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12 April 2023

Evaluating a Quality Improvement Initiative in a High Dependency Unit in Tanzania

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Abstract

Evaluating a Quality Improvement Initiative in a High Dependency Unit in Tanzania

By Samantha Strelzer

Background: Historically, the United Republic of Tanzania has had a 41.4% mortality rate in the Intensive Care Unit (ICU) setting, and a 2018 study reported that in LMICs, poor-quality care resulted in 5 million excess deaths. It was found that the average knowledge of critical care amongst providers was 38.6% in hospitals in Tanzania. In Tanzania, the Ministry of Health and Social Welfare (MoHSW) has taken steps toward Quality Improvement (QI), yet the Tanzanian health sector continues to face resource constraints, unsustainable QI projects, and gaps in knowledge and skills. These conditions have contributed to unacceptably high mortality rates for Tanzanian patients.

Purpose: This research aims to elucidate a more robust understanding of how to transform quality of care in a low resource setting, considering the gap in published research. The goal is to understand barriers and facilitators to implementing QI projects in Tanzania.

Methods: Through the Emory-Muhimbili Partnership for Health Administration Strengthening and Integration of Services (EMPHASIS) and with support from Abbott Fund Tanzania, a two-day critical care training program was developed for providers. It included the following modules: Vital Signs Directed Therapy (VSDT), Cardiopulmonary and Brain Resuscitation (CPBR) knowledge, Blood Glucose Monitoring and Introduction to Critical Care Concepts. In a pre-post study, data was collected from pre- and post-tests and reported in REDCap. Descriptive statistics and paired t-tests were performed, setting alpha at 0.05. Qualitative semi-structured interviews were used to understand the experience of those involved in the training program. Utilizing inductive conventional content and rapid qualitative analysis, interview themes were extracted. A total of seven providers were interviewed.

Conclusion: A pre-/post-test analysis demonstrated an improvement in knowledge, skills and increased comfort in responding to emergencies. Themes from interviews showed respondents appreciated the training and found change management concepts useful. This study suggests a Critical Care Training Program significantly improves the knowledge amongst ICU/HDU providers and that QI programs impact the culture of change. This research exemplifies a systematic approach to strengthening capacity of critical care delivery in limited resource settings, with implications for further innovation in other LMICs.

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CHAPTER 1: Introduction

Historically, the United Republic of Tanzania has had very few hospitals with Intensive Care Unit (ICU)-level care, and those that do have had a high 41.4% mortality rate (Sawe et al., 2014). A 2018 study reported that in LMICs, poor-quality care resulted in 5 million excess deaths (Kruk et al., 2018; Sawe et al., 2014). Adequate and standardized critical care skills are a necessity when caring for critically ill patients. Nonetheless, there are multiple constraints to making this a reality, including a lack of well-trained providers, insufficient and ineffective allocation of resources and lack of feedback on quality assessments (Renggli et al., 2019). It was found that the average knowledge of critical care amongst providers was 38.6% in hospitals in Tanzania (Bankanie et al., 2021). As such, questions arise as to what standard providers should be held to and how to engender change in this field.

Quality is a concept that has grown in popularity in healthcare since the 20th century (Boaden et al., 2008; Kruk et al., 2018). It has become inherent in the delivery of care to the individual as well as has become an important aspect in the larger field of health. As such, quality care should be the goal for all providers and stakeholders in the healthcare sector. Yet, the question is: what is the optimal way to fuse concepts of quality with treating patients and how can the health sector transform to turn these concepts into practice? Quality improvement (QI) is a practice that has been become part of the dialogue about patient care since the mid 1900s and was introduced in Tanzania in 2007 (Ishijima et al., 2014; MoHSW, 2011).

In Tanzania, the Ministry of Health and Social Welfare (MoHSW) has taken steps toward QI through the Tanzania Quality Improvement Framework (TQIF). The framework's aims are: (1) to encourage all health workers at all levels and other stakeholders in the sector to develop innovative approaches for QI and implement them; and (2) to outline what needs to be done to

institutionalize quality of health care at various levels based on national interests and vision (MoHSW, 2011). Despite this commitment, the Tanzanian health sector continues to face many familiar challenges of resource constraints, unsustainable QI projects, and gaps in knowledge and skills (Nangawe, 2012). This has been the experience at the National Hospital in Dar es Salaam, where ICUs have far below the international standard of beds and the triaging process for the admission of patients to the ICU is convoluted and inefficient (Engdahl Mtango et al., 2019). These conditions have contributed to the unacceptably high morbidity and mortality rates for Tanzanian patients with critical illness (Sawe et al., 2014).

In considering how to deliver care, efficient quality is the ultimate goal – being able to deliver care given the amount of resources available – with an ever increasing amount of need in a population (Lifvergren, 2013). An efficient system is able to use less resources while improving patient outcomes, thus allowing for more resources to be used for more patients. There are concerns today about the unsustainability of healthcare systems (Lifvergren, 2013; Institute of Medicine, 2000; Institute of Medicine 2001; WHO, 2006). Thus, a more efficient system (focusing on quality versus quantity), grounded in context, prioritizing patients and maximizing resource usage will be imperative to improve patient outcomes and limit disease.

Problem Statement

Many LMICs have been strapped for resources amidst a growing need for care for more people. Due to low resources, providers may be trained by attending schooling in a number of different countries and return with a number of different of understandings of how to preform care. Similarly, training is not always consistent, leading to variable knowledge levels and approaches to delivering care. All of this contributes to a lack of sustainable initiatives. This is

the case in Tanzania, where there is a lack of standardization across providers even within the same ward as the National Hospital. There is a paucity of research surrounding the best way to implement sustainable quality and create a culture of change in LMIC settings, with most studies being US- or euro-centric.

Synergy Statement

The overarching goal of this thesis is to use a synergistic approach of integrating a pre/post quantitative study and an interview-based qualitative study to better understand QI efforts at the National Hospital in Tanzania. The findings are complementary; they support a better comprehension of how QI can be woven into the fabric of quality care, with possibility for extrapolation to best alter the culture of how changes occur. Thus, this thesis presents two manuscripts, one for quantitative data and one for qualitative data to investigate the data separately. In the conclusion of the thesis paper, we look at a larger picture of QI in Tanzania and coalesce a narrative from the strengths of each manuscript jointly.

Purpose Statement & Research Question

A more dynamic understanding of how a quality improvement framework implemented in a low resource setting can transform delivery of care would provide much needed information on how to create sustainable change and shifting the culture of care. Examining the factors that contribute to or inhibit the success of a QI program is valuable and timely, as it shows what aspects of the current system need to be addressed and the how a culture affects quality efforts within a healthcare system.

This research aims to elucidate a more robust understanding of how to transform quality of care delivered in a low resource setting, especially considering the gap in published research amongst LMICs. The goal is to understand barriers and facilitators to implementing quality improvement projects in Tanzania. We work with a specific quality improvement project in the HDU at the National Hospital in Tanzania seeking to improve skills of staff and providers. Thus, the first research question is as follows: How does a critical care training program based in quality improvement concepts affect the comfortability and self-efficacy of providers in a critical care setting? The null hypothesis is as follows: Providers who receive this QI-based critical care and life-saving skills training will not demonstrate a change in their knowledge and comfortability. A secondary research question aims to understand how QI initiatives shifts the culture of change amongst providers.

Significance Statement

There is limited research in LMICs on the processes of delivering quality healthcare through a quality improvement lens. Care is subjective and context specific, thereby necessitating research based in context. Understanding factors that contribute to improved quality care will create empirical data for future context-specific augmentations in delivering care. This research is necessary in a low-resource setting to demonstrate where champions in quality improvement can successfully transform critical care units and shift the culture of the unit to improve quality.

Definition of Terms

5-S	5-S Approach
6S	Six (6) Sigma
AHA	American Heart Association
CC	Critical care
CPR	Cardiopulmonary resuscitation
CPBR	Cardiopulmonary and brain resuscitation
HDU	High dependency unit, considered a step down unit from the ICU, requires one organ failure
HIC	High Income Country
ICU	Intensive care unit
IDI	In-depth interview (guide)
IHI	Institute for Healthcare Improvement
JICA	Japan International Cooperation Agency
LMIC	Low & Middle Income Country; Defined according to World Bank definitions (World Bank, n.d.)
MNH	Muhimbili National Hospital
PDSA	Plan/Do/Study/Act
QA	Quality Assurance; for the sake of clarity in this thesis and manuscript, QI and QA will be interchangeable
QI	Quality Improvement; for the sake of clarity in this thesis and manuscript, QI and QA will be interchangeable
QM	Quality Management
SCQM	Strategic Collaborative Quality Management
SDG	Sustainable Development Goals
SOP	Standard operating procedure
SWOT/SWOC	Strength, Weaknesses, Opportunities, and Threats/Challenges
TPC	
TQIF	Tanzania Quality Improvement Framework
TQM	Total Quality Management
VSDT	Vital signs directed therapy
WHO	World Health Organization

CHAPTER 2: Comprehensive Review of the Literature

INTRODUCTION AND RELEVANCE TO RESEARCH

Although the idea of quality is not new nor profound, it should be an integral part of the delivery of a service, whether that be manufacturing products in the business sector or care in the healthcare sector. Quality is pervasive in every field of service, yet it can have many definitions and inhabit various forms. As such, a comprehensive understanding and assessment of what quality is in this context, how it has evolved overtime as well as what quality *improvement* entails will elucidate the pertinence of this subject in this case study. This literature review will begin to form a picture of the current knowledge, research and opinions concerning quality improvement. This review will also focus on change management, giving a metaphysical and epistemological methodology of how to change processes and behavior. Moreover, it is imperative to understand the current level of knowledge, care and approach in a context-specific setting. This literature review will thus seek to illustrate the current approach in quality in Tanzanian healthcare settings as well as where gaps may continue to be in the ability to deliver care. As this research is focused on training and acceptance of such training, it is important to know baseline levels of knowledge and expertise in this setting. Last, this research will review the current levels of critical care skills in Tanzania and at MNH, specifically examining CPR and basic lifesaving skills. In doing so, this will allow for understanding as to why the research conducted was inherently going to be successful and where further aspects need to be revised for future QI implementation. Therefore, such a comprehensive background allows for context-specific analysis, focusing on the most salient issues and to tease out solutions to a complex issue and gain a thorough basis for analysis.

QUALITY IMPROVEMENT

The Origin of Quality Improvement

The history of Quality Improvement (QI) is complex with many contributors to and variations of similar concepts. QI originated in the industrial sector (Boaden et al., 2008). Any approach or method to improve the outcomes and experience for the patient has to do with universal health coverage (UHC), which can materialize in a number of ways. UHC is part of the Sustainable Development Goals from the UN (Kruk et al., 2018). To achieve universal health coverage, Leslie et al. (2018) recommends three principles to be at the heart of care, including meaning, utility and innovation (Leslie et al., 2018). All of these principles have an underlying understanding the quality is at the core and that it is necessary to address quality in order to achieve the three principles and, more broadly, UHC. Leslie et al. recommends focusing on patients in order to achieve higher quality across the healthcare sector and to focus on innovation (Leslie et al., 2018). This has implications that can be used in context-specific situations, by focusing on innovative mechanisms to promote and improve quality while constrained by resources or other barriers to quality care. QI specifically in healthcare must be attuned to changing the system and ensuring that there is a communal expectation of achieving this (Bartunek, 2011). Nonetheless, often there is a split between what is recommended and what actually occurs in the delivery of care (Aveling et al., 2012). Some of this is attributed to hyper-focused QI programs that prevent learning and communication (Aveling et al., 2012).

Continuous improvement (CI) can be considered a necessary part of QI, since one of the tenets of QI is to be continually improving (Batalden & Davidoff, 2007). CI specifically aims to engender constant and incremental improvements in the process to affect the outcome and requires a prioritization to create directionally positive change (Bessant et al., 1994).

Nonetheless, CI has been found difficult to maintain, requiring buy-in from stakeholders to invest in the cultural shift in prioritization and process organization (Bessant et al., 1994). Instead, the author chooses to consider CI only as part of the continual efforts housed in QI of healthcare facilities and those who seek to implement QI programs attempting to improve quality continuously in whatever capacity that means. Batalden & Davidoff argue that healthcare cannot have peak quality if commitments to QI do not become "an intrinsic part of everyone's job, every day, in all parts of the system" (Batalden & Davidoff, 2007, 2). This is important to note, because again, it demonstrates a need for a shift in culture and that all players must invest in achieving the goals of the implemented framework. In an attempt to produce an Institutionalization Framework for Quality Assurance (QA) measures, Silimperi et al., 2003 argues that any QA must define, measure and improve quality and are influenced by capacity building, communication and information and rewarding quality (Silimperi et al., 2003). Their conceptual model is shown in **Figure 1**. As part of the operational framework, defining quality pertains to setting expectations, measuring quality is defined by calculating a baseline of performance and patient satisfaction and improving quality is the tools employed; all are needed synergistically to attain a sustainable quality care approach (Silimperi et al., 2003, 68). The ultimate goal, according to Silimperi, is to achieve QA that is an integrated part of daily activities in healthcare at and specific to every level (Silimperi et al., 2003).

Figure 1. Conceptual model demonstrating different components of quality for institutionalization. As cited from Silimperi et al., 2003, 68.

Quality Improvement in Healthcare

Quality Improvement in healthcare was a vital change in the approach to patient care. In 1916, Codman presented and is considered the originator of outcomes-based patient care (Boaden et al., 2008). This was a fundamental shift in how patients are perceived by providers. Boaden, coalescing a narrative amongst this evolution of quality in healthcare and contending that outcomes do not equate evenly with equality has defined quality simply, that healthcare quality is "safe, effective, patient-centered, timely, efficient and equitable" (Boaden et al., 2008, 10).

Donabedian, in 1966, published a report about how quality can have multiple aspects and highlighted the importance of the interactions between provider and patient (Boaden et al., 2008). Most importantly, Berwick is seen by many as the founder of QI in healthcare when he created the National Demonstration Project in 1987 to demonstrate to others the possible significance of applying QI to health (Boaden et al., 2008; Berwick et al., 1990; Lifvergren, 2013) Berwick founded the Institute for Healthcare Improvement (IHI) in 1991 to address

quality management in healthcare (Lifvergren, 2013). He argued for changes to healthcare based on quality rather than audits (Berwick, Endhoven & Bunker 1992; Boaden et al., 2008). The Institute for Healthcare Improvement began a campaign in the United States to have hospitals attempt to prevent five million medical harm outcomes from 2006 to 2008. While this number was not quantifiably reached, it was found that hospitals had improved outcomes (such as 65 hospitals having no incidence of VAP for one year or more) and were committed to incorporating quality in their actions (Institute for Healthcare Improvement, 2008). The IHI and Berwick largely influenced subsequent iterations of quality in the healthcare sector. Following this, Batalden & Stoltz (1993) introduced a *continual* improvement that combines professional knowledge with improvement knowledge, focusing on subject, discipline and values (Batalden & Stoltz, 1993; Lifvergren, 2013). Influenced by Walter Shewhart (1939), who focused on the process of production, W. E. Deming introduced the idea of improvement knowledge, which is composed of knowledge of system, knowledge of variation, knowledge of psychology and theory of knowledge (Shewhart 1939; Deming, 1993; Lifvergren, 2013).

In 1986, Deming coined the "plan/do/study/act" (PDSA) cycle in quality improvement, which enacts small tests and is part of a continual improvement (Deming 1986; Boaden et al., 2008, 47). PDSA can be considered part of the improve phase of Six Sigma and akin to Rapid Improvement Events in Lean (Boaden et al., 2008). In 1995, Carey & Lloyd defined quality improvement as actions taken no matter the level at status quo to improve process and that quality depends on the values of the implementing entity (Carey & Lloyd, 1995).

In 1996, Langley et al., coined the term "science of improvement" building on Deming and applying PDSA to the healthcare sector. Langley's work is now utilized for current approaches in healthcare (Boaden et al., 2008, 47; Lifvergren, 2013, 21). Following this, in

partnership between IHI and the Institute of Medicine, “To Err is Human” and “Crossing the Quality Chasm” were published to address patient safety and performance expectations, respectively (Institute of Medicine, 2000; Institute of Medicine 2001).

In 1994 Dean & Bowen published a work intending to sharpen quality management principles, practices and techniques which influenced Batalden & Davidoff’s efforts to define quality improvement in 2007 (Lifvergren, 2013). They defined QI as “the combined and unceasing efforts of everyone – healthcare professionals, patients and their families, researchers, payers, planners and educators – to make the changes that will lead to better patient outcomes (health), better system performance (care) and better professional development (learning)” (Batalden & Davidoff, 2007, as quoted in Lifvergren, 2013, 24). Berwick expanded upon earlier thinking to include wider methodology for healthcare usage by focusing on non-healthcare sector approaches to quality (Berwick 2008; Boaden et al., 2008). By 2004, total quality principles were found as the key methodology in Sweden (Lifvergren, 2013).

The following six mechanisms that have been created to achieve quality improvement and have generally been created in North America, the UK and Japan. Plan-Do-Study-Act (PDSA) cycle enacts small tests and is part of a continual improvement (Boaden et al., 2008). Statistical Process Control (SPC) focuses on cost reduction and creating shared communication between entities within the same system. The IHI has promoted this approach, and it has been seen as a cost effective approach to QI (Boaden et al., 2008). Six Sigma was originally developed in the 1980s by Motorola and build on ideas of Total Quality Management (TQM). Six sigma focuses on a systematic method using statistics and works to identify the underlying cause that causes variation in achieving objectives (Boaden et al., 2008). Six Sigma includes a DMAIC framework of “Define, Measure, Analyze, Improve and Control” (Lifvergren, 2013,

38). Six Sigma is often combined with Lean for a Lean Six Sigma approach and has been seen to be used in the UK (Boaden et al., 2008). Lean: The concept of Lean was produced by Toyota in Japan and includes a framework of 5S: sort, simplify/set in order, shine, standardize, sustain (further elucidated below) (Boaden et al., 2008). Lean has been emphasized due to the possibility of increasing stakeholder interest in quality of the entity produced (Boaden et al., 2008). It is often combined with Six Sigma to form Lean Six Sigma as seen in **Figure 2**, since together they can include rapid action methodologies termed "Kaizen." Lean can remove steps that do not add additional value to the Six Sigma system and the process can be accomplished more quickly (Boaden et al., 2008; Randhawa & Ahuja, 2017). Lean has been used in the UK, Japan and the United States as well as in select LMICs, supported by HIC organizations (Boaden et al., 2008). Theory of Constraints concentrates on the aspect that constrains the system from reaching the next level of quality and has not been readily applied to healthcare (Boaden et al., 2008). Mass Customization centers on mass production and has not been popularly used in healthcare (Boaden et al., 2008).

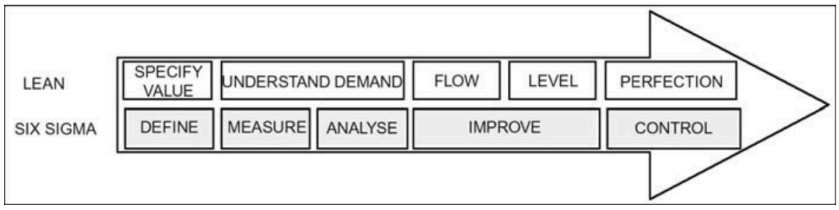


Figure 2. The process of Lean Six Sigma and how they work together towards QI measures. Adapted from Boaden et al., 2008, 81.

It is important to understand quality improvement techniques and adapt them to healthcare-specific scenarios, as healthcare can be considered a complex system with a professional service, requiring any quality interventions to pertain to the clinical and the

managerial aspects (Boaden et al., 2008). It has been seen that competence of medical personnel affects quality of care (Boaden et al., 2008). This therefore requires a high caliber of expertise amongst providers to improve the quality for the patrons – the patients. When resources are of concern, whether in a HIC or LMIC setting, the ability to deliver care within the limits of the system's capacity is imperative no matter the approach. As such, it is apropos to frame how QI approaches have performed in real contexts.

THE 5-S METHOD

The 5-S Method: Background

5-S, as part of the Lean Method originated from the Japanese Toyota Motor Corporation in the 1960s, incorporating five terms for optimizing the workplace: Seiri, Seiton, Seisou, Seiketsu, and Shitsuke, which translated mean Sort, Set, Shine, Standardize and Sustain, respectively, as shown in **Figure 3** from Ishijima et al., 2014 (Ishijima et al., 2014, 138; Randhawa & Ahuja, 2017; MoHSW, Tanzania, 2013). 5-S is predicated on the idea that an orderly system encourages efficiency alongside a culture of invested employees (Randhawa & Ahuja, 2017). Seiri/Sort means ensuring and compartmentalizing what is needed in the workplace. Seiton/Set endeavors to prioritize and organize. Seisou/Shine is to clean the tools for use, but also, to reset the mindset. Seiketsu/Standardize means to maintain the achieved progress by repeating the first three Ss and creating a standard operating procedure (SOP). Shitsuke/Sustain focuses on the individual players that will implement the changes and relies on changing the behavior and mindset of employees (Randhawa & Ahuja, 2017).

	Japanese	English	Meanings
S1	*Seiri*	Sort	Remove unused items for current work processes from your workplace. This step will also help to identify what is missing from your workplace
S2	*Seiton*	Set	Organize everything needed in proper order for easy work. This step is based on finding efficient and effective storage of necessary items. Setting of necessary items can save time and energy when looking for something
S3	*Seiso*	Shine	Maintain high standard of cleanliness of workplace, tools and equipment. This will create ownership of infrastructure, equipment and tools, and will make it easy to find any abnormality of infrastructure, equipment and tools
S4	*Seiketsu*	Standardize	Maintain an environment where S1 to S3 are implemented in the same manner throughout the organization
S5	*Shitsuke*	Sustain	Maintain S1-S4 through discipline, commitment and empowerment. This step focuses on defining a new mind-set and standard in the workplace

Figure 3. 5-S Terms in Japanese and English with their definitions as published in Ishijima et al., 2014, 138.

Osada (1991) and Hirano (1995) further developed the application for 5-S, arguing that this can lead to continual improvement due to the step-wise process (Osada, 1991; Hirano, 1995; Randhawa & Ahuja, 2017). **Figure 4** depicts the flow of 5-S from Osada as depicted in Randhawa & Ahuja, 2017 (Osada, 1991; Randhawa & Ahuja, 2017). 5-S and Lean differ from other approaches due to the emphasis on training employees to have autonomy over improving quality, encouraging them to continually strive towards increased quality and empowering them to suggest changes (Randhawa & Ahuja, 2017). Although some barriers to implementation have included under investment or resistance amongst employees and lacking communication and leadership, 5-S has seen success when it is integrated into the system and aligns with the organization's mission, has support from leadership and includes a training/education with resources for employees (Randhawa & Ahuja, 2017). After deploying this method, the Japanese organizations that used this approach soon found that compared to others, this was the only one that could produce high quality at a low cost (Randhawa & Ahuja, 2017).

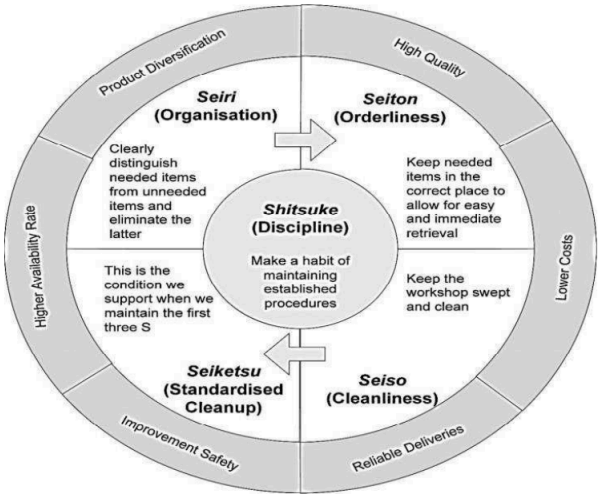


Figure 4. The 5-S concept from Osada and how each component works together. Adapted from Randhawa & Ahuja, 2017, 5.

The 5-S Method: LMICs & Tanzania

5-S in Asian LMICs has been successfully implemented in the face of limited resources and personnel (Ishijima et al., 2014). In 2007, the Asia-Africa Knowledge Co-Creation Program (AAKCP) was introduced, where 15 countries (including Tanzania) participated to learn from their Asian counterparts and use the 5S-KAIZEN-TQM approach to QI (Ishijima et al., 2014). The 5S-KAIZEN-TQM was originally created in Japan and implemented in Sri Lanka. Eventually, the Japan International Cooperation Agency (JICA) transformed this into an attainable method for healthcare, focusing on a team-based and step-by-step method to transforming quality care and complying with SDG targets 3.3, 3.b, 3.c and 3.d. Moreover, there is a focus on including government officials and medical providers as stakeholders in the development of interventions (UNOSSC, 2019). 5-S is part of the original Japanese tool, "KAIZEN" refers to "participatory performance and productivity improvement" via "incremental and reflective team actions" and "TQM" meaning Total Quality Management (UNOSSC, 2019). Since 2007, 22 countries including Armenia, Bangladesh, Benin, Burkina Faso, Burundi, Cambodia, Democratic Republic of the Congo, Egypt, Eritrea, Iraq, Jordan, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mongolia, Morocco, Niger, Nigeria,

Senegal, South Africa, Sri Lanka, Sudan, Uganda, United Republic of Tanzania and Vietnam have now begun implementing this following the AAKCP introduction (UNOSSC, 2019).

Mbeya Referral Hospital in western Tanzania was set as the pilot hospital to test 5S-KAIZEN-TQM approaches and began rolling out the approach in other level 3 hospitals (Ishijima et al., 2014). Subsequently, in 2008, MoHSW officially adopted "5S-CQI (KAIZEN)-TQM" as the official framework for QI in healthcare, based on the 5-S methodology and published a guideline for its usage in 2009 with a plan for scaling up the implementation of the approach (MoHSW, 2011, 12; Ishijima et al., 2014, 139). This method is the most appropriate due to its low cost feature, increasing efficiency across the healthcare system while also allowing for input from providers to improve quality (Randhawa & Ahuja, 2017). While other countries have struggled in execution, Tanzania has become a model for this methodology amongst other East African countries (Ishijima et al., 2014; MoHSW, 2011). Specifically, JICA has reported that Tanzania has augmented patient satisfaction, hospital cleanliness, work environment and revenue (UNOSSC, 2019).

5-S Method and Training of Trainers

A study done by Ishijima et al., utilized the "cascade approach" recommended in the MoHSW 2011 framework by "training of trainers" (ToTs) at 46 hospitals in Tanzania and focusing on knowledge gained pertaining to 5S-KAIZEN-TQM and QI with pre- and post-tests (MoHSW, 2011, 30; Ishijima et al., 2014, 140). The study found that training trainers was important to the success of knowledge garnered and for the ability for trainers to transfer knowledge to their colleagues and subordinate staff, but that it cannot be implemented in silos (Ishijima et al., 2014). Rather, ToTs should be done focusing on mid-level staff and be done in

tangent with promoting investment in the outcome of the program to further achieve successful implementation (Ishijima et al., 2014)

In other review by the MoHSW to formulate a strategic plan, the 5S-CQI (KAIZEN)-TQM was tested at six hospitals, including MNH, and also included ToTs (Nangawe, 2012). This research found that the 5S method and focus on ToTs improved capacity building of infection prevention and control (IPC) was valuable in creating new norms of the hospital and changed the perspective and thought process in the healthcare environment (Nangawe, 2012). Moreover, the study found 5S-CQI (KAIZEN)-TQM to be cost-effective and efficient for QI at these hospitals (Nangawe, 2012). Certain capacity-related weaknesses remained, such as an insufficiency in clinical skills (Nangawe, 2012).

CHANGE MANAGEMENT AND HEALTHCARE

It is well known that there are personnel shortages both in LMICs and HICs that can affect health outcomes (Lifvergren, 2013). Additionally, due to the differences in capacity for CC in LMICs, there has been a documented lack of formal training and preparation to treat critically ill patients (Engdahl Mtango et al., 2019). In addition to this, there is often a gap between the theory of quality care and the actual execution, as demonstrated in a cross-sectional study (van Rossum et al., 2016). To improve care, an individual's ability to change alongside the initiatives introduced must be addressed and must be an integral part of any programs developed. Gordan & Pollack (2018) found in a Canada study that there were substantial benefits to drawing on ideas beyond the traditional (Gordon & Pollack, 2018; Kumah et al., 2016). By integrating change management with healthcare practice and interventions, care and quality can be transformed (Gordon & Pollack, 2018).

Moran & Brightman (2011) define change management as "the process of continually renewing an organization's direction, structure, and capabilities to serve the ever-changing needs of external and internal customers" (Moran and Brightman, 2001: 111, as quoted in By, 2005, 369). Nonetheless, change management is an ambiguous topic with an exponential amount of definitions, disciplines and theories that support it (Gordon & Pollack, 2018). For instance, there are multiple models for change management, as it is utilized in many sectors, but the most known are the strategic Kotter model, the tactical Jick model and General Electric's acceleration process model (Mento et al., 2002; Noble et al., 2011). Change management can be categorized as a procedural mechanism, one of the main categories for collective learning proposed by Shani & Docherty 2003, whereby new tools and methods are introduced to attain progress (Shani & Docherty 2003, 2008). An important model for change is "changing as three steps," which includes 'unfreezing' behavior, making a change and then 'freezing' in this new dynamic (Cummings et al., 2016). Such a model demonstrates how to manage adaptations, but also, it acknowledges the dynamic nature of change.

Change management can direct the culture of an organization, which fits in well with QI concepts of reorganizing processes and individuals' responsibilities (Hudelson et al., 2008). This is especially important considering staffing shortages. Change management and QI have a reciprocal effect – where change management can spur further improvements in QI and QI can impact the culture of the healthcare system which, in turn, affects quality (Silimperi et al., 2003). Indeed, resistance can be positively used in change management, working with resistance from individuals to change the system (Waddell & Sohal, 1998). Such resistance could reveal the underlying systemic issues that are preventing progress, allowing change management champions to harness and mold the process to encompass those who are resistant.

There are certain prerequisites in order to facilitate a change in culture. These are context specific but can include positive relationships across levels of providers, knowledgeable providers or effective communication (Bartunek, 2011). Capacity building is a necessary component and refers to a continual guarantee that providers have skills and knowledge to adequately complete tasks and provide for patients (Franco et al., 2002; Silimperi et al., 2003). It can take many forms from the most formal of trainings to peer-supported improvements (Silimperi et al., 2003). Zambia has faced issues in the past in trying to create sustainable QI due to capacity building issues (Franco et al., 2002). Change management also has a component of communication, to share and promote and encourage a community in achieving QI activities (Silimperi et al., 2003). Research has shown that limited communication across the community can be a barrier (Bartunek, 2011). These communities inform and are informed by the individuals that they are comprised of and the horizontal and vertical institutional linkages between them, thus creating a continually changing cohort.

Thus, it follows that change is inherently a dynamic process (Lifvergren, 2013; By, 2005). This means that there is no one way to effective change, especially considering the diversity of learning and attitude towards a new approach. Some research has determined that barriers to practice have been from morale, hierarchy and communication of staff (Engdahl Mtango et al., 2019). Change can depend on frequency, how it appears and scale (By, 2005; Senior, 2002) It is, therefore, important to note that change inherently challenges the status quo and can upend the current system and power dynamic (Mosadeghrad, 2012). Other studies demonstrate that the behavior and motivations of individuals affect QI success and must be understood (Boaden et al., 2008; Franco et al., 2002). Change management is really about managing *people* (Moran & Brightman, 2000). If individuals who are to carry out the

implementation do not understand or believe in the how, why and when of QI, then they will not feel ownership and will not be invested in changing their practice (Aveling et al., 2012; Mwidunda & Eliakimu, 2015). It makes sense, then, that change must not only be dynamic, but it should also be innovative.

The biggest considerations when trying to alter the status quo and change people's mindsets and practices is that change is not linear and that it is continual (Moran & Brightman, 2000). It does not have to break the system (Kramer & Magee, 1990). Rather, it should work in tangent with what currently exists to shift little by little to create waves of change that better outcomes. Studies have shown that while cultural change and training is integral to sustainable change, ineffective change management can hinder the progress of QI (Mosadeghrad, 2012; MoHSW, 2011). Other issues to the success of QI also hinge on the perception amongst providers and their drive to deliver care. Due to hierarchal issues in healthcare settings nurses have been seen to lack initiative and be uncomfortable making decisions (Engdahl Mtango et al., 2019). Such dynamics can affect patient outcomes and inhibit quality care or perpetuate the burden of disease.

It has been documented that the long-term success of a program is primarily contingent on the investment of members of the team and the resources that exist to further their training (Kacholi & Mahomed, 2020). Moreover, the individuals must trust their trainers and the change agents to optimally achieve change (Mosadeghrad, 2012). Indeed, by training providers and including them in the process, ownership can be felt and further spur innovative engagement in the activities and investment in the outcome of QI (Lifvergren, 2013; Weiner et al., 1997). Additionally, when there is teamwork, there are further improvements in the quality due to more perspectives and ideas to improve the system (Silimperi et al., 2002; Ishijima et al., 2014).

Change management also means taking the onus in performing a task. Aveling et al. (2012) argues that hierarchies can inhibit the uptake of a program (Aveling et al., 2012). When trainings are implemented alongside QI projects, the key success was ascribed to the team aspect and support, contributing towards a comradery (Kacholi et al., 2021). Therefore, any intervention should address how to take ownership to not wait to provide care and how to create partnerships across hierarchical levels, working towards a mutual goal.

A Ghanaian cross-sectional study across two hospitals revealed that while the priorities were to garner communication, skills, a cohesive team and to be able to work through change, the biggest barrier was inadequate training that inhibited empowerment (Kumah et al., 2016). In Iran, change management was employed during training to encourage quality techniques amidst a culture of learning. This training found increased cooperation and teamwork and more involvement from employees to facilitate quality delivery of care (Mosadeghrad, 2012). In Tanzania, the MoHSW has promoted the concept of Training of Trainers and the importance of developing every individual provider and their sense of responsibility toward the culture of care (MoHSW, 2011).

CASE STUDIES: HEALTHCARE AND QI

Many studies have been published surrounding the effectiveness of QI in healthcare, contributing to a growing body of literature for others to draw upon. Weiner et al. published their findings from a survey-based study conducted in 1989 and 1993 in the United States regarding QI in hospitals (Weiner et al., 1997). The study, after asking respondents about extent of provider QI training, provider participation in QI projects, extent of formal QI teams in the healthcare system and processes used to implement QI, found a positive correlation between

active involvement from leadership in QI initiatives and its success (Weiner et al., 1997). Importantly, Weiner et al. noted that 'leadership' can result from various sources, demonstrating variability and the possibility for adaptation in different contexts (Weiner et al., 1997). A study in Skaraborg, Sweden examined how the use of quality management in the SkaS health system improved "quality, efficiency and safety in hospital care" (Lifvergren, 2013, iii). This study was informative, as Sweden has one of the leading healthcare systems and efficient in being able to deliver good patient outcomes amidst low costs (Lifvergren, 2013). Since 2006, SkaS has employed a Six Sigma as the crux of quality strategy but has considered quality since the 1990s (Lifvergren, 2013). Lifvergren found that between 2006 and 2008, care was implemented based the IHI framework using a collaborative and strategic approach, incorporating different levels of the system and staying patient-focused (Lifvergren, 2013). Impressively, there was a 75% success rate with an estimated €40,600 saved across all projects (Lifvergren, 2013). Lifvergren also argued that the success was as a result of examining execution as well as the learning process in quality care (Lifvergren, 2013).

Another study conducted by Hudelson et al. in 2008 investigated different perspectives and values amongst practitioners (nurses and physicians) at University Hospitals of Geneva, Switzerland (Hudelson et al., 2008). The findings from this study found that improved quality was achieved when focusing the importance of the human aspect of care and its intersection with the technical competency (training and competency), when there is consensus and communication amongst nurses and doctors and the need for self-reflection (Hudelson et al., 2008). The primary obstacle to achieving quality care included institution- or systems-level barriers (Hudelson et al., 2008). While the above studies are important to understand a background in QI success, they were conducted in HIC settings, clearly underlining the paucity

of contextualized research in lower-research settings.

LESSONS FROM LMICS

While the above studies are important to understand a background in QI success, they were conducted in HIC settings, clearly underlining the paucity of contextualized research in lower-research settings.

Historically, LMICs have experienced issues in developing a robust healthcare system, with some, such as in South Africa, seeing a decline and failing to meet basic level of care, resulting in loss of public trust (Maphumulo & Bhengu, 2019; Murthy & Adhikari, 2013). Other challenges have included poor infrastructure and lack of adequately trained providers, sometimes resulting in a rationing of care (Murthy & Adhikari, 2013; Engdahl Mtango et al., 2019; Maphumulo & Bhengu, 2019). Specifically, in West Africa, funding and economy constraints have contributed to the above issues (Okafor, 2009). This can all contribute to avoidable deaths. In 2016, five million deaths in LMICs were attributed to substandard care (Kruk et al., 2018).

Moreover, some of the least developed aspects of healthcare in LMICs are critical care (CC) facilities and programs (Baker et al., 2013, 1). Studies have found that CC and ICUs continue to be novel in LMICs or poorly developed in Sub Saharan Africa (Tumukunde et al., 2019; Okafor, 2009; Dünser et al., 2006). Indeed, ICUs in LMICs may be approximately twenty years behind the development of HIC ICUs (Dünser et al., 2006). Establishing robust CC predicates on the ability to build capacity, often a costly endeavor due to fixed costs inherent in CC (Murthy & Adhikari, 2013). In Nigerian and Ugandan ICUs, the mortality rate was 35.1% and 25%, respectively (Okafor, 2009). Other issues toward a functioning critical care unit include lack of trained providers/support staff and equipment availability causing shortages or

spreading of disease. According to Murthy & Adhikari, Nigeria had a ratio of 368,421people per one CC nurse compared to the United States' ratio of 628:1 (Murthy & Adhikari, 2013). A systematic review across 15 LMICs in 2015 underlined the disparity in resources: on average there were 1.6 beds per 100,000 people versus 33.6 beds per 100,000 in HICs (Tumukunde et al., 2019; Murthy et al., 2015). A lack of beds can contribute to higher mortality rates (Dünser et al., 2006). These limiting factors have been due to and have exacerbated an absence of SOPs and guidelines in LMICs (Murthy & Adhikari, 2013). Nonetheless, research has shown that simply widening the reach of care does not on its own improve patient outcomes (Kruk et al., 2018).

LMIC Solutions and Approaches

Therefore, there necessitates an approach that can maximize limited resources to address CC and ICU issues, requiring adaptation and context-specific application of solutions used in higher-resource settings to reach UHC and quality care. Some existing solutions have been to employ safe reuse of equipment, adapting skills to make up for the lack of technology and new processes for delivering care (Tumukunde et al., 2019). Another option is the Overseas Doctor's Training Scheme (ODTS) from the UK and other training exchange programs that exist in South Africa and India to train providers from limited resource settings (Okafor, 2009). Yet, all of these aims can incur costs, and there needs to be a comprehensive and cohesive solution to improve delivery of care.

One such way has been to create national quality improvement programs, which have proven effective in both HIC and LMICs and support networks have specifically helped in LMICs (Mwidunda & Eliakimu, 2015; Renggli et al., 2019). QI in healthcare has been shown to limit mistakes, improve care timeliness and efficiency and lower costs (Maphumulo & Bhengu,

2019). Additionally, QI can help mitigate the prevalence of disease including sepsis and VAP, especially amongst critically ill patients (Murthy & Adhikari, 2013; Said, 2012). A large part of improving care, however, has to do with the prioritization in policy (Okafor, 2009, 25). In summary, Nambiar et al. recommends a five-prong approach to improving quality, including: systems thinking, stakeholders' participation, accountability, evidence-based intervention and innovative evaluation – focusing on the importance of creating a culture to implement QI strategies (Nambiar et al., 2017). Countries such as Tanzania, Uganda and Kenya all have determined quality to be a central aspect in improvements to delivery of care and consider quality health as a constitutional right (Ishijima et al., 2014; Maphumulo & Bhengu, 2019; MoHSW, 2011).

Based on western concepts and earlier studies, Mosadeghrad adapted QI concepts and created the "Strategic Collaborative Quality Management" (SCQM) (Mosadeghrad, 2012). Action research, defined as "research with, not research on" (Lifvergren, 2013, 14), was conducted at a hospital in Iran (Mosadeghrad, 2012). The SCQM Model was based on the 5-S, Six Sigma and Kaizen, among other QI techniques (Mosadeghrad, 2012). The study found success of its adapted quality management/improvement concepts due to its emphasis of weaving QI into every level of management. Mosadeghrad argues that a large part of this success was due to the creation of a culture of learning and facilitation across every level of a quality project following effective provider training (Mosadeghrad, 2012).

In one of the few examples from a LMIC, a tertiary referral hospital in Malawi recently established a High Dependency Unit (HDU), which served an indispensable role at the onset of the COVID-19 pandemic to provide quality (Morton et al., 2020). The program focused on a participatory approach to standardize care and improve quality with the aim for sustainable

results. Utilizing the UK levels of hospital care as a framework, the unit worked to designate a space for the HDU, train nurses and improve SOPs (Morton et al., 2020). Due to the participatory approach, nurses gave input, resulting in a more customized training program alongside partnerships solidified amongst key stakeholders (Morton et al., 2020).

In another example, the African Health Initiative across Mozambique, Rwanda, and Zambia sought to establish QI projects over a seven-year period (Wagenaar et al., 2017). Following in-depth interviews amongst program staff, there were a total of 450 action-plans with varying success from 10-80%. Throughout all, there was an increase in the feeling of ownership and empirical data used to drive QI projects (Wagenaar et al., 2017).

TANZANIA

In order to frame this research, it is imperative to place this study in context – what does healthcare in Tanzania look like? Historically what type of Quality Improvement efforts and interventions have been tried? How this has generated a culture of QI both at the hospital and national level.

Background on Tanzanian Healthcare Sector & Muhimbili National Hospital

A 2018 study reported that in LMICs, poor-quality care resulted in 5 million excess deaths (Kruk et al., 2018). The factors contributing to this glaring statistic have included lack of well-trained staff, insufficient resources, ineffective allocation of limited resources, and lack of feedback on quality assessments (Renggli et al., 2019).

Impressively, the Tanzanian government recognizes the “Right to Health” that is part of the Constitution of the World Health Organization and encourage their citizens to have

awareness of this right (MoHSW, 2011). Such rhetoric in official policy shows that in referencing the Constitution, they are designating health not only as a right for each individual but as a priority to be addressed in key policy as well. Additionally, a bit utopian in its aspirations, the Tanzania Vision 2025 was created in 1998 to direct the further development of the country in order to improve Tanzanian quality of life – both with regard to health and beyond (MoHSW, 2011). Since then, this schematic has served to create standards and a mission for the health of all Tanzanians (MoHSW, 2011). With this in mind, it is not a surprise that Tanzania has endeavored to improve delivery of care to complement its aims to improve quality of life.

While many LMICs have made strides in recent years to overhaul their healthcare systems to integrate quality measures, there are still a number of issues, specifically in the amount and quality of ICUs in these hospital facilities. This has been the experience in Tanzanian hospitals, where ICUs have far fewer than the international standard of beds and the triaging process for the admission of patients to the ICU is convoluted and inefficient and may can result in a rationing of beds (Engdahl Mtango et al., 2019). Hospitals in Tanzania are also lacking in provider training (Baker et al., 2013). These conditions have contributed to the unacceptably high morbidity and mortality rates for Tanzanian patients with critical illness (Sawe et al., 2014).

ICUs

The majority of research on ICUs focuses on HICs (Engdahl Mtango et al., 2019). This means that for a number of factors – such as setting and resources availability – research does not reflect the needs of LMICs. Care is context specific, so standard of care *must* be met in context and in consideration of resource availability and type. Thus, it is important to understand

how the ICUs function and to revise them to meet the needs of patients. It has been reported that all of the tertiary hospitals in Tanzania are constrained by resources and personnel, which has affected patient care. At the ICU level, in this same report, none of the ICUs met the minimum standard of care (Sawe et al., 2014). Across the country, the need has outweighed the demand, and there has been a historic lack of structure to triaging in the ICU (Engdahl Mtango et al., 2019).

Specifically, Muhimbili National Hospital (MNH) is a large tertiary hospital in Dar es Salaam that serves as one of four referral hospitals. In 2014, it was reported to have 1300 beds with a ratio of one ICU bed for every 217 hospital beds and one cardiac monitor per ICU bed (Sawe et al., 2014). This is more than the number of beds in 2009 – where there were only 38 beds in total across all four national referral hospitals (Engdahl Mtango et al., 2019). Now, there is 1 ICU bed for every 21 hospital beds at the National Hospital (T. Said, personal communication, April 4, 2023). The most frequent category of disease at the MNH ICUs were post-operative observation and infections, demonstrating the importance of considering disease in a critical care setting (Sawe et al., 2014). Tanzania has a high level of ventilator support needs, with MNH seeing approximately 20-40 patients receiving short term ventilation each week (Said, 2012). Recent audits have been done at MNH and have determined a need for improved quality assurance at MNH (Kidanto et al., 2009). Within MNH and across the rest of the hospital facilities in Tanzania, it is thus evident that there is much to be improved and standardized to facilitate quality care for patients.

High Dependency Units (HDU)

HDUs are used to treat patients that need more care than a general ward but do not offer the degree of monitoring and expertise that an ICU offers (Vincent & Rubenfeld, 2015). They can serve as a location for patients that require short-term intensive care or for patients "stepping down" from the ICU, which can improve ICU bed availability and, ultimately, care for the sickest patients (Vincent & Rubenfeld, 2015). In High Income Countries (HIC), the utility of HDU has been evaluated with mixed results, but the potential benefit for LMIC hospitals has not been thoroughly researched (Vincent & Rubenfeld, 2015). Due to the challenges physicians at MNH have experienced with identifying critically ill patients in the wards at MNH, the implementation and utilization of HDU admission guidelines can potentially improve the identification of critically ill patients (Engdahl Mtango et al., 2019).

Training

It has also been documented that knowledge and usage of critical care skills are insufficient (MoHSW, 2011). A study from 2013 found that 80% of the hospitals studied in Tanzania lacked staff with critical care training and that there were no national guidelines for Emergency and Critical Care (Baker et al., 2013). Moreover, subsequent studies reported an absence of adequate training in providers and no constant standard for ICU admission (Sawe et al., 2014; Engdahl Mtango et al., 2019). This demonstrates a lack of training as well as a lack of standardization across hospital settings, as there may not even be an ICU in the hospital where providers train. A study by Makene et al. in 2014 demonstrated that while improvements had been made, there was still a lingering lack of critical care skills amongst providers in newborn care facilities (Makene et al., 2014). The study contended that despite improvements in

knowledge, further critical care skills and resuscitation training was necessary to improve future newborn outcomes (Makene et al., 2014). In another more recent study conducted at multiple sites including MNH, Nyangarika & Bundala examined the facilitators to effective patient quality care. Their findings reported that no matter the type of leadership, success was encouraged when utilizing teamwork, focusing on culture and continuous training (Nyangarika & Bundala, 2020).

Training is imperative for all providers, but especially in the ICUs. Frequent and rapid changes can occur in patients in the ICU, so inadequate knowledge can lead to poor patient outcomes and poor practice (Said, 2012). In one observational study of ICU nurses at MNH, while 89.83% of nurses had the knowledge required, there was a lack of application (Said, 2012). Another study determined that nurses caring for critically ill patients relied only their prior experience only and that there was low morale for treating patients (Engdahl Mtango et al., 2019). This review illustrates the need to have a continuing education about care and the use of knowledge and that training should be quality-specific to help translate knowledge into practice.

Quality Improvement in Context: Tanzania

It is important to denote how Quality Improvement has become part of the health sector in Tanzania and what that means for improving patient outcomes and reducing the burden of disease. As aforementioned, the concepts of Quality Improvement have existed for an extended amount of time. In Tanzania, Quality Improvement was introduced in the 1970s, but was not widespread and there was a lack of a concerted effort due to resource limitations and a lack of prioritization (Mwidunda & Eliakimu, 2015). This changed following a HIV epidemic in Tanzania that led to a major inundation of funding with international entities becoming investing

in eliminating HIV. In tangent with this aim, many international partners had a secondary focus concerning QI when achieving their goal (Mwidunda & Eliakimu, 2015). As such, this meant a closer examination of the process of QI in Tanzania and making a more concerted effort to institutionalize QI in healthcare. This also demonstrates that until recently, there were different levels of training, expectations and a lack of standardization across the nation pertaining to quality improvement and more broadly, quality care. This has manifested in certain programs becoming more robust (Renggli, 2019), albeit still below international standards (Mwidunda & Eliakimu, 2015). As such, 1994 saw healthcare reforms and the Tanzanian Ministry of Health and Social Welfare conducted an assessment of the breadth and depth of QI across different healthcare facilities in 2004 (Mwidunda & Eliakimu, 2015; MoHSW, 2011).

Resulting from the 2004 assessment, the Ministry of Health and Social Welfare (MoHSW) took steps toward quality improvement (QI) becoming institutionalized through the Tanzania Quality Improvement Framework (TQIF). Institutionalization in Tanzania was defined by the MoHSW as making QI "integral" and "sustainable" and "woven into the daily activities and routine" and that such efforts are "continuously implemented…and supported by a culture of quality improvement" (MoHSW, 2011, 43). Thus, the framework's aims are: (1) to encourage all health workers at all levels and other stakeholders in the sector to develop innovative approaches for QI and implement them; and (2) to outline what needs to be done to institutionalize quality of health care at various levels based on national interests and vision (MoHSW, 2011; Mwidunda & Eliakimu, 2015).

Quality Improvement in Tanzania is defined by the MoHSW in 2011 as activities aimed to:

> *"identify, implement and maintain best clinical and organizational practices that ensure better care for clients in order to achieve positive health outcomes. Sustaining these better*

> *care practices and corresponding results requires continuous implementation of QI activities at the point of service delivery and QI support activities from higher levels of the health system" (MoHSW, 2011, 38)*

And, a mission was set and defined:

> *"Quality improvement shall focus all health care services through instilling among health workers a philosophy of client and community centered care, ensuring strong and transparent leadership at all levels and making quality of health care part and parcel of the culture of daily activities of all health staff, partners and the public in general" (MoHSW, 2011, 5).*

Such a definition and mission set the tone for the expectation of QI programs and for the standards of providers at healthcare facilities that are delivering care.

The first edition of the TQIF (2004) allowed for revision of policies and further developing the QI program, including: The National Health Policy (2007), The Health Sector HIV and AIDS Strategic Plan-II (2009-2012), The Health Sector Strategic Plan III (2009-2015), The National Development Plan (2011-2016), among others (MoHSW, 2011). A key outcome of TQIF was that in conjunction with these plans, specific QI methods were introduced as well as a further solidification of international partners assisting in actionizing QI projects nationally (MoHSW, 2011; Mwidunda & Eliakimu, 2015).

Still, there was not a complete consensus on what standard of practice would materialize as when incorporating a QI framework (Mwidunda & Eliakimu, 2015). Thus, the MoHSW further analyzed the situation and produced a revised TQIF (2011), which included a "strength, weaknesses, opportunities, and threats" (SWOT) analysis (MoHSW, 2011, iv). Numerous strategies were formulated following the SWOT analysis done by MoHSW (MoHSW, 2011, 17-). In total, as a result of the 2011 version of TQIF, QI became standardized, including its

operational tools needed for success in Tanzania (Mwidunda & Eliakimu, 2015; Nangawe, 2012). Following another situational analysis in 2012, MoHSW designed a National Health and Social Welfare Quality Improvement Strategic Plan (NHSWQISP) (2013–2018) to specifically create strategies for implementation and including a framework for monitoring QI success (Mwidunda & Eliakimu, 2015). Last, five versions of the Tanzanian Health Sector Strategic Plan (HSSP) have been created to further discuss and standardize QI, with the most recent being HSSP V (2021-2026) (Renggli et al., 2019; MoHCDGEC, 2021). The HSSP sets goals to achieve the WHO 2030 Sustainable Development Goals and applies these objectives across multiple sectors and levels of health and life. In HSSP III, multiple strategies indicated that the TQIF would be implemented in tangent (Nangawe, 2012). Now, the HSSP V indicates that the government has played a key role in Tanzania achieving elevated development status and was created to build off the prevailing gaps from the HSSP IV (MoHCDGEC, 2021). The HSSP has identified multiple communicable diseases to continue to burden the population and has indicated the use of QI programs to battle these diseases (MoHCDGEC, 2021). In summary, HSSP aims to promote a healthier population and move towards UHC based on the Tanzania Development Vision 2025 while focusing on equity, gender and socioeconomic inequalities and the social determinants of health (MoHCDGEC, 2021).

Such efforts also illustrate an evolution of what it means to implement QI in Tanzanian healthcare sector. This timeline of events demonstrates how QI has over the course of a decade become institutionalized, standardized and recognized as a priority in healthcare. Now, all healthcare entities must have a QI program with PDSA (Mwidunda & Eliakimu, 2015; Nangawe, 2012). Despite this commitment, the Tanzanian health sector continues to face many familiar

challenges of resource constraints, unsustainable QI projects, ineffective management and gaps in knowledge and skills (Nangawe, 2012; Renggli et al., 2019).

Thus, there was a movement in approach and perspective toward critical care to utilize the best methods within a low-resource environment and employing equity in care (Tumukunde et al., 2019). Yet, research has demonstrated a remaining gap in the level of knowledge and standard of care seen in the ICUs in Tanzania (including at MNH) (Said, 2012; Kaihula, 2018). A study published in 2020 has demonstrated improved sustainability of QI teams with a score of 59.08% across four hospitals, but there is more progress to be made (Kacholi & Mahomed, 2020). Other issues have included lack of investment in QI or a hyper-focus on short-term activities, making many QI aims unsustainable and resulting in less successful outcomes (MoHSW, 2011; Renggli et al., 2019). Additionally, training was seen lacking in knowledge and application of quality improvement (MoHSW, 2011). Last, it is important to note that QI programs are often reliant on international entities for lack of funding from the government (Mwidunda & Eliakimu, 2015; Ishijima et al., 2014), which could potentially contribute to differing objectives based on the foreign partner's values.

Infectious Disease affecting Delivery of Care in Tanzania

Infectious disease has been a continuing issue in Tanzania (Sawe et al., 2014; Kacholi & Mahomed, 2020). In 2016, malaria was the leading cause of death amongst communicable diseases followed lower respiratory infections and HIV (Kacholi & Mahomed, 2020). In order to resolve some of the burden of disease, quality improvement in conjunction with IPC processes have been shown to improve healthcare outcomes (Mwidunda & Eliakimu, 2015). Furthermore, quality care can be interpreted as how much infectious diseases spread in the hospital setting as a

result of the actions of HCWs (MoHSW, 2011). Thus, it is pertinent that healthcare measures include a level of quality to keep patients safe, treat the sick and further alleviate the burden of disease. Indeed, MoHSW denotes that IPC is considered an indicator of quality (MoHSW, 2011). It could be interpreted that if a hospital cannot control outbreaks or continues to perpetuate poor hygienic standards that perpetuate illnesses, they cannot be considered to be providing quality care nor are protecting the populations they are serving.

An observational study conducted at MNH focused on ICU nurses and the association between knowledge and practice of nurses and the incidence of Ventilator Associated Pneumonia (VAP) (Said, 2012, vi). This was an important study, as VAP can have a high mortality rate and affects patients who have to be mechanically ventilated and intubated (Said, 2012, 1). The study found that practice was associated with education level but not ICU training and that hand washing hygiene can increase VAP (Said, 2012). It is important to highlight one data point – that 100% of nurses did not wash their hands prior to entering the ICU and only 66.7% washed their hands after being in contact with a patient (Said, 2012, vi). The study recommended that there is a need for knowledge amongst the nurses not only to prevent VAP, but also, so that the nurses can gain *confidence* in their actions towards preventing VAP (Said, 2012). This has been a trend amongst many of the studies that a lack of initiative for a variety of reasons has affected nursing ability and decision making (Said, 2012; Engdahl Mtango et al., 2019; Kacholi et al., 2021). Other studies have demonstrated that in low-resource settings, having a quality-based project that reminds providers about SOC protocols led to preventing spread of diseases including sepsis and other infections (Dünser et al., 2012; Walker et al., 2009; Apisarnthanarak et al., 2007).

RESUSCITATION SKILLS AMONGST NURSING PROVIDERS

Across many African countries, there is a gap between the knowledge of resuscitation and the ability to perform accurately (Kaihula et al., 2018). It has been demonstrated that CPR training can impact patient outcomes and provider comfortability in response. A study conducted across hospitals in Tanzania (not including MNH) from 2009 to 2013 revealed that a QI initiative improved newborn resuscitation skills and contributed to improved patient outcomes. Provider knowledge increased significantly about sepsis, resuscitation and necessary equipment (Makene et al., 2014). Nonetheless, the study perceived a continuing gap between knowledge and action, and specifically raised questions about how CPR would be sustained across varying levels of health facilities (Makene et al., 2014).

At MNH, the level of CPR knowledge and skill displayed was poor in all sectors and departments of the hospital in two different studies even though many had experience in previously performing CPR (Silande, 2010; Kaihula et al., 2018). Other studies showed that infrequent performance of CPR correlated with limited ability to retain skills and knowledge (Kaihula et al., 2018; Roshana et al., 2012). A descriptive cross-sectional study was implemented across approximately 270 registered nurses at MNH in 2010. The study assessed practical knowledge and theory of CPR practices, yet 70% of respondents were unable to correctly identify BLS concepts and 77% exhibited poor CPR practical performance (Silande, 2010). This study recommended in-service training to augment the knowledge of nurses concerning BLS and CPR (Silande, 2010). In another MNH study in 2018, those with prior training performed better, but nurses still performed poorly. Other studies in LMIC have echoed this finding, despite nurses often being most readily present during cardiac arrest or emergency situations (Kaihula et al., 2018; Shrestha, 2011; Parajulee & Selvaraj, 2011).

SUMMARY

Although the above literature review reveals ongoing work in QI in the healthcare setting, there remains a paucity of information and context-specific endeavors to improve not only quality, but also, the culture that encompasses the implementation process. Published literature has been strong in delineating what QI is, how it has transitioned to the healthcare sector and what are the different approaches for its implementation (Batalden & Davidoff, 2007; Gleeson et al., 2016; Bartunek, 2011; Hudelson et al., 2008; Bessant et al., 1994; Lifvergren, 2013; Aveling et al., 2012; Silimperi et al., 2003). Yet, quality outcomes are dependent on setting, so too, must the process be for a country with limited resources such as Tanzania. Previous studies have demonstrated both the importance of provider knowledge and change management/cultural changes to improve the uptake of QI programs, but this has not been fully investigated in this setting's context (Engdahl Mtango et al., 2019; Makene et al., 2014; Kacholi & Mahomed, 2020). Even the MoHSW has published that changing the culture and mindset has been one of the main obstacles in QI in Tanzanian healthcare facilities (MoHSW, 2011). Moreover, many studies have been published across other hospitals in Tanzania, so a more comprehensive understanding of QI at MNH, one of the largest referral hospitals, will elucidate more optimal future processes.

Since many LMICs do not often have ownership over research that occurs in their backyard, this research aims to be action research, working with in-country partners and providers on equal footing to investigate jointly. As nurses spend the most time in the ICU and critical care units, they can be considered integral to patient success (Maphumulo & Bhengu, 2019). Therefore, the goal is to identify and speak to the specific challenges for QI success and other barriers that present in this setting and train nurses to improve their quality of care.

Additionally, there are extreme limitations due to a lack of resources which can further exacerbate sepsis and other infectious diseases (Murthy & Adhikari, 2013). Having trained workers can prevent further spread, since they will know what to look for as well as will not be carriers of disease (Okafor, 2009). This research addresses QI in a low-resource setting, critical care training to improve provider skills, change management to shift the culture to all subsequently improve patient outcomes and limit the spread of disease.

CHAPTER 3: Manuscript I Quantitative

Evaluating a Quality Improvement Initiative at the National Hospital in Tanzania

Contribution of Student

For this manuscript, the student conducted primary research in-country: for quantitative data, the student gathered data from training and for qualitative data, the student conducted all interviews. For analysis, the student cleaned, coded and conducted all statistical analysis with mentorship from thesis chair Alex Edwards. The student created all figures and tables and received editorial assistance from Alex Edwards, Saria Hassan and Brittany Murray.

Journal Requirements

Journal of Global Health: "A common submission in this category has up to 4000 words (excluding the abstract and references), 10 tables/figures and 50 references (except for systematic reviews). The abstract should not exceed 350 words and should be structured in four paragraphs: Background, Methods, Findings, and Conclusions." ("Information For Contributors," n.d.)

ABSTRACT

Background: Historically, the United Republic of Tanzania has had a 41.4% mortality rate in the Intensive Care Unit (ICU) setting, and a 2018 study reported that in LMICs, poor-quality care resulted in 5 million excess deaths. It was found that the average knowledge of critical care management amongst providers was 38.6% in hospitals in Tanzania. In Tanzania, the Ministry of

Health and Social Welfare (MoHSW) has taken steps toward Quality Improvement (QI), yet the Tanzanian health sector continues to face resource constraints, unsustainable QI projects, and gaps in knowledge and skills. These conditions have contributed to unacceptably high mortality rates for Tanzanian patients. This research aims to evaluate the impact of a training program.

Methods: Through the Emory-Muhimbili Partnership for Health Administration Strengthening and Integration of Services (EMPHASIS) and with support from Abbott Fund Tanzania, a two-day critical care training program was developed for providers. It included the following modules: Vital Signs Directed Therapy (VSDT), Cardiopulmonary and Brain Resuscitation (CPBR) knowledge, Blood Glucose Monitoring and Introduction to Critical Care Concepts. In a pre-post study, data was collected from pre- and post-tests and reported in REDCap. Descriptive statistics and paired t-tests were performed, setting alpha at 0.05.

Results: The overall score changes amongst participants for CPBR and VSDT were significant ($p<0.001$). Six out of ten questions in CPBR demonstrated significant improved change ($p<0.001$). All questions in the VSDT training showed significant improvement ($p<0.001$). The Muhimbili University and Allied Sciences (MUHAS) has a minimum passing score of 50% and the American Heart Association (AHA) standard is a minimal passing score of 84%. For CPBR, 63 (95.5%) passed the MUHAS standard and 25 (37.9%) met AHA standards. For VSDT, 62 (95.2%) and 17 (25.4%) passed, respectively.

Conclusion: A pre-/post-test analysis demonstrated an improvement in knowledge, skills and increased confidence in responding to emergencies. This study suggests a Critical Care Training Program significantly improves the knowledge amongst ICU/HDU providers and that QI programs impact the culture of change. This research exemplifies a systematic approach to

strengthening capacity of critical care delivery in limited resource settings, with implications for further innovation in other LMICs.

INTRODUCTION

Historically, the United Republic of Tanzania has had a high 41.4% mortality rate in the Intensive Care Unit setting, and a 2018 study reported that in LMICs, poor-quality care resulted in 5 million excess deaths (Sawe et al., 2014; Kruk et al., 2018). Adequate and standardized critical care skills are necessary when caring for critically ill patients. Nonetheless, there are multiple constraints to making this a reality, including a lack of well-trained and motivated staff, insufficient and ineffective allocation of resources and lack of adequate assessments to measure quality parameters (Renggli et al., 2019). It was found that in testing nurses' ICU knowledge, the mean score out of 100 was 38.6% in Tanzania (Bankanie et al., 2021). As such, questions arise as to what standard providers should be held to and how to engender change in this field.

Quality is a concept that has grown in popularity in healthcare since the 20th century (Kruk et al., 2018; Boaden et al., 2008). Quality care should be the goal for all providers and stakeholders in the healthcare sector. Yet, what is the optimal way to fuse concepts of quality with treating patients and how can the health sector transform to turn these concepts into practice? Quality improvement (QI) is a practice that has been become part of the dialogue about patient care since the mid 1900s and was introduced in Tanzania in 2007 (Ishijima et al., 2014, 138; MoHSW, 2011, 13).

In Tanzania, the Ministry of Health and Social Welfare (MoHSW) has taken steps toward QI through the Tanzania Quality Improvement Framework (TQIF). The framework's aims are: (1) to encourage all health workers at all levels and other stakeholders in the sector to develop innovative approaches for QI and implement them; and (2) to outline what needs to be done to institutionalize quality of health care at various levels based on national interests and vision (MoHSW, 2011). Despite this commitment, the Tanzanian health sector continues to face many

familiar challenges of resource constraints, unsustainable QI projects, and gaps in knowledge and skills (Nangawe, 2012). This has been the experience at the National Hospital in Dar es Salaam, where ICUs have far below the international standard of beds and the triaging process for the admission of patients to the ICU is convoluted and inefficient (Engdahl Mtango et al., 2019). These conditions have contributed to the unacceptably high morbidity and mortality rates for Tanzanian patients with critical illness (Sawe et al., 2014). Moreover, there are multiple units of varying capacity depending on patient need to provide care for critically ill patients.

High Dependency Units (HDU) exist to treat patients that need more care than a general ward but do not offer the degree of monitoring and expertise that an ICU offers (Vincent & Rubenfeld, 2015). They can serve as a location for patients that require short-term intensive care or for patients "stepping down" from the ICU, which can improve ICU bed availability and, ultimately, care for the sickest patients (Vincent & Rubenfeld, 2015). In High Income Countries (HIC), the utility of HDU has been evaluated with mixed results, but the potential benefit for LMIC hospitals has not been thoroughly researched (Vincent & Rubenfeld, 2015). In one of the few examples from an LMIC, a tertiary referral hospital in Malawi recently established an HDU, which served an indispensable role at the onset of the COVID-19 pandemic (Morton et al., 2020).

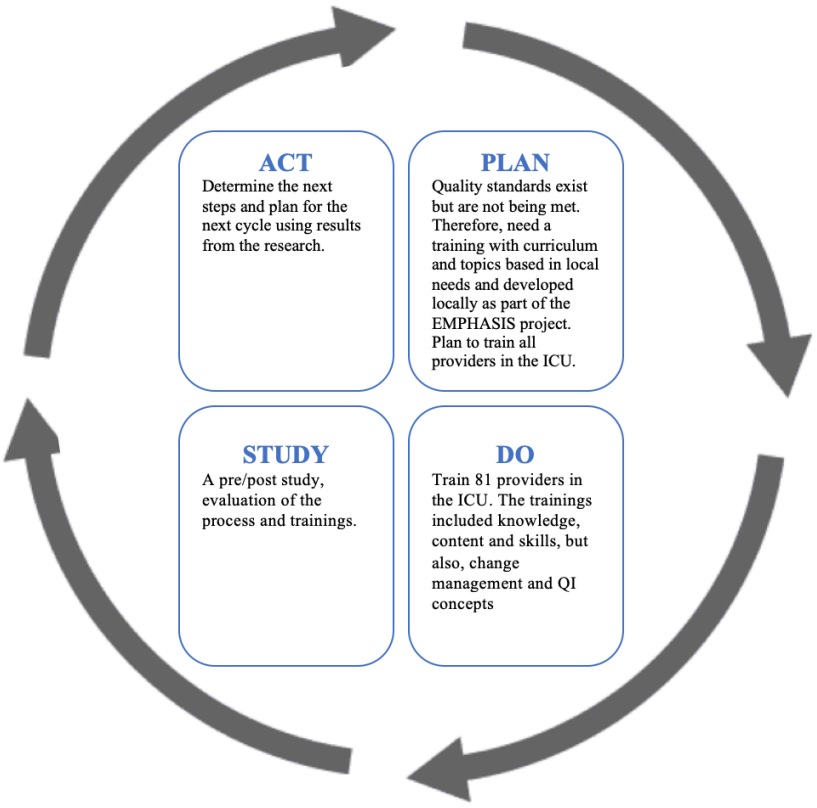
In considering how to deliver care, efficiency is the ultimate goal – being able to deliver quality care given the amount of resources available – with an ever increasing amount of need in a population (Lifvergren, 2013). An efficient system is able to use less resources while maintaining high quality patient outcomes, thus allowing for more resources to be used for more patients. Thus, a more efficient system, grounded in the setting's context to maximize resource usage will be imperative to improve patient outcomes and limit disease.

Many LMICs have been strapped for resources amidst a growing need for more care for more people. Due to low resources, providers may be trained by attending schooling in a number of different countries and return with a number of different of understandings of how to preform care. Similarly, other countries may train some providers while another wave of international entities may train others. As such, training is not always consistent, leading to variable knowledge levels and approaches to delivering care. This is the case in Tanzania where there is a lack of standardization across providers even within the same ward as the National Hospital. With such growing needs for care in Tanzania and in other LMICs, there is a gap as to what the most appropriate method of transforming the delivery of healthcare. Some countries have implemented an audit approach, while others have begun utilizing quality improvement (Øvretveit, 1994). Nonetheless, there is a paucity of research and published results in LMIC settings, with most studies being US- or euro-centric. A more dynamic understanding of how programs using a quality improvement framework implemented in a low resource setting can transform delivery of care would be illuminating for scaling up programs and assisting populations. In examining the factors on a micro-scale that contribute or inhibit the success of a program aimed to improve quality of care is valuable and timely on the macro-scale, demonstrating parameters needed to be addressed for further improvement

At MNH, the level of CPR knowledge and skill displayed was poor in all cadres and departments of the hospital (Kaihula et al., 2018). Additionally, it was noted that nurses spend the most time out of providers in critical care units and are integral to patient success (Maphumulo & Bhengu, 2019, 1). Thus, it is especially imperative for nurses to be trained and feel confident in responding to emergencies since a systematic review has demonstrated that

there are significantly less ICU beds in LMICs compared to HICs for the same denominator of individuals (Tumukunde et al., 2019).

This research aims to elucidate a more robust understanding of how to transform quality of care delivered in a low resource setting, especially considering the gap in published research amongst LMICs. The research can be framed in the PDSA cycle:



We work with a specific quality improvement project in the HDU at the National Hospital in Tanzania seeking to improve skills of staff and providers. Thus, the research first question is as follows: How does a critical care training program based in quality improvement concepts affect the technical competence and self-efficacy of providers in a critical care setting? The null hypothesis is as follows: Providers who receive this QI-based critical care and life-saving skills training will not demonstrate a change in their knowledge and comfortability.

Quality is setting specific, so it must be met in context and in consideration of resources. The first step should be to equip providers with the necessary tools to meet the standard of care, deliver quality and improve outcomes despite limited resources. The training employed in this research is vital in changing the culture of MNH, but also, in increasing the dissemination of knowledge across the facility. MoHSW has recommended a "cascading approach" to training (MoHSW, 2011, 30). This intervention utilized such an approach to reach a broader number of providers, since ICU nurses are considered a pillar of critical care units (Said, 2012; Maphumulo & Bhengu, 2019, 1). As such, this research addresses QI at the National Hospital by focusing on critical care training to improve basic life support skills, change management to shift the culture and build capacity, all to subsequently improve patient outcomes and limit the spread of disease.

METHODS

This research was built collaboratively through the Emory-Muhimbili Partnership for Health Administration Strengthening and Integration of Service (EMPHASIS). This study and QI initiative were completed as a part of the larger EMPHASIS project, a five-year research partnership between Emory University and Muhimbili and supported by the Abbott Fund Tanzania (Church, 2020). EMPHASIS is a capacity building effort to give ownership to Muhimbili partners by ensuring that all studies at MNH have an in-country co-researcher (Church, 2020). EMPHASIS focuses on nurses, recognizing the importance of their role as providers and creates an equitable collaboration towards increased quality (Church, 2020).

Study Design

This qualitative study at the National Hospital, Muhimbili National Hospital (MNH), in Dar es Salaam, Tanzania between June and July in 2022, semi-structured interviews were conducted amongst providers delivering care for critically ill patients in the ICU and HDU.

Study Setting

MNH is located in Dar es Salaam, near the coastal port of the nation's capital. It is one of the largest referral hospitals and situated on the same campus Muhimbili University of Health and Allied Sciences (MUHAS), which has frequent overlap with the main hospital, as MNH is a teaching hospital. The hospital is comprised of multiple wards, coordinated into "blocks" including the Mwaisela Block, where the majority of providers who participated in the study worked. Mwaisela has four floors with an ICU and surgical ICU (SICU) located on the ground floor and HDUs on each ward, including the ICU and SICU. Across the entire hospital there are

74 beds designated for ICU use, comprising 4.93% of total beds. In Mwaisela, there were 10 beds both the ICU and SICU at the time of the study. The HDU was comprised of 6 beds in each ward and is housed in a separate room. Patients are admitted to the ICU from the medical units. Within the ICU, patients are monitored using critical care technology, including mechanical ventilators, central lines and IVs, catheters, pulse oximeters, antibiotics, oxygen respirators.

Training Program:

A two-day training program was developed by the Muhimbili team for critical care nurses and providers. The two-day critical care training program included the following modules: Vital Signs Directed Therapy (VSDT), cardiopulmonary and brain resuscitation (CPBR) knowledge, Blood Glucose Monitoring and "Introduction to Critical Care Concepts." Each day of training began with a pre-test for that day's module topics. CPBR had a practical session to practice skills learned with group scenarios. Each day had a post-test to evaluate knowledge gained. At the close of the training, participants were given an optional training evaluation to provide feedback.

Participants:

Participants were selected from the block or ward and comprised of nurses and physicians. The cohorts that completed training were considered of individuals from the ward and some that were leaders in some capacity in their role, with the idea of their disseminating the information to the rest of their ward or block. Criteria for selection of all participants included working in a critical care setting, such as the HDU or ICU. This allowed for participants from a number of different blocks and departments (ex. ICU vs SICU). These participants were

considered important due to their work in critical care.

Data Collection & Instruments:

Prior to training, a self-administered written knowledge test was given to each participant on each day of the two-day training. There were two tests administered, one assessed knowledge of the training dedicated to VSDT, and the other assessed the day of training dedicated to CPBR, Blood Glucose Monitoring and "Introduction to Critical Care Concepts." Each test was created to mirror the subsequent training, following American Heart Association (AHA) standards. The CPBR test was comprised of ten multiple choice questions. The VSDT test consisted of seven fill-in-the-blank questions and three open-ended questions. See Appendix 2 for further information about the test instruments.

Upon completion of the test, we collected each test and entered the data into REDCap electronic data capture tools (Harris et al., 2009; Harris et al., 2019). A REDCap form was created to automatically anonymize participants in the study. Throughout the training, groups completed practice-based skill requirements together as a prerequisite in order to move on to the next module of training. The data was subsequently analyzed to examine outcomes and significance.

At the end of the two-day training and after the post-test, a questionnaire was distributed to participants for their feedback and evaluation of the training, seen as a proxy for the QI program at MNH. The questionnaire consisted of 26 scaled questions about their feelings toward the training, including the quality, delivery and relevance of each module, usefulness in practice for each module, length of time of each module and other logistics involved in the training (See Appendix 2). The training also consisted of 4 open-ended questions. Open-ended questions were

originally in English, but the author added Kiswahili to improve clarity and accuracy of response to question stem. All questions were created in conjunction with the QI team at MNH. Additions of Kiswahili were validated by the QI team at MNH.

Survey Design

The pre- and post-tests were revised between training Groups 2 and 3 using a formative process to boost clarity and ensure answers conformed to AHA standards. The original questions had been adapted from AHA CPR questions and formulated by in-country partners. After Group 2 had been trained, questions and answers were revised in terms of wording and unit standardization during implementation to improve clarity, including adding Kiswahili (the main language of participants) to open-ended questions and reformatting. All revisions were made in conjunction with the QI team at MNH. Additions of Kiswahili were added by the author and accuracy was validated by the QI team at MNH. In the CPBR test, there were ten total questions and only one had a notable change to the stem to improve clarity, but weighting was not changed. Question 8's stem was changed to more closely align with the original validated CPR test from the AHA. The original question was "Which method should be used to open the airway for a patient?" A qualifier of "patient with suspected head or neck injury/trauma" was added to the end to improve clarity. Analysis of difference between questions was completed for Questions 7 and 8 pre and post change (**Table 13**).

Analysis

Data was collected from handwritten pre- and post-tests completed by the participants and assessed by trainers for completeness. Data quality was assessed and all variables were

preliminarily examined using REDCap reporting stats and charts function, but for more in-depth analysis, R Studio (version 4.2.2) was used. Descriptive statistics were performed for all variables. Paired t-tests were performed to determine significance, setting alpha at 0.05.

Ethical Considerations

This research was determined to be IRB-exempt since all data was de-identified prior to analysis. Prior to traveling to MNH and collecting data, the study proposal was submitted to both the Emory Global Health Institute and Emory University's Institutional Review Board (IRB00002551) and determined exempt. IRB SOCIOB 03152021

RESULTS

Two-day trainings were conducted for four groups of critical care providers, comprised of nurses and physicians. A total of 80 providers participated over four groups of trainings and were chosen to participate due to their work in critical care.

Demographic data about the participants and descriptive statistics give a background about the training. A total of 80 providers (3.7% physicians, 96.3% nurses) completed the training. Sixty-two (77.5%) were female and eighteen (22.5%) were male. There is also a delineation between how many individuals completed a pre- and/or post-test for each training day based on the training group (**Table 1**).

There was a statistical change in score from pre- to post-test for each question in the CPBR and VSDT trainings (**Table 2**). It also demonstrates the average, standard deviation and change in percent correct for each question. The overall score changes amongst participants for CPBR and VSDT were significant ($p<0.001$). Six out of ten questions in CPBR demonstrated significant improved change ($p<0.001$). All questions in the VSDT training showed significant improvement ($p<0.001$). Graphical analysis allows for the ability to see a difference between the pre-test and post-test scores and the score changes for CPBR and VSDT (**Figure 1 and 2**).

Analysis was completed to demonstrate the number of respondents who achieved each score level from 0% to 100% in the pre- and post- CPBR test (**Table 3**). For CPBR, The Muhimbili University and Allied Sciences (MUHAS) has a minimum passing score of 50% and the American Heart Association (AHA) standard is a minimal passing score of 84% (MUHAS, 2018; American Heart Association, n.d.). Of those who completed the post-test, 63 (95.5%) passed the MUHAS standard and 25 (37.9%) met AHA standards. In CPBR training, the mean test score increased from 49% to 76% ($p<0.001$). It also demonstrated the quantity of participants

that achieved changes in percentage points from the pre- to post-test for CPBR. 31 (46.3%) respondents had a score increase of at least three points (30%) from pre- to post-test.

Analysis was completed to demonstrate the number of respondents who achieved each score level from 0% to 100% in the pre- and post- VSDT test and the amount of participants that achieved each change from pre- to post-test (**Table 4**). Using the same passing standards from above, of those who completed the post-test, 62 (95.2%) passed the MUHAS standard and 17 (25.4%) met AHA standards. In VSDT training, the mean test score increased from 49% to 70% ($p<0.001$). It also demonstrated the quantity of participants that achieved changes in percentage points from the pre- to post-test for VSDT. 16 (23.9%) respondents had a score increase of at least thirty percent from pre- to post-test.

During research, Groups 1 and 2 struggled with answering certain questions and so were changed to improve clarity of the language. Question 8's stem was changed to improve clarity (**Table 13**). These results demonstrate the change in correct pre- and post-test answers split by the original and revised Question 8 and, for reference, the change to Question 7. Groups 1 and 2 achieved only 61.8% correct on post-test Question 7 compared to 84.6% correct amongst Groups 3 and 4. For Question 8, Groups 1 and 2 achieved 74.1% correct compared to 84.6% for Groups 3 and 4.

Evaluation and Feedback Form Results

The study found that there were varying frequencies of trainings desired by respondents, with the majority seeking at least every six months' frequency (**Table 5**). There were changes to the program that trainees would like to see (**Figure 3**). The most given response was for more time to be given for trainings. Respondents indicated what types of future trainings they would

like. 10a demonstrates that most respondents want technical or skills-based trainings with most respondents would like training on ECG (**Figures 4a & 4b**). The trainees also reported changes they will make in their practice going forward (**Figures 5a & 5b**). The majority of respondents indicated a culture-based shift with the most frequent answer being about teaching others the concepts they learned. According to trainees, skills were the most useful aspect of the trainings to respondents with an overwhelming amount of respondents marking the CPR/CPBR was the most helpful (**Figures 6a & 6b**). Since trainees filled out evaluation forms, opinion-based responses informed trainee perspectives about the trainings (**Figure 7**). In training feedback, trainees perceived that CPBR and teamwork were the most valuable aspects of training. 20 (24.4%) respondents thought the training was too short. 15 (18.5%) trainees reported that they will teach their colleagues about the trainings. With regards to future trainings, trainees asked to see training additional medical concepts 11 (13.6%) and also additional training on leadership styles 2 (2.5%). It shows that 16 (64.0%) of respondents feel that they are very likely to change their practice after the training. 17 (65.4%) of respondents felt that the overall critical care training program was very good. Last, all participants who answered the question (26, 100%) felt that they were satisfied or very satisfied with what they learned from the program.

Table 1. Demographic and Descriptive Data of Training Participants, Descriptive Statistics

Metric	Count N (%)
Total number of participants	80
Sex	
Female	62 (77.5%)
Male	18 (22.5%)
Profession	
Doctor	3 (3.7 %)
Nurse	77 (96.3%)
Total Number of CPBR Participants	78
Group 1 CPBR	27
Group 2 CPBR	25
Group 3 CPBR	12
Group 4 CPBR	14
Total Number of VSDT Participants	72
Group 1 VSDT	24
Group 2 VSDT	21
Group 3 VSDT	13
Group 4 VSDT	14

Table 2. T-Tests of CPBR Score Change per Question

CPBR Metric	**Mean Difference (Standard Deviation)**	**Change in Percent Correct from Pre to Post**	**p-value**
Overall Pre-/Post-Test Score *	2.507 (1.544339)		**p<0.001**
Q1 (Action for Unresponsive Patient without Pulse)	0.030 (0.6264064)	+8.7%	0.6863
Q2 (CPR Components)	0.060 (0.8071599)	+0.8%	0.5311
Q3 (Rate for Chest Compressions) *	0.984 (0.9665205)	+55.5%	**p<0.001**
Q4 (Depth for Chest Compressions) *	0.455 (0.713991)	+38.6%	**p<0.001**
Q5 (Steps after each Chest Compressions) *	0.343 (0.8727922)	+18.3%	**p<0.01**
Q6 (When are Interruptions for Chest Compressions Allowed)	0.046 (0.7401745)	+4.3%	0.6346
Q7 **(**When to Switch Compressors)	0.179 (1.084114)	+43.2%	0.1704
Q8 (Method to Open Airway for Patient with Head/Neck Trauma) *	0.364 (0.8561224)	+24.1%	**p<0.001**
Q9 (What Heart Rhythm Indicates Shock is Needed) *	1.231 (1.407467)	+43.2%	**p<0.001**
Q10 (Whether to Continue CPR After Shocking Patient) *	0.239 (0.5336384)	+23.9%	**p<0.001**
Score Change Metric*,**	2.51 (1.53)		**p<0.001**
VSDT Metric*			
Overall Pre-/Post-Test Score*	21.209 (10.34103)		**p<0.001**
Q1 (Glascow Coma Scale) *	0.397 (0.8488747)	+32.0%	**p<0.001**
Q2 (Appropriate Airway Sounds)*	1.279 (1.646757)	+55.1%	**p<0.001**
Q3 (Breathing: Respiratory Rate) *	1.147 (1.040446)	+46.5%	**p<0.001**
Q4 (Breathing: Oxygen Saturation)*	1.088 (0.8933468)	+45.1%	**p<0.001**
Q5 (Breathing: Ventilator Support Level)*	1.074 (1.43845)	+17.4%	**p<0.001**
Q6 (Circulation: Heart Rate)*	0.588 (1.199941)	+19.1%	**p<0.001**
Q7 (Circulation: Systolic Blood Pressure)*	0.632 (1.391921)	+11.7%	**p<0.001**
Q8 (Steps to Managing Low Respiratory Rate)*	0.824 (1.220976)	+1.4%	**p<0.001**
Q9 (Steps to Opening and Maintaining Obstructed Airway)*	1.191 (1.406354)	+1.6%	**p<0.001**
Q10 (Steps to Managing Low Systolic Blood Pressure)*	1.324 (1.164669)	+56.8%	**p<0.001**
Score Change Metric*,**	21.58 (10.70)		**p<0.001**

*Significant, alpha set at 0.05

**One sample T-Test used; paired T-Test used for all other analyses

***Note: All VSDT questions had multiple subparts. This table shows how many individuals answered *all* parts correctly. Q1-Q4 had four subparts, Q5-Q8 had five subparts, Q9 had six subparts, Q10 had three subparts. Please see Appendix 2 for questions in detail.

Table 3.
Number of Respondents Who Achieved Each Score Level and Amount of Change for CPBR

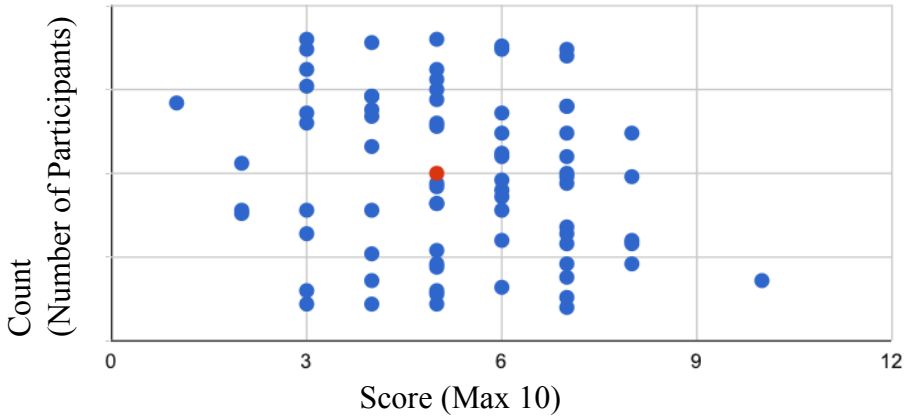
Score	Pre CPBR Score	Post CPBR Score	CPBR Change in Percentage Points Pre- to Post-Test
-10%			1
0-10%	1	0	15
11-20%	3	0	20
21-30%	10	1	14
31-40%	10	2	11
41-50%	17	0	3
51-60%	12	9	3
61-70%	16	10	0
71-80%	4	19	0
81-90%	0	23	0
91-100%	1	2	0
Mean	52.8%	77.9%	
Median	50%	80%	

Table 4.
Number of Respondents Who Achieved Each Score Level and Amount of Change for VSDT

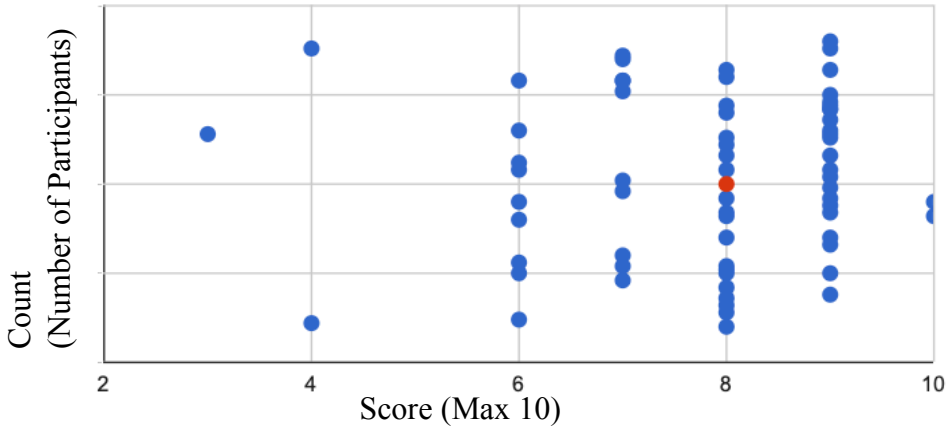
Score	Pre VSDT Score	Post VSDT Score	VSDT Change in Percentage Points Pre- to Post-Test
0-10%	0	0	10
11-20%	0	0	24
21-30%	2	0	17
31-40%	14	0	16
41-50%	18	5	0
51-60%	26	11	0
61-70%	8	14	0
71-80%	0	20	0
81-90%	1	14	0
91-100%	0	3	0
Mean	49.75%	70.69	
Median	51.11%	73.33%	

Figure 1: CPBR Pre and Post Test Data.

Pre-Test Scores



Post-Test Scores



CPBR Score Change from Pre- to Post-Test

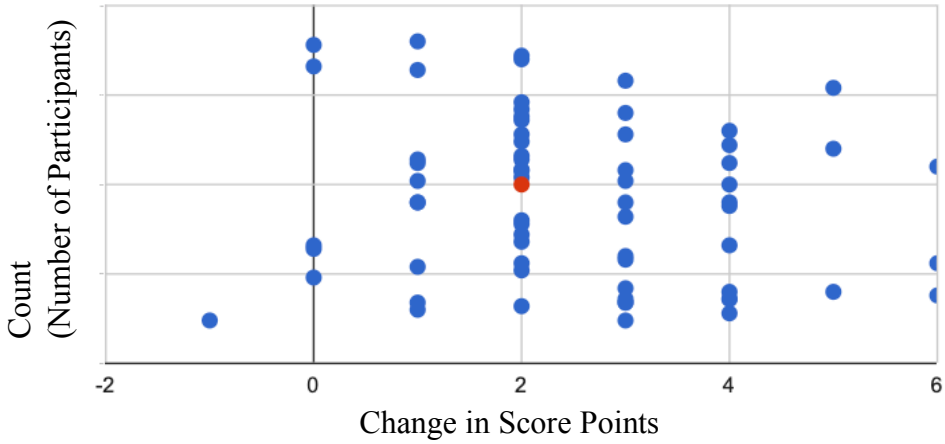
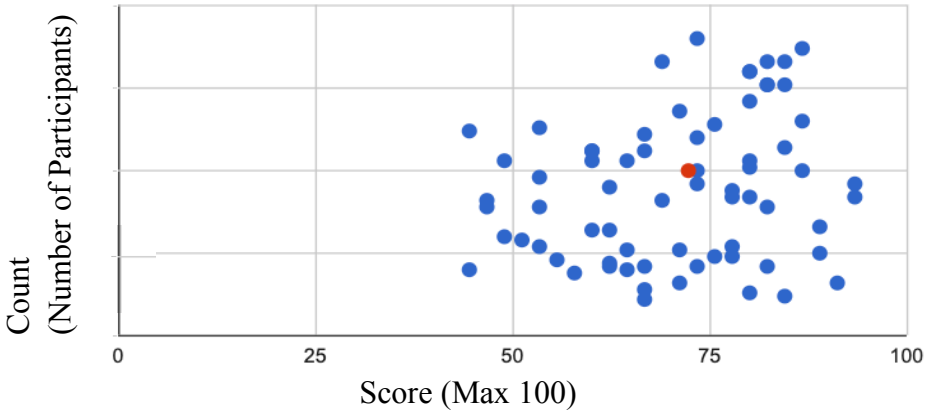
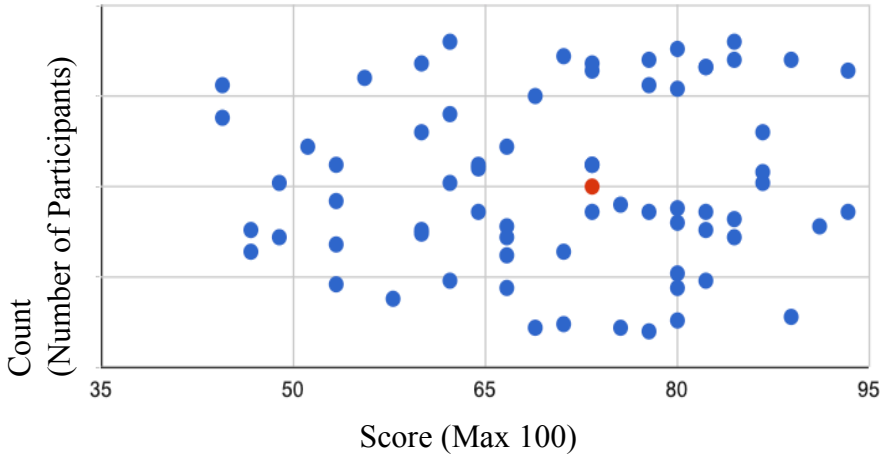


Figure 2: VSDT Pre and Post Test Data.

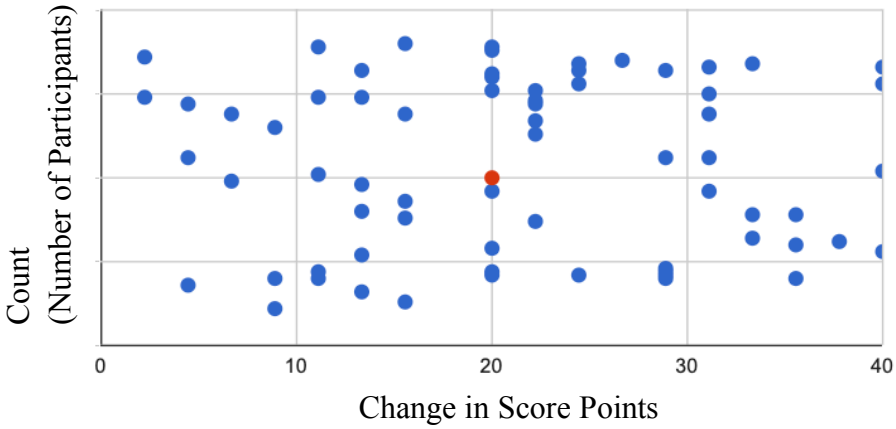
Pre-Test Scores



Post-Test Scores



VSDT Score Change from Pre- to Post-Test



Training Evaluation and Feedback Qualitative Data

Note: Skills are considered anything tangible, Culture is considered anything non-tangible

Table 5. Frequency of Future Trainings Desired by Respondents

Frequency	Amount of Respondents N (%)
More Frequently Than 3 Months	6 (24%)
Every 3 Months	12 (48%)
Every 6 Months	7 (28%)

Figure 3. Changes to the Program that Trainees Would Like to See

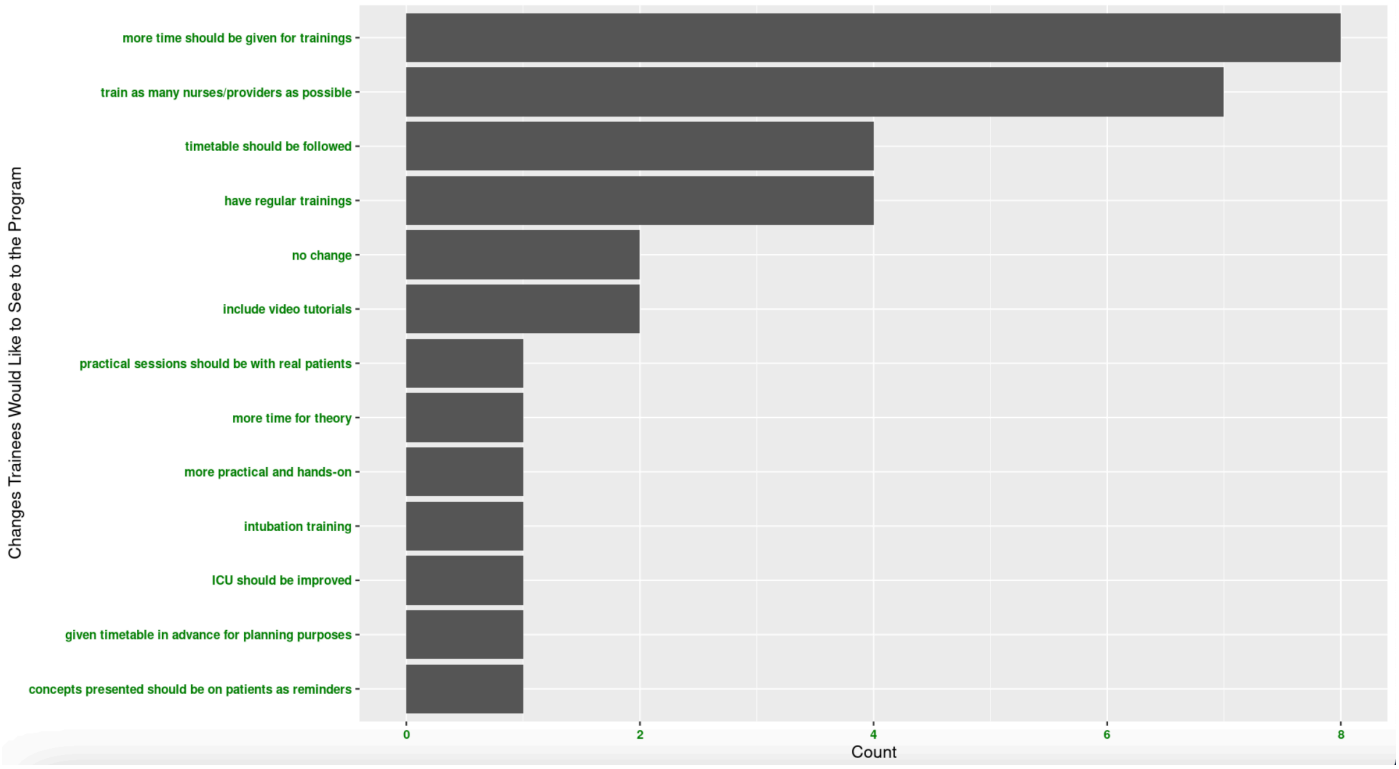
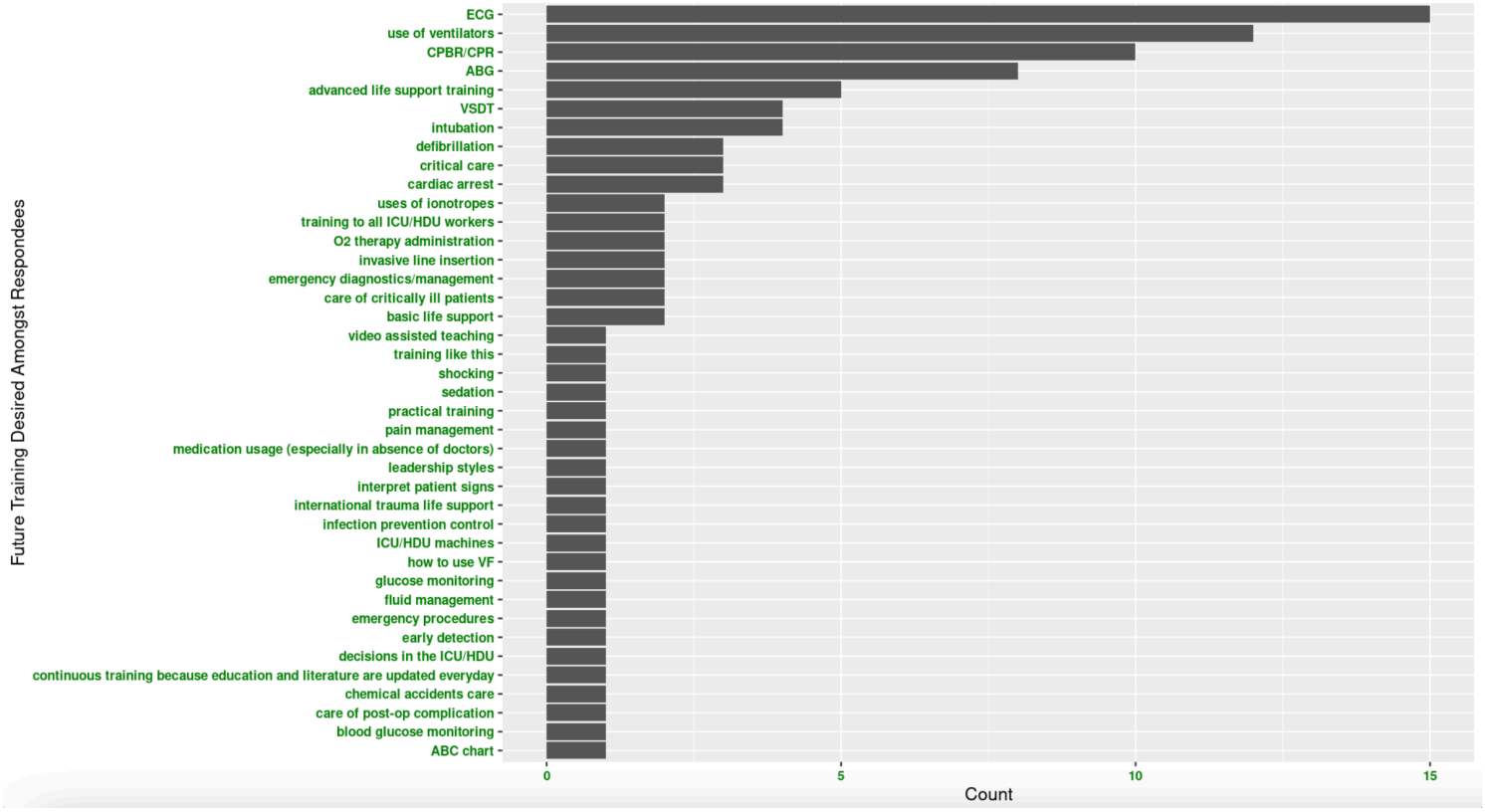
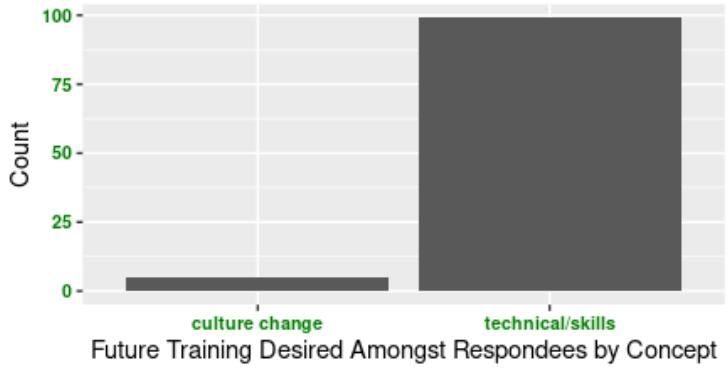


Figure 4a & 4b.

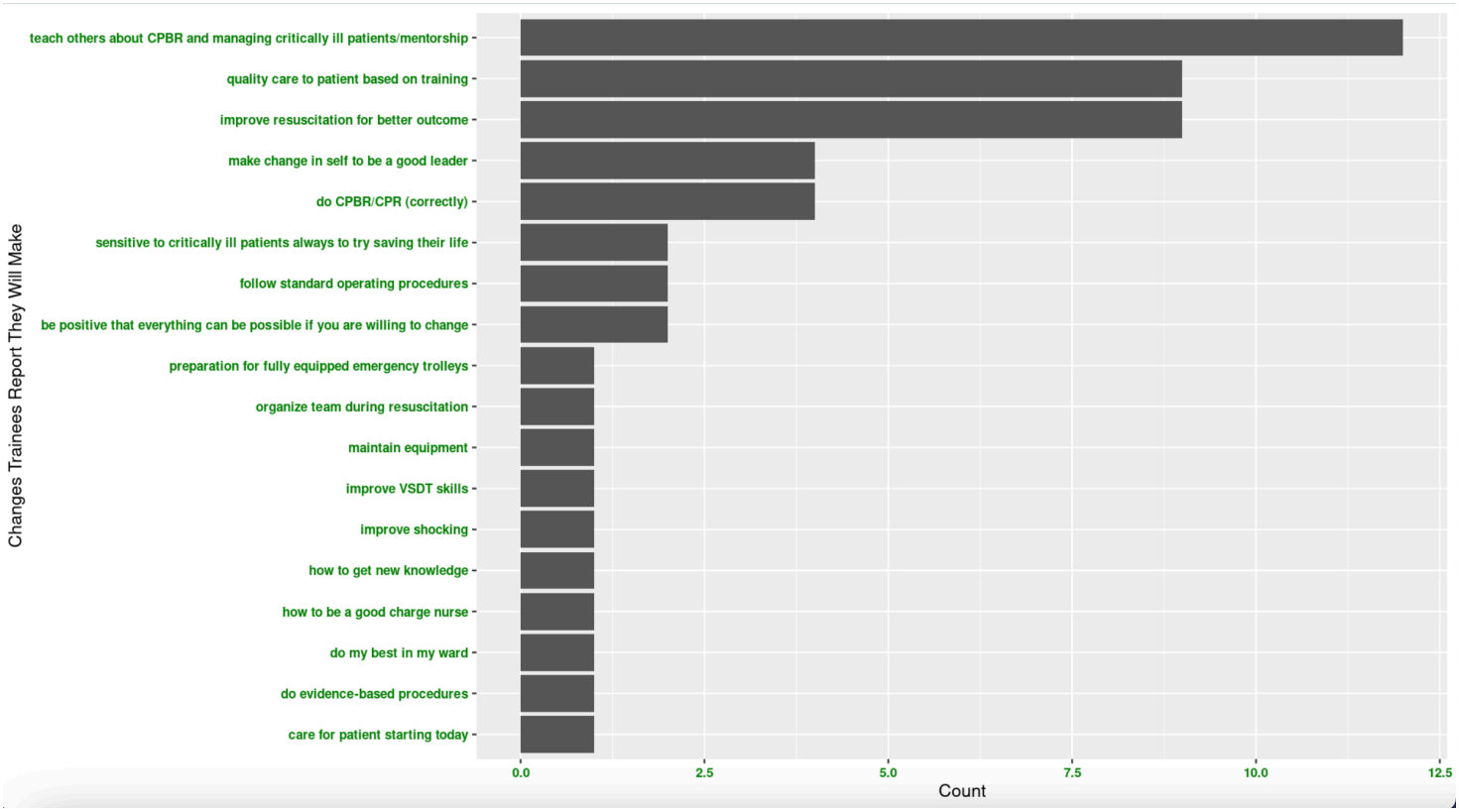


4a. Future Trainings Desired Amongst Respondents

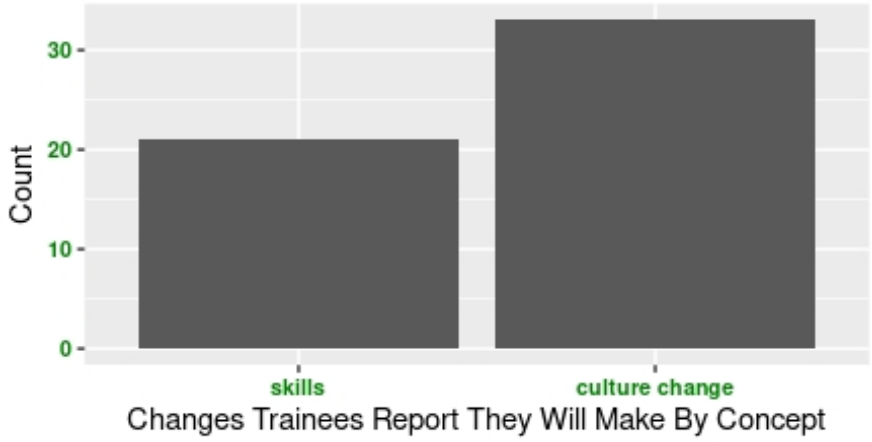


4b. Future Trainings Desired Amongst Respondents by Concept

Figure 5a & 5b.

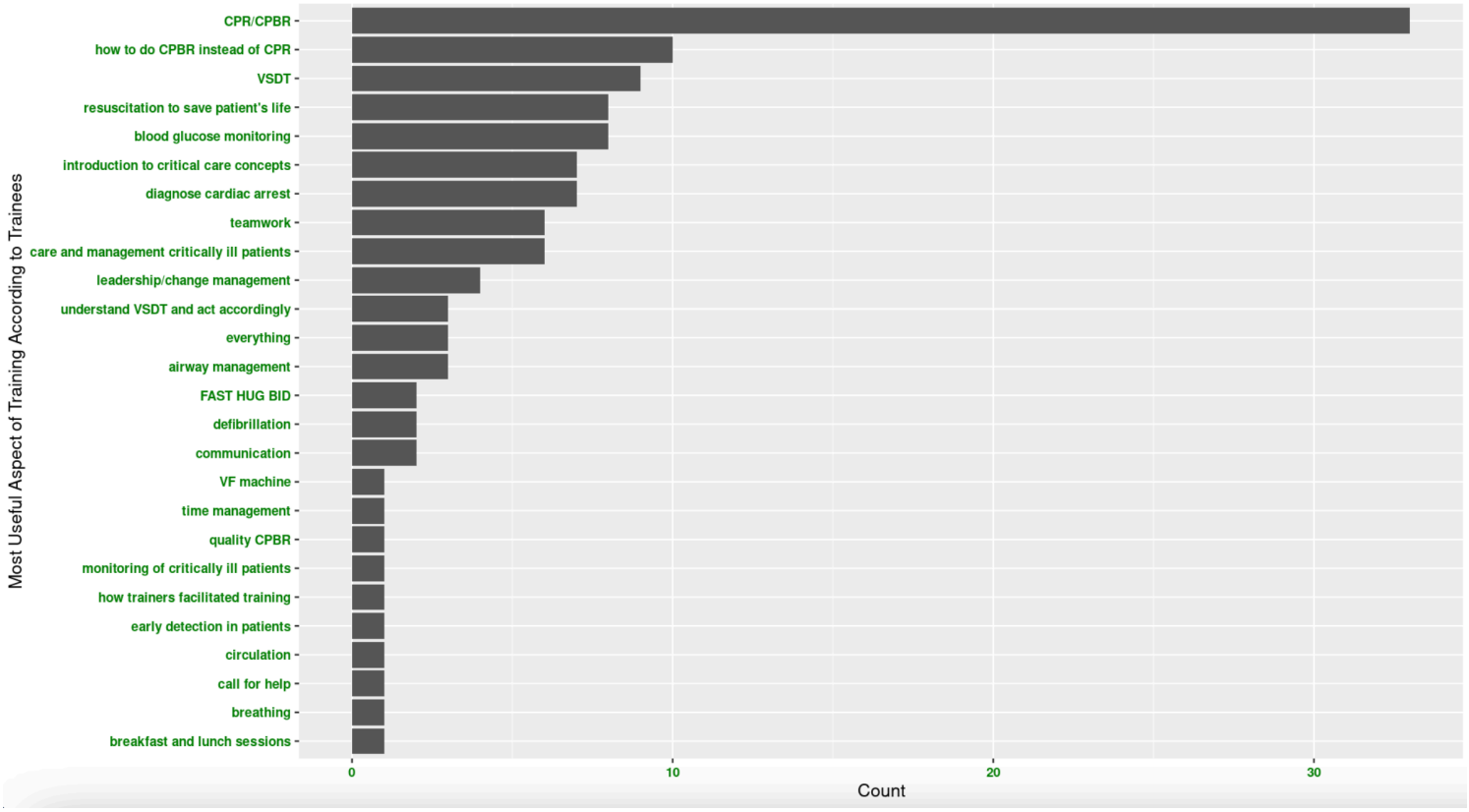


5a. Changes Trainees Report They Will Make

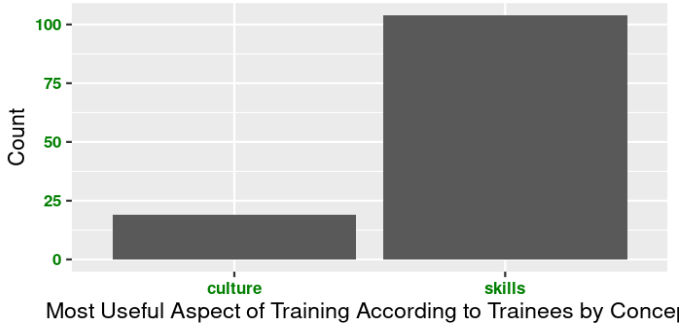


5b. Changes Trainees Report They Will Make by Concept

Figure 6a & 6b.

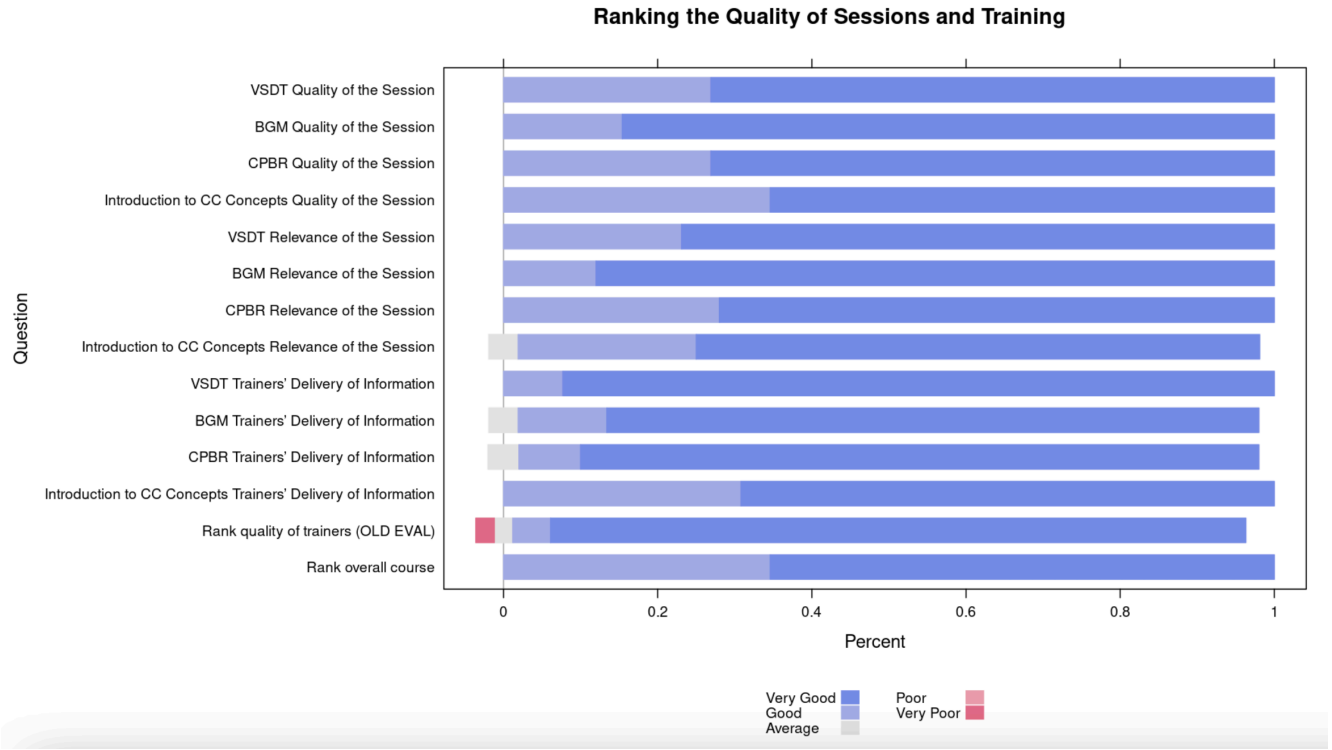


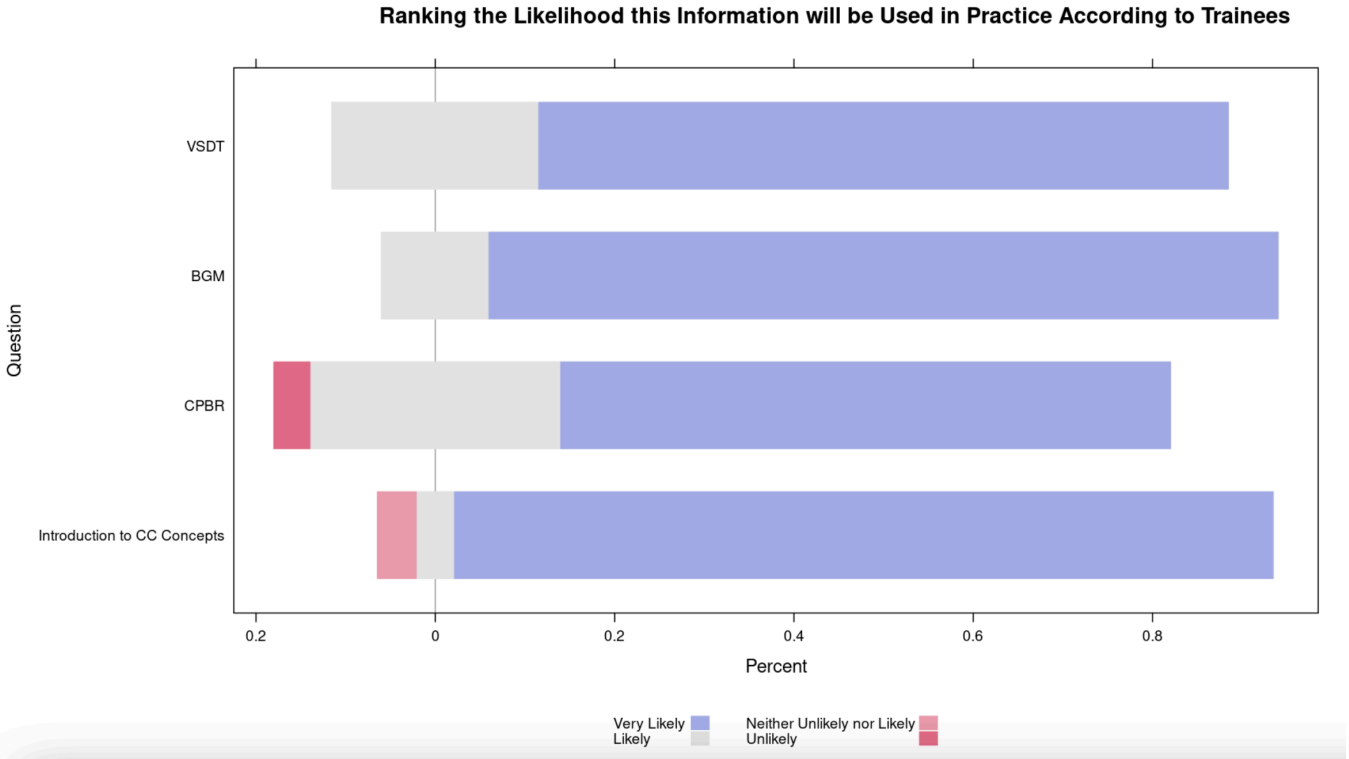
6a. Most Useful Aspect of Training According to Trainees

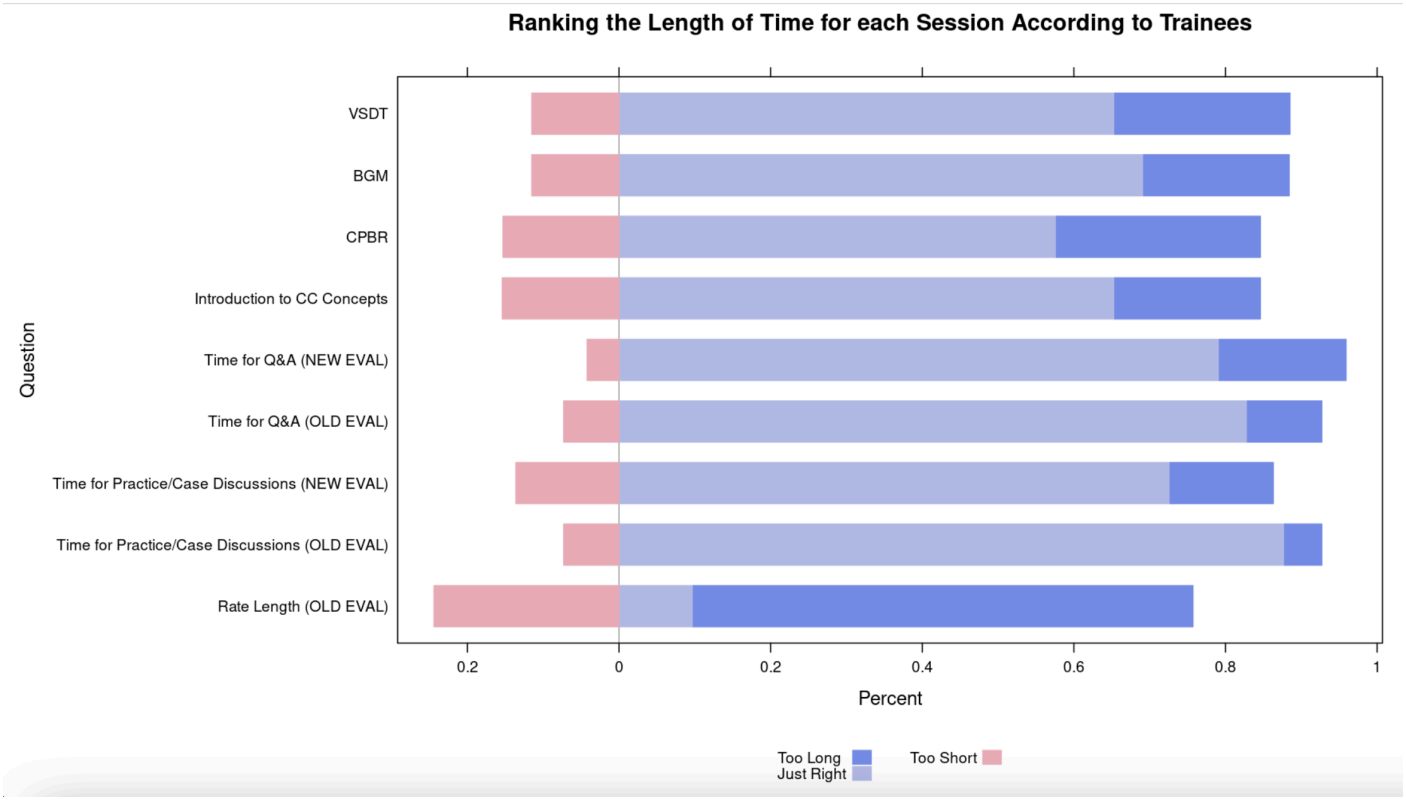


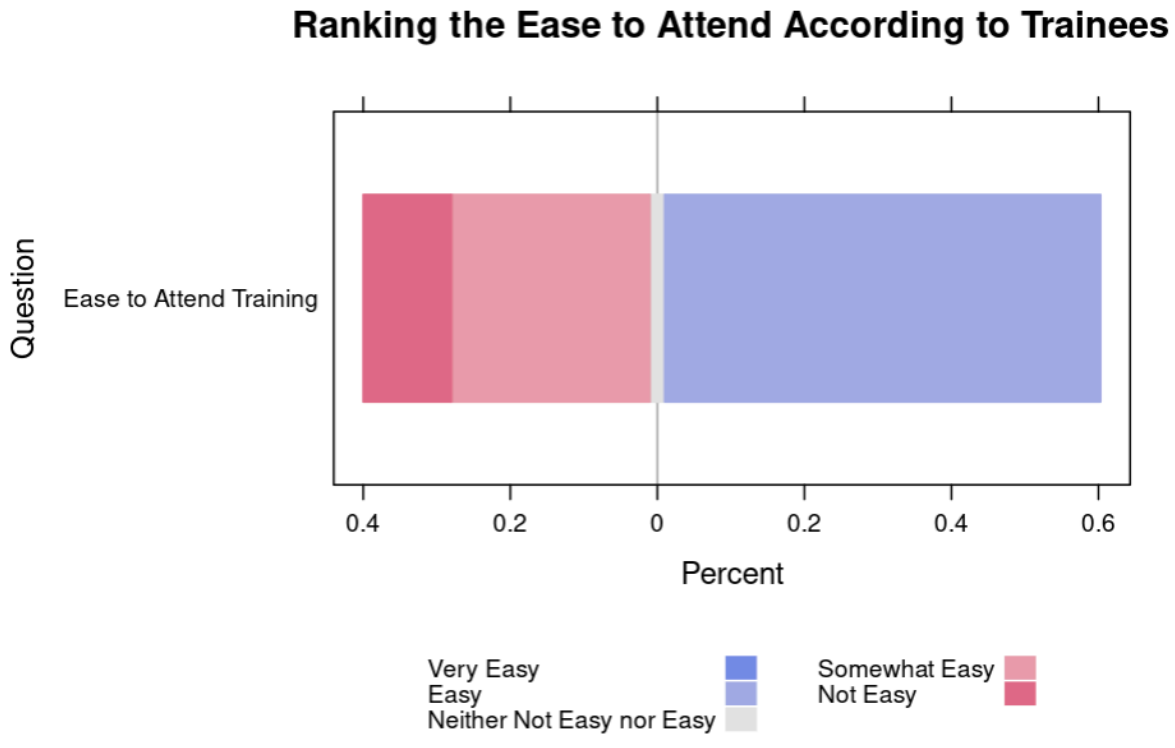
6b. Most Useful Aspect of Training According to Trainees

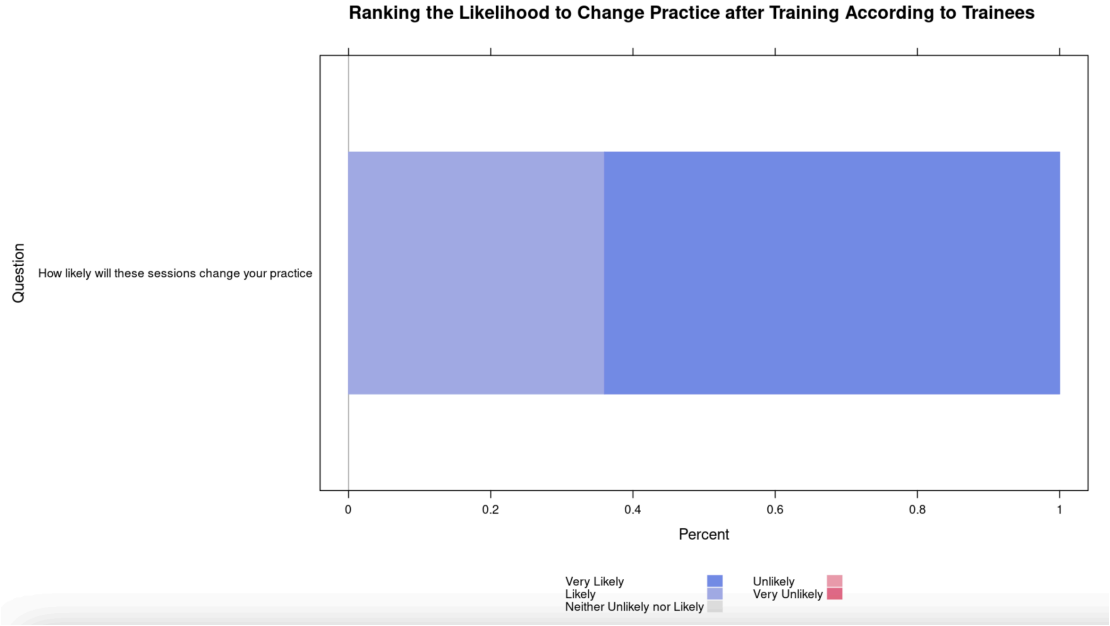
Figure 7. Training Evaluation and Feedback Quantitative Data

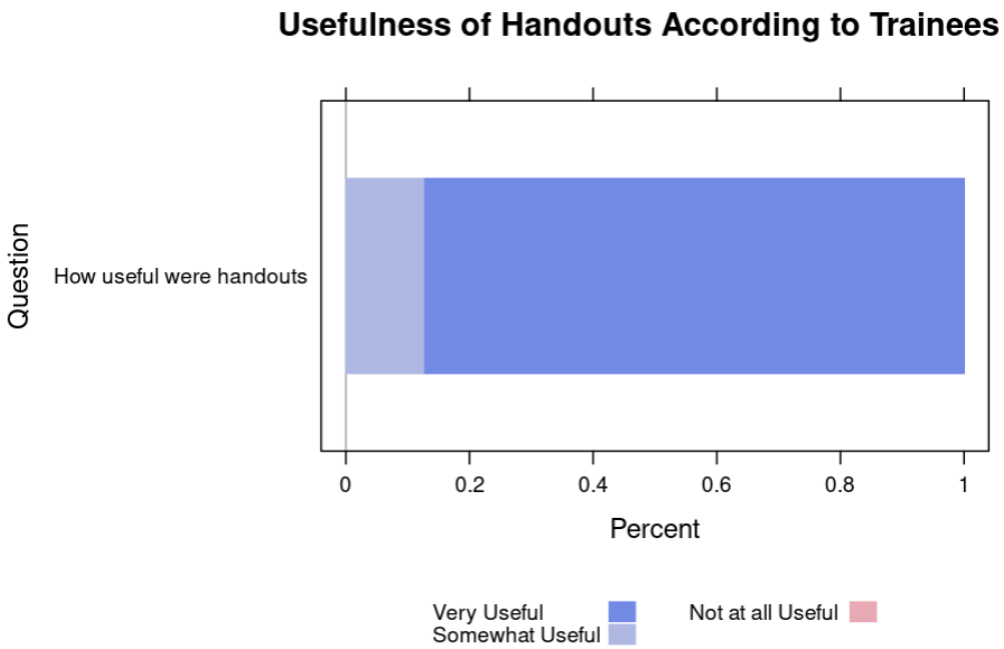


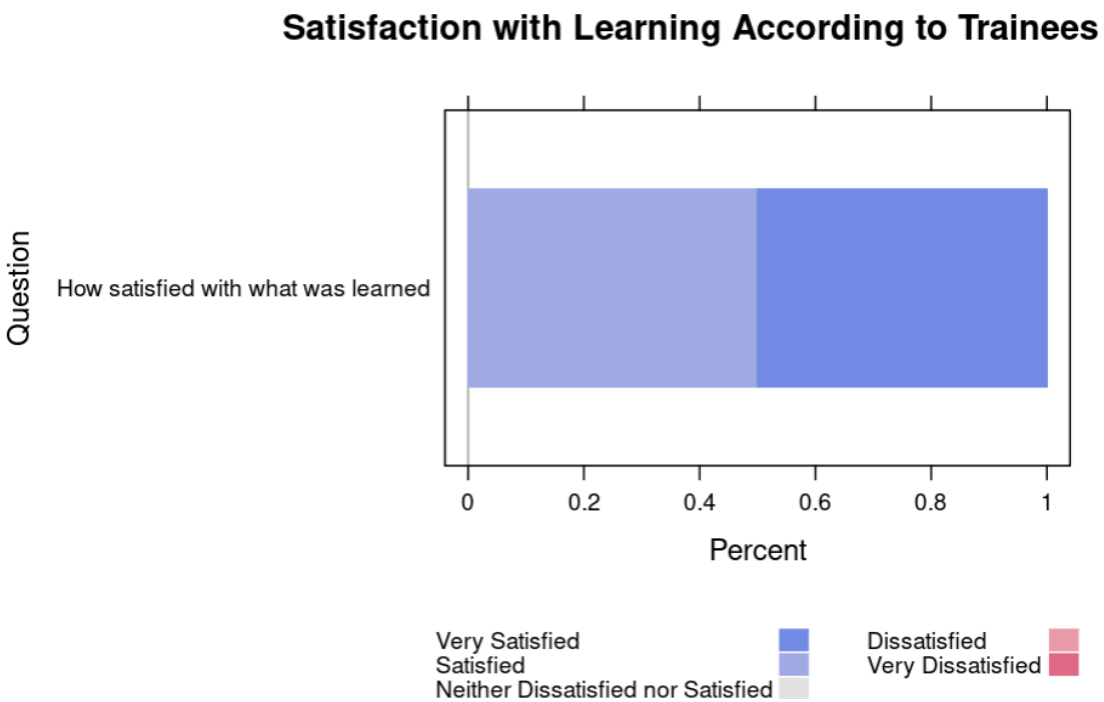



Ranking the Length of Time for each Session According to Trainees
Question
VSDT
BGM
CPBR
Introduction to CC Concepts
Time for Q&A (NEW EVAL)
Time for Q&A (OLD EVAL)
Time for Practice/Case Discussions (NEW EVAL)
Time for Practice/Case Discussions (OLD EVAL)
Rate Length (OLD EVAL)
0.2
0
0.2
0.4
0.6
0.8
1
Percent
Too Long
Just Right
Too Short


Ranking the Ease to Attend According to Trainees
Question
Ease to Attend Training
0.4
0.2
0
0.2
0.4
0.6
Percent
Very Easy
Easy
Neither Not Easy nor Easy
Somewhat Easy
Not Easy


Ranking the Likelihood to Change Practice after Training According to Trainees
Question
How likely will these sessions change your practice
0
0.2
0.4
0.6
0.8
1
Percent
Very Likely
Likely
Neither Unlikely nor Likely
Unlikely
Very Unlikely


Usefulness of Handouts According to Trainees
Question
How useful were handouts
0
0.2
0.4
0.6
0.8
1
Percent
Very Useful
Somewhat Useful
Not at all Useful


Satisfaction with Learning According to Trainees
Question
How satisfied with what was learned
0
0.2
0.4
0.6
0.8
1
Percent
Very Satisfied
Satisfied
Neither Dissatisfied nor Satisfied
Dissatisfied
Very Dissatisfied

DISCUSSION

Technical Competence

The pre- and post-test results highlight the increase in technical competence and skills. 31 participants (46.3%) in CPBR and 16 participants (23.9%) in VSDT had an increase in 3 points or 30%, respectively. This demonstrates an increase in the understanding of the skills tested. In CPBR training, participants demonstrated a significant increase in skills and knowledge across six of the questions. These topics included questions about chest compressions, opening airways after head/neck trauma, when to continue CPR and what heart rhythm indicates a shock is needed. The topics that did not show a significant change in score may need to be revisited for evaluating provider knowledge. The results from VSDT training are important to highlight. Every single question had a significant increase in score change across participants.

Most importantly, 95.5% of participants and 95.2% of participants met MUHAS standards for CPBR and VSDT, respectively. 25 (37.9%) and 17 (25.4%) met AHA standards for CPBR and VSDT. Previous studies have demonstrated that there has been a limited correct knowledge in CPBR skills. Thus, this training has increased the amount of correct knowledge for basic life support. Additionally, this training specifically focused on the brain resuscitation component of CPR. This was a new component introduced in critical care training and highlighted the need to consider the brain during resuscitation.

Other studies have reported that competence of medical personnel affects quality of care (Boaden et al., 2008). A study conducted at a hospital in Iran found success of its adapted quality management/improvement concepts due to its emphasis of weaving QI into every level of management. Mosadeghrad argues that a large part of this success was due to the creation of a culture of learning and facilitation across every level of a quality project following effective

provider training (Mosadeghrad, 2012). In another example from a LMIC, a tertiary referral hospital in Malawi recently established a High Dependency Unit (HDU), which served an indispensable role at the onset of the COVID-19 pandemic to provide quality (Morton et al., 2020). The program focused on a participatory approach to standardize care and improve quality with the aim for sustainable results.

Therefore, this could have important implications for future QI initiatives in critical care settings at the National Hospital and more generally to other LMICs. The critical care training program focused on utilizing local trainers and instructing on change management concepts. In conjunction with this, future trainings should build on concepts learned to reinforce competencies and hone in on more advanced and specific trainings.

Culture Change

Another interesting outcome of the training was found through the evaluation and feedback forms. The participants highlighted that while they found the most useful aspect of the trainings to be skills, specifically CPR/CPBR and that they desire more technical trainings, the participants reported that they will make cultural changes. Amongst the cultural change that participants noted they would like to make, teaching others and providing quality care were the most popular answers. All participants noted that they were likely or very likely to change their practice after the training. This demonstrates the desire amongst participants to propagate knowledge and improve the standard of care that they deliver. Such outcomes promote the ideas of quality improvement and how to direct change across a wider subset of providers in healthcare.

Change management can direct the culture of an organization, which fits in well with QI concepts of reorganizing processes and individuals' responsibilities (Hudelson et al., 2008, 31). It has been documented that the long-term success of a program is primarily contingent on the investment of members of the team and the resources that exist to further their training (Kacholi & Mahomed, 2020). Moreover, the individuals must trust their trainers and the change agents to optimally achieve change (Mosadeghrad, 2012). Indeed, by training providers and including them in the process, ownership can be felt and further spur innovative engagement in the activities and investment in the outcome of QI (Lifvergren, 2013; Weiner et al., 1997).

A Ghanaian cross-sectional study across two hospitals revealed that while the priorities were to garner communication, skills, a cohesive team and to be able to work through change, the biggest barrier was inadequate training that inhibited empowerment (Kumah et al., 2016). In Iran, change management was employed during training to encourage quality techniques amidst a culture of learning. This training found increased cooperation and teamwork and more involvement from employees to facilitate quality delivery of care (Mosadeghrad, 2012). In Tanzania, the MoHSW has promoted the concept of Training of Trainers and the importance of developing every individual provider and their sense of responsibility toward the culture of care (MoHSW, 2011).

This research demonstrates need for an emphasis on the role that culture plays in gaining technical competence that leads to program success. Future initiatives should focus on engaging multiple levels of workers and imbuing them with the tools to have a level of autonomy over their work. In doing so, they will feel empowered to attend to their duties and may go above and beyond in their care for patients, thereby improving the quality of care delivered.

Need for Continual Trainings/Future Direction

Quality improvement by its definition is an ongoing process (Batalden & Davidoff, 2007; Batalden & Stoltz, 1993). As such, this aspect of QI is significant and must be recognized. Most trainees noted that they would like trainings at least every six months. Such input from participants is informative as to the desire for more skills and improving the quality of care that they deliver.

While smaller trainings do exist at the National Hospital that involve rehearsal of skills, there is a need for an institutionalized continual training framework (T. Said, personal communication, July 3, 2022). By designing and executing a recurring training program, this will keep skills sharp and continue to allow for provides to feel ownership over the care they deliver. Moreover, it may allow for others to learn proper skills and gain knowledge. The National Hospital could create a calendar of more formalized trainings, allowing for providers to be able to look forward to reviewing their skills and gain more information. This could also increase trust and allow to plan ahead to allocate resources appropriately for the future trainings.

Extrapolations to Broader Tanzania QI

Quality has been identified as a major aspect in the creation of initiatives in Tanzania, codified in the its Vision 2025 to create programs that promote care and improve quality of life (MoHSW, 2011). Nonetheless, a previous study by Kaihula et al. in 2018 demonstrated that while quality standards exist at the National Hospital, there is a wide deficit in CPR/CPBR skills (Kaihula et al., 2018). This study highlighted that even though people were conducting CPR routinely, it was not being done well and highlighted a need for quality improvement. During that study, only 25% and 50% passed MUHAS standards and only 4% and 9% of providers

passed AHA standards for CPR (Kaihula et al., 2018). This current study saw a more established QI and a focus on critical care providers. As this study demonstrated higher passing rates, one possible reason could be the focus on QI and on training those providers who are leaders in the ICU. Other studies have measured quality and have found similar lacking results in adequate knowledge of critical care concepts (Roshana et al., 2012; Silande, 2010).

On another note, an observational study conducted at MNH focused on ICU nurses and the association between knowledge and practice of nurses. The study found that practice was associated with education level but not ICU training (Said, 2012). The study recommended that there is a need for knowledge amongst the nurses not only to prevent Ventilator Associated Pneumonia, but also, so that the nurses can gain *confidence* in their actions (Said, 2012).

Thus, the most recent critical care training program by the EMPHASIS team has shown how a program rooted in QI principles has affected the providers with the potential impact of changing the culture of care. Evaluation of Quality Improvement initiatives is necessary, as it is powerful in being able to direct changes and create a sustainable framework for continuous improvement. Studies have demonstrated the importance of QI and how it can shape health-based interventions, but there is a paucity in understanding skills interventions that incorporate change management theories (Boaden et al., 2008). Adequate care directly shapes the outcome of the patient. Training and ensuring there is a widespread standard of care that has the potential improve health outcomes as well as create a more rapid response in providers due to increased competence.

Conclusion

In conclusion, knowledge of the correct practice and how to use it could improve survival rates and limit the spread of disease. This pre/post study demonstrates how it is imperative to train ICU providers to improve their competence, contribute to a positive culture change and create a sustainable foundation for continual trainings. While respondents found many of the trainings to be too short, they found the trainings to be of very good quality and very likely used in their practice. Improving knowledge and comfortability can create downstream effects. There was a significant increase in the technical competence of providers and increase in the desire to change their practice to reflect the skills they have learned and better the quality of care they deliver. When providers are more knowledgeable, they are better able to provide quality care (Nangawe, 2012; Lifvergren, 2013). This research has demonstrated the importance of training. Studies have demonstrated that when providers have knowledge of skills and are able to apply them, this limits the spread of infectious diseases and improves outcomes (Dünser et al., 2012; Walker et al., 2009; Apisarnthanarak et al., 2007). In order to better facilitate quality in a critical care setting, it will be important to draw from these findings to shape future programs, noting the key role that providers play in the uptake of any program and understanding the insight they provide from their integral position in patient-facing care. Quality Improvement research is a powerful force that can help direct future initiatives and mechanisms to improve quality and develop a robust care program.

CHAPTER 4: Manuscript II Qualitative

Evaluating Perspectives Amongst Providers on a Quality Improvement Initiative at the National Hospital in Tanzania

Contribution of Student

For this manuscript, the student conducted primary research in-country: for quantitative data, the student gathered data from training and for qualitative data, the student conducted all interviews. For analysis, the student cleaned, coded and conducted all statistical analysis with mentorship from thesis chair Alex Edwards. The student created all figures and tables and received editorial assistance from Alex Edwards, Saria Hassan and Brittany Murray.

Journal Requirements

Journal of Global Health: "A common submission in this category has up to 4000 words (excluding the abstract and references), 10 tables/figures and 50 references (except for systematic reviews). The abstract should not exceed 350 words and should be structured in four paragraphs: Background, Methods, Findings, and Conclusions." ("Information For Contributors," n.d.)

ABSTRACT

Background: Historically, the United Republic of Tanzania has had a 41.4% mortality rate in the Intensive Care Unit (ICU) setting, and a 2018 study reported that in LMICs, poor-quality care resulted in 5 million excess deaths. It was found that the mean average of knowledge in

critical care settings was 38.6% in hospitals in Tanzania. In Tanzania, the Ministry of Health and Social Welfare (MoHSW) have taken steps toward Quality Improvement (QI), yet the health sector continues to face resource constraints, unsustainable QI projects, and gaps in knowledge. These conditions have contributed to unacceptably high mortality rates. This research aims to elucidate a better understanding of the barriers and facilitators to implementing quality improvement projects in Tanzania to transform quality care in a low resource setting.

Methods: Through the Emory-Muhimbili Partnership for Health Administration Strengthening and Integration of Services (EMPHASIS) and with support from Abbott Fund Tanzania, a two-day critical care training program was developed for providers. It included modules on Vital Signs Directed Therapy (VSDT), Cardiopulmonary and Brain Resuscitation (CPBR) knowledge and critical care concepts. Qualitative semi-structured interviews were used to understand the experience of those involved in the training program. Utilizing inductive conventional content and rapid qualitative analysis, interview themes were extracted. A total of seven providers were interviewed.

Results: All providers recognized a positive impact of QI at their institution, noting that QI is both institution-wide as well as engenders a culture shift. A supportive team dynamic with identified advocates to champion QI practices has been a key factor. Moreover, the interviewees consistently identified barriers to providing quality care and to integrating QI at the National Hospital. Respondents perceived that change management has had an effect on their practice and the hospital culture.

Conclusion: Themes from interviews showed respondents appreciated the training and found change management concepts useful. This study suggests a Critical Care Training Program significantly improves the knowledge amongst ICU/HDU providers and that QI programs impact

the culture of change. This research exemplifies a systematic approach to strengthening capacity of critical care delivery in limited resource settings, with implications for further innovation in other LMICs.

INTRODUCTION

Despite the necessity of adequate and standardized skills when caring for critically ill patients, the United Republic of Tanzania has had a high 41.4% mortality rate in the Intensive Care Unit setting (Sawe et al., 2014). Additionally, there were 5 million preventable deaths due to poor quality care in 2018 in Low and Middle Income Countries (LMICs) (Kruk et al., 2018). In conjunction, it can be difficult to achieve high quality of care in healthcare institutions due a lack of well-trained, limited availability of resources and missing assessments to measure changes made to healthcare delivery processes (Renggli et al., 2019). For instance, in Tanzania, when testing critical care skills for nurses, the mean score was 38.6% out of 100% (Bankanie et al., 2021). Thus, research must be done to understand how to best improve quality of care and what factors help to promote a higher level delivered across the institution.

Quality improvement has existed for decades, but its involvement in the healthcare sector is newer, increasing since the 20th century (Kruk et al., 2018; Boaden et al., 2008). Quality should be intimately linked to successful delivery of care, yet there are questions as to how to best integrate quality into a healthcare institution and what mechanisms should be in place to engender improved approaches towards treating patients. Quality improvement (QI) is one such mechanism that allows for multiple aspects of providing care to be affected, including the setting, culture, competence and provider dynamic. Although QI is relatively new in Tanzania (only existing since 2007), it has been linked to healthcare since the mid 1900s (Ishijima et al., 2014; MoHSW, 2011).

While Tanzanian government has shown commitment to improving the healthcare sector, it has been handicapped by limited resources, providers lacking adequate knowledge and unsustainable initiatives (Nangawe, 2012). The National Hospital in Dar es Salaam has exhibited

such resource constraints and unsustainability, as the number of ICU beds has been much lower than the international standard and admissions to the ICU has been deemed inefficient (Engdahl Mtango et al., 2019). As a result, Tanzania has had extremely high mortality rates amongst those with critical illness (Sawe et al., 2014).

There is a growing need for care, leaving many LMICs struggling to allocate resources. An optimized healthcare delivery mechanism would be one that is able to deliver quality care within the constraints of available resources (Lifvergren, 2013). Effective systems are able to maximize the amount of quality that the system can deliver despite using less resources to do so. This would allow for more resources to be distributed and used for a wider number of patients. Yet, since many LMICs have not been able to achieve this, providers in these settings may receive training from other countries or providers may leave to perform care elsewhere. For instance, an international group may send trainers to train local providers to that country's standards in one region, while another entity trains providers in another region to their own standard. This could lead to gaps in care and differing standards, creating variable levels of knowledge and differing perspectives to delivering care. Such is the case in Tanzania; standardization is lacking across providers and within institutions. In considering the aforementioned need for more care with a growing number of people, there are questions as to how to best shift the culture of delivering care to improve patient outcomes. One method is the audit approach, while other entities have employed quality improvement (Øvretveit, 1994). Notwithstanding, most published literature has focused on the global north, resulting in a paucity of published research in lower-resource settings. Therefore, a more in-depth understanding of the perceptions, facilitators and barriers of quality programs can help to direct change and improve care.

At the National Hospital, a previous study has determined that the level of CPR knowledge displayed was poor across the entire institution (Kaihula et al., 2018). Yet, since nurses spend the most time in critical care units, they can be considered indispensable to the success of the unit and patient outcomes (Maphumulo & Bhengu, 2019). A review published noted that LMICs have significantly fewer ICU beds per patient compared to HICs (Tumukunde et al., 2019). Therefore, nurses should be trained to the standard of care and be prepared to be respond to emergencies.

This research aims to shed light on how to transform quality of care delivered in a low resource setting, especially considering the gap in published research amongst LMICs. The goal is to understand barriers and facilitators to implementing quality improvement projects in Tanzania.

METHODS

This research was built collaboratively through the Emory-Muhimbili Partnership for Health Administration Strengthening and Integration of Service (EMPHASIS). This study and QI initiative were completed as a part of the larger EMPHASIS project, a five-year research partnership between Emory University and Muhimbili and supported by the Abbott Fund Tanzania (Church, 2020). EMPHASIS is a capacity building effort to give ownership to Muhimbili partners by ensuring that all studies at MNH have an in-country co-researcher (Church, 2020). EMPHASIS focuses on nurses, recognizing the importance of their role as providers and creates an equitable collaboration towards increased quality (Church, 2020).

Study Design

This qualitative study at a large tertiary and national hospital in Dar es Salaam, Tanzania between June and July in 2022, semi-structured interviews were conducted amongst providers delivering care for critically ill patients in the ICU and HDU.

Study Setting

MNH is located in Dar es Salaam, near the coastal port of the nation's capital. It is one of the largest referral hospitals and situated on the same campus Muhimbili University of Health and Allied Sciences (MUHAS), which has frequent overlap with the main hospital, as MNH is a teaching hospital. The hospital is comprised of multiple wards, coordinated into "blocks" including the Mwaisela Block, where the majority of providers who participated in the study worked. Mwaisela has four floors with an ICU and surgical ICU (SICU) located on the ground floor and HDUs on each ward, including the ICU and SICU. Across the entire hospital there are

74 beds designated for ICU use, comprising 4.93% of total beds. In Mwaisela, there were 10 beds both the ICU and SICU at the time of the study. The HDU was comprised of 6 beds in each ward and is housed in a separate room. Patients are admitted to the ICU from the medical units. Within the ICU, patients are monitored using critical care technology, including mechanical ventilators, central lines and IVs, catheters, pulse oximeters, antibiotics, oxygen respirators.

Training Program:

A two-day training program was developed by the Muhimbili team for critical care nurses and providers. The two-day critical care training program included the following modules: Vital Signs Directed Therapy (VSDT), cardiopulmonary and brain resuscitation (CPBR) knowledge, Blood Glucose Monitoring and "Introduction to Critical Care Concepts." Each day of training began with a pre-test for that day's module topics. CPBR had a practical session to practice skills learned with group scenarios. Each day had a post-test to evaluate knowledge gained. At the close of the training, participants were given an optional training evaluation to provide feedback.

Participants:

In-depth interviews were conducted with nurses at MNH using purposive sampling. Participants voluntarily participated. The criteria for participation included having worked in critical care and either been a trainer in QI project or been a trainee. The rationale for choosing this population was their recent and intimate experience with a quality improvement project and ability to speak to their experience as possibly informing future patient outcomes. The snowballing method was employed to engender more participation from other providers. Nurses

from various wards were invited and trainers were specifically asked to participate to share their knowledge.

Data Collection & Instruments:

The In-depth interview (IDI) guide was created based on QI principles and considered research-specific context. Concepts included facilitators and barriers to care and perspectives on quality improvement, change management and the training the conducted or received. Topics were piloted amongst the Emory research team, and the IDI guide was created. It was subsequently adapted for the trainings while in-country by the author by reviewing the questions with providers that were leading the trainings. The interview was conducted in English, as the majority of the trainers/trainees spoke conversational English, it is considered one of the languages of the hospital, is taught in nursing and medical school in Tanzania and was the common language with the researchers.

The author conducting the interviews was a student at Emory University Rollins School of Public Health. She has had experience conducting interviews in settings where the primary language is not English and has taken Master-level courses in qualitative methods, including creating and piloting an IDI. The researcher was aware of the tenets of 'medical tourism' and the importance of utilizing cultural humility in foreign settings. As such, the researcher endeavored to create rapport with those interviewed, learning Kiswahili phrases and words as well as participating in the ICU and listening during turn-over and ward rounds. Interviewees decided their location for the interview to promote openness and confidence. Three interviews were conducted in ICUs and four interviews were conducted in offices or break rooms. It was communicated that these interviews would be done to ensure privacy for the

respondents. Interviews lasted between 15 minutes to one hour. Informed consent was performed and interviews were recorded to facilitate a conversation without having to take notes. Field notes were written by the researcher afterward to assist with later recall.

Natural language processing was conducted on all seven interviews in R Studio Statistical Program 4.2.2. Using data dictionaries dplyr, tidyverse, janeaustenr and magrittr, sentiment and frequency analysis were run. Stop words were removed and the janeaustenr data dictionary was altered to change the definition of the following words: arrest and patient. Language specific sentiment analysis was performed across all interviews. The data dictionary was altered due to false negatives or false positives based on the context of the interviews. Sentiment analysis allows for an overview of whether text is positive or negative by removing stop words and assigning values to evaluate positive versus negative opinions.

Analysis

Transcription services were utilized after numbering the interviews for anonymity purposes. The transcripts of each interview were analyzed using thematic content analysis with a summary template to summarize the main themes from the interviews. The author analyzed each transcript using rapid qualitative analysis and created a summary sheet to evaluate for major themes across all interviews. Further, both transcripts and evaluation feedback forms were exported to R Studio Statistical Program for content analysis. By removing stop words, sentiment analysis and word frequencies could be run. For the IDIs, this allowed for major themes, ideas and frequency of words to be determined as well demonstrate differences across interviews. For the evaluation feedback forms, this allowed for themes and what respondents valued to be determined.

Ethical Considerations

This research was determined to be IRB-exempt since all data was de-identified prior to analysis. Prior to traveling to MNH and collecting data, the study proposal was submitted to both the Emory Global Health Institute and Emory University's Institutional Review Board (IRB00002551) and determined exempt. IRB SOCIOB 03152021.

Verbal informed consent was obtained from each participant prior to beginning the interviews and prior to any recording. This was documented. The interviewer began with an introduction that explained the objective of the interview and that confidentiality was paramount and would be maintained at all phases of the interview. Names were not shared by the researcher with other participants or providers and were anonymized prior to analysis.

RESULTS

Seven providers were interviewed. Respondents were either trainers or trainees during the Critical Care Skills Training Program, which was one project of many implemented by the EMPHASIS project. Two of these providers were trainers for the critical care training program, while the rest were participants in the program. Three interviewees were male. All participants were nurses and had had some level of exposure to QI in the past.

Interview Sentiment Analysis

Moving away from traditional qualitative methodology, sentiment analysis of the semi-structure was created (**Figure 8**). Language specific sentiment analysis was performed across all interviews using R Studio Statistical Programming. Sentiment analysis allows for researchers to rank words based on emotions found in standard dictionaries. The dictionary used for this analysis was Bing Liu (Hu & Liu, 2004) which was modified for a medical context (how). This method allows for us to match each work in the interview (excluding stop words) to an emotion scale that ranks each word as positive or negative. Then, the ratio of positives to negatives can be examined. The interviews had an overarching positive outcome. Some positive words were knowledge, gained, improved, comfortable. However, there were some negative sentiments, including words such as challenges, shortage, issue, hard.

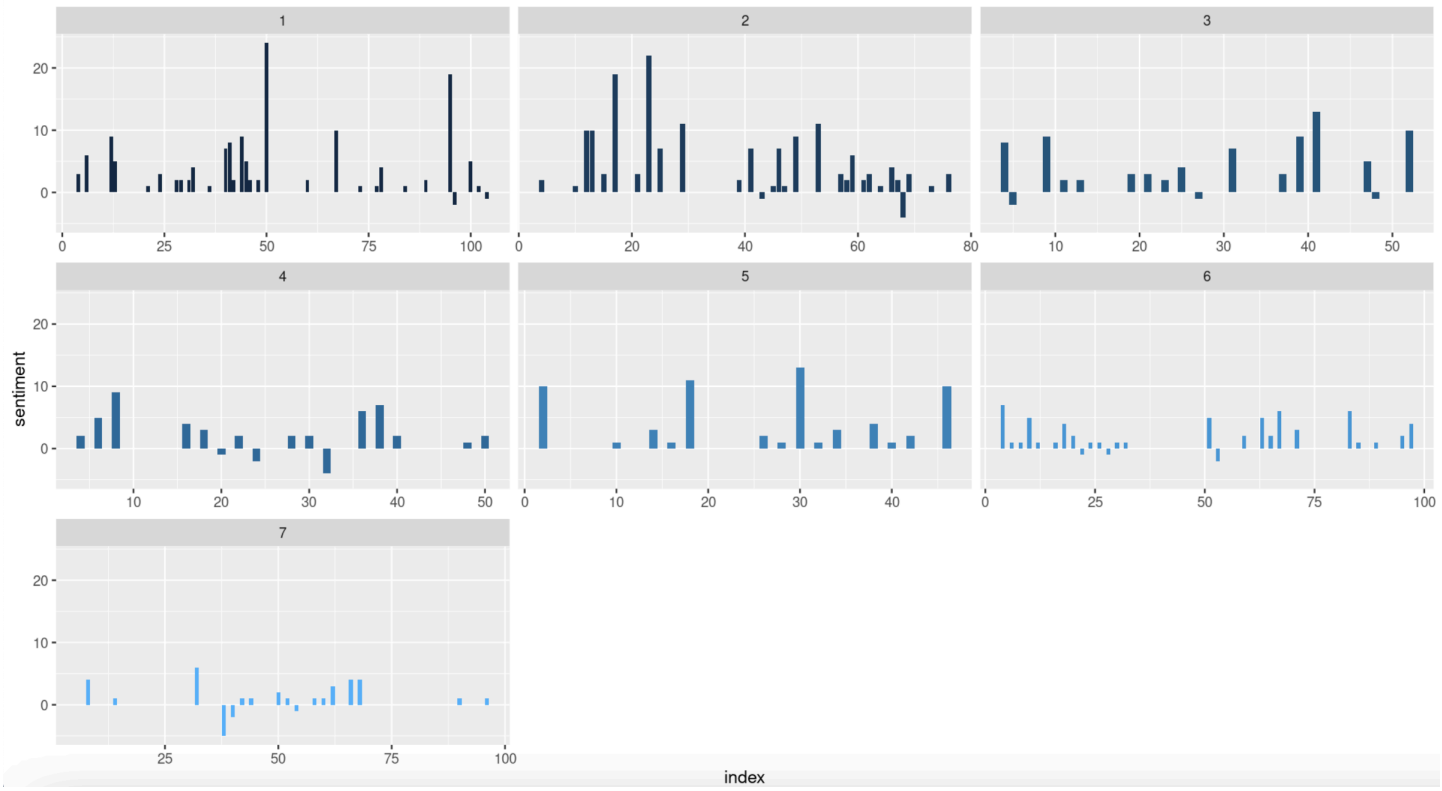


Figure 8. Sentiment Analysis Across All Interviews.

Qualitative Interview Analysis

Following analysis of the in-depth interviews (IDI), seven themes were revealed and will be subsequently discussed. These themes address the perceptions and lived experiences of critical care providers faced with limited resources and demonstrate the on-going needs in this setting as well as avenues for success in promoting quality. Participants identified numerous facilitators and barriers to QI, especially in the context of the training they either led or participated in and recognized the role that change management played as part of the process. Many of the major themes had subthemes that aligned across respondents. The themes that emerged were the following:

1. Positive Impact of QI at MNH
2. Multiple Facilitators Contribute to the Success of QI and the Critical Care Skills Training Program
3. Barriers that Inhibit the Success of QI and the Critical Care Skills Training Program
4. Change Management Led to Positive Culture Shift
5. Increased Feeling of Competence in Practice Following Training

Themes	Salient Quotes
Theme 1: Positive Impact of QI at MNH	
Subtheme 1: QI Cuts Across Multiple Sectors at the National Hospital	*"The [QI] project would cut across everything" (IDI1)*
Subtheme 2: QI Brings a Culture Shift Across the Institution	*"…Now we discussing one by one patient…will they take some time to discuss the patient" (IDI5)*
Theme 2: Multiple Facilitators Contribute to the Success of QI and the Critical Care Skills Training Program	
Subtheme 1: Engagement of Nurses at Different Levels along with Providers to Strengthen the Team Dynamic	*"It's not possible to have all nurses with the same level of education and understanding, but if you work in team…those who [has] lower level of education will find things easy, because they learn from those who are knowledgeable" (IDI1)*
Subtheme 2: Champions to Support QI initiatives and Participant Learning	*"So, when we're teaching them those things, remember the change management, you are going to be change champion. Let's now forget about what you… used to be doing." (IDI2)*
Subtheme 3: Drive to Help Patients	*"But because we are in the field…we have to help people." (IDI6)*
Theme 3: Barriers Exist that Inhibit the Success of QI and the Critical Care Skills Training Program	

Subtheme 1: Varied Nursing Education Level	*"It's not possible to have all nurses with the same level of education and understanding, but if you work in team some, those who is, lower level of education will find things easy because they learn from those who are knowledgeable" (IDI1)*
Subtheme 2: Outside Influences Affect QI	*"Issues of manpower can depend [on] government employed" (IDI3)*
Subtheme 3: Limited Physical and Human Resources	*"Tanzania still faces just a challenge of shortage of nursing professionals" (IDI5)*
Subtheme 4: Change is Hard	*"You have to put a lot of effort to make things move" (IDI3)*
Theme 4: Sustainability of Successful QI Programs	
Subtheme 1: Knowledge Dissemination	*"[My] wish is that every nurse, especially this block, Mwaisela block would at least have a chance to attend this training" (IDI1)*
Subtheme 2: Continued Evaluation of Resource Needs and Availability	*"The challenges most of them are the same as before. Short manpower, short equipment. So, some time someone can practice in a low quality to, to deficit of equipment" (IDI3)*
Subtheme 3: Continuation of Trainings	*"We need to practice, because if you learn without practice [it is] obvious…you are going to forget everything" (IDI1)*
Theme 5: Change Management Led to Positive Culture Shift	
Subtheme 1: Supportive Team Dynamic	*"My subordinates who have gone to the [training] I've seen their behavioral changes towards taking care of their patients in the HDU…when something happens, they are now quicker than before…And I've seen them applying their knowledge" (IDI7)*

Subtheme 2: Positive Attitude Toward Culture of Change	*"You need to show leadership…because if we, as a nurse, you don't show leadership that means sometimes patient may die" (IDI1)*
Subtheme 3: Positive Culture Change Towards Environment	*"The ICU nurses, I see the difference… they are willing to start to learn new things. And also when someone is not aware about the same thing, he or she is not ashamed to ask…And they get to learn (IDI5)*
Theme 6: Increased Feeling of Competence in Practice Following Training	
Subtheme 1: Positive Attitude Toward Training	*"… So, the knowledge we gained from the training is very good. I like it. And I would prefer for all of, all our staffs will get the same, the, the same knowledge as we get there" (IDI6)*
Subtheme 2: Increased Confidence	*"[QI will] highlight a bright future. And that is my expectation, because you cannot not easily force someone to work as per standard, if she or he is not well-equipped with knowledge. So, to me knowledge is very essential…" (IDI3)*
Subtheme 3: Increased Usage of Learned Skills	*"I think the effect of training so many nurses, is on the mortality rate - …our main focus. So, if the mortality rate reduces that will be a good effect for the training." (IDI1)*

Theme 1: Positive Impact of QI at MNH

The first theme amongst respondents concerned how they felt about QI and how they experienced it at MNH. All the respondents had exposure to QI at the hospital and knew about the EMPHASIS project and its endeavors. Respondents highlighted that there has been changes in programming and support since QI has been introduced at MNH. The subthemes from this first theme include: QI is an institution-wide initiative and QI brings a culture shift across the institution.

QI Cuts Across Multiple Sectors at the National Hospital

Quality improvement has had an impact at the National Hospital by cutting across all activities and divisions. Despite its relative newness, it has become integrated in many different new initiatives. Respondents indicated that in the past there was a focus on "quantity versus quality" (IDI2), a feeling that quality was only "existing in books" (IDI2) and that it has been a problem. Relative to these feelings of what the hospital was like before the introduction of QI at MNH, respondents noted the introduction of QI has been in a systems-wide approach:

> *"The [QI] project would cut across everything" (IDI1)*
>
> *"If there is need for training we do it in house" (IDI3)*
>
> *"If there is something we needed, [the QI team] come[s]." (IDI4)*

Nonetheless, participants spoke to the infancy of QI at the hospital:

> *To me, this was a new program at this block, Mwaisela, it's a new program. It hasn't been there before, we keep on training our staff as in-house training here, but we didn't have the big program that like which we have now HDU training (IDI3)*

> *When I started here at Muhimbili…there was no ICU, there was a room! with one ventilator, but now we've got six functional ICUs, which can do hemodynamic monitoring, invasive monitoring, we can do all the advanced procedures. So, to me that's a great success… Yes, so, it's only this past few years that we started to implement the quality project, which, of course changes, you know, people are ready to change, it will take some time. (IDI2)*

QI Brings a Culture Shift Across the Institution

QI now exists in many initiatives at the National Hospital, which has shifted how participants view quality at the hospital. Participants addressed that there is an increased emphasis on capacity building due to the QI program, which has promoted further quality. Without the QI program, MNH would "keep like stagnant…and not provide quality care, [rather] the opposite of it, we provide poor quality care to our clients" (IDI3). Participant 5 demonstrated how focusing on quality has materialized in critical care:

> *There [are] some changes, even the way we are receiving the report there [are] some changes: **now we discussing one by one patient**, not only hearing what is the report from somebody, the condition of the patient is this and this, this and this will they take some time to discuss the patient, [this] is [the] changes I notice (IDI5)*

Other participants spoke about having a heightened attention and giving increased value to new aspects due to QI. For instance, the role of QI affecting infectious disease or how to improve the safety of the providers and patients while also mitigating the mortality rate due to infectious

disease. Participants also identified the need to set standards and apply them across the hospital and the importance of timely care, demonstrating an increased focus on quality aspects.

> *"[commitment amongst providers] towards improvement of the health of our people, towards rescuing our patients from death. That's what I'd like to see" (IDI7).*

Theme 2: Multiple Facilitators Contribute to the Success of QI and the Critical Care Skills Training Program

While MNH is considered a resource-limited setting, respondents identified multiple factors that improve quality and attenuate the path to successful QI. These included engagement of nurses at different levels along with providers to strengthen the team dynamic, having champions to support QI initiatives and participant learning and a drive to help patients.

Engagement of Nurses at Different Levels along with Providers to Strengthen the Team Dynamic

Across the interviews, a subtheme that emerged was how a successful program or ward involves a team of different levels of nurses with varying education levels. Doing so allows for the entire team to work together with involvement from all providers.

> *"It's not possible to have all nurses with the same level of education and understanding, but if you work in team…those who [has] lower level of education will find things easy, because they learn from those who are knowledgeable" (IDI1)*

> *"We take time to train our nurses" (IDI3).*

Respondents remarked how training is necessary for the success of the program and how it was their responsibility to train those providers who may not have had formal training in a critical care setting. In increasing the level of the group by uplifting the individual, respondents felt that this helped to facilitate delivering better care. Since interviewees felt that they had this responsibility to engage other nurses, some viewed themselves as mentors. At the hospital, participants mentioned a weekly one-hour review amongst nurses following the morning report so that any nurse from any ward could attend "so that we can teach each other" (IDI4).

Champions to Support QI initiatives and Participant Learning

A subtheme identified was that there are certain individuals that can champion the QI initiatives across the hospital, which promotes participant learning. Interviewees reported the ability to both learn from others and to show by example to spark change in others. Since some of the participants held more of a supervisor role and were part of the training team in the Critical Care Skills training program, they felt that they were responsible for promoting QI. Interviewees aligning with individuals who share the vision of quality and using that to promote changes across the institution.

> *"So, when we're teaching them those things, remember the change management, you are going to be change champion. Let's now forget about what you… used to be doing." (IDI2)*

Respondents spoke about the importance of having a support network either within the training or as a broader concept for QI at the hospital. They spoke about the institutional level and how having support can ease the facilitation of programs and help to manage change across the

hospital. Participants also underlined a need for a strategic plan to forge a path ahead and ensure the sustainability of quality improvement across the hospital. Participants felt that the trainers were helpful and supportive, and how their instruction clearly identified the standard of care's dos and don'ts.

> *"To continue this program is important, so we need to have strategic plan on how to make sure these are quality assurance programs and which will include the training to continue so you have, to have like a move to make changes using the training" (IDI3)*

> *"Change champions [is about] making other people to change from their routine ways of doing things into critical care, because we say this is a specialty with the concepts totally different from the general ward" (IDI2)*

Drive to Help Patients

Participants remarked heavily on the importance of education and training amongst providers to deliver quality care. Underlining all of this was a demonstrated drive to care for their patients and the population:

> *"But because we are in the field…we have to help people." (IDI6)*

> *"Taking critically ill patients is [a] very nice experience because, you manage a patient totally, you'll provide a total care that means…one nurse, one patient" (IDI1)*

> *"We are responsible to make sure things are going as its planned, everything in on place, together with a quality team" (IDI6)*

Theme 3: Barriers Exist that Inhibit the Success of QI and the Critical Care Skills Training Program

Participants addressed many difficulties in performing quality care and implementing QI initiatives at MNH. Respondents spoke to these issues and the following subthemes were found: nursing education level, outside influences affect QI, limited physical and human resources and change is hard.

Varied Nursing Education Level

Participants identified education in the critical care setting as continuing to be a problem for successful QI. According to interviewees, educating in accordance with protocol can limit risk and the spread of disease. Education can reduce mortality, since the education of the individual lifts the level of the group but that this has been lacking at the hospital. Participants focused on how knowledge is at the core of being a nurse and how knowledge makes one effective. Similarly, participants recognized that for those who do not perform well, is not necessarily due to intelligence level, but rather, on their education and inability to make informed decisions.

> *"It's not possible to have all nurses with the same level of education and understanding, but if you work in team some, those who is, lower level of education will find things easy because they learn from those who are knowledgeable" (IDI1)*

Outside Influences Affect QI

Another major idea expounded upon by participants was how lack of prioritization of QI can hamper its efficacy. Respondents mentioned how prioritization is imperative in low-resource

settings; a need to focus on the most pertinent topics. Yet, the providers noted that many times there was a lack of support from the government level, which acts as demotivation, but also constrains resources and the ability to reach intended goals.

"Issues of manpower can depend [on] government employed" (IDI3)

Limited Physical and Human Resources

There was a noticeable mention of the lack of resources and difficulty in acquiring needed equipment. Participants listed all the equipment necessary for a functioning and quality critical care unit, but that it is not always available due to shortages. This, according to interviewees, affects the quality, since resources are not available or do not arrive on time, such as the scarcity of life-saving medications like adrenaline and inotropes during emergency resuscitations.

"Without those equipment [it] is not easy to implement critical care" (IDI1).

Despite limited equipment, participants highlighted that a shortage of staff would rendering even a functional ICU incapacitated. For instance, they mentioned the standard operating procedure is to have three patients to one nurse in the HDU, but the reality is "one nurse to take care of seven patients" (IDI1). This contributed to overworking nurses, the type of care provided and increases in errors. The same participant noted how shortages affect them personally – that they cannot attend training because of personnel shortages

"Tanzania still faces just a challenge of shortage of nursing professionals" (IDI5)

Change is Hard

Participants spoke to the process of change, that it is hard and that it being hard can affect QI. Respondents addressed the levels of behavior change and how not every person adapts as readily due to motivation levels. Similarly, with it being difficult to change providers, the issue is the willingness to act or ability to adapt, forcing a slower movement to make sure every provider changes themselves and how they deliver care.

"You have to put a lot of effort to make things move" (IDI3).

"They'll get the knowledge but…they were not motivated" (IDI2).

Theme 4: Sustainability of Successful QI Programs

While respondents noted that they were happy and proud of their work and of the QI initiatives at MNH, there were certainly a number of entities that were identified to be improved upon. The subthemes identified from Theme 4 are as follows: knowledge dissemination, continued evaluation of resource needs and availability and continuation of trainings.

Knowledge Dissemination

Participants advocated for a wider dissemination of knowledge across the hospital. Training stimulated change. Some respondents affirmed that as leaders, they will share the knowledge gained to those not in attendance. Other interviewees spoke to this as well, citing that they would like to see more people trained so that more people have new and updated knowledge. Others asked that training materials be readily available to all.

"[My] wish is that every nurse, especially this block, Mwaisela block would at least have a chance to attend this training" (IDI1)

Continued Evaluation of Resource Needs and Availability

Alongside desiring well-functioning critical care units, participants sought a more robust QI program by facilitating training and improving both support and communication for the QI facilitators. In terms of a more developed program, there was confusion in developing the training project concerning the questions, the communication across the project and the need for the trainers to take on multiple responsibilities and provide their own materials. By having multiple duties, it can inhibit the ability to create a strong program as well as for the trainees to be able to participate. Other suggested improvements to the program included equipment, training of the trainers and exchange of education with other healthcare professionals.

> *"The challenges most of them are the same as before. Short manpower, short equipment. So, some time someone can practice in a low quality to, to deficit of equipment" (IDI3)*

Continuation of Trainings

In order to create a robust program, all participants spoke to the need for continuous trainings to practice concepts learned and introduce new areas that may be currently lacking. Doing so would promote sustainability of change according to participants. The providers also reiterated certain trainings they would like to see, highlighting the use of machines. Respondents spoke about wanting practice sessions with frequency to apply what they learn during training and prevent future loss of knowledge.

> *"We need to practice, because if you learn without practice [it is] obvious…you are going to forget everything" (IDI1)*

Theme 5: Change Management Led to Positive Culture Shift

Provider participants expanded on change management concepts and attitude changes after training in their responses. The respondents that are trainers or supervisors had much to say on how culture plays a role in delivering quality care. The following subthemes were found: supportive team dynamic, positive culture of change in attitude and positive culture change towards resources.

Supportive Team Dynamic

A supportive team dynamic was highlighted as an important mechanism to utilize in the units following the QI initiative and training. Respondents recognized the success of a team dynamic as a result of change management concepts included in the training and how this has changed behavior on the ward These participants discussed their role as change champions. They felt that change is important and played a role in how they perceive QI initiatives. Change champions have the ability, according to participants, to instigate this change, which has improved others' ability to work in their role.

> *"The first, change I wanted was to change their mindset. I'm sure the majority, more than half, I managed to do that. Because it all starts in the mind, if you want to change people." (IDI2)*

> *"You can have an influence from the management but also how to a deal, personality issues, the attitude issues." (IDI3)*

"My subordinates who have gone to the [training] I've seen their behavioral changes towards taking care of their patients in the HDU…taking into consideration about the urgency of taking care of those patients, when something happens, they are now quicker than before…And I've seen them applying their knowledge" (IDI7)

Others discussed how critical care units such as the HDU are different than that of a normal ward and the need to mold new change champions. In doing so, this enforces the idea of change management and uplifting the group.

"In HDU you are doing much more, you're going a step ahead, and there are some of the things that you're supposed to initiate yourself as a nurse. So, when we're teaching them those things, remember the change management, you are going to be change champion. Let's now forget about what you used to be doing. You need now to be doing like this" (IDI2)

Participants also noted that because of this team dynamic, there is more learning occurring and more of a supportive environment in which to learn.

"The ICU nurses, I see the difference… they are willing to start to learn new things. And also when someone is not aware about the same thing, he or she is not ashamed to ask…And they get to learn (IDI5)

"The culture has been changing, because some things which are going wrong, it's some people's attitudes, but the quality improvement team…has been with us all the time" (IDI7)

Positive Attitude Toward Culture of Change

Another shift identified amongst participants was that they felt positively towards needing to change their mentality towards their responsibilities and actions on the ward. Participants highlighted that this was due to change management concepts included in the QI training.

> *"change management, which I felt is the most, most important of them all, and it was supposed to be taught after the introduction, but I had not heard about the change management, but just from critically thinking, you know, I say no…Why can't we start with the change management? So that at least our participant[s] are ready for the change management…which was very helpful…in our topics we're always referring to the change management and everybody loved the topic" (IDI2)*

Other participants who received the training discussed how they felt change management training affected them. Participants discussed how important the change management concepts were in empowering them to advocate for their patients and improve their way of practicing.

> *"You need to show leadership…because if we, as a nurse, you don't show leadership that means sometimes patient may die" (IDI1)*

> *"So, every nurse has to assume leadership, despite maybe not entitled as a charge but has to assume responsibility. Assume leadership, in an application of the knowledge you have -- then you can [have a] good output in terms of taking care of patients." (IDI1)*

Respondents said that they recognized the gradient of change due to the training and could see how people change at different rates. They felt the impetus to change in order to assist the patient directly and also work alongside others to take care of the patients.

> *"I have to change, I have to change, I have to change, you know, sometimes you may, uh, we may fail to take care of critically ill patient, or enduring so many issues that they interfere, impair our ability to take over patient." (IDI1)*

> *"The good thing I noticed that people now are sharped minded…And they are well organized, because every day we remind each other when there is cardiac arrest what should be done or to what nurse should supposed to do, and avoid panicking during compression or during cardiac arrest, stay calm" (IDI5)*

> *"Change management has helped me to be able to manage staff with different behaviors, because not everyone will change promptly…Not all the people will change on the same day. Some are slow, some will, will wait and change later on, and that has taught me that I have to go with people the way they are, but eventually they'll change (IDI7)*

Positive Culture Change Towards Environment

Following training and QI initiatives, participants felt that they were better able to utilize resources and work in the critical care environment. They feel that they are now able to perform their responsibilities with better quality in a critical care setting.

> *"Before the training, when we have the emergency, we see that most of them people their frightened, lashing, they are tense but now not after the training…after training in case of*

the change management we have very much improvement because now, for example can say that if we are doing CPR before the training all the time during the emergency and resuscitation the doctors would be the team leader of the resuscitation. So, nowadays that even your nurse can be a leader. Because of the, we have seen, we have been told that the training from anyone who is competent, knowledgeable, experienced can be a leader during resuscitation." (IDI4)

"The patient was on arrest, but I mobilized the, the, the other staffs to identify this patient is on an arrest, so we have to act immediately. So, I lead them, I instruct them on how to do contact with a, doctor on call. We participate on an intubation in NGT session, and the patient was? Improved!" (IDI6)

In creating this culture shift, interviewees felt that the dynamic of how they work has changed, they are more attuned to the setting that they work in and are focused on improving patient outcomes. They feel that they have a more step-wise approach and protocol to treating patients, imbued with how to work in a critical care environment.

"It reminded us not to do work as a daily routine… we saw the dynamics to change according to the environment. I supposed to do this and this, this is my daily routine. No, everything changes" (IDI5)

"How to approach the emergenc[y] patient… how to respond in it? So, you have to assess the patients, check the pulse, no response? No response, you have to start CPR or calling for help, while the help arrive you have to lead them. Yeah, because you're the

one with the patient, you know what happened. So, you'd have to lead them on what to do (IDI6)

Theme 6: Increased Feeling of Competence in Practice Following Training

Respondents spoke about how they felt following the training and the changes in their skills competence and knowledge. Subthemes include positive attitude towards training, increased confidence and increased usage of skills learned in the training.

Positive Attitude Toward Training

Participants spoke about prioritizing critical care concepts including VSDT, CPBR, etc. in formulating the training. All trainees had overall positive feedback about the program and that this affects their peers in the ward. They felt that the topics were not too complicated (the material was easy to understand), were helpful and thought change management to be an appropriate part of the training. Respondents felt the training was productive and were glad to have the ability to ask questions.

"No need to wait [for] somebody, 'I don't know how to do something. We need to wait for somebody' no, you have to act because you have the knowledge. So, the knowledge we gained from the training is very good. I like it. And I would prefer for all of, all our staffs will get the same, the, the same knowledge as we get there" (IDI6)

"Training has really helped us" (IDI7).

"[The training] was so amazing" (IDI6)

Increased Confidence

Participants also discussed an increased confidence in responding to emergencies and being in the critical care setting. One interesting finding was how respondents felt about the duration of training. Many mentioned a desire for increased time for the trainings.

Amongst the respondents that have acted as trainers, they noticed that the providers they had taught "started enjoying" the work they now did. Other trainers described their perceptions of how QI has affected the trainees to improve the standard to which they are held and increase trainees' confidence in the ability to meet that standard.

> *"[QI will] highlight a bright future. And that is my expectation, because you cannot not easily force someone to work as per standard, if she or he is not well-equipped with knowledge. So, to me knowledge is very essential: after knowledge you're going to check on the practices…there will be changes – there must be changes!" (IDI3)*

> *"You see how the group gets training, but they appreciate it, everyone appreciate[s] it. And I as a supervisor, I see it." (IDI3)*

Increased Usage of Learned Skills

Participants learned the differences in skills needed in the critical care setting as compared to the general ward. This has led nurses responding quickly to changes in patient statuses and being able to perform when the situation calls upon it. Interviewees noted that they have seen a change in both themselves and other trainees – that they are practicing what they have learned.

Participants noted outcomes in the SICU, with trainees stopping others from practicing incorrect care procedures after the training. Multiple provider respondents delineated that they learned about the importance of brain resuscitation as opposed to just cardiopulmonary resuscitation. Other participants stated that they learned about the importance of timing in resuscitation and being a leader during resuscitation and that now:

"We are going to save a patient" (IDI5)

Others spoke to seeing changes in resuscitation and the knowledge of how to do resuscitations that focus on the brain component specifically. For instance, some did not know how to correctly perform compressions previously but now felt they could use their skills adequately.

"My knowledge about resuscitation has improved from what I was before" (IDI7)

As such, interviewees felt that the training would have an effect on patient outcomes, reducing mortality rate and improving confidence, since they will regularly use the skills they learned.

"I think the effect of training so many nurses, is on the mortality rate of – is our main focus. So, if the mortality rate reduces that will be a good effect for the training." (IDI1)

"If someone is well knowledgeable, you will never hear…someone complaining…after, because he knows what to do. He knows how to prioritize, he knows how to detect change to patients, you see, so he has to take care of patient according to changes" (IDI1)

DISCUSSION

Certain themes became clear in analyzing the data. All providers recognized a positive impact of QI at their institution, noting that QI is both institution-wide as well as engenders a culture shift. While QI may be relatively new in this setting, it has created capacity building and affected quality. This aligns with the Ministry of Health and Social Welfare (MoHSW) aims for improved care. In 2008, MoHSW adopted the 5S-CQI (KAIZEN)-TQM framework for QI in healthcare, demonstrating a prioritization of spreading QI methodologies and scaling up implementation (MoHSW, 2011, 12; Ishijima et al., 2014, 139). The 5S-CQI (KAIZEN)-TQM has a low cost feature and allows for input from providers to improve quality (Randhawa & Ahuja, 2017). Tanzania has since become a model for employing this framework amongst other East African countries (Ishijima et al., 2014, 138; MoHSW, 2011, 13). This research supports this idea, as there have been a multitude of overlapping and concurrent quality projects, showing that QI has been far-reaching at the hospital with multiple factors driving improved quality.

The data also demonstrates what factors have contributed to improving quality and utilizing said improved quality in practice. A supportive team dynamic with identified advocates to champion the uptake of QI practices has been a key factor. A study done by Ishijima et al., utilized the "cascade approach" recommended in the MoHSW 2011 framework by "training of trainers" (ToTs) at 46 hospitals in Tanzania and focusing on knowledge gained pertaining to 5S-KAIZEN-TQM and QI with pre- and post-tests (MoHSW, 2011, 30; Ishijima et al., 2014, 140). The study found that training trainers was important to the success of knowledge garnered and for the ability for trainers to transfer knowledge to their colleagues and subordinate staff, but that it cannot be implemented in silos (Ishijima et al., 2014, 146). Rather, ToTs should be done

focusing on mid-level staff and be done in tangent with promoting investment in the outcome of the program to further achieve successful implementation (Ishijima et al., 2014, 148).

Underlying this idea of a team that aims to deliver care is the drive to help patients. Care will not be provided if the motivation and empathy is lacking. The respondents showed an impassioned awareness of the struggle patients in critical care settings face and the duty that they felt was necessary to care for these patients and improve their outcomes.

Moreover, the interviewees consistently identified barriers to providing quality care and to integrating QI at the National Hospital. They noted that change can be difficult and may take concerted effort. The biggest considerations when trying to alter the status quo and change people's mindsets and practices is that change is not linear and that it is continual (Moran & Brightman, 2000). Yet, research has shown that it does not have to break the system (Kramer & Magee, 1990). Instead, concepts such as change management can be employed to alleviate the stress of change. For instance, shifting slowly at first to eventually generate larger waves of change can be easier to accomplish and be more sustainable.

Respondents perceived the effect that change management has had on their practice and the hospital culture. They felt a need to change and to think critically. This is an important point, as studies have shown that ineffective change management can inhibit QI (Mosadeghrad, 2012; MoHSW, 2011, 22). Additionally, change management creates a leader out of any worker and to assume responsibility as leaders in their wards. Previous studies have cited barriers to effectual care due to hierarchal issues that prevent nurses from making decisions (Engdahl Mtango et al., 2019). The respondents in this study felt that they now had increased comfortability, empowered to address issues and respond to emergencies without waiting for the physician.

In any study, there are questions of sustainability of the data found. Interviewees felt that the skills they garnered – both hard and soft – would be useful in their practice. Furthermore, almost all of the participants felt that they would be agents for disseminating the information to others in their ward, propagating the leadership and skills they gained from the training. When a training program can create ripples across the institution there is an increased likelihood that more providers will be exposed to and engage with quality concepts. The more people that can be trained and exposed the more the institution can shift and provide better quality care. This will also be accomplished with continual trainings, which many respondents identified as something they desired. While there may be limited resources, interviewees felt that continual trainings will improve their ability to retain the information they learned, spread this information to others and increase the quantity of topics they receive training for.

Quality has been proven to be an integral part of many processes including healthcare. Without a prioritization of quality, standards of care cannot be optimized. Training is imperative for all providers, but especially in the ICUs. Frequent and rapid changes can occur in patients in the ICU, so inadequate knowledge can lead to poor patient outcomes and poor practice (Said, 2012, 30). One study recommended that there is a need for knowledge amongst nurses to gain confidence in their actions (Said, 2012, 12). In an observational study of ICU nurses at MNH, while 89.83% of nurses had the knowledge required, there was a lack of application (Said, 2012, 31). Another study determined that nurses caring for critically ill patients relied only their prior experience only and that there was low morale for treating patients (Engdahl Mtango et al., 2019, 6). This review illustrates the need to have a continuing education about care and the use of knowledge and that training should be quality-specific to help translate knowledge into practice.

In another example, the African Health Initiative across Mozambique, Rwanda, and Zambia sought to establish QI projects over a seven-year period (Wagenaar et al., 2017). Following in-depth interviews amongst program staff, there were a total of 450 action-plans with varying success from 10-80%. Throughout all, there was an increase in the feeling of ownership and empirical data used to drive QI projects (Wagenaar et al., 2017). Quality improvement can be the key factor to improving the dynamic within the healthcare setting and allowing for all players to contribute to quality delivery of care. Since critical care units continue to be novel or poorly developed in Sub Saharan Africa, informed research can help direct the future of quality improvement to create a more robust critical care unit (Tumukunde et al., 2019; Okafor, 2009; Dünser et al., 2006).

Thus, in recognizing the importance of high levels of quality care, it is necessary to understand the players and actors that contribute to a quality system. Nurses are considered to be integral to patient success (Maphumulo & Bhengu, 2019). In addition to this, those whose role it is to carry out and deliver care have been shown to play a key role in the success of a program (Mosadeghrad, 2012; Aveling et al., 2012; Mwidunda & Eliakimu, 2015). As such, their input, insight and perspectives can help to understand the impact of a QI program and subsequently direct the future of its initiatives. Qualitative research allows for a more in-depth understanding of perceptions and attitudes around a subject.

Evaluating the perspectives of providers on QI at the National Hospital in Tanzania has suggested that there are certain factors that aid and others that inhibit as well as a culture that shapes QI. This research enables a more robust understanding of how programs can become sustainable. Since this research was setting specific to the National Hospital, evaluation of the

data must be setting specific as well, however, there are possibilities for extrapolations to other QI programs in LMICS.

Although this research demonstrated the mechanisms for and provider impressions of QI at the National Hospital, there are avenues for future research that would continue to shed light on how to improve quality care in a low-resource setting. To further improve quality in healthcare and critical care settings, it could be useful to expand this research by interviewing more providers or more people from different levels of care at the National Hospital. Moreover, further research should examine the retention of these skills over time. Last, research could be useful if it focused on other hospitals in the region to compare the QI programs.

Limitations and Weaknesses

There were a number of limitations inherent in this research. As respondents for the IDI were volunteers and the schedule of all providers was extremely busy, there was a small sample of respondents. As such, this may have skewed the data. Since snowballing methodology was employed to recruit volunteers for the IDIs, this may have created a bias as to who were respondents. Other methods may have created a different environment for respondents to participate. The scope is limited to critical care workers, as the objective of the training was to target this population. Some providers may have avoided interviewing due to a language barrier.

Conclusion

In conclusion, this research had enabled a more in-depth understanding of the fabric of the quality improvement program at the National Hospital in Dar es Salaam, and what the perceptions of QI and the training program are amongst respondents. The main finding

demonstrated a generally positive view of the trainings and QI, a drive to help patients, the importance of change management and a number of factors that respondents felt influence the success of QI. This research exemplifies a systematic approach to strengthening capacity of critical care delivery in limited resource settings, with implications for further innovation in other LMICs. Last, this study has shown what a sustainable QI can look like. It is important to invest in change champions, thus who can promote quality amongst their cohort and help bring trainings to disseminate information to others. Creating sustainable programs can be difficult, nonetheless, determining the factors that promote its success, such as in this research, can impart a clearer understanding of the path forward to better quality care no matter the resource limitation.

CHAPTER 5: Conclusion and Recommendations

CONCLUSION

Quality Improvement is powerful in being able to direct changes and create a sustainable framework for continuous improvement. Studies have demonstrated the importance of QI and how it can shape health-based interventions, but there is a paucity in understanding skills interventions that incorporate change management theories (Boaden et al., 2008, 10). Adequate care directly shapes the outcome of the patient. Training and ensuring there is a widespread standard of care has the potential to limit the spread of disease by encouraging good and hygienic practice as well as create a more rapid response in providers due to increased competence.

Quality has been identified as a major aspect in the creation of initiatives in Tanzania, codified in the its Vision 2025 to create programs that promote care and improve quality of life (MoHSW, 2011). In Tanzania, the Ministry of Health and Social Welfare (MoHSW) have taken steps toward QI through the Tanzania Quality Improvement Framework (TQIF). The framework's aims are: (1) to encourage all health workers at all levels and other stakeholders in the sector to develop innovative approaches for QI and implement them; and (2) to outline what needs to be done to institutionalize quality of health care at various levels based on national interests and vision (MoHSW, 2011). Despite this commitment, the Tanzanian health sector continues to face many familiar challenges of resource constraints, unsustainable QI projects, and gaps in knowledge and skills (Nangawe, 2012). This has been the experience at the large tertiary hospital in Dar es Salaam, where ICUs have far fewer than the international standard of beds and the triaging process for the admission of patients to the ICU is convoluted and inefficient (Engdahl Mtango et al., 2019). These conditions have contributed to the unacceptably high morbidity and mortality rates for Tanzanian patients with critical illness (Sawe et al., 2014).

Moreover, there are multiple units of varying capacity depending on patient need to provide care for critically ill patients.

A previous study by Kaihula et al. in 2018 demonstrated that while quality standards exist at the National Hospital, there is a wide deficit in CPR skills (Kaihula et al., 2018). This study highlighted that even though people were conducting CPR routinely, it was not being done well and highlighted a need for quality improvement. During that study, only 25% and 50% passed MUHAS standards and only 4% and 9% of providers passed AHA standards for CPR (Kaihula et al., 2018). Other studies have measured quality and have found similar lacking results in adequate knowledge of critical care concepts (Roshana et al., 2012; Silande, 2010). This current study evaluated a more intense, holistic, and team-based QI initiative with a focus on critical care providers which demonstrated higher passing rate. The success of the more recent program was explained by the qualitative data. Here we showed that reasons included the whole-institution culture shift towards one of quality improvement, the role of multidisciplinary teams, and change management, to name a few.

On another note, studies have demonstrated the importance of confidence in delivering care. An observational study conducted at MNH focused on ICU nurses and the association between knowledge and practice of nurses. The study found that practice was associated with education level but not ICU training (Said, 2012). The study recommended that there is a need for knowledge amongst the nurses not only to prevent Ventilator Associated Pneumonia, but also, so that the nurses can gain *confidence* in their actions (Said, 2012).

Furthermore, one of the measures of quality of care is how much infectious diseases spread in the hospital setting as a result of the actions of HCWs (MoHSW, 2011). Thus, it is pertinent that healthcare measures include a level of quality to keep patients safe, treat the sick

and further alleviate the burden of disease. Indeed, MoHSW denotes that IPC is considered an indicator of quality (MoHSW, 2011). It could be interpreted that if a hospital cannot control outbreaks or continues to perpetuate poor hygienic standards that perpetuate illnesses, they cannot be considered to be providing quality care nor are protecting the populations they are serving.

The mixed-methods approach of the study is valuable to demonstrate the different factors of the critical care skills training program and the larger QI initiative at the National Hospital. The quantitative portion allowed for an understanding of the skills gained and insight into the training itself, while the qualitative aspect demonstrated the perspectives of providers in an in-depth manner. The data from each can stand alone, but are also important drawing conclusions to inform a larger picture. The data is complementary, since the respondents who were interviewed underwent the training or were trainers themselves, therefore, their perspective adds personalization as to the success of the training. On the other side, the outcomes of the training informed those who interviewed.

Thus, the most recent critical care training program by the EMPHASIS team has shown how a program rooted in QI principles has affected the providers with the potential impact of changing the culture of care. The major aspects that this study found the training impacted were technical competence, a shift in the culture and a highlighted need for sustainability.

Quantitative

Technical Competence

The pre- and post-test results highlight the increase in technical competence and skills. 31 participants (46.3%) in CPBR and 16 participants (23.9%) in VSDT had an increase in 3 points

or 30%, respectively. This demonstrates an increase in the understanding of the skills tested. In CPBR training, participants demonstrated a significant increase in skills and knowledge across six of the questions. These topics included questions about chest compressions, opening airways after head/neck trauma, when to continue CPR and what heart rhythm indicates a shock is needed. The topics that did not show a significant change in score may need to be revisited for evaluating provider knowledge. The results from VSDT training are important to highlight. Every single question had a significant increase in score change across participants.

Most importantly, 95.5% of participants and 95.2% of participants met MUHAS standards for CPBR and VSDT, respectively. 25 (37.9%) and 17 (25.4%) met AHA standards for CPBR and VSDT. Previous studies have demonstrated that there has been a limited correct knowledge in CPBR skills. Thus, this training has increased the amount of correct knowledge for basic life support. Additionally, this training specifically focused on the brain resuscitation component of CPR. This was a new component introduced in critical care training and highlighted the need to consider the brain during resuscitation.

Other studies have reported that competence of medical personnel affects quality of care (Boaden et al., 2008). A study conducted at a hospital in Iran found success of its adapted quality management/improvement concepts due to its emphasis of weaving QI into every level of management. Mosadeghrad argues that a large part of this success was due to the creation of a culture of learning and facilitation across every level of a quality project following effective provider training (Mosadeghrad, 2012). In another example from a LMIC, a tertiary referral hospital in Malawi recently established a High Dependency Unit (HDU), which served an indispensable role at the onset of the COVID-19 pandemic to provide quality (Morton et al.,

2020). The program focused on a participatory approach to standardize care and improve quality with the aim for sustainable results.

Therefore, this could have important implications for future QI initiatives in critical care settings at the National Hospital and more generally to other LMICs. The critical care training program focused on utilizing local trainers and instructing on change management concepts. In conjunction with this, future trainings should build on concepts learned to reinforce competencies and hone in on more advanced and specific trainings.

Culture Change

Another interesting outcome of the training was found through the evaluation and feedback forms. The participants highlighted that while they found the most useful aspect of the trainings to be skills, specifically CPR/CPBR and that they desire more technical trainings, the participants reported that they will make cultural changes. Amongst the cultural change that participants noted they would like to make, teaching others and providing quality care were the most popular answers. All participants noted that they were likely or very likely to change their practice after the training. This demonstrates the desire amongst participants to propagate knowledge and improve the standard of care that they deliver. Such outcomes promote the ideas of quality improvement and how to direct change across a wider subset of providers in healthcare.

Change management can direct the culture of an organization, which fits in well with QI concepts of reorganizing processes and individuals' responsibilities (Hudelson et al., 2008, 31). It has been documented that the long-term success of a program is primarily contingent on the investment of members of the team and the resources that exist to further their training (Kacholi

& Mahomed, 2020). Moreover, the individuals must trust their trainers and the change agents to optimally achieve change (Mosadeghrad, 2012). Indeed, by training providers and including them in the process, ownership can be felt and further spur innovative engagement in the activities and investment in the outcome of QI (Lifvergren, 2013; Weiner et al., 1997).

A Ghanaian cross-sectional study across two hospitals revealed that while the priorities were to garner communication, skills, a cohesive team and to be able to work through change, the biggest barrier was inadequate training that inhibited empowerment (Kumah et al., 2016). In Iran, change management was employed during training to encourage quality techniques amidst a culture of learning. This training found increased cooperation and teamwork and more involvement from employees to facilitate quality delivery of care (Mosadeghrad, 2012). In Tanzania, the MoHSW has promoted the concept of Training of Trainers and the importance of developing every individual provider and their sense of responsibility toward the culture of care (MoHSW, 2011).

This research demonstrates need for an emphasis on the role that culture plays in gaining technical competence that leads to program success. Future initiatives should focus on engaging multiple levels of workers and imbuing them with the tools to have a level of autonomy over their work. In doing so, they will feel empowered to attend to their duties and may go above and beyond in their care for patients, thereby improving the quality of care delivered.

Need for Continual Trainings/Future Direction

Quality improvement by its definition is an ongoing process (Batalden & Davidoff, 2007; Batalden & Stoltz, 1993). As such, this aspect of QI is significant and must be recognized. Most trainees noted that they would like trainings at least every six months. Such input from

participants is informative as to the desire for more skills and improving the quality of care that they deliver.

While smaller trainings do exist at the National Hospital that involve rehearsal of skills, there is a need for an institutionalized continual training framework (T. Said, personal communication, July 3, 2022). By designing and executing a recurring training program, this will keep skills sharp and continue to allow for provides to feel ownership over the care they deliver. Moreover, it may allow for others to learn proper skills and gain knowledge. The National Hospital could create a calendar of more formalized trainings, allowing for providers to be able to look forward to reviewing their skills and gain more information. This could also increase trust and allow to plan ahead to allocate resources appropriately for the future trainings.

Extrapolations to Broader Tanzania QI

Quality has been identified as a major aspect in the creation of initiatives in Tanzania, codified in the its Vision 2025 to create programs that promote care and improve quality of life (MoHSW, 2011). Nonetheless, a previous study by Kaihula et al. in 2018 demonstrated that while quality standards exist at the National Hospital, there is a wide deficit in CPR/CPBR skills (Kaihula et al., 2018). This study highlighted that even though people were conducting CPR routinely, it was not being done well and highlighted a need for quality improvement. During that study, only 25% and 50% passed MUHAS standards and only 4% and 9% of providers passed AHA standards for CPR (Kaihula et al., 2018). This current study saw a more established QI and a focus on critical care providers. As this study demonstrated higher passing rates, one possible reason could be the focus on QI and on training those providers who are leaders in the

ICU. Other studies have measured quality and have found similar lacking results in adequate knowledge of critical care concepts (Roshana et al., 2012; Silande, 2010).

On another note, an observational study conducted at MNH focused on ICU nurses and the association between knowledge and practice of nurses. The study found that practice was associated with education level but not ICU training (Said, 2012). The study recommended that there is a need for knowledge amongst the nurses not only to prevent Ventilator Associated Pneumonia, but also, so that the nurses can gain *confidence* in their actions (Said, 2012).

Thus, the most recent critical care training program by the EMPHASIS team has shown how a program rooted in QI principles has affected the providers with the potential impact of changing the culture of care. Evaluation of Quality Improvement initiatives is necessary, as it is powerful in being able to direct changes and create a sustainable framework for continuous improvement. Studies have demonstrated the importance of QI and how it can shape health-based interventions, but there is a paucity in understanding skills interventions that incorporate change management theories (Boaden et al., 2008). Adequate care directly shapes the outcome of the patient. Training and ensuring there is a widespread standard of care that has the potential improve health outcomes as well as create a more rapid response in providers due to increased competence.

Certain themes became clear in analyzing the data. All providers recognized a positive impact of QI at their institution, noting that QI is both institution-wide as well as engenders a culture shift. While QI may be relatively new in this setting, it has created capacity building and affected quality. This aligns with the Ministry of Health and Social Welfare (MoHSW) aims for improved care. In 2008, MoHSW adopted the 5S-CQI (KAIZEN)-TQM framework for QI in

healthcare, demonstrating a prioritization of spreading QI methodologies and scaling up implementation (MoHSW, 2011, 12; Ishijima et al., 2014, 139). The 5S-CQI (KAIZEN)-TQM has a low cost feature and allows for input from providers to improve quality (Randhawa & Ahuja, 2017). Tanzania has since become a model for employing this framework amongst other East African countries (Ishijima et al., 2014, 138; MoHSW, 2011, 13). This research supports this idea, as there have been a multitude of overlapping and concurrent quality projects, showing that QI has been far-reaching at the hospital with multiple factors driving improved quality.

The data also demonstrates what factors have contributed to improving quality and utilizing said improved quality in practice. A supportive team dynamic with identified advocates to champion the uptake of QI practices has been a key factor. A study done by Ishijima et al., utilized the "cascade approach" recommended in the MoHSW 2011 framework by "training of trainers" (ToTs) at 46 hospitals in Tanzania and focusing on knowledge gained pertaining to 5S-KAIZEN-TQM and QI with pre- and post-tests (MoHSW, 2011, 30; Ishijima et al., 2014, 140). The study found that training trainers was important to the success of knowledge garnered and for the ability for trainers to transfer knowledge to their colleagues and subordinate staff, but that it cannot be implemented in silos (Ishijima et al., 2014, 146). Rather, ToTs should be done focusing on mid-level staff and be done in tangent with promoting investment in the outcome of the program to further achieve successful implementation (Ishijima et al., 2014, 148).

Underlying this idea of a team that aims to deliver care is the drive to help patients. Care will not be provided if the motivation and empathy is lacking. The respondents showed an impassioned awareness of the struggle patients in critical care settings face and the duty that they felt was necessary to care for these patients and improve their outcomes.

Moreover, the interviewees consistently identified barriers to providing quality care and to integrating QI at the National Hospital. They noted that change can be difficult and may take concerted effort. The biggest considerations when trying to alter the status quo and change people's mindsets and practices is that change is not linear and that it is continual (Moran & Brightman, 2000). Yet, research has shown that it does not have to break the system (Kramer & Magee, 1990). Instead, concepts such as change management can be employed to alleviate the stress of change. For instance, shifting slowly at first to eventually generate larger waves of change can be easier to accomplish and be more sustainable.

Respondents perceived the effect that change management has had on their practice and the hospital culture. They felt a need to change and to think critically. This is an important point, as studies have shown that ineffective change management can inhibit QI (Mosadeghrad, 2012; MoHSW, 2011, 22). Additionally, change management creates a leader out of any worker and to assume responsibility as leaders in their wards. Previous studies have cited barriers to effectual care due to hierarchal issues that prevent nurses from making decisions (Engdahl Mtango et al., 2019). The respondents in this study felt that they now had increased comfortability, empowered to address issues and respond to emergencies without waiting for the physician.

In any study, there are questions of sustainability of the data found. Interviewees felt that the skills they garnered – both hard and soft – would be useful in their practice. Furthermore, almost all of the participants felt that they would be agents for disseminating the information to others in their ward, propagating the leadership and skills they gained from the training. When a training program can create ripples across the institution there is an increased likelihood that more providers will be exposed to and engage with quality concepts. The more people that can be trained and exposed the more the institution can shift and provide better quality care. This will

also be accomplished with continual trainings, which many respondents identified as something they desired. While there may be limited resources, interviewees felt that continual trainings will improve their ability to retain the information they learned, spread this information to others and increase the quantity of topics they receive training for.

Quality has been proven to be an integral part of many processes including healthcare. Without a prioritization of quality, standards of care cannot be optimized. Training is imperative for all providers, but especially in the ICUs. Frequent and rapid changes can occur in patients in the ICU, so inadequate knowledge can lead to poor patient outcomes and poor practice (Said, 2012, 30). One study recommended that there is a need for knowledge amongst nurses to gain confidence in their actions (Said, 2012, 12). In an observational study of ICU nurses at MNH, while 89.83% of nurses had the knowledge required, there was a lack of application (Said, 2012, 31). Another study determined that nurses caring for critically ill patients relied only their prior experience only and that there was low morale for treating patients (Engdahl Mtango et al., 2019, 6). This review illustrates the need to have a continuing education about care and the use of knowledge and that training should be quality-specific to help translate knowledge into practice.

In another example, the African Health Initiative across Mozambique, Rwanda, and Zambia sought to establish QI projects over a seven-year period (Wagenaar et al., 2017). Following in-depth interviews amongst program staff, there were a total of 450 action-plans with varying success from 10-80%. Throughout all, there was an increase in the feeling of ownership and empirical data used to drive QI projects (Wagenaar et al., 2017). Quality improvement can be the key factor to improving the dynamic within the healthcare setting and allowing for all players to contribute to quality delivery of care. Since critical care units continue to be novel or poorly developed in Sub Saharan Africa, informed research can help direct the future of quality

improvement to create a more robust critical care unit (Tumukunde et al., 2019; Okafor, 2009; Dünser et al., 2006).

Thus, in recognizing the importance of high levels of quality care, it is necessary to understand the players and actors that contribute to a quality system. Nurses are considered to be integral to patient success (Maphumulo & Bhengu, 2019). In addition to this, those whose role it is to carry out and deliver care have been shown to play a key role in the success of a program (Mosadeghrad, 2012; Aveling et al., 2012; Mwidunda & Eliakimu, 2015). As such, their input, insight and perspectives can help to understand the impact of a QI program and subsequently direct the future of its initiatives. Qualitative research allows for a more in-depth understanding of perceptions and attitudes around a subject.

Evaluating the perspectives of providers on QI at the National Hospital in Tanzania has suggested that there are certain factors that aid and others that inhibit as well as a culture that shapes QI. This research enables a more robust understanding of how programs can become sustainable. Since this research was setting specific to the National Hospital, evaluation of the data must be setting specific as well, however, there are possibilities for extrapolations to other QI programs in LMICS.

Although this research demonstrated the mechanisms for and provider impressions of QI at the National Hospital, there are avenues for future research that would continue to shed light on how to improve quality care in a low-resource setting. To further improve quality in healthcare and critical care settings, it could be useful to expand this research by interviewing more providers or more people from different levels of care at the National Hospital. Moreover, further research should examine the retention of these skills over time. Last, research could be useful if it focused on other hospitals in the region to compare the QI programs.

Other Findings

There are many other quality initiatives that occur at MNH. One such practice has been the creation of a flowchart for charting purposes. Where previously nurses were conducting care via task allocation – where "one nurse will be allocated to do maybe, bed bathing but another one is responsible for drugs, another one responsible for whatever," introducing a flowchart places all of this information in one place (T. Majuta, personal communication, July 10, 2022). Moreover, it allows for one nurse to following one patient and get to know their needs intimately and subsequently creating a more holistic picture of the care of the patient – a *total* patient care. Nurses at first felt that it would be too much work for one person, but a change champion forged the path, selecting one patient each day to lead by example and demonstrate to the other providers in the unit how it could be done. This change champion found that the providers, when they followed her lead would say, "Ey! today, I've enjoyed, I wish one day I'll be like you." (T. Majuta, personal communication, July 10, 2022). This initiative overhauled the model of care in the ICU in Tanzania to deliver quality care as well as improved the culture by creating behavioral change.

It can be difficult to change the status quo, so empowering providers to feel that they have ownership both over their abilities and also in the setting in which they work has shown in this context to be vital. This research exemplifies a systematic approach to strengthening capacity of critical care delivery in limited resource settings, with implications for further innovation in other LMICs. Last, this study has shown what a sustainable QI can look like. It is important to invest in change champions, thus who can promote quality amongst their cohort and

help bring trainings to disseminate information to others. Creating sustainable programs can be difficult, nonetheless, determining the factors that promote its success, such as in this research, can impart a clearer understanding of the path forward to better quality care no matter the resource limitation.

Strengths

The strength of this research was in the partnership with the local providers, leaders and champions at the National Hospital. The research was founded in cultural humility, ensuring that all stakeholders had a voice and that the research reflected the needs of the population rather than just the aims of the researchers. Moreover, the research had very tangible outcomes that could be seen directly following the conclusion of training for the participants.

This manuscript contributes to the existing literature on quality improvement, change management and care in limited-resource settings. While there is existing research on quality improvement and change manage and, separately, on care in low-resource settings, change management, QI and provider perspectives have not necessarily been fully investigated. Other research in Tanzania has primarily focused on people in higher-level positions and their perspectives. Since providers are integral to the success of care (Mosadeghrad, 2012; Aveling et al., 2012; Mwidunda & Eliakimu, 2015), their understanding and feelings toward QI and training programs are important to distinguish. Given the possibility for more wide-reaching implications on healthcare institutions and the effect on patient outcomes, this study allows for a more nuanced dialogue about the essential pillars of QI. Therefore, this research points towards sustainable changes, QI processes and what guides culture to engender changes in low-resource settings.

Limitations

There were a number of limitations inherent in this research. As respondents for the IDI were volunteers and the schedule of all providers was extremely busy, there was a small sample of respondents. Moreover, due to resource and equipment constraints, trainings had to be moved and may have impacted the outcome of the trainings. With regards to weaknesses, the researcher wanted was constrained by the availability of data and whether participants attended the training. As such, this may have skewed the data. Since snowballing methodology was employed to recruit volunteers for the IDIs, this may have created a bias as to who were respondents. Other methods may have created a different environment for respondents to participate. The scope is limited to critical care workers, as the objective of the training was to target this population. Some providers may have avoided interviewing due to a language barrier. Additionally, interviews and feedback can be considered subjective to some degree and so this may have affected data collected.

RECOMMENDATIONS

This research aimed to elucidate a more robust understanding of how to transform quality of care delivered in a low resource setting, especially considering the gap in published research amongst LMICs.

In order to better facilitate quality in a critical care setting, it will be important to draw from these findings to shape future programs, noting the key role that providers play in the uptake of any program and understanding the insight they provide from their integral position in patient-facing care. As such, there are many avenues for future research, which include but are

not limited to: a longitudinal understanding of critical care skills amongst ICU providers, other factors that influence the success of QI and how to promote and prioritize quality care in limited resource settings.

Since this research primarily trained and involved nurses, as they have an integral role as part of the healthcare team. The data underscores that a program that involves nurses can be extremely successful. Further initiatives at the National Hospital and in other LMICs should include and prioritize involving nurses. This will serve to further strengthen the uptake of a QI program as well as improve the delivery of care across the hospital.

Conclusion

In conclusion, this research had enabled a more in-depth understanding of the fabric of the quality improvement program at the National Hospital in Dar es Salaam, and what the perceptions of QI and the training program are amongst respondents. In the quantitative portion, this research has found a significant increase in the technical competence of providers and increase in the desire to change their practice to reflect the skills they have learned and better the quality of care they deliver. In the qualitative component of this research, the main finding demonstrated a generally positive view of the trainings and QI, a drive to help patients, the importance of change management and a number of factors that respondents felt influence the success of QI.

QI has proven to help mitigate negative patient outcomes and limit the spread of infectious disease (Murthy & Adhikari, 2013; Said, 2012). When providers are more knowledgeable, they are better able to provide quality care (Nangawe, 2012; Lifvergren, 2013). This research has demonstrated the importance of training. Training improved the technical

competence of the participants. Moreover, it increased the confidence in responding to emergency issues in the critical care setting. The research also highlighted the importance of change management. There have been many questions as to how to best help both individuals and institutions change (Moran & Brightman, 2000; Kramer & Magee, 1990). It can be difficult to change the status quo, so empowering providers to feel that they have ownership both over their abilities and also in the setting in which they work has shown in this context to be vital. This research exemplifies a systematic approach to strengthening capacity of critical care delivery in limited resource settings, with implications for further innovation in other LMICs. Last, this study has shown what a sustainable QI can look like. It is important to invest in change champions, thus who can promote quality amongst their cohort and help bring trainings to disseminate information to others. Creating sustainable programs can be difficult, nonetheless, determining the factors that promote its success, such as in this research, can impart a clearer understanding of the path forward to better quality care no matter the resource limitation.

CHAPTER 6: Extended Results

Table 5. Ranked Quality of the Sessions According to Trainees

	Very Poor	Poor	Average	Good	Very Good
VSDT Quality of the Session				7 (26.9%)	19 (73.1%)
BGM Quality of the Session				4 (15.4%)	22 (84.6%)
CPBR Quality of the Session				7 (26.9%)	19 (73.1%)
Introduction to CC Concepts Quality of the Session				9 (34.6%)	17 (65.4%)
VSDT Relevance of the Session				6 (23.1%)	20 (76.9%)
BGM Relevance of the Session				3 (12.0%)	22 (88.0%)
CPBR Relevance of the Session				7 (28.0%)	18 (72.0%)
Introduction to CC Concepts Relevance of the Session			1 (3.8%)	6 (23.1%)	19 (73.1%)
VSDT Trainers' Delivery of Information				2 (7.7%)	24 (92.3%)
BGM Trainers' Delivery of Information			1 (3.8%)	3 (11.5%)	22 (84.6%)
CPBR Trainers' Delivery of Information			1 (4.0%)	2 (8.0%)	22 (88.0%)
Introduction to CC Concepts Trainers' Delivery of Information				8 (30.8%)	18 (69.2%)
Rank quality of trainers (OLD EVAL)	1 (2.4%)		1 (2.4%)	2 (4.9%)	37 (90.2%)

Table 6. Ranked Likelihood this Information will be Used in Practice According to Trainees

	Very Unlikely	Unlikely	Neither Unlikely nor Likely	Likely	Very Likely
VSDT				6 (23.1%)	20 (76.9%)
BGM				3 (12.0%)	22 (88.0%)

CPBR		1 (4.0%)		7 (28.0%)	17 (68.0%)
Introduction to CC Concepts			1 (4.3%)	1 (4.3%)	21 (91.3%)

Table 7. Ranked Length of Time for each Session According to Trainees

	Too Short	Just Right	Too Long
VSDT	3 (11.5%)	17 (65.4%)	6 (23.1%)
BGM	3 (11.5%)	18 (69.2%)	5 (19.2%)
CPBR	4 (15.3%)	15 (57.7%)	7 (26.9%)
Introduction to CC Concepts	4 (15.4%)	17 (65.4%)	5 (19.2%)
Time for Q&A (NEW EVAL)	1 (4.2%)	19 (79.2%)	4 (16.7%)
Time for Q&A (OLD EVAL)	3 (7.3%)	34 (82.9%)	4 (9.8%)
Time for Practice/Case Discussions (NEW EVAL)	3 (13.6%)	16 (72.7%)	3 (13.6%)
Time for Practice/Case Discussions (OLD EVAL)	3 (7.3%)	36 (87.8%)	2 (4.9%)
Rate Length (OLD EVAL)	10 (24.4%)	4 (9.8%)	27 (65.9%)

Table 8. Ranked Overall Course According to Trainees

	Very Poor	Poor	Average	Good	Very Good
Rank overall course				9 (34.6%)	17 (65.4%)

Table 9. Ease to Attend According to Trainees

	Not Easy	Somewhat Easy	Neither Not Easy nor Easy	Easy	Very Easy
Ease to attend (NEW EVAL)	1 (5.3%)	3 (15.8%)	1 (5.3%)	14 (73.7%)	
Ease to attend (OLD EVAL)	6 (15.0%)	13 (32.5%)		21 (52.5%)	

Table 10. Likelihood to Change Practice after Training According to Trainees

	Very Unlikely	Unlikely	Neither Unlikely nor Likely	Likely	Very Likely
How likely will these sessions change your practice				9 (36.0%)	16 (64.0%)

Table 11. Satisfaction with Learning According to Trainees

	Very Dissatisfied	Dissatisfied	Neither Dissatisfied nor Satisfied	Satisfied	Very Satisfied
How satisfied with what was learned				13 (50.0%)	13 (50.0%)

Table 12. Usefulness of Handouts According to Trainees

	Not at all Useful	Somewhat Useful	Very Useful
How useful were handouts		5 (12.8%)	34 (87.2%)

Table 13. Changes in Percent Correct Amongst Respondents in CPBR Test Once Question Stem was Altered for Clarity between Groups 2 and 3 Sessions.

	Q7		**Q8**	
	Pre	Post	Pre	Post
Group 1&2	15 (24.2%)	34 (61.8%)	29 (46.8%)	40 (74.1%)
Group 3&4 (Improved Question Stem)	9 (34.6%)	22 (84.6%)	16 (61.5%)	22 (84.6%)

When calculating a paired t-test where group12 is considered pre and group34 is considered post, the paired t-test is significant: p value = 0.0153, t= 5.0151
*See **Table 2** or **Table 14** for Question Topic

Table 14. Percent Correct per Question on Pre versus Post Test CPBR

CPBR	**Pre-Test % Correct (n=75)**	**Post-Test % Correct (n=67)**
Q1 (Action for Unresponsive Patient without Pulse)	64 (85.3%)	63 (94.0%)
Q2 (CPR Components)	71 (94.7%)	64 (95.5%)
Q3 (Rate for Chest Compressions)	30 (40.0%)	64 (95.5%)
Q4 (Depth for Chest Compressions)	36 (48.0)	58 (86.6%)
Q5 (Steps after each Chest Compressions)	21 (28.0%)	31 (46.3%)
Q6 (When are Interruptions for Chest Compressions Allowed)	27 (36.0%)	27 (40.3%)
Q7 (When to Switch Compressors)	18 (24.0%)	45 (67.2%)
Q8 (Method to Open Airway for Patient with Head/Neck Trauma)	38 (50.7%)	50 (74.8%)
Q9 (What Heart Rhythm Indicates Shock is Needed)	9 (12.0%)	37 (55.2%)
Q10 (Whether to Continue CPR After Shocking Patient)	47 (62.7%)	58 (86.6%)

Table 15. Percent Correct per Question on Pre versus Post Test VSDT

VSDT	**Pre-Test % Correct (n=70)**	**Post-Test % Correct (n=69)**
Q1 (Glascow Coma Scale)	4 (5.71%)	26 (37.7%)
Q2 (Appropriate Airway Sounds)	0 (0.0%)	38 (55.1%)
Q3 (Breathing: Respiratory Rate)	9 (12.9%)	41 (59.4%)
Q4 (Breathing: Oxygen Saturation)	5 (7.14%)	36 (52.2%)
Q5 (Breathing: Ventilator Support Level)	2 (2.86%)	14 (20.3%)
Q6 (Circulation: Heart Rate)	14 (20.0%)	27 (39.1%)
Q7 (Circulation: Systolic Blood Pressure)	9 (12.9%)	17 (24.6%)
Q8 (Steps to Managing Low Respiratory Rate)	0 (0.0%)	1 (1.44%)

Q9 (Steps to Opening and Maintaining an Obstructed Airway)	1 (1.43%)	2 (3.0%)
Q10 (Steps to Managing Low Systolic Blood Pressure)	12 (17.1%)	51 (73.9%)

Please note: All questions had multiple subparts. This table shows how many individuals answered *all* parts correctly. Q1-Q4 had four subparts, Q5-Q8 had five subparts, Q9 had six subparts, Q10 had three subparts. Please see Appendix 2 for questions in detail.

Figure 9. Graphical Representation of Likelihood to Change Practice after Training According to Trainees

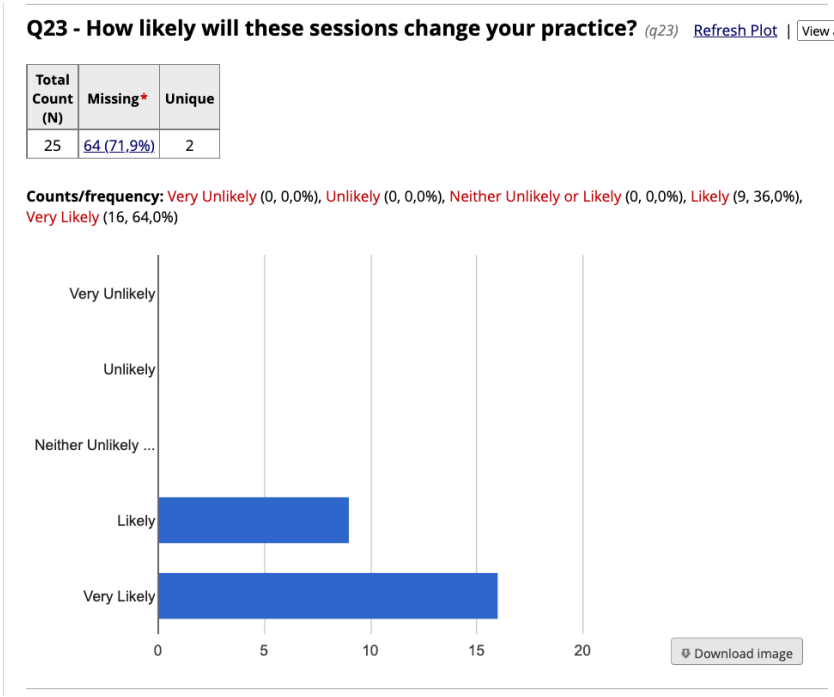


Figure 10. Graphical Representation of Ranked Overall Course According to Trainees

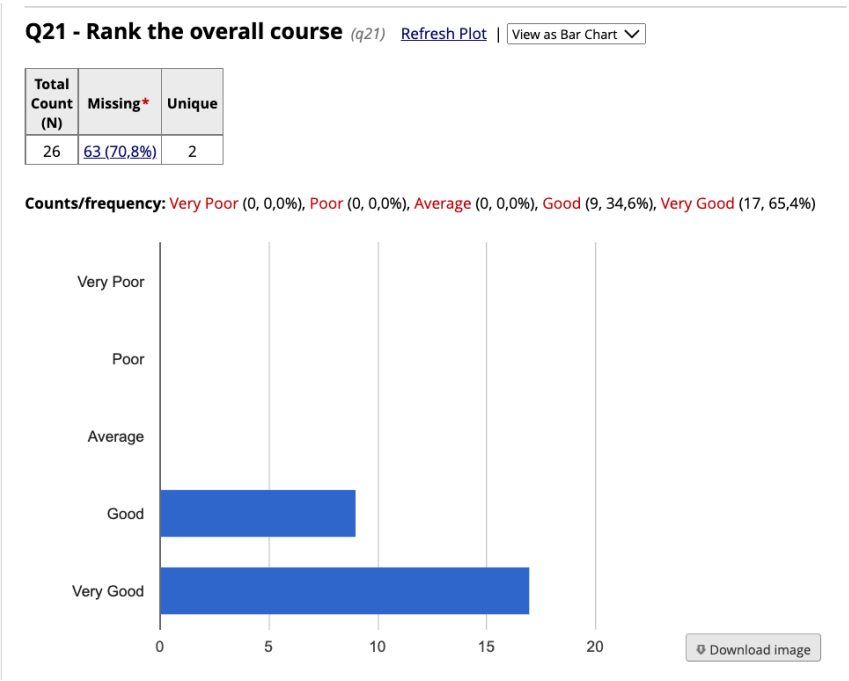


Figure 11. Graphical Representation of Satisfaction with Learning According to Trainees

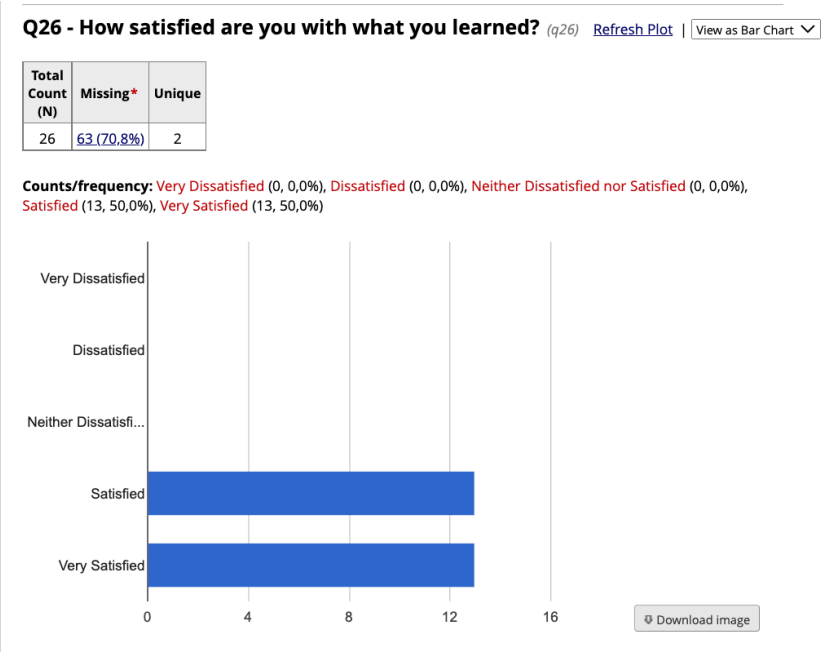


Figure 12. Word Cloud of Most Used Words from Respondents Across all Interviews

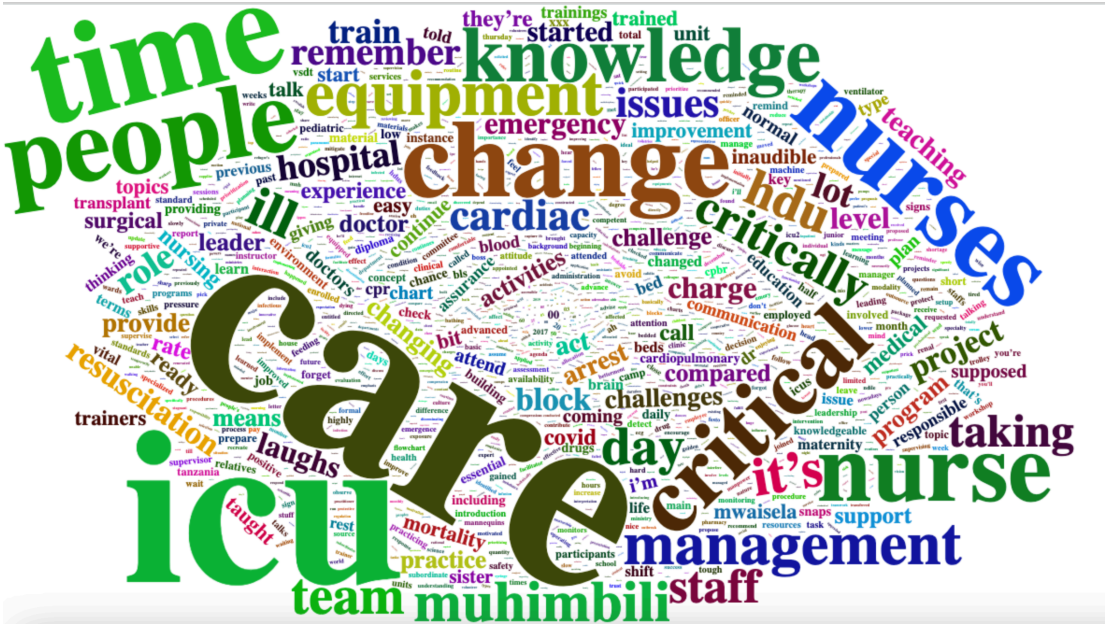


Figure 13. Frequency of Trainings Desired by Respondents

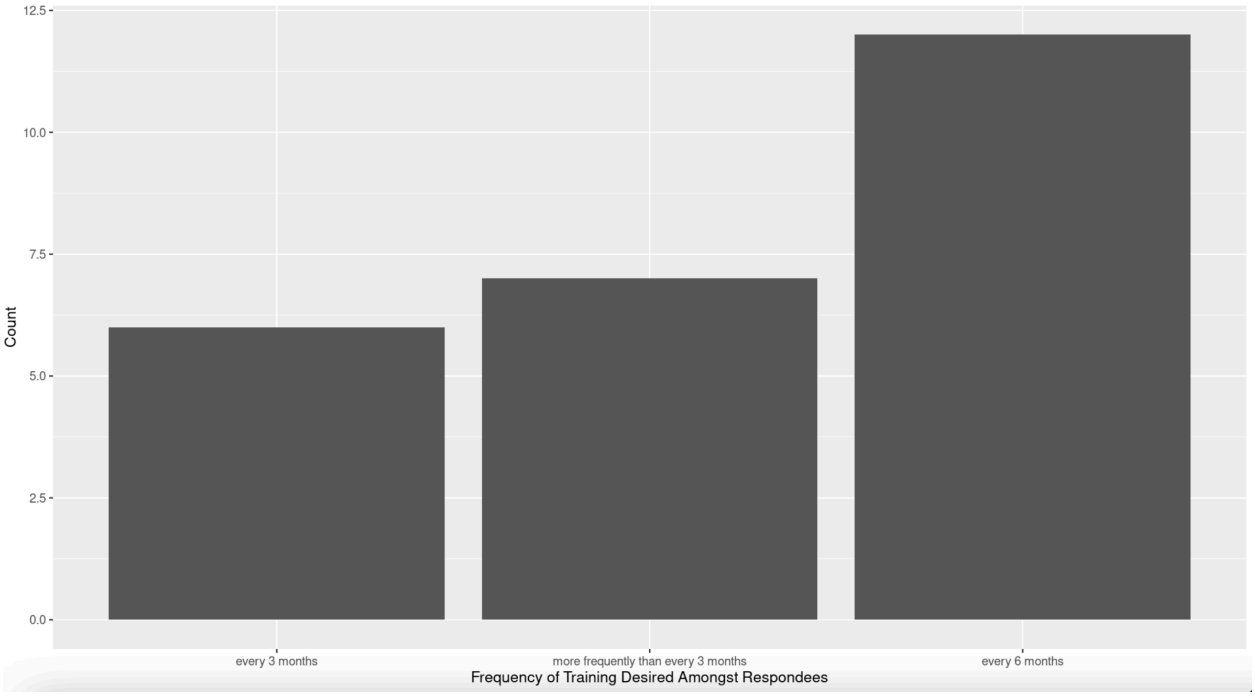


Figure 14. Graphical Representation of Number of Respondents Who Achieved Each Score Level for CPBR Test

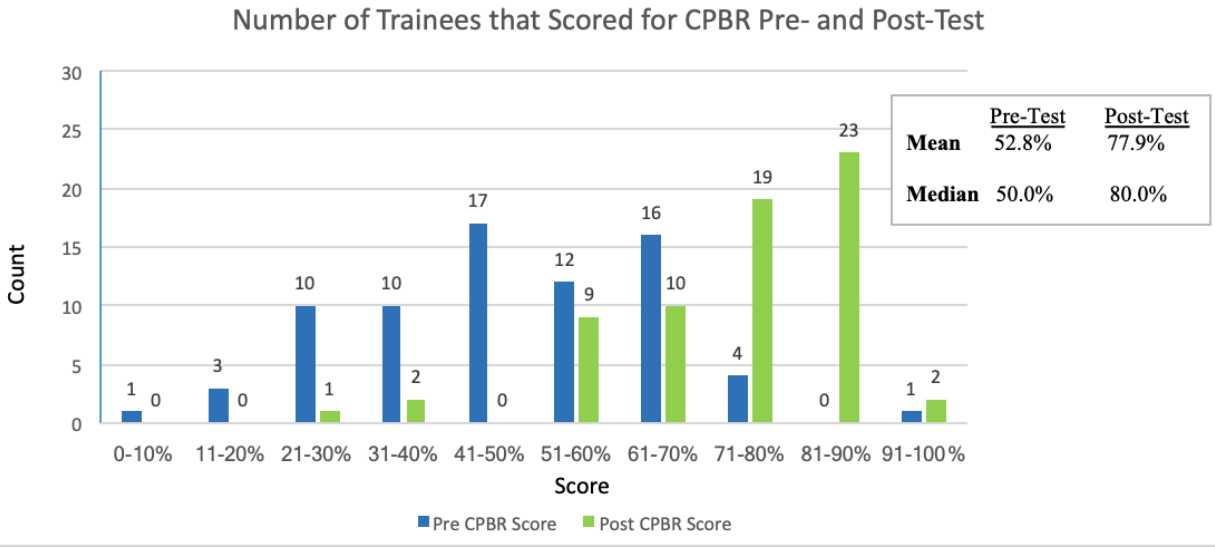


Figure 15. Graphical Representation of Number of Respondents with Change in Percentage Points for CPBR Test

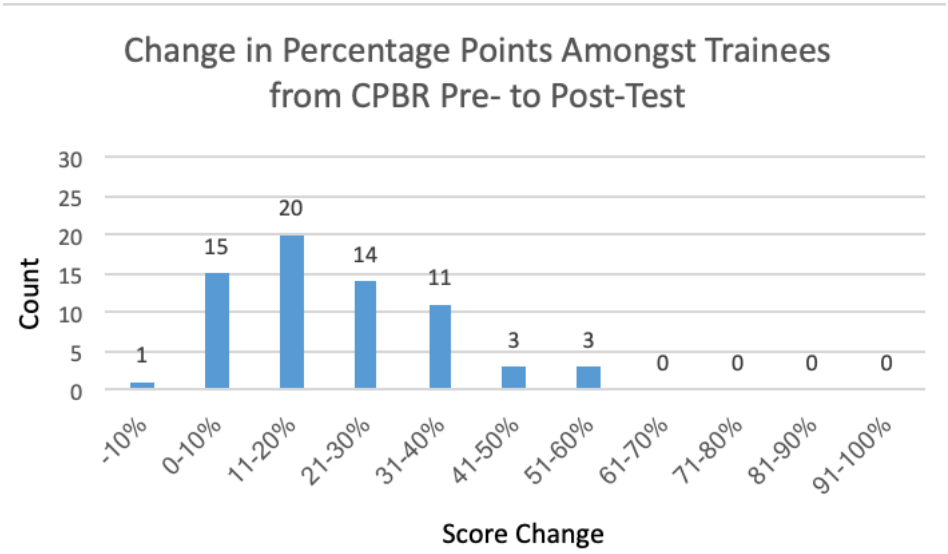


Figure 16. Graphical Representation of Number of Respondents Who Achieved Each Score Level for VSDT Test

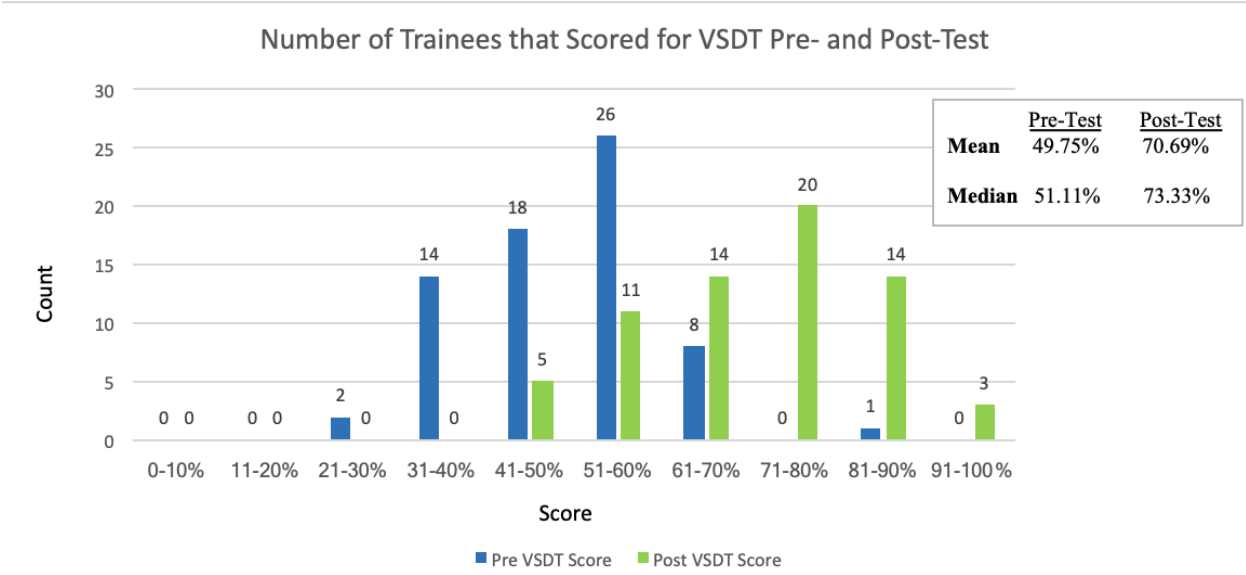
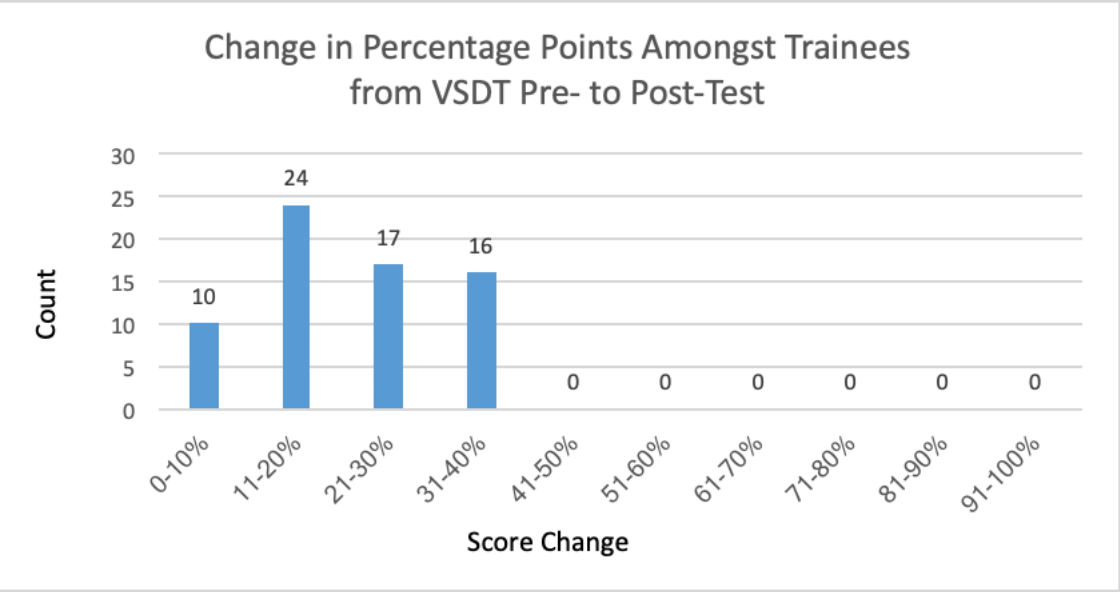


Figure 15. Graphical Representation of Number of Respondents with Change in Percentage Points for VSDT Test



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APPENDICES

Appendix I: In-Depth Interview Guide

QI Tanzania In-Depth Interview Guide:
Research Question: How has the HDU Basic Life Support training at Muhimbili National Hospital affected those who have underwent training?
Study Population: Nurses, Doctors, Staff at Muhimbili National Hospital in Dar es-Salaam, Tanzania
Goal Themes Examined: Change in perspective**;** Change in way care is performed**;** Change in culture/environment of workers**;** Change management

Introduction
Thank you for agreeing to participate in this interview today. My name is Samantha Strelzer. I am a student from a research team at Emory University in Atlanta, GA, USA partnered with the EMPHASIS project. We are conducting interviews among Muhimbili (NURSES/ PHYSICIANS/ HOSPITAL ADMINISTRATORS) like yourself. The purpose of this conversation is to gather current perspectives about the HDU training and Quality Assurance at Muhimbili. Quality assurance is the concept of implementing a program and assessing its success, focusing on the structure, process, and outcome. With the information gathered, we hope to better understand the challenges and successes of the current HDU program. The interview should take approximately 20-30 minutes to complete. Your participation is completely voluntary. If there are any questions that you would like to skip or are uncomfortable with, please let me know. Some of the topics may be sensitive. You may choose to end the interview or withdraw at any point. All information you provide will be kept anonymous and confidential. We will ask for your consent to record this interview momentarily. Your responses are important and valuable to us. We thank you for your participation and for taking the time to assist us with this information today.

Do we have your consent to record this interview? As a reminder, all responses will be kept anonymous and confidential. Y/N

This interview will last about 20-30 minutes. Are you still able to participate? Y/N

Introductory Question
We are going to begin with some questions about yourself and your position here.
1. Please describe your role here at Muhimbili?
    a. Probe: how long have you been in this role? What were you doing previous to this?
    b. Probe: How has your role changed over time?

Main/Key Questions
Module 1: Previous Experience/General Experience
Now, we will ask about Quality Improvement. To remind you, Quality Improvement is implementing a program and assessing its success.
2. What experiences have you had (if any) with Quality Assurance?
    a. Probes: What did it look like? Can you share more?
    b. Probes: What did it feel like to be involved in this experience?

c. F/U: Where was that?

Module 2: Quality Improvement at MNH

3. Can you describe how you were involved in the current Quality Improvement program at Muhimbili?
    a. Probe: why did you get involved in this current Quality Improvement program?
    b. Probe: how did your involvement affect your other roles and responsibilities?
    c. What exactly about this intervention led to the behavior change?
    d. Probe: How did you feel about this intervention? (change culture of unit?)
4. What type of preparation/support did you receive for your involvement, if any?
    a. Probes: Have they been helpful? Why or why not?
    b. Probe: How did the hospital / External/Third-party affect the support you received?
    c. Probe: Is it important to you?
5. Can you describe how your role has changed (if at all) after the HDU training/QI?
    a. Probes: Can you provide any examples?
    b. F/U: why do you consider this a facilitator?
    c. F/U: How did you evaluate that success?
6. Can you describe some of the challenges and facilitators to implementing the HDU training / Quality Improvement project in your department?
    a. Probes: Can you provide any examples?
    b. F/U: why do you consider this a barrier?

Closing Question

Last, we are now going to conclude with some more general questions to end the interview.

7. If EMPHASIS/trainings were to continue, what changes would you make, if any to the program?
8. What recommendations do you have for someone in your position with regards to Quality Assurance/EMPHASIS?

Thank you for your participation today. Your responses are greatly helpful in our research and our aims to improve Quality Improvement. If you have any questions be sure to reach out to Sister XXX, Dr. XXX or myself. Thank you again.

VSDT Pre and Post Test

Trainee ID Number _____

PRE - TEST Vital Signs Directed Therapy (VSDT)

Group Number? _____

Q1 - Glascow Coma Scale

	R	Y	G
GCS 15	○	○	○
GCS 3	○	○	○
GCS 8	○	○	○
GCS 5	○	○	○

Q1 GCS Score _____

Q2 - Airway (Sounds)

	R	Y	G
Snoring	○	○	○
Gurgling	○	○	○
Wheezing	○	○	○
Crepitation	○	○	○

Q2 Airway Sounds Score _____

Q3 - Breathing (Respiratory Rate)

	R	Y	G
RR 15	○	○	○
RR 45	○	○	○
RR 22	○	○	○
RR 7	○	○	○

Q3 RR Score

Q4 - Breathing (Oxygen Saturation)

	R	Y	G
Oxygen Saturation 96%	○	○	○
Oxygen Saturation 94%	○	○	○
Oxygen Saturation 89%	○	○	○
Oxygen Saturation 40%	○	○	○

Q4 O2 Sat Score _____

Q5 - Breathing (Ventilator Support Level)

	R	Y	G
Oxygen in Ventilator (FiO2) 90%	○	○	○
Oxygen in Ventilator (FiO2) 60%	○	○	○
Oxygen in Mask 12L/min	○	○	○
Oxygen in Mask 2L/min	○	○	○
Breathing Air	○	○	

Q5 Breathing Ventilator Support Score _____

Q6 - Circulation (Heart Rate)

	R	Y	G
HR 150	○	○	○
HR 35	○	○	○
HR 60	○	○	○
HR 50	○	○	○
HR 125	○	○	○

Q6 HR Score _____

Q7 - Circulation (Systolic Blood Pressure)

	R	Y	G
SBP 90	○	○	○
SBP 200	○	○	○
SBP 80	○	○	○
SBP 130	○	○	○
SBP 60	○	○	○

Q8 Pre

	Position airway	Clear (head tilt, chin lift, jaw thrust)	Give o2	Suctioning	Secure airway/intubation
Q8 - According to VSDT ABCs, what are the steps to manage a patient with Respiratory Rate (RR) of 50 breaths per minute	☐	☐	☐	☐	☐

Q8 Score _____

Q9

	Position chin	Head tilt, lift	jaw thrust	OPAs	Intubation	Suction
Q9 - According to VSDT ABCs, what are the steps to opening and maintaining a patient's airway that is obstructed?	☐	☐	☐	☐	☐	☐

Q9 Score _____

Q10

	Elevate the foot of bed	Position 30	Give R/L or N/S 500mL in min then assess - recheck vital signs, if 2L given in 2 hrs then call DR
Q10 - According to VSDT ABCs, what are the steps to manage a patient with systolic blood pressure (SBP) of 88mmHg?	☐	☐	☐

Q10 Score _____

Total Pre Score _____

POST - TEST VSDT

Q1 - Glascow Coma Scale

	R	Y	G
GCS 15	○	○	○
GCS 3	○	○	○
GCS 8	○	○	○
GCS 5	○	○	○

Q1 GCS Score Post _____

Q2 - Airway (Sounds)

	R	Y	G
Snoring	○	○	○
Gurgling	○	○	○
Wheezing	○	○	○
Crepitation	○	○	○

Q2 Airway Sounds Score Post _____

Q3 - Breathing (Respiratory Rate)

	R	Y	G
RR 15	○	○	○
RR 45	○	○	○
RR 22	○	○	○
RR 7	○	○	○

Q3 RR Post _____

Q4 - Breathing (Oxygen Saturation)

	R	Y	G
Oxygen Saturation 96%	○	○	○
Oxygen Saturation 94%	○	○	○
Oxygen Saturation 89%	○	○	○
Oxygen Saturation 40%	○	○	○

Q4 O2 Sat Score Post _____

Q5 - Breathing (Ventilator Support Level)

	R	Y	G
Oxygen in Ventilator (FiO2) 90%	○	○	○
Oxygen in Ventilator (FiO2) 60%	○	○	○
Oxygen in Mask 12L/min	○	○	○
Oxygen in Mask 2L/min	○	○	○
Breathing air	○	○	○

Q5 Breathing Ventilator Support Score Post _____

Q6 - Circulation (Heart Rate)

	R	Y	G
HR 150	○	○	○
HR 35	○	○	○
HR 60	○	○	○
HR 50	○	○	○
HR 125	○	○	○

Q6 HR Score Post _____

Q7 - Circulation (Systolic Blood Pressure)

	R	Y	G
SBP 90	○	○	○
SBP 200	○	○	○
SBP 80	○	○	○
SBP 130	○	○	○
SBP 60	○	○	○

Q7 SBP Score Post _____

Q8

	Position airway	Clear (head tilt, chin lift, jaw thrust)	Give o2	Suctioning	Secure airway/intubation
Q8 - According to VSDT ABCs, what are the steps to manage a patient with Respiratory Rate (RR) of 50 breaths per minute	☐	☐	☐	☐	☐

Q8 Score Post _____

Q9

	Position chin	Head tilt, lift	Jaw thrust	OPAs	Intubation	Suction
Q9 - According to VSDT ABCs, what are the steps to opening and maintaining a patient's airway that is obstructed?	☐	☐	☐	☐	☐	☐

Q9 Score Post

Q10

	Elevate the foot of bed	Position 30	Give R/L or N/S 500mL in min then assess - recheck vital signs, if 2L given in 2 hrs then call DR
Q10 - According to VSDT ABCs, what are the steps to manage a patient with systolic blood pressure (SBP) of 88mmHg?	☐	☐	☐

Q10 Score Post

Total POST Score

Score Change

Group Number? _____

PRE - TEST Cardiopulmonary and Brain Resuscitation

Q1 - What would you do when you find an unresponsive patient with no pulse?

- ◯ Start chest compressions
- ◯ Wipe the face with towel
- ◯ Shout for help and start chest compressions immediately
- ◯ None of the above

Q2 - CPR consists of which components?

- Chest compressions
- ◯ Ensure access to
- ◯ airway Rescue
- ◯ breathing
- ◯ All of the above

Q3 - At what rate should chest compressions occur?

- ◯ 60 - 70 compressions/min
- ◯ 90 - 100 compressions/min
- ◯ 100 - 120 compressions/min

Q4 - What is the correct depth for chest compressions for an adult?
cm

- At least 5 cm
- ◯ At least 10
- ◯
- ◯ At least 2.5 cm

Q5 - After each compression, one should:

- ◯ Check the pulse
- ◯ Allow for complete chest
- ◯ recoil Provide rescue
- ◯ breathing
- Yell for help

Q6 - In a routine CPBR rescue, when are interruptions when to chest compressions allowed?

- ◯ When they are less than 10 seconds but never possible
- ◯ When they are less than 30
- ◯ seconds When they are less than
- 15 seconds

Q7 - When would you switch compressors during CPR

- ◯ Every 1 minute
- ◯ Every 30 seconds
- ◯ Every 2 minutes
- ◯ Every 3 minutes

Q8 - Which method should be used to open the airway for a patient with suspected head or neck injury/trauma?

- ◯ Head tilt, chin lift
- ◯ Heimlich
- ◯ Jaw thrust
- ◯ Hyperextension of the neck

◯
◯
◯ Ventricular fibrillation
◯ (VF) Ventricular
◯ tachycardia (VT) Both C and D are correct

Q10 - After shocking the patient, it is no longer necessary to continue with CPR

◯ True
◯ False

PRE-~~test CPBR Score~~

_____

POST - TEST (CPBR)

Q1 - What would you do when you find an unresponsive patient with no pulse?	◯ Start chest compressions ◯ Wipe the face with towel ◯ Shout for help and start chest compressions immediately ◯ None of the above
Q2 - CPR consists of which components?	Chest compressions ◯ Ensure access to ◯ airway Rescue ◯ breathing ◯ All of the above
Q3 - At what rate should chest compressions occur?	◯ 60 - 70 compressions/min ◯ 90 - 100 compressions/min ◯ 100 - 120 compressions/min
Q4 - What is the correct depth for chest compressions for an adult?	◯ At least 5 cm ◯ At least10cm ◯ At least 2.5 cm
Q5 - After each compression, one should:	◯ Check the pulse ◯ Allow for complete chest ◯ recoil Provide rescue ◯ breathing Yell for help
Q6 - In a routine CPBR rescue, when are interruptions when to chest compressions allowed?	◯ When they are less than 10 seconds but never possible ◯ When they are less than 30 ◯ seconds When they are less than
Q7 - When would you switch compressors during CPR	15 seconds ◯ Every 1 minute ◯ Every 30 seconds ◯ Every 2 minutes ◯ Every 3 minutes
Q8 - Which method should be used to open the airway for a patient with suspected head or neck maneuver injury/trauma?	Head tilt, chin lift ◯ Heimlich ◯ ◯ Jaw thrust ◯ Hyperextension of the neck
Q9 - When do you shock the patient during CPR	Asystole ◯ Atrial ◯ flutter ◯ Ventricular fibrillation ◯ (VF) Ventricular ◯ tachycardia (VT) Both C
	and D are correct

POST-test CPBR Score

Total Score Change

Basic Life Support Training Evaluation

Please mark the following sessions attended during the course (select all that apply)

- ☐ Vital Signs Directed Therapy (VSDT)
- ☐ Blood Glucose Monitoring
- ☐ Cardiopulmonary and Brain Resuscitation (CPBR)
- ☐ Introduction to Critical Care Concepts

Vital Signs Directed Therapy

	Very Poor	Poor	Average	Good	Very Good
Q1 - Rank the quality of the session	○	○	○	○	○
Q2 - Rank the relevance of the session	○	○	○	○	○
Q3 - Rank the delivery of information from the trainers	○	○	○	○	○

Blood Glucose Monitoring

	Very Poor	Poor	Average	Good	Very Good
Q4 - Rank the quality of the session	○	○	○	○	○
Q5 - Rank the relevance of the session	○	○	○	○	○
Q6 - Rank the delivery of information from the trainers	○	○	○	○	○

Cardiopulmonary and Brain Resuscitation

	Very Poor	Poor	Average	Good	Very Good
Q7 - Rank the quality of the session	○	○	○	○	○
Q8 - Rank the relevance of the session	○	○	○	○	○
Q9 - Rank the delivery of information from the trainers	○	○	○	○	○

Introduction to Critical Care Concepts

	Very Poor	Poor	Average	Good	Very Good
Q10 - Rank the quality of the session	○	○	○	○	○
Q11 - Rank the relevance of the session	○	○	○	○	○
Q12 - Rank the delivery of	○	○	○	○	○

Rank the likelihood you think you will use the information from each session in your practice

	Very Unlikely	Unlikely	Neither Unlikely or Likely	Likely	Very Likely
Q13 - Vital Signs Directed Therapy (VSDT)	○	○	○		○
Q14 - Blood Glucose Monitoring	○	○	○	○	○
Q15 - Introduction to Critical Care Concepts	○	○	○		○
Q16 - Cardiopulmonary and Brain Resuscitation (CPBR)	○	○	○		○

Rank the length of time for each session

	Too Short	Just Right	Too Long
Q17 - Vital Signs Directed Therapy	○	○	○
Q18 - Blood Glucose Monitoring	○	○	○
Q19 - Cardiopulmonary and Brain Resuscitation	○	○	○
Q20 - Introduction to Critical Care Concepts	○	○	○

General Course Evaluation

Q21 - Rank the overall course

Very Poor
○ Poor
○ Poor
○ Average
○ Good
○ Very Good

Q22 - How easy was it to arrange time to attend?

Not Easy
○ Somewhat
○ Easy
○ Neither Not easy nor
○ Easy
○ Easy
Very Easy

Q23 - How likely will these sessions change your practice?

○ Very Unlikely
○ Unlikely
○ Neither Unlikely or
○ Likely
○ Likely
Very Likely

Q24 - Rate the time for questions and answers

○ Too

Right
Too
Long

Q25 - Rate the time for practice/case discussions

Too
Short
Just
Right
Too
Long

Q26 - How satisfied are you with what you learned?

- ◯ Very Dissatisfied
- ◯ Dissatisfied
- ◯ Neither Dissatisfied nor
- ◯ Satisfied
- ◯ Satisfied
  Very Satisfied

Q27 - What changes (if any) would you make to the training program overall?

Q28 - How frequently should these trainings occur (refreshers, monthly, every 6 months, etc.)

Q29 - What is the most useful thing you learned in training?

Q30 - What kinds of training (in general) would you like to see the unit deliver in the future