## Original Article

# A Comparison of the Glasgow Coma Scale with Full Outline of Unresponsiveness Scale in Prediction of Patient Outcomes in The Critical Care Unit at Kenyatta National Hospital

**Kwamboka Delilah**
**Senior Nursing Officer, Kenya Medical Training College, P. O. Box 329-40202. Keroka, Kenya**

**Kerubo Lydia**
**Tutorial Fellow, Meru University of Science and Technology, P.O. Box 972-60200. Meru, Kenya**

**Correspondence: Kerubo Lydia, Tutorial Fellow, Meru University of Science and Technology, kerubo.lydie@gmail.com, P.O. Box 972-60200. Meru, Kenya**

**Abstract**

Neurological assessment is key in the prognosis and management of critically ill patients. The Glasgow Coma Scale (GCS) and Full Outline of Unresponsiveness scale (FOUR) aid in assessments, decisions, and outcome prediction. The goal was to compare the performance of the GCS with FOUR scales in the outcome prediction in ICU. This was an analytical prospective study. The Census method was used to select 55 Kenyatta National Hospital ICU clients. The performance of the GCS and FOUR scores in predicting survival was analyzed using binary logistic regression. ROC curves were computed to assess the accuracy of the GCS and FOUR scales. Calculation of cut-off points was calculated and determination of overall accuracy of prediction of results, sensitivity, and specificity was identified. 67% of the patients were male; the mean age was 41 years; the average length of stay was ten days. Most patients were referrals from other facilities. Patients with a low level of GCS below 6, at admission, were 40%, at 48 hours they were 39% and for low scores of FOUR at admission were 47%, at 48 hours were 39% while those with high scores (above 14) were 40%. The survival rate for both scales at 48 hours was 100%, which continued to decrease over the days. On day 14, the predicted survival was 50% while the actual survival was 65%. The sensitivity of GCS at admission was 47.4% and 98% during evaluation while FOUR scores were 68.4% at admission and were 100% on day 14. At 48 hours and 14 days of admission to the ICU, FOUR score was able to accurately predict the survival rate of patient outcomes. Findings will be presented at scientific conferences. The researcher recommends a larger study to be done to confirm that the FOUR score is a more reliable tool for the assessment of ICU patients.

**Keywords:** Glasgow Coma Scale, Full Outline of Unresponsiveness scale, ICU, Neurological, Assessment

### Introduction

Neurological assessments have become key over the recent past to ensure accurate determination of prognosis, mortality and to ensure appropriate resource administration. Choosing and utilizing a suitable scoring scale is critical in the early stages of patient assessment, for an appropriate decision making of the initial diagnosis, management, and the likely course of a medical condition (Hosseini et al., 2016). Several prognostic models have been used in predicting patient outcomes (Akavipat et

al., 2011). These scales include; the Edinburgh-2 coma scale, the Glasgow-Liege scale, Pittsburgh brain stem score, Comprehensive level of consciousness scale, Reaction Level Scale, the Innsbruck Coma Scale, the Glasgow coma scale (GCS), and the Full outline of unresponsive scale (FOUR) (Wijdicks et al., 2011). Most of these scales are not in use because of their complexity and similarity to the GCS and health care workers' preference to use the GCS.

Introduced by Graham Teasdale and Bryan J. Junnuett, the Glasgow Coma Scale (GCS) has been used to measure the level of consciousness in trauma and acute medical clients in the hospital and at the field level by medical personnel (Alhassan et al., 2019). Advances to have an accurate and better scoring system have seen the birth of many other tools including the Full outline of unresponsiveness scale (FOUR) score and Glasgow Liege scale. The FOUR score was developed by Wijdicks in 2005 and is more reliable in determining the patient's neurological status. It is a 16-point scale, with scores ranging from 0 to 16. (Akavipat, 2009). The FOUR score has shown to be a more reliable tool in the assessment of ICU patients because it assesses the brain stem reflexes and considers the inability to assess the verbal component of these clients, unlike the GCS.

The Glasgow coma scale is a tool that determines the level of consciousness of patients in three identified classes of responsiveness; eye response, motor activity, and verbal response. The examiner has to assess each of these three responses independent of each other and then give a score. The sum of the score from each component response is the GCS score (Wijdicks et al., 1998). The GCS has remained the most objective way to measure the mental status of the patients. Independently the component was summed from best eye response, which has scores of four to one. Best verbal response, with scores of five to one, and motor response with scores of six to one. (Alhassan et al., 2019). Regardless of its worldwide use, the GCS has several disadvantages that make it less reliable and accurate. They include the inability to score the verbal component for those patients who are aphasic, intubated, and sedated, also inconsistent inter-observer agreement (Saika et al., 2015). The FOUR score stands out because of such limitations exposed by the GCS, which includes its ability for use in scoring intubated and sedated patients by excluding the verbal response in GCS and replacing it with brainstem reflexes and respiratory assessment. Decreasing scores of GCS and FOUR are linked with a worsening level of consciousness and a high mortality rate. Globally there has been a need to identify a tool that is more reliable in evaluating the neurological status of patients (Jain and Iverson, 2022). Most healthcare providers in the past have either used the FOUR score or GCS. The existence of the two scales for assessing patients seems to be sufficient reason for a comparative study on their performance in prognosis and predicting outcomes for critically ill patients. The fact that most studies that have been conducted since 2005 have come into an agreement that the FOUR scoring tool is more reliable at the prediction of patient outcomes in ICUs.

In Africa, there are a few studies conducted on the subject of the FOUR score while more studies have focused on the GCS. In Kenya, there are a few studies that have been conducted on the neurological assessment of patients and they have advocated for the use of the GCS (Abdallah et al., 2020; Jain and Iverson, 2022). Despite the FOUR scale being more reliable and superior, it has not been used in the Kenyan setting. Currently, there is no hospital documented in Kenya as having embraced the scoring tool in the neurological assessment of its clients (Janeway et al., 2019). The purpose of the study is therefore to compare the performance of FOUR score and GCS in outcome predictions of clients in ICU. This is why the study will endeavor to find out the reliability of the FOUR scale and its ability in predicting outcomes of critically ill patients in ICU on the fourteenth day since admission, KNH.

**Methodology**

The study adopted an analytical prospective study design to compare the GCS and FOUR scales in the prediction of patient outcomes. The study focused on patients at the main, cardiac, and medical ICU of the Kenyatta National Hospital in April 2020. Data was collected using an observation checklist to determine the similarities and differences in the prediction of outcomes using the two assessment scales at the Intensive care unit

of Kenyatta National Hospital. The medical ICU is located on the 8th-floor and the 7th floor, both with a bed capacity of 10, but 8 functional beds, though geographically separated they are treated as one department. The main ICU is located on the first floor with a 21-bed capacity and is opposite the burns unit and renal department. The cardiac ICU is on the fourth floor with a bed capacity of five. This study included patients in the main, cardiac, and medical critical care units of Kenyatta National Hospital. The target population included adult patients above the age of 16 years, admitted at main, cardiac, and medical ICU. The estimated number of patients admitted in all three ICUs per month is 65. A study sample was recruited from the population. To qualify for the study, patients admitted were required to be above 16 years of age in main, cardiac, neurological, and medical ICU admitted to the ICU for less than 48 hours, and provide informed consent given through the next of kin.The sample size calculation was guided by Fisher et al. (2004). Since the average admission number of patients in cardiac ICU, the multidisciplinary and medical ICU of Kenyatta national hospital is less than ten thousand (10,000). Yamane formula (1967) was used in sample adjustment. After the adjustment, 55 Respondents were included in the study.

The Census data collection method was employed to recruit a sample of 55 participants that met the inclusive criteria at the main, cardiac, and medical ICU in KNH. By involving all patients in the three ICUs, the study provided a true measure of the population with no sampling error. The census method was appropriate because the population was well defined and the number was manageable. The participants were recruited until the required sample size was attained.

A structured systematic observation checklist was adopted to obtain the required information. The observation checklist was organized into four sections: Part one had the demographic characteristics of patients. The second section contained the GCS score to evaluate the level of consciousness of the participant according to the three components of the tool with a column of GCS scores on admission and the day of evaluation of outcomes if the patient was still alive. The third section had the FOUR score tool with four parts, a column of FOUR scores on admission and the day of evaluation of outcomes if the patient was still alive. The fourth section had the patients' outcome at day fourteen, whether alive or dead, predicted outcome of the two scales, and the length of ICU stay was noted. Before conducting the study, the study tool was pretested to determine its validity. Pretesting of the tool involved five critically ill patients (10% of 55) at Gynecology CCU. This was done to ensure a proper flow of questions as well as correction of mistakes identified before the study commenced, to ascertain that the tool is accurate and reliable. There were no gaps were identified.

For validity; to ensure consistency and congruity to the identified gap, an observation checklist was designed to address the problem under investigation and presented to experts (research supervisor) in the Nursing department, critical care nurses, and a statistician who evaluated them for applicability in regards to the objective of the study. Their comments were assimilated accordingly to improve the efficacy of the tool.

The observation checklist was tested for consistency, accuracy, timing, and reliability. The results that were obtained from the tool ensured testability; the reliability of the instrument was estimated using Cronbach's Alpha Coefficient. A Cronbach's Alpha Coefficient of at least 0.70 was accepted.

All participants meeting the inclusion criteria in the three units were recruited to attain a sample size of 55 participants by the researcher. Approval to conduct this study was sought from KNH/UON ERC, the Kenyatta National Hospital Head of Department, and Unit in-charges for ICU. Privacy and anonymity were observed, names and other means of identity were not used during the data collection process and analysis.

Data was analyzed using SPSS version 24. Categorical data were analyzed using percentages while continuous data were analyzed using standard deviation and mean. A chi-square test for association was conducted to determine the association between patient characteristics and outcomes. A Chi-square test for association was also conducted to determine the association between the predicted GCS and FOUR score in relation to the patients' actual outcome at the end of the evaluation.

The performance of the GCS and FOUR scores in predicting patient outcomes was analyzed using binary logistic regression. Survival analysis was performed using the Kaplan Meier method. Sensitivity analysis was used to determine the reliability of the GCS and FOUR scale in predicting actual outcomes. The ROC curves were computed to assess the accuracy of the GCS and FOUR scale based on the area under the curve analysis. Calculation of cut-off points was calculated and determination of overall accuracy of prediction of results, sensitivity, and specificity will be identified.

**Results**

**The Level of Consciousness:** The respondent's level of consciousness using both GCS and FOUR were assessed at admission, after 48 hours, and after 14 days. The assessment was based on a cut-off of 6 for GCS and 9 for FOUR scale. A score of six and below for GCS is associated with a poor outcome while a score of 12 and above predicts a good outcome.

Based on GCS scale, at admission, 22 (40%) of the respondents had a low level of consciousness less than 6, at 48 hours 21 (39%) and at 14 days, 14 (30%) had a low level of consciousness of less than 6. While at 14 days, respondents with a score of 12 and above were 18 (40%). In assessing the FOUR scale, at admission, 26 (47%) of the respondents had a lower level of consciousness of 9 and below. At 48 hours 24 (45%) and at 14 days, 13 (28%) had a score of nine and below. While those with higher levels of consciousness of 12 and above at 14 days were, 24 (52%) as shown in Table 1.

**Predicted outcomes:** The findings revealed that FOUR score predicted 29 (53%) to die by the end of evaluation while GCS predicted, 33(60%) to die by the end of evaluation. The actual outcome at the end of evaluation is shown in Table 2.

**Patient characteristics and outcome:** The results found that length of stay, $x^2(2) = 10.583$, p =0.005, and patient intubation $x^2(1) = 10.354$, p =0.001 were significantly associated with patient outcome at the end of evaluation.

**Predicted scale outcomes and actual patient outcomes:** The findings from chi-square tests showed that there was an association between predicted FOUR score at admission and actual patient outcome, $x^2$ (1) = 5.209, p =0.022. However, there was no significant association between predicted GCS outcome at admission and actual patient outcome, $x^2$ (1) = 3.684, p =0.055.

**Predicted GCS outcome at admission and actual patient outcome:** A binary logistic regression was conducted to determine whether predicted GCS outcome significantly predicts actual patient outcome. The model was not significant ($x^2(1) = 3.595$, $p = 0.058$,) yielding a small effect size (r = 0.063). Thus, the outcome as predicted by GCS at admission was not a significant predictor of actual patient outcome at the end of the evaluation (after 14 days) as shown in Table 5.

**Predicted FOUR score outcome at admission and actual patient outcome:** A binary logistic regression was conducted to determine whether FOUR score predicted outcome at admission was a significant predictor of actual patient outcome at the end of evaluation as shown in Table 6. FOUR score at admission was found to be a significant predictor of actual patient outcome ($p = 0.026$, $OR= 3.8$, 95%$CI$ [1.12.51]. The findings show that FOUR score at admission was 3.8 times more likely to predict an accurate actual outcome at the end of evaluation.

**Survival Analysis: Mean and Median Survival Time:** Kaplan Meier survival analysis was performed to determine the survival rate among patients who were included in the study within the study period (14 days). The mean estimate survival time was 13.98, 95% CI (12.82 – 15.14 days) median was 14 days, 95%CI (13.68 – 14.32 days) as shown in Table 10.

**Survival analysis curve:** The results as shown in Figure 1 shows that, at admission (Zero days) all patients were alive, after 48 hours the results show that 100% of the patients were alive. The average median length of stay in the ICU was 14 days. At 14 days, the probability of survival was 50%. The analysis also shows that by the end of evaluation on day 14 approximately 65% of the respondents were alive.

**Table 1: Level of consciousness among respondents using GCS and FOUR scales**

| Scale | Measurement Score | Level Consciousness at Admission (n =55) n (%) | Level Consciousness after 48 hours (n =53) n (%) | Level Consciousness after 14 days (n =46) n (%) |
|---|---|---|---|---|
| GCS | <6 | 22 (40) | 21 (39) | 14 (30%) |
| | 6 – 12 | 19 (35) | 18 (34) | 14 (30) |
| | >12 | 14(25) | 14 (27) | 18 (40) |
| FOUR | < 9 | 26 (47) | 24 (45) | 13 (28) |
| | 9 -12 | 11 (20) | 13 (25) | 9 (20) |
| | > 12 | 18 (33) | 16 (30) | 24 (52) |

**Table 2: Actual and predicted outcomes at the end of evaluation**

| Predicted Outcome at Admission | Alive n (%) | Died n (%) |
|---|---|---|
| FOUR score | 26 (47%) | 29(53%) |
| GCS | 22(40%) | 33(60%) |
| Actual outcome at the end of the evaluation | 19(35%) | 36(65%) |

**Table 3: Association between patient characteristics and outcome at the end of the evaluation**

| | | Patient Outcome | | | | | |
|---|---|---|---|---|---|---|---|
| | | Death | Alive | Total | chi-square | df | p- value |
| Age group of patients | <18 Years | 3 (43%) | 4(57%) | 7 | 1.302 | 3 | 1 |
| | 19 - 30 Years | 4(40%) | 6(60%) | 10 | | | |
| | 31 - 50 Years | 7(39%) | 11(61%) | 18 | | | |
| | >50 years | 5(25%) | 15(75%) | 20 | | | |
| Gender | Male | 14(38%) | 23(62%) | 37 | 0.542 | 1 | 0.336 |
| | Female | 5(28%) | 13(72%) | 18 | | | |
| Education | No formal education | 2(29%) | 5(71%) | 7 | 0.343 | 3 | 1 |
| | Primary education | 2(33%) | 4(67%) | 6 | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Secondary education | 11(38%) | 18(62%) | 29 | | | |
| | Tertiary education | 4(31%) | 9(69%) | 13 | | | |
| Occupation | Formal employment | 2(40%) | 3(60%) | 5 | | | |
| | Self-employment | 10(35%) | 19(65%) | 29 | 0.632 | 4 | 1 |
| | Unemployed | 4(33%) | 8(67%) | 12 | | | |
| | Student | 3(38%) | 5(62%) | 8 | | | |
| | Others | 0 | 1(100%) | 1 | | | |
| Source of admission | Other wards in KNH | 2(13%) | 13(87%) | 15 | | | |
| | A&E | 13(43%) | 17(57%) | 30 | 4.141 | 2 | 0 |
| | Referral from another facility | 4(40%) | 6(60%) | 10 | | | |
| Length of stay within the ICU | <2 Days | 5(100%) | 0 | 5 | | | |
| | 3 - 14 Days | 12(29%) | 29(71%) | 41 | 10.583 | 2 | 0 |
| | Above 14 Days | 2(22%) | 7(78%) | 9 | | | |
| Sedated | Yes | 10(50%) | 10(50%) | 20 | 3.32 | 1 | 0.064 |
| | No | 9(26%) | 26(74%) | 35 | | | |
| Patient intubated | Yes | 15(56%) | 12(44%) | 27 | | 10.354 | 0.001 |
| | No | 4(14%) | 24(86%) | 28 | | | |

**Table 4: Association between the predicted scale outcomes and actual patient outcomes at the end of the evaluation**

| | | Patient Outcome | | | | | |
|---|---|---|---|---|---|---|---|
| | | Death | Alive | Total | chi square | df | p-value |
| Predicted Outcome at admission by GCS | Died | 9(52.9%) | 8(47%) | 17 | 3.684 | 1 | 0.055 |
| | Alive | 10(26%) | 28(74%) | 38 | | | |
| Predicted FOUR outcomes at admission | Died | 13 (50%) | 13(50%) | 26 | 5.209 | 1 | 0.022 |
| | Alive | 6(21%) | 23(79%) | 29 | | | |

**Table 5: Relationship between predicted GCS outcome at admission and actual patient outcome**

**Omnibus Tests of Model Coefficients**

| | | Chi-square | df | Sig. |
|---|---|---|---|---|
| Step 1 | Step | 3.595 | 1 | 0.058 |
| | Block | 3.595 | 1 | 0.058 |
| | Model | 3.595 | 1 | 0.058 |

**Model Summary**

| Step | -2 Log likelihood | Cox & Snell R Square | Nagelkerke R Square |
|---|---|---|---|
| 1 | 67.310[a] | 0.063 | 0.087 |

a. Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

**Variables in the Equation**

| | | B | S.E. | Wald | df | P-value | OR | 95% C.I.for OR Lower | Upper |
|---|---|---|---|---|---|---|---|---|---|
| Step 1[a] | Predicted Outcome at admission by GCS | 1.147 | 0.610 | 3.541 | 1 | 0.060 | 3.150 | 0.953 | 10.408 |
| | Constant | -1.265 | 1.039 | 1.482 | 1 | 0.223 | 0.282 | | |

a. Variable(s) entered on step 1: Predicted Outcome at admission by GCS.

**Table 6: Relationship between predicted FOUR score outcome at admission and actual patient outcome**

**Omnibus Tests of Model Coefficients**

| | | Chi-square | df | Sig. |
|---|---|---|---|---|
| Step 1 | Step | 5.292 | 1 | 0.021 |
| | Block | 5.292 | 1 | 0.021 |
| | Model | 5.292 | 1 | 0.021 |

**Model Summary**

| Step | -2 Log likelihood | Cox & Snell R Square | Nagelkerke R Square |
|---|---|---|---|
| 1 | 65.613[a] | 0.092 | 0.127 |

a. Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

**Variables in the Equation**

| | B | S.E. | Wald | df | P-value | OR | 95% C.I.for OR Lower | Upper |
|---|---|---|---|---|---|---|---|---|

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Step 1[a] | Predicted FOUR outcomes at admission | 1.344 | 0.603 | 4.961 | 1 | 0.026 | 3.833 | 1.175 | 12.506 |
| | Constant | -1.344 | 0.909 | 2.187 | 1 | 0.139 | 0.261 | | |

a. Variable(s) entered on step 1: Predicted FOUR outcomes at admission.

**Table 7: Means and Medians for Survival Time**

| Mean[a] | | | | Median | | | |
|---|---|---|---|---|---|---|---|
| | | 95% Confidence Interval | | | | 95% Confidence Interval | |
| Estimate | Std. Error | Lower Bound | Upper Bound | Estimate | Std. Error | Lower Bound | Upper Bound |
| 13.976 | .592 | 12.816 | 15.136 | 14.000 | .164 | 13.678 | 14.322 |

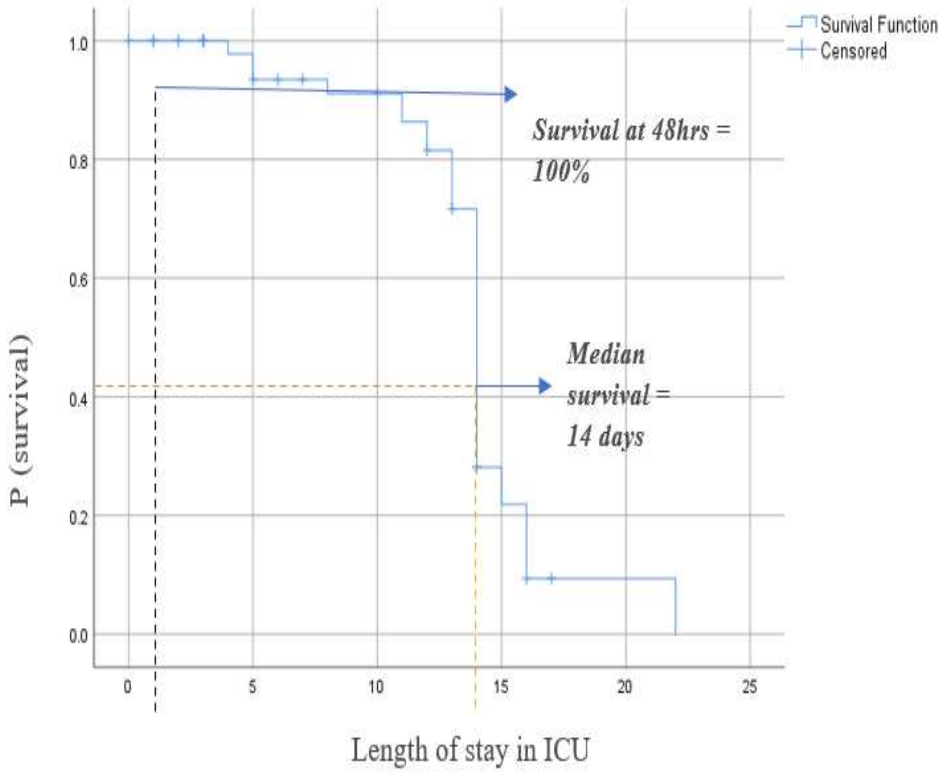


**Figure 1: Respondents survival analysis**

**Reliability of the GCS and Four score in the prediction of patient outcomes:** Receiver operating curve (ROC): The ROC curves show that there was no significant difference in the predictive value between FOUR score and GCS in predicting patient outcome.

**Area under the curve:** Based on the findings, the predictive accuracy of FOUR scale was higher than GCS considering that the AUC for FOUR score was significantly higher (AUC= 0.761, 95%CI (0.439 – 0.827) than GCS (AUC = 0.633, 95% CI (0.471 – 0.850).

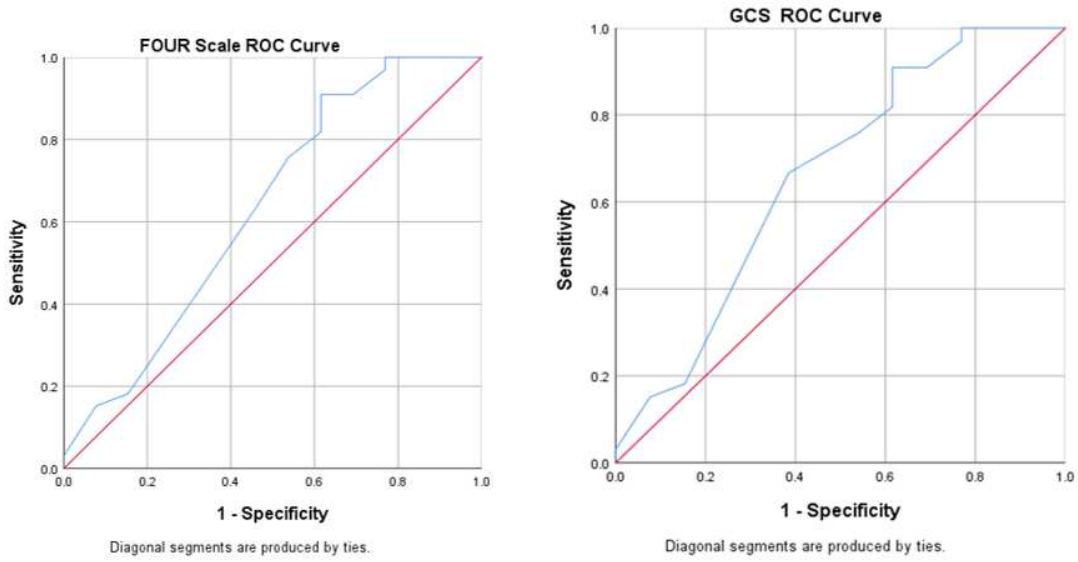


**Figure 2: ROC curves for GCS and FOUR scales**

**Table 8: Area under the curve for FOUR and GCS scales in the prediction of outcome**

**Area Under the Curve**

Test Result Variable(s): Length of stay in the ICU

| Scale | Area | Std. Error[s] | Asymptotic Sig.[b] | Asymptotic 95% Confidence Interval Lower Bound | Upper Bound |
|---|---|---|---|---|---|
| FOUR | 0.761 | 0.099 | 0.164 | 0.439 | 0.827 |
| GCS | 0.633 | 0.097 | 0.092 | 0.471 | 0.85 |

a. Under the nonparametric assumption
b. Null hypothesis: true area = 0.5

**Sensitivity analysis:** The results show that both scales did not effectively predict the outcome at admission with FOUR score having a higher sensitivity of 68.4% while GCS had 47.8%. At 48 hours of admission, FOUR score was able to effectively and correctly predict patient outcomes with a sensitivity of 100%. The FOUR score was also able to successfully predict a survival outcome at 14 days with a sensitivity of 100% compared to 98% obtained by the GCS scale.

**Conclusion:** The study revealed that both scales were able to predict patients' outcome with different accuracy and sensitivity rates. The GCS had a low predicting power especially in the early hours of admission but sensitivity increased as time went by. The FOUR score has proved to be a more reliable tool in patients' assessment because of its high sensitivity and prediction power. In summary, most of the studies have revealed that both GCS and FOUR scores are significant in the prediction of outcomes in patients, but the FOUR is more reliable, superior, and convenient for the prediction of outcomes of ICU patients.

The FOUR scale is easy to apply with fewer requirements on the assessment of the nervous system in checking mental status and most importantly identifies some unconscious states. The new scoring system classifies coma and identifies relevant conditions in patients with altered levels of consciousness, which allows additional distinction of in-CCU mortality prediction for clients on admission with a low GCS. Since patients in ICU are on intubation and sedation, the FOUR is therefore important and reliable to apply it in assessing comatose clients. The two tools were able to predict the survival analysis of the respondents fairly well with a small difference between the predicted and actual survival status. This hence shows that the GCS and FOUR score good predictors of patient outcomes in ICU patients.

**Recommendations:** The following recommendations were made based on the results:

1. Using larger sample sizes and studying different centers may yield more reliable and valuable results.
2. Different members of the healthcare team should do follow-up studies to improve inter-rater reliability.
3. A larger study should be done and all patients followed up until discharge or death for more reliable results. Though the GCS and FOUR scales were both able to predict patient outcomes, further studies are necessary to ascertain which tool is more reliable and specific for use in critically ill patients in ICU.

## References


Abdallah, A., Demaerschalk, B.M., Kimweri, D., Aden, A.A., Zhang, N., Butterfield, R., Asiimwe, S., B., O'Carroll, C.B., (2020). A comparison of the Full Outline of Unresponsiveness (FOUR) and Glasgow Coma Scale (GCS) scores in predicting mortality among patients with a reduced level of consciousness in Uganda. Neurocrit. Care 32, 734–741. https://doi.org/10.1007/s12028-019-00806-4

Akavipat, P., (2009). Endorsement of the FOUR Score for Consciousness Assessment in Neurosurgical Patients. Neurol. Med. Chir. (Tokyo) 49, 565–71.

Akavipat, P., Sookplung, P., Kaewsingha, P., Maunsaiyat, P., (2011).. Prediction of discharge outcome with the full outline of unresponsiveness (FOUR) score in neurosurgical patients. Acta Med. Okayama 65, 205–210. Alhassan, A., Fuseini, A.-G., Musah, A., 2019. Knowledge of the Glasgow Coma Scale among Nurses in a Tertiary Hospital in Ghana. Nurs. Res. Pract. 2019, 1–7.

Heidari Gorji, M.A., (2016).Comparison of Glasgow Coma Scale, Full Outline of Unresponsiveness and Acute Physiology and Chronic Health Evaluation in Prediction of Mortality Rate Among Patients With Traumatic Brain Injury Admitted to Intensive Care Unit. Anesthesiol. Pain Med. 7, e33653. https://doi.org/10.5812/aapm.33653

Jain, S., Iverson, L.M., (2022).Glasgow Coma Scale, in: StatPearls. StatPearls Publishing, Treasure Island (FL).

Janeway, H., O'Reilly, G., Schmachtenberg, F., Kharva, N., Wachira, B., (2019). Characterizing injury at a tertiary referral hospital in Kenya. PLOS ONE 14, e0220179. https://doi.org/10.1371/journal.pone.0220179

Saika, A., Bansal, S., Philip, M., Devi, B.I., Shukla, D.P., (2015). Prognostic value of FOUR and GCS scores in determining mortality in patients with traumatic brain injury. Acta Neurochir. (Wien) 157, 1323–1328. https://doi.org/10.1007/s00701-015-2469-6

Wijdicks, E.F.M., Kokmen, E., O'Brien, P.C., (1998). Measurement of impaired consciousness in the neurological intensive care unit: A new test. J.

Neurol. Neurosurg. Psychiatry 64, 117–119. https://doi.org/10.1136/jnnp.64.1.117

Wijdicks, E.F.M., Rabinstein, A.A., Bamlet, W.R., Mandrekar, J.N., (2011). FOUR score and Glasgow Coma Scale in predicting outcome of comatose patients: a pooled analysis. Neurology 77, 84–85.