ACUTE CORONARY SYNDROME IN-HOSPITA MORTALITY AND ASSOCIATED FACTORS AMONG PATIENTS ADMITTED TO WOLKITE UNIVERSITY COMPREHENSIVE SPECIALIZED HOSPITAL, 2023-2026: A CROSS-SECTIONAL CHART REVIEW

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Acute Coronary Syndrome In-Hospital Mortality and Associated Factors among Patients Admitted to Wolkite University Comprehensive Specialized Hospital, 2023-2026: An Institutional Cross-Sectional Chart Review

A Thesis Submitted to the Department of Internal Medicine in Partial Fulfilment of the Requirement for Certificate of Specialty in Internal Medicine.

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Approval sheet

We hereby certify that we have read and evaluated this Thesis titled "**Acute Coronary Syndrome In-Hospital Mortality and Associated Factors among Patients Admitted to Wolkite University Comprehensive Specialized Hospital,, 2023-2026: An Institutional Cross-sectional Chart Review"** prepared under our guidance by **Dr. Abdulsemed Worku**. We recommend that the Thesis shall be submitted as fulfilling the requirements for the award of **Certificate of Specialty in Internal Medicine.**

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As members of the Board of Examiners of the Certificate of Specialty in Internal Medicine Thesis open defense examination, we have read and evaluated this thesis prepared by **Dr. Abdulsemed Worku,** and examined the candidate. We hereby certify that, the thesis is accepted for fulfilling the requirements for the award of the **Certificate of Specialty in Internal Medicine.**

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Declaration

I, **Dr. Abdulsemed Worku (MD)**, as a resident of Internal Medicine program declare that this thesis entitled to assesses "**Acute Coronary Syndrome In-Hospital Mortality and Associated Factors among Patients Admitted to Wolkite University Comprehensive Specialized Hospital,, 2023-2026: An Institutional Cross-sectional Chart Review"** is my original work in partial fulfillment for the requirement in **certificate of specialty in Internal Medicine program** and not submitted for any other educational program fulfillments or publications. All sources used here for review of the proposal and the thesis are duly acknowledged.

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Abstract

Background: *Acute coronary syndrome remains a major cause of in-hospital mortality in low-resource settings, where access to reperfusion therapy and specialized cardiac care is limited. Evidence on determinants of outcomes in such contexts is scarce, particularly from non-revascularization centers in Ethiopia.*

Objective: *To determine the magnitude of in-hospital mortality and identify its independent predictors among patients admitted with Acute Coronary Syndrome at Wolkite University Specialized Hospital, in the years 2023-2026; Wolkite Ethiopia.*

Methods: *A cross-sectional chart review was conducted among 212 consecutive Acute Coronary Syndrome patients admitted between 2023 and 2026. Sociodemographic characteristics, clinical presentation, laboratory parameters, in-hospital complications, and outcomes were extracted using a structured checklist. The primary outcome was in-hospital mortality (died vs discharged alive). Bivariate logistic regression was performed to identify candidate predictors, followed by multivariable logistic regression using an events-per-variable–guided approach. Model fitness was assessed using the Hosmer–Lemeshow test and pseudo R^2 statistics.*

Result*: The overall in-hospital mortality rate was 16.1%, with substantially higher mortality among patients presenting with ST-segment elevation myocardial infarction. In multivariable analysis, Killip class IV at presentation [AOR=11], ST-segment elevation myocardial infarction diagnosis [AOR= 3.6], elevated serum creatinine indicating acute kidney injury (AOR ≈ 10), and composite in-hospital complications [AOR=14] were independently associated with in-hospital mortality. The final model demonstrated good fit (Hosmer–Lemeshow, p = 0.718) and strong explanatory power (Nagelkerke R^2 = 0.73).*

Conclusion*: In-hospital mortality among Acute Coronary Syndrome patients in our study was high and driven primarily by clinical severity and in-hospital complications. Early risk stratification and improved supportive care for high-risk patients are essential to improve outcomes in resource-limited settings.*

Keywords: Acute Coronary Syndrome, Wolkite and In-Hospital Mortality

Abbreviations and Acronyms

ACS – Acute Coronary Syndrome

ACSH- Ayder Comprehensive Specialized Hospital

ACEI- Angiotensin converting enzyme inhibitors

Afib- Atrial Fibrillation

AHF- Acute Heart Failure

AKI- Acute Kidney Injury

AMI- Acute Myocardial Infarction

AOR- Adjusted Odds Ratio

ARBs- Angiotensin Receptor Blockers

BB- Beta Blocker

BID- "Bis in die" (Latin), twice a day

BP- Blood Pressure

CABG- Coronary Artery Bypass Graft

CAD- Coronary Artery Disease

CKMB-Creatinine Kinase Muscle Band

COR- Crude Odds Ratio

CRVHD- Chronic Rheumatic Valvular Heart Disease

DALYs- Disability Adjusted Living Years

ECG-Electrocardiography

ED- Emergency Department

GRACE- Global Registry of Acute Coronary Events

GBD- Global Burden of Disease

CCA- Coronary CT Angiography

CCU- Cardiac critical Care Unit

CHF- Congestive Heart Failure

CMR- Coronary Magnetic Resonance

CVD- Cardio-Vascular Disease

HD- Heart Disease

HMIS- Health Management Information Systems

IHD- Ischemic Heart Disease

ICU- Intensive Care Unit

LDL- Low density Lipoprotein

LVEF- Left Ventricular Ejection Fraction

LVH- Left Ventricular Hypertrophy

LBBB- Left Bundle Branch Block

MACE- Major Adverse Coronary Events

NSTEMI- Non- ST Elevation Myocardial Infarction

OMT- Optimized Medical Therapy

PO- Per Os (Oral)

PCI- Percutaneous Coronary Intervention

PVCs- Premature Ventricular Complexes

SSA- Sub-Saharan Africa

STE- ST segment Elevation

STEMI- ST- elevation Myocardial Infarction

TG – Triglycerides

TASH- Tikur Anbessa Specialized Hospital

TIA- Transient Ischemic Attack

UFH- Unfractionated Heparin

UoG- University of Gonder

WKUSH- Wolkite University Specialized Comprehensive Hospital

WKU- Wolkite University

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1. INTRODUCTION

1.1. Background

Acute Coronary syndrome (ACS) is a life-threatening medical emergency defined as a spectrum of clinical manifestations which results from inadequate perfusion of the heart that includes unstable angina (UA), Non-ST Elevation Myocardial Infarction (NSTEMI) and ST Elevation Myocardial Infarction (STEMI). It is seen in those with significant narrowing of coronary arteries due to dominant cause of atherosclerotic plaque rupture or due to imbalance between oxygen demand and supply which results in decrement of blood supply to the heart muscle (8, 23). Based on the underlying cause Myocardial Infarction (MI) is classified into 5 classes, M1 to M5 (8).

It's manifested mainly by retrosternal chest pain that could be referred to jaw, teeth, shoulder, arms, and hands. Atypically the pain may be located to epigastrium or sometimes painless (silent). Classically the angina is associated with diaphoresis, shortness of breath, fatigue, vomiting, sudden doom to collapse and if severe enough to complete loss of consciousness. Associated risk factors usually incriminated are; modifiable ones: Hypertension (HTN), obesity, dyslipidemia, bad nutritional behavior, sedentary life style, smoking, and the non-modifiable ones: old age (>65), family history, genetics and sex (male gender more affected). Diagnosis wise; having sudden onset typical mostly and less commonly atypical presentation with troponin value at least once > 99^{th} percentile of Upper Limit of Normal (ULN) range with rising and dropping patterns, ECG ST- T wave changes, Q waves, LBBB or equivalents, and imaging (echocardiography, CCA, CMR, and nuclear imaging) evidences of new myocardial dysfunction and coronary artery stenosis. If 1 criteria's is met in the presence of myocardial injury biomarkers, Acute Myocardial Infarction (AMI= STEMI and NSTEMI) is confirmed; but diagnosis of Unstable Angina (UA) is challenging to confirm immediately as biomarkers will not be detected rather clinical manifestation with proper imaging is required(9).

Its management mainly relies on rapid reperfusion (medically and/or surgically), timely evidence-based Optimized Medical Therapy (OMT), and advanced supportive medical therapies (4).

High income countries (HICs) have experienced significant decrement in mortality rates from all cardiovascular conditions since the 1960s due to advancement in both treatment and prevention of Coronary Artery Disease (CAD); mortality downed to below 5 %(6). Particularly, advances in the acute management of ACS includes many celebrated achievements in intensive care and interventional approaches to cardiovascular medicine; the establishment of the cardiac Coronary Care Unit (CCU), the introduction of streptokinase & latest thrombolytic drugs (Tenecteplase, Alteplase) and the development of coronary artery catheterization (PCI), balloon angioplasty, and surgical revascularization /Coronary Artery Bypass Graft (CABG) (6, 23).

However, low and Low-Middle-income Countries (LMICs) such as Ethiopia continue to face substantial barriers to optimal ACS care. These include home to door delays, limited diagnostic and reperfusion capacity, particularly primary Percutaneous Coronary Intervention (PCI), shortages of essential medicines, and gaps in OMT adherence and staffing. Several risk factors which have been found associated with ACS such as HTN, dyslipidemia, Diabetes Mellitus (DM), and smoking has been increasing dramatically in developing countries. Hypertension is the strongest cardiovascular Disease (CVD) risk factor in the African context and roughly one in six people has hypertension in SSA and, only half of the populations with it are aware of their hypertension, indicating uncontrolled blood pressure causing premature CVDs (30, 46).

In sub-Saharan Africa; in Ethiopia specifically, recent pooled analyses and systematic reviewed documents show a rapid emergence of AMI as a visible contributor to hospital admissions and in-hospital mortality, driven by uncontrolled cardio-metabolic risks and health-system constraints (46).

1.2. Statement of the problem

CardioVascular Diseases (CVDs) were the leading cause of disability-adjusted life years (DALYs) and deaths estimated in the Global Burden of Disease (GBD). As of 2023, there were 437 million (95% UI: 401 to 465 million) CVDs DALYs globally, a 1.4-fold increase from the number in 1990 of 320 million (292 to 344 million). Ischemic heart disease (IHD), intracerebral hemorrhage, ischemic stroke, and hypertensive heart disease were the leading

cardiovascular causes of DALYs in 2023 globally. Out of the top killer IHD components, ACS is the leading cause of morbidity and mortality worldwide (47). According to the World Health Organization (WHO), CAD accounted for an estimated 17.9 million deaths in 2023, representing nearly **16%** of all global deaths annually (1). Nearly two-thirds of all DALYs and over half of deaths occur in LMICs (1, 2). Unlike HICs; having well documented ACS prevalence and case fatality bay large registries and databases, Sub-Saharan Africa's (SSA) exact prevalence and fatality was not clearly identified. As a result, prevalence of ACS in SSA was considered relatively uncommon. It's expected that most of the cases were misdiagnosed or under diagnosed due to limited diagnostic as well as therapeutic means (electrocardiographs, myocardial biomarkers, PCI, CABG, and cardiac imaging),and shortages of physicians. However, its prevalence is predicted to rise rapidly in the next two decades due to the rising prevalence of risk factors, especially HTN, DM, overweight and obesity, physical inactivity, increased tobacco use and dyslipidemia. Not only prevalence, age-standardized mortality rate from ACS was projected to rise by 70% in African men and 74%, in women by 2030(46, 47).

In high-resource settings; due to wide availability of PCI, in-hospital mortality after ACS is generally in the low single digits; a nationwide England and Wales cohort reported in-hospital mortality showed this fact (5.3%) (34).

Despite advances in trials and evidence-based interventions (PCI, thrombolytics, statins, ACEIs/ARBs, beta blockers, antiplatelets, and anticoagulants) that markedly reduce short-term and longer-term mortality after ACS , many low- and middle-income settings continue to experience proportionately higher early mortality following ACS(4). For example, the CREATE registry in India observed overall in-hospital mortality was near 8.6% and disproportionately high in STEMI case fatality where PCI access was limited (20). Similarly, regional registries in the Middle East reported variable in-hospital mortality in the single digits, with center-level differences driven by reperfusion capability and comorbidity burdens (18, 38).

Systematic reviews of sub-Saharan African studies show marked heterogeneity in reported in-hospital mortality, with substantial proportions of cohorts reporting far higher mortality than typical HIC series (46).

Similar to the other SSA countries; Ethiopia has a huge gap in registries and databases to access national ACS burden and case fatality (30, 44). The National health data management center reported that ACS roughly increasing in alarming rate and is number 1 daily killer across the country; 170 people died of ACS per day as per report of 2021(48). Hospital based studies and a recent national pooled analysis indicated in-hospital mortality of 14.82% across facility series and highlighted consistent excess case fatality relative to better resourced systems and these excess deaths are concentrated among patients who present late or who lack access to timely reperfusion (30).

Overall, this global, national as well center-level differences in burden and in-hospital mortality of ACS is driven by multiple factors: at patient level; clinical as well as sociodemographic characteristics, burden of risk exposure & comorbidities, pre-hospital system/infrastructure level factors and in-hospital factors: mainly timely reperfusion capability & evidence-based OMT. After all, the outcomes of ACS doesn't rely on the degree of knowledge about it do we have, rather it rely on how fast the system responds for reperfusion of the infarcted myocardium as soon as possible. Hence, barriers to timely reperfusion in these settings include both pre-hospital delays driven by limited symptom recognition and access issues, and in-hospital system gaps such as scarce PCI capacity, irregular availability of thrombolytic agents, and inconsistent application of evidence based medicines (30, 43). The net result is that patients in resource-limited settings often experience larger infarct size, higher rates of heart failure and cardiogenic shock at presentation, and poorer short-term survival compared with patients treated in well organized, timely functional reperfusion centers (23).

Wolkite University Comprehensive Specialized Hospital (WKUSH) serving as a referral center for about 4 million population in Central Ethiopia Region (CER); but without PCI, medical thrombolytic drugs, cardiac CCU and poor staffing is expected to have higher in-hospital mortality and secondary outcomes. Besides, little is known about the outcomes, and

its predictors and determinants of ACS management in this institution. Hence; by this study, generating local evidence is essential to guide clinical practice, strengthen acute cardiac care, reducing complications and improving survival among ACS patients in WKUSH, and be bases for local health policy at regional and national level by designing pre-hospital and in-hospital level quality improvement pathways.

1.3. Literature Review

1.3.1. Global Epidemiology of ACS

A century ago, ACS meant death or near certain death; but today, for many patients in well-structured and functional health systems, timely reperfusion and optimal evidence-based mortality benefiting drugs often mean survival and a return to productive life with in-hospital mortality below 5%(9,23,34). Though the prevalence is still high, landmark trials and guidelines have shaped modern care demonstrating that primary PCI where available, medical thrombolysis, early Dual AntiPlatelet Therapy (DAPT), anticoagulation when appropriate, Beta-Blockers (BB), Angiotensin Converting Enzyme Inhibitors (ACEIs), statins, pain alleviation and authentic timely supportive care bundles together confer the greatest chance of survival and functional recovery (10, 11).

Comparatively; in-hospital mortality in LMICS variable huge (20, 30, 46). A Systematic review from SSA showed highly variable mortality of 1.2%- 24.5%(46), Gulf countries RACE Registry ranges 5-8% (18), Indian ACS registry CREAT reported 8.6% mainly STEMI cases due to limited PCI access (20), and Ethiopian national systematic review with pooled in-hospital mortality of 14.5% overall and 16.5% for STEMI shows this fact(30).

In this settings, Registries and population based studies showed delays measured in hours to days from symptom onset to hospital presentation are a dominant driver of poor outcomes (20,30,46); even small delays to reperfusion translate to measurable increases in infarct size, heart failure, and mortality(39,40). Moreover, available studies in these settings are mostly retrospective, single centered, small study population number, and heterogeneity of the study reports are the main obstacles to decrease the hugely reported mortality (30, 46). Yao H, et al, 2021: A 10 year's systematic review of 27 eligible institutional based studies in the SSA from 16 countries reported high in-hospital mortality of 1.2%- 24.5%, and follow up

mortality of 7.8%-43.3% in nations with no or underused reperfusion centers. Comparatively, studies from South Africa, Ghana, and Cotidevor showed lower mortality (46). Conversely, studies from Djibouti, Tanzania, and Ethiopia accounted double digit mortality. The commonest predictor for mortality was delayed symptom onset to arrival in critical cardiac care unit/centers: Tanzania's being the longest (6.6 days) followed by Burkina Faso (4.3 days) and South Africa's; from single study report, being the shortest (2.3-3.6 hours) with some functional EMS and first contact medical transportation (46).

Ethiopia, being in this same region; having few reperfusion centers and unparalleled poor infrastructures for huge population, ACS mortality burden is understudied (30). In 2021, National data center reported there is 170 deaths/day due to CVDs, out of which 45% is due to ACS. Though, national population/large registry based study was not done to identify ACS burden, management outcome and its determinants, there are tens of institutional retrospective, few cohort and one systematic review reports . Among few quality studies on ACS outcome in Ethiopia is, the only systematic review and meta-analysis undertaken on 2023: a 20 year national systematic review of 12 eligible studies among 1191 ACS patients, reported pooled in-hospital mortality rate of 14.82%, a higher rate observed in STEMI patients (16.12%). Maximum mortality of 19% was recorded from University of Gonder (UoG) study of 150 STEMI patients, and the minimum in-hospital mortality of 10% was reported by Jimma University (JU) study of 150 NSTEMI patients. All the included studies were from Addis Ababa (4 studies) and 2 regions; Amhara (2 studies from UoG) and Oromia (3 studies from JU) (30). The review is still questioned with significant heterogeneity of study design and quality of the included studies; from which generalization to the nation is difficult. Other single centered studies mainly undertaken from tertiary teaching hospitals similarly report a two digit in-hospital mortality of ACS ranging between 8-24.5%(30).

1.3.2. Clinical features and Diagnosis

Once infarction/ischemia of myocardium is happened resulting pumping and/or electrical malfunction, within seconds to minutes it will be manifested typically by retrosternal chest pain with varying radiation, diaphoresis, syncope and pre-syncope. Global large registries and studies showed majority of STEMI patients (>90%) present with typical symptoms (6, 9, 10). Atypically patients may merely present with complaints of nausea/vomiting, shortness of

breath, fatigue, palpitations, or syncope, epigastric pain or may be silent without classic central/retrosternal chest pain; and NSTEMI/UA, elderly, DM and women were more associated with atypical presentation. GRACE (10) showed that up to 30% of the patients presented with these atypical symptoms. Another study from UK(34); out of 693,388 patients from 247 hospitals, typical chest pain was in 80%, dyspnea was 26%, diaphoresis was 21% and atypical presentations was common in NSTEM/UA, elderly and women which in turn was associated with late presentation and poor outcome ($p<0.001$) (34).

Studies from LIMCs; particularly Gulf RACE-2(38), CREATE (20), and few SSA systematic reviews and multiple multicenter and single center studies reported comparable type of presentation (10-20%) (46). A retrospective cross-sectional study on ACS outcome done in Ayder Comprehensive Specialized Hospital (ACSH) in Mekele reported that out of 160 ACS patients, 92% presented with typical chest pain (27).

Among the decisive factors for ACS in-hospital mortality is time; that's why some scholars said time is muscle for the heart to revive. Median pre-hospital delay from HIC settings is significantly short compared to LMICs. Median delay of symptom onset to door in GRACE registry was 2.6 hours (10). Similarly, from TIMI IIB score registry (7089 UA/NSTEMI ACS patients from ESSENCE, PRISM, and TIMI IIB trials), median symptom to door delay was <6 hours in 44% of the study participants (11). Gulf RACE-1(38) and Gulf RACE-2(18) reported variable delay; but pooled median delay was 4.3 and 3.8 hours respectively. And, first ECG within 10 minutes of arrival was 33% and 64% respectively (18, 38). On the other side, the Indian CREAT study reported symptom to door time was 300 minutes and first ECG within 10 minutes was 69%. Delay in SSA region is obviously expected to be huge; multifaceted by poor infrastructures and disease awareness among many (42, 46). The 20 years SSA systematic review of ACS treatment outcome showed wide gap in home to door to cardiac unit admission time, ranging from South African 2.3 hours to Tanzanian 6.6 days. From the review, there is no consistently reported first ECG done within 10 minutes data (46).

Ethiopia; being in this resource constrained region is not exceptional to had large delay on symptom onset to door time, >50% of the 1191 ACS patient enrolled on the 20 years ACS outcome systematic review study delayed >12 hours and < 25% arrived before 6 hours. Pooled symptom to door delay was 12-16 hours, whereas, first ECG within 10 minutes was

reported to be around 90%, but lower in non-tertiary hospital studies (30). A cross-sectional study of knowledge, attitude belief about ACS in 200 patients; in 2023 Addis Ababa, reported 50-55% of patients presented with typical symptoms and 30-35 % delayed for care >12 hours attributed atypical symptoms unawareness(43).

Diagnosis wise, early ECG remains the single most important diagnostic and screening tool; serial ECGs and troponin testing confirm diagnosis and inform risk stratification (6, 8). The Fourth Universal Definition of MI clarifies use of high-sensitivity troponin for myocardial injury versus myocardial infarction (8). Biomarker testing with cardiac troponin is now standard in tertiary centers and registry analyses, with high troponin availability reported in many facility series (30). Echocardiography is used widely to assess left ventricular function; in pooled LMIC & Ethiopian series, a substantial minority of patients exhibit LVEF below 40% at early assessment (29). ECG patterns and imaging findings differ by region in part because of differences in time to presentation, with STEMI proportions higher in many LMIC hospital series and NSTEMI relatively more common in HICs registries (20, 34).

When type of ACS at presentation was reviewed, the GRACE registry (14) mostly showed UNSTEMI/UA (70%) and STEMI was 30%. Similarly, the UK ACS study (34) reported STEMI was 38.8% and UNSTEMI was 61.2%. Besides, The Gulf RACE-1(38) Middle East prospective ACS registry (2008-2009) report also showed STEMI was 38%, NSTEMI was 39%, and UA was 23% (total ACS patients from 6 countries was 7930). Another study from India; CREATE (20); (2001-2005), a prospective analysis of register data of 20,468 ACS patients from 89 hospitals of 10 regions reported 60% had STEMI, 26% had NSTEMI and 14% had UA.

Conversely in SSA; with no large population registries or databases for review, pooled data from few available systematic reviews and multicenter to single center studies showed STEMI predominance ranging 50 to 70%(46). The Mekele retrospective chart review study of 160 ACS reported STEMI was 60%, with median 15 hours delay of symptom to door (27). Heart failure and reduced left ventricular ejection fraction are frequent complications at presentation in many LMIC and Ethiopian cohorts; pooled estimates from Ethiopia place heart failure on admission in the 35-45% range (30). Similarly, cardiogenic shock and ventricular arrhythmias are reported in variable proportions but are consistently associated

with substantially higher in-hospital mortality in both regional and global registries (23). Killip class remains a simple and reliable bedside predictor of mortality and non-fatal Major Adverse Coronary Events (MACE) in validated prognostic models (10).

1.3.3. Risk factors of CAD and predictors of bad outcome of ACS:

In the United States, North America, and Europe population studies reported the median age at ACS presentation is 70 years with male-to female ratio of approximately 3:2. Some patients have a history of stable angina, whereas in others, ACS is the initial presentation of CAD (3). Another retrospective nationwide cohort study undertaken in United Kingdom: MINAP registry to study multimorbidity and survival for ACS patients, 2003-2013, sampling 693,388 patients from 247 hospitals; the mean age (years) was 69.3 ±13.6, female were 33.5%. Hypertension was the commonest of modifiable risk factors (58%), followed by dyslipidemia (42%), DM (23%), prior IHD (19%), and smoking (28%). With respect to comorbidity burden, 60% had >/2 chronic comorbidities; the commonest were HF (14%), CKD (13%), COPD (11%), cancer (6%) and stroke/TIA (9%). With regard to diagnostic timeliness: median time to ECG was 14 minutes (IQR, 8-23) and troponin testing was >95%. Regarding to killip class: killip I (72%), II (16%), III (8%) and IV was 4%. Echocardiography was performed in 78% of patients and LVEF<40% in 29% overall (34).

Studies conducted in developing countries reported earlier onset of ACS with average age of 55-60 years. According to CREATE: a prospective analysis of register data in India published on 2008, of the 20,468 patients who were given a definite diagnosis, 60% had STEMI, and the mean age of these patients was 57·5 ±12 years; patients with STEMI were younger (56 ±12 years) than those with non-STEMI or unstable angina (59 ±12 years)(20). The Gulf RACE-2 registry of 6 Middle East countries 7930 ACS patients reported, mean age was 56.6 years, male were 80%, DM 46%, HTN- 51%, dyslipidemia- 34%(38). Smoking was 35% in Gulf RACE-1 study of 5000 ACS patients (18). The SSA ACS outcome systematic review and meta-analysis pool data reported mean age was 55-65 years (46). Family history and ethnicity contribute to variation in age at onset and disease severity; for example, South Asian ethnicity is associated with early ACS presentation in Indian and comparative studies (20). Physical inactivity, unhealthy diets and harmful alcohol patterns are repeatedly cited as population drivers of the cardio-metabolic transition in LMICs and are implicated indirectly in many regional and facility reports (2, 20). Chronic kidney disease, systemic inflammation

and anemia commonly accompany and amplify coronary risk and are independently associated with worse outcomes across multiple studies (41, 42).

In HICs GRACE and TIMI risk scores are widely used and are effective in predicting complications and mortality (11, 14). The most validated and multinational risk pattern showing data of ACS from HIC is a prospective multinational GRACE registry of approximately 102,341 patients (1999-2005) from 94 hospitals of 14 countries. It identified 8 modifiable risk factors for CAD; which are obesity, sedentary life style, hypertension, smoking, dyslipidemia, CKD, DM, alcohol and bad nutritional behavior. The mean age of patients pooled in to the registry was 65 years, 33% female, Killip II-V 23%, HTN 57%, DM 26%, smoking 41%, prior MI 30%(10). In this study first ECG within 10 minutes was 72 %(10, 14).

In GRACE score, risk of ACS mortality categorized in to low, medium, and high based on the score out of 8 points (10). It had designed 8 predictors of ACS bad outcome; which are: Age >65 (OR= 1.7 per 10 years), killip class (OR= 2 per class), low Systolic BP (OR= 1.4 per 20 mmHg drop), ST segment deviation (OR= 2.4), cardiac arrest at presentation (OR=4.3), serum creatinine (OR= 1.2 per 1 mg/dL increase), positive initial cardiac enzymes (OR= 1.6), and increase in Heart Rate (HR) (OR= 1.3 per 30 bpm increase). Amongst, cardiac arrest at presentation is the strong predictor of in-hospital mortality.

Age and higher Killip class at presentation are highly reproducible predictors of in-hospital mortality across other registries (20, 34). Renal dysfunction, as reflected by elevated serum creatinine, is an independent predictor of mortality in multinational models and in multiple African and Ethiopian studies (41, 46). Reduced LVEF and the presence of heart failure at presentation confer substantial excess risk for early mortality in registries and facility reports (29). Late presentation and prolonged ischemic time are among the most important modifiable predictors of death; analytic studies demonstrate a continuous relationship between delay and mortality (39).

Arrhythmic complications (sustained atrial fibrillation, sustained ventricular tachycardia, and ventricular fibrillation) and mechanical complications (pump failure, rarely wall rupture) are associated with very high case fatality (23). Comorbidity burden and multimorbidity combine

to increase both in-hospital and 1-year mortality, with higher hazards observed in patients with multiple chronic conditions across large population cohorts (34).

When 14 days composite of events for UA/UNSTEMI was scored based on TIMI risk model out of 7; by prognosticators scoring 1 for each, using Age >65, >/ 3 CAD risks factors, known CAD >/ 50% stenosis, Aspirin (ASA) use in prior 7 days, >/2 anginal events in prior 24 hours, ST deviation, and elevated cardiac enzymes, risk of UNSTEMI/UA was bad outcome was nearly perfectly predicted. The model showed that event rates rose steeply with higher TIMI score: score 0/1- 4.7%, score 2- 8.3%, score 3-13.2%, score 4- 19.9%, score 5-26.2%, score 6/7- 40.9 % (11).

The Ethiopian systematic review reported pooled risk factors for the ACS patients studied as follows: HTN- 54.8%, DM-38.5%, Dyslipidemia- 31.2%, smoking-22.6%, physical inactivity- 18.3%, obesity-14.9%, alcohol use 13%, unhealthy diet-60%, CKD-9.6%, and prior IHD- 12.3%. And the non-modifiable risk factors: male sex (70%) was not significantly associated- AOR 1.32(95% CI 0.91-1.93), age > 65 years (45%) was an independent predictor of poor outcome AOR 2.14(95% CI 1.442-3.23). Family history was reported in 11.8% and showed consistent associations with recurrent Ischemic events AOR of 1.89. The study reported pooled AOR for DM was 2.8(v95% CI 1.6-4.7), and for HTN AOR 1.9 (95% CI 1.2, 3.1). Patients with >/ 3 modifiable risk factors had AOR 4.9 of in-hospital mortality (30).

In-hospital mortality in Ethiopia range between 8.2% and 24.5%, and recurrent events remain common. Delayed presentation and limited reperfusion capacity are the dominant contributors to poor outcomes (30). According to Fanta K, et al. (2021), in a prospective cohort of 181 patients, the 30-day mortality rate reached 12.7%, with only 7.2% receiving reperfusion therapy (PCI or thrombolysis)(26). Heart failure developed in 42.4%, cardiogenic shock in 29.8%, and recurrent MI in 14.6%. Another study from SPMMCH reported that from 268 patients: HTN (53.4%), DM (33.1%), and dyslipidemia (29%) were leading risk factors. From the study, Mean age was 56.4 ± 12.5 years, 67% were male with in-hospital mortality of 10.5%. Delayed presentation (>12 h) was noted in 61.2% of patients. Independent predictors of death were: cardiogenic shock (AOR = 5.8; 95% CI 2.6‑12.4),

killip class ≥ II (AOR = 4.1; 95% CI 1.9‑8.9), and late presentation > 12 h (AOR = 3.7; 95% CI 1.6‑8.2). Complications frequency: Heart failure in 42%, recurrent ischemia in 15%, and arrhythmia was in 11% (24). Another study on Recovery of ACS and its Predictors on 220 patients in Addis Ababa hospitals reported that recovery rate was 71.5%, death was 12%. Predictors of delayed recovery were: Age > 65 (AHR = 2.2), Killip class ≥ II (AHR = 3.4), and no reperfusion (AHR = 2.8) (25). The ACSH Retrospective ACS outcome chart review study from 196 ACS patients (2020) also reported: mortality rate was 8.2% and independent predictors were: STEMI (AOR = 2.1), cardiogenic shock (AOR = 5.3), and late arrival > 12 h (AOR = 3.4). ACSH study reported reperfusion therapy capacity was 6.6 %(27).

An unmatched case–control study to identify determinant of in-hospital mortality (2024) from UoG from 210 ACS patients reported that predictors of death were: Age > 65 (AOR = 4.5; 95% CI 1.7–11.9), cardiac arrest on admission (AOR = 6.2), LVEF < 40% (AOR = 3.7), and delayed presentation (AOR = 2.9) .Mean hospital stay was 5.3 days (41). Another study from UoG which evaluated OMT adherence and post-discharge outcomes reported: recurrent ACS was 18%, and predictors of recurrent ACS were: Non-adherence to medication (AHR = 3.1), DM (AHR = 2.7) and multivessel disease (AHR = 3.9) (29). A multi-center 5 years review study on ACS patients (2025) from four tertiary hospitals to study management patters and outcomes reported: In-hospital mortality of 13.9%, reperfusion therapy of 8% and common independent predictors of death were: low LVEF (AOR = 3.8), shock (AOR = 6.1), and no aspirin on arrival (AOR = 2.7)(33).

A study done to verify laboratory and hematological indices predict outcomes of 300 ACS patients on 2024 reported that significant predictors of mortality were: high Neutrophil to Lymphocytes Ratio (NLR) > 4.5 (AOR= 3.6), RDW > 14% (AOR= 2.9), and anemia with Hgb < 12 g/dL (AOR= 2.4) (42).

Knowledge and Awareness about ACS cross-sectional study by Demisse L, et al. (2022) done in Addis Ababa reported that good knowledge of ACS symptoms was only 36.5%, symptom to door delay due to poor perception was 47% and it attributed to the delayed presentation > 12 hours of symptom onset to first medical contact (43).

1.3.4. Management of ACS

In HICs once ACS is suspected/confirmed, rapid but systematic stratification of patients in to high, moderate and low risk group guides immediate next step of management aggressiveness. Among many national and multinational risk scorers, land mark trial/systematic review validated risk of death scorers are TIMI (11) for NSTEMI/UA and GRACE (14) for STEMI; provide not only mortality risk estimates but also guide the intensity of monitoring and early invasive strategies in suitable settings. However, these scores were derived in high-income regions and may require local validation in African cohorts where case mix, settings, staffing and patient as well as system level delays differ significantly (35). For patients with STEMI, primary PCI within guideline time targets confers the best outcomes where it can be delivered in a timely manner (4). Beyond reperfusion, OMT (ASA, P2Y12 inhibitors, BBs, ACEI/ARBs, high-intensity statins and anticoagulants) substantially reduce early and late ischemic events and are universally recommended (12, 13). Trials such as TRITON-TIMI 38(12) and PLATO (13) established the benefit of more potent inhibitors, but issues of cost and bleeding risk affect generalizability to LMICs. Where primary PCI is unavailable or delayed, immediate fibrinolysis followed by structured transfer for coronary angiography (a pharmaco-invasive strategy) is an effective alternative and is commonly implemented in many LMIC contexts (19).

Despite these trials and guidelines recommendations, adherence to evidence based OMT and reperfusion therapy varies widely across the globe: HICs report high PCI use rate >50% and near universal use of discharge secondary prevention (14, 34), whereas many LMIC series report low PCI penetration <10% and variable discharge practice (30, 46).

1.3.5. System factors

Quality improvement interventions in LMIC hospital networks can improve process measures and medicine use; however, pragmatic trials show that changing mortality requires sustained system wide implementation and addressing pre-hospital delays (16, 17). Regional experience suggests that stepwise investment and strengthening EMS, ensuring medical

thrombolytic availability, and building organized transfer network are pragmatically feasible strategies to reduce early deaths where universal PCI is not yet attainable (19).

Ethiopian studies reported that despite moderate improvement in diagnostic accessibility (ECG performed in > 90% of cases, troponin in ~ 75%) evidence-based pharmacotherapy adherence is suboptimal (29, 33). The pooled reperfusion rate of < 10% stands in stark contrast to global rates (> 70%), underscoring the critical gap in emergency cardiac care capacity (30, 32).

Finally; in this review, key evidence gaps identified includes limited contemporary, prospective registry data that link pre-hospital delays, in-hospital process metrics, reperfusion modality and standardized outcomes across representative Ethiopian hospitals. Additionally, context-specific implementation research is needed to determine which combinations of system interventions (public education, thrombolysis scale-up, pharmaco-invasive networks, and hospital quality improvement) most efficiently reduce mortality in constrained settings (17, 19).

1.4. Significance of the Study

Beside to limited researches on the topic; the existing researches are not generalizable to national level due to: mostly single centered, small sample size, majority retrospective, heterogeneity of study designs included in the systematic review, no population representing large registry/database on ACS outcome study; and up to the researchers knowledge till this time there is no similar study undertaken in WKUSH. Considering the inconsistent patterns and variations of in-hospital mortality across national tertiary hospitals but with frequently reported predictors: delayed presentation, absence/under use of reperfusion therapy and variable OMT adherence, this study will provide practical data of in-hospital outcomes of ACS in a non-PCI hospital setting like ours, identify modifiable factors associated with poor outcomes, and inform context appropriate quality improvement measures. Findings will be useful to clinicians, hospital administrators and regional public health authorities for prioritizing resources (e.g., ECG availability, thrombolytics, essential medicines, staffing and PCI), training needs, and care pathways aligned to the local context.

Taken all these together, local data are required to prioritize WKUSH's ACS outcome study is well positioned to contribute such data and to use findings to drive changes that will save lives by identifying the most actionable gaps to inform feasible interventions such as improving door-to-ECG times, standardizing early pharmacotherapy, and strengthening monitoring for complications, and local health policy will be based for ACS management.

1.5. Conceptual Frame Work

The conceptual framework illustrates the relationships between patient-level characteristics, clinical presentation, health-system and in-hospital care factors, and outcomes among patients admitted with ACS at WKUSH**.** Patient-level factors such as age, sex, residence, comorbid conditions, and behavioral risk factors influence both the clinical presentation and the type and timeliness of care received. These factors may predispose patients to delayed presentation, severe disease at admission, and increased vulnerability to adverse outcomes. Clinical presentation reflects the severity of ACS at hospital arrival and includes symptom profile, Killip class, LVEF, presence of shock or arrhythmias, cardiac arrest and timing of presentation. These variables directly affect treatment decisions and prognosis. Health-system and in-hospital management factors encompass pre-hospital delay, referral pathways, diagnostic and treatment capacity, medication use, monitoring level, and length of hospital stay. In resource-limited settings, gaps in reperfusion therapy, critical care availability, and guideline-directed management may significantly modify outcomes (see figure-1 below).

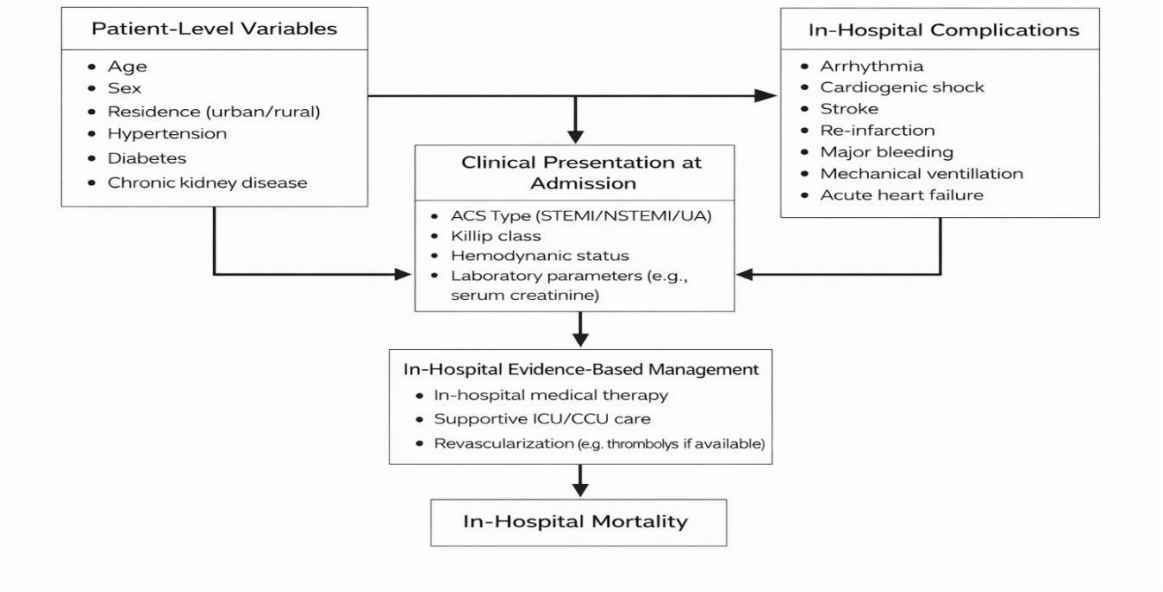

Fig-1 Conceptual framework illustrating patient-level factors, clinical presentation, health-system and in-hospital management determinants, and outcomes among patients with ACS.

(The conceptual framework was adapted from established ACS outcome models and international guideline-based determinants, including the GRACE registry (10), and prior observational studies in Ethiopia (30))

2. OBJECTIVE

2.1. General objective

- ★ The general objective 0f this study was to determine ACS in-hospital Mortality and associated factors among patients admitted to WKUSH, 2023-2026, Wolkite, Gurage Zone, Ethiopia.

2.2. Specific objectives

Specific objectives of this study were:

- ★ To determine ACS In-hospital mortality among patients admitted to WKUSH in 2023-2026, Wolkite, Gurage Zone, Ethiopia
- ★ To identify associated factors of in-hospital mortality among patients admitted to WKUSH on 2023-2026, Wolkite, Gurage Zone, Ethiopia.

3. METHODS AND SUBJECTS

3.1. Study Area and Study period

WKUSH is a tertiary teaching hospital found in the Central Ethiopia region, Gurage zone 172 kilometers southwest of Addis Ababa and 10 kilometers south of Wolkite town, in Gubrye sub city. It was established in July 2019 and serves as a referral center for Gurage zone and nearby regions for around 4 million people catchment areas. It is a tertiary teaching referral hospital affiliated with Wolkite University, College of health sciences with a total admission capacity of 300 beds for general major wards, orthopedics, ophthalmology, psychiatry units and general ICU having 6 beds. So far, the hospital has served for around 327,000 patients and sees around 70,000 patients per year.

It has adult ED partitioned to red, yellow and green areas with modest emergency settings for medical and surgical patients with around 20 beds. The Emergency department was established and run by 8 general internists and 1 Emergency and Critical care Medicine (ECCM) physician. It sees around 20,000 critical patients per year referred from nearby primary hospitals and local health centers. It has a red zone which has 5 beds with wall mounted monitors for each bed but no mechanical ventilator at emergency department availed. WKUSH also has a well-equipped general ICU with a total of 5 beds with installed mechanical ventilators for each. Both ED and ICU are run by general internists, except ED red zone. Patients with an admission diagnosis of ACS during the study period to whom initially stabilized at ED and admitted to the general ICU for certain days to weeks then transferred to general medical ward after improvement in **January 2023- January 2026**. And these charts were reviewed and analyzed in September 2025- February 2026.

3.2. Study design

Retrospective cross-sectional study was employed for the sampled patients' charts admitted with a confirmed diagnosis of acute coronary syndrome (ACS) from January 2023 to January 2026 time period.

3.3. Source Population

Out of the total 310 patients admitted to the hospital, 230 Patients admitted during the time period with complete medical records.

3.4. Study population

212 patients' charts with ACS who were admitted to WKUSH from January 2023to January 2026 time period (Eligible charts).

3.5. Eligibility criteria

Inclusion criteria

- All patients with documented ACS diagnosis in medical records and final outcome (discharge, death) were included.
- Age >= 18 years

Exclusion criteria

- Patients with incomplete records precluding determination of primary outcome were exclude from the study.
- Patients who presented within the study period for re-infarction after a previous ACS admission still within the study period 2023-2026 (Recurrent MI), hence the last record of ACS admission will be included.
- Age < 18 years
- Patients with ACS and death on arrival
- Patients who were self-discharged against medical advice; hence outcome couldn't be known.

3.6. Variables

Dependent variable used in the study was:

- In-hospital treatment outcomes of ACS (discharged alive vs Died)

Independent variables used in the study were:

Sociodemographic factors

- Age, sex, family history, smoking, and site of residence

Patient and clinical factors

- Comorbidities and risk factors (DM, hypertension, chronic kidney disease, Obesity, Dyslipidemia, IHD/MI, stroke history and any debilitating chronic illnesses),
- clinical features at presentation(typical vs atypical symptoms, vital signs, and complications)
- type of ACS (STEMI/NSTEMI/UA),
- symptom-to-door time,
- Complications during admission period (HF with Killip classification, arrhythmia, shock, LVEF)
- Level of laboratory markers rise (creatinine, cardiac biomarkers, WBC, Hgb, and LDL)

Hospital level factors

- Treatments received (thrombolysis, beta-blockers, ACEI/ARB, statins, heparins, analgesics), and
- Timing of first ECG & interventions, ICU admission and supportive management.
- Referral
- Length of stay in the hospital (LOS)

3.7. Sample size determination and Sampling techniques

❖ **Sample size**

Sample size was calculated using double-population proportion formula (for Primary Outcome predictors of In-hospital Mortality) using statistical software EPi-Info™ statcalc 7.1.2.0 by assuming prevalence of different ACS outcome predictors, margin of error 5%, confidence level of 95%, power 80%, and 10% of non-respondent as follows:

Using the formula: $n = ((Z_{\alpha/2} + Z_{\beta})^2 * [p1 (1-p1) + p2 (1-p2)]) / (p1 - p2)^2$

Possible ACS treatment outcomes	Exposure	Difference	Calculated sample size	Reference
• Complications at Presentation : Heart Failure (HF) classified by Killip classification, Arrhythmias, Shock	STEMI vs NSTEMI	25%	125	28
Length of Stay in the Hospital • Duration of hospitalization measured in days.	ICU admitted vs Non- ICU	40%	53	26
In-Hospital Mortality Rate • Rate of death during hospitalization.	Delayed presentation (>12 hrs.)	15%	230	30
Discharge Disposition • Outcomes at discharge categorized as: o Death o Discharged alive	Early Guideline adhered management	20%	143	40

Accordingly the optimal sample size was 230.

❖ **Sampling technique**

Simple lottery method was used to select 230 charts out of 310 total admitted ACS patients; 80 out of the total 310 patients were selected by lottery method using computerized numbering. Then eligibility was checked cautiously and 212 patients were identified as eligible for the study.

3.8. Data collection tools, techniques and procedure

To collect a quality data, 1 medical intern and 1 health officer were selected and trained them on the data collection process. After important materials were prepared and getting ethical clearance, lists of Eligible ACS patients admitted to WKUSH in the review period were identified from respective area nursing logbooks by the trained data collectors. The Standardized checklist (see Annex-1); which was slightly modified from previous similar studies after review to contextualize it to WKUSH, divided into 5 sections: sociodemographic, risk factors & comorbidities, clinical characteristics, investigations, acute in hospital treatment, complications, and outcome was used to collect data from 212 eligible charts.

3.9. Data Quality Assurance

To achieve the quality of data the following actions were undertaken by the PI were:

- ★ Training for data collectors
- ★ Daily supervision and random checks for completeness.
- ★ Data validity tests
- ★ Double data entry into SPSS v27 performed.

3.10. Data Management, Processing and Analysis

Data was entered into SPSS V27 installed computer by the PI after the study variables were properly classified based on their measurement scale. Then the variables were coded when necessary, then data entered in to SPSS V27, recoded, transformed, and cleaned. Finally, the data was prepared for analysis after model fitness checked. Model adequacy was assessed using goodness of fit and explanatory power measures. The Hosmer–Lemeshow test showed no evidence of lack of fit ($\chi^2 = 5.37$, df =8, $p = 0.718$), indicating that the model predictions were consistent with observed outcomes. The final model demonstrated strong explanatory capacity, with Cox & Snell and Nagelkerke pseudo R^2 values of 0.44 and 0.73, respectively. Model convergence was achieved without instability, supporting the reliability of the estimated parameters.

Descriptive statistics was used to summarize baseline characteristics using text, table, and figures.2 Continuous variables were presented in means and standard deviation. Categorical

variables were expressed as frequency, and percentages. The relationship between independent and dependent variables was analyzed by using logistic regression, variables with $p<0.2$ in bivariate analysis were eligible for multivariate analysis model. Finally, multivariate logistic regression was run and identified independent predictors of in-hospital mortality. The odds ratio (AOR) was calculated and $p<0.05$ at 95% CI was considered statistically significant.

3.11. Operational Definitions

ACS -was defined as patients admitted with ST-elevation myocardial infarction (STEMI), and non-ST-elevation ACS [non-STEMI/unstable angina (UA)] with documented ECG, biomarker and/or clinician decision results from the patient's chart.

CKD: Documented diagnosis of CKD from patient's chart.

Current Smoker: was Smoking cigarettes/tobacco within 1 month of index admission for ACs.

Dyslipidemia: patient had previously documented dyslipidemia which was either on life style measures or statins identified from the chart.

Elective PCI: PCI done for STEMI if patients have persistent symptoms or have a significant occlusion which is not the culprit artery for the current presentation on angiography. It is done on an elective basis.

Former Smoker: Had stopped smoking/tobacco use for at least 1 month before admission period.

Hypertension- patient had documented HTN and on medication or known HTN with no medication.

MACE-non fatal major adverse cardiac events: composite end point of in hospital stroke, re-infraction, cardiogenic shock and heart failure.

Obesity: patient with documented diagnosis of Obesity.

Previous myocardial infarction (MI): The patient had at least 1 documented previous MI before admission period or defined Ischemic heart disease (IHD).

Primary PCI: mechanical intervention for acute MI done immediately upon diagnosis of MI.

Re-infarction: Diagnosis of a recurrent myocardial infarction confirmed by ECG changes or elevation of cardiac markers (Re-elevation of the CK-MB to above the ULN and increased by at least 50% over the previous value) within the index admission period.

Treatment outcome: treatment outcome of patients with ACS was explained by in-hospital mortality. It was calculated by dividing the total number of patients who died during their hospital stay by the total number of patients who participated in the study. In-hospital mortality was defined as the percentage of patients who died during their hospital stay. So, the outcome was either death or discharged alive.

3.12. Ethical considerations

Ethical clearance was sought from the Institutional Review Board of WKU, College of Medicine and Health Sciences. However, as the study used retrospective, de-identified data, the IRB waived individual informed consent. Rather a letter of permission was written, and chief clinical director office wrote letter of cooperation to chart documentation office (**Aneex-2).** Confidentiality was strictly maintained; data was be stored on password protected computer and aggregated for reporting.

3.13. Plan for data dissemination and utilization

The result of the study will be presented and disseminated to WKUSH and other concerned bodies. Then, the result will be published in reputable journals.

4. **RESULTS**

Of the 230 patients' charts selected for the study 18 patients; 8 charts with no adequate data for ACS diagnosis and 10 patients left against medical advice, were excluded. A total of 212 patients had a confirmed ACS diagnosis: out of which 105 (49.5%) with STEMI and 107 (50.5%) were NSTEMI.

4.1. Sociodemographic characteristics

One hundred forty one (66.5%) of 212 patients were male; Male to female mortality rate was 14:3. The mean age of participant was 58.13 (±8.5) years; when categorized: 62.7 % (133) of the patients were within the range of 45-65 years, similarly most ACS deaths were within this category (67.6%). And there was 1 ACS death below the age of 45 years. Mean age of ACs mortality was 61; whereas for survived patient it's was 58 years. Of the total participants, 154 (72.6%) were urban residents. ACS related mortality in urban residents was 22 (64.7%) compared to rural (12/35.3%).

Table 1-Baseline Sociodemographic characteristics of participants, by Treatment outcomes of ACS

Baseline Characteristics		Treatment outcomes of ACS (N=212)				Total	
		Died		Alive			
		N	%	N	%	**N**	**%**
Sex	F	6	17.6	65	36.5	71	33.49
	M	28	82.4	113	63.5	141	66.51
Age in years	M (SD)	61 (± 8.5)		58 (±8.5)		59 (± 7)	
Age strata by years	<45 years	1	29.4	19	10.7	20	9.04
	45-65	23	67.6	110	61.8	133	62.73
	>65	10	2.9	49	27.5	59	27.83
Area of Residence	Urban	22	64.7	132	74.2	154	72.64
	Rural	12	35.3	46	25.8	58	27.36

M- Male, SD- Standard Deviation,

4.2. Risk factors and comorbidities

Out of the 212 patients, HTN was the commonest (N= 122 (57%)) risk factor. DM was the next overall frequent risk factor reported; overall it was 28.77% (N= 61). Over all Prevalence

of smoking was 26.89 % (57); and 8 (23.5). Family Hx of CAD/Premature Cardiac death and obesity were more prevalent in ACS survived patients (see table-2 below).

Table 2-Risk factors and Comorbidities by Treatment outcomes of ACS

Risk factors and Comorbidities	Treatment outcomes (N=212)				Total	
	Died		Alive			
	N	%	N	%	N	%
Had HTN	25	73.5	97	54.5	124	57.5
Had DM	6	17.6	55	30.9	61	28.77
Had Dyslipidemia	4	11.8	20	11.2	24	11.32
Hx of smoking	8	23.5	49	27.5	57	26.89
prior Hx IHD/MI	10	29.4	38	21.3	48	22.64
Hx of CKD	7	20.6	13	7.3	20	9.4
Hx of stroke/TIA	1	2.9	11	6.2	12	5.66
Had CHF/other HD	8	23.5	25	14	33	15.57
Family Hx of CAD/Premature Cardiac death	1	2.9	26	14.6	27	12.74
Obesity	2	5.9	37	20.8	39	18.4

Hx- history, TIA- transient Ischemic Attack, CHF- Congestive Heart Failure, HD- Hearth Diseases, CAD- Coronary Artery Disease

4.3. Clinical features at presentation

Overall, majority (66.9%/142) of the patients came to WKUSH ED department lately (after 12 hours of symptom onset) and mean delay in in-hospital died patients was 42 hours whereas survived patients mean delay was 28 hours. Only 16 (7.5%) patients presented within 5-6 hours of symptom onset. With regard to type of symptoms reported; overall typical presentation was the commonest (67.5%). Overall 48.6 % (103) of the patients were tachycardic at presentation.

Majority of the patients had positive cardiac biomarkers (Troponin I); overall 125 (58.9%) were positive, out of which 32 (88%) died. One in four patients had LDL- C above 100 mg/dl and 20 patients had >130 mg/dL. AKI was reported in 42 patients; out of which 22 died (64.7%). 31 patients presented with killip class 3 and 4 acute heart failure; 19 died vs 12 survived. LVEF was reported to be below 30% (very low LVEF); in 26 patients and 18 of them died. (See table-3 below).

Table 3- Clinical features and Investigations at presentation by Treatment outcomes of ACS

Clinical features and Investigations at presentation		Treatment outcomes (N=212)				Total	
		Died		Alive			
		N	%	N	%	N	%
Delayed Hours(Late presenters)		29	85.3	113	63.5	142	66.9
Mean Delay hrs.		42 (±13.5)		28 (±11.5)		38 (± 12.2)	
Typical symptoms at presentation		24	70.6	119	66.9	143	67.5
High SBP at presentation		6	17.6	59	33.1	65	30.6
Tachycardic		31	91.2	72	40.4	103	48.6
Tachypnic		30	88.2	54	30.3	84	39.6
Hypoxic at presentation		15	44.1	12	6.7	27	12.73
Acute HF Killip classification (N=212)	Killip Class 4	9	26.5	2	1.1	11	5.19
	Killip class 3	10	29.4	10	5.6	20	9.43
	Killip class 2	5	14.7	43	24.2	48	22.64
	Killip class1	10	29.4	123	69.1	133	62.73
Elevated CTn		32	88.23	93	53.3	125	58.96
Very low LVEF (N= 115)		18	52.94	6	3.3	24	20.87
low Hemoglobin		18	52.9	31	17.4	49	23.11
AKI at presentation		22	64.7	20	11.2	42	19.81
admission Cardiogenic shock		10	29.4	1	.56	11	5.19
Leukocytosis		27	79.4	65	36.5	91	42.9

SBP- Systolic Blood Pressure, HF- Heart failure, CTn- cardiac Troponin, LVEF- Left Ventricular Ejection Fraction, AKI- Acute Kidney Injury

4.4. In- Hospital management and Process of care

As the hospital lacked Cardiac Critical Unit (CCU) and it's staffing; 8 critical patients were directly admitted to the general ICU; whereas the rest 204 (96.2%) patients were initially treated in ED red zone then admitted to ICU.

As all patients presented lately; there was no indication for medical thrombolysis; though no thrombolysis capacity in the hospital was recorded. Similarly, no surgical thrombolysis was done despite it was indicated for 134 (63.2%) patients for the obvious no access reason. Out of these 134 patients who were candidate for surgical thrombolysis 43 (32.09 %) were referred to Addis Ababa for PCI and arteriography interventions. On the other hand, standard loading and maintenance doses of DAPT, UFH, and atorvastatin was given for 100% of the patients within 24 hours of ED presentation.

However, BB and ACEIs/ ARBs was not initiated within 24 hours of presentation in 22/19 (55.8/85%) patients respectively. Moreover, Vasopressor/Inotrope was used for 11 patients for whom they presented to ED with cardiogenic shock and 10 of them died.

Regarding capacity of investigations done in the admission period; CBC, Lipid profile, renal function tests, RBS, and ECG was determined for all patients but first below 10 minutes ECG done at ED was difficult to extract from the chart. Echocardiography was done for 114 (54.2%) patients and LVEF was < 30% for 24 patients, 30-45% for 44 patients and above 45% for 47 patients.

Table 4- Selected In _hospital management and care process by Treatment outcomes of ACS

In-Hospital management course	Treatment outcomes (N=212)				Total	
	Died		Alive			
	N	%	N	%	N	%
BB not given within 24 hours of arrival	22	55.8	8	6.74	30	14.62
ACEi not given	19	82.35	16	8.99	35	20.75
Vasopressor/Inotropes was used	10	29.41	1	.9	11	5.19
ECG Done	34	100	178	100	212	100
10minutes ECG not Done	3	8.8	24	13.48	27	12.74
Echo was not done	5	14.7	93	52.24	98	46.2
CTn not measured	0	17.64	15	8.41	21	9.9
PCI was indicated at Presentation	34	100	100	56.17	134	63.21
Referred for PCI/Arteriography	NA	NA	43	24.15	43	20.28

BB- Beta blocker, ACEi- Angiotensin Converting Enzyme inhibitor.

4.5. In-Hospital complications

Overall, approximately 35 % of the patients were more likely to develop non-fatal MACE: in-hospital cardiogenic shock in 16, life threatening arrhythmia in 19, stroke/TIA in 9 and MV was used in 13 patients (See table 5 below).

Table 5- In-Hospital Mortality and complications by Treatment outcomes of ACS

In-Hospital Complications		Treatment outcomes (N=212)				Total	
		Died		Alive			
		N	%	N	%	N	%
Admission	STEMI	30	88.23	75	42.1	105	49.5

Diagnosis	NSTEMI	4	11.76	103	57.89	107	50.5
In-Hospital Cardiogenic Shock/Cardiac arrest/HF		13	35.29	3	1.68	16	12.4
Life threatening Arrhythmia (Afib/AF/VT/Vfib)		10	29.4	9	5.05	19	8.96
Stroke/TIA/Major bleeding		3	8.8	6	3.37	9	5.7
MV used		12	35.3	1	0.56	13	6.13
Hospital Stay in Days (M and SD		6±5		5±2		6±3	
Final Disposition	Discharged Died	34	100	NA	NA	NA	NA
	Referred	NA	NA	43	24.1	43	20.28
	Home discharged	135	NA	135	100	135	63.68

Afib- Atrial fibrillation, AF-Atrial Flutter, VT- Ventricular Tachycardia, Vfib- Ventricular fibrillation, , MV- mechanical Ventilation, M- Mean, SD- Standard Deviation

4.6. ACS In-Hospital Mortality

A total of 212 patients admitted with acute coronary syndrome (ACS) were included in the study. The overall in-hospital mortality rate was 16.1%. Mortality varied markedly by ACS subtype, with a substantially higher proportion of deaths among patients presenting with ST-segment elevation myocardial infarction (STEMI) compared with non-ST-elevation ACS. But with significant statistics difference across ACS subtypes; STEMI 30 (28.5%) vs 4 (3.74%) with NSTEMI (see table 5 above).

4.7. Associated factors for In-Hospital ACS mortality

To identify the independent predictors of in-hospital ACS mortality, initially Binary followed by multivariate binomial regression for variables with P< 0.2 was performed to determine predicators of ACS in-hospital all-cause mortality. After adjustment for potential confounders (patient demography, clinical finding, key risk factors, in-hospital medication and complication) factors associated with high likely to predict in-hospital mortality were higher killip classes at presentation, composite in-hospital Complications, renal dysfunction and STEMI diagnosis.

In bivariate logistic regression analysis, several sociodemographic, clinical, and laboratory variables showed significant crude associations with in-hospital mortality.

Older age, male sex, and rural residence demonstrated higher crude odds of mortality compared with their respective reference groups. Among cardiovascular risk factors and

comorbidities, CKD, anemia, and elevated serum creatinine were significantly associated with mortality at the crude level.

Clinical severity indicators showed the strongest crude associations. Patients presenting with STEMI, Killip class IV, hypotension, tachycardia, and those who developed in-hospital complications had markedly increased crude odds of death. Variables related to In-hospital course; particularly the occurrence of any in-hospital complication, demonstrated the highest crude odds ratios.

Variables with a p-value <0.2 in bivariate analysis and those with strong clinical relevance were considered candidates for multivariable analysis. After adjustment for confounding factors, four variables remained independently associated with in-hospital mortality: Patients presenting with Killip class IV had markedly higher odds of in-hospital mortality compared with those in Killip class I–III. This variable emerged as the strongest independent predictor of death. STEMI presentation was also independently associated with significantly increased odds of in-hospital mortality compared with non-ST-elevation ACS. Elevated serum creatinine (AKI) at presentation had higher adjusted odds of mortality, indicating the prognostic importance of renal dysfunction in ACS. Composite in-hospital complications (the occurrence of at least one in-hospital complications: Cardiogenic Shock, AHF, Life threatening Arrhythmia, Stroke/TIA, Major bleeding, and Re-infarction) was independently associated with increased odds of mortality, even after adjusting for baseline severity and ACS subtype. Male sex was 2.6 times more likely to develop in-hospital mortality compared to female sex when other variables are controlled

Sociodemographic variables (age & residence), delayed presentation, anemia, and other clinical parameters lost statistical significance after adjustment, suggesting that their crude associations were largely explained by underlying disease severity and in-hospital complications. Factors associated with less likely to develop in-hospital ACS mortality were normal hemoglobin level at admission (AOR= 0.84, CI 0.7-0.9) and normal Heart rate (AOR=0.9, CI 0.85-0.96) (see table 6 below)

Table 6- Predictors of In-Hospital Mortality of ACS; COR and AOR

Variables	Category	Final outcome				COR				AOR			
		Died		Alive									
		N	%	N	%	P	COR	95% CI		P	AOR	95% CI	
Sex	F	6	17.6	65	36.5	1							
	M	28	82.4	113	63.5	0.02	3.81	1.06	6.8	.89	1.1	.22	5.8
CKD	Yes	7	20.6	13	7.3	0.02	3.29	1.21	8.99	.54	.59	.11	3.2
	No	27	79.4	165	92.7	1							
Delay in Hrs.	>12	29	85.2	113	63.5	.018	3.34	1.23	9.01	.13	3.4	.69	17.1
	<12	5	14.8	65	36.5	1							
Killip class	**IV**	**9**	**26.5**	**2**	**1.1**	**.000**	**31.7**	**6.5**	**155**	***.004**	**11**	**6.9**	**131**
	I-III	**25**	**73.5**	**176**	**98.9**	**1**							
Admission Dx	**STE**	**30**	**82.4**	**75**	**42.1**	**.000**	**10.3**	**3.5**	**30.5**	***.02**	**7.1**	**1.4**	**38.6**
	NSTE	**4**	**17.6**	**103**	**57.9**	**1**							
Hgb	<12.5	18	52.9	31	17.4	.04	5.3	2.4	11.6	.29	2.2	.51	9.5
	>12.5	16	47.1	147	82.6	1							
HR (bpm)	>100	30	82.4	67	37.6	.000	12.4	4.2	36.8	.08	4.3	.8	23.2
	<100	4	17.6	111	62.4	1							
RR	>24	30	82.4	54	30.3	.000	17.2	5.8	51.3	.17	3.2	.6	17.1
	<24	4	17.6	124	69.7	1							
WBC	>11.5	27	79.4	65	36.5	.000	6.7	2.7	16.3	.25	.39	.07	1.99
	<11.5	7	20.6	113	63.5	1							
SCr	**>1.2**	**14**	**41.2**	**20**	**11.2**	**.000**	**14.5**	**6.2**	**33.7**	***.034**	**4.6**	**1.1**	**19.6**
	Norma	**20**	**58.8**	**158**	**88.8**	**1**							
LDL (mg/dL	>100	25	73.5	84	47.2	.006	3.1	1.37	7.05	.78	1.2	.3	5.2
	<100	9	26.5	94	52.8	1							
Comp	**Yes**	**26**	**76.5**	**18**	**10.1**	**.000**	**28**	**11**	**73**	***.001**	**11**	**2.6**	**51.8**
	No	**8**	**23.5**	**160**	**89.9**	**1**							

LDL-C= Low Density Lipoprotein- Cholesterol, ST- T Ab= ST-T wave Abnormalities, SCr= Serum Creatinine, Comp= Composite in-hospital Complications, * = significant,

5. **DISCUSSION**

ACS patients in our study with regard to admission diagnosis type was comparably equal; STEMI 49.5 % vs NSTEMI/UA 50.5% and the mean age of the patients was 58((±8.5) years; with UNSTEMI slightly younger to older age difference of 61 (±13.5); which is in similar pattern to studies such as GULF-RACE (18) (STEMI 60%, mean age 57.5), and the SSA meta-analysis reported similar pattern. However, a decade younger and higher proportion of ST-T deviation was observed when compared to studies from HICs studies: GRACE (10) (STEMI 32%, mean age 66 years). Earlier age for first ACS is likely due to earlier acquisition of adverse exposures such as smoking and IHD risk factors (hypertension, diabetes mellitus) with concomitant poor management. High proportion of NSTEMI/UA in our study might be due to higher number of extremes of age categories at presentation and under diagnosis of UA (0%), higher rates of metabolic risk factors (DM, HTN, Dyslipidemia, obesity and exposure compared to STEMI patients. Another varying observation in our study is high prevalence of smoking (28.5%); which may be also the likely reason for higher proportion of UNSTEMI patients (33 vs 24).

In our study 72% of patients presented after 12 hours of symptom onset; 2 times higher compared from CREATE(2) in which 31% of patients presented after 12hr of the onset of chest pain. the mean delay hours between symptom onset and hospitalization was 58 hours, far longer than the GRACE mean delay time (3.4hrs) (10), but in close pattern with the national meta-analysis (30). This huge delay of our study participants might be due to lack of emergency transport facilities, economic reasons, and lack of awareness and higher number of atypical presentation (33.5%) compared to GRACE(<20%). Patients presented with atypical symptoms have worse outcome unlike those presented with typical chest pain in present study which further strength the reports of previous studies (10). Compared to the national (30) and SSA meta-analysis; the metabolic risks HTN (57.5%), DM (28%), Obesity (19.5%) and Dyslipidemia (12%) were significantly higher. clinicians and healthcare providers has to focus on primary prevention by early screening and CAD risk management and similar with report of previous studies such as GULF-RACE (18). Over all adherence evidence based treatment within 24 hours of hospital arrival was high for DAPT, Atorvastatin, and anticoagulation (27, 30). But use of beta blockers and ACEIs was low (<87%); likely due to high number of patients with AKI (43) and killip class 3 & 4

pulmonary edema patients (24).Timely referral for PCI indicated patients is area which needs further clarification; 32.1 % patients (43 out of 134 patients; mostly STEMI) were referred after mean LOS of 3.5-5 days. This may be due to poor patients revascularization cost affordability, professionals' low level of adherence or knowledge for ACS MACE predicting models such as GRACE, TIMI-11B and HEART score which significantly aids in identifying imminent risky patients. Whatsoever the reason for poor referral system is; its high likely cause for the high STEMI mortality (28.5%) compared to 16.25% in Ethiopian national meta-analysis study (30), and high in-hospital life threatening complications such as arrhythmia and cardiogenic shock.

In-hospital mortality rates in our study (16.1 %) were alarmingly high even compared to reports from LMIC countries; with significant difference between STEMI and non-STEMI (28.5% vs 3.4% AOR: 3.1, P= 0.003). But, still high mortality rate in this study is not surprising since we are a non-re-vascularizing institution. None of STEMI patients or high risk NSTEMI/UA patients arrived in the golden medical thrombolysis time period; let alone the absence of even the conventional thrombolytics like streptokinase in the hospital.

The other important and alarming area of gap is, the rate of non-fatal major adverse cardiac event (MACEs): such as arrhythmia and in-hospital shock especially in STEMI patients was high (> 35%) compared to even local studies such as the Mekele and UoG (25-30%) (27, 33) were also more common in our study participants. However, our findings pattern was partly supported by previous studies such as MINRAP (34) registry which showed that Patients presenting with STEMI had a higher risk in-hospital MACE [AOR= 2.75, CI 1.81, 4.17)] than patients presenting with NSTE-ACS, even after adjustment for potential confounders. The (MINAP)(34) Registry in England and Wales, reported that, more than quarters of participants were anemic and the condition increased risk of 30 days mortality (27.7%).

Although older age, delayed presentation, prolonged LOS and rural residence have been consistently associated with increased ACS mortality in prior studies (30), these variables were not independently associated with in-hospital mortality in the present study. The lack of association between age and in-hospital mortality may be explained by the relatively younger patient population and the predominance of acute clinical severity markers, which exert a stronger influence on early mortality than chronological age. Residence was not independently associated with in-hospital mortality after adjustment, suggesting that its effect

is mediated through clinical severity rather than geographic location alone, Delayed presentation did not independently predict in-hospital mortality, possibly because the absence of reperfusion therapy limited the clinical impact of time-to-presentation, and because delay was common across the cohort. Length of hospital stay was not independently associated with in-hospital mortality in this study. This may be explained by reverse causality, as early death results in shorter hospitalization, while survivors of complications often experience prolonged stays.

Additionally, limited availability of advanced cardiac interventions and uniform discharge practices in the study setting may have reduced variability in hospital stay, diminishing its prognostic value. Furthermore, in-hospital mortality predominantly reflects early disease severity rather than duration of hospitalization, suggesting that length of stay may be more relevant to longer-term outcomes rather than acute survival.

To sum it up, while prior studies demonstrate the prognostic importance of age, delay on presentation, and residence in settings with timely reperfusion, the present findings highlight how system-level constraints modify the impact of these variables in resource-limited hospitals.

5.1. STRENGTH AND LIMITATION

The primary strengths of our study was that we evaluated patients charts cautiously and extracted the pattern of mortality rate, in-hospital complications and predictors of outcome which didn't get attention in our setup previously (vital signs monitoring, use of risk scorers. Event per Variable (EPV) guided multivariable modeling to ensure statistical validity and Model stability and use of a composite complication variable to address sparse data bias. In addition, our study demonstrated process of care for ACS in resource limited setting.

However, our study has limitations such as: one- no causality can be asserted between parameters that are correlated as its observational study, two- comparisons between patients according to ACS subtypes were not randomized and, despite careful adjustments on a large number of potentially confounding variables, our findings can only be considered indicative. Third, limited sample size although we prolonged study period on our own cost still the final sample size was limited. So, our study was underpowered to analysis difference the effect of

risk factors such as HTN, age, residence area and sex. Fourth, study site was not randomly selected, so the finding/practice might not necessarily represent all hospitals in the country. However geographical location of the site favored inclusion of diverse population which indicate usefulness of our data.

6. CONCLUSION AND RECOMMENDATIONS

6.1. CONCLUSION

In-hospital mortality among patients admitted with ACS at WKUSH was high, particularly among those presenting with STEMI and advanced clinical severity. Killip class IV, STEMI presentation, renal dysfunction, and in-hospital complications were the main independent predictors of mortality. These findings underscore the critical impact of disease severity and hospital course on outcomes in settings without revascularization services.

Metabolic risk factors; HTN, DM, Obesity, and dyslipidemia, of ACS was alarmingly high, especially in urban residents.

Timely patient referral was poor in our study; hence it needs further improvement. Tachycardia at presentation, Killip class 4 AHF, In-hospital cardiogenic shock and major arrhythmias (Afib/AF, VTac/Vfib) were factors predicted poor in-hospital outcome.

Age, delay in presentation, residence area and LOS are not independently associated with in-hospital mortality in our study compared to previous studies.

6.2. RECOMMENDATIONS

For Clinical practice:

Early identification of high-risk patients using Risk scorers (TIMI &GRACE, and HEART)

Enhanced monitoring and aggressive supportive care for STEMI patients

Prompt recognition and management of in-hospital complications.

Health system: WKUSH, FMOH, and CER

Development of regional referral pathways for reperfusion therapy.

Strengthening of intensive care and cardiac monitoring capacity

Implementation of standardized ACS management protocols

Feature Research:

Prospective multicenter studies to validate findings

Establishment of an ACS registry to monitor outcomes and quality of care

Future studies incorporating long-term outcomes and functional status.

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8. ANNEXES

ANNEX 1- Chart Review Check list used for data collection

Instructions for data collectors: write exact wording as depicted for each request. Use one abstraction form per patient. Record date as DD-MM-YYYY and time as HH: MM. For each patient, he/she will have unique study ID. So, assign 001, 002, and 003...etc.) on the provided space. Circle codes provided properly. Write specific writings found on the patient chart for __areas provided below. For missing data record '9' uniformly.

Section 1: Sociodemographic information

1. Study ID_____
2. Age (in years) _____
3. Sex: 0- Female, 1- Male
4. Residence: 0- Rural, 1- Urban

Section 2: Risk factors & comorbidities

5. Hypertension: 0- Yes, 1- No,
6. Diabetes mellitus: 0- Type 2, 1- Type 1, 2- No DM
7. Dyslipidemia: 0- Yes, 1. N0
8. Smoking history: 0- Current, 1- Former, 2- Never
9. Prior IHD/MI history: 0- Yes, 1- No,
10. Chronic kidney disease: 0- Yes, 1- No
11. Stroke /TIA history? 0- Yes, 1- No
12. CHF? 0- Yes, 1- No,

13. Family history of CAD/premature cardiac sudden death? 0. Yes, 1. No

14. Obese; 0. Yes, 1. No,

15. If other comorbidities, specify_____

Section 3: Clinical presentation

16. Symptom onset to ED presentation delay is_____ (hours)

17. Presenting symptoms is: 0. Typical, 1. Atypical

18. Initial BP (systolic) is _____mmHg

19. HR= ____bpm

20. RR= _____breaths/min

21. SpO2_____%

22. Killip class on admission: 1-I, 2- II, 3- III, 4- IV

23. Cardiogenic shock on admission: 0- Yes, 1- No,

Section 4: Investigations

24. ECG performed in ED: 0- N0, 1- Yes,

25. ECG findings: 0- STE, 1- ST deviation/ T wave depression,

26. Cardiac Troponin measured: 0- No, 1- Yes

27. If for Q27 is yes, Cardiac Troponin result: 0_ Elevated, 1- Normal,

28. Echocardiography done: 0- No, 1- Yes

29. If yes for Q29, LVEF% = _____

30. Hemoglobin on ED admission= _____ (g/dL)

31. WBC on ED admission= _____x10^3 cells/mL

32. PLT on admission = _____`x 10^5 cells/mL

33. Creatinine on ED admission= _____ mg/dL

34. LDL= _____mg/dL

Section 5: Acute management

35. Standard dose Aspirin given within 24 hours at ED: 0 - No 1-Yes

36. Standard dose clopidogrel given within 24 hours at ED: 0- No, 1-Yes,

37. Standard dose Anticoagulant given within 24 hours (UFH/LMWH): 1- Yes, 0- No

38. Beta-blocker given within 24 hours of arrival: 1- Yes, 0- No

39. Standard dose ACEI/ARB given 1- Yes, 0- No

40. Standard dose Statin given within 24 hours of arrival 1- Yes, 0- No

41. Initially Treated at where 0- ICU, 1- ED

42. If 1 for Q42, then admitted to 1. Ward 0. ICU

43. Medical thrombolysis indicated at presentation time: 1- Yes, 2- No

44. PCI indicated at admission? 1- Yes, 2- No,

45. If yes for 45, referral done? 1- Yes 2- No,

Section 6: In-hospital course & complications

46. Admission Diagnosis 1. STEMI, 2. NSTEMI, 3. UA

47. Use of inotropes/ vasopressors? 1-Yes, 2- No,

48. Mechanical ventilation: 1-Yes, 2- No

49. Development of acute heart failure within admission period? 1- Yes, 2- No

50. Life threatening Arrhythmia within admission period (VTac/Vfib/Afib)? 1- Yes, 2- No

51. Recurrent ischemia or reinfarction within admission period: 1-Yes, 2- No

52. Stroke within admission period: 1-Yes, 2- No

53. Major bleeding events within admission period: 1-Yes, 2- No

54. Cardiogenic shock developed within admission period: 1-Yes, 2- No

55. Other complications: _____

Section 7: Disposition

56. Length of stay_____ days

57. Outcome: 1- discharged alive 2- Death

58. Final Disposition: 1-Alive home discharged, 2- Referred, 3- Died in hospital.