Assessment of shock management practices on patient outcomes at the intensive care units in Kisumu County, Kenya

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ABSTRACT

Shock continues to be a leading cause of death for critical illness patients, especially in developing nations where critical care facilities are inadequate and the use of best practices by medical professionals is inconsistent. There is inadequate information on the preparedness of facilities, compliance by medical personnel with shock management protocols, and patient outcome in Intensive Care Unit [ICU] facilities in Kenyan counties. **:** To assess the level of facility readiness for shock management in intensive care units of selected hospitals Kisumu County, Kenya and to determine the level of adherence to established shock management protocols among healthcare providers in intensive care units of selected hospitals Kisumu County, Kenya. The research adopted the Structure Process Outcomes Model by Donabedian. An integrated methodological concurrent cross-sectional analysis was carried out in four hospitals with functional Intensive Care Units in the county of Kisumu. Healthcare practitioners in shock management and retrospective documentation of adult patients with shock admitted during the period of April 2023 to April 2024 were enrolled into the study. The sample size consisted of 142 respondents who were recruited through the use of census technique. Census technique was utilized to recruit all 142 eligible health care practitioners; whereas 237 records of the patients were reviewed retrospectively; purposive sampling was used to identify 12 key informants and four focus group discussions among 32 health care practitioners. The research was carried out through the use of structured questionnaires, facility audit checklist, clinical observation checklist, retrospective medical record form, key informant interviews, and focus group discussion. Quantitative data were analyzed using descriptive and inferential statistical methods, such as chi-square test, t-test, ANOVA, Mann-Whitney U test, Kruskal Wallis test, multiple linear and logistic regressions. The level of the facilities' readiness greatly differed among the hospitals, with the private hospitals being more structurally ready than the public hospitals ($F(3,131)=18.76$, $p<0.001$). The differences were significant regarding the functionality of the equipment ($\chi^2=12.45$, $p=0.006$), availability of the specialists, medication supply, and staffing. The healthcare professionals scored an average knowledge of 61.4%±12.8%, with consultants scoring highest and the Kenya Registered Community Health Nursing (KRCHN) nurses scoring lowest. Significant disparities in facility readiness and adherence to evidence-based shock management protocols exist across Intensive Care Units in Kisumu County and are associated with poor patient outcomes. Strengthening Intensive Care Unit infrastructure, ensuring consistent availability of essential equipment and medications, improving healthcare provider training, and promoting timely adherence to standardized shock management protocols are essential to improve survival among critically ill patients.

Keywords: Critical Care, Donabedian Model, Facility Readiness, Intensive Care Unit, Kenya, Patient Outcomes, Protocol Adherence, Shock Management

I. INTRODUCTION

Across the globe, shock continues to be a leading cause of death in critically ill patients. Septic shock is one of the most prevalent types of distributive shock, affecting millions of people yearly and resulting in significant ICU mortalities around the world. According to research studies, an estimated 49 million cases of sepsis develop across the globe each year, resulting in about 11 million deaths, which constitute nearly 20 percent of all deaths across the world (Rudd et al., 2020). In high-income countries, advancements in critical care delivery through the introduction of protocols of care delivery, improved monitoring, faster diagnoses, and goal-directed therapy have led to decreases in mortality rates due to shock during the past twenty years (Omullo, 2026). Programs such as the Surviving Sepsis Campaign have advocated for the early detection of shock and the timely provision of antibiotics, fluids, and vasopressors.

The prevalence of shock among people in sub-Saharan Africa is made even worse by the fact that there are other diseases which make one vulnerable to shock. For instance, conditions like malaria, tuberculosis, HIV/AIDS, bacterial infections, injuries and obstetrics make one prone to shock. The other problem that exists in many African countries is that there are not enough ICU facilities as well as critical care facilities for shock management. According to some

researchers, less than one-third of the healthcare facilities have access to critical interventions like vasopressors, mechanical ventilators and monitors (Abate et al., 2023).

In Kenya, there are various problems encountered during shock management in the country because of the availability of medical facilities in the health centers which is based on the devolved health care structure. From existing research carried out in referral hospitals, the mortality rate of patients suffering from shock remains very high and at times more than 60% (Treml et al., 2022; Hopkinson et al., 2021). There are several reasons for such a high mortality rate among them are; late administration of antibiotics, poor fluid resuscitation, poor monitoring, and shortage of trained personnel and lack of necessary drugs (Ministry of Health, Kenya, 2020).

The Kisumu County is one of the areas in which such difficulties are expected to be prevalent. The region is characterized by a relatively high disease burden, particularly that of the infectious type, which includes malaria and HIV. This situation makes patients more vulnerable to severe infections and complications resulting from shock. Additionally, cases of traumatic injury and obstetric emergencies remain one of the main causes of critical illness, which requires intensive care. Despite the disease burden in the area, the inadequate capacity for intensive care units, staffing problems, and inconsistent access to critical care resources might have an impact on the quality of treatment of the condition under investigation. Currently, the available literature lacks information about the level of facility readiness, health care provider adherence to evidence-based guidelines, and patients' outcomes in relation to shock management in Kisumu County. Thus, there is a need to develop context-based evidence on shock management practices in Kisumu County. This research aims to fill the existing gap in knowledge through evaluation of facility readiness, health care provider practices, and patients' outcomes with regards to shock management in selected intensive care units in accordance with the Donabedian model.

1.1 Statement of the Problem

Shock is a life-threatening condition characterized by a severe malfunctioning of circulation, requiring quick detection and intervention within ICUs to prevent organ dysfunction and mortality. Unfortunately, despite the application of the best practices of shock management, there are poor patient outcomes globally, particularly in developing countries owing to the inefficiencies within the healthcare system (Rudd et al., 2020). Such challenges faced by the ICUs include lack of critical care equipment, diagnostic tools, human resource, and drugs that could help with shock management (Abate et al., 2023). These challenges would impede the processes of diagnosis and treatment, hence leading to poor patient outcomes. The resource differences between the public and private hospitals within Kisumu County affect staffing, laboratory services, monitoring, and drugs availability (Musungu et al., 2023; Waruru et al., 2025). In addition, there is a paucity of information about the patient outcomes with respect to shock management protocol and protocol adherence within ICUs in Kisumu County. As such, this study aims at investigating facility readiness, shock management protocol adherence, patient outcomes, and perception in ICUs within Kisumu County from the perspective of Donabedian model.

1.2 Research Objective

i. To assess the level of facility readiness for shock management in intensive care units of selected hospitals Kisumu County, Kenya.
ii. To determine the level of adherence to established shock management protocols among healthcare providers in intensive care units of selected hospitals Kisumu County, Kenya.

II. LITERATURE REVIEW

2.1 Theoretical Review

2.1.1 The Donabedian Model

The Donabedian (1966) model will serve as the main theoretical background for this study. The model identifies three interrelated constructs for defining quality of care: Structure (resources and systems), Process (activities in the clinic), and Outcome (patient outcome). According to this theory, structural elements influence processes in the clinic that in turn affect patient outcomes. The Donabedian model is suitable for assessing care in cases of shock because this approach allows one to look at both resources, clinical processes, and patient outcomes simultaneously and determine what needs to be changed (Campbell et al., 2000).

This model has been extensively used in critical care research. For instance, Essendi et al. (2015) have used this framework in the study of nutritional support in European ICUs and proved that structure factors (availability of protocols and dietitians) influence processes (timing of starting of nutrition) and outcomes (mortality and length of stay). In low-resource settings, the framework has been used in the assessment of care for emergencies in obstetrics (Essendi et al., 2015) and neonatal intensive care (Moxon et al., 2019).

Moore et al. (2015) validated the Donabedian Structure-Process-Outcomes (SPO) model through empirical findings derived from 23,584 trauma cases managed under an integrated trauma system in Canada. The research showed

that facilities that exhibited a higher level of structural capacity such as resource endowment and personnel were more likely to have higher compliance to evidence-based processes. This greatly enhanced the patient outcomes and lowered mortality rates. In this regard, it was clear that healthcare quality depends on the interplay between structure, process, and outcomes; hence, validating the Donabedian model as an evaluation tool for healthcare performance. Nonetheless, the study failed to investigate how the readiness of healthcare facilities, compliance to evidence-based shock management protocols, and patient outcomes interrelate within intensive care units. This created a gap in the literature which the current study sought to fill by analyzing these related factors using the Donabedian model in adult ICUs of Kisumu County, Kenya.

Dedius et al. (2026) used the qualitative case study protocol to assess the views of healthcare providers on the early recognition and management of acute kidney injury among children in rural Tanzania applying Donabedian's Structure–Process–Outcome (SPO) model as a theoretical basis for the analysis. Specifically, the researchers proposed conducting in-depth interviews with healthcare providers to explore the impact of structure-related variables, clinical process, and healthcare outcome on the quality of acute kidney injury management in low-resourced facilities. Dedius et al. (2026) noted that the SPO model presents an excellent tool for identifying all the factors contributing to the poor outcomes of patients. Moreover, it highlights the necessity to incorporate the views of healthcare providers to identify the challenges associated with the implementation of evidence-based practices. Nevertheless, as the protocol, it does not provide any empirical findings or analyze the relationship between facility readiness, adherence of healthcare providers to evidence-based shock management practice, and patients' outcomes. This is the gap which the current study fills through empirical analysis of these variables within the framework of the SPO model.

2.2 Empirical Review

2.2.1 Facility Readiness for Shock Management

According to Eisenberg et al. (2025), in the retrospective cohort study conducted by them, epinephrine and norepinephrine have been compared as the principal vasopressor used in the treatment of septic shock in pediatrics. This study focused on in-hospital mortality rate, organ dysfunction, ICU admission time, and further vasopressor needs. Findings of this study have found that the children receiving norepinephrine have lower chances of mortality rate, organ dysfunction, ICU stay, and need of any other vasopressor. Nevertheless, the study only targeted children and examined the effectiveness of vasopressor therapy without considering facility readiness, adherence of health care providers to evidence-based shock protocols, and organizational factors that might affect patient outcomes in adult ICUs. There is little evidence concerning the interrelatedness of these aspects in resource-limited county hospitals in Kenya. This study seeks to fill the existing gap by investigating the issues of facility readiness, provider adherence, and patient outcomes among adult patients with shock in selected ICUs in Kisumu County.

Hernández et al. (2022) conducted a cohort study to evaluate the influence of the implementation of Sepsis Code Program on the treatment of sepsis patients in the Internal Medicine ward. The study involved conducting pre-intervention and post-intervention assessments to evaluate the sepsis management protocol adherence, antibiotic administration, length of stay, and mortality rates of the patients. Findings from this study revealed that the use of the Sepsis Code Program led to better adherence to evidence-based practices, timely administration of antibiotics, and a reduction in mortality. The authors concluded that standardized protocols increase quality and timely management of sepsis. The study however, investigated only sepsis management at the internal medicine ward that was highly resourced without investigating facility readiness, knowledge of healthcare providers, and adherence to protocols among different shock categories in adult ICUs. As a result, there was lack of evidence on facility readiness, healthcare providers' adherence, and outcomes in adult ICUs in resource-limited facilities. This gap was bridged by this study through investigation of facility readiness, adherence to shock management practices, and outcomes in adult ICUs in Kisumu County, Kenya.

A pre/post study design was conducted by Lee et al. (2024) to evaluate the impact of the introduction of point-of-care lactate testing on the implementation of the sepsis bundle and patient outcomes in the emergency room. In this case, the study was meant to assess the impact of point-of-care lactate testing on the patient management process through the measurement of lactate levels, implementation of the sepsis bundle, antibiotic prescription and patient outcomes. According to the findings of the study, point-of-care lactate testing had a great impact on sepsis bundle implementation and patient outcomes. Nonetheless, the study was done in an emergency department setting in a well-resourced health facility and only examined one diagnostic intervention. The study did not investigate facility preparedness for the management of septic shock, healthcare provider compliance with shock management guidelines, or patient outcomes in adult ICUs. There was lack of information on the inter-related variables in resource-limited county hospitals. In this regard, the current study aimed to fill this gap in knowledge by examining facility preparedness, healthcare provider compliance with shock management guidelines and patient outcomes in adult ICUs in Kisumu County, Kenya.

Adaptation of the Sepsis 1-Hour Bundle to Resource Limited Healthcare Facilities in Turkana County, Kenya was investigated by Omullo (2026). It was found that the feasibility of implementation of evidence-based sepsis management guidelines could be enhanced by contextually adapting the guidelines in order to account for low

infrastructural capacity, personnel shortages, and lack of diagnostics in healthcare facilities. The study concluded that adaptation of international guidelines for sepsis management to local realities would increase the effectiveness of shock management in resource-poor environments. However, this research study was mostly devoted to contextual adaptation of sepsis protocols and paid little attention to assessment of the readiness of facilities and healthcare providers to implement evidence-based shock management practices, along with its relation to the health outcomes. In other words, there is very little data concerning these interrelated issues in intensive care units of counties in Kenya. The present study was designed to fill in this gap.

2.2.2 Healthcare Providers' Adherence to Evidence-Based Clinical Processes

Caggegi et al. (2026) investigated the extent to which clinical guidelines regarding cardiogenic shock management were being followed and its effect on the delivery of care. In their research, the researchers sought to determine whether there existed any difference between adherence levels and health professionals' provision of recommended services such as early hemodynamic evaluation, prompt provision of vasopressor and inotropic therapy, and mechanical circulatory assistance among others. Results indicated that greater adherence to recommended practices resulted in better patient management and outcomes while the variations in compliance were attributable to differences in available resources and practice at institutions. As a result, the authors recommended the need for greater compliance with guidelines for optimal cardiogenic shock management. Nevertheless, the study considered only cardiogenic shock and did not look into facility readiness, healthcare professionals' compliance with evidence-based practices and patient outcomes across shock categories in resource-limited adult ICUs. Thus, information on the above areas in counties hospitals was still lacking. This study seeks to fill this gap through an investigation of facility readiness, adherence to evidence-based practices and patient outcomes in all shock categories in adult ICUs in Kisumu County, Kenya.

A descriptive exploratory study was conducted by Elsayed (2025) to assess the knowledge and practice of nurses regarding patients suffering from hypovolemic shock in the intensive care unit of Hehia Central Hospital in Egypt. In the study, a convenient sample of 100 nurses working in the ICU of the selected hospital was studied using self-administered questionnaires and observational checklists as instruments for data collection. Results of the study showed that 59.0% of the nurses exhibited poor knowledge and 56.0% of them had poor clinical practice when taking care of the patients with hypovolemic shock. Moreover, there was a very strong positive correlation between nurses' knowledge and practice levels as indicated by highly statistically significant relation ($p < 0.001$). However, it should be mentioned that the study concentrated on nurses taking care of patients with hypovolemic shock in one hospital and did not examine facility readiness, adherence of other healthcare providers, and patients' outcomes. The present study was aimed to address this research gap by studying facility readiness, healthcare providers' adherence to evidence-based shock management practices, patients' outcomes, and healthcare providers' perceptions in adult ICUs in Kisumu County, Kenya.

Through their cross-sectional study done in Germany with a national sample approach, Ehrenbrusthoff et al. (2022) assessed the level of evidence-based practice (EBP) adherence and the factors affecting EBP adoption by healthcare practitioners. In the study, 889 healthcare professionals participated which included nurses, physicians, physiotherapists, occupational therapists, and speech therapists, and filled the standardized online questionnaire. Findings revealed that the level of adherence to evidence-based practice was moderate among all healthcare professionals, and implementation was significantly related to EBP knowledge, positive attitude, leadership support, and availability of scientific evidence. Healthcare professionals who underwent formal EBP training had significantly better implementation of evidence-based practice compared to those who were not under EBP training ($p < 0.001$). The study suggested that organizational support, professional development, and leaders' support are vital in achieving higher levels of evidence-based clinical practice adherence. Nonetheless, the study was conducted in a high-income country and does not specifically evaluate adherence to evidence-based shock management guidelines and patients' outcomes in resource-poor ICUs. This forms the context in which the current study has been done to evaluate adherence of healthcare providers to evidence-based shock management in adult ICUs in Kisumu County, Kenya.

The study on factors influencing nursing practices and compliance with infection prevention and control interventions regarding neonatal sepsis was done using the cross-sectional study design by Pendo et al. (2025) in selected health facilities within the Pwani Region of Tanzania. The research involved 247 nurses in neonatal units through the administration of structured questionnaires regarding IPC practices and knowledge. According to results, about 68.4% of nurses had good adherence to IPC interventions. Good adherence was significantly associated with provision of IPC training (AOR = 2.71, 95% CI: 1.53–4.79, p = 0.001), presence of IPC guidelines (AOR = 2.34, 95% CI: 1.29–4.22, p = 0.005), and supportive supervision (AOR = 2.18, 95% CI: 1.20–3.95, p = 0.010). The researchers found out that enhancing training, guidelines and support for supervisory activities would improve adherence to evidence-based practices among nurses. The research, however, did not investigate shock management among adult patients but neonatal sepsis in the region under study. This is a contextual gap that the current study fills.

III. METHODOLOGY

3.1 Research Design

The research philosophy underpinning the current study is pragmatism and the research design used was concurrent mixed-methods cross-sectional analysis. In pragmatic research philosophy, there is the support of the combination of quantitative and qualitative research methods since the objective of pragmatism is to seek practical solutions to complicated health care issues (Creswell & Plano Clark, 2017). The use of mixed-methods was appropriate due to the fact that quantitative data facilitated objectivity of measuring the level of readiness of facilities for shock management, health care providers' adherence to evidence-based practices of managing shock and patient outcomes while qualitative data gave an insight on the experiences and perceptions of the healthcare providers regarding the management of shock. The combination of both datasets led to triangulation of the data resulting in enhanced validity and completeness of the findings (Patten, 2016).

3.2 Study Area

The research was carried out in Kisumu County, Kenya, in four hospitals with existing ICUs in adults: Jaramogi Oginga Odinga Teaching and Referral Hospital (JOOTRH), Aga Khan Hospital Kisumu, Avenue Hospital Kisumu, and Nightingale Mililani Hospital. These hospitals were selected based on purposeful sampling method because they are representative of the major sectors in healthcare in the county, which includes public, faith-based, and private healthcare providers. They have varying levels of staffs, facilities, equipment, and resources, which would give chance to the researcher to compare the readiness of the hospitals and the shock management practices in each of them. The county has a high prevalence of shock-related illnesses such as sepsis, malaria, trauma, and obstetric emergencies.

3.3 Target Population

For the study, the target population consisted of the health care providers who were part of shock treatment in ICU and the records of adult patients admitted to the ICU who had been diagnosed with shock. The healthcare providers who met the inclusion criteria were nurses, medical officers, clinical officers, consultants, anesthetists, and physiotherapists who had had at least six months' experience in ICU. Patients whose records were of adults who had been diagnosed with shock and were being treated in the ICU from April 2023 to April 2024 were selected. A total number of 142 subjects were selected using a census method.

3.4 Sampling and sample size

For the quantitative research design, the method of census sampling was adopted. Since the target population was finite, available and manageable, all the 142 eligible healthcare providers in the ICUs of the selected hospitals were surveyed. This census method of sampling was free from any form of sampling errors, thus eliminating the need for any statistical estimation of sample size. For the case of retrospective patient records reviews, all the eligible adult ICU records of patients with shock who were admitted to the hospital within the period of April 2023 and April 2024 were included in the study. From a preliminary examination of ICU admission registers and the hospital records, it was estimated that there would be about 200-250 eligible patient records within the four hospitals. In the qualitative part of the study, purposive sampling was done in order to identify information-rich participants engaged in shock management practices. Eight to ten key informant interviews (2-3 from each hospital) and four focus groups discussion (1 from each hospital comprising of 6-8 members) were conducted.

3.5 Data Collection Instruments and procedures

The data was collected using a structured questionnaire, checklist for clinical observation, checklist for facility audit, form for reviewing patients' records, key informant interview guide, and focus group discussion guide, which were designed based on EECC and shock management guidelines. After obtaining ethical approval and permission from the hospitals taking part in this research, questionnaires were distributed to healthcare professionals, facility audits and clinical observations were conducted, patients' records were reviewed, and KIIs and FGDs were conducted with purposefully selected individuals. The data collection process was performed in the four ICUs that participated in this study between April 2023 and April 2024. The instrument validity was tested by experts, and Content Validity Index (CVI) of 0.92 was achieved. Reliability testing during a pilot study revealed satisfactory results for internal consistency ($\alpha = 0.84$, KR-20 = 0.81) and inter-rater reliability ($\kappa = 0.82$).

3.6 Data Analysis

The quantitative data analysis was performed using the SPSS 25 software package and the R program. Frequency distribution, percentages, mean values, medians, and standard deviation statistics were used to describe the study variables. The inferential statistical methods were chi-square test, t-test, analysis of variance (ANOVA), Mann-Whitney U test, Kruskal-Wallis test, correlation analysis, multiple linear regression, and binary logistic regression. P-

value less than 0.05 indicated the statistical significance. The qualitative data were transcribed and analyzed thematically using NVivo 12 according to the methodological framework of Braun and Clarke.

3.7 Ethical Considerations

The ethical approvals for the research were gotten from Masinde Muliro University Ethics Review Committee, National Commission for Science, Technology and Innovation (NACOSTI), and the participating hospitals. Informed consent was gotten from healthcare providers while for patients' records, the consent was waived. Confidentiality was maintained by keeping anonymity and securing data.

IV. FINDINGS & DISCUSSION

4.1 Demographic Characteristics of Healthcare Providers

The demographics of the healthcare providers involved in the study are highlighted in Table 1. These demographics include age, sex, professional qualification, cadre, years of experience in an ICU setting, highest level of education, past life support training, and employing hospital.

Table 1

Demographic Characteristics of Healthcare Providers

Characteristic	Category	Frequency (n)	Percentage (%)
Gender	Male	58	43.0
	Female	75	55.6
	Prefer not to say	2	1.5
Age Group	20-29 years	48	35.6
	30-39 years	62	45.9
	40-49 years	18	13.3
	50-59 years	3	2.2
	60-69 years	4	3.0
Professional Qualification	KRCHN	52	38.5
	BScN	41	30.4
	MScN	8	5.9
	Medical Officer	14	10.4
	Consultant	6	4.4
	Clinical Officer	8	5.9
	Anesthetist	6	4.4
ICU Experience	<2 years	38	28.1
	2-5 years	52	38.5
	6-10 years	31	23.0
	>10 years	14	10.4
Life Support Training (Last 3 Years)	Yes	79	58.5
	No	56	41.5
Type of Life Support Training (n=79)	BLS only	34	43.0
	BLS + ACLS	28	35.4
	BLS + ACLS + ATLS	12	15.2
	Other combinations	5	6.3

A majority of the subjects were females (55.6%), between 30 and 39 years old (45.9%), and had worked for 2 to 5 years in the ICU (38.5%). The nursing professionals (KRCHN and BScN) comprised the highest proportion of professionals (68.9%). Interestingly, a large proportion (41.5%) of the subjects had no life support training within the last three years, thus showing the need for continuing professional development. Of the subjects that had been trained, 43.0% had received BLS alone, while only 15.2% were well-trained in all aspects.

4.2 Patient Record Characteristics

The total number of patient records evaluated in the four hospitals included admissions between April 2023 and April 2024. HIV/AIDS was the most prevalent comorbidity (28.7%) in light of its high prevalence rate in the region of Kisumu County. More than 30% of the patients had more than one comorbidity.

4.2.1 Level of Facility Readiness for Shock Management in Intensive Care Units

Table 2 shows the extent of facility readiness to manage shocks among the chosen facilities in Kisumu County. The study looked at some structural aspects such as equipment, medication, diagnostics, staffing, and the presence of clinical protocols that would measure how ready the facilities were in managing shocks.

Table 2

Summary of Facility Readiness for Shock Management across Selected Hospitals in Kisumu County

Readiness Component	JOOTRH	Aga Khan	Avenue	Nightingale	Overall Observation
Nurse-to-patient ratio (day)	1:3	1:2	1:2	1:3	Only Aga Khan met recommended staffing levels
Nurse-to-patient ratio (night)	1:4	1:3	1:3	1:4	All hospitals reported staffing deficits
Full-time intensivist availability	No	Yes	No	No	Specialist availability varied substantially
Equipment functionality (%)	80.0	100.0	95.0	77.5	Higher functionality observed in private hospitals
Blood gas analyser availability	Intermittent	Yes	No	No	Limited diagnostic support across facilities
Lactate meter availability	Yes	Yes	Yes	No	Diagnostic limitations observed
Norepinephrine availability (%)	80	100	100	75	Variable access to first-line vasopressors
Meropenem availability (%)	40	100	80	25	Significant antibiotic stock variation
Written shock management protocol	Yes	Yes	Yes	No	Most facilities had protocols
Protocol visibly posted	No	Yes	Yes	No	Accessibility differed across hospitals
Context-adapted protocols	No	No	No	No	No locally adapted protocols available
Composite structural capacity score (%)	64.5	91.5	80.5	54.0	Significant differences across hospitals

Differences in the level of facility readiness for the management of shock situation was noted between the study hospitals. There were differences in the functionality of equipment available in the facilities ($\chi^2 = 12.45$, $p = 0.006$) indicating that there is inequality of access to required materials when managing critical patients in the respective hospitals. There were significant differences in the scores on the composite structural capacity in the various hospitals ($F(3,131) = 18.76$, $p < 0.001$), whereby Aga Khan Hospital was found to be better prepared than the other two hospitals ($p < 0.001$).

Findings from this study are similar to those of Hernández et al. (2022), whereby the implementation of the Sepsis Code Program led to improved compliance with appropriate use of antibiotics and evidence-based practices as well as reduced mortality rates. Similarly, Lee et al. (2024) found out that the point-of-care lactate testing was helpful in improving sepsis bundles' compliance and ultimately improving patient outcomes through early diagnosis. The strong relationship between mortality and cardiogenic shock, septic shock, multiple organ dysfunction syndrome (MODS) and acute kidney injury is in line with the findings by Eisenberg et al. (2025), who found out that evidence-based vasopressors improved patient outcomes. These findings are also supported by Omullo (2026).

4.2.2 Level of Adherence to Established Shock Management Protocols Among Healthcare Providers

Table 3 illustrates the knowledge and compliance levels of healthcare providers in terms of shock management guidelines. It gives an overall summary of their performance based on the knowledge gained in shock management domains by healthcare provider category and institution.

Table 3
Provider Knowledge and Adherence Characteristics

Indicator	Result	Interpretation
Overall knowledge score	61.4 ± 12.8%	Fair performance
Highest professional score	Consultants: 86.7%	Excellent
Lowest professional score	KRCHN Nurses: 52.6%	Poor
Highest hospital score	Aga Khan: 68.5%	Good
Lowest hospital score	Nightingale Mililani: 54.8%	Poor
Shock classification knowledge	72.4%	Relative strength
Recognition criteria	68.2%	Moderate
Fluid resuscitation knowledge	58.6%	Weakness
Vasopressor therapy knowledge	52.4%	Significant weakness
Antibiotic timing knowledge	48.5%	Significant weakness
Overall classification accuracy	81.0%	Moderate diagnostic accuracy

Knowledge differences reported in Table 2 revealed that there is a highly significant difference in knowledge among different professional groups ($F(5,129)=14.28$, $p<0.001$) and different hospitals ($F(3,131)=6.84$, $p=0.003$). Consultants and healthcare providers at Aga Khan Hospital were found to perform significantly better than others. The lack of knowledge was most prominent in the use of vasopressors and timing of antibiotic administration.

In Table 4, there is a comparison of the actual shock management practices, which include the timing of certain procedures against the clinical standards for evidence-based shock management process in the chosen ICUs.

Table 4
Observed Adherence and Timeliness of Shock Management Processes

Clinical Indicator	Adherence (%)	Median Time (hours)	Recommended Standard
Shock recognition	71.4	-	≤30 min
Lactate measurement	38.1	2.5	≤1 hour
Blood cultures before antibiotics	42.9	-	100%
Antibiotic administration	28.6	3.0	≤1 hour
Initial fluid bolus	52.4	1.5	≤30 min
Vasopressor initiation	61.9	4.5	≤6 hours
Repeat lactate measurement	26.2	-	≤6 hours
Urine output documentation	85.7	-	100%

Adherence to interventions observed was always lower than the self-reported adherence rate, thus creating a discrepancy between intention to adhere and adherence to intervention. There were significant discrepancies found between self-reports and observations on timing of administration of antibiotics ($\chi^2=8.42$, $p=0.004$) and lactate assessment ($\chi^2=6.38$, $p=0.012$). Time taken to perform interventions also varied significantly among hospitals (Kruskal-Wallis $H=18.42$, $p<0.001$) with Aga Khan Hospital having the shortest time and Nightingale Mililani taking the longest time. The accuracy of shock classification varied significantly by shock type ($\chi^2=14.28$, $p=0.006$) with cardiogenic and distributive shock having higher misclassification rates.

Factors affecting the knowledge scores of healthcare providers have been analyzed using multiple regression in Table 5. This table provides information about the significant predictors of knowledge and their contributions towards the variation in knowledge scores of providers in selected ICUs.

Table 5
Multiple Regression Analysis for Predictors of Knowledge Scores

Variable	B	SE	β	t	p-value	95% CI
(Constant)	42.36	4.28		9.89	0.0001	33.89-50.83
Professional qualification	6.82	1.24	0.42	5.50	0.0009	4.36-9.28
Years of ICU experience	3.45	0.86	0.28	4.01	0.0005	1.74-5.16
Life support training (yes)	8.94	2.12	0.31	4.22	0.0001	4.74-13.14
Hospital type (private vs. public)	5.28	1.98	0.19	2.67	0.0009	1.36-9.20
Age	1.02	0.94	0.08	1.09	0.279	-0.84-2.88

Model summary: $R^2 = 0.48$, Adjusted $R^2 = 0.46$, $F(5,129) = 23.84$, $p < 0.001$

The model accounted for 46% of the variation in knowledge score (adjusted $R^2=0.46$) showing a relatively good explanatory model. The significant independent variables were: A multiple linear regression model yielded various

significant determinants of healthcare providers' knowledge scores. The professional qualification emerged as the strongest determinant of knowledge score. Consultants, medical officers, and BScN nurses had statistically higher knowledge scores compared to KRCHN nurses. Having undergone life support training during the past three years also contributed to better knowledge score, raising it by 8.94 percentage points on average. Moreover, the number of years of work experience in the ICU positively affected knowledge score, as each additional year increased it by approximately 3.45%. Another significant variable is hospital type, as knowledge score of healthcare providers in private hospitals proved to be higher than in public ones.

The current findings corroborate the work of Caggegi et al. (2026), which showed that high adherence to cardiogenic shock management guidelines enhances patient care and outcomes, with adherence levels depending on the hospital resources and clinical practice. In this regard, the present study also found statistically significant differences between hospitals with regard to knowledge and adherence, whereby private hospitals showed high knowledge levels and intervention time compared with public hospitals. Furthermore, the current results agree with those of Elsayed (2025) that revealed 59% of ICU nurses having inadequate knowledge and 56% demonstrating incompetence during practice, with knowledge being statistically significantly related to clinical practice ($p < 0.001$). Moreover, the current research indicated professional qualifications, ICU experience, and life support training as significant predictors of knowledge. Finally, the current results confirm the findings of Ehrenbrusthoff et al. (2022) and Pendo et al. (2025) who reported the important role of professional training, organizational factors, and clinical guidelines in improving adherence to evidence-based practice. Overall, the findings imply the importance of developing healthcare providers' training, organizational support, and facility readiness for adherence to evidence-based shock management guidelines.

4.3 Patient Outcomes Associated With Shock Management

In Table 6, the distribution of patient outcomes according to shock type is presented in terms of the number of survivors, non-survivors, and their mortality rates for patients admitted to the chosen ICUs.

Table 6

Overall Mortality by Shock Type

Shock Type	N	Survived n (%)	Died n (%)	Mortality Rate (%)
Septic shock	138	58 (42.0)	80 (58.0)	58.0
Hypovolemic shock	52	31 (59.6)	21 (40.4)	40.4
Cardiogenic shock	28	9 (32.1)	19 (67.9)	67.9
Distributive (other)	12	6 (50.0)	6 (50.0)	50.0
Mixed/Undetermined	7	3 (42.9)	4 (57.1)	57.1
Overall	237	107 (45.1)	130 (54.9)	54.9

Total mortality rate was 54.9% with wide variations based on the different shock types (χ^2=11.24, p=0.024). The highest mortality rate was in the cardiogenic shock group (67.9%) and the second highest was in the septic shock group (58.0%). The hypovolemic shock group exhibited the lowest mortality rate (40.4%). Comparisons between shock types showed significant differences between cardiogenic and hypovolemic shock groups (p=0.002)

Table 7 illustrates the distribution of mortality for the selected hospitals, comparing survival rates and mortality results from patients admitted to each ICU.

Table 7

Mortality by Hospital

Hospital	N	Survived n (%)	Died n (%)	Mortality Rate (%)	χ^2	p-value
Aga Khan Hospital	52	32 (61.5)	20 (38.5)	38.5	9.84	0.020*
Avenue Hospital	41	22 (53.7)	19 (46.3)	46.3		
JOOTRH	112	42 (37.5)	70 (62.5)	62.5		
Nightingale Mililani	32	11 (34.4)	21 (65.6)	65.6		

*Statistically significant at p<0.05

Mortality rates varied considerably between hospitals (χ^2=9.84, p=0.020). Aga Khan Hospital reported the least mortality rate (38.5%) whereas Nightingale Mililani reported the highest mortality rate (65.6%). Comparison of mortality rates between pairs of hospitals showed that Aga Khan Hospital's mortality rate was significantly lower than that of JOOTRH (p=0.008) and Nightingale Mililani.

Table 8 displays the ICU stay in relation to shock types and patients' outcomes, showing a comparison of median hospitalization periods of surviving and non-surviving patients in regard to various shock types.

Table 8

Length of ICU Stay by Shock Type and Outcome

Shock Type	All Patients Median (IQR) days	Survivors Median (IQR) days	Non-Survivors Median (IQR) days	Mann-Whitney U	p-value
Septic shock	5 (3-9)	7 (4-12)	4 (2-7)	1842.5	<0.001
Hypovolemic shock	4 (2-7)	5 (3-8)	3 (1-5)	218.0	0.008
Cardiogenic shock	3 (1-6)	6 (4-9)	2 (1-4)	42.5	0.002
Distributive (other)	4 (2-8)	6 (3-10)	2 (1-4)	8.0	0.041
Overall	**4 (2-8)**	**6 (3-10)**	**3 (1-5)**	**4826.5**	**<0.001**

The median duration of ICU stay was 4 days (IQR 2-8). The survivors spent longer time in ICU (median 6 days) than those who did not survive (median 3 days) (U=4826.5, p<0.001). The trend was similar for all kinds of shock states.

Table 9: Median Length of ICU Stay for Selected Hospitals, Comparing Length of Hospital Stay of Patients Treated at Different ICUs.

Table 9

Length of ICU Stay by Hospital

Hospital	Median ICU Stay (days)	IQR	Range	Kruskal-Wallis H	p-value
Aga Khan Hospital	5	3-9	1-21	8.42	0.038*
Avenue Hospital	5	2-8	1-18		
JOOTRH	4	2-7	1-16		
Nightingale Mililani	3	1-6	1-14		

*Statistically significant at p<0.05

There was a great difference in the duration of stay in the various hospitals (H=8.42, p=0.038). The duration of stay in Aga Khan and Avenue was high (5 days each) in comparison to JOOTRH (4 days) and Nightingale Mililani (3 days), due to high survival rate and availability of resources for organ support.

In Table 10 is illustrated the frequency and distribution of the complications experienced by the patients during their ICU stay, indicating the most frequent adverse clinical events related to shock treatment.

Table 10

Frequency of Complications during ICU Stay

Complication	Frequency (n)	Percentage (%)
Any complication	182	76.8
Acute Kidney Injury (AKI)	118	49.8
- Requiring dialysis	42	17.7
Multi-organ failure	89	37.6
Persistent hypotension (>24 hours)	76	32.1
ARDS	54	22.8
DIC	38	16.0
Healthcare-associated infection	35	14.8
- Ventilator-associated pneumonia	22	9.3
- Central line-associated bloodstream infection	13	5.5
Cardiac arrest	42	17.7
Brain death	18	7.6

More than three-quarters of patients (76.8%) had complications while in the ICU. The most common type of complication was acute kidney injury, which was seen in almost half of patients (49.8%), with 17.7% needing renal replacement therapy. Thirty-seven percent of patients had multi-organ failure. The high incidence of complications indicates the severe condition of the patients and possibly poor initial management.

Table 11 displays the relationship between major complications and death in patients suffering from shock, highlighting the relative risk of death due to each complication.

Table 11

Association between Complications and Mortality

Complication	Mortality with Complication (%)	Mortality without Complication (%)	Relative Risk (95% CI)	χ^2	p-value
AKI	68.6	41.2	1.67 (1.32-2.11)	17.84	<0.001
Multi-organ failure	86.5	35.8	2.42 (1.96-2.98)	58.42	<0.001
ARDS	74.1	49.2	1.51 (1.22-1.86)	10.84	0.001
DIC	84.2	49.2	1.71 (1.42-2.07)	16.42	<0.001
Cardiac arrest	97.6	45.6	2.14 (1.93-2.37)	41.28	<0.001

All the complications showed significant associations with mortality risk. The relative risk of death in case of multi-organ failure (RR=2.42; 95% CI: 1.96-2.98) was the highest, followed by cardiac arrest (RR=2.14) and DIC (RR=1.71). The results indicate the importance of prevention through optimal management. A binary logistic regression analysis was carried out to determine predictors of mortality. Predictors were selected according to clinical relevance and their significance in the bivariate analysis.

Table 12 highlights the results of logistic regression analysis that determines the independent predictors of mortality in shock patients. The logistic regression model assesses the impact of patient characteristics and hospital characteristics on the probability of death.

Table 12

Logistic Regression Analysis for Predictors of Mortality

Variable	B	SE	Wald	df	p-value	Odds Ratio	95% CI for OR
Age >60 years	0.84	0.38	4.89	1	0.027	2.32	1.10-4.89
Septic shock (vs. hypovolemic)	1.12	0.42	7.11	1	0.008	3.06	1.35-6.95
Cardiogenic shock (vs. hypovolemic)	1.48	0.52	8.10	1	0.004	4.39	1.58-12.18
HIV/AIDS comorbidity	0.76	0.36	4.46	1	0.035	2.14	1.06-4.33
Time to antibiotics >3 hours	1.24	0.41	9.15	1	0.002	3.46	1.55-7.72
Time to fluids >1.5 hours	0.92	0.39	5.56	1	0.018	2.51	1.17-5.39
Lactate not measured	1.08	0.44	6.03	1	0.014	2.94	1.24-6.97
AKI development	1.32	0.40	10.89	1	0.001	3.74	1.71-8.20
Multi-organ failure	2.24	0.48	21.78	1	<0.001	9.39	3.67-24.06
Public hospital (vs. private)	0.98	0.42	5.44	1	0.020	2.66	1.17-6.07
Constant	-3.42	0.68	25.30	1	<0.001	0.03	

Model summary: Omnibus χ^2=98.42, df=10, p<0.001; Nagelkerke R^2=0.52; Hosmer-Lemeshow goodness-of-fit χ^2=6.84, df=8, p=0.554.

A significant model was obtained using logistic regression (χ^2=98.42, p<0.001), and it explained 52% of variance in mortality rate (Nagelkerke R^2=0.52). Also, the Hosmer-Lemeshow test showed a good fit of the model (p=0.554). The following variables were found to be significant independent predictors of mortality in patients with shock in this study. Multi-organ failure was identified as the most significant predictor of mortality in patients with shock as patients suffering from this condition were almost 9.4 times more likely to die than patients with no involvement of organs in the process (OR = 9.39, 95% CI: 3.67–24.06, p < 0.001). Another significant predictor of mortality is cardiogenic shock because patients with this condition were about 4.4 times more likely to die than patients with hypovolemic shock (OR = 4.39, 95% CI: 1.58–12.18, p = 0.0

Factors relating to clinical process were also important contributors to mortality. Those patients who received antibiotic therapy more than three hours post-shock recognition had approximately 3.5 times greater chances of mortality than those who received early antibiotic administration (OR = 3.46, 95% CI: 1.55-7.72, p = 0.002). Septic shock was associated with higher mortality rates because such patients had almost 3.1 times greater chances of dying compared to the patients with hypovolemic shock (OR = 3.06, 95% CI: 1.35-6.95, p = 0.008). Failure to determine lactate level was associated with nearly three times greater risks of mortality (OR = 2.94, 95% CI: 1.24-6.97, p = 0.014). Hospital and patient characteristics had significant effects on mortality outcomes as well. Admissions to public hospitals were associated with a nearly threefold increase in mortality compared to private institutions (OR = 2.66, 95% CI: 1.17–6.07, p = 0.020). Late administration of fluids, beyond 1.5 hours since diagnosis, had a 2.5 times greater likelihood of mortality (OR = 2.51, 95% CI: 1.17–5.39, p = 0.018). Elderly age over 60 years old was associated with 2.3 times higher odds of

mortality (OR = 2.32, 95% CI: 1.10–4.89, p = 0.027). In addition, the presence of HIV infection was a factor that contributed to an increase in mortality risks of patients. Namely, patients diagnosed with HIV infection had a 2.1 times greater likelihood of dying compared to their HIV-negative counterparts (OR = 2.14, 95% CI: 1.06–4.33, p = 0.035).

Table 13 shows the correlation between adherence to critical shock management processes and patient mortality, in comparison of mortality between adherent and non-adherent patients for various evidence-based medical practices.

Table 13

Association between Process Adherence and Mortality

Process Indicator	Adherent Group Mortality (%)	Non-Adherent Group Mortality (%)	Absolute Risk Reduction (%)	Number Needed to Treat	χ^2	p-value
Lactate measured within 1 hour	41.2	61.8	20.6	5	8.42	0.004
Antibiotics within 1 hour	38.6	59.8	21.2	5	6.84	0.009
Appropriate fluid bolus	47.8	62.4	14.6	7	4.92	0.027
Blood cultures before antibiotics	48.2	60.1	11.9	9	3.86	0.049
Vasopressors within 6 hours (if indicated)	51.4	67.2	15.8	7	5.24	0.022
CVP monitoring (when indicated)	52.8	58.4	5.6	18	0.84	0.359

There was a significant decrease in mortality among individuals who adhered to the process indicator. The most prominent risk reduction was recorded among those who received timely antibiotics (21.2% with an NNT of 5) and those who had their lactate level measured early (20.6%, NNT of 5). This indicates that each 5 people who receive antibiotics early (within an hour) or have their lactate level measured early (within an hour) would save one additional life. Central venous pressure monitoring in isolation did not reduce mortality rate.

The findings corroborate with the work of Eisenberg et al. (2025), who have proved that evidence-based management brings about positive effects on outcomes of patients experiencing septic shock; but this study reveals that mortality rates in adult ICUs vary depending on the severity of the condition and delay in treatment. The findings are also in line with the work of Hernández et al. (2022) and Lee et al. (2024), who have found out that the timely use of antibiotics and early lactate testing has positive effects on the process of adherence to the guidelines on sepsis management and reduces mortality rates. In addition, the low mortality rate in facilities that are well equipped is in agreement with the findings by Nagata et al. (2021) and Omullo (2026), who have pointed out the importance of ICU organization and facility preparedness on patient outcomes. Similar to the findings by Moore et al. (2015), these findings reveal the importance of healthcare structure on the process and patient outcomes.

V. CONCLUSION & RECOMMENDATIONS

5.1 Conclusion

The study reveals that there were huge differences in terms of readiness of the facilities for shock management between participating ICUs. In general, private hospitals had more readiness for shock management than public hospitals in terms of availability of necessary equipment, drugs, diagnostic services, personnel and critical care specialists. Further conclusion is that healthcare providers failed to follow the shock management protocols. While the level of knowledge of the healthcare providers was satisfactory, there were important deficiencies in areas like prompt antibiotic administration, vasopressors, lactate and fluid resuscitation. The level of knowledge of healthcare providers with high professional education, ICU experience, life support training, and those from more resourceful hospitals was higher. The study results show that both improvement in facilities readiness and healthcare provider training is required in order to provide better shock management in adult ICU.

In summary, the results showed that patient outcomes have not improved in terms of poor patient outcome, high mortality, high incidences of complications, and variation in the duration of hospitalization in ICUs. Failure to administer timely antibiotics and fluids, failure to assess lactate levels, the occurrence of acute kidney injury and multiple organ failure, and being admitted to public hospitals were some of the predictors of death. It is clear from the results that there is need for improvement of the readiness of facilities and adherence to evidence-based treatment of shock in ICUs.

5.2 Recommendations

There should be more emphasis on investment in the equipment and resources required for effective shock management through proper staffing, availability of required resources at all times, adherence to treatment protocols, training and mentoring of staff members, quality audits, and team work by the staff for better results.

Declaration of Interest

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