keera-Kitaka<sup>4</sup>

## Abstract

**Background:** Involvement of undergraduate health professions students (HPS) in research will facilitate evidence based clinical practice among future healthcare practitioners. This study aimed to assess research involvement among undergraduate HPS students and associated factors in Uganda.

**Methods:** A cross-sectional study was conducted using an online assessment tool sent through WhatsApp groups and E-mail addresses of HPS in 12 medical schools in Uganda between 20th September and 5th October 2021. **Results:** We enrolled 398 participants with a mean age of  $23.9 \pm 3.7$  years. Of this, 267 (67.1%) were male. One hundred twenty (30.2%) participants previously participated in a research activity: 90 (58.4%) as research assistants, 39 (25.3%) published as first authors, and 25 (16.2%) as co-authors. Training on the conduct of research was received by 242 (65.8%) participants, and 326 (81.9%) had intentions of conducting research in the future. Factors influencing participation in research activities were, age  $\geq 25$  years (adjusted odds ratio (aOR): 1.9, 95% confidence interval (95% CI): 1.2–3.2,  $p = 0.012$ ), being male (aOR: 2.1, 95%CI: 1.2–3.6,  $p = 0.008$ ), and being in a clinical year i.e., year 3 (aOR: 3.2, 95% CI: 1.1–9.3,  $p = 0.033$ ), year 4 (aOR: 3.3, 95% CI: 1.1–9.5,  $p = 0.028$ ) and year 5(aOR: 11.6, 95% CI: 3.2–42.1,  $p < 0.001$ ). Lack of funds (79.6%), and mentorship (63.3%) were reported as major barriers to research.

**Conclusions:** Despite a high proportion of HPS showing interest in getting involved in research, less than one-third reported previous involvement. Addressing barriers such as funding could potentially improve research involvement and output among undergraduate HPS in resource-limited settings.

**Keywords:** Research, Undergraduate, Health, Students, Uganda



## Background

Globally, medical research and innovation remains a basic cornerstone upon which new advancements and guidelines in clinical practice are based [1]. Provision of adequate health care services for the best patient management outcomes is pivoted on the interplay between health research scientists whose work is more dedicated to carrying out medical research and clinicians who are mainly in direct patient care [2]. A balance between these two professions is therefore crucial for continuous delivery of evidence-based care [3]. Unfortunately, the medical field is still and has for decades suffered a global shortage of health research scientists [3–5], a problem which if not curbed early could retard progress in evidence-based clinical practice [2].

HPS are generally looked at as the primary pool from which emerge majority of the various health care professionals with clinicians and health research scientists inclusive. However, a great tendency to later prefer clinical practice to health research as a career has been reported among many HPS worldwide [6, 7] despite many of them showing good attitudes towards scientific research earlier [8–11]. This has become among the leading causes of insufficient health research-scientists worldwide. Delayed exposure to research during undergraduate HPS' training has been a commonly reported reason for this imbalance [12, 13]. Though the primary objective of undergraduate HPS' education is to train students in providing safe and effective patient care [14, 15], the expeditious advancements in the health care system and the increasing amount of easily accessible information demand that health care practitioners make decisions based on reliable scientific evidence [15].

Sub-Saharan Africa (SSA) has continued to suffer the world's biggest burden of disease and mortality. This has been linked to its suboptimal quality of health care delivery, which is fueled by insufficient research evidence [16]. Evidence can only be derived through carrying out high standard quality research to generate local data based on common health problems that can be used to inform guidance [16]. Despite employing various interventions to boost research such as incorporating research methods into education curriculum by many African countries [17, 18], the overall research output from SSA is still low [19]. This paucity of research has led to over dependence by many African countries' clinical practice on research findings from developed countries, which have different disease burden and level of medical advances compared to SSA. This could result in undesirable outcomes as observed in West Africa where shortage of skilled clinical scientists just fueled disease progression and mortality instead of its containment during the



Ebola virus disease outbreak [20].

In Uganda, despite the increasing number of undergraduate HPS' schools in the last two decades from only two in 2003 to now 12 in 2021 [21], the volume of undergraduate research output has slightly improved, but still very low. In 2003, research done at one public HPS' school reported that the major barriers for students to do undergraduate research were lack of collaborations, lack of guidance and lack of funding [22]. However, this study was done 18 years ago when the country had only two undergraduate HPS' schools and involved only one HPS' school.

Because different HPS' schools may operate on different curricular, timetables, and administrative bodies, it is critical to know whether similar factors exist currently in other public and private universities, or they differ and in the different health care (HC) courses offered. Therefore, in this study, we aimed to assess research involvement of undergraduate students exploring awareness, barriers and motivators in all the 12 undergraduate HPS' schools in Uganda.

## Methods

### Study design

Between 20th September and 5th October 2021, we conducted an online, descriptive and cross-sectional study across 12 universities in Uganda. Study area and setting

The study was conducted in Uganda. There are currently 54 universities in Uganda turning out over 40,000 graduates annually. However, only 12 universities offer health professional courses with an estimated population of 10,000 students. These include both private and public Undergraduate HPS' schools and they are Makerere University (MAK), Mbarara University of Science and Technology (MUST), Busitema University (BU), Kabale University (KU), Gulu University (GU), Kampala International University (KIU), King Caesar University (KCU), Uganda Christian University (UCU), Muni University, Soroti University, Lira University, and Islamic University in Uganda (IUIU). MAK, GU, BU, MUST, Muni, Kabale and Soroti are public universities whilst the rest are private. Target population

All undergraduate students, 18 years or older, from year 1 to year 5 of study pursuing a health profession program at any of the above-mentioned universities. Programs included were Bachelor of Medicine and Surgery (MBChB), Bachelor of Biomedical Sciences (BSB), Bachelor of Nursing/Midwifery (BSN/MW), Bachelor of Pharmacy (BPHARM), Bachelor of Dental Surgery (BDS), Bachelor of Medical Radiography (BMR), Bachelor of Science in Anesthesia (BSA), among others. The estimated target population was 10,000 students.

### Sample size

A sample size of 420 participants was calculated using the modified Kish—Leslie formula for infinite population, with a prevalence of 50%, margin of error of 5% at 95% confidence interval, and a 10% non-response rate.

### Study variables

The independent variables included were sex, age, year of study, university of study, type of university ownership and program of study. Dependent variables included questions on students' awareness about research, attitudes, anticipated motivational factors and barriers for research involvement.

### Data collection tool

The questionnaire used had 33 questions and was adopted from previously validated questionnaires by Sayedalamina et al. [19] and Lloh et al. [20]. It consisted of 5 sections as below:

Section I. Had 7 Questions about participants' demographics.

Section II. Had 10 questions assessing for participants' awareness about Research.

Section III. Had 9 questions, assessing for participants' attitudes towards research.

Section IV. Had 3 questions, assessing for participants' perceived motivational factors and benefits for engaging in research.

Section V. Had 4 questions, assessing for participants' perceived barriers for research involvement and intentions of doing research as a career.

eligible participants via students WhatsApp groups, personal WhatsApp inboxes plus personal email addresses. We assigned a research assistant to each class and program of study per participating HPS' school. These were mainly influential people of good reputation among their colleagues, such as class representatives and program association leaders, who continuously shared the link to all the eligible WhatsApp groups and students in their contacts inviting students to participate in the study. To reduce bias due to imbalances/ poor representation of participants from different programs, year of study and school of study among others, we ensured that we assign data collectors in each category and in numbers appropriate to the population of students per category. The questionnaire was self-administered written in simple English for effective understanding by the participants.

### Quality assurance

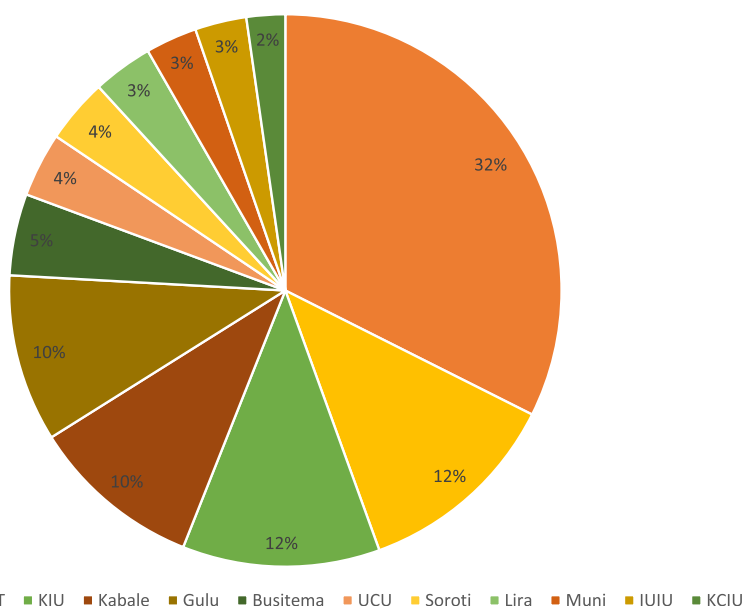
The questionnaire was pre-tested among 15 undergraduate students from the College of Veterinary Medicine, Makerere University, and the identified corrections necessary were made before administering the tool to the final study participants. The questionnaire had check points that ensured that only completed forms could be submitted, and that each participant could submit only one response form, hence excluding duplication of responses from participating more than once.

### Data collection procedure

Data was collected by convenience sampling method. The survey link to the online questionnaire was sent to

### Data management and analysis

Upon completion of data collection, entries were downloaded. Data cleaning and coding were done using



**Fig. 1** Distribution of participants across all the universities

Microsoft Excel 2016 and coded data exported to STATA 15.0 for analysis. Demographic characteristics, awareness, barriers, benefits, and motivational factors to participate in research were first summarized as in tables with frequencies and percentages for categorical variables and mean and standard deviation for numerical variables. Attitude was summarized on a figure format. Associations between independent and dependent variables were assessed using Chi-square or Fisher's exact tests. Multivariable logistic regression was performed adjusting for confounders (course and institutions). A  $p < 0.05$  was considered statistically significant.

## Results

A total of 406 responses were obtained. After data cleaning, 398 entries were eligible for analysis (response rate, 398/420 (95%).

## Demographic characteristics of respondents

Of the 398 respondents, 267 (67.1%) were male, 220 (55.3%) were pursuing MBChB, and 307 (77.1%) were from public universities (Fig. 1). The mean age of the respondents was  $23.9 \pm 3.7$  years. Other demographic characteristics are presented in Table 1.

## Awareness about research

Most (92.7%,  $n = 369$ ) respondents had ever heard of the concept of medical research and 297 (80.7%) knew a colleague who had participated in research. One-hundred and twenty (32.6%) respondents had personally participated in research outside academic requirements. Of this, 90 (58.4%) participated as research assistants, 39 (25.3%) as principal investigators and 25 (16.2%) as co-investigators. Of those that had participated in research before this survey, 27 (22.5%) had published a paper in a

**Table 1** Participants' characteristics that influence participation in research activities

Variable	Total	Participation in research				Binary logistic regression	
		Chi-square/Fischer's exact test			P-value	aOR (95% CI)	p-value
	N (%)	Yes, n (%)	No, n (%)				
<b>Total</b>	<b>398 (100)</b>	<b>120(32.5)</b>	<b>249 (67.5)</b>		<b>N/A</b>		
<b>Age</b>					0.001		
< 25	302 (75.9)	78 (28)	201 (72)			Reference	
≥ 25	96 (24.1)	42 (46.7)	48 (53.3)			1.9 (1.2–3.2)	0.012
<b>Mean (SD)</b>	<b>23.9 (3.7)</b>	<b>24.6 (3.5)</b>	<b>23.5 (3.8)</b>				
<b>Sex</b>					0.002		
Female	131 (32.9)	26 (21.7)	94 (78.3)			Reference	
Male	267 (67.1)	94 (37.8)	155 (62.2)			2.1 (1.2–3.6)	0.008
<b>Course</b>					0.246		
MBChB	220 (55.3)	73 (35.6)	132 (64.4)			Reference	
BDS	10 (2.5)	1 (11.1)	8 (88.9)			1.1 (0.5–2.2)	0.780
BNUR	52 (13.1)	16 (33.3)	32 (66.7)			0.2 (0–2.1)	0.183
BPARM	44 (11.1)	8 (20)	32 (80)			0.5 (0.2–1.3)	0.177
Others	72 (18.1)	22 (32.8)	45 (67.2)			1 (0.5–2)	0.964
<b>Year of study</b>					<0.001		
Year 1	43 (10.8)	5 (13.5)	32 (86.5)			Reference	
Year 2	111 (27.9)	26 (26.3)	73 (73.7)			2.1 (0.7–6)	0.176
Year 3	97 (24.4)	32 (35.2)	59 (64.8)			3.2 (1.1–9.3)	0.033
Year 4	119 (29.9)	38 (33.3)	76 (66.7)			3.3 (1.1–9.5)	0.028
Year 5	28 (7)	19 (67.9)	9 (32.1)			11.6 (3.2–42.1)	<0.001
<b>University ownership</b>					0.426		
Private	91 (22.9)	24 (28.9)	59 (71.1)			Reference	
Public	307 (77.1)	96 (33.6)	190 (66.4)			0.8 (0.4–1.5)	0.527
<b>Student's education funding status</b>					0.224		
Government funded	145 (36.4)	38 (28.6)	95 (71.4)			Reference	
Private funded	253 (63.6)	82 (34.7)	154 (65.3)			1.3 (0.8–2.3)	0.282

N: Total sample, n: proportion of the sample, N/A Not applicable, aOR Adjusted odds ratio, CI Confidence interval



peer-reviewed journal. Twenty-one (70%) of the 27 publications were in international journals.

With regard to research-related training, 242(65.8%) respondents reported to have had prior training in proposal writing, 101(27.4%) manuscript writing and 68(18.5%) publication process (Table 2).

#### Attitudes towards undergraduate research

Three hundred and twenty-five(81.6%) respondents strongly agreed that research is an important aspect in human health, and that it plays a significant role in making clinical decisions and policies ( $n=306$ , 76.1%).

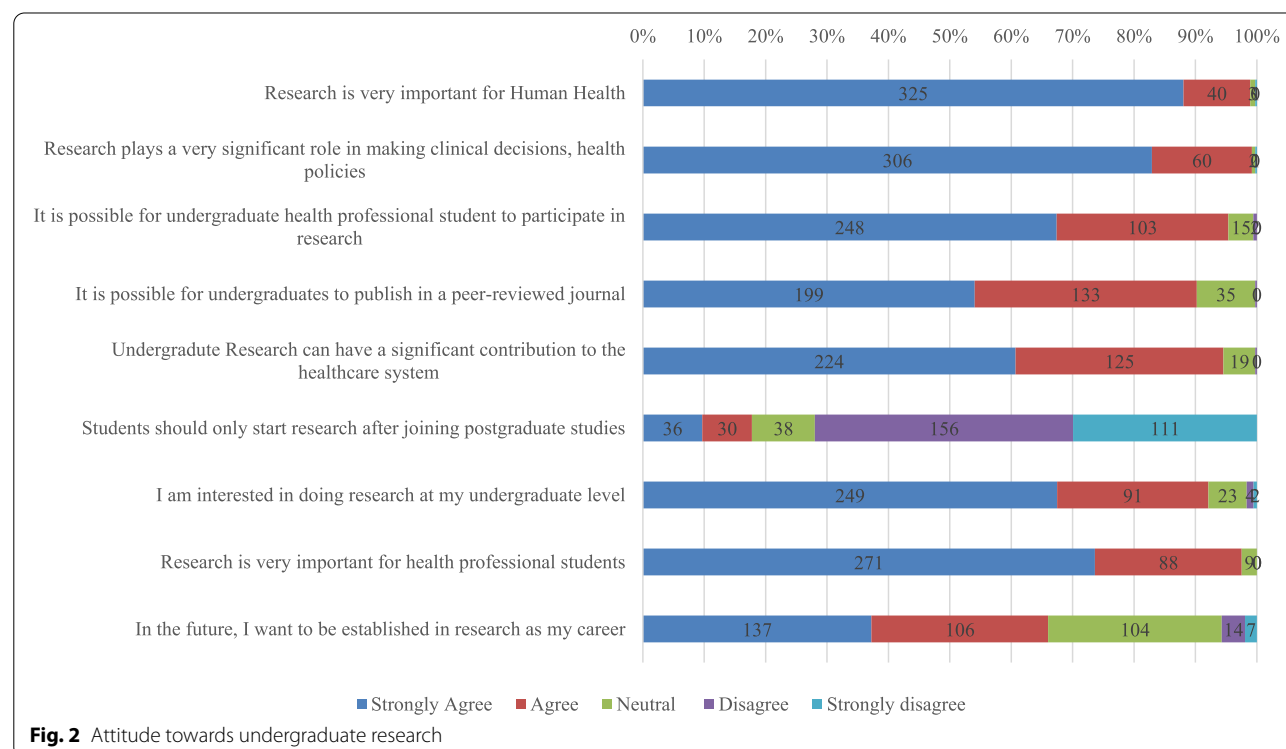
Majority ( $n=349$ , 87.6%) also believed that undergraduate research can have a significant impact on the health system of the country and 243(61.1%) were open to taking on research in their future careers (Fig. 2).

#### Motivational factors and perceived barriers to participation in research

Personal development ( $n=300$ , 75.4%), contribution to patient care ( $n=294$ , 73.9%), gaining experience ( $n=266$ , 66.8%), collaboration with senior researchers ( $n=244$ , 61.3%) and developing a robust Curriculum Vita ( $n=226$ ,

**Table 2** Responses to awareness questions

Question	Frequency	Percent
<b>Have you ever heard about medical research? (N = 398)</b>		
Yes	369	92.7
No	29	7.3
<b>Know an undergraduate colleague that have participated in research? (N = 398)</b>		
Yes	297	80.7
No	71	19.3
<b>Ever participated in any research activity outside your academic requirement? (N = 398)</b>		
Yes	120	32.5
No	249	67.5
<b>What was your role in that study? (N = 120)</b>		
Research Assistant	90	58.4
First Author	25	16.2
Co-Author	39	25.3
<b>Ever published any research paper in a peer-reviewed journal? (N = 120)</b>		
Yes	27	22.5
No	93	77.5
<b>If yes, how many articles? (N = 27)</b>		
1 article	14	51.9
2 articles	6	22.2
3 or more articles	7	25.9
<b>Have you had any first-author publication? (N = 27)</b>		
Yes	11	40.7
No	16	59.3
<b>What kind of journal was your paper(s) published?(N = 27)</b>		
International	21	70
Regional	2	6.7
Local	7	23.3
<b>Have you had any training on research proposal writing?(N = 398)</b>		
Yes	242	65.8
No	126	34.2
<b>Have you had any training on manuscript writing? (N = 398)</b>		
Yes	101	27.4
No	267	72.6
<b>Have you had any training on journal publication process? (N = 398)</b>		
Yes	68	18.5
No	300	81.5



56.8%) were the most reported motivating factors for participation in research by respondents (Table 3).

Participants reported lack of funds ( $n = 317$ , 79.6%), lack of mentorship ( $n = 252$ , 63.3%), collaboration opportunities ( $n = 201$ , 50.5%) as the major barriers to their participation in research (Table 4). Majority of participants ( $n = 168$ , 42.2%) reported difficulties in study designing and manuscript writing ( $n = 155$ , 38.9%) as the most challenging steps in conducting a research process (Table 4).

Likewise, participants believed that they would participate in research if funding ( $n = 303$ , 76%), mentorship ( $n = 288$ , 72.2%), research training ( $n = 240$ , 60.0%) were availed to them. Otherwise, majority of participants ( $n = 326$ , 81.9%) had intentions of doing research in future.

#### Factors associated with research involvement

On bivariate analysis (Table 1), age ( $p < 0.001$ ), sex ( $p = 0.002$ ) and year of study ( $p < 0.001$ ) were significantly associated with participation in research activities.

Table 1 indicates that participants 25 years or older had nearly 2-fold higher odds of taking part in research activities than younger colleagues (aOR: 1.9, 95% CI: 1.2–3.2,  $p = 0.012$ ). Male participants had 2.1-fold higher odds of being more engaged in research than their female

counterparts (aOR: 2.1, 95% CI: 1.2–3.6,  $p = 0.008$ ). Additionally, participants in higher years had higher odds of participating in research compared to first year students with increasing odds i.e., year 3 (aOR: 3.2, 95% CI: 1.1–9.3,  $p = 0.033$ ), year 4 (aOR: 3.3, 95% CI: 1.1–9.5,  $p = 0.028$ ) and year 5 (aOR: 11.6, 95% CI: 3.2–42.1,  $p < 0.001$ ).

#### Discussion

This study, aimed at assessing the awareness, attitude, motivation factors and barriers to research involvement among health professional students in Uganda revealed that over three-quarters of respondents were aware of medical research and with a positive attitude towards it. The major motivators for research involvement were the desire for personal development and contributing towards patient care, while lack of funds and mentorship were the main barriers for the majority.

The very high awareness (92.7%) and positive attitude towards research reported in this study could be possibly because most HPS' schools in the country have course units on research methods incorporated in their curricular. In addition, the introduction of programs aimed at boosting undergraduate research at a few Universities such as the Health Professionals Education Partnership Initiative (HEPI) at Makerere, Busitema and Kabale

**Table 3** Motivational factors and perceived benefits of participating in research

Question, N = 398	Frequency	Percentage
<b>What do you hope to benefit from conducting research?</b>		
Personal development	300	75.4
Acknowledgement	172	43.2
Monetary rewards	149	37.4
Contribution to patient care	294	73.9
Experience	266	66.8
Collaboration with senior researchers	244	61.3
Developing your CV by having many research papers	226	56.8
Increasing acceptability into a residency program	191	48
Passion	192	48.2
Others	4	1
<b>What kind of assistance do you need to improve your research participation?</b>		
Funding	303	76.1
Guidance on research topic selection	242	60.8
Early exposure	216	54.3
Research training	240	60.3
Providing supervisor volunteers	146	36.7
Mentorship	288	72.4
Facilitating institutional review	108	27.1
Creating a suitable environment	134	33.7
Collaboration with other researchers	184	46.2
Easing ethics approval	109	27.4
Guidance on manuscript writing	183	46
Guidance on publication of results	149	37.4
Avenues for presentation of research findings	145	36.4
Others	1	0.3
<b>Do you have any intentions of doing research in your future career?</b>		
Yes	326	81.9
No	43	10.8

Universities have strived to expose students to more research work outside the one they do for their academic requirements.

Our finding agrees with those reported by previous studies among medical and Nursing students where more than half of participants reported to be aware about research [23, 24] and had positive attitude towards it [8, 24, 25], but in contrast with that by Chellaiyan and colleagues in India [26] where less than a quarter of students had a positive attitude towards medical research. Such and more programs like research results dissemination conferences aimed at exposing students to research are encouraged to better this awareness and positive attitudes. Despite this good awareness and attitude however, only one-third (32.5%) of students had engaged in research activities outside their class research work. This could be to the fact that most HPS' schools have tight schedules with overwhelming workload that limits time for most students to engage in co-curricular

activities including research. This finding is almost like one reported in India where only 34.3% of students had engaged in research activities [26] but in contrast to one by Mubuke et al. among Ugandan graduate radiographers where 70% had actively engaged in research activities [11]. Mentorship on how to plan and balance classwork alongside co-curricular activities during medical school could help more students to actively engage in research work.

Our findings showed that less than one-fourth (22.5%) of participants had published at least one research article, and this finding is similar to previous studies in India [26] and Sweden [10] that reported that only 15 and 17.4% students respectively had published their work in peer reviewed journals. However, this finding is Lower compared to one reported among medical practitioners in Nigeria [20] where more than one-fourth (34.3%) of participants had published at least one article in a peer reviewed journal. Nevertheless, in our study, 70 %



**Table 4** Barriers to participation in research

Question	Frequency	Percentage
<b>What factors would limit you from conducting research?</b>		
Lack of mandatory courses on research methodology	161	40.5
Lack of time for research conduction	193	48.5
Lack of funds	317	79.6
Lack of collaborations	201	50.5
Lack of interest in research	55	13.8
Lack of statistical support	135	33.9
Lack of mentorship	252	63.3
Difficulty in dealing with patients	45	11.3
Difficulty in obtaining approval for the study	155	38.9
Others	9	2.3
<b>What are the commonest challenges you usually find when carrying out research?</b>		
Lack of mentorship	223	56
Lack of motivation	141	35.4
Lack of time	166	41.7
Complexity of the research process	165	41.5
Lack of opportunities like sponsorship	279	70.1
Others	7	1.8
<b>What type of research do you find difficult carrying out?</b>		
Case Report	64	16.1
Basic science	47	11.8
Retrospective clinical study	111	27.9
Prospective clinical study	114	28.6
Clinical trial	222	55.8
Cross-sectional study	82	20.6
Review articles	66	16.6
Others	12	3
<b>At which of the following steps of research do you find the biggest challenge?</b>		
Designing a study	168	42.2
Study sampling	85	21.4
Participant Recruitment	122	30.7
Biological statistics	121	30.4
Manuscript writing	155	38.9
Paper presenting	77	19.3
Others	12	3

of those who had published had done so in international journals as opposed to local or regional journals. This is possibly because more international journals waiver either partially or fully on article processing charges (APCs) for authors from low-income countries compared to regional journals. APCs have been reported in the past as one of the major factors considered by Authors from resource limited settings when choosing a journal to publish their articles from [20]. Also, the perceived increased visibility and acknowledgement to the authors in international journals compared to local and regional journals could be another trigger for this preference.

Three-fourth of respondents were motivated to involve in research for personal development and contribution to patient care. This finding is congruent with that reported in Nigeria among medical practitioners [20] but in contrast with that by Pallampathy and others among students in India who reported personal interest, facilitation of foreign exams, and peer pressure as their main motivational factors for research involvement [23]. Majority (80%) of students expressed the desire to pursue a career in research. This outcome is like those reported in South Africa [24] and England [25], where majority of students exhibited a high interest in doing research as a career.

With such high interests kept to implementation, more research scientists will be anticipated in future and could lead to tremendous advancements in evidence-based medical practice, hence improved quality, and outcomes of patient care. Concerned stake holders such as medical education heads, ministry of health and other drivers of the health care system are recommended to take appropriate supportive interventions for such dreams to remain vibrant and with the motivation for better health.

Majority of respondents reported lack of funds, mentorship, and collaboration as the perceived barriers to research involvement. This could be because currently, there are generally very few research grants for undergraduate students both locally and globally, the generally suboptimal mentorship programs in most Ugandan universities, as well as the relatively bigger age gap between the famous research scientists in the country and the students. This result is congruent with that found in Malaysia that reported lack of skills, funding [27] and among Pharmacy students in Saudi Arabia who reported lack of funding, lack of encouragement [10] but in contrast with that reported among medical students in India who reported difficulty in choosing a topic, collecting data, lack of time [26] and difficulty in follow up of patients [23] as the major barriers. Improvement in early mentorship in medical schools as already suggested by participants in the study by Munabi and colleagues [28] could help in curbing such obstacles.

We also report that participants aged 25 years or older, being male, and in a higher academic year of study had higher odds of being involved in research compared to those younger than 25 years, females, and in earlier years of study, respectively. This is possibly because participants at a higher age and class of study have had more exposure to the various health disciplines including research course units, seen and interacted with senior researchers in the field, hence more chances of obtaining inspiration, mentorship, and collaboration for active research. Also, students in higher years of study have adapted to the general HPS school pressure and can easily plan well to balance their academics with co-curricular activities including research- a very time requiring activity. This finding concurs with that reported by Kyaw and colleagues in Malaysia [27] and another in Sweden [10] where students of older age and in higher years of study were more knowledgeable about research than the younger and in lower years of study. It also agrees with various studies that found a higher association between male sex and research involvement [24, 25]. However, it contrasts with that reported in Saudi Arabia where age above 25 years was associated with less involvement in research [20].

Our study has some important limitations. Firstly, we used convenience method hence only responses from respondents who could manage to answer the online questionnaire were captured, and they may not be the actual representative of all health profession students in the country. Secondly, the results are based on participants' self-reported answers without proof confirmation by the investigators, such as one's total number of publications and the journals used, hence liable to possibility of recall bias and telling lies. However, it is a nationwide study, covering all the 12 medical schools and their respective programs of study in the country, with significant representation from each medical school, hence these results can be generalized.

## Conclusion

Despite the massive awareness for and good attitude towards research among the respondents, active research involvement and publication is still very low. Lack of funding and mentorship are the perceived barriers to research involvement. Future investments in small grant acquisition, research training and mentorship programs are recommended.

## Abbreviations

APCs: Article Processing Charges; COVID-19: Coronavirus disease-2019; HEPI: Health Professional Education Partnership Initiative; HPS: Health Profession Student; MAKCHS: Makerere University, College of Health Sciences; MBChB: Bachelor of Medicine and Bachelor of Surgery; MHREC: Mulago Hospital Research and Ethics Committee; SSA: Sub-Saharan Africa.

## Acknowledgements

We commend the following people who assisted us in data collection from the different medical schools. Asaph Asimwe (Soroti University), Nagaba Grace (Kabale University), MbulakaRemigious (Uganda Christian University) Stuart Kitandwe (MAKCHS) Muhangi Jimmy (Kabale University), Nabyonga Esther (Busitema University), Niwamanya Edwin (Kampala International University) and Kafuko Josephat (Kabale University).

The authors gratefully thank all respondents for their time and internet data spared to participate in this study. This study was conducted by the MAKCHS Research and Writers' club (MAKCHS-RWC) cabinet members 2020-2021.

The authors declare no competing interests in this work.

## Authors' contributions

B.K., L.A., R.N., I.A., J.K., D.B., A.S.N., R.Ng., R.Nd., J.N., N.S., F.B. and S.B.K. made substantial contributions towards this work. All authors took part in the conceptualization and designing of the study. B.K., L.A., R.N., I.A., J.K., D.B., A.S.N., R.Ng., R.Nd., J.N., and F.B. collected data and drafted the manuscript. N.S. analyzed the data, while B.K., F.B. and S.B.K. critically revised the article for final important intellectual content. All the authors agreed to submit the work to this journal and agree to be accountable for all aspects of this work.

## Funding

No funding was received from any institution, organization, or company for the production of this work.

## Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

## Declarations

### Ethics approval and consent to participate

Mulago Hospital Research and Ethics Committee (MHREC) approved the study protocol (reference number: MHREC 2126). Mulago Hospital is the teaching hospital for Makerere University college of health sciences (MAKCHS) and its Research and Ethics Committee is authorized to approve any research done by students from MAKCHS. Informed consent was sought from each participant before taking part in the study. This was effected by requesting the participant to click on the "I accept to participate" option at the end of the consent statement on the study tool before starting to answer the questionnaire. None of the participants' personal identifiers such as name or photos were captured during data collection. The data collected was password-protected on the principal investigator's computer, could only be accessed by the investigators and was used only and specifically for this study alone, after which it will be deleted from all the devices following publication of this paper. The study was conducted in accordance with the *Declaration of Helsinki*.

### Consent for publication

Not applicable.

### Competing interests

The authors declare that they have no competing conflicts.

### Author details

<sup>1</sup>School of Medicine, College of Health Sciences, Makerere University, Kampala, Uganda. <sup>2</sup>Mulago National Referral Hospital, Kampala, Uganda. <sup>3</sup>Department of Medical Microbiology and Immunology, Faculty of Medicine, Gulu University, Gulu, Uganda. <sup>4</sup>Department of Pediatrics and Child Health, School of Medicine, College of Health Sciences, Makerere University, Kampala, Uganda.

Received: 31 October 2021 Accepted: 28 March 2022

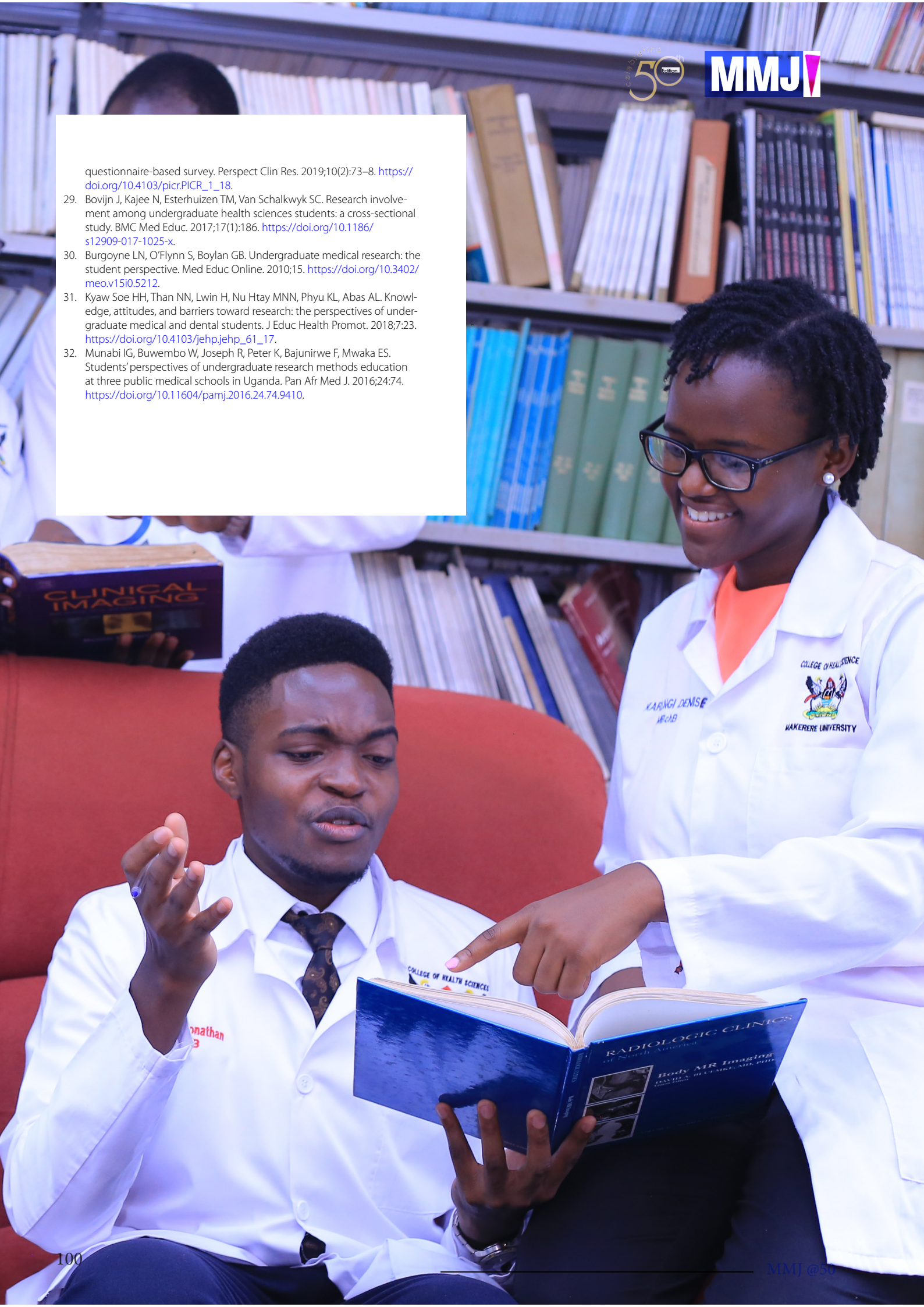
Published online: 06 April 2022

## References

- Al-Shalawy FAN, Haleem A. Knowledge, attitudes and perceived barriers towards scientific research among undergraduate health sciences students in the central province of Saudi Arabia. *Educ Med*. 2015;7:16–21.
- Mahmood Shah SM, Sohail M, Ahmad KM, Imtiaz F, Iftikhar S. Grooming future physician-scientists: evaluating the impact of research motivations, practices, and perceived barriers towards the uptake of an academic career among medical students. *Cureus*. 2017;9(12):e1991. <https://doi.org/10.7759/cureus.1991>.
- Ommering BWC, Wijnen-Meijer M, Dolmans DHJM, Dekker FW, van Blankenstein FM. Promoting positive perceptions of and motivation for research among undergraduate medical students to stimulate future research involvement: a grounded theory study. *BMC Med Educ*. 2020;20(1):204. <https://doi.org/10.1186/s12909-020-02112-6>.
- Milewicz DM, Lorenz RG, Dermody TS, Brass LF, National Association of MD-PhD Programs Executive Committee. Rescuing the physician-scientist workforce: the time for action is now. *J Clin Invest*. 2015;125(10):3742–7. <https://doi.org/10.1172/JCI84170>.
- Ommering BWC, van Blankenstein FM, Wijnen-Meijer M, van Diepen M, Dekker FW. Fostering the physician-scientist workforce: a prospective cohort study to investigate the effect of undergraduate medical students' motivation for research on actual research involvement. *BMJ Open*. 2019;9(7):e028034. <https://doi.org/10.1136/bmjopen-2018-028034>.
- Rashid KA, Gomathy S, Manan A. The involvement of doctors in research activities of in two major hospitals in Penang, Malaysia. *MJPHM*. 2012;12:31–8.
- Imafuku R, Saiki T, Kawakami C, Suzuki Y. How do students' perceptions of research and approaches to learning change in undergraduate research? *Int J Med Educ*. 2015;6:47–55. <https://doi.org/10.5116/ijme.5523.2b9e>.
- Ryan EJ. Undergraduate nursing students' attitudes and use of research and evidence-based practice - an integrative literature review. *J Clin Nurs*. 2016;25(11–12):1548–56. <https://doi.org/10.1111/jocn.13229>.
- Bhagavathula AS, Bandari DK, Tefera YG, Jamshed SQ, Elnour AA, Shehab A. The attitude of medical and pharmacy students towards research activities: a multicenter approach. *Pharmacy (Basel)*. 2017;5(4):55. <https://doi.org/10.3390/pharmacy5040055>.
- Alhomoud FK, AlGhalawin L, AlGofari G, AlDjani W, Ameer A, Alhomoud F. Career Choices and Preferences of Saudi Pharmacy Undergraduates: A Cross Sectional Study. *Saudi Pharm J*. 2019;27(4):467–74. <https://doi.org/10.1016/j.jsps.2019.01.009>.
- Mubuuke AG, Businge F. Self-reported competence and impact of research training among medical radiography graduates from a developing country. *J Med Imaging Radiat Sci*. 2019 Mar;50(1):113–8. <https://doi.org/10.1016/j.jmir.2018>.
- Goldhamer ME, Cohen AP, Bates DW, Cook EF, Davis RB, Singer DE, et al. Protecting an endangered species: training physicians to conduct clinical research. *Acad Med*. 2009;84(4):439–45. <https://doi.org/10.1097/ACM.0b013e31819a7cb1>.
- Weaver AN, McCaw TR, Fifolt M, Hites L, Lorenz RG. Impact of elective versus required medical school research experiences on career outcomes. *J Investig Med*. 2017;65(5):942–8. <https://doi.org/10.1136/jim-2016-000352>.
- Möller R, Shoshan M. Medical students' research productivity and career preferences; a 2-year prospective follow-up study. *BMC Med Educ*. 2017;17(1):51. <https://doi.org/10.1186/s12909-017-0890-7>.
- Frenk J, Chen L, Bhutta ZA, Cohen J, Crisp N, Evans T, et al. Health professionals for a new century: transforming education to strengthen health systems in an interdependent world. *Lancet*. 2010;376(9756):1923–58. [https://doi.org/10.1016/S0140-6736\(10\)61854-5](https://doi.org/10.1016/S0140-6736(10)61854-5).
- Ngeh EN. Research among undergraduate biomedical students in Cameroon: contextual barriers, room for improvement. *Pan Afr Med J*. 2019;33:149. <https://doi.org/10.11604/pamj.2019.33.149.18807>.
- Houlden RL, Raja JB, Collier CP, Clark AF, Waugh JM. Medical students' perceptions of an undergraduate research elective. *Med Teach*. 2004;26(7):659–61. <https://doi.org/10.1080/01421590400019542>.
- Griffin MF, Hindocha S. Publication practices of medical students at British medical schools: experience, attitudes and barriers to publish. *Med Teach*. 2011;33(1):e1–8. <https://doi.org/10.3109/0142159X.2011.530320>.
- Langer A, Díaz-Olavarrieta C, Berdichevsky K, Villar J. Why is research from developing countries underrepresented in international health literature, and what can be done about it? *Bull World Health Organ*. 2004;82(10):802–3.
- Adefuye AO, Adeola HA, Bezuidenhout J. The physician-scientists: rare species in Africa. *Pan Afr Med J*. 2018;29:8. <https://doi.org/10.11604/pamj.2018.29.8.13239>.
- "List of medical schools in Uganda – Wikipedia" [https://en.m.wikipedia.org/wiki/List\\_of\\_medical\\_schools\\_in\\_Uganda](https://en.m.wikipedia.org/wiki/List_of_medical_schools_in_Uganda)
- Munabi IG, Katabira ET, Konde-Lule J. Early undergraduate research experience at Makerere University Faculty of Medicine: a tool for promoting medical research. *Afr Health Sci*. 2006;6(3):182–6. <https://doi.org/10.5555/afhs.2006.6.3.182>.
- Pascal Iloh GU, Amadi AN, Iro OK, Agboola SM, Aguocha GU, Chukwuonye ME. Attitude, practice orientation, benefits and barriers towards health research and publications among medical practitioners in Abia state, Nigeria: a cross-sectional study. *Niger J Clin Pract*. 2020;23(2):129–37. [https://doi.org/10.4103/njcp.njcp\\_284\\_18](https://doi.org/10.4103/njcp.njcp_284_18).
- Meraj L, Gul N, Zubaidazain AI, Iram F, Khan AS. Perceptions and attitudes towards research amongst medical students at Shifa College of medicine. *J Pak Med Assoc*. 2016;66(2):165–89.
- Alsalem SA, Alkhairi MAY, Alzahrani MAA, Alwadai MI, Alqahtani SSA, Alaseri YFY, et al. Challenges and barriers toward medical research among medical and dental students at King Khalid University, Abha, Kingdom of Saudi Arabia. *Front Public Health*. 2021;9:706778. <https://doi.org/10.3389/fpubh.2021.706778>.
- Sayedalamir Z, Halawa TF, Baig M, Almutairi O, Allam H, Jameel T, et al. Undergraduate medical research in the Gulf cooperation council (GCC) countries: a descriptive study of the students' perspective. *BMC Res Notes*. 2018;11(1):283. <https://doi.org/10.1186/s13104-018-3381-y>.
- Chellaiyan VG, Manoharan A, Jasmine M, Liaquatthali F. Medical research: perception and barriers to its practice among medical school students of Chennai. *J Educ Health Promot*. 2019;8:134. [https://doi.org/10.4103/jehp.jehp\\_464\\_18](https://doi.org/10.4103/jehp.jehp_464_18).
- Pallamparthi S, Basavareddy A. Knowledge, attitude, practice, and barriers toward research among medical students: A cross-sectional



- questionnaire-based survey. *Perspect Clin Res*. 2019;10(2):73–8. [https://doi.org/10.4103/picr.PICR\\_1\\_18](https://doi.org/10.4103/picr.PICR_1_18).
29. Bovijn J, Kajee N, Esterhuizen TM, Van Schalkwyk SC. Research involvement among undergraduate health sciences students: a cross-sectional study. *BMC Med Educ*. 2017;17(1):186. <https://doi.org/10.1186/s12909-017-1025-x>.
  30. Burgoyne LN, O'Flynn S, Boylan GB. Undergraduate medical research: the student perspective. *Med Educ Online*. 2010;15. <https://doi.org/10.3402/meo.v15i0.5212>.
  31. Kyaw Soe HH, Than NN, Lwin H, Nu Htay MNN, Phyu KL, Abas AL. Knowledge, attitudes, and barriers toward research: the perspectives of undergraduate medical and dental students. *J Educ Health Promot*. 2018;7:23. [https://doi.org/10.4103/jehp.jehp\\_61\\_17](https://doi.org/10.4103/jehp.jehp_61_17).
  32. Munabi IG, Buwembo W, Joseph R, Peter K, Bajunirwe F, Mwaka ES. Students' perspectives of undergraduate research methods education at three public medical schools in Uganda. *Pan Afr Med J*. 2016;24:74. <https://doi.org/10.11604/pamj.2016.24.74.9410>.



# White coats and the spread of infection: should they remain or not?

**Rim Karam**

Lebanese American University  
rim.karam@lau.edu

**Chemutai Beliza**

Makerere University  
Belizachemutai@gmail.com

**Zulfiya Emefa Gbedemah**

University of Ghana Medical School  
zgbedemah@gmail.com

**Laura Jaramillo Gaviria**

Universidad de Los Andes-Colombia  
l.jaramillo@uniandes.edu.co





The white coat has filled in as the prestigious image of doctors for more than 100 years. A kid's first memory of a physician is an individual in a white coat. Patients have an expectation to be treated in doctors' clinics, healthcare facilities and centers by an individual dressed in white. At essentially all medical schools, the primary emblematic movement to assume the role of a physician is the "White Coat Ceremony" started by Arnold P. Gold, MD. This is the formal cloaking of a doctor-to-be as she or he sets out into his/her clinical journey.

However, not all specialists wear white covers today — pediatricians and therapists shun it—and not all societies' orders anticipate that their physicians should do as such. Patients in Denmark and England don't anticipate that their physicians should be dressed in white; those in Sweden, Finland and Norway do. Studies show that more youthful patients incline toward a specialist not to sport white, while older generations favor the inverse.<sup>1</sup>

White coats are used mainly for identification, yet there has always been some unease towards them. Like medical caretakers' garbs and other clinical articles of clothing, white coats may have an influence in communicating pathogenic microbes in the healthcare setting, as they are known to be cross-contaminated with drug resistant microorganisms.<sup>2</sup> In this article, we will discuss how white coats should be handled by professionals and whether they should be replaced by another identification marker for physicians.

Research has shown that the white coats of many medical students in particular are

contaminated. It is believed that this is because of poor Infection Prevention Control (IPC) training as well as poor white coat laundering habits. Medical students are often required to wear white coats when on the wards or when seeing patients and although they tend to see many patients they tend to have minimal training on IPC and about the consequences of nosocomial infections. (Loh et al. 2000) Loh et al. (2009) found out that at the University College Hospital Medical School, the majority of students keep their white coats in lockers at the school, usually only washing when the coat is visibly stained. Additionally 71 out of 100 students rated their white coats as dirty, however a third of the students only laundered their coats monthly despite perceiving their coats to be dirty.

It has also been demonstrated that microorganisms can survive between 10 and 98 days on fabrics which are used to make white coats, which include cotton, and polyester, or polyester materials. The white coats of health care workers are mostly contaminated by *Staphylococcus aureus*. In a study by Wong et al. in 1991 in East Birmingham Hospital, *S. aureus* was isolated from a quarter of the coats examined. Loh et al. identified that 100% of students white coats showed *S. aureus* in 1999. A study conducted by Treacle et al. at the University of Maryland School of Medicine (2009) showed that 22% of coats were contaminated with *S. aureus* and 4 % with Methicillin-resistant *Staphylococcus aureus* (MRSA). A study conducted by Muhadi et al. at the University of Kuala Lumpur (2007) showed a 54% incidence of contamination of long sleeved white coats by *S. aureus*. Other organisms that contaminate



The white coat has filled in as the prestigious image of doctors for more than 100 years. A kid's first memory of a physician is an individual in a white coat. Patients have an expectation to be treated in doctors' clinics, healthcare facilities and centers by an individual dressed in white. At essentially all medical schools, the primary emblematic movement to assume the role of a physician is the "White Coat Ceremony" started by Arnold P. Gold, MD. This is the formal cloaking of a doctor-to-be as she or he sets out into his/her clinical journey.

However, not all specialists wear white covers today — pediatricians and therapists shun it—and not all societies' orders anticipate that their physicians should do as such. Patients in Denmark and England don't anticipate that their physicians should be dressed in white; those in Sweden, Finland and Norway do. Studies show that more youthful patients incline toward a specialist not to sport white, while older generations favor the inverse.<sup>1</sup>

White coats are used mainly for identification, yet there has always been some unease towards them. Like medical caretakers' garbs and other clinical articles of

microbes in the healthcare setting, as they are known to be cross-contaminated with drug resistant microorganisms.<sup>2</sup> In this article, we will discuss how white coats should be handled by professionals and whether they should be replaced by another identification marker for physicians.

Research has shown that the white coats of many medical students in particular are contaminated. It is believed that this is because of poor Infection Prevention Control (IPC) training as well as poor white coat laundering habits. Medical students are often required to wear white coats when on the wards or when seeing patients and although they tend to see many patients they tend to have minimal training on IPC and about the consequences of nosocomial infections. (Loh et al. 2000) Loh et al. (2009) found out that at the University College Hospital Medical School, the majority of students keep their white coats in lockers at the school, usually only washing when the coat is visibly stained. Additionally 71 out of 100 students rated their white coats as dirty, however a third of the students only laundered their coats monthly despite perceiving their coats to be dirty.

It has also been demonstrated that microorganisms can survive between 10 and 98 days on fabrics which are used to make white coats, which include cotton, and polyester, or polyester materials. The white coats of health care workers are mostly contaminated by *Staphylococcus aureus*. In a study by Wong et al. in 1991 in East Birmingham Hospital, *S. aureus* was isolated from a quarter of the coats examined. Loh et al. identified that 100% of students' white coats showed *S. aureus* in 1999. A study conducted by Treacle et al. at the University of Maryland School of Medicine (2009) showed that 22% of coats were contaminated with *S. aureus* and 4 % with Methicillin-resistant *Staphylococcus aureus* (MRSA). A study conducted by

Muhadi et al. at the University of Kuala Lumpur (2007) showed a 54% incidence of contamination of long sleeved white coats by *S. aureus*. Other organisms that contaminate white coats include *Acinetobacter* (Loh et al.2000), (Munoz-Price et al. 2012), *Pseudomonas aeruginosa*, *Escherichia coli* (Qaday et al.2015), and diphtheroids (Uneke et al. 2010).

Interestingly it has been purported that the white coats of physicians are contaminated more than those of surgeons. Qaday et al. (2015) found that there was a higher contamination of white coats of those who work in the non surgical department compared to the surgical department, probably because of the frequent removal of the coats to scrub in for theater. Ultimately, the high rates of the bacterial contamination of white coats are associated with the continuous shed of infectious microorganisms in the hospital environment, and constant contact between health care providers and patients.

But, why are dirty coats so common among medical students and professionals who are subjected to disinfection procedures? From a socio-cultural perspective, over time the doctor has devalued the meaning of the white coat, wearing it outside the hospital or office, perhaps out of ignorance of the meaning and value of the white coat, perhaps simply out of habit of wearing it. The careless use of coats outside the hospital constitutes a negligent iatrogenic conduct, understood as a behaviour that causes an unwanted damage to health, caused or provoked by a legitimate medical act, intended to cure or improve a certain pathology. Paradoxically it refers to the damage caused by the doctor or healer.

The way forward would be by reducing the use of white coats by replacing the coat with a plastic apron when examining patients or wounds (Loh et al.2000), using short sleeve scrubs, banning the use of coats in canteens and organizing laundry services for staff. Additionally doctors



White coats may have an influence in communicating pathogenic

and medical students could be given multiple scrubs. Training sessions on IPC and proper handling of white coats could be organized frequently. Finally medical students should be encouraged to frequently wash their lab coats and scrubs and should also be taught how to properly handle them out of the hospital setting, to reduce the chances of spread of infections.

## References

The Doctor's White Coat—an Historical Perspective. (2007). *AMA Journal of Ethics*, 9(4) ,

310–314. <https://doi.org/10.1001/virtualmentor.2007.9.4.mhst1-0704>

Wong, D., Nye, K., & Hollis, P. (1991). Microbial flora on doctors' white coats. *BMJ*, 303(6817), 1602–1604. <https://doi.org/10.1136/bmj.303.6817.1602>

Loh, W., Ng, V.V., Holton, J. (2000) Bacterial flora on the white coats of medical students, *Journal of Hospital Infection*, Volume 45, Issue 1, Pages 65-68, ISSN 0195-6701 , <https://doi.org/10.1053/jhin.1999.0702>

Treacle, A. Thom, k., Furuno, J., Strauss, S., Harris, A., Perencevich, E. (2009) Bacterial contamination of health care workers' white coats, *American Journal of Infection Control*, Volume 37, Issue 2, Pages 101-105, ISSN 0196-6553 , <https://doi.org/10.1016/j.ajic.2008.03.009>.

Munoz-Price, S., Arheart, K., Mills, J., Cleary, T., DePascale, D., Jimenez, A., Fajardo-Aquino, Y., Coro, G., Birnbach, D., Lubarsky, D. (2012) Associations between bacterial contamination of health care workers' hands and contamination of white coats and scrubs, *American Journal of Infection Control*, Volume 40, Issue 9, Pages e245-e248, ISSN 0196-6553, <https://doi.org/10.1016/j.ajic.2012.03.032>.

Muhadi, S., Aznamshah, N., and

Jahanfar, S. "A cross sectional study on the microbial contamination of the medical student's white coats," *Malaysian Journal of Microbiology*, vol.

3 , no.1, pp. 35–38, 2007.

Qaday, J., Sariko, M., Mwakyoma, A., Kifaro, E., Mosha, D., Tarimo, R., ... Shao, E. (2015). Bacterial Contamination of Medical Doctors and Students White Coats at Kilimanjaro Christian Medical Centre, Moshi, Tanzania. *International Journal of Bacteriology*, 2015, 1 – 5. doi:10.1155/2015/507890

Uneke, C., & Ijeoma, P. (2010). The Potential for Nosocomial Infection Transmission by White Coats Used by Physicians in Nigeria: Implications for Improved Patient-Safety Initiatives.

*World Health & Population*, 11(3) , 44–54. doi:10.12927/whp.2010.21664

Tristán Fernández JM, Ruiz Santiago F, Villaverde Gutiérrez C, Maroto Benavides MR, Jiménez Brobeil S, Tristán Tercedor MR. Contenido simbólico de la bata blanca de los médicos. *Antropo* 2007;14:37-45.

OMS. Prevención de las infecciones nosocomiales Page 1. Prevención de las infecciones nosocomiales. Guía Práctica. 2ª edición. Revisores G. Ducel, FundaciónHygie [www.who.int/entity/csr/resources/publications/drugresist/en/PISpanish3.pdf](http://www.who.int/entity/csr/resources/publications/drugresist/en/PISpanish3.pdf).







# ANTIMICROBIAL RESISTANCE,

## A THREAT TO GLOBAL HEALTH



**BY JACOB MICHAEL OTHIENO, BSB**

Antimicrobial resistance (AMR) is a health challenge of global concern today. It occurs when bacteria, fungi and viruses develop resistance to the drugs (antimicrobials) used to treat infections caused by them hence increasing the risk of severe illness, spread of disease, and death due to ineffectiveness of the antibiotics.

The misuse of antibiotics both in the human health and agricultural sector is a major driver of the drastic rise observed in resistance today and in fact; Centre for Disease Control and Prevention included AMR in its list of top 10 global health threats in 2019.

In the human health sector, patients regularly use antibiotics without prescriptions from health officials. This is most vividly seen in the current COVID-19 pandemic. Even a portion of those that go through the proper procedure of getting a prescription fail to comply with the doctor's instructions. Another contributing factor to the rise of antibiotic resistance is the subset of inconsiderate health care practitioners that care more for profits than patients' wellbeing. Patients are told to buy and take antibiotics for the wrong disease states. This is a worrying development and if no positive and immediate intervention is taken, we are likely to face drastic rise in resistance.

In the farming sector, antibiotics like Penicillins, Tylosin and Virginiamycin are

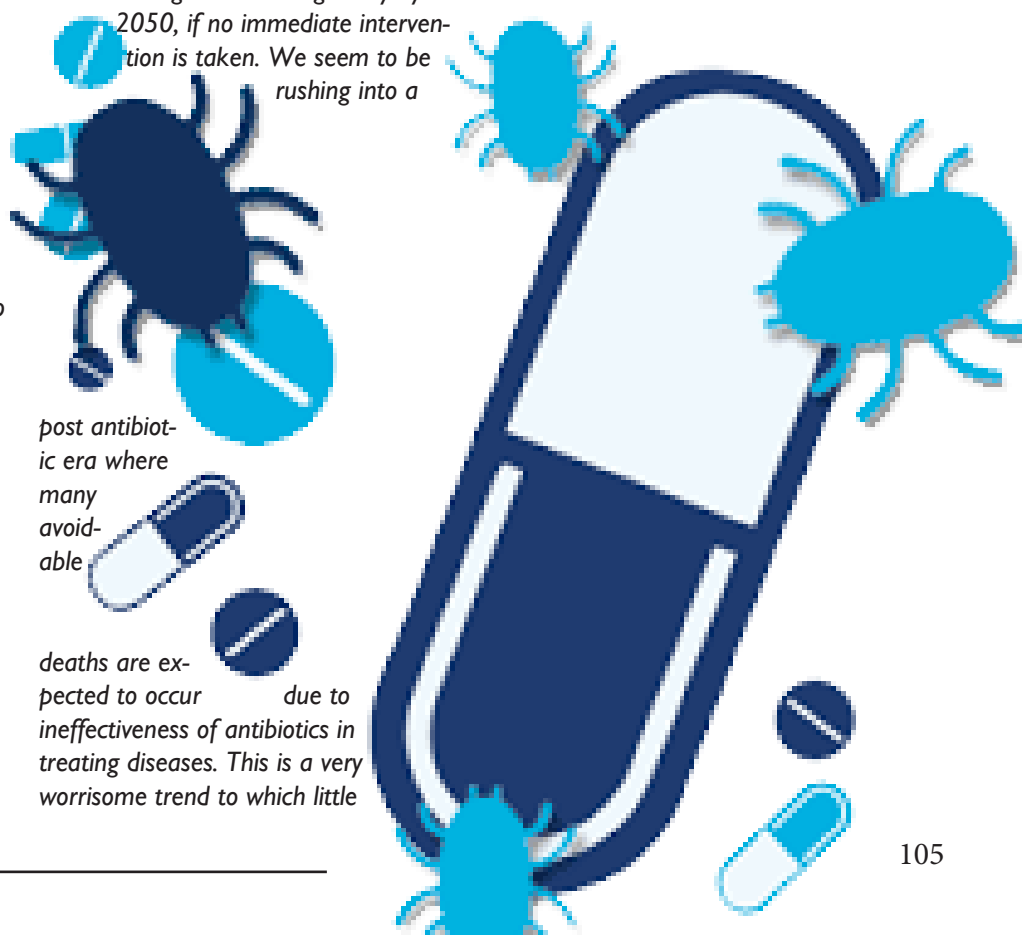
in constant use as growth promoters. They are administered to enhance growth of livestock and increase their animal protein. This too has played a major role in the rise of resistance to antibiotics. The inappropriate use of these drugs has created a significant threat to human health since pathogen resistant organisms that develop in these livestock end up in the food supply and are widely consumed in food products, especially if served raw, leading to emergence of more serious foodborne illnesses. The illnesses caused by these resistant strains of microbes are even more pathogenic and difficult to treat since they are no longer susceptible to common therapeutics yet animals and humans are regularly subjected to the same antimicrobials

2020 reports from the World Health Organization (WHO) project the deaths of over 10 million people and economic losses totaling 100 trillion globally by 2050, if no immediate intervention is taken. We seem to be rushing into a

attention is being paid.

To put a stop to this emerging global health threat, there is need for more research and collaboration in devising effective mitigation and prevention measures. Everyone has a responsibility to ensure proper use of antibiotics. If we all adhere to the guidelines, we shall be in a good position to reduce the rise in resistance.

The majority of the world's population is still in the dark about the complications which may arise from improper use of antibiotics. I therefore believe that as medical students, we should aspire to inform our communities about the effects of misuse of antibiotics. This will play a key role in averting the devastating outcomes that would arise from further rise in AMR.



post antibiotic era where many avoidable

deaths are expected to occur due to ineffectiveness of antibiotics in treating diseases. This is a very worrisome trend to which little



# THE UNSEEN WORLD AND RISE OF MUTANTS

There is an unseen world all around us. Outside and within our bodies. Our skin, the food we eat, where we sleep...

For years, the unseen world has staged wars against the human world. The human world has had a natural defense system, called the **IMMUNE SYSTEM**, an organization whose primary goal is to defend the human world from infections from different microbes like bacteria, viruses. This defense system soon proved inadequate to protect the human world.

This unseen world is filled with billions and billions of bacteria. For centuries, this unseen world has led to millions of people's death, from attacks as small as scratches to wars as big as surgeries.

Before World War II, the humans discovered new technology and started making Special Agents a part of a Special Forces group called **ANTIBIOTICS**. This Special Forces Group caused such terror amongst the unseen world as had never been seen. Bacteria died by the millions.

Over time, the bacteria also started developing new technologies and, through genetic engineering, started transforming themselves to avoid being wiped out and ensure the next generation's survival. This transformation gave birth to new strains called **MUTANTS**. These mutants were able to evade the ANTIBIOTICS and still cause chaos in the human world.

Through the misuse of this Special Forces Group, the human world has allowed the bacteria to learn more about the Special Agents and create even more mutants.

The human world's future may be compromised and making the war against the unseen world hard to win.

For so many years, the layman has asked the question, "**WHAT IS THIS UNSEEN WORLD?**"

(Written by Dr. Mpaju David)

# Advancing surgical education, research and mentorship among undergraduate students.



*Otolia Isaac,*

*President Makerere University Surgery Society 2019-2020*

**Makerere University Surgery Society (MUSS)**, an undergraduate student academic club with a full capacity of student leadership and patronage of Dr Jane Fualal Odubu (Breast and endocrine surgeon, Head of endocrine surgery unit- Mulago National Referral Hospital).

**Objectives:** Promote surgical education through; surgical skills sessions, student centered mini-rounds with guidance of a surgeon; mentorship of students by surgeons and participation in activities organized by the surgeon's associations.

**Activities:** The society carried out mini-rounds incorporated with mentorship sessions, with Dr Jane Fualal Odubu (Undergraduate surgery and excellence, breast and endocrine surgery), Dr Kakembo Nasser (Paediatric Surgery), Dr Muhumuza Michael and Dr Muhindo Alex (Neurosurgery), Dr Lokale Hans (Postgraduate studies, General surgery and Fellowships in USA/Europe), and a department member of Urology.

The students participated in the Women in Surgery Walk (WiSA) walk in October 2019 in

Kampala and the College of surgeons of East, Central and Southern Africa (COSECSA) scientific conference and AGM in December 2019, in Kampala.

**Remarks:** With changes in trends of learning, students should come up with avenues to enhance their own learning and increase opportunities of interface and interaction with the surgeon through mentorship, mini-rounds and skills sessions. This is all made possible through the bridging arm of Makerere University Surgery Society between the students and surgeons; and the outstanding guidance by the patron.

The future prospects of the society are to upscale its activities to; bi-weekly mini-rounds, monthly mentorship sessions, student exchange during the electives period with partner societies within East Africa.

*To be great, a surgeon must have a fierce determination to be a leader in his field. He must have a driving ego, a hunger beyond money. He must have a passion for perfectionism. He is like the actor who wants his name in lights- Donald B. Effler 1915-2004, Cardiac surgeon.*



# PHARMACY- A PILLAR OF GLOBAL HUMAN HEALTH



**Chelimo  
Betony.**

In light of the commemoration of the World Pharmacists Day on the 25th September, 2021 under the theme “Pharmacy: Always trusted for your health”, it became prudent of all to

appreciatively take into account the ever growing role of the Pharmacy sector in the continued sustenance of modern global human health in an ever-evolving global ecosystem.

Pharmacy is the clinical Health science that links medicinal science with Chemistry and is charged with discovery, production, safe and effective use, control and proper disposal of medications and drugs. The word “pharmacy” originates from the Greek word “pharmakon” which ideally means a “drug”. Pharmacy is a spin-off of Apothecary, which was the informal sector charged with medicinal therapeutics from the commencement of the earliest civilisations up until and including the Renaissance period. Government regulation of the medicine sector led to the birth of the

policy oriented science known as Pharmacy which evolved into an integral part of the nexus that is the modern health care system.

The dynamics of time have essentialised the use of medicine in various medical procedures majorly therapeutics and prophylaxis. The practice of pharmacy entails the manufacture of these drug substances to required standard to provide the desired benefit as much as possible while reducing side effects to the least possible. This is largely achievable through the quality orientation that is synonymous with the Pharmacy sector. A further duty entrusted to the human resource in the Pharmacy sector is the regulatory oversight of the manufacture, supply and use of drug substances to further uphold the required quality orientation. As such, various world governments have taken up a policy of requiring drug dispensing and manufacture units to register with a trained pharmacy professional for supervision.

Owing to the complexity of medicines and their usage, a systematic approach in medical science is necessitated. This systemization is incumbent upon the Pharmacy sector which is the control panel for medicinal usage. Thus, the knowledge and understanding of pharmacology has developed courtesy of the Pharmacy sector. Pharmacology as a branch of Pharmacy is vital in

ensuring the 3R's of drug usage which are **“right drug, right patient, right dose”** (from The top 9 Pharmacist duties and responsibilities at thebalancecareers.com). A secondary advantage herein is antimicrobial stewardship (AMS) to control the spread of antimicrobial resistance. AMS is largely achievable through promotion and following of the 3 R's.

That said, it is evident the invaluable role of Pharmacy in modern healthcare and what is clear is that the future of Pharmacy is bright as the world swims along the turbulent tides of change.

Inexhaustible are the contributions of Pharmacy to human health; as inexhaustible as the nobility of the pharmacy profession.

***Viva la pharmacie.***







# DENTISTS AND THEIR ROLE IN FIGHTING SUBSTANCE



Dr. Abraham Tentena (BDS).

Substance abuse according to the Diagnostic and Statistical manual of mental disorders is a maladaptive pattern of substance use leading to clinically significant impairment or distress as manifested by one or more of the following, occurring within a 12 month period: failure to fulfill major obligations at work, school or home, recurrent substance use in situations where it is physically hazardous, legal problems related to recurrent use, continued use despite having persistent social or interpersonal problems caused by the effects of the substance. In a study by Kasirye R on basic practices in Peer- Peer prevention programs in the Eastern Region of Uganda, it was found that 60-70% of students used illicit drugs with alcohol and cannabis taking the biggest percentage. This is worrying statistic considering that it is even just a small representation of a much bigger picture. Drug use has increased as society has continued to evolve and pressure has shifted from being community oriented to a more individualistic lifestyle and this has



caused a spike in the number of people looking and finding ways to cope with the pressures of day to day life.

The question of whether dentists should be concerned about this trend and actively involve themselves in helping these individuals is one that ultimately comes down to the individual practitioner. The ethical principle of beneficence however calls us to seek for the greatest good for the patients under our care. Patients should thus not be handled as cases but rather as multifaceted individuals whose socio-cultural and economic needs must be considered and addressed as far as we are in our mandate to do so. Some drug users will have obvious signs in their mouths that could indicate use for example oral thrush, frictional hyperkeratosis, leukoplakia, Xerostomia, oral squamous cell carcinoma etc. Other patients may show signs of withdrawal symptoms or outward signs of self-neglect indicative of substance abuse.

When a dentist recognizes these, empathetic and exploratory questioning must be done to establish whether the patient has a drug abuse problem. After it is established that there is a drug abuse problem, the dental patient must be handled as a complex patient and treatment plans must be modified to offer the greatest and most comfortable benefit to them. This is because factors

**ABUSE** like pain control, delayed healing, comorbidities, predisposition to more severe disease and compliance to treatment plan can affect how successful the treatment goes. Aside from ensuring that the patient's oral health is returned to optimal condition, the dentist can also play a role in getting the patient help for a bigger underlying problem; drug abuse.

During history taking, the dentist may be the first one to bring it to the attention of the patient that they could have a substance abuse problem. They can then offer addiction screening protocols, counselling services and referral pathways to institutions and organizations that specialize in caring for people with substance abuse problems. They must also be stringent when prescribing medication that could potentially be abused for example opioid analgesics.

The number of people who seek different healthcare services is vast. The upward trend in health seeking behavior is also going to continue as services are brought closer to the people and life expectancy increases in stride. Dentists are some of the frontline health workers and are often the first point of contact with the health system and for some cases, they may be the only points of contact. This is why it is imperative that they are cognizant of the role they could play in staying and reducing a growing universal problem: substance abuse.



**Rachel Ndyabawe,  
Makerere  
University, College  
of Health Sciences  
MBChB Year 5.**



# World Antimicrobial Awareness Week

November 18 - 24

Salutations readers,

Let us shift our focus to antimicrobial resistance for a moment here. “What is that again?” you say. In simple terms, antimicrobial resistance is when micro-organisms (such as a bacteria, viruses, fungi, and parasites) change themselves such that they can no longer be destroyed by anti-microbial agents. Antimicrobial agents include antibiotics working against bacteria, antivirals against viruses and so on. When a patient develops such a condition, it means that they can easily die from their illness because the antimicrobial agent being prescribed by the doctor cannot kill the disease-causing micro-organism. This makes antimicrobial resistance a very crucial topic.

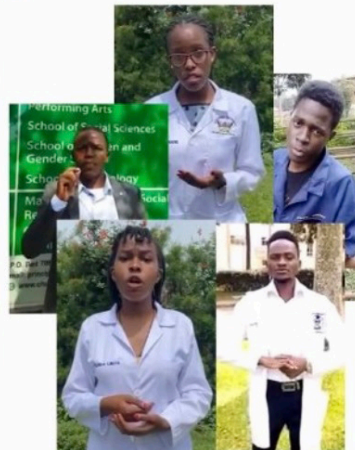
resistance.

Further still, it is important to note that these resistant microbes can spread from animals and crops to humans through improper handling and cooking of animal and plant products. Among humans these resistant microbes emerge when patients self-medicate, do not complete dose of the prescribed drugs simply because they feel better and then sharing the remaining pills with another patient.

From these above, one can easily tell how best to prevent the acquisition of this tragic condition like practicing good sanitary activities in the first place to prevent acquisition and spread of infectious micro-organisms. Then also avoid taking drugs without a proper prescription from a health worker and always finish the dose given to you even if you feel a momentary relief of symptoms.

My colleagues and I from Makerere University in collaboration with Nottingham Trent University put together a concise videoclip of under five minutes which generally talked about the causes of antimicrobial resistance and its prevention and a few of these have been mentioned earlier. I would like to send my gratitude to my team members (Linda Atulinda, Ignatius Asasira, Ssemuusi Allan and Bashir Katumba) who made this video a successful learning palace.

## Category: Video/Song Winner



The World Antimicrobial Awareness Week (WAAW) ran from 18<sup>th</sup> November to 24<sup>th</sup> November this year. It was such a huge success with a couple of learning platforms being set up on zoom by different universities all over the country. A number of posters were also developed by many students in an effort to educate thousands about antimicrobial



You can find this amazing video on this Twitter page:

**NTU-MAK Partnership**





# RWC COMMITTEE



Asasira Ignatius,  
MBChB V  
President



Kiyimba Blaise,  
MBChB  
Vice President



Atulinda Linda,  
MBChB V  
Editor-in-chief



Anastacia Sebbowa Nabyonga,  
BSB  
General Secretary



Edison Aryatunga,  
MBChB III  
Head of Publicity



Ndyahabwe Rachel,  
MBChB V  
Finance Secretary



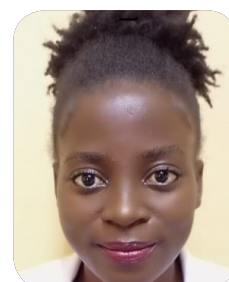
Kabunga Jonathan,  
MBChB V  
External Correspondent



Nakiganda Rachel,  
MBChB V  
Class Representative



Banturaki Davis,  
MBChB III  
Class Representative



Nalunkuma Rachael,  
MBChB  
Internal Correspondent



# MAKERERE UNIVERSITY BIOMEDICAL RESEARCH CENTRE

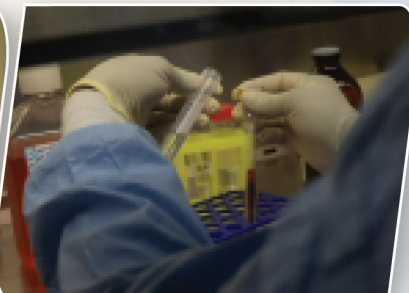
## OUR SERVICES

- RESEARCH.
- INNOVATION
- LABORATORY SERVICES
- CLINICAL CARE
- TRAINING
- RESOURCE MOBILISATION

## OUR LOCATION IS

Makerere University Biomedical Research Centre  
Mulago Hill Road

2nd Floor Micro-Path Building  
P.O Box 75018, Clock Tower, Kampala  
Uganda .



Official Email: [makbrc@chs.mak.ac.ug](mailto:makbrc@chs.mak.ac.ug) / Official Telephone: +256393194316  
Website: <https://www.brc.mak.ac.ug>