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Outcomes of Primary percutaneous coronary intervention Across Three Distinct Clinical Settings: A Single Operator's Clinical Journey

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ABSTRACT

Background: *Global disparities in evidence-based care continue to exist. In ST-elevation myocardial infarction (STEMI), primary PCI is the favored approach, yet results differ due to patient characteristics, delays, hospital capabilities, and operator skill. In Bangladesh, PCI achievements are significant, but results vary, particularly among high-risk patients and in cases with system delays. This research examines PCI outcomes in three environments under one operator, concentrating on procedural effectiveness and in-hospital outcomes.* ***Methods & Materials:*** *This retrospective analysis encompassed 500 adult STEMI patients who received primary PCI from a singular operator at three centers in Bangladesh (2010–2026). Information on clinical and procedural factors was gathered from records. The main result was mortality during hospitalization. The analysis employed SPSS along with suitable statistical tests, and ethical approval was acquired.* ***Results:*** *In this study of 500 STEMI patients (n = 100, 200, 200), baseline features were comparable ($p > 0.05$) with the exception of smoking ($p < 0.05$), and approximately 60% had single-vessel disease. Pre-dilatation showed variability (~50.8%, $p < 0.05$), whereas other procedural aspects were similar. In-hospital mortality was minimal (3.2%) with no difference among centres ($p > 0.05$). Univariate analysis revealed no notable associations, whereas multivariate regression found diabetes to be the sole independent predictor (AOR ≈ 0.306, 95% CI: 0.105–0.889, $p < 0.05$). The clinical environment showed no considerable impact (AOR ≈ 1).* ***Conclusion:*** *Primary PCI demonstrated comparable results in all centers, exhibiting low mortality rates and no significant differences. Diabetes was the sole negative predictor, whereas the hospital environment had no effect.*

Keywords: *Primary percutaneous coronary, Three Distinct Clinical Settings, Ejection fraction, Myocardial infarction.*

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INTRODUCTION

ST-elevation myocardial infarction (STEMI) remains a leading cause of cardiovascular morbidity and mortality worldwide, despite advances in evidence-based care. Primary percutaneous coronary intervention (PCI) is the preferred reperfusion strategy and is associated with superior outcomes compared to thrombolytic therapy when performed in a timely manner [1–3].

Advances in PCI techniques and technology have expanded its use across diverse clinical environments. Nevertheless, patients presenting with STEMI are clinically heterogeneous, and variations in baseline risk profiles—including age, comorbidities, infarct characteristics, and hemodynamic status—significantly influence procedural outcomes [4,5]. In addition, treatment delays remain a critical determinant of prognosis. Prolonged ischemic time, particularly delays from first medical contact to balloon inflation, is strongly associated with increased in-hospital mortality and adverse cardiovascular outcomes [6,7]. In addition, operator experience and institutional volume significantly influence procedural success and complication rates [8]. High-risk clinical presentations, such as cardiogenic shock, further worsen outcomes even after successful revascularization [9].

Despite overall improvements, significant inter-hospital variation in PCI outcomes persists, highlighting the role of system-level factors such as workflow efficiency,

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catheterization laboratory readiness, and total ischemic time [10–12]. Systematic evidence further highlights the critical role of total ischemic time and hospital-related delays in determining survival following primary PCI [11]. Hospital characteristics, including PCI volume, availability of dedicated catheterization teams, and organizational efficiency, have been shown to significantly influence reperfusion delays and clinical outcomes in STEMI patients [12]. In Bangladesh, primary PCI has shown high procedural success, but outcomes still vary due to delays in presentation and healthcare system limitations [13,14].

Against this background, this study evaluates primary PCI outcomes across three distinct clinical settings under a single operator to assess whether institutional variation influences in-hospital outcomes when procedural practice is standardized.

METHODS & MATERIALS

Study design and setting

This was a retrospective observational study conducted to evaluate the outcomes of primary percutaneous coronary intervention (PCI) performed by a single operator across three centres in Bangladesh. The study was carried out in three healthcare institutions: Zia Heart Foundation, Fortis Escorts Heart Institute, and Khwaja Younus Ali Medical College Hospital. A total of 500 consecutive cases were included over the study period spanning from August 2010 to January 2026.

Study population

The study population consisted of adult patients (≥18 years) diagnosed with ST-elevation myocardial infarction (STEMI) who underwent primary PCI performed by the same operator during the study period.

Inclusion criteria

- Patients diagnosed with STEMI based on clinical presentation, electrocardiographic findings, and/or cardiac biomarkers
- Patients undergoing primary PCI
- Procedures performed by the designated single operator

Exclusion criteria

- Patients undergoing elective or staged PCI
- Patients treated with thrombolysis alone without PCI
- Patients with incomplete clinical or procedural records

The Three-Centre Landscape

To compare experiences, we look at three typical environments:

Feature	Centre A: The Academic Hub	Centre B: The Private Specialist Clinic	Centre C: The High-Volume Public Hospital
Staffing	Dedicated 24/7 STEMI team.	On-call staff with variable cath lab experience.	High-turnover, high-efficiency residents and techs.
Equipment	Latest generation imaging & physiology (IVUS/OCT).	Standard fluoroscopy; focus on premium hardware.	Robust, high-durability systems; essential gear only.
Logistics	Complex triage; multiple departments involved.	Direct-to-lab protocols; streamlined billing.	Extreme patient volume; rapid room turnover.

Data collection procedure

Data were collected retrospectively from hospital records, catheterization laboratory databases, and patient files using a structured data extraction form. Information on baseline characteristics (age, sex, hypertension, diabetes mellitus, smoking status, dyslipidaemia, and family history of coronary artery disease), clinical parameters (ejection fraction and angiographic findings), and procedural details (pre-dilatation, post-dilatation, suction catheter use, and multivessel PCI) was recorded. The primary outcome of the study was in-hospital mortality. Secondary outcomes included the requirement of DC shock and procedural characteristics. All collected data were anonymized prior to analysis to ensure patient confidentiality.

Statistical analysis

Data were analyzed using Statistical Package for the Social Sciences (SPSS), version XX (IBM Corp., Armonk, NY, USA). Categorical variables were expressed as frequencies and percentages. Comparisons between groups were performed using the Chi-square test or Fisher's exact test, as appropriate. Multivariate logistic regression analysis was conducted to identify independent predictors of in-hospital mortality. Adjusted odds ratios (AORs) with 95% confidence intervals (CIs) were reported. A p-value of <0.05 was considered statistically significant.

Ethical considerations

The study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki. As this was a retrospective study using anonymized data, informed consent was waived where applicable. Approval was obtained from the relevant institutional authorities prior to data collection.

RESULTS

Baseline characteristics

Table I shows total of 500 patients undergoing primary percutaneous coronary intervention (PCI) across three centres (Centre A: n = 100, Centre B: n = 200, Centre C: n = 200) were included in the analysis. Baseline demographic and clinical characteristics were largely comparable across the study groups.Most patients were aged 41–55 years (43.8%) and male (80.0%). Hypertension (60.0%), diabetes mellitus (36.2%), and smoking (42.8%) were the most common cardiovascular risk factors. Smoking showed a statistically significant difference across centres (p = 0.026), while other baseline variables were similar.

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Table I: Baseline characteristics of study participants by centre (*n* = 500)

Variable	Centre A (n=100), n (%)	Centre B (n=200), n (%)	Centre C (n=200), n (%)	Total (n=500), n (%)	p-value
Age group					
≤25 years	1 (1.0)	1 (0.5)	0 (0.0)	2 (0.4)	
26–40 years	10 (10.0)	38 (19.0)	42 (21.0)	90 (18.0)	0.279
41–55 years	47 (47.0)	85 (42.5)	87 (43.5)	219 (43.8)	
≥56 years	42 (42.0)	76 (38.0)	71 (35.5)	189 (37.8)	
Male sex	78 (78.0)	160 (80.0)	162 (81.0)	400 (80.0)	0.829
Hypertension	61 (61.0)	120 (60.0)	119 (59.5)	300 (60.0)	0.969
Diabetes mellitus	38 (38.0)	69 (34.5)	74 (37.0)	181 (36.2)	0.800
Dyslipidaemia	27 (27.0)	45 (22.5)	36 (18.0)	108 (21.6)	0.187
Smoking	48 (48.0)	95 (47.5)	71 (35.5)	214 (42.8)	0.026*
Family history of CAD	16 (16.0)	32 (16.0)	22 (11.0)	70 (14.0)	0.288

Clinical characteristics

Table II presents ejection fraction (EF) distribution was similar across centres (p = 0.127). Overall, 37.4% of patients had EF >50%, 39.0% had EF 41–50%, and 23.6% had EF 30–40%. Coronary anatomy showed significant variation across centres (p = 0.022), with single-vessel disease being most frequent overall (60.0%) and more common in Centre C (66.5%).

Table II: Clinical characteristics across centres

Variable	Centre A n (%)	Centre B n (%)	Centre C n(%)	Total n(%)	p-value
Ejection fraction					
30–40%	24 (24.0)	58 (29.0%)	36 (18.0)	118 (23.6)	0.127
41–50%	41 (41.0)	73 (36.)	81 (40.5)	195 (39.0)	
>50%	35 (35.0)	69 (34.5)	83 (41.5)	187 (37.4)	
Coronary anatomy					
Single vessel disease	56 (56.0)	111 (55.5)	133 (66.5)	300 (60.0)	0.022*
Double vessel disease	34 (34.0)	66 (33.0)	60 (30.0)	160 (32.0)	
Triple vessel disease	10 (10.0)	23 (11.5)	7 (3.5)	40 (8.0)	

Procedural characteristics

Table III shows pre-dilatation was performed in 50.8% of cases overall and showed significant variation across centres (p = 0.017), being less frequently used in Centre C. Post-dilatation (15.3%) and suction catheter use (6.2%) were low and did not differ significantly between centres.

Table III: Procedural characteristics

Variable	Centre A n (%)	Centre B n (%)	Centre C n (%)	Total n (%)	p-value
Pre-dilatation	56 (56.0)	112 (56.0)	86 (43.0)	254 (50.8)	0.017*
Post-dilatation	8 (16.3)	12 (13.3)	32 (16.0)	52 (15.3)	0.826
Suction catheter use	10 (10.0)	10 (5.0)	11 (5.5)	31 (6.2)	0.207

Outcomes of Primary percutaneous coronary intervention

Table IV presents, in-hospital mortality was low (3.2%) and did not differ significantly across centres (p = 0.953). DC shock was required in 10.4% of cases, while multivessel PCI was performed in 7.8%, with no significant inter-centre differences observed.

Table IV: Outcomes of Primary percutaneous coronary intervention Across Three Clinical Settings

Outcome	Centre A n (%)	Centre B n (%)	Centre C n (%)	Total n (%)	p-value
Death	3 (3.0)	7 (3.5)	6 (3.0)	16 (3.2)	0.953
Survival	97 (97.0)	193 (96.5)	194 (97.0)	484 (96.8)	
DC shock	12 (12.0)	19 (9.5)	21 (10.5)	52 (10.4)	0.798
Multivessel PCI	9 (9.0)	15 (7.5)	15 (7.5)	39 (7.8)	0.882

Association of procedural factors with mortality

Table V shows there was no statistically significant association between DC shock and mortality (p = 0.166). Notably, no deaths occurred among patients requiring DC shock. Multivessel PCI also showed no significant association with mortality (p = 0.097), although a numerically higher proportion of deaths was observed in this group.

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Table V: Procedural factors and mortality

Variable	Death n (%)	Survived n (%)	Total n (%)	p-value
DC shock (Yes)	0 (0.0)	52 (10.7)	52 (10.4)	0.166
DC shock (No)	16 (100)	432 (89.3)	448 (89.6)	
Multivessel PCI (Yes)	3 (18.8)	36 (7.4)	39 (7.8)	0.097
Multivessel PCI (No)	13 (81.2)	448 (92.6)	461 (92.2)	

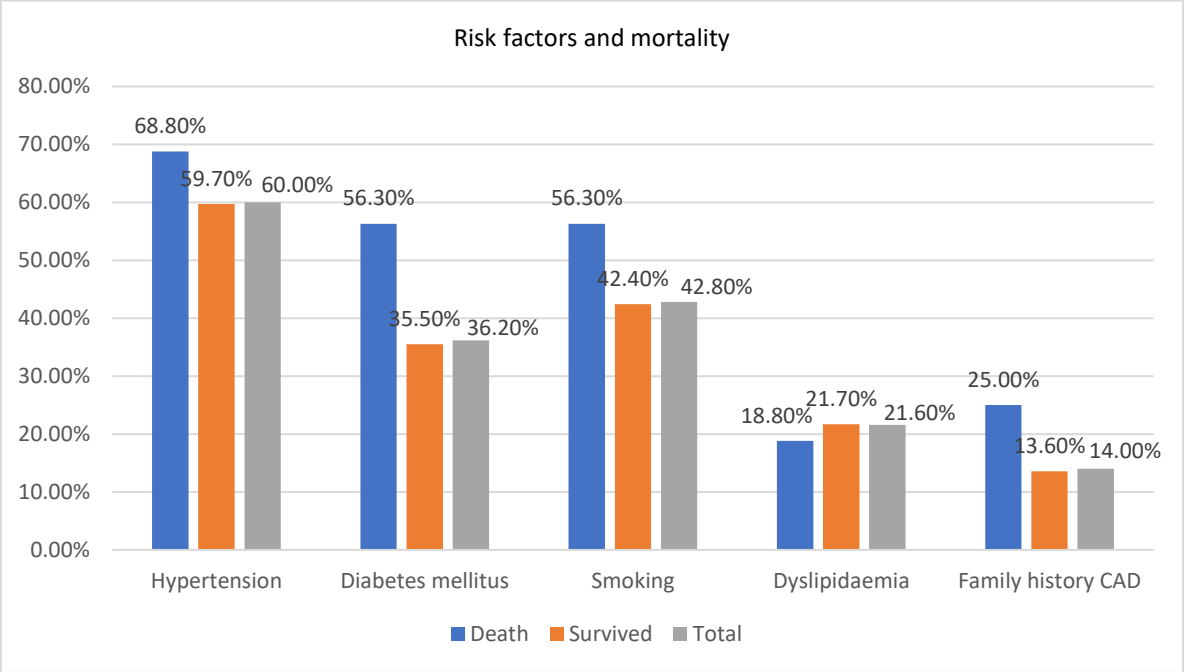

Figure 1: Distribution of Cardiovascular Risk Factors in Relation to Mortality

Association of risk factors with mortality

Figure 1 shows that hypertension was present in 68.8% of patients who died compared to 59.7% of those who survived. Diabetes mellitus was notably higher among the death group (56.3%) than among survivors (35.5%). Similarly, smoking was more common in patients who died (56.3%) compared to those who survived (42.4%). In contrast, dyslipidaemia was slightly lower in the death group (18.8%) compared to the survival group (21.7%). A positive family history of coronary artery disease was observed in 25.0% of patients who died, compared to 13.6% among survivors.

Overall, although certain risk factors such as diabetes mellitus, smoking, and family history appeared more frequent among patients who died, no significant association was found.

Multivariate logistic regression analysis

Table VI shows in multivariate analysis, diabetes mellitus was the only independent predictor of in-hospital mortality (adjusted OR = 0.306, 95% CI: 0.105–0.889; p = 0.030). Other variables including age, sex, hypertension, smoking, dyslipidaemia, ejection fraction category, multivessel PCI, DC shock, and clinical centre were not statistically significant predictors. Model instability was observed for some variables due to the low number of mortality events.

Table VI: Multivariate logistic regression for mortality

Variable	AOR	95% CI	p-value
Diabetes mellitus	0.306	0.105–0.889	0.030
Hypertension	0.828	0.257–2.662	0.751
Smoking	0.717	0.246–2.089	0.542
Dyslipidaemia	1.706	0.399–7.300	0.471
Multivessel PCI	0.359	0.084–1.527	0.165

Effect of clinical setting on mortality

Table VII presents after adjustment, no significant difference in mortality was observed between centres. Compared with Centre A, mortality was similar in Centre B (AOR = 0.856, p = 0.838) and Centre C (AOR = 1.023, p = 0.970), indicating that clinical setting was not an independent predictor of in-hospital mortality.

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Table VII: Adjusted effect of clinical setting on mortality

Comparison	AOR	95% CI	p-value
Centre B vs A	0.856	0.192–3.820	0.838
Centre C vs A	1.023	0.314–3.327	0.970

DISCUSSION

This study indicates that primary PCI conducted by one operator at three hospitals in Bangladesh resulted in comparable in-hospital outcomes, even with varying hospital environments. Baseline characteristics were mostly similar, showing slight differences in smoking. Results indicate that the skill of the operator and a standardized approach are more crucial than variations among institutions, aligning with registry information that connects PCI results to both operator and system efficacy [15].

Left ventricular ejection fraction was consistent among all centers, suggesting similar baseline myocardial performance. Coronary anatomy displayed considerable variation, with single-vessel disease occurring most frequently, particularly in Centre C. This corresponds with findings that STEMI is typically the result of occlusion in a single culprit vessel [16].

Pre-dilatation varied among centres, being less common in Centre C, possibly due to operator choice and selective application of direct stenting. Post-dilatation and thrombus aspiration rates were low and comparable among the groups. Findings from the TASTE (Thrombus Aspiration in ST-Elevation Myocardial Infarction in Scandinavia) and TOTAL (Trial of Routine Aspiration Thrombectomy with PCI versus PCI Alone in STEMI Patients) trials indicate that thrombus aspiration does not offer routine advantages, endorsing the selective application of additional techniques. In general, variations were contingent on the operator [17,18].

The in-hospital death rate was low, showing no considerable variations among centres, and the rates of DC shock and multivessel PCI were comparable as well. This suggests uniform results across different contexts, reinforcing the idea that prompt reperfusion is the primary factor influencing survival in STEMI, not hospital differences [15,19].

DC shock showed no significant link to mortality, and there were no fatalities among shocked patients, likely indicating successful acute resuscitation during PCI [20]. Multivessel PCI demonstrated no notable link to mortality, aligning with data indicating that standard multivessel intervention does not enhance early outcomes in STEMI and must be tailored to individual cases [21]. None of the conventional risk factors were significantly linked to in-hospital mortality, although diabetes and smoking displayed higher numerical tendencies. This demonstrates the significant impact of immediate primary PCI in lowering early risk, where results are more affected by acute conditions than by pre-existing comorbidities [6,22].

Diabetes mellitus was the sole independent factor predicting in-hospital mortality, aligning with its recognized negative impact in MI. Other factors and clinical environments were not significant, likely because of low event rates and uniform PCI practices, suggesting that patient characteristics are more crucial than institutional variations in early results [19,23].

Following adjustment, the clinical environment did not influence in-hospital mortality, with comparable results observed in all centers, suggesting that variations between hospitals did not impact early survival using a single-operator PCI method. This provides evidence that prompt reperfusion and standardized care are crucial factors influencing outcomes over the institutional setting [24].

Overall, Primary PCI performed by a single operator across various centres yielded similar results, with mortality primarily affected by patient characteristics, particularly diabetes, rather than the hospital environment.

CONCLUSION

Primary PCI conducted in three distinct clinical environments in Bangladesh demonstrated consistently positive outcomes with low in-hospital mortality and no significant variations among centers. Even though slight differences in procedural practice were noted, the overall results were comparable across all environments. Diabetes mellitus was the sole factor linked to poorer in-hospital outcomes, whereas the type of clinical environment did not notably affect the results. These results indicate that, with a consistently skilled operator, primary PCI results are similar in various hospital settings, as patient-related factors have a greater impact than differences between institutions.

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