Triage Category and Factors Influencing Priority of Acute Myocardial Infarction Patients at Tikur Anbessa Specialized Hospital

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Original Research

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Abstract

**Background:** Acute myocardial infarction (AMI) is the leading cause of morbidity and mortality worldwide. AMI should be treated within a “golden time”, which is < 90 minutes from the onset of the symptom to balloon insertion. Late recognition of diagnosis has increase mortality and long term outcome of the patients in AMI patients. Patients in high priority triage categories were under triage which leads to long waiting time. Determine the associated factors for **high priority triage category scale** of AMI patients.

**Result:** Among the total of 131 study participants, 91(69.5%) of them were males. The mean age of the study participants were 54 year with the standard deviation of 12.75. Patients who were categorized under high priority triage category accounts 47.3% of the total study participants with 95% CI (38.9-56.5). Among the total study participants 78(59.5%) of them were ST elevation myocardial infarction. Having more than 5 years of triage experience (OR: 13.63, 95% CI (2.32-79.86)) and having Triage early warning score of 5-10 during admission (OR: 65.28, 95% CI (5.39-790.52)) has a signicant association on categorizing AMI patients in High priority triage category.

**Conclusion & Recommendation:** Nearly half of the patients at emergency room were categorized under high priority. Triage early warning score and triage nurse experience were the factors which had a significant effect on categorizing AMI patients as high priority triage. Assigning of senior nurses at emergency triage room could improve triage category and early diagnosis and treatment for AMI patients at Tikur Anbessa Specialized Hospital.

**Background**

Triaging is sorting out patients based on the severity of the clinical condition. Literally the word triage comes from French word “Trier” which means to sort. In the world history triaging first comes from the war time. During the war time there was sorting and treating of patients based on the chance of the survival not based on arrival time(1).

After a war time triage was applied mostly in western countries, by using different triage tools. Such as 3 tier, 4 tier and 5 tier systems(2). Now a time 5 tier system applied widely in different countries by using different components(3). Among the different 5 tier systems Cape triage category is the one tool which is used in South Africa and in our country(4).

Cape triage score was first applied and established in the western South Africa. It consists of 5 color system to categorize the incoming patients(4). In cape triage score the most critical patients who need to see by doctor immediately categories in red color, and also the patients who should see by a doctor within 10 minute categorize in orange color. This color coding method gives for the patients based on calculating triage early warning scale (TEWS)(4). TEWS is a composite score of the patient’s physiology. The score is derived by assigning a number between 0 and 2 for each of the patient’s vital signs. The higher the score the greater the urgency(4).
Chest pain is the symptoms which is categories in orange and red color coding system (4). Chest pain is a typical symptom for acute myocardial infarction (AMI) disease (5). AMI is the leading cause of morbidity and mortality in worldwide (6). AMI should be treated within a “golden time” which is < 90 minutes from the onset of the symptom to balloon insertion (7). For the AMI patients favorable outcomes is associated with rapid diagnosis and treatment (8), (9). Rapid treatment also mostly associated with early detecting the diagnosis when the patients come in emergency triage room.

Triaging in emergency room is associated with different medical and non-medical factors. Having co morbidity has an important factor for triaging AMI patients (10). Among the mode of arrival in the hospital, ambulatory arrival had a significant association with assigning AMI patients in low priority category (11). Additionally atypical symptoms had an impact for assigning patients in low priority category in emergency room (12).

Among the different modern triage tools, five levels Triage system is valid and reliable method for assessment of the severity of incoming patient condition (13). In early detection of AMI diagnosis, Manchester triage system (MTS) has a very good specificity but it has low sensitivity which indicate patients in high priority categories were under triage which leads to long waiting time (14).

According to algorithm from American Heart Association every patient who presented symptoms of chest discomfort suggestive of ischemia must receive medical treatment within 10 minutes (6).

Modified “HEART” risk score is valid in chest pain patients with suspected NSTEMI (15). In different world places time to admission and time to treatment of AMI patients is still prolonged. And also arriving time which is weekend had an effect on the mortality of the AMI patients (16).

Early recognition of diagnosis and minimal time of onset of symptom to balloon has a positive effect on the mortality and long term outcome of the patients in AMI patients. A study done in Japan states that short onset to balloon time was associated with better 3 year clinical outcome in patients with MI (17).

In our country there is an emergency room triage rooms mostly in tertiary public hospital. Tikur Anbessa Specialized Hospital emergency room has a triage room which has two assigned nurses for sorting the incoming patients by using cape triage color coding tool.

As far as my knowledge in Ethiopia I couldn’t find a study which is emphasized on initial triage category and factors influencing care priority among AMI patients.

This study will try to assess the initial triage category of AMI patients which is important for calculating the percentage of AMI patients who was assigned in high priority triage category, and also it will assess the different associated factors which have an effect on assigning the AMI patient as a high priority triage category.

This study will be a strong evidence for improvement and strengthening triaging in the hospital emergency department. It will also show a clear relation of the triage tool and the quality of triaging AMI patients.
patients. It will give important evidence for the improvement of the triage tool which is used in the hospital.

**Result**

Among the total 131 study participants 91(69.5%) of them were males. The mean age of the study participants were 54 year with the standard deviation of 12.75. Patients who were categorized under High priority triage category accounts 47.3% of the total study participants with 95% CI (38.9–56.5).

Among the total study participants 78(59.5%) of them were STEMI. Addis Ababa was the region with 73 of the study participants came from. Taxi was the most using mode of arrival method rather than other modes, which accounts 80(61.1%). But only 28(45.2%) were categorized under High priority triage category. Patients who comes with Ambulance were 32(24.2%), among them 27 of them were categorized under High priority triage category. Triage nurses who had more than 5 years of experience been more likely categorizing MI patients under High priority triage category (Table 1).
Table 1.1
Socio demographic characteristics and initial assessment information of AMI patients who were seen between September 2010 and September 2012 E.C in emergency room at Tikur Anbessa Specialized Hospital by triage priority.

| Variables                  | Total number (n = 131) | High priority (n = 62) | Low priority (n = 69) | P value |
|----------------------------|------------------------|------------------------|-----------------------|---------|
| Sex                        | n = 131                |                        |                       |         |
| Male                       | 91(69.5%)              | 48(77.4%)              | 43(62.3%)             | .209    |
| Female                     | 40(30.5%)              | 14(22.6%)              | 26(37.7%)             |         |
| Age                        | n = 131                |                        |                       |         |
| 18–39                      | 20(15.3%)              | 6(9.7%)                | 14(20.3%)             | .092    |
| 40–59                      | 55(42.0%)              | 26(41.9%)              | 29(42.0%)             |         |
| >=60                       | 56(42.7%)              | 30(48.4%)              | 26(37.7%)             |         |
| Mode of arrival            | n = 131                |                        |                       |         |
| Ambulance                  | 32(24.4%)              | 27(43.5%)              | 5(7.2%)               | .000*** |
| Taxi                       | 80(61.1%)              | 28(45.2%)              | 52(75.4%)             |         |
| Private car                | 4(3.1%)                | 4(6.5%)                | 0                     |         |
| Walking                    | 14(10.7%)              | 3(4.8%)                | 11(15.9%)             |         |
| Carried                    | 1(0.8%)                | 0                      | 1(1.4%)               |         |
| Triage nurse experience    | n = 131                |                        |                       |         |
| Less than 2 years          | 21(16%)                | 5(8.1%)                | 16(23.2%)             | .000*** |
| 2–5 years                  | 65(49.6%)              | 22(35.5%)              | 43(62.3%)             |         |
| More than 5 years          | 45(34.4%)              | 35(56.5%)              | 10(14.5%)             |         |

Hypertension was the most common cardiovascular risk factor among the study participants. 99(75%) of the study participants had chest pain during admission, 57(57.57%) of them were come to the hospital after 24 hours of the onset of the pain.

50% of the study participants had severe chest pain during admission and 31(62%) of them were categorized under High priority triage category. (Table 2)
Table 2.1
clinical information of AMI patients who were seen between September 2010 and September 2012 E.C in emergency room at Tikur Anbessa Specialized Hospital by triage priority.

| Variables   | Total n = 131 | High priority n = 62 | Low priority n = 69 | P value |
|-------------|--------------|----------------------|---------------------|---------|
|             | n(%)         | n%                   | n%                  |         |
| CAD         | Yes          | 10(7.6%)             | 4(6.5%)             | 6(8.7%) | .878     |
|             | no           | 121(92.4%)           | 58(93.5%)           | 63(91.3%) |         |
| HF          | Yes          | 34(26.0%)            | 15(24.2%)           | 19(27.5%) | .813     |
|             | no           | 97(74.0%)            | 47(75.8%)           | 50(72.5%) |         |
| CVD         | Yes          | 75(57.3%)            | 41(66.1%)           | 34(49.3%) | .077     |
|             | no           | 56(42.7%)            | 21(33.9%)           | 35(50.7%) |         |
| COPD        | Yes          | 3(2.3%)              | 2(3.2%)             | 1(1.4%)  | .925     |
|             | no           | 128(97.7%)           | 60(96.8%)           | 68(98.6%) |         |
| AKI/CKD     | Yes          | 5(3.8%)              | 5(8.1%)             | 0        | .051     |
|             | no           | 126(96.2%)           | 57(91.9%)           | 69(100%) |         |
| None        | Yes          | 27(20.6%)            | 9(14.5%)            | 18(26.1%) | .156     |
|             | no           | 104(79.4%)           | 53(85.5%)           | 51(73.9%) |         |
| DM          | Yes          | 33(44.0%)            | 20(48.8%)           | 13(38.23%) | .099     |
|             | no           | 42(56.0%)            | 21(51.2%)           | 21(61.77%) |         |
| HTN         | Yes          | 54(72.0%)            | 29(70.73%)          | 25(73.53%) | .145     |
|             | no           | 21(28.0%)            | 12(29.27%)          | 9(26.47%) |         |
| Previous MI | Yes          | 7(9.34%)             | 1(2.43%)            | 6(17.6%)  | .12      |
|             | no           | 68(90.66%)           | 40(97.57%)          | 28(82.4%) |         |
| Smoking     | Yes          | 4(5.34%)             | 3(7.31%)            | 1(2.94%)  | .106     |
|             | No           | 71(94.66%)           | 38(92.69%)          | 33(97.06%) |         |
Table 3.1
Chest pain and characteristics of pain among AMI patients who were seen between September 2010 and September 2012 E.C in emergency room at Tikur Anbessa Specialized Hospital by triage priority.

| Variable          | Total  | High priority | Low priority | P value |
|-------------------|--------|---------------|--------------|---------|
|                   | n=131  | n=62          | n=69         |         |
| Chest pain        |        |               |              |         |
| n=131             |        |               |              |         |
| Yes               | 99(75.57%) | 50(80.6%)     | 49(71.1%)    | .208    |
| No                | 32(24.43%) | 12(19.4%)     | 20(28.9%)    |         |
| Onset of pain     |        |               |              |         |
| n=99              |        |               |              |         |
| Within 1 hour     | 10(10.11%) | 5(10.0%)      | 5(10.2%)     | .886    |
| 1–3 hour          | 7(7.07%)  | 3(6.0%)       | 4(8.16%)     |         |
| 4–6 hour          | 5(5.05%)  | 2(4.0%)       | 3(6.12%)     |         |
| 7–12 hour         | 9(9.09%)  | 4(8.0%)       | 5(10.2%)     |         |
| 13–24 hour        | 11(11.11%) | 6(12.0%)      | 5(10.2%)     |         |
| >24 hour          | 57(57.57%) | 30(60.0%)     | 27(55.10%)   |         |
| Severity of pain  |        |               |              |         |
| n=99              |        |               |              |         |
| Mild              | 6(6.06%)  | 0             | 6(12.25%)    | .011    |
| Moderate          | 43(43.43%) | 19(38.0%)     | 24(48.98%)   |         |
| Severe            | 50(50.50%) | 31(62.0%)     | 19(38.78%)   |         |

Having more than 5 years of triage experience has 11 times more likely categorizing MI patients in High priority triage category compared to having less than 2 years’ work experience.

AMI patients who have 1–4 score of TEWS is 98.5% less likely categorized under high priority triage category as compared to 5–10 TEWS score. (Table 4)
Table 4.1
Association of the factors with triage priority among AMI patients who were seen between September 2010 and September 2012 E.C in emergency room at Tikur Anbessa Specialized Hospital.

| Factors                      | High priority | Low priority | Crude odds ratio (95% CI) | Adjusted odds ratio (95% CI) |
|------------------------------|---------------|--------------|---------------------------|-------------------------------|
| **Mode of arrival**          |               |              |                           |                               |
| n = 131                      |               |              |                           |                               |
| Ambulance                    | 27            | 5            | 21.6(4.42–105.32)***      | 7.95(0.911–69.49)             |
| Taxi                         | 28            | 52           | 2.154(0.561–8.28)         | 1.425(0.247–8.234)            |
| Private car                  | 4             | 0            | 6461899371(.00)          | (78991239)                   |
| Others                       | 3             | 12           | 1                         | 1                             |
| **Nurse experience**         |               |              |                           |                               |
| n = 131                      |               |              |                           |                               |
| Less than 2 years            | 5             | 16           | 1                         | 1                             |
| 2–5 years                    | 22            | 43           | 1.63(0.53–5.06)           | 1.633(0.31–8.23)             |
| More than 5 years            | 35            | 10           | 11.2(3.28–38.15)***       | 13.63(2.32–79.86)***         |
| **Pulse rate/minute**        |               |              |                           |                               |
| n = 131                      |               |              |                           |                               |
| 60–100                       | 28            | 52           | 1                         | 1                             |
| < 60                         | 7             | 3            | 4.33(1.04–18.08)**        | 3.99(0.627–25.47)            |
| 101–119                      | 19            | 13           | 2.71(1.17–6.29)**         | 0.88(0.217–3.578)            |
| >=120                        | 8             | 1            | 14.85(1.76–124.89)**      | 3.92(0.16–95.52)             |
| **Respiratory rate/minute**  |               |              |                           |                               |
| n = 131                      |               |              |                           |                               |
| 12–20                        | 22            | 45           | 1                         | 1                             |
| 21–30                        | 40            | 21           | 3.89(1.87–8.10)***        | 1.989(0.601–6.59)            |
| >=30                         | 0             | 3            | .000                      | .000                          |
| **Oxygen saturation/%**      |               |              |                           |                               |
| n = 131                      |               |              |                           |                               |
| < 90                         | 22            | 7            | 4.87(1.90–12.45)**        | 0.182(0.024–1.475)           |
| 90–100                       | 40            | 62           | 1                         | 1                             |
| **TEWS**                     |               |              |                           |                               |
| n = 131                      |               |              |                           |                               |
| 1–4                          | 31            | 68           | 1                         | 1                             |
| 5–10                         | 31            | 1            | 68(8.87–520.9)***         | 65.28(5.39–790.52)**         |

Discussion
In this study more than half of AMI patients were triaged under low priority triage category. 47.3% (38.9%-56.5%) of the patients categorized under High priority triage category. Among the factors triage nurse experience and TEWS has a positive significant association on categorizing AMI patients under High priority triage category.

In this study by using cape triage system 47.3% of AMI patients were categorized under high priority triage category. In other studies which were done on other triage systems such as MTS also showed that the percentage of high priority categorized AMI patients were within the range of this study finding (18, 11).

In other studies which were done on ATS and CTS were showed that the percentage of high priority triaged patients were higher as 80% (19, 12). This difference might cause by sample size which this study used was at least 10 times less than other studies were used, which might increase the prevalence.

Although age hasn't a significant effect in categorizing AMI patients, the mean age of the study participants were 54.4 years with SD 12.73 in this study. This finding was similar to other studies done in other studies (21). In other study done in Brazil Hospital showed that age hadn't a significant effect in categorizing AMI patients (5). Other study showed that younger age AMI patients were highly categorizing under high priority triage category. In contrary in other studies the finding implicates older age had a positive significant effect on categorizing under high priority triage category (12, 9). These differences might be explained by the number of sample size. Most of the other studies were used higher sample size which will increase a chance of getting a significant effect on the outcome variable and also as a mean age of the patients implicates most of the patients were older age groups which might cause a positive significance on the outcome variable. But in other study negative significance between age and the outcome variable needs a further investigation to know the cause.

Although mode of arrival had not a significant effect on priority categorization, most of ambulance arrival patients were categorized under high priority triage category. This finding also supported by other similar findings (21). But ambulance arrival had a positive effect on categorizing patients under high priority category in other different studies which were studied on other triage systems (11, 12).

75.57% of chief complaint of the patients in this study was chest pain; however chest pain hadn't a significant association on prioritization of AMI patients. In other study done at Brazil Hospitals found similar finding on the association of chest pain and care priority (5). But other study found that having chest pain during admission had a positive significance on categorizing AMI patients under high priority triage category.

Hypertension was the common risk factor which was found on 41.2% AMI patients on this study. The prevalence of HTN was also similar as this finding in other study done in MTS (22). There is also a study which was done at Brazil hospitals found 68.6% of patients had HTN as a risk factor and also high systolic and diastolic blood pressure had a positive significance on categorizing AMI patients under high
priority triage category (5). But in this study HTN had not any significant effect on categorizing AMI patients.

Among chest pain characteristics onset of pain of more than 24 hours and severe pain accounts higher number in the study participants; however either onset or severity hadn’t a significant effect in categorizing AMI patients. But in a study done in MTS at Brazil hospitals showed that onset of pain of less than 1 hours had a positive significant effect ($P < 0.001$) on categorizing AMI patients under high priority triage category and also higher pain intensity had a positive effect ($P < 0.001$) on categorizing AMI patients in high priority triage category (5).

Triage nurse experience had a positive significant effect in AMI patients’ prioritization. In this study nurses who had more than 5 years of triage experience had 11 times more likely categorizing AMI patients under high priority triage category as compared to nurses who had less than 2 years triage experience. But other studies showed that nurse experience hadn’t any significant effect on categorizing AMI patients (21). These differences might be explained by difference on educational curriculum on the nursing school. The other studies were undertake on Latin America and Europe countries, in this countries nursing school might incorporate the detail sign symptoms of AMI patients in the undergraduate and graduate studies. This might explain there was not a significant difference between junior and senior nurses on categorizing AMI patients.

In this study TEWS was one of the factors which affect AMI patients categorization ($P < 0.001$). It showed AMI patients who had 5–10 TEWS had 65 times likely categorizing under high priority triage category as compared to patients who had 1–4 TEWS. But most of the study participants had a TEWS of 1–4. AMI patients who had 1–4 TEWS were 98% less likely categorized under high priority triage category. Therefore more than half of AMI patients were categorized under low priority triage category. This finding implicates that most of triage nurses were using TEWS rather than using chief complaint of the AMI patients who come at emergency triage room. This leads increased number of low TEWS score patients categorized under low priority triage category.

As a limitation of this study, it was done by using retrospective chart review method. This might not incorporate much information about the patients’ clinical information and any other additional information. And also this study only explained the association of high priority triage category and the associated factors. It does not include low priority triage category association with the independent variables. Additionally this study used a small sample size which might have effect on the relations between the dependent and independent variables. And also this study had done at only one tertiary hospital.

As strength this study were done at a tertiary hospital which has a high flow of patients in the emergency department. This might enable as to generalize the study findings. This study tried to explain the unseen side of treatment in AMI patients, which can be a milestone finding to improve the early treatment of AMI patients at emergency departments in the tertiary hospitals.
Conclusion

High priority triage categorized patients were almost half of the total patients seen at the emergency room at Tikur Anbessa Specialized Hospital. Much of patients who had small TEWS were less likely categorized under high priority triage category. This will increase the time of the patients seen by doctors and it will delay the diagnosis of the patients. Having more than 5 years’ experience in emergency triage was more likely to be associated with categorizing AMI patients under high priority triage category.

Methodology

The study was conducted at Tikur Anbessa Specialized Hospital. Which is a tertiary hospital located in Addis Ababa. It is a referral hospital and it has an 800 bed capacity all over the wards as well as emergency room(22). It has a high flow of incoming patients into emergency department. Averagely in one day 60 new patients will admit and sort in emergency triage room. The study includes Adult Patients who were diagnosed with ST elevation myocardial infarction and Non-ST elevation myocardial infarction between September 2010 and September 2012 E.C. The study was used retrospective cohort study of AMI patients who was seen from September 2010 – September 2012 E.C.

The data was obtained from the patients chart review and also the administrative registry form. By using structured English language checklists which have socio demographic, triage sheet information, medical information and health professional information questions. The study population information was obtained from the emergency room electronic registry form.

The clinical presentation, mode of arrival, the name of the triage nurse and the triage score was derived from the triage tool, and the triage nurse experience of triage room was got from the emergency nursing directorate office. The demographic background, the actual diagnosis and clinical information was collected from the patient chart.

The data was collected by two trained BSC graduate data collector nurses. They were taking training about the objective of the study and the data variables. They extract the data from the sample population chart by using a structure checklist and they were used a glove to handle every chart and they were using facemask for taking chart from the chart room professional. The data collected each day was checked in daily basis and it was coded by numbers for the confidential purpose.

The collected data was analyzed by using SPSS 23 version software. For the analysis purpose the patients’ data was divided into High priority category (red and orange) and low priority category (yellow and green). Then the collected data was entered into SPSS version 23 for the statistical analyses. Descriptive analysis (frequency), chi- square and logistic regression analysis was done for finding association between outcome variable and independent variables. By using bivariate analysis (chi square) each independent variable were assessed for association (relation) to the outcome variable. The variables which had a P value of < 0.05 with the significant level of 95% CI was chosen to include in multivariate analysis by using logistic regression to control cofounders. The model fitness for the
analysis were checked by calculating Hosmer – Lemeshow goodness-fit and the p value were > 0.05, therefore the logistic regression model is a good model to operate the analysis.

**Abbreviations**

| Abbreviation | Description                                      |
|--------------|--------------------------------------------------|
| ACIPH        | Addis continental institute of public health     |
| AMI          | Acute myocardial infarction                      |
| AOR          | Adjusted odd ratio                               |
| CAD          | Coronary artery disease                          |
| CKD          | Chronic kidney disease                           |
| COPD         | Chronic obstructive disease                      |
| COR          | Crude odd ratio                                  |
| CVD          | Cardiovascular disease                           |
| DM           | Diabetes mellitus                                |
| HF           | Heart failure                                    |
| HTN          | Hypertension                                     |
| MTS          | Manchester triage system                         |
| STEMI        | ST elevation myocardial infarction               |
| NSTEMI       | Non ST elevation myocardial infarction           |
| TEWS         | Triage early warning scale                       |
| SPSS         | Statistical package for social sciences          |

**Declarations**

**Ethics approval and consent to participate**

After review of the proposal approval of ethical clearance was garnered from ACIPH ethical and research review office. Permission for conduct the study in the study area was gotten from Tikur Anbessa Specialized Hospital research office / administration office and emergency department.

**Consent for publication**

Not applicable

**Availability of data and materials**
Not applicable

**Competing interests**

The authors declare that they have no competing interests.

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**Authors’ contributions**

FB writes the background, methods sections and analyzed and interprets the patients’ data.

AW revising the method part and gives comments in the manuscript.

HG was commenting and editing the manuscript.

TS write the discussion part.

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