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RESEARCH ARTICLE

Building critical care capacity for resource-limited countries with complex emergencies in the World Health Organization Eastern Mediterranean Region: Developing and Implementing a Critical Care National Training Program in Yemen

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ABSTRACT

Background: Caring for critically ill patients is challenging in resource-limited and complex emergency settings such as Yemen, where the burden of disease and mortality from potentially treatable illnesses and injuries is higher than in resource-rich areas. Barriers to delivering quality critical care in these settings are numerous and include deficiencies in health systems structure, a limited capable healthcare workforce, insufficient financial resources, and access constraints due to insecurity, among many other factors. **Methods:** Potential solutions include the development of focused practical and educational programs for capacity building of national healthcare professionals' knowledge and skill sets in the care of critically ill patients. This requires adaptation of proven curricula into a national training program to promote implementation of evidence-based critical care. **Results:** Yemen successfully introduced a 9-week national critical care training program that targeted both physicians and nurses from 11 of 12 southern governorates from 5th June to 11th August 2022. The procedures for its development and its implementation are described in this report. Successful continued development and implementation are contingent on ongoing adaptation, secured financial resources, and support from academic institutions such as the Faculty of Medicine and Health Sciences University of Aden (Yemen), the Oman Medical Specialty Board (Sultanate of Oman), health care authorities and partners. Technologies utilized included tele-education and a simulation skills center using high fidelity manikins, in addition to the lectures and bed-side training sessions in Intensive Care Unit (ICU). **Conclusion:** Critical care training is a vital need and of paramount importance in resource-limited and complex emergency settings such as Yemen and programs should be developed and sustained under country ownership with support from internal and external partners. The current challenges and shortfalls require new approaches such as a comprehensive, focused critical care/ICU national training program to build a cadre of critical care professionals in the country together with the provision of human, material, and financial resources support. Through producing a cadre of critical care/ICU national professionals, this course is contributing to enhancing the emergency preparedness and response capacities in Yemen, as well as building sustainable critical care capabilities within the national health system that will further save many lives in Yemen.

Introduction

The World Health Organization (WHO) Eastern Mediterranean Region (EMR) comprises 22 countries with a population of nearly 700 million people spread over parts of Central and South Asia, the Middle East and North Africa. The countries of the region vary greatly in resources, growth indices, and economic strengths.[1] More than 102 million require humanitarian assistance across the region,[2] representing 34% of the global total; it is the source of more than 60% of the world's refugees.[3]

Yemen is one of the most fragile, conflicted affected and vulnerable countries in EMR. At the beginning of 2022, it is estimated that 23.4 million people need humanitarian assistance, with 12.6 million being targeted for humanitarian health aid.[4] The country is also prone to multiple other emergencies, such as disease outbreaks (e.g. cholera, dengue, diphtheria), food insecurity (over 19 million are food insecure; 504,000 children are severely malnourished), and natural disasters (e.g. recurrent storms, floods, droughts).

After more than seven years of continuous conflict, Yemen's health system is in a fragile state. It requires the strengthening and further developing of health care system delivery responding to the vital health needs and to save lives and promote health. Yemen faces increasing demands for critical care and Intensive Care Unit (ICU) services while suffering from a brain drain to the private sector and abroad of specialized health workers in these areas. Only 50% of health facilities are fully functioning and those that remain open often lack sufficient numbers of qualified health staff, basic medicines, medical equipment like masks and gloves, and oxygen and other essential supplies to meet the immediate needs of the community.[5]

The COVID-19 pandemic placed an additional burden on an already fragile health system to meet the surge needs of patients with severe and critical illnesses. In addition to the severe humanitarian crisis, many factors have played a role in the deterioration of the Yemeni health system. These include tensions within the community, rapid decline in the socio-economic status, food and environmental insecurity, and water with sanitation problems, among many others.[6]

Although building up critical care capacity and well-functioning ICUs has been one of the most urgently needed investments in resource-limited countries,[7-9] this has not received proper attention in the Region due to long and complex conflicts resulting in limited investment in the health system, multiple competing health care needs and demands, and donor preferences for funding primary care and maternal and child health programs. As a result, the affected countries often seek quick-fix solutions instead of investing in long-term and in-country programs. The most common solutions for scaling up critical care capacity in resource-limited settings has centered around foreign experts deployments, infra-structure improvements and application of guidelines that come from high-income countries.[7,10] Long timelines and prohibitive cost often make these not sustainable due to the decline and instability in the local economy.

Being triggered by the COVID-19 pandemic, WHO with the Yemen Ministry of Public Health and Population (MoPHP) has been providing a number of short courses in case management to scale up the critical care capacity of national healthcare professionals, targeting more than 2000 healthcare workers since early 2020, with support from the World Bank and other partners. These programs have included introductory ICU training on the fundamentals of critical care to help build technical and clinical competencies in the management of critically ill patients.[7,11,12] These and other short-term trainings, usually five to ten days, have been well received in numerous countries and have played a significant role in the immediate filling of gaps in ICU coverage by delivering the basics of critical care to physicians and nurses, and other healthcare professionals.[7,13]

Nonetheless, limitations are recognized including lack of evidence for the impact of short-term training on longer-term knowledge retention, practice at the bedside, and patient outcomes. Some studies of short courses in critical care have shown improved knowledge among participants.[14] However, the long-term benefit, sustainability and scalability of short courses remain uncertain. A further issue is that human capacity and infrastructure vary widely within country and regions and even within cities with respect to the number, skill set, cadre of ICU healthcare workers and distribution of resources especially between the private and public sectors.

These shortfalls and limitations require alternative approaches. In response, WHO is collaborating with the MoPHP Yemen, Faculty of Medicine and

Health Sciences University of Aden (Yemen), Oman Medical Specialty Board (Oman), World Bank and other partners to develop and implement a comprehensive 9-week-long, focused critical care national training program. Moreover, ensuring the sustainability of skills implementation in Yemen, WHO linked the Oman Medical Specialty Board to the Faculty of Medicine and Health Sciences University of Aden. At the end of the training program, the Oman Medical Specialty Board provided a virtual two-day critical care training to the participants who had completed the national training program. This innovative Yemen-Oman collaboration also served as an external evaluation of participant achievements through the 9-week national course.

The program aimed to rapidly build a cadre of critical care/ICU professionals for Yemen by using a multidisciplinary approach, with adaptive training concepts targeting frontline healthcare workers. This report describes the experience of developing and implementing the training program, including progress made and challenges faced.

Methodology

Preliminary assessments in critical care/ICU capacity and findings

The first step was to define the magnitude and needs for critical care services, more specifically the burden of disease and specific determinants of critical care in Yemen. In response to the lack of data regarding critical care needs and ICU capacities in resource-limited settings during the early stages of the COVID-19 pandemic, WHO developed an ICU assessment instrument to facilitate timely delivery of life-saving items and strengthen human resource capacities in the ICU.[7] Site assessments were performed in the major hospital ICUs and IUs (isolation units) during 2020 - 2021 at central and sub-national levels of Yemen using the ICU assessment tools, and both quantitative and qualitative analyses were made. As preparation to the 9-week national training program for critical care, in early 2022, additional site visits and interviews took place at 15 hospitals and facilities recommended as possible practical training sites by the MoPHP. The selection was based on site assessment and structured interviews of the ICU directors and ICU nurse managers.

The overall key findings included: care of the critically ill patients in public hospitals is constrained due to limited ICU caregiver skills and inadequate health system infrastructure; the burden of critically ill and injured patients with medical, obstetric, pediatric, surgical and trauma is disproportionate to the capacity of the ICU system; the role of nurses is undervalued and inadequately supported while physicians and nurses should be considered equally pivotal to quality care management in the ICUs. In addition, a severe brain drain from public to private sector was observed for various reasons, such as benefits from better pay, working conditions, lifestyle and sometimes work-life balance. Other findings relevant to critical care included: the critically ill patients that present to public hospital ICUs in Yemen are from across the age spectrum, the majority are poor and seek care late, and include vulnerable populations such as children and pregnant women facing continuous food, money and life insecurity.

Taking these preliminary findings in critical care capacity and ICU assessments into consideration, identification of the specific determinants of critical care in Yemen was done using focus groups and through quantitative methods (surveys) just prior to the course. The WHO Critical Care Assessment Tool and an ICU assessment instrument were used in two facilities, and structured interviews of ICU directors and ICU nurse managers took place in 15 hospitals and facilities. Focus group meetings were held with senior instructors of the Faculty of Medicine and Science University of Aden, emergency coordinators from the MoPHP, and senior health professionals in Yemen.

Qualitative analysis was done with a focus on determination of the level of knowledge, attitude, team orientation and skills among ICU providers in public hospitals. Input was received from healthcare workers during the site visits and observations made. Occupational illness, workload and inadequate remuneration producing low motivation were common concerns of ICU staff. Other resource constraints such as hospital infrastructure, access to and supply chain of drugs, equipment and availability of subspecialists that impact care and burden of critical care were also discovered. Data from surveys showed that ICU structure was of moderate availability, which included staffing, infrastructure, equipment, oxygen supply and biomedical support. The survey also showed that ICU processes were of low availability. This included a paucity of written protocols, standard

operating procedures (SOPs) and checklists being used in the ICUs. In addition, there was no formal program of quality improvement, management of equipment or supply in the assessed ICUs.

After a number of consultations with the MoPHP, Faculty of Medicine and Health Sciences University of Aden, and senior health professionals, and site visits to ICUs, a proposal for a 9-week duration national certificate training course in critical care was developed.

Main objectives of the training are:

i. To empower national doctors and nurses to ensure timely and effective recognition, triage and management of critically ill patients.
ii. To develop a cadre of national experts in critical care to lead medical teams in public hospital ICUs at the central and sub-national levels.
iii. To bring autonomy and self-sufficiency in human resources, knowledge and high-quality skills in critical care by introducing a national certificate program.
iv. To establish a well-structured and multidisciplinary partnership in critical care involving the ministry, the university, hospitals and international partners in order to bring sustainability and quality assurance with monitoring functions to the training.

Selection of participants

During the decision-making process for the number of participants, consideration was first given to the continuation of day-to-day work in the ICUs. Bringing a large number of healthcare workers from the local ICUs as course participants and facilitators could have potentially constituted a limiting factor in ongoing provision of critical care and the continuation of ICU work in each governorate. Taking these factors into consideration, and keeping an instructor-to-participant ratio of 1–6 during all practical sessions, an optimum student intake of 24 per course was chosen. This enabled proper guidance and assessment of the students by facilitators. An average of two physicians and two nurses were chosen, through a competitive process, from each of 11 of the 12 governorates in the south Yemen, which gave a total of 48 participants for the training. The selection was made through written tests in life support and critical care, followed by interviews. Essential requirements for participants were that they be licensed physicians or nurses currently working in public hospital ICUs, and preference was given to those currently with leadership roles in their respective ICUs.

Teaching methods

The 9-week course curriculum included didactic lectures, university-based practical skills simulations and clinical bedside learning sessions in ICUs. The curriculum for the program was developed by a working group which involved WHO, the University of Aden, host hospitals, and national health care professionals. The delivery of the core curriculum was by qualified ICU doctors and nurses and senior university instructors with dedicated time to train and mentor. More specifically:

- A blended learning approach incorporating adult learning principles was adopted, taking into consideration the prior knowledge and experience of the trainees.
- Interactive training methods such simulation with high fidelity manikins were used to teach a team-based approach at the Center for Clinical Skills, Faculty of Medicine and Health Sciences University of Aden.
- Experience sharing during didactic sessions was encouraged to demonstrate that creative solutions can be achieved and case study discussions addressed local realities.
- Practical bedside training took place in selected hospital ICUs. The practical trainers and mentors were selected ICU physicians and nurses.
- The didactic lectures were delivered by trainers from numerous disciplines including critical care physicians, critical care nurses and nurse managers, respiratory therapists, surgeons, neurosurgeons, anesthesiologists, internal medicine specialists, obstetricians, pediatricians, and administrators. They included senior professors and teaching staff members from the MoPHP, University of Aden, and public and private hospitals.

Structure, length and delivery of the training

The curriculum for the critical care certificate course is composed of five modules of study which encompasses the fundamentals of critical care to management of an ICU and was given in a 9-week track. The schedule was a continuous (except for national holidays) six-day a week, eight-hour a day

program. Course participants underwent formative and summative written examinations, practical examinations, skills laboratory assessments and ICU workplace-based assessments. The minimum composite passing score was set at 70%.

Oversight of program implementation, monitoring, evaluation, and quality assurance was conducted in close collaboration with the MoPHP and University of Aden. Throughout the process of development and implementation, the working group continuously modified and reinforced the program structure to best fit the local needs and context. Further, a learning network was established to strengthen knowledge and foster academic exchange between national and international academic institutions.

The training program was rigorous in schedule but flexible in content and format; facilitators were encouraged to adapt and prioritize content as per local need and learning capacity of participants. The curriculum modules of study included theory, practice in the skills laboratory and bedside learning in the ICU as outlined in Table 1.

Table 1: Breakdown of critical care certificate course curriculum

Week	Area	Total Hours		
		Lecture	**Skills Lab**	**Practical session in ICU**
1&2	1. Life Support and Fundamentals of Critical Care	60	20	0
3&4	2. Pharmacology, Critical Care Procedures and Advanced Respiratory & Cardiac Support	40	20	20
5&6	3. Management during Critical Illness I and Case studies in Medical & Surgical care	30	0	50
7&8	4. Management during Critical Illness II and Special Populations care	30	0	50
9	5. Intensive Care Unit Management	20	0	20
	Total	**180**	**40**	**140**

Theory (lecture)

The theoretical component took place in classrooms and conference venues with sufficient internet access. The structure of classroom-type presentations for theoretical knowledge was further augmented by an on-line/virtual reality WHO/European Society of Intensive Care Medicine (ESICM) C19 Skills Preparation Course (SPACE).[12] The combined teaching model with the C19 SPACE Course was conducted in a continuous 9-week period for all participants. Course facilitators simultaneously took the on-line C19 Skills Preparation course for trainers. All physician and nurse participants, with one exception, successfully completed the 24 hours of continuing education and passed the Skills Preparation course on-line examination. During the didactic delivery, every other day quizzes and weekly written exams were administered to document learners progress, achievements and skills acquisition. A twice weekly written feedback evaluation was received from both trainees and trainers (facilitators). For the first half of the course, a biweekly facilitators committee meeting was held to review the curriculum and to ascertain whether teaching methods or information should be amended.

Skills Laboratory simulation

Skills practice took place in the Center for Clinical Skills at the Faculty of Medicine and Health Sciences University of Aden. Simulations of critical care management and medical emergencies using high-fidelity manikins with video capture for debriefing and learning experience were utilized. Training in trauma life support skills with use of simulations and manikins were also incorporated. Organizational and teamwork aspects of ICU management were integrated into the curriculum, in addition to specific technical aspects of critical care; indeed, these elements were considered integral to the critical care training. This included the monitoring of quality care, empowerment of nurses on treatment decisions in acute situations, attitudes with regard to teamwork and systematized handover of patients.

Practical session in ICU

Practicum took place in ICU settings in 5 chosen hospitals (4 private and 1 public) in Aden. Bedside teaching was conducted by selected critical care specialists in the hospitals. Training took place in a total of 10 ICUs (within the 5 hospitals) which included medical, surgical, pediatric and neonatal units. Most of the selected critical care specialists who served as facilitators for the practical training were also involved in the delivery of classroom lectures. Admission and discharge policies, ICU protocols and checklists, unit quality audits, and use of clinical practice guidelines in life support and critical care were all integral components of the practical curriculum. During the first half of the 9-week course, students were posted to different ICUs each week on a rotation basis to learn and acquire experience in a variety of hospitals, ICUs and from a variety of specialists. Based on weekly feedback from trainees and facilitators, this was changed in the second half of the course since keeping students assigned to a particular hospital for consecutive weeks allowed for better continuity, improving learning, work experience and assessment of students.

There was a balance of lecture and practical training with 180 hours of classroom and 180 hours of either skills practice in the laboratory or clinical bedside training (see Table 1). A further requirement of the course was to complete the online WHO/ESICM Skills Preparation Course (SPACE) training during the nine weeks. The audio-visual material reinforced the face-to-face teaching. This addition of the online training requirement augmented the live training and did not result in less face-to-face teaching time. A focus of the training course was on implementation of evidence-based interventions in a setting-relevant manner. During the implementation of the program, regular adjustments were made to curriculum and format based on student feedback and facilitator recommendations as the course progressed.

Assessments and Evaluation

During the course, biweekly written examinations were administered to monitor progress of trainees. A twice weekly written feedback evaluation was received from both trainees and facilitators. For the practical skills and bedside learning assessment, practical examinations and workplace-based assessments were conducted. Trainees were assessed by using Objective Structured Clinical Exam (OSCE) type practical examinations with ICU scenarios at the Center for Clinical Skills and by using standardized workplace-based assessments in the hospitals.

In addition, the Oman Medical Specialty Board conducted a 2-day Fundamental Critical Care Support (FCCS) course[15] with skills sessions and testing at the very end of the 9-week training course. This course was added value to the national course, also served as a final appraisal of participant progress and achievement.

Participants who successfully finished the complete program received the National Certificate in Critical Care from the Faculty of Medicine and Health Sciences University of Aden, the Fundamentals of Critical Care Support (FCCS) from the Oman Medical Specialty Board and the C19 Skills Preparation Course (SPACE) certificate from WHO/ESICM. To ensure retention of these trained individuals, participants were asked to sign a contract with the MoPHP to work in public hospital ICUs in Yemen for a minimum of two years.

Results

Optimum student intake per course was chosen for practical and pragmatic reasons, as addressed in the previous section. All 24 physicians and 24 nurses completed the 9-week course of 180 hours lectures, 40 hours skills practice and 140 hours of bedside ICU training. 20 physicians (83%) and 23 nurses (96%) received a passing composite score of 70% or greater.

All 48 participants of the 9-week course, with one exception, successfully completed the on-line WHO/ESCIM C19 SPACE training and passed the on-line examination. 24 physicians completed the FCCS course given by the Oman Medial Specialty Board, with 23 passing the post-test (96%). The FCCS course for the nurses had to be postponed due to the language barrier.

A working group of 26 national facilitators contributed significantly to the development and delivery of the 9-week critical care certificate course. The Center for Clinical Skills using high-fidelity manikins was officially opened at the University of Aden and extensively utilized during the course. Five hospitals in Aden and numerous ICU professionals were involved in the practical training during the certificate course.

The beginnings of a partnership with the Oman Medical Specialty Board have developed, which is expected to bring continued technical support for

critical care training and other endeavors in improving critical care in Yemen.

Strengths

The curriculum for the 9-week critical care certificate program was developed by a multidisciplinary working group which contextualized the material for Yemen. The delivery of the practical training was through qualified critical care physicians and nurses actively working in ICUs in Yemen. Oversight of the program, the implementation, monitoring/quality assurance and evaluation were done in close collaboration with the Faculty of Medicine and Health Sciences University of Aden. In addition, the Fundamental Critical Care Support (FCCS) course was conducted by the Oman Medical Specialty Board and added value to the overall course as a final assessment and evaluation of the course participants. The sustainability of the training program was a primary objective and efforts were made to ensure well-structured partnerships involving the university, the ministry, hospitals and international partners such as Oman.

The training program was rigorous in schedule but flexible for content and format with changes made on a frequent basis based on facilitator assessments and student feedback. The working group continuously modified and reinforced the program to best fit needs and context. Local trainer autonomy was emphasized along with close monitoring, constant feedback and improvement. Weekly facilitators committee meetings were held during the first half of the course to review student progress and student feedback. The set curriculum was constantly modified and updated where deemed necessary for this first iteration of the course.

The online WHO/ESICM C19 Skills Preparation Course (SPACE) aided both student and facilitator learning during the 9-week training program and was very well-received. The availability of the Arabic translation in the online course was especially helpful for the nurse participants. During the 9-week course, it was seen that physicians and nurses read in more detail and they entered into discussions during lecture and during rounds more readily because of the fundamentals they learned through the on-line training. At times students would challenge the facilitators on points from critical care guidelines that they learned from the on-line course and facilitators would encourage them to continue reading and understanding of the guidelines.

A learning network/partnership was also established with the Oman Medical Specialty Board. This initial endeavor, the official 2-day FCCS course, which took place at the end of the 9-week training and included skill stations and testing should be the start of a successful collaboration.

Successful participants received three certificates: 1. The National Certificate in Critical Care from the Ministry of Public Health and Population and Faculty of Medicine and Health Sciences University of Aden, 2. The Fundamentals of Critical Care Support (FCCS) certificate from the Society of Critical Care Medicine and Oman Medical Specialty Board, and 3. The online C19 Skills Preparation Course (SPACE) certificate from WHO and the European Society of Intensive Care Medicine (ESICM).

Challenges

Though the plan was to have input from numerous partners prior to the start of the 9-week program, the curriculum was developed primarily by WHO with input from the Faculty of Medicine and Sciences, University of Aden. Subsequent input on the curriculum was received from partners while the course was in progress.

The initial plan was to have critical care professionals and specialists give a majority of the didactic training. Early in the course a number of lectures were delivered by instructors not necessarily active in clinical work in the ICU. This was due to unforeseen clinical commitments or other circumstances of the critical care specialists. During the practical training, sometimes ICU instructors could not give full-commitment to the teaching of students due to various reasons. At times it was noted students not actively engaged in work/learning in the ICU.

Regarding evaluation and monitoring, there is currently not an adequate mechanism to fully evaluate the impact of the 9-week course. The retention of knowledge and skills of participants and changes in level of implementation of these skills in the ICU needs to be followed up and evaluated.

How does the program impact the health outcomes of critically ill patients?

An appraisal to determine whether this training is associated with patient outcomes would be ideal. One possible way to evaluate the impact of the program on the health outcomes of critically ill patients is to conduct ICU assessment periodically and continue to monitor the progress of ICU practice and patient outcomes e.g. if it will bring a decrease in ICU mortality or improvement of other performance indicators. A periodic ICU assessment with quantitative and qualitative analytic scores would guide the course participants and their fellows towards goal-oriented and a programmatic

approach in providing quality care to critically ill patients.

Looking ahead

Further improvement, updates and changes need to be made to the curriculum and program of the 9-week critical care national certificate course. There is a working group primarily represented by the Faculty of Medicine and Health Sciences University of Aden along with several private hospital ICU physicians which were the majority contributor to this first iteration of the certificate course. There is a plan for further cascade trainings and it is vital to have proper oversight and to ensure and monitor the level of quality in these trainings. All materials on the curricular aspects of the certificate course have been shared with those responsible for the next iteration of the training. Many important logistical and program management advice were also shared.

The established nascent learning network with the Oman Medical Specialty Board should be sustained and strengthened. The initial endeavor was the Fundamental Critical Care Support (FCCS) course from the Society of Critical Care Medicine which the physicians took part in, and further opportunities and ventures in critical care should be actively explored.

Lastly, in addition to the critical care capacity building through training, the existing public ICUs need to address structural priorities (e.g., staff compensation, equipment repair, nurses and nurse manager training etc). Major work is needed on ICU processes in both public and private hospitals (e.g., infection prevention and control, biomedical and consumables standardization, use of guidelines, standard operating procedures, and checklists). Specific outcome measurements should be tracked and reported in all hospitals (e.g., standardized mortality ratio, specific healthcare associated infection (HAI) rates). An ICU needs to be a robust combination of well-equipped facility and well-trained multidisciplinary team, and the latter (well-trained human resources) may be even more important in resource-limited settings.

Conclusion

There is increasing awareness of the importance of identifying strategies capable of improving intensive care/ICU in resource-limited settings with complex emergencies. Educational interventions to accelerate development of sustainable critical care capacity in such settings are necessary because of the lack of post-graduate critical care training pathways and relatively limited access to continuing medical education. Interventions can range from short courses to longer-term programs based on local absorption capacity and academic partnerships. However, the long-term benefit, sustainability and scalability of short courses remain uncertain. These shortfalls and limitation require alternative approaches.

A key strategy that may improve outcome is a national training program to empower physicians and nurses to ensure timely and effective recognition, triage and management of critically ill patients; to build a cadre of national experts in critical care that can lead medical teams in public hospital ICUs at the national and sub-national levels; to bring autonomy and self-sufficiency in human resources, knowledge and high-quality skills in critical care; and to establish well-structured and multidisciplinary partnerships in critical care involving ministries, universities, hospitals and international partners in order to bring sustainability and quality assurance with the monitoring functions to the program.

Our project is one example of an educational program targeting physicians and nurses for sustainable critical care/ICU capacity improvement at the central and sub-national levels in Yemen through a certified 9-week course. Gains achieved by focusing on improving the knowledge, skills and attitudes of ICU staff with a focus on quality patient care in resource-limited environments can stimulate the implementation of other local capacity building measures.

Important factors for sustainability and avoidance of redundancy include integration with the local medical education system, alignment with priorities of local health authorities, development of academic partnerships in the country or region of interest, use of renewable resources where possible and adaptation to local cultural values. In addition, it is essential to have a plan for retention of newly, highly trained individuals. These programs should be complemented by continuing education opportunities for successful graduates to ensure competencies to practice effectively, maintenance of skills and remaining up-to-date, and for continuous improvement.

Such programs should be developed following a systematic process or roadmap as has been addressed in this report[16]. This approach utilizes a systems approach that addresses numerous aspects of the healthcare system thereby augmenting prospects of success for the training program and

long-term health system strengthening. The program can be developed in an iterative fashion allowing for adaptation to local realities. The program delivery should embrace and make use of the diverse background and experience of national ICU staff and facilitators from hospitals and academia from a variety of disciplines. An in-country longer-term critical care training program in a resource-limited setting with complex emergencies is a paradigm shift using a model that is adaptive, focused, feasible and sustainable while promoting multidisciplinary and collaborative teamwork in critical care.

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Photos: Skills training in use of resuscitation devices, critical care procedural skills, and teamwork training at the Center for Clinical Skills in the Faculty of Medicine and Health Sciences, University of Aden, August 2022 (credits: WHO).




Photos: Critical care training during clinical postings in the intensive care unit, at Al-Boreehi Hospital and Al-Naqeeb Hospital ICUs, August 2022 (credits: WHO).

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