Establishing neurosurgery in Malawi – the story of a fruitful collaboration

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Abstract:

Until 2011 there was no neurosurgical service in Malawi apart from simple shunt surgery. Since then, little by little, a neurosurgical unit has been built up at Queen Elizabeth Central Hospital in Blantyre, with support from Oslo University Hospital. Today, the neurosurgical unit has one operating room and a 6-bed high dependency unit for postoperative care. Three neurosurgeons, two young trainees, and a team of dedicated nurses and assistants perform a total of 400 surgeries annually. Three quarters of the patients are children. An increasing proportion of the operations are craniotomies.

A CT scanner was installed in December 2020 and will probably lead to increased demand for general neurosurgery, in particular for trauma surgery. A second operating room and a 30-bed unit are needed in the near future. Two more trainees will start in 2022.

The plan is to have a sustainable, self-supporting service in 5-10 years' time.

KEYWORDS:
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A Malawian initiative

When 36-year-old Patrick Kamalo returned to Malawi in 2011 after finishing his neurosurgical training in Durban, South Africa, he had a clear mission: To establish his country´s first neurosurgical department at Queen Elizabeth Central Hospital (QECH) in Blantyre.

The task was overwhelming, as he was the only practicing neurosurgeon in Malawi, a low-income country with 15 million people at the time. Although QECH was considered the best surgical hospital in the country, it was neither equipped nor staffed for neurosurgery.

What Dr. Kamalo did have, was a strong motivation. Seven years earlier, his newborn son had successfully undergone an endoscopic third ventriculostomy (ETV) at the Cure Children's Hospital in Uganda. Kamalo experienced personally how valuable a simple neurosurgical intervention could be and decided to become a neurosurgeon. He started his training in 2007, with the ambition to make high-quality neurosurgery available for fellow countrymen in need.

Upon his return to Malawi from training in South Africa, Kamalo realized that he would not get very far by himself, as the only practicing neurosurgeon in a poor country. He decided to ask neurosurgeons abroad for support and contacted Oslo University Hospital (OUH) in 2011. His appeal for help landed on a desk at OUH, where it eventually caught the attention of a neurosurgeon who had just returned from a visit to Addis Ababa, Ethiopia, where a pioneering neurosurgical training program had been implemented with encouraging results[1]. Maybe the Ethiopian model for building up neurosurgery could be of value also in Malawi?

After a feasibility study in Malawi in 2012 and acceptance by the principal stakeholders – the Malawian Ministry of Health, the College of Medicine in Blantyre, the Norwegian Embassy in Lilongwe, and the Department of Global Health at OUH - a long-term agreement was signed between the two hospitals and Fredskorpset (a Norwegian governmental aid organization, now called NOREC). The Blantyre-Oslo Neurosurgery Project was subsequently launched in November 2013 and managed administratively by the Department of Global Health.

This is the story about our experiences during eight years of collaboration to establish Malawi's first neurosurgical unit.

The Blantyre-Oslo Neurosurgery Project

The objective was to build a sustainable neurosurgical service at QECH - with adequate equipment and with relevant training of neurosurgeons and nurses.
The collaboration was expected to last for ten years or more. We planned to provide basic neurosurgical equipment and train a neurosurgical team, including neurosurgeons, ward nurses, OR nurses, anesthesia clinical officers and medical technicians. When selecting candidates for training, we decided to put special emphasis upon their enthusiasm to train

others. We also agreed to concentrate on neurosurgical diseases with a favorable cost/benefit ratio. We did not conclude about the role of para-medical clinical officers in neurosurgery. It is still a matter of debate whether we could proceed more rapidly and effectively by also training clinical officers to perform some of the more standardized neurosurgical operations.[2,3]

In our opinion, a sustainable service should have at least five trained neurosurgeons, two or three residents, 1000 operations or more per year, at least two fully equipped ORs, sufficient ward and outpatient areas and basic support from radiology (CT, MRI, and later interventional neuroradiology), laboratory services, anesthesiology (acute care, OR, recovery, an Intensive Care Unit) and rehabilitation.[4]

Surgery in Malawi at baseline in 2011

Neurosurgery

At QECH, Jonathan Waluza, a clinical officer with three years of training, had been performing shunt surgeries for more than ten years.[5] Otherwise the hospital was neither equipped nor staffed for neurosurgery. That year Patrick Kamalo was the only full-time practicing neurosurgeon in the country.

Equipment and facilities

In 2014, an OR and a small HDU were renovated and equipped for neurosurgery.

Table 1 shows important milestones in the gradual build-up of the service.

Exchange and training of relevant healthcare personnel

The exchange of nurses between Malawi and Norway started in November 2013. Until March 2020, thirty-nine Malawians, i.e. nurses, clinical officers, theatre assistants and medical technicians had visited OUH for six-month periods of specialized neurosurgical training.[6] After the first six years of exchange, 60% of the participants were still members of the neurosurgical team, some of them from the beginning of the project, while the others either left the project shortly after their return or after serving for some time.

The training of neurosurgeons turned out to be more complicated. We needed a sufficient volume of surgical activity and a training program in order to comply with the COSECSA (College of Surgeons of East, Central and Southern Africa) regulations and get their accreditation.[7] Moreover, the hardest part was finding the right candidates; qualified young doctors, willing to go through six years of intensive training. This took us four years. Finally, in January 2018, Leonard Chafewa and Sithembile Chimaliro were ready to start their careers as neurosurgical trainees at QECH (Fig. 1, Fig. 2). After basic training in general surgery, they became full-time residents and members of the neurosurgical team in January 2020. Two more residents will start their training in 2022.

Year	Event
2010	• Patrick Kamalo certified as a specialist neurosurgeon in South Africa
2011	• Kamalo' s initiative and visit to Oslo University Hospital
2012	• Feasibility visit from Oslo to Queen Elizabeth Central Hospital, Blantyre • ETV introduced • 0,35 T MRI available five days a week • *Hydrocephalus shunt operations common, 200/year, mostly done by clinical officer* • *Craniotomies hardly done; lack of proper drills, only basic bone instruments and a dental drill available* • *Severe head injuries common, rarely operated, CT not available, very high mortality*
2013	• Formal agreement about long term collaboration Blantyre-Oslo • Exchange beginning: one OR nurse, one head nurse and one anesthesia clinical officer from Malawi to Oslo
2014	• Norwegian specialists visiting Malawi • Exchange continues, with specialist nurses (OR, neurosurgery and anesthesia) and medical engineers from Norway. Nurses, clinical officers and technicians from Malawi • HDU established with 6 beds • Dedicated OR refurbished, with neurosurgical and anesthetic equipment. • Two Malawian doctors starting neurosurgery training in Morocco (WFNS Africa 100) • *Huge foramen magnum meningioma operated*
2016	• *First ruptured aneurysm operated*
2017	• COSECSA accreditation for training of neurosurgeons
2018	• Malawi's first neurosurgical training program launched, neurosurgical trainees begin 6 years of specialization (2018-2023) • EMR (electronic medical record) introduced, developed by Kamalo and Malawian information technology (IT) experts
2020	• Online teaching once a week and tele-radiology • CT scanner installed

Table 1 Milestones – building up neurosurgery in Malawi

Image 1.
a. Leonard Chafewa and Sithembile Chimaliro, the first neurosurgical residents to be trained in Malawi (Photo: H. Slettebø)
b. Three generations of neurosurgeons; resident Sithembile Chimaliro; Head of Department Patrick Kamalo, and visiting neurosurgeon Haldor Slettebø.(Photo: C.G. Aukrust)

From Norway a total of 21 OR nurses, anesthesia nurses, neurosurgeons, anesthesiologists, and medical engineers have traveled southward for shorter or longer periods (2 weeks – 6 months). Nurses have visited for 6-12 months, while neurosurgeons mostly have stayed for 2-4 weeks. On average, the visiting surgeons have covered three months annually until the COVID-19 pandemic.

Five of the visiting neurosurgeons have come from OUH, three from Hungary, and four from other countries (Sweden, Hong Kong, the United Kingdom and Germany). A colleague from Bergen, Knut Wester, with first-hand experience from the Ethiopian project, gave a one-week introductory course for the new residents in 2020.[1]

In 2012 the WFNS (World Federation of Neurosurgical Societies) announced the Africa 100 project which aimed at training 100 neurosurgeons in Africa by 2020.

Malawi was fortunate to be offered two scholarships to Dr Geoffrey Ndekha and Dr Davis Mpando. Both left for training in Morocco in October 2014 and returned as specialists in neurosurgery six years later.
In January 2021, with funding from Germany, a trainee anesthesiologist was enrolled to subspecialize in neuro-anesthesia.

Most of the time only one specialist neurosurgeon, Patrick Kamalo, has been present at QECH. He has felt a heavy burden from the steadily increasing surgical activity and from being constantly on call until recently, when the residents began their neurosurgical training.

The exchange of healthcare personnel between QECH and OUH was stopped

temporarily in March 2020 due to the COVID-19 pandemic. Hopefully, the exchanges will resume in 2022.

Training program in neurosurgery

When the COVID-19 pandemic occurred in early 2020, we had to adapt our training program to the new travel restrictions.
The practical training, including surgery, out-patient clinic, on call-duties and clinical rounds, has mainly been supervised by Dr. Kamalo and Dr Mpando in Malawi. Both residents have kept the COSECSA surgical e-log books. In September 2021, one resident had assisted at 177 procedures and performed 99 unsupervised routine operations.
Theoretical education has included 81 weekly on-line lectures since March 2020. Initially, the lectures dealt with general neurosurgery, positioning and infection prophylaxis. A lecture by Professor Enoch Uche from Enugu, Nigeria, focused explicitly on the challenges and prospects of neurosurgical training in sub-Saharan Africa. These general lectures were succeeded by lecture series covering neuroanatomy, spine, trauma and vascular neurosurgery.
We encouraged the residents to actively search for information and to give lectures themselves. Thus, the two residents have delivered one-third of the presentations. The remaining lectures were given by neurosurgeons from Sweden, Norway, Nigeria, and Germany. All the lectures have been interactive.

In parallel to these lectures, radiologists at OUH have given the two candidates at QECH an introduction to neuroradiology - including topics such as brain tumors, spine tumors, hydrocephalus, brain infections, cervical trauma, low back pain, and postoperative care. Future lectures will focus on how to optimize the use of the new CT equipment for neurosurgical purposes.
Both of the residents have started a scientific project on pediatric hydrocephalus by writing a research plan and applying for ethical permits. They have also participated and presented at international conferences.[8]
The department of neurosurgery participates regularly in morbidity and mortality meetings together with the other surgical disciplines at QECH.

Situation in 2021

General surgery

There are four central hospitals in Malawi, situated in the main cities, with a total of around 40 surgeons and five anesthesiologists. In addition, there are 50 secondary level hospitals where practically all surgeries are conducted by non-physician clinical officers. Malawi has the lowest density of surgeons in the world, 0,24 per 100 000 population, and the country has a huge unmet burden of surgical conditions. [5,9,10]

Neurosurgery department at QECH

Today, Patrick Kamalo is heading a small neurosurgical team at QECH. The two specialists, recently trained in Morocco, and the two residents, as well as dedicated nurses in the OR and in the HDU, are members of the team. A medical technician is also part of the neurosurgical family.
On a normal day, there are 30-40 neurosurgical patients in the hospital – only

six of them in the neurosurgical HDU. The other patients are spread all over the hospital: in the hydrocephalus room, the premature ward, the medical or the surgical ward.

Patient records and imaging are available on-line through the new tailor-made EMR system, developed by Kamalo and Malawian IT specialists in 2018. The system is used and updated continuously, e.g. in the handover meeting at 7.30 a.m., during the rounds, in the outpatient clinic and in the OR. It is also a basic instrument for quality improvement by measuring hospital-acquired infections, surgical complications, and mortality.

The annual number of neurosurgical operations has doubled since 2013, and the complexity is increasing (Fig. 3).

The neurosurgical practice is mostly pediatric with 75% of the procedures conducted in patients below 17 years of age, and 50% in patients six months old or younger (Table 2).

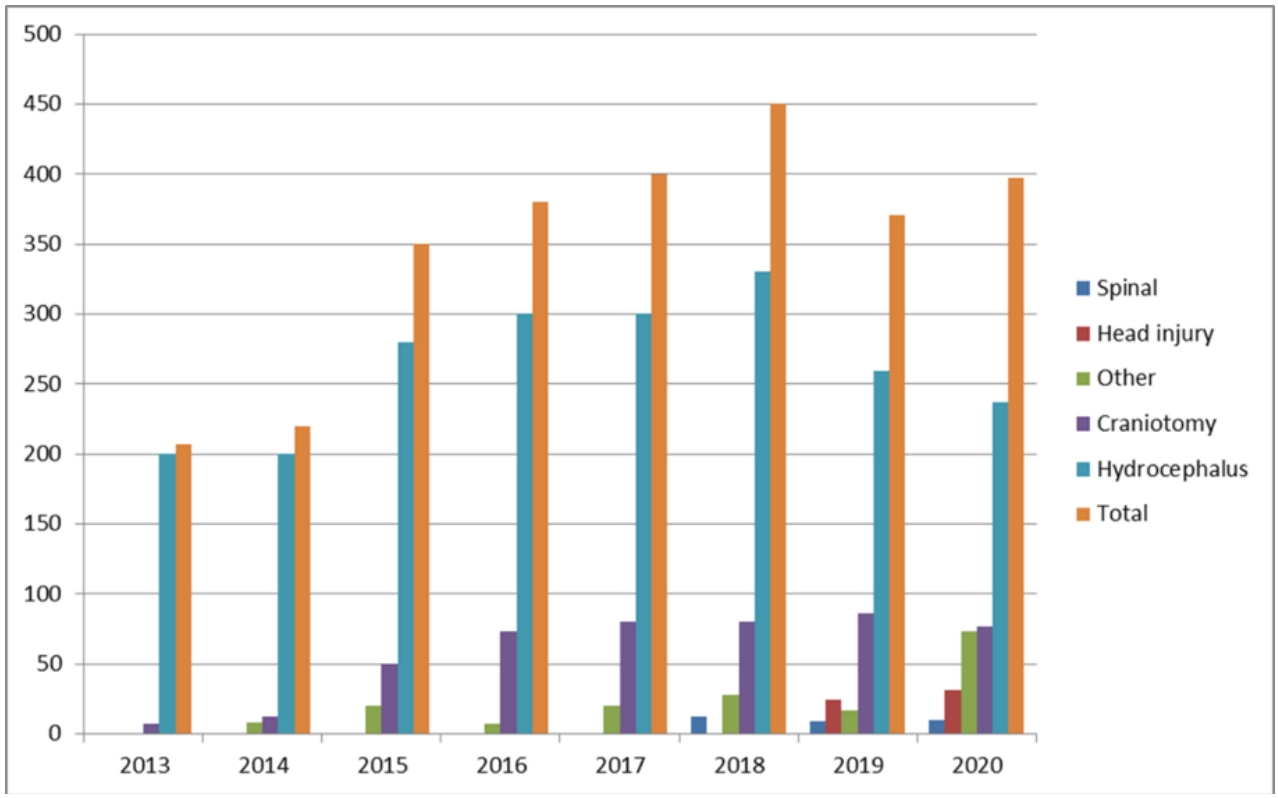

Image 2
Neurosurgical operations per year at Queen Elizabeth Hospital, Malawi (2013-2020)

Total operations 2017	408
Children, total number below 17 years	303
Infants up to 1-year-old	176
Median age	6 months

Diagnoses	
Encephalocele	6
Brain tumor	18
Other	16

Hydrocephalus	263 (86%)
VPS	89 (34%)
ETV +/- CPC	161 (61%)
Other	13 (5%)

Table 2 Pediatric neurosurgical operations in 2017
CPC = choroid plexus coagulation, ETV = endoscopic third ventriculostomy, VPS = ventriculoperitoneal shunt

ETV procedures were introduced in 2012 by Dr. Kamalo after his 3-month training period at the Cure Children's Hospital in Uganda. Today ETVs are performed in 60% of the hydrocephalus patients (Table 2). More than half of the hydrocephalus cases have a post-infectious etiology.[11,12]
The proportion of craniotomies has seemingly reached a plateau but is expected to increase again after the CT scanner was installed in December 2020

Discussion

One might argue that neurosurgery is too expensive to be prioritized in a poor country with major public health problems and a frail healthcare system. It is true that neurosurgery sometimes can be expensive and give little benefit for patients in spite of high costs, e.g. in some malignant tumors, in the most severe cases of head injury, and in complex vascular operations followed by several weeks in the Intensive Care Unit. But generally speaking, neurosurgery is an indispensable part of healthcare all over the

world and constitutes an important part of "Essential Surgery", - a list of 44 basic and cost effective surgical procedures, feasible in low- or middle-income countries (LMICs) and addressing substantial needs.[13,14] Three of the essential procedures are part of our daily neurosurgical work: burr holes, shunt operations and treatment of fractures. In addition, other cost-effective neurosurgical procedures might be considered for the Essential Surgery list: craniotomy for head injury, for benign tumors and for some brain infections.[15]

From a Norwegian perspective

An important learning point for us has been to observe that a lot of neurosurgery can be done with simple means and minimal bureaucracy. The best example is probably the EMR system developed by Kamalo and local IT specialists. It provides simple, rapid, useful and available information (text and imaging) every day in a lot of different settings: presenting patients during the morning meeting, updating patient information during rounds or outpatient visits, planning surgery, assembling information and extracting statistics. Dr. Kamalo's EMR system is simple and more user-friendly than other cumbersome electronic patient record systems.

Most of the neurosurgical diseases are similar in Malawi and Norway. However, the scope of neurosurgical disease at QECH looks different in several ways:

- In patients presumed to have a brain tumor, a variety of infectious diseases, such as tuberculomas, are important differential diagnoses.
- Benign brain tumors, e.g. acoustic neuromas or meningiomas, are bigger since diagnoses usually are delayed.
- Malignant brain tumors are rarely seen in the hospital, probably because patients die without a diagnosis.
- Road traffic accidents are much more common in Malawi than in most other countries and constitute a major public health issue.[16]
- Around 60% of children with hydrocephalus at QECH are treated effectively without implantation of a shunt.[11]
- Some patients with treatable conditions such as benign tumors, hydrocephalus or tuberculomas, present with irreversible damage to visual function or cognition because of delayed diagnoses.

Last year, for instance, we met a nine-year-old girl, accompanied to the hospital by her grandmother. She had started to bump into things, and after a while, a CT scan was performed, as she had become blind and helpless. The scans showed an extreme communicating hydrocephalus. It is part of the story that she became deaf by the time she was seven years old and then didn't go to school anymore because she also stopped talking.

From a Malawian perspective (Patrick Kamalo)

Malawi is the obvious winner in this collaboration. We noticed major progress in the development of the neurosurgery service in November 2014 when the HDU and the OR were opened and we received crucial equipment for the conduct of major operations.

Although we say that the number of operations conducted has doubled since 2013, in actual sense, the number of major operations has increased five-fold. This would not have been possible without substantial help from Norway. OUH provided us with equipment, training of nurses and other personnel, but also continued support with maintenance of equipment and provision of consumables which were unavailable in Malawi.

In other departments at QECH we have seen locally trained specialists give up and leave the country since they were unable to do their job without adequate support.

It is an undeniable fact that had it not been for the collaboration, Patrick Kamalo would have left Malawi long time ago due to frustration in not being able to do what he trained in.

We have also learnt that maintenance of equipment is of paramount importance. During the feasibility visit from OUH in 2012, it was noted that there was a lot of equipment at QECH which was nonfunctional. We therefore planned to include medical technicians early in the project and this has paid off.

Another aspect we have benefitted from is good organization of the wards. The neurosurgery theatre and ward are now models in their respective departments. After noticing the unique care offered by the neurosurgery HDU, the management of the newly opened Mercy James Centre (for Paediatric Surgery and Intensive Care) turned to OUH to partner with them in order to develop ward and theatre systems for the new pediatric surgery hospital. Thus, from 2016 our Malawian-Norwegian collaboration comprised 3 institutions: OUH, QECH Neurosurgery and the Mercy James Centre. The neurosurgical HDU has also inspired the development of a similar unit for respiratory medicine and a new Stroke Unit at QECH.[17]

Another important lesson we have learnt is about the fusion of cultures. The exchange program includes a two-week training of participants drawn from different parts of the world (four continents) where NOREC is operating. The cultural training is a part of the program meant to help the participants to integrate in the countries which will be hosting them. This exercise brings appreciation of other cultures but also understanding and accommodation of cultural practices. After complaints from local staff in Malawi about the behavior of some visiting staff in one of the projects at QECH, the Neurosurgery Project was contacted to understand how cultural tensions could be dealt with. We recommended that they should take part in the two-week orientation program. Both Malawian staff and the visitors participated, and they gave a very good report of the training.

Challenges with retention of skilled staff, staff motivation and sustainability of the gains we have, made may pose threats to the project. Most of our nurses are young and newly graduated and will probably be motivated by continued professional development. We realize that neurosurgical nursing is intensive and demanding and that our healthcare workers are among the least paid in the world. This has led to loss of some staff to better-paying jobs. We have, however, non-monetary incentives in place to improve staff morale.

We will soon need a second OR to accommodate the increased activity in cranial and spinal surgery. We have recently taken over the spine surgery service previously run by the Department of Orthopedics. With a well-functioning CT service running 24 hours a day and

competent residents on call, we expect the number of craniotomies to increase rapidly. Our plan is to have one theatre dedicated for hydrocephalus patients and another theatre for major neurosurgical operations.

For a long time we have felt that having a dedicated space for all neurosurgery patients will greatly enhance the quality of care we give our patients.

We also hope to have an MRI scanner installed in the near future. Since most of our patients are children, we try to minimize exposure to radiation and preferably use MRI scanning instead of CT. We are therefore continuously lobbying our government to acquire an MRI scanner for our hospital. Currently there is only one MRI machine in the country situated in the capital city 300 km away. Each week we are sending three or four patients to the capital for MRIs. This demonstrates the great need for an MRI machine in our hospital.

Conclusion

Our main conclusion is that establishing the first neurosurgical unit in Malawi has proven to be difficult, but feasible.

Difficult because of Malawi's weak economy and the general scarcity of doctors and nurses in the country.

Feasible mostly because of patience, strong motivation and will to succeed among the Malawians involved in the project – and with a little help from their Norwegian friends.

The Blantyre-Oslo Neurosurgery Project has been inspired by a well-functioning project in Addis Ababa, Ethiopia, where 35 specialist neurosurgeons have been trained in their homeland during a 10-year period from 2006.[1] Today, neurosurgical training in Ethiopia is self-supporting and independent of foreign trainers. We hope for a similar achievement in Malawi in five- or ten-years' time.

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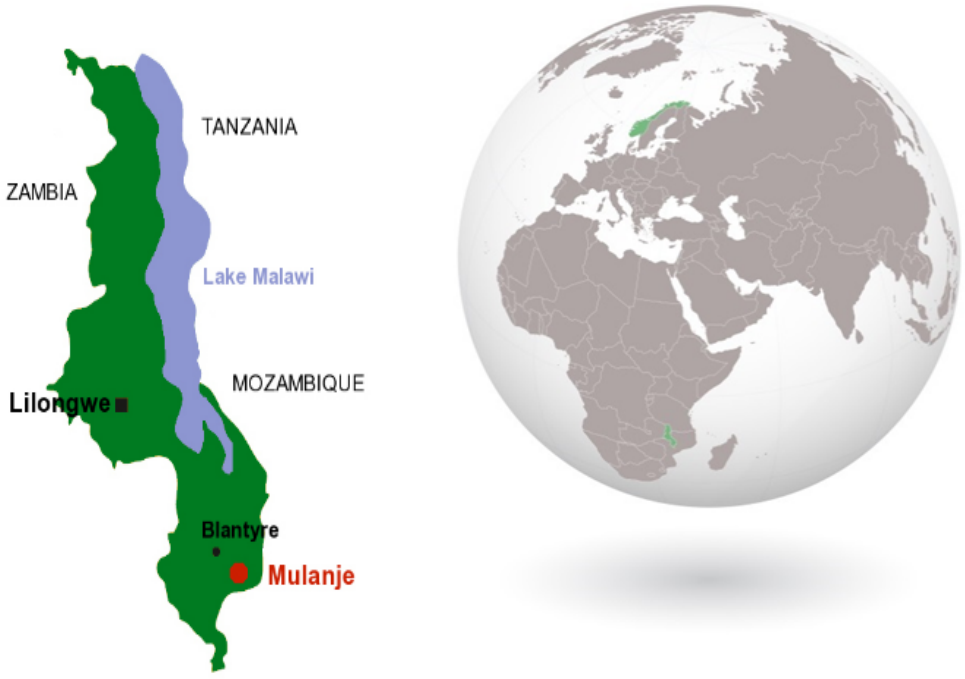
Supplement

Facts about Malawi

Malawi is a land-locked country in sub-Saharan Africa, see Fig. 3. Blantyre is the center of finance and commerce, a city with 1 million inhabitants in a region with one third of Malawi's population.



Land Area:	118,484 Km2
Population:	18,6 million (2019)
GDP/capita 2020:	US$246.00
2020/1 National health budget	
- per capita:	US$14.58
- proportion of total budget:	10.7%
- proportion of GDP	5.93%
Capital city:	Lilongwe
Other Major Cities:	Blantyre, Mzuzu, Zomba
Infant mortality:	30 per 1000 living births (reduced from 55 in 2009)
Life expectancy:	64 years (increased from 45 in 2000)

World Bank Overview on Malawi's economy (2021, March 18)

The country has an estimated population of 18.6 million (2019), which is expected to double by 2038.

Malawi remains one of the poorest countries in the world despite making significant economic and structural reforms to sustain economic growth. The economy is heavily dependent on agriculture, employing nearly 80% of the population, and it is vulnerable to external shocks, particularly climatic shocks.

*Malawi's **development challenges** are multi-pronged, including vulnerability to external shocks such as weather and health. The COVID-19 pandemic has further negatively impacted economic growth and livelihood. Other challenges include rapid population growth and environmental degradation. Energy shortages still stand out, with about 11.4% of the population having access to electricity. Infrastructure development, the manufacturing base, and adoption of new technology are low, and corruption levels remain high with Transparency International ranking Malawi at 129/180 economies in 2020.*