

Emergency Department St Francis Referral Hospital, Ifakara, Tanzania

Project Report from November 2019 to April 2021

Start of the project: September 2015



Collaborators

- St Francis Referral Hospital (SFRH), Ifakara, Tanzania
- Ifakara Health Institute (IHI), Ifakara, Tanzania
- Swiss Tropical and Public Health Institute (SwissTPH), Switzerland
- Emergency Department of the Muhimbili National Hospital, Dar es salaam, Tanzania
- Voluntary Service Organization (VSO), Great Britain
- Aerzte für Ifakara, Austria
- Swiss Agency for Development and Cooperation (SDC), Switzerland
- University Hospital Basel, Switzerland
- Sponsors: Symphasis Foundation, Hella Langer Foundation, Ernst Göhner Foundation, Else Kröner Fresenius Stiftung, Germany, private sponsors,

Donor for this particular time period November 2019-April 2021: **Else Kröner Fresenius Stiftung, Germany**: Else Kröner Fresenius Preis für Entwicklungszusammenarbeit 2019 (please see video (<https://www.youtube.com/watch?v=hdztpb6ipJI>))

Report prepared by

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Board certified in Internal Medicine, Emergency Medicine and Sonography

1. Summary

The SFRH serves currently a population of about 1 million people of the Kilombero-, Ulanga-, and Malinyi districts in Tanzania. Before the start of the project in September 2015, no emergency department was in place. The aims of the project are:

- **Training** of medical personnel in emergency medicine, triage and sonography
- **Organisation** of the Emergency Department (ED): triage; clinical shift operation; availability of drugs and consumables; Implementation of equipment; collection of patient data.
- **Research** on distribution of diseases and clinical, sonographical, and echocardiographical diagnoses

Training on emergency medicine is done by regular courses and daily during morning meetings. Additionally bedside teaching, training in performing and interpreting electrocardiograms (ECG), training in using a defibrillator, chest tube insertion, and in using other equipment such as monitors, nebulizer, and the iStat point of care system is integrated in routine work.

Emergency-, point of care-, and abdominal sonography is taught by courses, during regular weekly sessions, and during every day practice. One echocardiographer has been trained in echocardiography since October 2017, five more doctors are trained in echocardiography since 2021.

In 2015, the former outpatient clinic was reorganized to the ED integrating a new emergency room for patients with serious conditions, which was opened in May 2016. A total of 7 clinical officers, 3-4 rotating intern doctors, and 13 nurses work at the ED. Triage is operating since December 2015, using a score of 3 severity categories. The ED operates in 3 shifts 24 hours a day. Emergency drugs, fluids, and other consumables are available at the ED. Patients are diagnosed using clinical skills, ultrasound, ECG, and point of care tests (Malaria rapid tests, urine dipstick, urine pregnancy test, blood glucose tests, HIV tests). Since March 2020, the iSTAT point of care system (Abbott, Chicago, USA) is being operated: Laboratory parameters from blood such as hemoglobin, electrolytes, liver enzymes, creatinine and blood gas analysis are measured at the ED with results being available after 5 minutes. Stabilization of the patient is sought within the emergency room (ER) and treatment recommendation is done for the first 24 hours. Patient data is collected electronically using eHMS-system computer software. Since March 2020, the ED has an own budget and bank account, thus is functioning in a semiautonomic financial status.

From June 2016 until May 2017, 35'903 patients were seen at the ED. Most common diagnoses were infectious diseases (48%), trauma (10%), abdominal (8%), and cardiovascular diseases (6%). A total of 8% of the patients had a serious life-threatening condition. From November 2019 to October 2020, the number of patients increased dramatically to 84'228 patients, and 7892 (9.3%) had a life-threatening condition.

Several research projects are linked to the ED: Description of clinical and sonographical diagnoses in the ED, prevalence of heart diseases, outcomes in patients with peripartum cardiomyopathy, and the ultrasound in managing tuberculosis studies (FASH (focused assessment with sonography in TB-and HIV patients) observational study and a two-center trial.

Major achievements since the beginning of the project in 2015:

- Fully operating emergency department managing 84'000 patients per year, including equipment and consumables
- Trained health care workers in emergency medicine (9 clinical officers, two MDs, 13 nurses, in addition: 3 to 10 intern doctors rotating every 2 months)
- Training center for ultrasound and echocardiography: Since 2018, 9 courses in point of care emergency ultrasound and obstetrics ultrasound were done: A total of 5 sonographers passed the exams in both point of care (POCUS) emergency - and obstetric sonography, 8

- in POCUS, and 6 in obstetric sonography, and are certified by European Federation of Societies for Ultrasound in Medicine and Biology (EFSUMB) after passing the exams done according to Schweizerische Gesellschaft für Ultraschall in der Medizin (SGUM) and EFSUMB-guidelines. Six of them participated already as instructors in ultrasound courses. One echocardiography course has been done in 2020. One echocardiographer with skills according to latest international recommendations and guidelines, who performed more than 3500 echos according these guidelines, and five more doctors currently being trained in echo.
- Functioning electronic patient database system (eHMS)
 - Three scientific papers, two studies ongoing, one study finished recruitment currently data-analysis (eFASH trial)
 - This project received the Else Kröner Fresenius Preis 2019 für Medizinische Entwicklungszusammenarbeit (<https://www.youtube.com/watch?v=hdztpb6ipJI>)

Achievements since November 2019

- First course in Echocardiography
- First POCUS course organized by local experts only
- iSTAT point of care lab system (Abbott) implemented
- Semiautonomic financial status of the ED

2. Status before start of the project

The SFRH serves currently a population of about 1 million people of the Kilombero and Ulanga district in Tanzania. Patients travel up to 180 kilometers to reach the hospital. The hospital has 360 beds, and provides medical service in surgery, obstetrics, gynaecology, pediatrics, internal medicine, ophthalmology, dental care, and urology. Financed by the SDC, the facilities for an emergency department were under construction. Before the start of the project, there was no emergency department. Emergency patients were seen in the outpatient clinic (OPD). There was no triaging system: Who came first was served first. Patients were waiting to be registered before being seen by medical personnel. There were no initial diagnostic procedures, and no initial treatment of severely ill patients. All diagnostic procedures and treatments were done in the wards. There was no emergency medicine equipment.



3. Aims of the project

The aims of the project are:

- **Training** of medical personnel in emergency medicine, triage, and sonography
- **Organisation** of the Emergency Department: Triage; clinical shift operation; availability of drugs, intravenous fluids, material, and oxygen; own ED-budget and cost-center; collection of patient data.
- **Implementation of equipment**, and training of staff in using it
- **Research**

Emergency room at the beginning of the project

4. Description of project procedures

4.1 Training

4.1.1 Training in Emergency Medicine

a) Courses in emergency medicine

September 2015 to December 2015: Four courses of theoretical and practical training in triage, trauma care, adult and pediatric emergency care (4x4 days) were done by the team of the emergency department of the Muhimbili National Hospital, Dar es Salaam, Tanzania, which was attended by 20 to 30 medical staff of the SFRH.



Dr Said Kilindimo from Muhimbili National Hospital

b) Everyday training in Emergency Medicine

November 2015- ongoing:

- **Everyday morning meetings** of 45 minutes to one hour are held with discussion of cases, attended by senior doctors, clinical officers, assistant medical officers, nurses, guest doctors from Switzerland, and the project leader.
- **Bedside teaching** by trained health care personnel, and the project leader is done daily while working actively with the team, including advanced cardiac life support, advanced trauma life support and emergency sonography.
- **Training in performing and interpreting electrocardiograms (ECG):** Regular teaching in interpretation of ECG is performed in presentations and during seeing patients, and teaching sessions in interpreting ECG is done regularly.
- **Training in using a defibrillator:** two to four times per month, teaching session in resuscitation and using the defibrillator is being done.
- **Training in chest tube insertion:** Training has been done during emergency insertion in trauma patients with hemothorax and pneumothorax, and in patients with empyema. Members of the emergency department team and all surgeons are able to insert chest tubes.
- **Training in using other equipment (monitors, nebulizer, oxygen cylinder, iSTAT point of care lab system).** Every new staff is instructed in using and maintenance of the equipment by the experienced members of the Emergency department. All staff is able to use the monitors, nebulizer machine, oxygen concentrator, and oxygen cylinder correctly.



Triage, Reception, and waiting area for ED patients



Triage, Reception, and waiting area for ED patients who are not in a serious condition at 9 am. Patients already have passed at the triage and wait to see a clinician.

4.1.2 Training in Ultrasound and Echocardiography

a) Abdominal- and Point of care emergency sonography courses

Since 2015, ultrasound is taught in everyday practice. Since 2018, regular courses in abdominal- point of care- and obstetrics ultrasound are being done at the St Francis Referral Hospital, with 20 to 26 participants per course, in collaboration with ultrasound experts from Switzerland. Courses are endorsed by EFSUMB (European Federation of Societies for ultrasound in medicine and biology). All courses were coordinated by Dr Martin Rohacek, attending them as an Instructor (1):

4.6 to 8.6. 2018: Abdominal ultrasound and emergency sonography, in collaboration with Klinik Hirslanden, Zürich, Switzerland (Prof. Jan Tuma, Prof A Serra, Dr F. Neugebauer, Dr Roland Stieger)

29.1. to 1.2.2019: Point of care ultrasound (POCUS) course in emergency medicine, in collaboration with SmW, Stiftung für medizinischen Wissenschaftstransfer, Switzerland (Prof Jan Tuma, Dr W. Gysel, Dr G Krähenbühl)

4.2. to 7.2.2019: Course in Obstetrical Sonography Level 1 and pregnancy screening weeks 20-24, in collaboration with SmW, Stiftung für medizinischen Wissenschaftstransfer, Switzerland (Dr G. Krähenbühl, Dr E. Neuenschwander)

4.6 to 9.6. 2019: POCUS Refresher course, in collaboration with Klinik Hirslanden, Zürich, Switzerland

4.11 to 7.11.2019: Point of care ultrasound (POCUS) course in emergency medicine, in collaboration with SmW, Stiftung für medizinischen Wissenschaftstransfer, Switzerland

8.11. to 12.11.2019: Course in Obstetrical Sonography Level 1 and pregnancy screening weeks 20-24, in collaboration with SmW, Stiftung für medizinischen Wissenschaftstransfer, Switzerland

3.2. to 6.2.2020: Point of care ultrasound (POCUS) course in emergency medicine, in collaboration with SmW, Stiftung für medizinischen Wissenschaftstransfer, Switzerland

7.2 to 11.2.2020: Course in Obstetrical Sonography Level 1 and pregnancy screening weeks 20-24, in collaboration with SmW, Stiftung für medizinischen Wissenschaftstransfer, Switzerland

2.11. to 5.11.2020: Point of care ultrasound (POCUS) course in emergency medicine, performed with instructors from St Francis Referral Hospital only

In December 2020, a first 2-day point of care ultrasound course for new intern doctors (beginners) has been held, led by Dr Max Bauer, with 16 participants attending.

Participants were clinicians from the Kilombero, Ulanga and Malinyi districts, from Dar es Salaam, Bagamoyo, and the St Francis Referral Hospital. Staff from the ED also attended other EFSUMB endorsed ultrasound courses at Huruma, Rombo, Tanzania in 2017.

A total of 5 sonographers passed the exams in both point of care (POCUS) emergency - and obstetric sonography, 8 in POCUS-, and 6 in obstetric sonography, and are certified by European Federation of Societies for Ultrasound in Medicine and Biology (EFSUMB) after passing the exams done according to Schweizerische Gesellschaft für Ultraschall in der Medizin (SGUM) and EFSUMB-guidelines. Nine of them participated already as instructors in ultrasound courses.

Another three, already certified sonographers received further training, and were trained to be instructors. In 2020, we had 9 instructors in ultrasound, who were instructing and lecturing during the course in November 2020, which was held without experts from Switzerland because of the corona pandemic. All instructors train younger colleagues everyday during everyday work at the ED. From 27.7.2020 to 21.05.2021, a total of **1237** ultrasound examinations have been performed at the ER by ED clinicians.



Dr Shabani is instructing colleagues



Dr Ndege is lecturing



Dr Evelyne Siongo is instructing



Courses February 2020

Dr Myovela is showing basics of echo



Exam in obstetric ultrasound passed! (2/2020)



POCUS November 2020



Exam in POCUS passed! (February 2020)

b) Extended Focused Assessment with Sonography in Trauma (eFAST):

Once per week (every Wednesday morning for one hour) a practical training in eFAST (extended focused assessment with sonography in trauma) for beginners is held in presence of the trained local sonographers of the ED. Thus, every doctor working at the Emergency Department is able to do the easy to learn eFAST, in order to detect free fluid in the abdomen, thorax, or pericardial space, and to detect pneumothorax. A total of 3 to 10 Intern doctors are rotating every 2 months. New Interns are trained in the first week in eFAST and are encouraged to use the ultrasound machine which is ready to be used for everyone 24 hours a day.



Dr Kitila is training intern doctors in eFAST

c) Echocardiography

Since October 2017, Victor Myovela is being trained by the project leader. Victor is a certified assistant radiologist and sonographer who was trained in radiology and ultrasound during 2 years in the Department of radiology at the KCMC hospital in Moshi. Currently, he performs all echocardiographies in the hospital. The project leader is supervising him for every patient and all echo clips and is checking unclear findings live on the patient. Also, management recommendations for every patient are done together with the project leader. Victor is hired by SFRH as a radiologist, but currently focuses fully on echocardiography, as cardiac diseases are a major health



Dr Myovela is performing an echocardiogram in a child with congenital heart disease

problem in rural Tanzania. During clinical duties, he additionally performs abdominal and obstetric ultrasound.

Three to seven echos per day are performed - more than 4000 echos in total since the beginning of the project, more than 3000 done by Victor under supervision. Patients are coming from far (Morogoro Town, Iringa, Twara, and Dodoma etc), only for echo examinations, to the SFRH. Since 2021, Dr Myovela trains 4 more doctors in echoicardiography, together with the project leader.

From 30.8. to 1.9.2020, the first course in echocardiography was done at our facility, with 9 participating Tanzanian echocardiographers. Instructors and lecturers were Dr Victor Myovela and Dr Martin Rohacek.



First echo-course in Ifakara September 2020

d) Ultrasound machines



Currently, we have 9 ultrasound machines (Philips H3, 2x Mindray M7, Chison eBit60, 2x Chison Sonobook 9, Toshiba UIMV 780A, Samsung Sonoace X8, Siemens acuson sequoia c512), four of them are fully equipped for echocardiography. Of these, three (one Mindray M7, Sonoace, Toshiba, and Siemens) were purchased in 2020, and one (Siemens, able to perform contrast enhanced ultrasound (CEUS) was donated by PD Dr Jan Tuma. All machines are working well. They are maintained by the sonographers.

4.2 Organization of the ER

4.2.1 ED facilities

On May 5th, 2016 the ED moved to the new facilities built by the SDC, which was inaugurated by the Minister of Health. The outpatient clinic and its staff has been incorporated in the new emergency department (ED). The ED consists of the former out patient clinic (OPD) and the new emergency room (ER), where patients with life threatening conditions are managed. Since Dezember 2015, the ED is in full operation 24 hours a day 7 days per week.



Emergency room for patients in serious conditions: Four instead of two monitors in the ER since 2020



Consultation room for patients without a serious condition

4.2.2. Lead of the emergency department

The lead of the emergency department is fully done by Tanzanian doctors. The project leader is only assisting in leading the ER, and working as a consultant and trainer.

4.2.3 Triage

Since December 2015, a triaging system is in full operation from 7 am to 5 pm. Every patient entering the Emergency Department is assessed by a trained nurse. Chief complaint, vital parameters (blood pressure, heart rate, temperature, and oxygen saturation) are assessed, and the patients are triaged in 3 priorities, according to a score: Priority 1 is a patient with a life-threatening condition, and is proceeding directly to the ED and is being seen and managed immediately by a doctor. Registration is being done later. Priority 2 and 3 patients register and wait they are seen by a doctor, priority 2 first, then priority 3. After 5 pm, the number of patients decreases, and mostly, every patient can be seen by a doctor immediately.



4.2.4 Clinical three-shift operation

The Emergency Department operates in 3 shifts during 24 hours 7 days a week. Currently, there are 7 clinicians (1 MDs, 5 clinical officers and 1 assistant medical officers) who work permanently at the ED, and 3 to 5 intern doctors rotate every 2 months to the ED. Since November 2020, 10 intern doctors work at the ED. Nurses positions were increased from 9 to 13. Duty rosters are done by the deputy head of emergency department.



4.2.5 Drugs and material

Emergency drugs including antibiotics, intravenous fluids, furosemide, epinephrine, atropine, phenobarbital, diazepam, and others. Material such as cannulas, syringes, gloves, disinfectants, sterile sets for chest tube insertion, clothes, bedsheets, are ready to use at the

ED since December 2015. Drugs and material are refilled every day. Patients get the needed drugs immediately in the ED. Drugs and material is charged to the patients, or they or the relatives buy and bring the used drug back later to the ED. If the patient cannot afford the drug, the emergency drug is given for free. This is financed by donations from private sponsors from Switzerland. The amount needed from outside to run this is about 30 US\$ per month.

4.2.6 Patient management

A working diagnosis is made at the ED using clinical skills, point of care tests (Malaria rapid tests, urine dipstick, urine pregnancy test, blood glucose tests, and HIV tests), sonography, ECG, and echocardiography. Lumbar puncture is performed in case of meningitis or encephalitis. Since 2020, the iSTAT point of care system (Abbott, Chicago, USA) is available: Blood is analysed for hemoglobin, creatinine, electrolytes, liver enzymes, blood gas analysis can be performed. Results are available after 5 minutes. Treatment such as intravenous fluids, antibiotics, pain killers, and salbutamol inhalations with a nebulizer are applied at the ED. Patients are moved to the wards or directly to surgical theatre after being stabilized. In case that emergency surgery is needed, such as in perforated peptic ulcers and intraabdominal hemorrhage, surgeons see patients directly in the ED and take patients directly to the theatre.

4.2.7 Cleaning

The hospital's cleaning team is cleaning the ER twice per day and additionally if needed.

4.2.8 Own budget and cost center for the ED

Since March 2020, a new payment system has been established: Relatives of patients with a serious condition (i.e. who need immediate treatment at the emergency room) pay for emergency service directly to ED staff, after they received emergency service. Besides consultations, emergency service includes ultrasound service, ECG, chest tube insertion, and iSTAT laboratory service. The money generated is used to pay overtime and double shifts, material such as cartridges for the iSTAT system, stretchers and a fridge, consumables such as gloves, and to pay for spare parts of the air condition system. From March through to December 2020, the ED, from services done at the emergency room only, generated 32'800'000 TZS (about 12'500 US\$).

4.2.9 Collection of patient's data

For the ED, data are available since May 2016. Since then, every clinician wrote data of the patients he attended during his shift on a sheet, which is given to the administration at the end of the shift. The administration collects all data using paper files. Patient data consists of name, age, address, diagnosis, malaria test result, treatment, and admission/referral. In August 2017, a student from the medical faculty of the Basel University, Switzerland, did a master thesis on the prevalence of diagnosis of ED-patients and did collect all data from May 2016 until July 2017. Additionally, in-hospital mortality was assessed. The publication of this research has been published. In 2018, an electronic patient data system (GoT-HoMIS) was installed by the hospital, and was changed to eHMS in 2020. This system is in full operation.

4.3 Equipment and material

The equipment consist of the following:

- Nine ultrasound machines: Two are used in the ER, always available to be used. The others are used for routine sonography, sonography in the wards, echocardiography, and research. One is used for contrast enhanced ultrasound only. All machines are used during ultrasound courses.

- Monitors (Dräger Infinity Delta) (ECG, oxygen saturation, blood pressure): In 2020, three more monitors have been added (two in the ER and one in an additional room) thus five monitors are available and working well. The monitors have been donated by the Kantonsspital Aarau, Switzerland.
- ECG-machine. Training in ECG is ongoing as described above.
- Nebulizer for Salbutamol-inhalation in case of an obstructive respiratory problem.
- Two Oxygen cylinder
- Two oxygen concentrators
- Defibrillator
- Chest tube system including vacuum pump, and 3 surgical sets.
- Glucometer, rapid malaria tests, urine dipsticks, urine pregnancy test, blood pressure meters ready to use.
- iSTAT point of care lab system
- Non-invasive equipment for airway management
- 3 stabilisers, 1 UPS system
- Respirator machine, donated by the NGO Aerzte für Ifakara, Austria
- One new suction machine, purchased in 2020

All newcoming staff members are instructed in the use and maintenance of the equipment by trained ED staffs.

Consumables such as medicaments, oxygen, IV fluid, cannulas, syringes, gauze, surgical blades, gloves, ECG paper etc is now available in adequate amounts. Oxygen is always available from a cylinder and from two oxygen concentrators.

Respirator machine: In August 2016, a new respirator machine was given to the hospital by the Austrian NGO “Aerzte für Ifakara”.

The respirator is used for non-invasive ventilation only, in patients with pulmonal edema and COPD. Staff is regularly trained in operating the machine.



A patient with respiratory failure receives non-invasive ventilation

5. Patients at the ED

The master student from University Hospital Basel collected all diagnoses from June 2016 until May 2017. During this period of one year, 35'903 patients were seen at the ED. Most common diagnoses are infectious diseases (48%), trauma (10%), abdominal problems (8%), and cardiovascular diseases (6%). A total of 8% of the patients had a serious life-threatening

condition. A detailed report of this work has been published (2). Since then, the number of patients has dramatically increased to 84'228 patients from November 1st 2019 to October 31st 2020. A total of 7892 (9.2%) patients had a serious condition, and were managed in the emergency room. These patients mostly suffered from trauma, hypertensive urgency, heart failure, severe pneumonia, malaria, emergencies during pregnancy (incomplete abortion, bleeding, ectopic pregnancy), intestinal obstruction, and sepsis.



An intern doctor does an eFAST in a patient who was injured by a crocodile



Teamwork is important in the emergency room



A trauma patient with a tension pneumothorax is being managed and stabilized before chest tube insertion

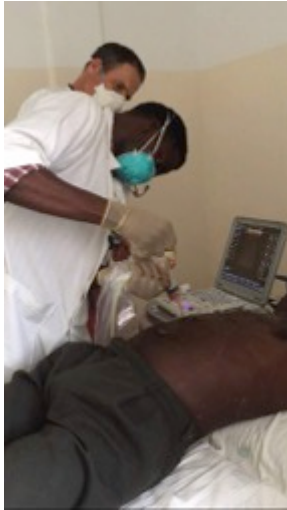
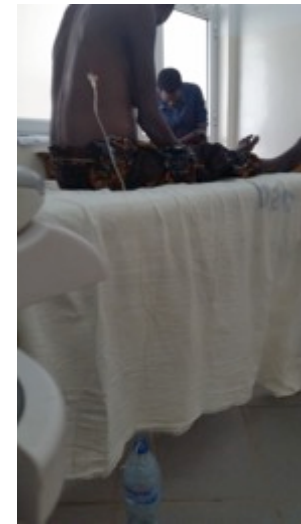


Ultrasound is the main diagnostic tool besides clinical skills

6. Echocardiography and sonography service for the hospital

Routine sonography examinations (obstetric, pelvic, abdominal, i.e. not emergency sonography) are done by the sonography team of the hospital, which consists of 2 sonographers. All echocardiography is done by the trained echocardiography, (VM), the project leader, and by 4 more doctors since 2021. From November 1st 2019 to October 31st 2020, a total of 829 echos were done, and more than 4000 since the beginning of the project. Routine sonography of the abdomen for second opinion, and special examinations such as duplex sonography of the leg, thyroid gland chest- and joint sonography, and invasive procedures such as insertion of drains, chest tubes, puncturing of joints, pleura and

pericardium (pericardiocentesis and pleurocentesis) are done by the emergency department sonography team.



A liver abscess is punctured by Dr Robert Ndege. A drain is inserted into a large liver abscess in another patient. Pleural fluid has been punctured, and pleural fluid drained.

7. Research

We performed 3 observational studies linked to the emergency department. The studies were approved by the ethical review boards of the University Basel, the Ifakara Health Institute review board, and the National Tanzanian ethical board (NIMR). All studies



were collaborations of local staff and 3 master students from the medical faculty at the University of Basel completed their master thesis. One study describing sonographical diagnoses at the ER), and the eFASH trial is ongoing.

7.1 Diagnosis in the ED

Since May 2016, all diagnoses of all ED patients are collected. These data were collected and recorded by a master student from Basel University (Noemi Simon). Also, in-hospital mortality rates were collected from 2015 until 2017 from hospital registries. The manuscript entitled "Diagnoses made in an Emergency Department in Rural sub-Saharan Africa" has been published (2).

7.2 Prevalence of heart diseases

Another medical student from Basel University (Laurine Roos) analyzed all echocardiographies done since the beginning of the project. This will be the largest study describing cardiac diagnoses from echocardiographies from a rural sub-saharan African setting. The publication of this work represents a master thesis (3).

7.3 TB-FASH (focused assessment with sonography in HIV-TB patients), and eFASH trial

All patients with suspected tuberculosis (TB) were eligible to be included in a prospective study (FASH). Recruitment was done at the ED, the chronic disease clinic of Ifakara (CDCI), and in the wards of the hospital. Included patients received a full TB diagnostic procedure and a sonography according the FASH protocol (pericardial and pleural effusion, abdominal lymphadeno-pathy, thickening of bowel wall, ascites). The frequency of sonographic signs of TB was compared in different patient groups (eg patients with confirmed vs not confirmed TB). 260 patients were included; 40% had microbiologically proven TB. All sonography was performed by Dr R Ndege, and the project leader. This study was financed by the foundation “Freiwilliger Akademischer Verein Basel”. A master student (Flavia Diggelmann) from University Hospital Basel did her masterthesis with this study. The work is published in open forum infectious diseases (4). The trial “Ultrasound in managing extrapulmonary tuberculosis” started in September 2018. In October 2020, recruitment of 700 patients has been achieved, follow-up lasted until March 2021. Currently, data are analyzed. The protocol has been published (5).

8. Sustainability

The ED project has to be sustainable. Therefore, the following efforts were/are done:

Leadership

The ED is led by local doctors: The project leader is present in everyday work as a consultant and continues the daily training. His assistance in leadership of the ED is no longer necessary.

Training

The concept of train the trainers generated 7 emergency clinicians able to teach others in emergency medicine, 9 ultrasound instructors and one echocardiography instructor who train other colleagues in emergency medicine, ultrasound, and echocardiography

ED-Budget/salaries

All costs for salaries of the medical staff of the ED is paid by the hospital administration or by the government of Tanzania. All consumables such as gloves, syringes, cannulas, giving sets, fluids, and oxygen, are provided by the hospital, and paid by the patients and from the ED budget as described above. Maintenance of the ultrasound machines and other equipment is done by the ultrasound- and ER team. Medication for poor patients is financed by contributions from private sponsors from Europe. The amount needed for these expenses is about 300 US\$ per year. The salary for the project leader and expat nurse are paid from external funds. Apart from that, the ED runs without further external financial needs.

Doctors and nurses from Switzerland

Miss Claudia Bucher, experienced emergency medicine nurse from Luzern, Switzerland, is working since May 2019. Besides routine work at the emergency room, she trains ED nurses in everyday practice.

Dr Martin Rohacek, project leader, works in Ifakara since 2015.

Dr Frederick Carlen worked as a civil servant from July to December 2019.

Dr Max Bauer works as a volunteer from September 2020 to January 2021 at the ER.

Dr Karin Hasler is an experienced emergency medicine doctor and instructor in ultrasound (SGUM) and works from April to June as a volunteer at the ED.



Patient with arrhythmia and heart failure is monitored

9. Achievements

9.1. Organisation of an Emergency Department

Implementation of a triaging system for patient triage

→ ACHIEVED!

Implementation of a clinical shift operation

→ ACHIEVED!

Drugs, intravenous fluids, and cannulas, and other needed material such as gloves, are always ready to use.

→ ACHIEVED!

Emergency medication, oxygen, fluids, and other consumables are always ready to use

→ ACHIEVED!

Implementation of own budget and cost center

→ ACHIEVED In 2020

overtime compensation and material can be paid from the budget

Collection of patient's data: started May 2016

→ ACHIEVED

The collection of patient data is done electronically since 2018

9.2. Training

Training of health care workers (medical doctors, assistant medical officers, clinical medical officers and nurses) in emergency medicine
→ **ACHIEVED**

Training of local medical personnel to become instructors in EM.

→ **ACHIEVED!**

7 experienced ED clinicians train other clinicians in emergency medicine. Additionally, one trained medical doctor and three clinical officers left the hospital and work in other facilities.

Training in sonography and echocardiography, training of local medical personnel to become instructors/teachers in sonography

→ **ACHIEVED!**

9 certified intructors in sonography who already were instructors in courses

9.3. Equipment is available, and staff knows how to use it

→ **ACHIEVED!**

iSTAT lab system implemmented, 3 more monitors installed, 4 more ultrasound machines acquired in 2020

9.4 Research: 3 publications, one ongoing trial, one ongoing observational study

→ **ACHIEVED!**



10. Further planning

Actually, all goals formulated at the beginning of the project have been achieved. However, training in emergency medicine, ultrasound, and echocardiography is going on in everyday practice, and in courses. More ultrasound and echocardiography courses are planed in 2021, also for beginners, students, and new intern doctors: Another echocardiography course is planned in September 2021, in collaboration with the department of Cardiology of the University hospital Basel. Further collaboration will be done with the new Else Kröner heart and lung clinic at the St Francis Referral Hospital, which is funded by the Else Kröner Fresenius Stiftung. Miss Claudia Bucher is continuing her work at the ED, her salary is financed from other funds since May 2021. Martin Rohacek continues to work in Ifakara continuing training and consulting ER doctors, and is involved in other projects at Ifakara, i.e the Else Kröner Heart and Lung Clinic project which started in November 2020.

10. Finances

Donors

- 100'000 Symphasis Foundation, Zürich in 2015
- 20'000 CHF Ernst Göhner Foundation, Zug in 2015
- 68'500 Euro Hella Langer Foundation, Gräfelfing) in 2015 and 2018
- 13'000 CHF grants for the three master students by FAG
- 17'000 CHF were donated by private sponsors
- 100'000 Euro by Else Kröner Fresenius Stiftung (November 2019: Else Kröner Fresenius Preis 2019 für Medizinische Entwicklungszusammenarbeit (<https://www.youtube.com/watch?v=hdztpb6ipJl>))

Income generated by the ED by services (consultation, ultrasound, ECG, iSTAT, excluding echos), from March 2020 to December 2020

Total cash: 27357000 TZS (10'430 US\$)

Total through patients with health insurance: 5352000 TZS (2'040 US\$)

Expenses from November 2019 to October 2020, from external funds (i.e Else Kröner Fresenius Stiftung)

From November to October 2020, a total of 100179 Euros has been spent (see Table below, excluding expenses for local staff salaries, overtime shifts, 2 stretchers, fridge, and consumables financed from the own ED budget)

A total of 74609 Euros has been spent on salaries (Martin Rohacek, MD (30%), Claudia Bucher, Nurse (70%). Another 30% salary of MR and CB has been financed from other project funds. A total of 22838 Euros has been spent for material, and 2730 Euros for consumables. Additional material (six Dräger Infinity Delta Monitors) has been donated by Kantonsspital Aarau: 2 have been installed in the emergency room, one in the ED ward room, one is used in the triage, one is used for research, and one has been installed in the operation theatre of the Bagamoyo District Hospital)

Overtime and double shifts of ED staff, 2 stretchers, one fridge, have been financed from the ED budget/Cost center (not shown in the table)



Reception of the ED processing payment

Table 1: Expenses of funds from Else Kröner Fresenius Stiftung November 1st 2019 through to April 30st 2021

Expenses November 1st 2019 to April 30st 2021				
	Euro	Months/Units	Total Euro	
Salaries				
Salary M Rohacek 30%	2625.99	18	47267.90	
Salary Claudia Bucher 70%	2278.50	12	27342.00	
Total			74609.90	
Material				
Mindray M7 machine	11931.90	1	11931.90	
Toshiba/Sonosite machines	2325.00	2	4650.00	
Siemens: Customs clearance/Transport	1341.06	1	1341.06	
Curved probe for Mindray	953.25	1	953.25	
Sector Echo probe for Mindray	983.00	1	983.00	
Laptop	595.20	1	595.20	
Computer for ER payment	530.10	1	530.10	
Suction machine	455.70	1	455.70	
Other Material	1398.72	1	1398.72	
Total			22838.93	
Consumables				
Ultrasound Gelly	168.33	1	168.33	
Chest Tubes	32.55	1	32.55	
Medikaments	279.00	1	279.00	
Start depot bank account ER	372.00	1	372.00	
Expenses for courses	1878.60	1	1878.60	
Total			2730.48	
Total			100179.31	
Income funded by Else Kröner Fresenius Stiftung			100000.00	
Balance			-179.31	

11. Communication and reception of the project

- In April 2016, the Minister of Health of Tanzania (Hon Ummu Mwalimu) and the Swiss Ambassador for Tanzania (Mrs F. Tinguely-Mattli) visited the Hospital and inaugurated the new Emergency Department.
- The project was presented at the 'National Meeting Day on Healthcare delivery in rural Africa', attended by the Chief Medical Officer (Prof. Muhammed Bakari): 'Innovation and implementation of health care in rural settings in Afrika' on June 30st 2016 in Dar es salaam, which was attended by 50 participants, including the Chief Medical Officer representing the Tanzanian Ministry of Health, the Swiss Ambassador for East Africa, and journalists from two Tanzanian newspapers.
- The following personalities visited the ED:

Government Tanzania:

- Hon. Ummu Mwalimu, Minister of Health, Tanzania;
- Prof. M. Bakari, Chief Medical Officer of Tanzania;
- Board members of the Ifakara Health Institute

Ifakara health Institute (IHI)

- Dr Honorati Masanja, Director of IHI

Swiss Embassy in Tanzania

- Florence Tinguely-Mattli, Swiss Ambassador for Tanzania
- Arthur Mattli, Swiss Ambassador for Eastern Africa
- H.E. Didier Chassot, Swiss Ambassador for Tanzania since 2020
- Manuel Sager, Head of SDC
- Romana Tedeschi, country head of SDC
- Leo Näscher, country head of SDC since 2020

SwissTPH and Swiss Universities and Hospitals

- Prof. Ch Hatz, Prof. M. Tanner, Prof S. Gagneux, Prof. D. Paris, Prof. Ch Lengeler, Prof, J. Utzinger (Swiss TPH)
- Prof M. Battegay, Prof A. Kiss, Prof. W. Langewitz, Prof T. Klimkait, Prof A. Urwyler, Dr. Werner Kübler, Director University Hospital Basel (University Hospital Basel)
- Prof. HJ. Furrer (Inselspital Bern)
- Prof. A. Serra, PD J Tuma, Klinik Hirslanden, Zürich



Conclusion

After five and a half years the second emergency department of Tanzania (after the ED in Muhimbili National Hospital, Dar es Salaam) is well running 24 hours a day 7 days a week, caring for 84'000 patients per year. Medical staff has been trained in organization of an ED, in

clinical emergency medicine, in ultrasound and echocardiography. Currently, an oxygen plant is being installed at the St Francis Referral Hospital, financed by the Rudolf Geigy Foundation, Basel, Switzerland. Thus, unlimited oxygen will be available at the ED from June 2021. Training has to go on.



Dr Martin Rohacek
Ifakara, 21.05.2021

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