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Impact of availability of catheter laboratory facilities on management and outcomes of acute myocardial infarction presenting with out of hospital cardiac arrest

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Words count: 3259 words Abstract: 247 words

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Abstract

Objectives:

We aimed to identify whether the availability of catheter laboratory affects clinical outcomes of out-of-hospital cardiac arrest (OHCA) complicating myocardial infarction (AMI).

Methods:

Patients admitted with a diagnosis of AMI and OHCA from the Myocardial Ischaemia National Audit Project (MINAP) between 2010 to 2017 were stratified into three groups based on initial hospital's catheter laboratory status: hospitals without a catheter laboratory (No-catheter lab hospitals), hospitals with diagnostic catheter laboratory (Diagnostic hospitals), and hospitals with PCI facilities (PCI hospitals). We used multivariable logistic regression to evaluate factors associated with clinical outcomes.

Results:

We included 12,303 patients of which 9,798 were admitted to PCI hospitals, 1,595 to no-catheter lab hospitals, and 910 to diagnostic hospitals. Patients admitted to PCI hospitals were more frequently reviewed by a cardiologist (96%, $p<0.001$) than no-catheter lab hospitals (80%) and diagnostic hospitals (74%), and more likely to receive coronary angiography (PCI hospitals (87%), diagnostic hospitals (31%), no-catheter lab hospitals (54%), $p<0.001$). They also were more likely to undergo PCI (PCI hospitals (42%), diagnostic hospitals (17%), no-catheter lab hospitals (17%), $p<0.001$). After adjustment, there was no significant difference in the in-hospital mortality (OR 0.76, 95% CI 0.55-1.06) or re-infarction (OR 1.28, 95% CI 0.72-2.26) in patients admitted to PCI hospitals nor in patients admitted to diagnostic hospitals (mortality (OR 1.28, 95% CI 0.72-2.26), re-infarction (OR 1.38, 95% CI 0.68-2.82)).

Conclusion:

There is variation in coronary angiography use between hospitals without a catheter laboratory and PCI centres, which was not associated with better in-hospital survival.

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Introduction:

Out of hospital cardiac arrest (OHCA) occurs in around 10% of patients with acute myocardial infarction (AMI) and is associated with significant mortality[1]. Patient outcomes following cardiac arrest remain poor despite advances in the fields of resuscitation and intensive care management[2]. If myocardial infarction is the cause for the OHCA, coronary revascularization may preserve the myocardium, improve the circulatory function, and prevent life threatening arrhythmias.

Hospital-related factors such as the availability of cardiac catheterization laboratory facilities potentially have a significant impact on the processes of care and clinical outcomes of AMI complicated by OHCA because coronary angiography and PCI often have an important role in the management of this high risk group[3,4]. Current evidence shows considerable variability in survival rates across receiving hospitals[5,6]. In the UK, specifically, there is clear evidence of heterogeneity in practice regarding rates of PCI access for this population[7]. In a study of outcomes after OHCA from the Great Paris registry, the highest survival rates were observed in hospitals with a high level of resources, commonly called "cardiac arrest centers"[8]. However, the previous studies focused on the AMI patients in general, without specific emphasis on the outcome of AMI complicated by OHCA, or didn't differentiate between diagnostic and PCI capable hospitals [4,9–11]. To the best of our knowledge, this is the first concurrent study to investigate the impact of the availability of catheter laboratory services on the in-hospital mortality of AMI patients with OHCA and differentiate between diagnostic and PCI hospitals.

The current strategy employed by the Emergency Medical Services (EMS) is to take patients with an OHCA to the nearest hospital regardless of its availability of catheter laboratory facilities, unless there is evidence of STEMI, in which case patients are routed directly to a PCI centre based on regionally agreed pathways. We used the Myocardial Ischaemia National Audit Project (MINAP), a national registry of AMI hospitalisation in England and Wales, to study the association of catheter laboratory facilities in the admitting hospital on the processes of care, utilization of coronary angiography and PCI, and the clinical outcomes of patients admitted with AMI complicated by OHCA.

Methods:

Study design

A population based retrospective observational cohort study performed using the MINAP registry, a national cardiac audit registry that collects information about the presenting profile and clinical care of patients hospitalised with diagnosis of AMI in England, Wales, and Northern Ireland[4,12,13]. The data collected are utilised for auditing quality of care and public reporting of AMI patients and also provides a resource for academic research [13–15].

Study population

The cohort for this study included all patients aged >18 years, with a discharge diagnosis of AMI (either STEMI or non-ST-segment myocardial infarction (NSTEMI)) and OHCA between January 1, 2010 and March 31, 2017. The discharge diagnosis of AMI was established by the treating clinician according to the presenting history, clinical examination, and the results of inpatient investigations based on the consensus document of the Joint European Society of Cardiology and American College of Cardiology[16]. Total of 16,087 cases met the case definition criteria as shown in supplementary figure 1. From the population that met the case definition, we excluded 888 cases because the presenting rhythm data was missing and 2,896 because the immediate cardiac arrest outcome data was missing. Supplementary table 1-A shows the patients' characteristics and clinical presentation of patients excluded because of missing data. Supplementary table 1-B shows the extent of the missing data imputed using the MICE algorithms across the three groups.

All patients were stratified into three groups based on catheter laboratory status of the initial admitting hospital: hospitals without a catheter laboratory (No-catheter lab hospitals), hospitals with diagnostic catheter laboratory (Diagnostic hospitals), and hospitals with PCI facilities (PCI hospitals). We used the national audit data from NICOR (National Institute for Cardiovascular Outcomes Research) website to classify the hospitals according to the availability of a catheter laboratory. Supplementary table 2 shows the number of hospitals with diagnostic angiography and PCI facilities over the study period. We collected detailed information on patient characteristics, clinical presentations, comorbidities, and discharge pharmacology. The outcomes of interest were in-hospital mortality, reinfarction, major bleeding, and utilization of coronary angiography and PCI. In-hospital major bleeding was defined as a composite of intracranial bleeding, retroperitoneal bleeding, and any bleeding with >3g/L fall in haemoglobin concentration.

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Ethical approval

Ethical approval was not required for this study under current arrangements by the National Health Service (NHS) research governance because MINAP database was collected and used for research purposes without informed patient consent by the National Institute for Cardiovascular Outcomes Research under section 251 of the National Health Service Act 2006[17].

Statistical analysis

We described the baseline characteristics as number and percentage for categorical variables, and as median and interquartile range (IQR) for continuous variables. Chi-square test and t-test were used to test for statistical significance between categorical and continuous variables respectively. The Kruskal Wallis test was used for skewed data. We used multiple imputation techniques with chained equations to account for the missing data. Age, sex, ethnicity, clinical diagnosis, presenting rhythm, restoration of spontaneous circulation (ROSC), and in-hospital mortality were registered as regular variables in the imputations model, while all other variables listed in supplementary table 1-B were imputed. The variable selection in the model was based on previous studies using the MINAP registry and prior clinical knowledge [4,13]. Using these models, 10 imputed datasets were generated which were used to perform all the analyses. Multivariable logistic regression models were used to study the association between availability of catheter lab and clinical outcomes. Multilevel logistic regression models were fitted to account for the nested structure of the data. A random intercept for hospital sites was used. In terms of the information on cardiac catheter lab facilities, this was categorized into "no-catheter lab, diagnostic hospitals, and PCI hospital" and modelled as a fixed effect in the models. The multilevel logistic regression model captures any unobserved hospital components and hospital factors that were omitted but may influence the outcomes. All models included the same variables used in the multiple imputation models as well as the year of admission. Estimates in the form of odds ratios (ORs) and 95% confidence intervals (95% CIs) were reported. Statistical significance was considered with an alpha of 0.05 in all the 2-sided tests used. Stata version 14.1 was used to perform all the analyses. To ensure that the way we assigned the comparison groups did not affect the outcomes we did a sensitivity analysis based on the clinical diagnosis, presenting rhythm, and ROSC.

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Results:

Patients' characteristics:

The analytic cohort was composed of 12,303 patients presenting with AMI complicated by OHCA. Most patients were admitted to PCI-capable hospitals (9,798) followed by no-catheter lab hospitals (1,595), and diagnostic catheter lab hospitals (910). STEMI was the dominant clinical diagnosis in the PCI capable hospitals (83.8%), whereas OHCA complicated with an NSTEMI were more likely to be admitted to diagnostic catheter lab hospitals (53.1%). Patients admitted to PCI capable hospitals were younger (median age 64, IQR (54-73)) compared to the no-catheter lab (median age 67, IQR (56-77)) or diagnostic catheter lab hospitals (median age 70, IQR (62-79)). Patients admitted to no-catheter lab and PCI capable hospitals had higher frequency of cardiogenic shock (22.3% and 22.9% respectively, $p<0.001$) compared to the diagnostic catheter lab hospitals (12.5%). Table 1 shows the patients' characteristics and clinical presentation of AMI with OHCA stratified according to the admitting hospital cardiac catheter lab status.

AMI patients with OHCA are increasingly admitted at hospitals with PCI facilities, with the proportion of patients admitted to PCI capable hospitals increasing from 70% in 2010 to 86% in 2017. In contrast, the proportion of patients admitted to hospitals without on-site catheter lab declined from 19% in 2010 to around 7% in 2017, while the proportion of patients admitted to diagnostic hospitals declined from 12% in 2010 to 6% in 2017. Figure 1 demonstrates the temporal trends of admission rate of AMI with OHCA.

Processes of care:

Patients admitted to PCI capable hospitals were also more frequently reviewed by a cardiologist (96%, $p<0.001$) compared to those hospitals without a catheter lab (80%) or those with diagnostic cardiac catheter facilities only (74%). Patients admitted to PCI capable hospitals were much more likely to receive coronary angiography (87%,) than those admitted to hospitals without a catheter lab (54%) or those admitted to hospitals with diagnostic catheter lab facilities (31%). Likewise, patients admitted to PCI capable hospitals were more likely to undergo PCI (42%) than those initially admitted to hospitals without a catheter lab (18%) or those with diagnostic catheter lab facilities only (17%) (Table 2). Administration of evidence-based medications like DAPT was more frequent in PCI hospitals (84%, $p<0.001$) compared to no-lab hospitals (64%) and diagnostic hospitals (63%).

The use of coronary angiography increased over the last decade in PCI capable hospitals (from 83% to 89%) and in hospitals without a catheter lab (from 48% to 65%). Supplementary figure 2 and 3 illustrates the temporal trends of coronary angiography and PCI use.

Clinical outcomes:

Crude mortality rates were higher in patients admitted hospitals without a catheter lab (44%) and with diagnostic catheter lab facilities only (47%) compared to PCI capable hospitals (27%). Figure 2 illustrates the temporal trends of in-hospital death of AMI with OHCA stratified by hospital type.

After adjustment and using hospitals with no catheter labs as a reference, there was no significant difference in the in-hospital mortality (OR 0.76, 95% CI 0.55-1.06) or re-infarction (OR 1.28, 95% CI 0.72-2.26) in patients admitted to PCI capable hospitals (table 3). Similarly, there was no significant difference in the in-hospital mortality (OR 0.78, 95% CI 0.52-1.20) or re-infarction (OR 1.38, 95% CI 0.68-2.82) in patients admitted to hospitals with diagnostic catheter lab facilities only.

Independent predictors of coronary angiography use:

After adjustment, patients admitted to PCI capable hospitals continued to have 6-fold higher odds of receiving coronary angiography compared to hospitals without catheter lab facilities as illustrated in supplementary table 3.

Sensitivity analysis:

We did a sensitivity analysis based on the clinical diagnosis to account for the official directives to the emergency medical services regarding transportation of STEMI and NSTEMI patients. We also did a sensitivity analysis based on the presenting rhythm, and ROSC as illustrated in supplementary table 4. The in-hospital mortality in STEMI patients was not different in patients admitted to PCI hospitals (OR 0.76, 95% CI 0.51-1.13) and diagnostic hospitals (OR 0.68, 95% CI 0.38-1.13). Similarly, the in-hospital mortality in patients with pulseless ventricular tachycardia or fibrillation was not different in patients admitted to PCI hospitals (OR 0.86, 95% CI 0.61-1.23) and diagnostic hospitals (OR 0.85, 95% CI 0.54-1.36).

We omitted the process of care variables and found that patients admitted to PCI hospitals had significantly lower in-hospital mortality (OR 0.58, 95% CI 0.42-0.79), but no significant differences in reinfarction (OR 1.08, 95% CI 0.64-1.84) and bleeding (OR 0.67, 95% CI 0.38-1.16) as shown in supplemental table 5.

Discussion

In this national analysis of AMI patients with OHCA, the majority of patients were admitted to hospitals with PCI facilities. Patients admitted to hospitals without catheter lab facilities were sicker with higher prevalence of cardiogenic shock and severe LV impairment. The crude mortality rates were lower in the PCI hospitals. However, hospital's catheter laboratory status was not associated with significant differences in in-hospital mortality or reinfarction once differences in baseline characteristics were adjusted for. We report significant differences in the processes of care between the different types of hospital studied with patients admitted to hospitals without PCI facilities less likely to be reviewed by a cardiologist, less likely to receive evidence-based medications, and less likely to receive invasive therapy in form of coronary angiography and PCI.

The current European and American guidelines recommend immediate coronary angiography with PCI in patients who present with STEMI and cardiac arrest[18,19]. The role of immediate coronary angiography and PCI in the treatment of patients who have been successfully resuscitated after cardiac arrest in the absence of STEMI remains uncertain[20]. Few observational studies initially suggested that early coronary angiography and PCI are associated with a better clinical outcome for AMI with OHCA without ST elevation on ECG [21,22]. In a large cohort of OHCA patients without ST-segment elevation from the Parisian Registry Out-of-Hospital Cardiac Arrest (PROCAT), emergent PCI was associated with a nearly 2-fold increase in the rate of a favorable outcome [22]. These assumptions could have played a part in the increase of admissions to PCI facilities between 2010 and 2017. In addition, an increase in the proportion of OHCA subjects admitted with STEMI from 66% to 75% was noted during the same timeframe[23]. There has also been an expansion of PCI services in the UK as the number of PCI capable centers increased from 114 in 2010 to 118 in 2017. Interestingly, while the proportion of patients transferred to PCI hospitals increased, this was not accompanied by a parallel rise in use of PCI. This phenomenon suggests that many patients transferred to the PCI hospitals were not suitable candidates for invasive coronary angiogram. Thus, the increase in the crude mortality rate noted in patients admitted to PCI hospitals could

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partially be due to admission of patients who are not suitable candidates for invasive coronary therapy.

In contrast to the findings of the observational studies, the COACT randomized trial (Coronary Angiography after Cardiac Arrest without ST-Segment Elevation trial) showed that a strategy of immediate angiography had no advantage compared to a strategy of delayed angiography with respect to overall survival at 90 days [20]. More recently, The TOMAHAWK trial (Immediate Unselected Coronary Angiography Versus Delayed Triage in Survivors of Out-of-hospital Cardiac Arrest Without ST-segment Elevation) showed that early coronary angiography did not improve 30-day survival among patients with OHCA of possible coronary origin[24]. There are several other ongoing trials which will help clarify the impact of early coronary angiography after cardiac arrest on the patients' survival.

In our national analysis of AMI patients with OHCA, patients admitted to the hospitals without catheter laboratory facilities were older with a higher frequency of cardiovascular risk factors, yet they were paradoxically much less likely to receive coronary angiography compared to patients admitted to PCI hospitals. One possible explanation may be related to the availability of input from a cardiologist. Patients admitted to PCI capable hospitals were far more likely to be reviewed by a cardiologist, and presumably they were then able to make an appropriate decision regarding the use of an invasive coronary strategy. By contrast, in hospitals without PCI facilities, the initial decision regarding coronary angiography and PCI depends on the responsible physician, who is unlikely to be an interventional cardiologist, and may not even be a cardiologist [4]. We also noted that the use of coronary angiography in patients admitted to hospitals with diagnostic catheter lab facilities was not significantly different from those admitted to hospitals without catheter laboratory facilities. This can be attributed to the predominance of STEMI in the cohort admitted to hospitals without catheter laboratory facilities which requires immediate transfer to PCI centers for primary PCI. The dominant clinical diagnosis in patients admitted to hospitals with diagnostic catheter laboratory was the NSTEMI that can initially be investigated locally, and only transfer those who requires PCI to PCI centers.

Regarding clinical outcomes, studies of the impact of availability of catheter laboratory facilities have shown inconsistent results. Earlier studies from MINAP by Couper et al which included patients admitted with OHCA secondary to AMI showed that availability of primary PCI services was not associated with lower mortality[7]. In contrast, a more recent multicentre study by Vopelius-Feldt et al in the UK showed that admission to a cardiac arrest centre is associated with a moderate improvement in survival to hospital discharge[25]. We observed no significant differences in the in-hospital mortality of patients with OHCA in the setting of AMI based on the availability of catheter laboratory services despite differences in utilization of coronary angiography and PCI. A key difference between Vopelius-Feldt et al study and our study is that they stratified outcomes by admission to a Cardiac Arrest Centre, defined as either Hospitals with 24-h availability of PPCI, 7 days per week or Hospitals with over 100 admissions of OHCA of presumed cardiac causes per year. In contrast our analysis focussed on the presence of catheter lab facilities only and did not consider OHCA volume or Cardiac Arrest centre status, in order to separate out the the impact of catheter laboratory facilities per se.

Another important difference between the two studies is that the study by Vopelius-Feldt adjusted for the OHCA management prior to hospital arrival and patients' comorbidities but they didn't adjust for the inpatient management variables. Our sensitivity analysis suggests that when we do not adjust for differences in processes of care and inpatient management, our findings become similar to those of Vopelius-Feldt et al. Therefore, the better outcomes associated with cath lab facilities reported by Vopelius-Feldt et al may merely reflect that cath lab status is acting as a surrogate for receipt of better processes of care. It is also worth noting that in the United Kingdom, patients requiring PCI and admitted initially to hospitals without PCI facilities will ultimately be transferred to PCI centers after stabilization, which could partially explain why the availability of a catheter laboratory plays a minor role in the clinical outcomes of AMI with OHCA. In addition, the pre-hospital management of OHCA that involve early identification and cardiopulmonary resuscitation are community-based and not hospital-dependent, which may minimize the differences in the clinical outcomes between the hospitals. All these factors support the current policy of initially treating AMI patients with OHCA at the closest medical facility particularly for cases without ST-elevation.

There are few limitations that should be considered when the presented results are interpreted. First, MINAP is a hospital-based registry and lacks information regarding long term mortality and other outcomes. Second, we did not have information about the duration of cardiac arrest and resuscitation nor the management and quality of care prior to hospital admission such as duration and quality of CPR. Third, MINAP does not record why care-related decisions were taken which makes it impossible to confirm the appropriateness of decisions related to coronary angiography utilization and inpatient management. Fourth, there

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is an issue of misclassification bias, where early mortality in the emergency department following admission with an OHCA may not have received a discharge diagnosis of AMI. It is plausible that this may be more common in smaller, less established centres, although believe that any small differences between centres in this regard would not materially change our findings. Finally, MINAP does not capture data on other aspects of post-resuscitation care such as use of targeted temperature management information around Glasgow Coma Scale (GCS).

Conclusion:

AMI patients with OHCA are increasingly admitted to hospitals with PCI facilities rather than hospitals without PCI facilities. The current policy of taking AMI patients with OHCA to the nearest hospital regardless of availability of catheter laboratory services is associated with significant differences in utilization of coronary angiography and PCI depending on whether a patient is managed at a hospital with PCI facilities or not, possibly related to the variation in availability of input from a cardiologist. Differences in care pathways in hospitals based on the presence of cardiac catherization facilities was not associated with significantly worse in-hospital mortality outcomes in hospitals without cardiac catherization facilities. Hospitals without catheter laboratories are encouraged to implement local protocols to ensure early availability of a cardiologist input regarding appropriateness of an invasive therapy to minimize this gap in the care of AMI patients presenting with OHCA.

Conflicts of interest: none

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Legends to figures

Figure 1: Temporal trends of admission rate of AMI with OHCA according to the cath lab status

Figure 2: Temporal trends of in-hospital death of AMI with OHCA and cath lab status

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Author statement file

***Credit authorship contribution statement*:**

Mohamed Dafaalla: Methodology, Data curation, Formal analysis, Writing - original draft, Visualization. Muhammad Rashid: Methodology, Data curation, Formal analysis, Writing - original draft, Visualization. Louise Sun: Writing - review & editing Tom Quinn: Writing - review & editing. Adam Timmis: Writing - review & editing. Harindra Wijeysundera: Writing - review & editing. Rodrigo Bagur: Writing - review & editing. Erin Michos: Writing - review & editing. Nick Curzen: Writing - review & editing., Mamas A. Mamas: Conceptualization, Supervision, Writing - review & editing

Declaration of interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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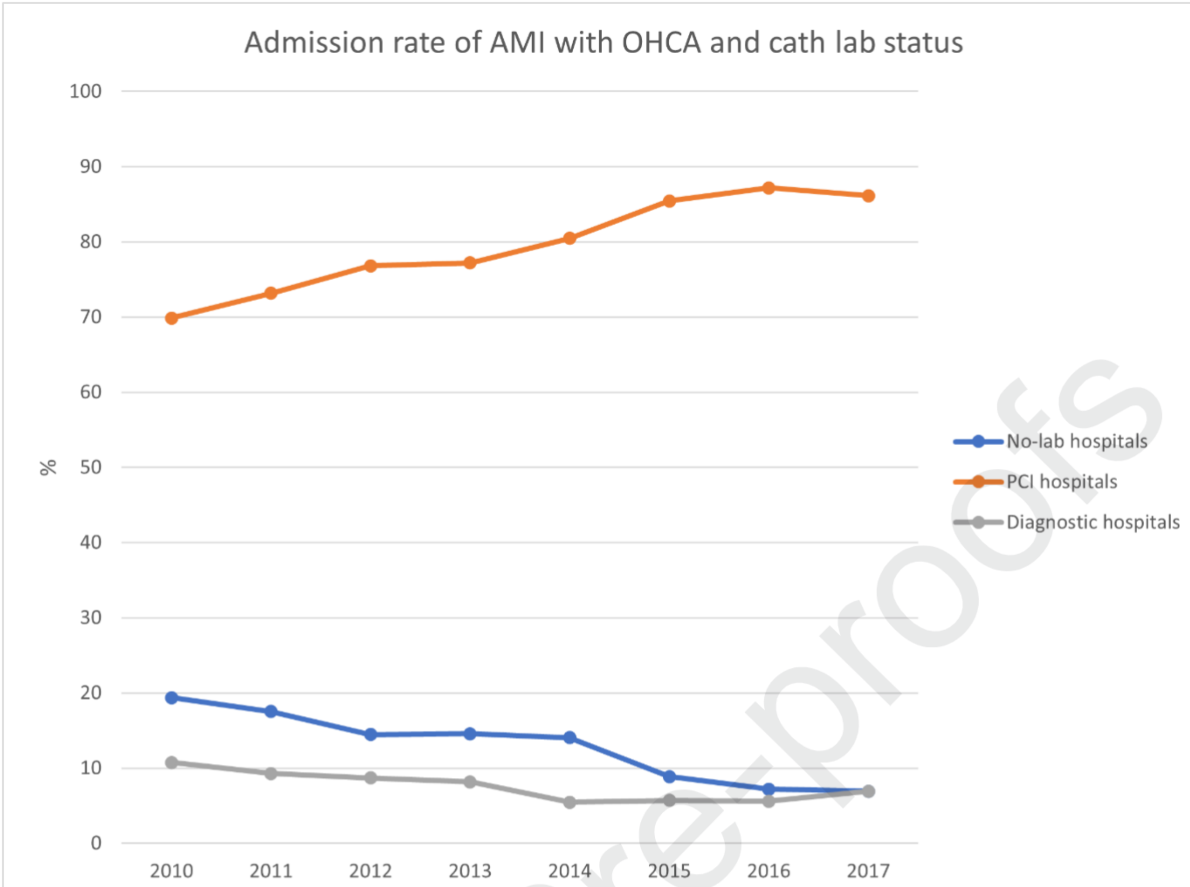

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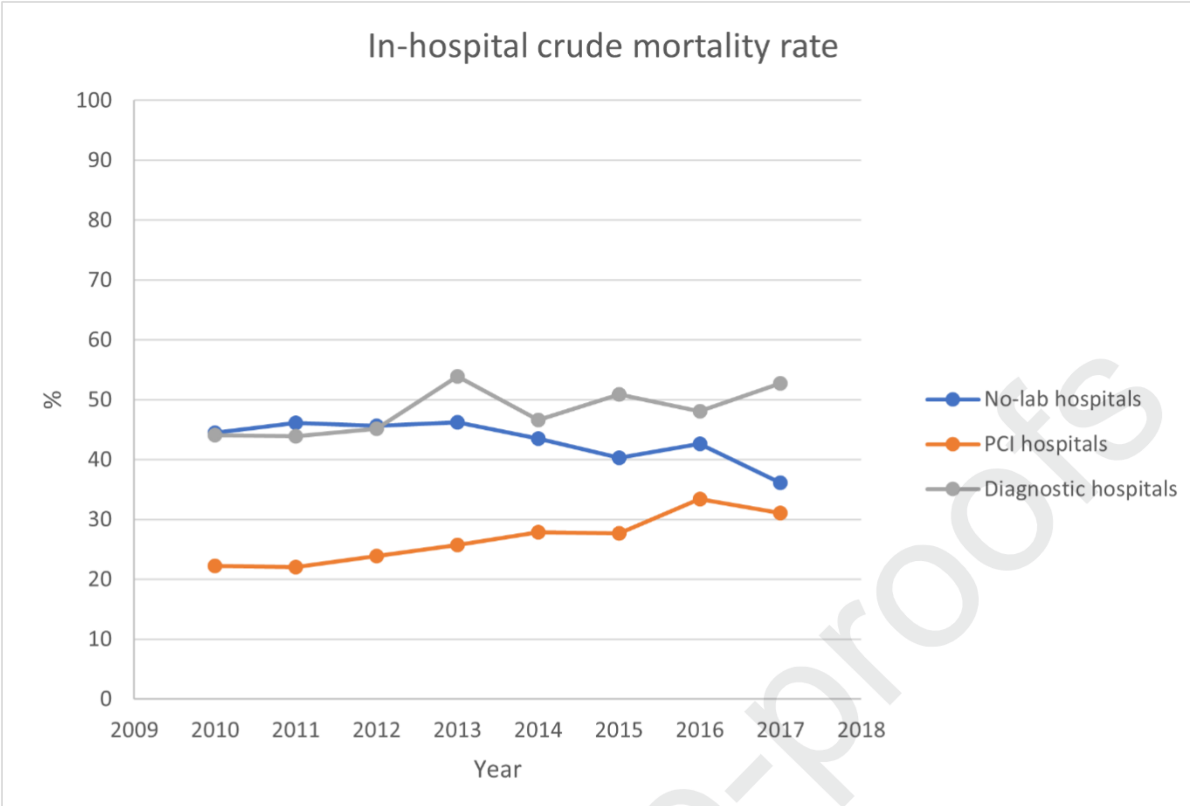

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Table 1: Patients' characteristics and clinical presentation of AMI patients with OHCA according to cath lab status

	No-lab hospital	Diagnostic hospital	PCI hospital	p-value
N	1595	910	9798	
Age (years), median (IQR)	67.0 (56.0, 77.0)	70.0 (62.0, 79.0)	64.0 (54.0, 73.0)	<0.001
Women	407 (25.5%)	258 (28.4%)	2143 (21.9%)	<0.001
White	1213 (91.5%)	808 (98.2%)	7938 (90.7%)	
BAME	112 (8.5%)	15 (1.8%)	813 (9.3%)	<0.001
BMI (kg/m2), median (IQR)	24.5 (22.9, 27.7)	26.9 (23.8, 30.2)	26.9 (24.2, 30.1)	0.041
Clinical diagnosis				
STEMI	954 (59.8%)	427 (46.9%)	8215 (83.8%)	<0.001
NSTEMI/UA	641 (40.2%)	483 (53.1%)	1583 (16.2%)	
Immediate arrest outcome				
No ROSC	68 (4.3%)	29 (3.2%)	201 (2.1%)	<0.001
ROSC	1527 (95.7%)	881 (96.8%)	9597 (97.9%)	
Neurologic deficit on discharge	106 (6.6%)	98 (10.8%)	715 (7.3%)	<0.001
Presenting rhythm				
Asystole	152 (9.5%)	80 (8.8%)	337 (3.4%)	<0.001
Pulseless VT/VF	1289 (80.8%)	712 (78.2%)	9037 (92.2%)	
PEA(EMD)	154 (9.7%)	118 (13.0%)	424 (4.3%)	
Call to hospital arrival (hours) , median (IQR)	1.0 (0.7, 1.3)	0.9 (0.7, 1.1)	1.2 (0.9, 1.6)	<0.001
Killip class				
Killip class I	538 (53.9%)	263 (55.8%)	4253 (61.7%)	<0.001
Killip class II	175 (17.5%)	107 (22.7%)	742 (10.8%)	
Killip class III	62 (6.2%)	42 (8.9%)	321 (4.7%)	
Killip class IV (shock)	223 (22.3%)	59 (12.5%)	1579 (22.9%)	
Site of infarction				
anterior	437 (47.5%)	148 (37.1%)	3816 (51.5%)	<0.001
inferior	264 (28.7%)	120 (30.1%)	2562 (34.6%)	
posterior	35 (3.8%)	28 (7.0%)	383 (5.2%)	
lateral	50 (5.4%)	23 (5.8%)	353 (4.8%)	
indetermined	134 (14.6%)	80 (20.1%)	293 (4.0%)	
Left ventricular function				
Good	283 (23.0%)	147 (20.0%)	2283 (27.5%)	<0.001
Moderate impairment	312 (25.4%)	155 (21.1%)	2848 (34.3%)	
Severe impairment	241 (19.6%)	113 (15.4%)	1406 (16.9%)	
Not assessed	393 (32.0%)	319 (43.5%)	1760 (21.2%)	
Creatinine (mmol/l), median (IQR)	107.0 (95.0, 137.0)	106.0 (86.0, 133.5)	93.0 (76.0, 113.0)	<0.001
Elevated cardiac enzymes	1358 (97.9%)	813 (99.8%)	8470 (97.5%)	<0.001
History of angina	251 (17.8%)	211 (26.9%)	1108 (12.7%)	<0.001
Previous MI	310 (21.6%)	233 (29.1%)	1371 (15.6%)	<0.001
DM	280 (19.5%)	153 (18.0%)	1286 (14.0%)	<0.001
HTN	627 (44.1%)	382 (47.8%)	3620 (41.2%)	<0.001

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Hypercholesterolemia	369 (26.6%)	194 (24.5%)	2410 (27.9%)	0.090
Peripheral vascular disease	65 (4.6%)	36 (4.6%)	329 (3.8%)	0.21
Smoking				
Never smoked	485 (41.2%)	333 (46.3%)	3148 (37.5%)	<0.001
Ex-smoker	282 (24.0%)	190 (26.4%)	1956 (23.3%)	
Active smoker	409 (34.8%)	197 (27.4%)	3280 (39.1%)	
FH of coronary artery disease	220 (21.8%)	94 (14.8%)	1840 (25.1%)	<0.001
Previous PCI	114 (8.0%)	54 (6.8%)	734 (8.3%)	0.31
Previous CABG	88 (6.2%)	73 (9.2%)	385 (4.4%)	<0.001
Stroke	117 (8.3%)	94 (11.8%)	498 (5.7%)	<0.001
Heart failure	106 (7.5%)	73 (9.3%)	300 (3.4%)	<0.001
Chronic kidney disease	80 (5.7%)	53 (6.7%)	275 (3.2%)	<0.001
Asthma/COPD	204 (14.5%)	139 (17.5%)	986 (11.3%)	<0.001

SD= standard deviation, FH= family history, BAME=black, Asian, and minority ethnic, CABG= coronary artery bypass graft, PCI= percutaneous intervention, MI= myocardial infarction, ROSC= restoration of spontaneous circulation, COPD= chronic obstructive pulmonary disease, LV= left ventricle, LVSD= left ventricular systolic dysfunction, IQR= Interquartile range

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Table 2: Processes of care and unadjusted clinical outcomes of AMI patients with OHCA according to catheter lab status

	No-lab hospital	Diagnostic hospital	PCI hospital	p-value
N	1595	910	9798	
Seen by cardiologist	1258 (80.8%)	654 (74.2%)	9399 (96.6%)	<0.001
Warfarin	48 (3.4%)	32 (4.2%)	410 (5.0%)	0.018
LMWH	704 (48.9%)	366 (48.2%)	4075 (49.5%)	0.74
Unfractionated heparin	183 (12.8%)	72 (9.5%)	4213 (51.5%)	<0.001
Fondaparinux	278 (19.5%)	224 (29.3%)	912 (11.2%)	<0.001
Aspirin	1269 (86.2%)	693 (80.3%)	9021 (95.9%)	<0.001
GP IIIa/IIb inhibitors	49 (3.4%)	11 (1.4%)	1628 (19.4%)	<0.001
P2Y12 inhibitors	987 (66.8%)	578 (67.9%)	8163 (86.4%)	<0.001
DAPT	955 (64.8%)	540 (62.6%)	7902 (84.0%)	<0.001
Furosemide	448 (31.4%)	244 (32.1%)	2343 (28.7%)	0.027
Oral beta blockers	828 (58.2%)	390 (51.5%)	6157 (74.7%)	<0.001
Discharged on beta blockers	644 (42.1%)	345 (39.3%)	6278 (65.2%)	<0.001
ACEI	717 (49.9%)	339 (44.7%)	4797 (57.5%)	<0.001
Coronary angiography	829 (54.8%)	262 (31.1%)	8340 (87.2%)	<0.001
PCI	203 (17.9%)	100 (17.2%)	3255 (42.3%)	<0.001
CABG	51 (4.5%)	18 (3.1%)	255 (3.3%)	0.11
In-hospital death	706 (44.3%)	434 (47.7%)	2645 (27.0%)	<0.001
Re-infarction	35 (2.4%)	26 (3.2%)	228 (2.5%)	0.41
Bleeding	67 (4.2%)	29 (3.3%)	293 (3.0%)	0.044

SD= standard deviation, IQR= Interquartile range, LMWH= low molecular weight heparin, PCI= percutaneous intervention, CABG= coronary artery bypass graft.

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Table 3: adjusted clinical outcomes of AMI patients with OHCA and cath lab status (reference- No-lab hospitals)

	No-lab hospitals	PCI hospitals OR(95% CI)	Diagnostic hospitals OR(95% CI)
In-hospital death	Reference	0.76(0.55-1.06)	0.78(0.52-1.2)
Re-infarction	Reference	1.28(0.72-2.26)	1.38(0.68-2.82)
Bleeding	Reference	0.58(0.33-1.03)	0.87(0.42-1.80)

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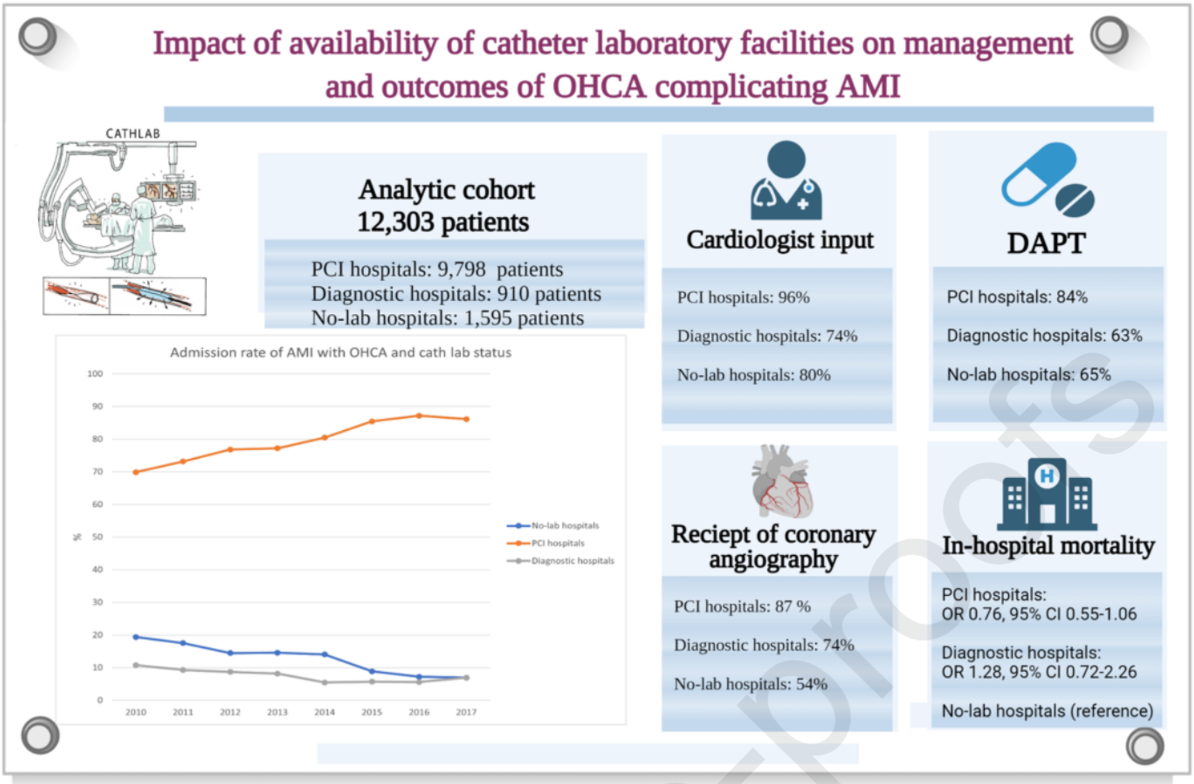

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