

# IRISH HEART ATTACK AUDIT

## NATIONAL REPORT 2017-2020



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**This work uses data provided by patients and collected by their healthcare providers as part of their care. NOCA would like to thank all participating hospitals for their valuable contributions, in particular the Clinical Leads and all Irish Heart Attack Audit Coordinators. Without their continued support and input, this audit could not produce meaningful analysis of heart attack care in Ireland. NOCA would also like to acknowledge the work of the Health Service Executive – particularly the National Heart Programme – and the National Ambulance Service, with whom we are developing a collaborative relationship in order to drive improvements in heart attack care in Ireland. We would also like to thank Philip Dunne, IT Systems Support, Healthcare Pricing Office, who provides ongoing support for the Heartbeat portal. This report underwent a single-blind review process. NOCA thanks the reviewers for their contribution to this report.**

# **Irish Heart Attack Audit**

## National Report 2017-2020



Dr Ronan Margey  
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25 March, 2022

Dear Dr Margey

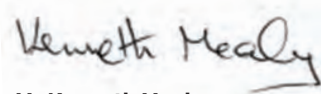
I wish to acknowledge receipt of the *Irish Heart Attack Audit National Report 2017- 2020*.

Following your presentation to the NOCA Governance Board on the 24th March 2022 and feedback garnered from our membership, we are delighted to endorse this report. I wish to congratulate you, Audit Manager Ms Joan McCormack and your governance committee in the development of this report which is a valuable quality improvement initiative.

Looking to the future, the Board, in the discussion of your report, suggested you and your governance group consider emphasising recommendations in regard to quality improvement initiatives as topics worthy of your attention.

Please accept this as formal endorsement from the NOCA Governance Board of the *Irish Heart Attack Audit National Report 2017-2020* and we wish you every success in your ongoing commitment to improving the care of Irish heart attack patients.

Yours sincerely,



**Mr Kenneth Mealy,**  
**Chair**  
**National Office of Clinical Audit Governance Board**

# PREFACE

I am delighted to welcome the publication of the *Irish Heart Attack Audit National Report, 2017–2020*. This report follows on from two previous heart attack reports covering data from 2014 and 2016 (which were published under the governance of the National Clinical Programme for Acute Coronary Syndrome) and is based on data collected in hospitals providing primary percutaneous coronary intervention (PCI) therapy for patients following a major heart attack (ST elevation myocardial infarction (STEMI)).



I would like to take this opportunity to commend the work of the National Clinical Programme for Acute Coronary Syndrome, and particularly Professor Kieran Daly, Dr Siobhan Jennings and Mr Brendan Cavanagh, who set out in 2010 to reorganise and monitor the treatment pathway for patients with heart attack through the publication of the *Acute Coronary Syndromes Programme Model of Care* (Health Service Executive, 2012) and the implementation of the optimal reperfusion service (ORS) protocol, which aims to facilitate timely reperfusion treatment for all patients with a STEMI. The 2013 establishment of a monitoring system for the ORS protocol, called Heartbeat, in collaboration with the Hospital In-Patient Enquiry (HIPE) system, has enabled continuous monitoring and reporting of data on patients with a major heart attack. I would like to thank all of the audit coordinators, many of whom are senior cardiology nurses, for their ongoing support of the Heartbeat portal, particularly during the challenging coronavirus disease 2019 (COVID-19) years. In 2019, governance of the Heartbeat portal was transferred to the National Office of Clinical Audit (NOCA) and is now ably led by Dr Ronan Margey, with the support of the Irish Heart Attack Audit (IHAA) Governance Committee (chaired by Dr Sean Fleming) and of the systems supporting clinical audit within NOCA. I wish them all continued success in this important work.

The results in this report present data on the care received by 5,629 patients who suffered a STEMI and received care in a hospital providing primary PCI therapy from 2017 to 2020. Although the authors do outline all data quality metrics, the results clearly identify key areas for improvement both for general population health and for all health services providing care to patients from the first call for help to cardiac rehabilitation in the community. It is clear that improved public health messaging encouraging patients to call 112 or 999 for help when they experience signs of a heart attack is necessary, given that only 37% of patients with a STEMI called for help within 1 hour of symptom onset over the 4-year reporting period. This report also finds that 34% of patients were current smokers (compared with a rate of 17% among the general population in Ireland), and that on average, those patients who smoke have a heart attack 10 years earlier than those who do not smoke. It is reassuring that the majority (72%) of patients with a STEMI are now admitted directly to a PCI centre, compared with 44% in 2014, and that the majority (84%) of those patients receive timely treatment. However, 28% of patients are transferred to a PCI centre from another hospital, and only 27% of this group received timely treatment. The reasons for this are likely multifactorial but are a cause for concern, as this report indicates that timely primary PCI was associated with a lower mortality rate.

On behalf of the National Heart Programme, I fully endorse all of the recommendations made within this report, and I hope that all key stakeholders will work together to deliver the quality improvement initiatives necessary in order for us to provide better healthcare to our citizens throughout their lives.

**Professor Ken McDonald, National Clinical Lead, National Heart Programme**

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# GLOSSARY OF TERMS AND DEFINITIONS

ACRONYM	FULL TERM
<b>ACS</b>	acute coronary syndrome
<b>ACE Inhibitor</b>	angiotensin-converting enzyme inhibitor; oral medication sometimes used in the treatment of high blood pressure, heart attack, heart failure and diabetes.
<b>ACS MOC</b>	Acute Coronary Syndrome Model of Care
<b>AMI</b>	Acute Myocardial Infarction
<b>ARB</b>	angiotensin II receptor blocker; oral medication sometimes used in the treatment of high blood pressure, heart attack, heart failure and diabetes.
<b>BMI</b>	Body mass index
<b>CABG</b>	coronary artery bypass graft
<b>cath lab</b>	catheterisation laboratory
<b>COVID-19</b>	coronavirus disease 2019; the disease caused by severe acute respiratory syndrome coronavirus 2.
<b>CR</b>	cardiac rehabilitation
<b>CSO</b>	Central Statistics Office
<b>DIDO</b>	door in door out
<b>dL</b>	decilitre
<b>DTB</b>	door to balloon
<b>DTN</b>	door to needle
<b>DVR</b>	Data Validation Report
<b>ECG</b>	electrocardiogram
<b>ED</b>	emergency department
<b>ePCR</b>	electronic patient care record
<b>ESC</b>	European Society of Cardiology
<b>FMC</b>	first medical contact
<b>FMCTB</b>	first medical contact - to balloon
<b>FMCTD</b>	first medical contact - to door
<b>g</b>	gram
<b>GP</b>	general practitioner
<b>GRACE</b>	Global Registry of Acute Coronary Events (United States of America)
<b>Heartbeat</b>	A web-based data collection tool.
<b>HIPE</b>	Hospital In-Patient Enquiry
<b>HIQA</b>	Health Information and Quality Authority
<b>HPO</b>	Healthcare Pricing Office
<b>HSE</b>	Health Service Executive
<b>ICD-10-AM</b>	International Statistical Classification of Diseases, Tenth Revision, Australian Modification

<b>ACRONYM</b>	<b>FULL TERM</b>
<b>ICPCD</b>	Integrated Care Programme for the Prevention and Management of Chronic Disease
<b>IHAA</b>	Irish Heart Attack Audit
<b>IQR</b>	interquartile range
<b>KPI</b>	key performance indicator
<b>long QT syndrome</b>	A disturbance of the heart's electrical system (which can be seen on an electrocardiogram) that can lead to heart rhythm problems.
<b>LOS</b>	length of stay
<b>MI</b>	myocardial infarction
<b>n/a</b>	not applicable
<b>NAS</b>	National Ambulance Service
<b>NCP-ACS</b>	National Clinical Programme for Acute Coronary Syndrome
<b>NHS</b>	National Health Service (United Kingdom)
<b>NOCA</b>	National Office of Clinical Audit
<b>NSTEMI</b>	non-ST elevation myocardial infarction
<b>ORS</b>	optimal reperfusion service
<b>PCI</b>	percutaneous coronary intervention
<b>primary PCI</b>	primary percutaneous coronary intervention
<b>QI</b>	quality improvement
<b>RCSI</b>	Royal College of Surgeons in Ireland
<b>SPSS</b>	Statistical Package for the Social Sciences
<b>statins</b>	A group of oral medications that work to reduce the level of cholesterol in the blood.
<b>STEMI</b>	ST elevation myocardial infarction
<b>thrombolysis</b>	Intravenous medication therapy to treat heart attack by pharmacologically dissolving arterial clots.
<b>UK</b>	United Kingdom
<b>MINAP</b>	Myocardial Ischaemia National Audit Project

# EXECUTIVE SUMMARY

The Heartbeat audit of ST elevation myocardial infarction (STEMI) care was first developed in 2012 in order to assess the effectiveness and quality of the newly formed National Clinical Programme for Acute Coronary Syndrome (NCP-ACS) STEMI optimal reperfusion service under the auspices of Professor Kieran Daly, Health Service Executive (HSE) Clinical Lead, and Dr Siobhan Jennings, Consultant in Public Health Medicine, HSE. In 2019, this audit and attendant database came under the governance of the National Office of Clinical Audit (NOCA) by agreement with the HSE and evolved into the Irish Heart Attack Audit (IHAA). Although this is the first national IHAA report, it continues on from the two previously published NCP-ACS reports on the state of STEMI services across the country based on data collected in 2014 (HSE, 2015) and 2016 (HSE, 2018a). With a maturing database and systematic analytic capabilities through the NOCA structure, this report provides a detailed evaluation of STEMI care in Ireland for the years 2017 to 2020.

While the identification of people at higher risk for heart attack, treatments to reduce their risk, and interventions to treat heart attacks and reduce complications have improved significantly since the 1970s, resulting in halving the heart attack mortality rate in Ireland over that time period, heart attacks still affect an estimated 6,000 people per year in Ireland.

STEMI is diagnosed on a 12-lead electrocardiogram (ECG). Internationally, the recognised gold standard treatment for STEMI is to perform emergency reperfusion, known as primary percutaneous coronary intervention (PCI), within 120 minutes of first medical contact. There has been a national reperfusion treatment protocol for STEMI in place in Ireland since 2012.

From 2017 to 2020, the IHAA evaluated data on 6,616 individuals submitted by 9 of the 10 participating PCI centres. The majority (78%) of STEMIs occurred in males, and the median age of patients with a STEMI was 63 years. However, there are important sex differences, with females typically presenting at a much older age (median age of 69 years for females versus 61 years for males). STEMI was the first manifestation of coronary heart disease in 75% of cases. The smoking rate remains disproportionately high among patients with a STEMI, with 34% of patients with a STEMI being active smokers at the time of their heart attack compared with the national average of 17% of the population being active smokers. The majority (64%) of heart attacks in persons aged under 40 years occurred in smokers, and smokers had heart attacks at a younger age compared with non-smokers (median age among males: 56 years for smokers versus 65 years for non-smokers; median age among females: 60 years for smokers versus 76 years for non-smokers).

Only 37% of patients with a STEMI sought help within 60 minutes of symptom onset. However, the proportion of patients brought directly to a PCI centre continues to rise and in 2020 it was at 72% (compared with 66% in 2016 (HSE, 2018a)), with only 26% of patients being transferred from non-PCI centres.

Of eligible patients with a STEMI, 93% received primary PCI as their reperfusion treatment in 2017–2020, a reduction from 96% in 2016 (HSE, 2018a). In 2020, 93% of primary PCI procedures are now performed via a radial approach, a continued improvement from 86% in 2016.

However, only 67% of eligible patients with a STEMI received timely reperfusion over the reporting period, which is a decline compared with the *Heart Attack Care Ireland 2016* report (HSE, 2018a). It is important to note that the timeliness of reperfusion does vary depending on how a patient accesses the service. For patients with a STEMI transported by ambulance directly to a PCI centre, 84% (n=2216) arrived within the target of 90 minutes or less. For patients with a STEMI who were transferred from another hospital to a PCI centre, only 22% (n=303) arrived within the target of 90 minutes or less. The median time from first medical contact to primary

PCI was 84 minutes for patients who were admitted directly to a PCI centre versus 155 minutes for patients who were transferred from non-PCI centres.

The unadjusted in-hospital mortality rate was 5.1% for patients with a STEMI; this is not substantially different from the report on the 2016 data. Timely primary PCI was associated with a lower mortality rate: patients who received timely primary PCI had an unadjusted in-hospital (PCI centre) mortality rate of 2.8%, compared with 5.2% among those who did not receive timely primary PCI.

Older age was associated with higher mortality. The mortality rate was 12% in those aged 75 years and over, 5% in those aged 65–74 years, and 3% in those aged 64 years and under.

This report highlights that timely reperfusion results in a clear mortality benefit for patients with a STEMI. While there are a number of areas in which trends are improving, challenges remain, especially with the key metric of timely reperfusion (and particularly for patients initially presenting to non-PCI centres). This highlights the importance of encouraging patients with heart attack symptoms to contact 112 or 999 so that they can receive a pre-hospital ECG diagnosis of STEMI and be directed immediately by the National Ambulance Service to PCI centres in order to avail of timely reperfusion. There is also a clear need for each PCI centre to develop a local audit and clinical governance network in partnership with non-PCI hospitals in order to help address systematic barriers to the timely transfer of patients with a STEMI from non-PCI hospitals so that delayed reperfusion can be avoided and alternative reperfusion strategies adopted if necessary, all of which should translate to reduced mortality rates and improved quality of care for patients with a STEMI. Finally, this report identifies a number of data quality and completeness issues that should be targets for the IHAA to continue to improve incrementally.

## KEY FINDINGS

# KEY FINDINGS

### DEMOGRAPHICS AND CARDIOVASCULAR RISK FACTOR PROFILE



- A total of 6,616 cases were submitted to the Heartbeat portal during the 2017–2020 reporting period (2017: 1,681; 2018: 1,768; 2019: 1,689; 2020: 1,478).
- The annual number of cases has remained stable since 2016 (Health Service Executive, 2018a), with the exception of 2020, likely due to the impact of the coronavirus disease 2019 (COVID-19) pandemic on presentations with an ST elevation myocardial infarction (STEMI).
- A STEMI diagnosis was confirmed in 85% (n=5629) of cases submitted to the Heartbeat portal.
- The majority of patients with a STEMI were male (n=4382, 78%), and 22% (n=1247) of patients with a STEMI were female.
- The median age of patients with a STEMI was 63 years (interquartile range (IQR): 54–72 years).
- The median age of male patients with a STEMI was 61 years (IQR: 53–70 years) and the median age of female patients with a STEMI was 69 years (IQR: 58–78 years).
- More than one-half (n=2461, 56%) of male patients with a STEMI were aged between 41 and 64 years.
- Female patients who present with a STEMI are older than male patients. Nearly one-quarter (n=270, 22%) of female patients with a STEMI were aged 80 years and over, compared with 8% (n=337) of male patients with a STEMI (p<0.05).
- Seventy-five percent (n=4247) of patients with a STEMI presented with a STEMI as their first manifestation of coronary heart disease.
- Twenty-five percent (n=1400) of patients with a STEMI also had at least one known cardiovascular disease condition or known major organ comorbidity.
- Fourteen percent (n=783) of patients with a STEMI also had a diagnosis of diabetes.



## KEY FINDINGS

- Smoking rates remain excessively high among patients presenting with a STEMI, with one-third (n=1922, 34%) of patients with a STEMI being smokers at the time of admission. This is disproportionately higher than the smoking rate among the general population, which is 17%, and highlights the adverse impact of smoking on heart attack risk.
- In patients with a prior heart attack presenting with a new STEMI, 250 (26%) had continued to smoke following their prior heart attack.
- Current smokers present with a STEMI at a much younger age than non-smokers: aged 56 years versus 65 years in male patients, respectively, and aged 60 years versus 76 years in female patients, respectively.
- The majority (n=129, 64%) of patients aged under 40 years who presented with a STEMI were current smokers.
- Over the 4-year reporting period (2017–2020), 78% (n=4372) of patients with a STEMI also had at least one cardiovascular risk factor.
- The most prevalent heart attack risk factors were previous hypertension (n=2427, 43%) and previous hypercholesterolaemia (n=2401, 43%).

# KEY FINDINGS

## KEY FINDINGS

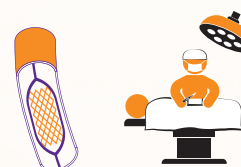
# KEY FINDINGS

### PATHWAY TO A PERCUTANEOUS CORONARY INTERVENTION CENTRE



- Over the 4-year reporting period, only 37% (n=1267) of patients with a STEMI called for help within 60 minutes of symptom onset.
- The majority (n=3240, 58%) of patients with a STEMI were transported to a percutaneous coronary intervention (PCI) centre directly by ambulance. Just under one-third (n=1593, 28%) of patients with a STEMI were transferred to a PCI centre from another hospital. This remains broadly unchanged since 2016 (31%).
- For patients with a STEMI who were transported directly by ambulance to a PCI centre, 84% (n=2216) arrived within the target of 90 minutes or less.
- For patients with a STEMI transferred from another hospital to a PCI centre, 22% (n=303) arrived within the target of 90 minutes or less.
- Emergency department (ED) bypass rates with direct admission to the catheterisation laboratory (cath lab) continue to rise. From 2017 to 2020, 81% (n=3763) of patients with a STEMI who were transported by ambulance for primary PCI were brought to the cath lab and 19% (n=868) were brought to the ED.

### TIMELINESS OF REPERFUSION



- Between 2017 and 2020, 67% of patients with a STEMI received timely reperfusion (either thrombolysis within 30 minutes or primary PCI within 120 minutes). This is a decrease compared with 70.3% of patients who were treated in 2016.
- Only 39% of patients treated with thrombolysis were timely.
- The national median time to primary PCI, regardless of referral source, was 98 minutes (IQR: 70–133 minutes). The national median time was 84 minutes (IQR: 64–110 minutes) for patients transported directly to PCI centres compared with 155 minutes (IQR: 118–238 minutes) for patients transferred from a non-PCI centre.
- Regardless of referral source, the median 'door to balloon' (DTB) times within PCI centres remain excellent, with an overall median time of 27 minutes (IQR: 19–44 minutes). This is within the recommended 30-minute time frame.
- More radial access is being performed. Between 2017 and 2020, the majority (n=4312, 91%) of patients received primary PCI through radial access, an increase from 86% among patients treated in 2016 (Health Service Executive, 2018a).

## KEY FINDINGS

### OUTCOMES



# KEY FINDINGS

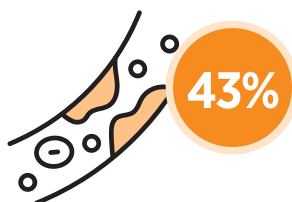
- Over the 4-year reporting period, the unadjusted in-hospital mortality rate was 5.1% (n=287) for patients with a STEMI.
- Timely primary PCI was associated with lower mortality. Patients who received timely primary PCI had an unadjusted in-hospital mortality rate at the PCI centre of 2.8% (n=79), compared with 5.2% (n=67) among those who did not receive timely primary PCI.
- Older age was associated with higher mortality. The mortality rate was 12% (n=129) in those aged 75 years and over, 5% (n=68) in those aged 65–74 years, and 3% (n=90) in those aged 64 years and under.
- Missing data precluded the calculation of 30-day mortality rates. This variable was missing or recorded as unknown for 51% (n=2854) of patients.
- Complication rates in terms of stroke (n=38, 1%) and bleeding (n=35, 1%) were low among patients who received reperfusion therapy. Bleeding complications were more commonly seen in patients who were treated with thrombolysis (n=7, 4%) than in patients who received primary PCI (n=28, 1%), but the rate of absolute risk was low in both groups.
- The National Clinical Programme for Acute Coronary Syndrome (NCP-ACS) sets a key performance indicator (KPI) of a median length of stay (LOS) of 4 days or fewer for patients with a STEMI. The median PCI centre LOS recorded was 1 day (IQR: 1–2 days) for patients who were transferred to another acute hospital in order to complete STEMI care, and 4 days (IQR: 3–7 days) for patients who completed their acute hospitalisation at the PCI centre.
- The NCP-ACS sets a KPI of 90% of patients with a STEMI receiving smoking cessation advice. Thirty-four percent (n=1922) of patients with a STEMI were current smokers and 85% (n=1637) of this cohort were recorded as receiving smoking cessation advice.
- The NCP-ACS sets a KPI of 90% of patients with a STEMI receiving a discharge bundle of five medications. Seventy-six percent (n=3515) of the cases that had data recorded for each of the five medications were recorded as having all five medications prescribed on discharge.
- The NCP-ACS sets a KPI of 90% of patients with a STEMI receiving referral for timely cardiac rehabilitation. Seventy-one percent (n=4001) of patients were referred to cardiac rehabilitation over the reporting period; however, it is not known how many actually received it.
- Missing data, including both missing or not recorded data and data recorded as unknown, were common. For example, missing data accounted for 9% (n=438) of records of bleeding complications, 11% (n=539) of records of stroke, 24% (n=1353) of records of survival status at discharge, 51% (n=2854) of records of 30-day survival status, and 85% (n=3399) of records of date of cardiac rehabilitation phase 3. Twelve percent (n=672) of patients had no data recorded on receipt of any discharge medications. The rates of missing data affect the quality of the conclusions that can be drawn from the dataset.

# KEY FINDINGS 2017-2020

## RISK FACTORS



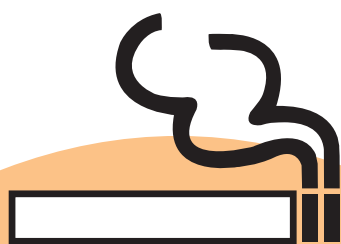
43% of patients had a previous history of high blood pressure (known as hypertension)



43% of patients had a previous history of high cholesterol (known as hypercholesterolemia)



14% of patients had a diagnosis of diabetes



26% of patients with a previous heart attack presenting with a new heart attack continue to smoke

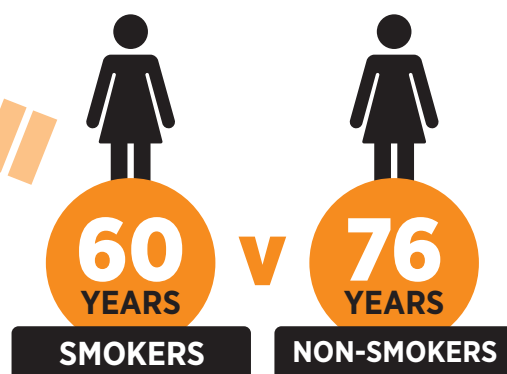
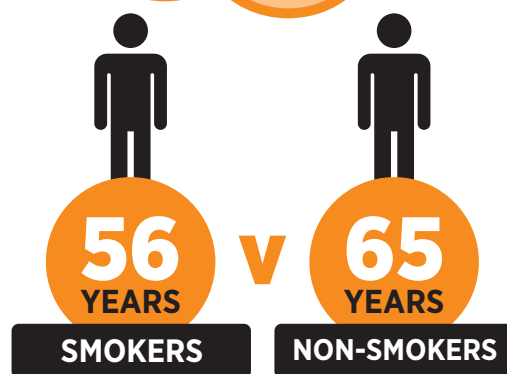


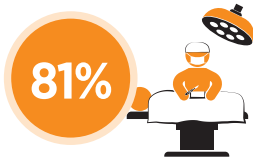
64% of patients under 40 were current smokers



34% of patients smoked at the time of admission

Current smokers present with heart attack at a much younger age





**81%** of patients who were brought by ambulance to the PCI centre bypassed the Emergency Department and were brought directly for primary PCI treatment



**84%** of patients brought directly by ambulance to a PCI centre arrived within the 90 minutes or less goal



**22%** of patients transferred from another hospital to a PCI centre arrived within the 90 minutes or less goal



**67%** of patients received timely treatment to restore blood flow (known as reperfusion)



In patients brought directly to PCI centres by ambulance, the median time between diagnosis of a heart attack and treatment with primary PCI was **84 minutes** compared to **155 minutes** for patients transferred from another hospital



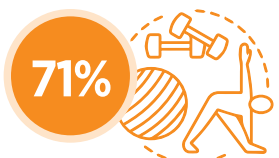
**91%** of patients received primary PCI through radial access



**85%** of patients who were smokers received advice on how to quit smoking (90% is the national target)



**76%** of patients were prescribed all five recommended medications to reduce their risk of future heart attacks (90% is the national target)



**71%** of patients were referred to cardiac rehabilitation (90% is the national target)



Patients who received timely primary PCI had a **2.8%** mortality rate compared to **5.2%** for patients who did not receive timely primary PCI

# RECOMMENDATIONS

## RECOMMENDATIONS FOR THE IRISH HEART ATTACK AUDIT



- **RECOMMENDATION 1.** Implement a national ST elevation myocardial infarction (STEMI) transfer form for use when transferring patients from a non-percutaneous coronary intervention (PCI) hospital to a PCI centre.
- **RECOMMENDATION 2.** Improve the data quality of the follow-up dataset within the Heartbeat portal.
- **RECOMMENDATION 3.** Develop a process for accessing accurate 30-day mortality rates in patients with a STEMI using the death register in the Central Statistics Office (CSO).

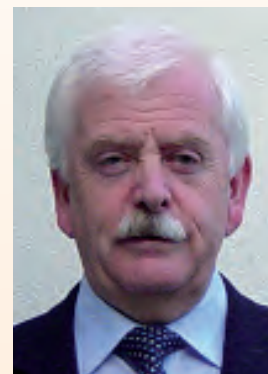
## RECOMMENDATIONS FOR THE HEALTH SERVICE EXECUTIVE



- **RECOMMENDATION 4.** Introduce a key performance indicator that measures the 'door in door out' time with the aim of achieving the European Society of Cardiology's guideline target of 30 minutes or less.
- **RECOMMENDATION 5.** Improve timeliness of reperfusion for patients with a STEMI presenting to non-PCI centres.
- **RECOMMENDATION 6.** Develop a public awareness campaign to encourage people with heart attack symptoms to call 112 or 999 immediately for emergency help in order to facilitate pre-hospital electrocardiogram (ECG) diagnosis of a STEMI.
- **RECOMMENDATION 7.** Improve the identification and control of cardiovascular risks.
- **RECOMMENDATION 8.** Improve public awareness of the adverse impact of smoking on heart attack risk.

# PUBLIC AND PATIENT INTEREST PERSPECTIVE

My name is Michael J. Ryan and I live in Limerick. I retired in 2006 from my position at the City Hall, Limerick, and was enjoying my retirement pursuing my hobbies of gardening, photography and travelling. I had no health issues until 2012 when, without warning, I suffered a serious heart attack and very shortly afterwards suffered a cardiac arrest at the emergency department (ED) at University Hospital Limerick (UHL). I was successfully resuscitated and immediately transferred by ambulance to Cork University Hospital (CUH), where I had four stents fitted. I was transferred back to UHL by ambulance on the following day and was released from UHL 5 days later. Since then, I have enjoyed excellent health. I consider myself extremely lucky on a number of counts. I knew immediately what was wrong, as I have been an emergency medical technician (EMT) with Civil Defence Ireland for many years and had dealt with numerous cardiac incidents. I did not panic and took the proper course of action even though I was home alone at the time. I received excellent professional care from the paramedic crew, at the EDs at UHL and CUH, and subsequently at the Coronary Care Unit (CCU) at UHL. With the help of my wife Sheyla, and my family, friends, and colleagues, I was back to doing everything I love in a very short time, and if I did not need to take daily medication I would not know that I had ever had a cardiac event. I am a member of the Heart Failure Patient panel that offers support to other cardiac patients.



The Irish Heart Foundation (IHF) requested that I become a Public and Patient Interest (PPI) representative on the Irish Heart Attack Audit (IHAA) Governance Committee. I was glad to accede to this request, even though I often feel a bit of a fraud as I feel so well and have had no ill effects following my heart attack. Several of my colleagues expected me to disappear and give up my interests – I hope that my involvement in this report will demonstrate that there is life after a cardiac event. A positive outlook is absolutely essential to a full recovery.

**Michael J. Ryan**

*Public and Patient Interest Representative*

Irish Heart Attack Audit Governance Committee

# PUBLIC AND PATIENT INTEREST PERSPECTIVE

My name is Lucinda McNerney and I am a cardiac arrest survivor and a person living with an inherited cardiac condition called long QT syndrome. I was diagnosed with this condition at the age of 18 years, which was more than 30 years ago now. I am on my fourth pacemaker and take beta-blocker medication. I live in East Cork with my husband and three children. As my condition is inherited, two of my children also have long QT syndrome; they are doing very well on their medication and my hope for them is that they live full and happy lives. I approached the IHF in 2005 to discuss setting up an information and support group for those with my condition. I wanted to support and advocate for others who have had a cardiac arrest and a lifelong diagnosis. We went on to run conferences and to develop peer-to-peer support and information and awareness nationally. I now work closely with medical professionals from the Inherited Cardiac Conditions Centre via the IHF Prevention of Sudden Cardiac Death Council where medical professionals, families and charities work together in order to save lives and to help those diagnosed with cardiac conditions to live as well as possible. I also work as the Patient Services Development Manager with the IHF, where I work with people who have had heart attacks, spontaneous coronary artery dissections, and other cardiac conditions.



It was this journey that my family is on that has led to my writing this piece and the fact that I am now on the IHAA Governance Committee as a PPI representative. Behind the collection and interpretation of data in this audit – which will help to not only develop a service but to save lives – are real people and healthcare professionals. I believe that placing the patient at the centre is the way forward for the development of our healthcare service. There is an expertise in patients' voices and an authenticity and value in having this experience at the table.

## **Lucinda McNerney**

*Public and Patient Interest Representative*

Irish Heart Attack Audit Governance Committee





# CHAPTER 1 INTRODUCTION

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# CHAPTER 1: INTRODUCTION

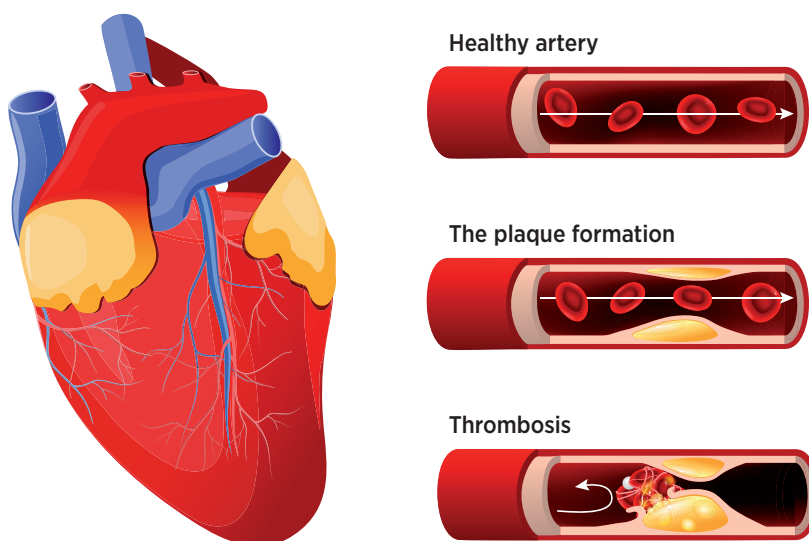
## INTRODUCTION

The National Clinical Programme for Acute Coronary Syndrome (NCP-ACS) was established in 2010 under the leadership of Professor Kieran Daly, with the aim of standardising the national delivery of treatment for patients presenting with acute coronary syndromes across the Republic of Ireland. The programme initially focused on standardising pre-hospital and hospital emergency care for patients with an ST elevation myocardial infarction (STEMI). The programme further developed a monitoring system called Heartbeat, which included a suite of performance indicators underpinned by a dataset, an electronic data collection system, and a structure for analysis and reporting of the timeliness, quality and outcomes of care. The NCP-ACS published two reports that covered the state of hospital and pre-hospital STEMI services across the country based on data collected in 2014 (Health Service Executive, 2015) and 2016 (Health Service Executive, 2018a), documenting the shift to time-critical interventional treatment of patients with a STEMI during that period.

Governance of the Heartbeat monitoring mechanism was transferred to the National Office of Clinical Audit (NOCA) in October 2019 and became part of the clinical audit structure managed by NOCA. The new audit, known as the Irish Heart Attack Audit (IHAA), aims to audit acute coronary syndrome (ACS) care by developing the existing Heartbeat monitoring mechanism to encompass STEMI, and to evolve to include non-ST elevation myocardial infarction (NSTEMI) and unstable angina hospital admissions. This first IHAA report presents STEMI data for the period 2017–2020, and was prepared by a multidisciplinary writing group and overseen by the IHAA Governance Committee, which was set up in 2020 (see Appendix 1).

## WHAT IS A HEART ATTACK?

A heart attack is a life-threatening medical emergency in which the supply of blood to the heart is suddenly cut off, usually by a blood clot forming at the site of pre-existing narrowing/blockage, which are often relatively mild, and have either ruptured or developed superficial erosion (also known as atherosclerosis/arteriosclerosis, plaque build-up, or 'hardening of the arteries'). The abrupt lack of blood supply to the heart can seriously damage the heart muscle (Figure 1.1). If left untreated, the heart muscle downstream from the blockage will begin to die. The extent of the damage is broadly correlated with the territory supplied beyond the blocked artery and the length of time the muscle is deprived of blood, and after a finite period (less than 20 minutes) is irreversible.



**FIGURE 1.1:** PLAQUE RUPTURE

Symptoms of a heart attack include:

- chest pain: the chest can feel like it is being pressed or squeezed by a heavy object, and the pain can radiate from the chest to the jaw, neck, arms and back
- shortness of breath
- an overwhelming feeling of anxiety
- pain in other parts of the body – it can feel as if the pain is travelling from your chest to your arms, jaw, neck, back and belly. Usually the left arm is affected but it can affect both arms
- feeling lightheaded or dizzy
- sweating
- feeling sick (nausea) or being sick (vomiting)
- an overwhelming sense of anxiety (like having a panic attack)
- coughing or wheezing

Often in female patients, elderly patients or patients with diabetes, heart attacks can manifest with different symptoms, milder symptoms or vague symptoms such as abdominal pain, confusion or sweatiness. These are sometimes called atypical symptoms and can make diagnosing a heart attack more difficult (Ibanez *et al.*, 2018).

## SYMPTOMS OF A HEART ATTACK



**CHEST  
PAIN**



**SHORTNESS  
OF BREATH**



**BODY  
PAIN**



**FEELING  
LIGHTHEADED**



**SWEATING**



**NAUSEA OR  
VOMITTING**



**SENSE OF  
ANXIETY**



**COUGHING OR  
WHEEZING**

**FIGURE 1.2A:** SYMPTOMS OF A HEART ATTACK

## RISK FACTORS OF A HEART ATTACK



**CURRENT  
OR FORMER  
SMOKING**



**ELEVATED  
CHOLESTEROL  
LEVELS**



**DIABETES**



**FAMILY HISTORY  
OF PREMATURE  
CHD**



**HIGH BLOOD  
PRESSURE**



**BEING  
OVERWEIGHT  
OR OBESE**

**FIGURE 1.2B:** RISK FACTORS OF A HEART ATTACK

Risk factors for chronic heart disease (CHD) include:

- current or former smoking
- elevated cholesterol levels
- diabetes
- family history of premature CHD (i.e. a first-degree relative aged under 60 years with a heart attack or CHD)
- high blood pressure
- being overweight or obese.

A number of additional conditions have more recently been recognised as risk factor equivalents for CHD, including long-term inflammatory disorders such as rheumatoid arthritis and other inflammatory arthritis; inflammatory skin disorders such as psoriasis; and inflammatory bowel disease.

Heart attacks affect an estimated 6,000 people per year in Ireland (NOCA, 2022). Early recognition and treatment of heart attack is critical to the outcome. There are two broad types of heart attack, distinguished by their electrocardiogram (ECG) appearance: STEMI and NSTEMI.

STEMIs are major heart attacks caused by a blockage in the main arteries supplying blood to the heart muscle (think of a blockage on a motorway and how it would affect traffic flow). STEMI account for about one-quarter of all heart attacks each year in Ireland.

STEMIs are diagnosed using 12-lead ECG machines. They are treated urgently with reperfusion (restoring blood flow) either by use of a clot-dissolving drug (thrombolysis) or by insertion of a wire into the artery in order to open it with a balloon and stent (metal scaffold) and allow blood to flow to the heart muscle again (percutaneous coronary intervention (PCI)). The internationally recognised gold standard treatment for STEMI is to perform emergency reperfusion within 120 minutes of first medical contact. This is known as primary PCI, sometimes referred to as primary angioplasty, and can only be done in a hospital equipped with an emergency catheterisation laboratory (cath lab). There has been a national reperfusion treatment protocol for STEMI in place in Ireland since 2012 (Health Service Executive, 2012).

NSTEMIs are different from STEMI in that blood flow in the coronary artery is only partially interrupted. NSTEMIs may be associated with waxing and waning symptoms occurring on and off over several hours or days. NSTEMIs account for about three-quarters of annual heart attack admissions in Ireland. NSTEMIs are initially treated medically. The management of NSTEMIs is currently outside the scope of the IHAA.

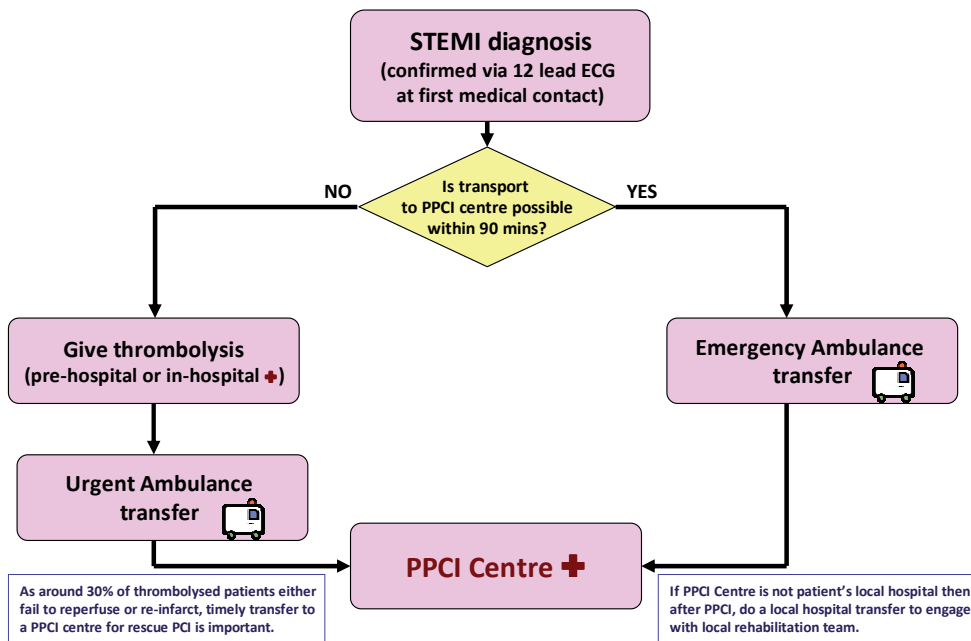
## THE OPTIMAL REPERFUSION SERVICE

ACS is the umbrella term used to describe heart attacks and unstable angina. The NCP-ACS was established in 2010 as a joint venture between the Irish Cardiac Society under the auspices of the Royal College of Physicians of Ireland (RCPI) and the Health Service Executive (HSE). Its defined role was to standardise the national delivery of treatment for patients with ACS. The NCP-ACS implemented an optimal reperfusion service (ORS) (Figure 1.3) protocol for the care of patients with a STEMI in January 2013, with the aim of saving lives by standardising STEMI care across the country.

The ORS protocol was developed in conjunction with stakeholders in both pre-hospital and hospital settings and with the RCPI Clinical Advisory Group. Furthermore, it was informed by discussion with international principals of successful programmes for ACS in diverse locations such as Austria, Denmark, France and the United Kingdom. The full protocol was published in 2012 as the *Acute Coronary Syndromes Programme Model of Care* (HSE, 2012).

The key features of the ORS include:

- the ORS protocol (Figure 1.3), which is based on likelihood of timely reperfusion by primary PCI
- standardised pre-hospital response:
  - triage, early treatment and transport of patients (including bypass of local hospitals; equipping emergency vehicles with 12-lead ECGs; training paramedics in ECG use, interpretation and transmission)
  - establishing a 'Code STEMI' freephone line to facilitate direct conversation between ambulance crew and cardiology staff at PCI centres, as well as establishing direct ambulance access to PCI centre cath labs without going through the emergency departments
  - enabling helicopter transfer for STEMI patients to a PCI centre in certain areas.
- primary PCI centres, designated based on population and on current staff and facilities using international best practice principles, with the following recommended characteristics:
  - a recommended minimum of two cath labs at every primary PCI centre in order to ensure access at all times
  - a recommended minimum interventional cardiologist on-call frequency roster of 1:5
  - recommended 24/7 provision of services at primary PCI centres
  - an initial target of 80% of patients receiving primary PCI for the national primary PCI programme, with 90% achieved after 5 years
  - a national protocol, with local adaptation if necessary
  - standardised data collection, as described in the *Heart attack care in Ireland 2014* report (HSE, 2015).
- standardised hospital response in PCI centres (and in referring hospitals), as well as immediate transport of STEMI patients to a PCI centre (in circumstances where transfer to a PCI centre within 90 minutes is not feasible, the ORS protocol mandated reperfusion with thrombolysis; the NCP-ACS recommended the urgent transfer of the small number of patients who receive thrombolysis to a PCI centre in order to ensure that emergency PCI can be performed if thrombolysis fails).



Source: HSE (2012)

**FIGURE 1.3:** OPTIMAL REPERFUSION SERVICE PROTOCOL

## MONITORING AND AUDITING HEART ATTACK CARE IN IRELAND – BACKGROUND

Prior to the establishment of the NCP-ACS, thrombolysis was the main modality of treatment for STEMI with ad hoc primary PCI available in certain PCI centres, usually during core working hours. An Acute Myocardial Infarction (AMI) Improvement Programme was initiated in 2006 in order to improve the timeliness of treatment of patients with a STEMI, which involved identifying key indicators of care used internationally and establishing a dataset and a mechanism of data collection, with subsequent feedback on performance against these indicators provided to participating hospitals (N=21). This initiative contributed significantly to setting up the mechanism for monitoring the NCP-ACS.

The initial AMI Improvement Programme was paper-based and monitored thrombolysis, and this evolved into an updated set of key indicators and an updated dataset (see Chapter 2) ultimately establishing an electronic data collection system. The project became known as Heartbeat and was led by Dr Siobhan Jennings. The electronic data system benefitted from the concurrent development of the Hospital In-Patient Enquiry (HIPE) system by the Economic and Social Research Institute (ESRI), in which a clinical portal or ‘add-on’ screen was appended to the HIPE system. HIPE collects administrative, demographic and clinical information on all inpatients in Irish public hospitals and thus provided a permanent electronic platform for the Heartbeat initiative. Data collection on Heartbeat started in 2013. A standardised dataset was developed based on the best available international comparators, including the United Kingdom’s (UK’s) Myocardial Ischaemia National Audit Project (MINAP), SwedeHeart, and National Cardiovascular Data Registry – Acute Coronary Syndromes (NCDR-ACS) datasets. This dataset included 66 variables collected on each STEMI case reflecting pre-hospital factors, demographics and risk factors, treatment timeliness and outcomes, and in-hospital outcomes (see Appendix 4).

The monitoring of treatment of patients with a STEMI that triggered the ORS protocol was recorded by the PCI centres regardless of whether patients self-presented to a PCI centre, were brought directly to a PCI centre, or were referred from surrounding general hospitals. This variation in performance between PCI centres reflects the geographical hinterland and population density served by each site, which influences reperfusion timeliness.

In 2019, governance of Heartbeat was transferred to NOCA, the IHAA was established and the IHAA Governance Committee was first convened.

## IHAA GOVERNANCE COMMITTEE

Heartbeat was renamed the IHAA in 2019. Dr Ronan Margey was appointed Clinical Lead of the IHAA, and the IHAA Governance Committee was established (see Appendix 1) with Dr Sean Fleming as Chairperson. Its membership comprises clinical experts, Public and Patient Interest (PPI) representatives, the Healthcare Pricing Office (HPO), senior accountable healthcare management, and research and specialist bodies. The purpose of the IHAA Governance Committee is to oversee the national clinical audit by:

- shaping the strategic direction of the IHAA
- ensuring that the IHAA complies with all legal and statutory requirements, such as freedom of information and data protection
- overseeing compliance with key NOCA policies, e.g. the NOCA Monitoring and Escalation Policy
- providing assurance to the NOCA Governance Board on the identification and management of IHAA risks
- reviewing and agreeing the content of IHAA annual reports before forwarding reports to the NOCA Governance Board for review and sign-off
- monitoring staffing needs for the IHAA, both in NOCA and at hospital level, and supporting requests for staff as the service grows
- acting as an escalation point for subcommittees of the IHAA Governance Committee and for the IHAA Clinical Lead
- ensuring that the IHAA adheres to the highest standards of corporate and social responsibility.

The Clinical Lead, supported by the NOCA Executive Team, has operational responsibility for implementing the IHAA.

## AIM AND OBJECTIVES OF THE IHAA

The IHAA Governance Committee developed the aim and objectives for the IHAA (Table 1.1) and ensures that these objectives are met and that confidential processes are upheld. The IHAA Governance Committee also ensures that all relevant stakeholders are represented in order to verify that outputs of the audit findings are interpreted appropriately.

**TABLE 1.1:** IRISH HEART ATTACK AUDIT AIM AND OBJECTIVES

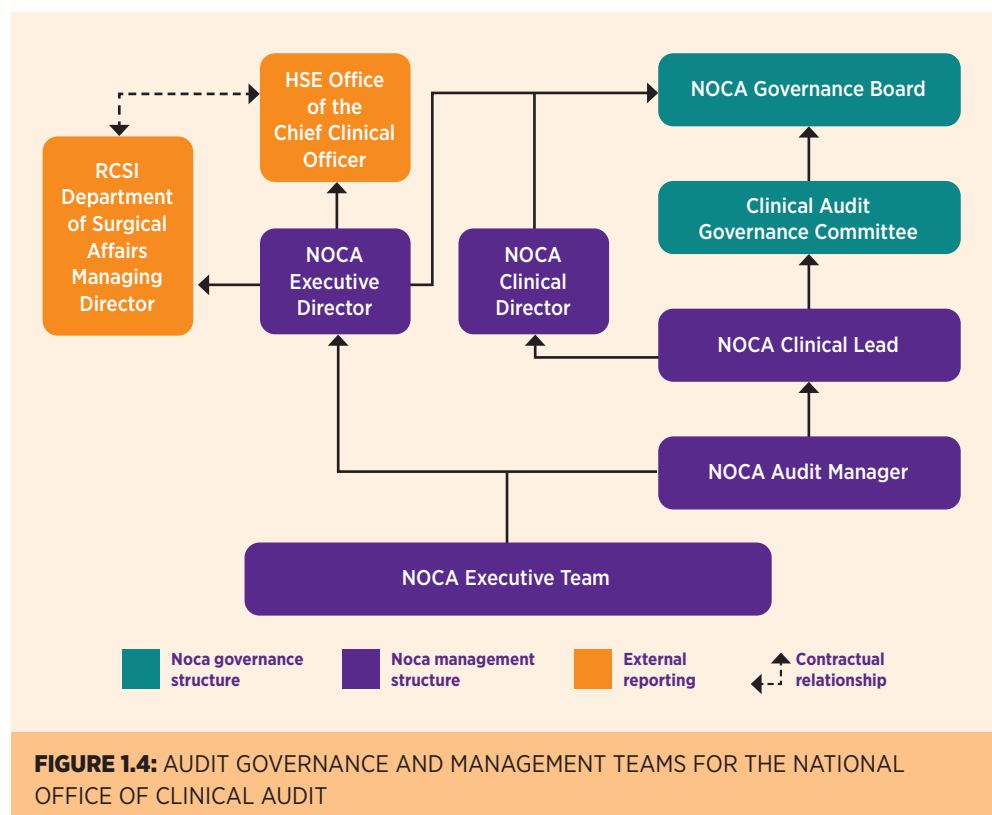
AIM
<b>To conduct audit of ACS care.</b>
OBJECTIVES
<p>To integrate the existing Heartbeat audit of STEMI into the IHAA within NOCA and to encompass STEMI, NSTEMI, and unstable angina hospital admissions.</p> <p>▶ To evolve and develop the current Heartbeat dataset to match international data collection best practice standards for ACS audit (i.e. the Swedeheart Swedish Coronary Angiography and Angioplasty Registry (SCAAR), National Cardiovascular Data Registry Myocardial Infarction Percutaneous Coronary Intervention Registry, and MINAP datasets).</p>
<p>▶ To maintain a database of all inpatients with an ACS in Ireland in order to support/promote continuous quality improvement initiatives at local and national level and to deliver the best patient outcomes.</p>
<p>▶ To support the collection of high-quality data on all inpatient ACS admissions in Ireland in order to permit local and national reporting of outcomes.</p>
<p>▶ To disseminate the outputs from the data to all relevant stakeholders in a timely manner.</p>
<p>▶ To benchmark ACS care and outcomes against national and international standards.</p>
<p>▶ To develop appropriate risk-adjusted modelling of outcomes in order to facilitate national, regional Hospital Group, and individual hospital- and physician-level quality improvement and to develop patient-reported outcome measures for ACS.</p>
<p>▶ To provide data to support and inform national policies for ACS and related cardiovascular conditions.</p>



## NATIONAL OFFICE OF CLINICAL AUDIT

NOCA enables the Irish healthcare system to continually improve by maintaining a portfolio of prioritised national clinical audits measured against national and international standards. By making reliable data available to those who use, manage and deliver healthcare, clinical audits help to refine Irish healthcare, improve patient outcomes, and achieve change at local and national level. NOCA works to promote an open culture of shared learning from national clinical audit in order to improve clinical outcomes and patient safety.

NOCA is funded by the HSE, Office of the Chief Clinical Officer, is governed by an independent voluntary board, and is operationally supported by the Royal College of Surgeons in Ireland (RCSI) (Figure 1.4).



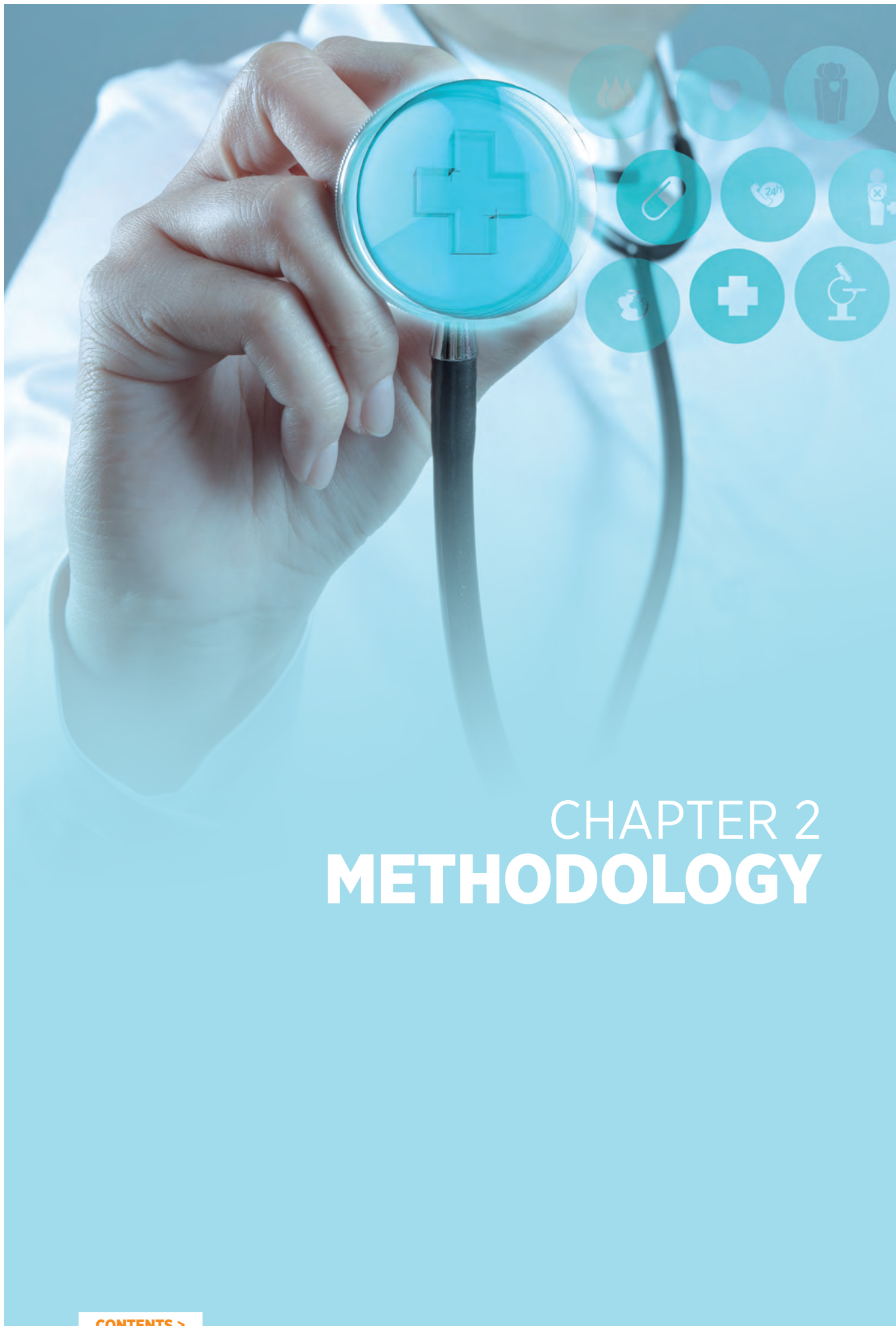
## WHO IS THIS REPORT AIMED AT?

The IHAA report for 2017–2020 is intended for use by a wide range of individuals and organisations, including:

1. patients and carers
2. patient advocacy organisations
3. healthcare professionals involved in heart attack care and primary PCI; hospital managers; and Hospital Groups
4. policy-makers
5. researchers.

The report has been designed in two parts:

1. The *Irish Heart Attack Audit National Report, 2017–2020* presents the key findings of the IHAA, case mix, patient pathway and outcomes.
2. The *Irish Heart Attack Audit National Report, 2017–2020: Summary Report* will be of particular interest to patients, patient organisations and the public.



# CHAPTER 2 METHODOLOGY

[CONTENTS >](#)

## CHAPTER 2: METHODOLOGY

In this first IHAA national report, data collected between 2017 and 2020 are reported. This chapter sets out the origin and current status of the NCP-ACS monitoring programme of the *Acute Coronary Syndromes Programme Model of Care* (HSE, 2012) and identifies the methods used to analyse the data presented within this report.

### BACKGROUND

From the outset, the monitoring of the *Acute Coronary Syndromes Programme Model of Care* (HSE, 2012) was recognised as a key pillar of the programme's development, and the identification and evolution of key indicators of care for STEMI and the development of an audit dataset based on international best practice was endorsed. An AMI Improvement Programme was initiated in 2006 in order to improve the timeliness of treatment for patients with a STEMI. This initiative contributed considerably to the mechanism set up for monitoring the *Acute Coronary Syndromes Programme Model of Care* (HSE, 2012). Furthermore, the paper-based data collection system was an important forerunner to the development of electronic monitoring of the NCP-ACS. The funding of this audit process in order to facilitate a network of data collection officers and continued oversight and governance of the audit was identified as a priority in the last NCP-ACS report, which was published in 2018 (HSE, 2018a). The monitoring of both programmes was led by Dr Siobhan Jennings, Consultant in Public Health Medicine.

### INDICATORS OF CARE

There are internationally validated and widely accepted quality indicators for benchmarking the process and quality of treatment of patients with a STEMI (Appendix 2). In 2012, building on previous work, a set of indicators was developed which highlighted the need to shift to primary PCI as the mainstay of acute treatment. These indicators reflected key, evidence-based elements of pre-hospital emergency diagnosis, pre-hospital emergency treatment, and hospital treatment on admission and on discharge which promote best outcomes in terms of mortality and morbidity. Ten key performance indicators (KPIs) were defined in the *Acute Coronary Syndromes Programme Model of Care* (HSE, 2012) and two of these KPIs are reported quarterly to the HSE's Business Intelligence Unit and inform the HSE's annual National Service Plan (Appendix 3).

### HEARTBEAT DATASET

These 10 KPIs were underpinned by a dataset (with data definitions) and agreed by the ACS Data Governance Group following a review of previous Irish work (Heartbeat), as well as an appraisal of international datasets (Appendix 2). The dataset was revised in 2014 and 2016. It will be further reviewed and revised as part of the IHAA's work.

The dataset consists of 66 data variables in 5 sections (Appendix 4): cardiovascular risk factors, including prior cardiovascular disease events; arrival and pre-hospital emergency diagnosis information; reperfusion therapy timeliness and intervention information; secondary care during hospital admission; and discharge information with limited follow-up to include vital status at 30 days. Data on demographics are collected via the Heartbeat portal within the HIPE system.



## DATA COLLECTION MECHANISM

Prior to the agreed *Acute Coronary Syndromes Programme Model of Care* (HSE, 2012), there was a limited electronic cardiology database that was specific to the south of Ireland, known as the Coronary Heart Attack Ireland Register (CHAIR) (Department of Health and Children, 2005), with no national electronic clinical database in existence. Consequently, in 2010, a collaborative development between the NCP-ACS and the Health Research and Information Division of the ESRI, which managed HIPE, resulted in a clinical 'add-on' screen being appended to the HIPE dataset. HIPE is the only State-supported electronic data collection mechanism, although it previously collected only administrative and diagnostic data on all inpatients in Irish public hospitals. This development in clinical data collection was utilised by a number of national clinical programmes, including the NCP-ACS, and the ACS component became known as the Heartbeat portal. The Heartbeat portal was fully established in 2013. HIPE is currently run by the HPO<sup>1</sup> within the HSE, and collaborates with NOCA on a number of national clinical audit programmes.



## DATA ENTRY

Currently, seven hospitals' primary PCI centres are designated to receive patients with a STEMI brought directly by emergency ambulance. Five provide 24/7 access and one provides access from 9.00am to 5.00pm, Monday to Friday. For parts of Donegal, Altnagelvin Hospital provides 24/7 coverage as part of a cross-border care arrangement between the HSE and the United Kingdom's National Health Service (NHS). A further three hospital PCI centres provide primary PCI from 9.00am to 5.00pm, Monday to Friday to patients with a STEMI who self-present to the PCI centre or are already inpatients (Table 2.1). The term 'PCI centre' will be used in this report when referring to both designated primary PCI and non-designated, 9.00am to 5.00pm weekday PCI centres.

**TABLE 2.1: PERCUTANEOUS CORONARY INTERVENTION CENTRES**

Designated primary PCI centres	9.00am–5.00pm weekday PCI centres
Cork University Hospital: 24/7	Beaumont Hospital
Letterkenny University Hospital (in cooperation with Altnagelvin Hospital):* 24/7	St Vincent's University Hospital
Mater Misericordiae University Hospital: 24/7	Tallaght University Hospital
St James's Hospital: 24/7	
University Hospital Galway: 24/7	
University Hospital Limerick: 24/7	
University Hospital Waterford: 9.00am–5.00pm, Monday–Friday	

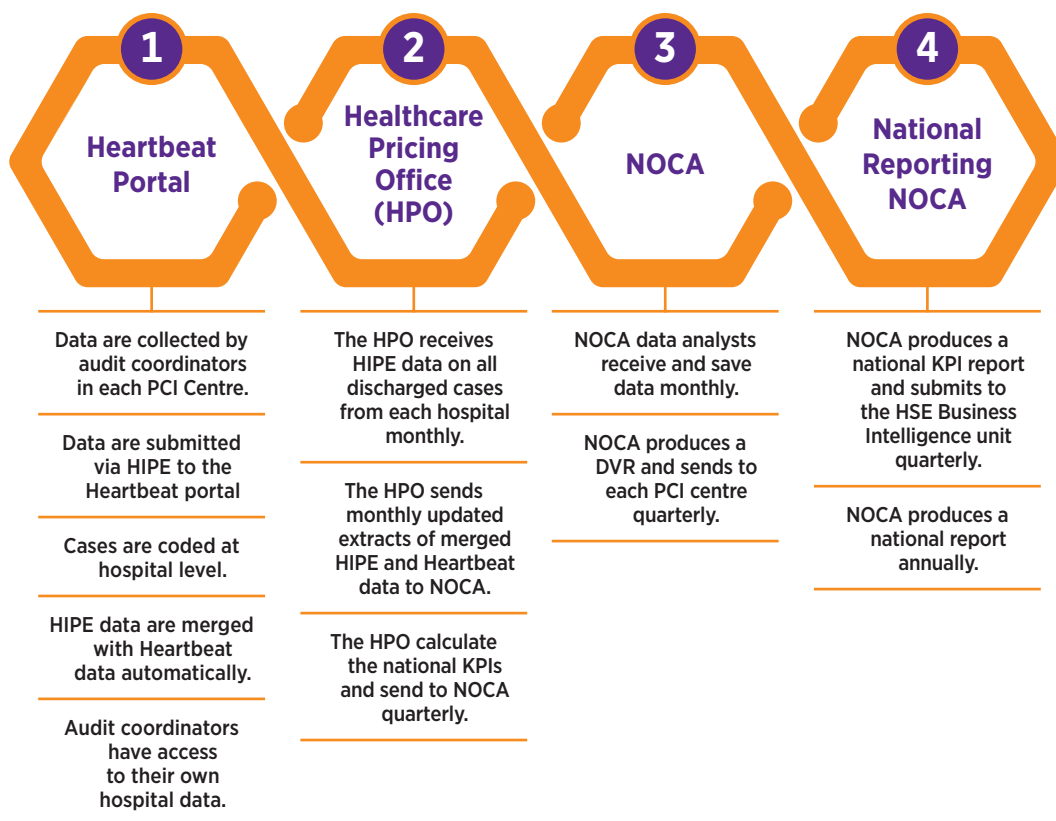
\* Patients in Donegal with a STEMI who receive primary PCI in Altnagelvin Hospital are transferred to Letterkenny University Hospital for all further STEMI care. All data related to cross-border care are submitted by the audit coordinator in Letterkenny University Hospital.

Each PCI centre has a nominated audit coordinator (usually an experienced cardiology nurse who has been formally trained in the Heartbeat dataset and data entry) and a clinical lead who leads on cardiac service governance within the hospital (Figure 2.2). The audit coordinator enters the data into the Heartbeat portal in the PCI centre. If a patient is discharged from a PCI centre to another hospital, follow-up data are sourced where possible by the audit coordinator in the

<sup>1</sup> On 1 January 2014, the National Casemix Programme and the Health Research and Information Division of the ESRI became the HPO.

PCI centre and are entered into the Heartbeat portal in the PCI centre. If this information is unavailable, it should be recorded as 'unknown'.

Consequently, the PCI centres carry the responsibility for recording the care of patients with a STEMI in conjunction with their referring hospitals. Figure 2.1 illustrates the data flow from the submission of data to the Heartbeat portal through to national reporting by NOCA. It is likely that a small number of patients who are admitted to a hospital without a cath lab may not transfer to a PCI centre due to specific contraindications and/or comorbidities. They are not recorded in the Heartbeat portal.



**FIGURE 2.1: HEARTBEAT DATA FLOW**

## DATA VALIDATION

A number of validations are built into the design of the Heartbeat portal that display messages when an apparently illogical sequence is encountered. In addition, there are a number of mandatory fields (mainly admission and reperfusion data) requiring entry before data can be stored.

In 2020, the NOCA data analytical team developed a data validation process for the IHAA. This process involves the data analyst producing a report of any missing information within the data and any data anomalies. The report is sent to the audit coordinators, who amend the record. A pilot Data Validation Report (DVR) was successfully implemented in two hospitals in January 2021. Throughout the remainder of 2021, DVRs were sent to hospitals quarterly in order to reduce missing data and data anomalies, thus improving data quality.

However, full data validation with the re-entry of a proportion of data has not yet been undertaken. NOCA plans to investigate how this could be achieved for the IHAA and for other audits.





## DATA ANALYSIS

NOCA received the Heartbeat data for the 2017–2020 reporting period from the HPO on 12 May 2021, and the NOCA Data Analyst completed the analysis following data checks with the HPO. The analysis was conducted using Statistical Package for the Social Sciences (SPSS) V25. Where appropriate, statistical tests were applied. The chi-squared statistical test was used for binary and categorical variables. Where appropriate, independent sample *t*-tests were used to determine the statistical difference in the means of the continuous variables. As a measure of statistical uncertainty, 95% confidence intervals were presented for the means of numerical variables. Where the observed *p*-value was less than or equal to 0.05, this was considered to indicate statistical significance.

The following definitions are important for interpretation of the outcomes evaluated in this report:

- A.** This initiative used the treatment window of 120 minutes from first medical contact (FMC) to treatment as set out in the European Society of Cardiology's (ESC's) 2010 STEMI guidelines (Hamm *et al.*, 2011). FMC is defined as the time of the first positive ECG taken as establishing the diagnosis of STEMI. Treatment time was taken as the time of wire cross or balloon inflation.
- B.** For thrombolysis, the accepted 'door to needle' (DTN) time definition was used. The internationally accepted target DTN time is considered to be less than 30 minutes.

In 2010, a mapping exercise was undertaken by the NCP-ACS in conjunction with the HSE Health Intelligence Unit and established that 80% of the population aged 55 years and over lived within a 90-minute drive of the major cities of Dublin, Cork or Galway. Consequently, it was agreed that within the 120-minute FMC to treatment window, the maximum pre-hospital drive time would be 90 minutes, allowing an in-hospital preparation time of 30 minutes.



## 2017-2020 REPORTING

Data collected between 2017 and 2020 are covered in this report. During this period, data were collected on the Heartbeat portal in nine PCI centres. Data were unavailable for University Hospital Waterford.

Mortality data are reported based on the discharge status from the PCI centre as recorded in HIPE. The Heartbeat dataset collects survival status on discharge from hospital; however, it is unclear if the discharge status is from the PCI centre or, if the patient was transferred to a second hospital for ongoing STEMI care, if this status is from the discharge from the second hospital. Therefore, mortality results in this report are limited to survival status on discharge from the PCI centre only.

The closed HIPE files for 2017, 2018 and 2019 were available for analysis, and the final date for submission of 2020 data was 30 April 2021, when the HIPE file was closed.

The HPO sent an anonymised extract of data for the national report to NOCA on May 12 2021.



## INCLUSION CRITERIA

The analysis in this report is based on records as captured on the Heartbeat portal. It includes patients who were:

- i discharged between 1 January 2017 and 31 December 2020, inclusive
- ii aged 18 years and over.



## EXCLUSION CRITERIA

This report excludes patients who:

- i were aged 17 years and under
- ii died in the emergency department.

FIGURE 2.2

# HOSPITALS AND PEOPLE WE WORK WITH

NOTE: Dublin Hospitals have been displayed collectively by hospital group

## SAOLTA UNIVERSITY HEALTH CARE GROUP

University Hospital Galway  
Letterkenny University Hospital

*\*ALTNAGELVIN HOSPITAL  
IHAA uses data from Altnagelvin Hospital, which provides 24/7 primary PCI coverage for parts of Donegal as part of a cross-border care arrangement between the HSE and the NHS.*

## UL HOSPITAL GROUP

University Hospital Limerick

## SOUTH/SOUTH WEST HOSPITAL GROUP

Cork University Hospital  
University Hospital Waterford

## RCSI HOSPITAL GROUP

Beaumont Hospital

## DUBLIN MIDLANDS HOSPITAL GROUP

St James's Hospital  
Tallaght University Hospital

## IRELAND EAST HOSPITAL GROUP

Mater Misericordiae University Hospital  
St Vincent's University Hospital

### LETTERKENNY UNIVERSITY HOSPITAL

IHAA CLINICAL LEAD:  
Dr Santosh David

IHAA AUDIT COORDINATOR:  
Anne McShane

### ALTNAGELVIN HOSPITAL\*

IHAA CLINICAL LEAD:  
Dr Godfrey Aleong

### UNIVERSITY HOSPITAL GALWAY

IHAA CLINICAL LEAD:  
Dr James Crowley

IHAA AUDIT COORDINATOR:  
Mary Hynes

### UNIVERSITY HOSPITAL LIMERICK

IHAA CLINICAL LEAD:  
Dr Samer Arnous

IHAA AUDIT COORDINATOR:  
Breda McDermott  
Catriona Ahern

### CORK UNIVERSITY HOSPITAL

IHAA CLINICAL LEAD:  
Dr Peter Kearney

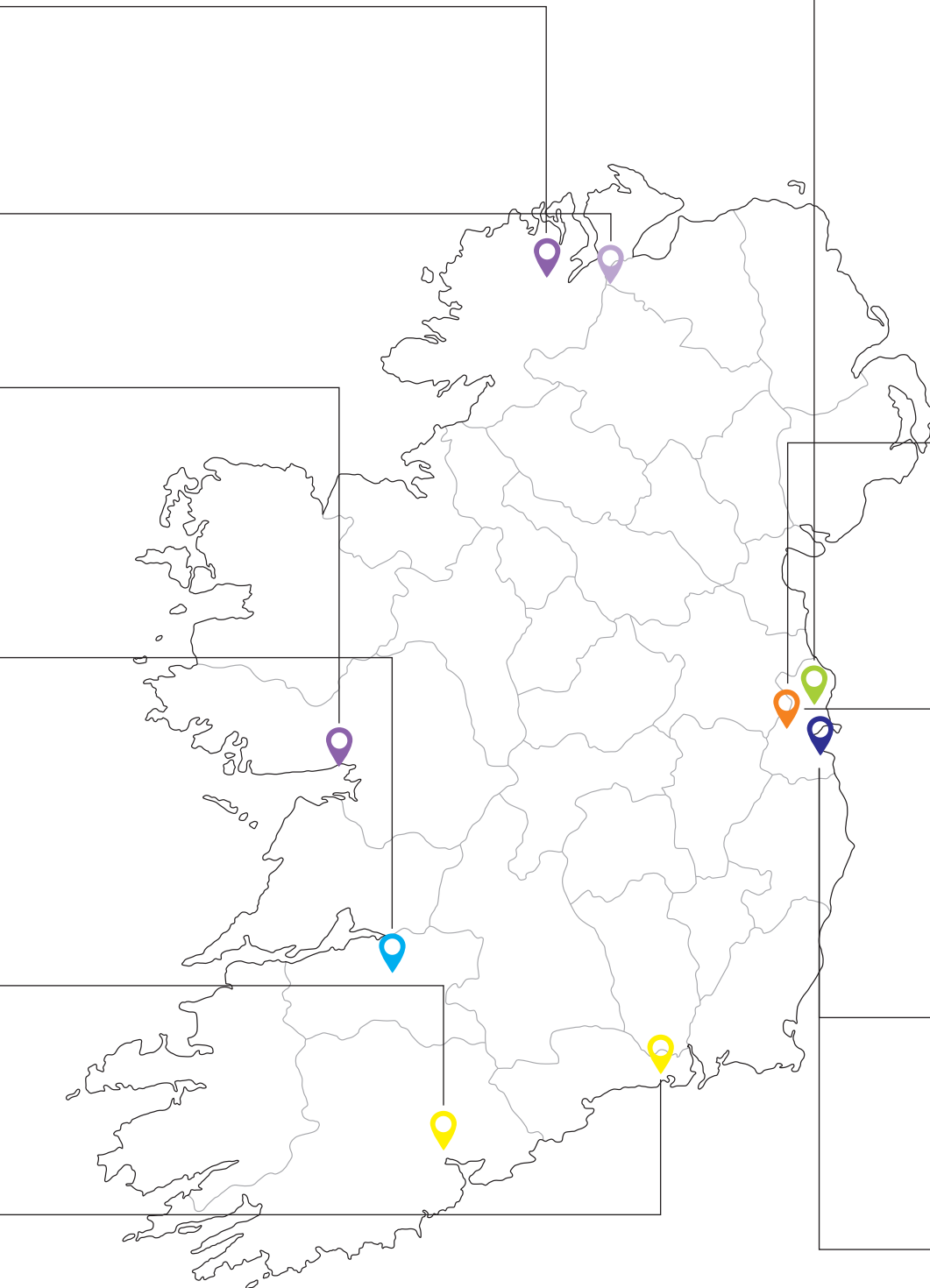
IHAA AUDIT COORDINATOR:  
Yvonne McConnon

### UNIVERSITY HOSPITAL WATERFORD

IHAA CLINICAL LEAD:  
Dr Patrick O'Callaghan

IHAA AUDIT COORDINATOR:  
Edel Cronin  
Myra Walshe





**BEAUMONT HOSPITAL**

**IHAA CLINICAL LEAD:**  
Dr Mark Kennedy

**IHAA AUDIT COORDINATOR:**  
Siobhan Quinn  
Gillian Miller  
Grace Muldoon

**MATER MISERICORDIAE UNIVERSITY HOSPITAL**

**IHAA CLINICAL LEAD:**  
Prof. Gavin Blake

**IHAA AUDIT COORDINATOR:**  
Susan Groarke  
Jamie Byrne

**ST VINCENT'S UNIVERSITY HOSPITAL**

**IHAA CLINICAL LEAD:**  
Dr Charles McCreery

**IHAA AUDIT COORDINATOR:**  
Lindsay McHenry

**ST JAMES'S HOSPITAL**

**IHAA CLINICAL LEAD:**  
Prof. Andrew Maree

**IHAA AUDIT COORDINATOR:**  
Sinead Teehan

**TALLAGHT UNIVERSITY HOSPITAL**

**IHAA CLINICAL LEAD:**  
Dr David Moore

**IHAA AUDIT COORDINATOR:**  
Catherine Markham



# CHAPTER 3

# DATA

# QUALITY



**Relevance**



**Accuracy and  
reliability**



**Timeliness and  
punctuality**



**Coherence and  
comparability**



**Accessibility  
and clarity**

**CONTENTS >**


## CHAPTER 3: DATA QUALITY


The purpose of the data quality statement (Table 3.1) is to highlight the assessment of the quality of the IHAA 2017–2020 data using nationally agreed dimensions of data quality as laid out in *Guidance on a data quality framework for health and social care* (Health Information and Quality Authority, 2018).


This data quality statement supports the interpretation and judgement of the information covering the reporting time period from 1 January 2017 to 31 December 2020, and identifies strengths and areas for improvement (e.g. the creation of DVRs and the data collection calendar).

### DATA QUALITY STATEMENT




**TABLE 3.1: OVERVIEW OF DATA QUALITY FOR THE IRISH HEART ATTACK AUDIT 2017-2020**

Dimensions of data quality	Definition (HIQA, 2018)	Assessment of dimension (IHAA)
<b>Relevance</b> 	<b>Relevant data meet the current and potential future needs of users.</b>	<p>Relevance of the IHAA data for 2017–2020 is assessed based on the following characteristics:</p> <ul style="list-style-type: none"> <li>• release of the data</li> <li>• value of the data</li> <li>• adaptability of the data</li> <li>• access to the data.</li> </ul> <p><b>Release of the data</b></p> <p>The IHAA Audit Manager, Assistant Audit Manager, and Clinical Lead work in collaboration with data users to determine relevance. Data users include the Hospital Groups, the Office of the Chief Clinical Officer, and the HSE Business Intelligence Unit. Data for KPIs are released quarterly to the HSE. Each participating hospital has the functionality to access and use its own data to support quality improvement initiatives and service development. The data are also used to inform responses to parliamentary questions and freedom of information requests.</p> <p><b>Value of the data</b></p> <p>The data informed two National Heart Attack reports covering patients treated in 2014 (HSE, 2015) and 2016 (HSE, 2018a), which have informed clinical practice both locally and nationally. The quarterly reporting of national KPIs informs HSE operations and the <i>National Service Plan 2021</i> (HSE, 2021b). NOCA's quarterly reports to the Hospital Groups, based on the KPI results, provide information at Hospital Group level.</p> <p><b>Adaptability of the data</b></p> <p>The dataset was revised in 2014 with the addition of variables including medical history and improved technology (e.g. ECG transmission).</p> <p><b>Access of the data</b></p> <p>Access to data from the Heartbeat portal has been limited to date due to inadequate resourcing and governance. All data requests for research and service evaluation will now be supported by NOCA's policies and procedures.</p>

Dimensions of data quality	Definition (HIQA, 2018)	Assessment of dimension (IHAA)
<p><b>Accuracy and Reliability</b></p> 	<p><b>The accuracy of data refers to how closely the data correctly describe what they were designed to measure. Reliability refers to whether those data consistently measure, over time, the reality of the metrics that they were designed to represent.</b></p>	<p>The accuracy and reliability of the IHAA data for 2017–2020 is assessed based on the following characteristics:</p> <ul style="list-style-type: none"> <li>• coverage</li> <li>• data capture and collection</li> <li>• data completeness and validity.</li> </ul> <p><b>Coverage</b></p> <p>Coverage refers to calculating the number of patients who should have their care included in this audit compared with the number of patients who are recorded in the Heartbeat portal. Data recorded in the Heartbeat portal refer to patients whose condition triggered the activation of the cath lab.</p> <p>Calculating coverage can be approached in two ways:</p> <p>1. COVERAGE ACROSS THE COUNTRY.</p> <p>For this report, data are included from:</p> <ul style="list-style-type: none"> <li>• Five designated primary PCI centres with 24/7 service: <ul style="list-style-type: none"> <li>- Cork University Hospital</li> <li>- Mater Misericordiae University Hospital</li> <li>- St James’s Hospital</li> <li>- University Hospital Galway</li> <li>- University Hospital Limerick.</li> </ul> </li> <li>• Three PCI centres that offer opportunistic primary PCI from 9.00am to 5.00pm, Monday to Friday: <ul style="list-style-type: none"> <li>- Beaumont Hospital</li> <li>- St Vincent’s University Hospital</li> <li>- Tallaght University Hospital.</li> </ul> </li> <li>• Letterkenny University Hospital (using data from Altnagelvin Hospital, which provides 24/7 primary PCI coverage for parts of Donegal as part of a cross-border care arrangement between the HSE and the NHS).</li> </ul> <p>Notably, this report for 2017–2020 does not include data from one centre which provides a primary PCI service from 9.00am to 5.00pm, Monday to Friday: University Hospital Waterford. An audit coordinator has been identified for University Hospital Waterford and data will be available for 2021.</p> <p>This means that 90% of hospitals providing primary PCI are included for this reporting period.</p> <p>2. DEGREE OF COVERAGE</p> <p>Another approach to calculating coverage is to study HIPE records. However, there are difficulties with this approach. First, HIPE does not use a unique patient identifier, but records:</p> <ul style="list-style-type: none"> <li>a) all episodes of STEMI, including patients who may not have accessed a PCI centre for reasons such as age and/or major comorbidities</li> <li>b) patients who are transferred back to their local hospital from a PCI centre following treatment.</li> </ul>

Dimensions of data quality	Definition (HIQA, 2018)	Assessment of dimension (IHAA)																				
<p><b>Accuracy and Reliability</b></p> 		<p>As such, HIPE is likely to have a higher number of episodes of STEMI than the number recorded in the Heartbeat portal.</p> <p>Second, diagnostic coding for a small proportion of cases may differ between Heartbeat (data collected in real time by cardiac nurses) and the coding on HIPE, which depends on coder interpretation of clinical notes and the application of coding guidelines.</p> <p>However, quantifying the number of cases with a principal diagnosis of STEMI (International Statistical Classification of Diseases, Tenth Revision, Australian Modification (ICD-10-AM) codes I21.0, I21.1, I21.2, I21.3, and I21.4) on HIPE in the PCI centres as a proportion of those recorded on Heartbeat does give an indication of coverage. Table 3.2 indicates the annual coverage nationally for the 4-year reporting period.</p> <div style="background-color: #f4a460; padding: 5px; text-align: center;"> <p><b>TABLE 3.2: DATA COVERAGE</b></p> </div> <table border="1"> <thead> <tr> <th>Year</th> <th>HIPE principal diagnosis of STEMI</th> <th>Heartbeat discharge diagnosis of STEMI</th> <th>Coverage</th> </tr> </thead> <tbody> <tr> <td>2017</td> <td>1671</td> <td>1427</td> <td>85%</td> </tr> <tr> <td>2018</td> <td>1699</td> <td>1502</td> <td>88%</td> </tr> <tr> <td>2019</td> <td>1611</td> <td>1400</td> <td>87%</td> </tr> <tr> <td>2020</td> <td>1420</td> <td>1300</td> <td>92%</td> </tr> </tbody> </table> <p><b>Data capture and collection</b></p> <p>Data are collected by trained audit coordinators in each participating hospital. These audit coordinators are often experienced cardiology nurses whose role includes the management of data collection. The electronic data collection mechanism in the Heartbeat portal has inbuilt methodologies to minimise errors at the point of data entry. A training manual for audit coordinators is available and further training is provided by the assistant audit manager as required in each participating hospital.</p>	Year	HIPE principal diagnosis of STEMI	Heartbeat discharge diagnosis of STEMI	Coverage	2017	1671	1427	85%	2018	1699	1502	88%	2019	1611	1400	87%	2020	1420	1300	92%
Year	HIPE principal diagnosis of STEMI	Heartbeat discharge diagnosis of STEMI	Coverage																			
2017	1671	1427	85%																			
2018	1699	1502	88%																			
2019	1611	1400	87%																			
2020	1420	1300	92%																			

Dimensions of data quality	Definition (HIQA, 2018)	Assessment of dimension (IHAA)
<p><b>Accuracy and Reliability</b></p> 		<p><b>Data completeness and validity</b></p> <p>Appendix 5 presents a completeness report of each variable (N=66) for the reporting period. Completeness of each variable was greater than 90% for 83% (n=55) of the variables; a further 11% (n=7) of the variables had over 80% completeness and the remaining 6% (n=4) had less than 80% completeness. Variables related to follow-up data represent the data with the lowest completeness rates. The first cardiac rehabilitation date is only completed in approximately 15% of cases.</p> <p>While the completeness is good, it is known that some variables are completed at the point of discharge from the PCI centre rather than at the point of final discharge of the patient with a STEMI from another hospital; thus, in some cases, the data are truncated at discharge from the PCI centre, leading to some inconsistency and inaccuracy. For this reason, mortality reporting is based on discharge from the PCI centre using the HIPE discharge destination status. There is some variation in how some variables are answered and revision of the training manual and additional training in 2021 will mitigate against this in future. This process will result in a revision of the training manual and additional training for the audit coordinators. In order to ensure that the data collected are complete and valid, the data analytical team has developed a DVR. The DVR was piloted in December 2020 and was rolled out to all participating hospitals in 2021.</p> <p>DVRs will be sent quarterly to each hospital's audit coordinator. Any corrections will be made within the Heartbeat portal and saved. Any variables that are causing concern will be discussed at IHAA Governance Committee meetings in order to check on relevance, and with the HPO in order to determine methods for reducing input errors. This will inform part of a data quality improvement plan for 2022.</p> <p>Data verification is an outstanding area from the beginning of this data collection process, as noted in the two previous reports covering data on patients who were treated in 2014 (HSE, 2015) and 2016 (HSE, 2018a). The IHAA Governance Committee would like to develop a data verification process whereby an agreed percentage of cases would be verified for accuracy, either through the re-entry of data at the hospital or through a chart review by an independent person to compare against the case details on Heartbeat. NOCA plans to investigate how this could be achieved for the IHAA.</p>

Dimensions of data quality	Definition (HIQA, 2018)	Assessment of dimension (IHAA)
<p><b>Coherence and comparability</b></p> 	<p><b>Coherent and comparable data are consistent over time and across providers and can be easily combined with other sources.</b></p>	<p>The coherence and comparability of Heartbeat data is assessed based on the following characteristics:</p> <ul style="list-style-type: none"> <li>• standardisation</li> <li>• coherence</li> <li>• comparability.</li> </ul> <p><b>Standardisation</b> The Heartbeat dataset was created based on the international guidelines (Appendix 2) outlined in Chapter 2 and amended to adapt to the Irish context.</p> <p><b>Coherence</b> A data dictionary is available to data users. In 2021, this was further updated.</p> <p>NOCA will hold annual workshops with the audit coordinators in order to discuss issues around data capture and coherence.</p> <p><b>Comparability</b> Heartbeat variables are comparable to European data collections, particularly when reporting on timeliness metrics (Appendix 2).</p>
<p><b>Timeliness and punctuality</b></p> 	<p><b>Timely data are collected within a reasonable agreed time period after the activity that they measure. Punctuality refers to whether data are delivered on the dates promised, advertised, or announced.</b></p>	<p>In 2020, all submissions were expected to be entered by the close of the HIPE file, which occurred on 30 April 2021.</p>
<p><b>Accessibility and clarity</b></p> 	<p><b>Data are easily obtainable and clearly presented in a way that can be understood.</b></p>	<p>There are several reports built into the Heartbeat portal that can be run by each hospital's audit coordinator. Heartbeat data can be exported locally into Excel for further analysis. Access to the data for research or service evaluation is managed by the Audit Manager following NOCA data access policies.</p>



The final dataset used for this report includes 6,616 cases from 9 participating hospitals. Of these 5629 have a discharge diagnosis of STEMI (Table 3.3).

**TABLE 3.3: TOTAL NUMBER OF CASES SUBMITTED TO THE HEARTBEAT PORTAL, BY HOSPITAL**

Hospital	Total cases on Heartbeat	Total STEMI cases on Heartbeat
Beaumont Hospital	59	56
Cork University Hospital	992	851
Letterkenny University Hospital	243	201
Mater Misericordiae University Hospital	1583	1334
St James's Hospital	1794	1634
St Vincent's University Hospital	80	62
Tallaght University Hospital	68	67
University Hospital Galway	884	675
University Hospital Limerick	913	749
<b>Total</b>	<b>6616</b>	<b>5629</b>

## SUMMARY

It is important to acknowledge all of the work involved in bringing Heartbeat from its inception in 2012 to the high standard of data collection that it has become. HIQA's *Guidance on a data quality framework for health and social care* (2018) has identified areas for improvement within this healthcare dataset as outlined within the data quality statement.

The following data quality initiatives have been identified and implementation began in 2021:

- implementing the DVR in order to improve coverage and completeness
- revising the data dictionary
- revising the training manual
- working with the National Ambulance Service to ensure the quality of pre-hospital data
- developing a data verification process.

The IHAA will continue to evolve, and we look forward to collaborating with all stakeholders in order to make it a high-quality and adaptable audit of heart attack services in Ireland.



# CHAPTER 4 DEMOGRAPHIC AND CARDIOVASCULAR RISK FACTOR PROFILE



[CONTENTS >](#)

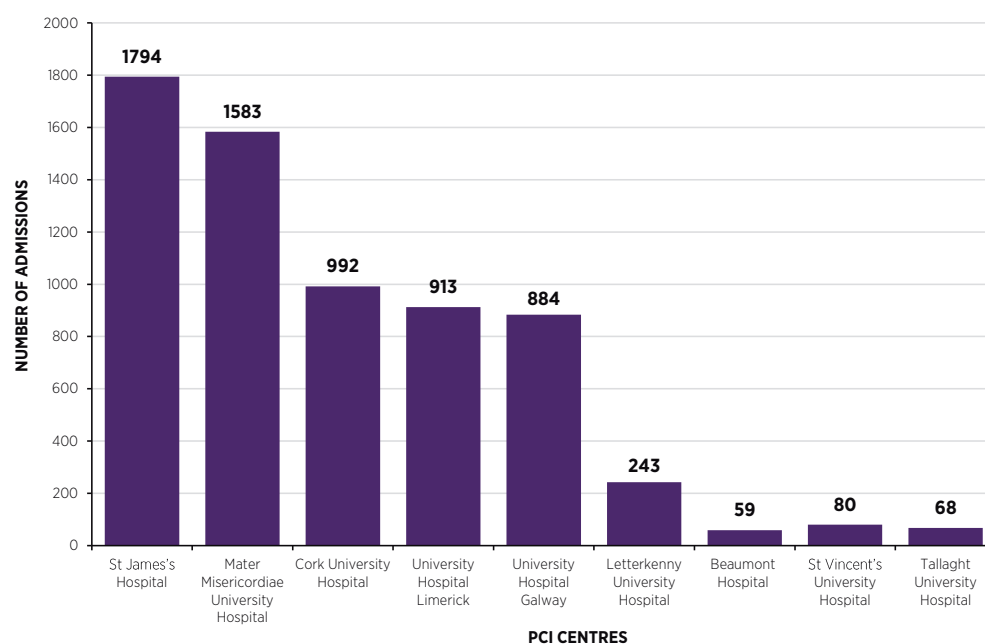
## CHAPTER 4: DEMOGRAPHIC AND CARDIOVASCULAR RISK FACTOR PROFILE

### SCOPE OF CHAPTER 4

Chapter 4 presents data on the demographic and cardiovascular risk factor profile of all cases submitted to the Heartbeat portal from 2017 to 2020. These submissions reflect the cases that triggered the optimal reperfusion service (ORS) protocol (Figure 1.2) and subsequent admission to a PCI centre. Where appropriate, comparisons are drawn between the profile of patients with a STEMI in the IHAA and that of the patients with a STEMI described in the *Heart Attack Care Ireland 2016* report (HSE 2018a), the *Myocardial Ischaemia National Audit Project – 2020 summary report (2018/19 data)* (Myocardial Ischaemia National Audit Project, 2020), and other published national reports on smoking and cardiovascular risk factor prevalence at population level. Emerging trends in age and sex demographics, comorbidities, smoking rates, and risk factor profiles are outlined and discussed.

### HEARTBEAT CASE SUBMISSIONS, 2017–2020

A total of 6,616 cases were submitted to the Heartbeat portal during the 2017–2020 reporting period (2017: 1,681; 2018: 1,768; 2019: 1,689; 2020: 1,478). These submissions reflect the cases that triggered activation of the ORS protocol (Figure 1.2), as described in Chapter 1, and subsequent admission to a PCI centre. Figure 4.1 displays the total number of cases submitted by participating hospitals over the reporting period. St James's Hospital (n=1794, 27%) and the Mater Misericordiae University Hospital (n=1583, 24%) account for more than one-half of all admissions to PCI centres from 2017 to 2020. Table 4.1 displays the total number of cases admitted to PCI centres, as per the ORS protocol each year. The annual number of cases over the reporting period remained relatively static compared with 2016, when 1,748 cases were reported. However, the number of cases entered fell by 12% from 1,689 in 2019 to 1,478 in 2020, reflecting the impact of the coronavirus disease 2019 (COVID-19) pandemic on admissions of patients with a STEMI. The impact of the COVID-19 pandemic on heart attack care is further discussed in the *NOCA COVID-19 Heart Attack Report Issue 1* (NOCA, 2021).



**FIGURE 4.1:** NUMBER OF HEARTBEAT CASE SUBMISSIONS, BY PERCUTANEOUS CORONARY INTERVENTION CENTRE, 2017-2020 (N=6616)

**TABLE 4.1:** NUMBER OF HEARTBEAT CASE SUBMISSIONS, BY PERCUTANEOUS CORONARY INTERVENTION CENTRE, BY YEAR (N=6616)

PCI Centres	2017		2018		2019		2020		Total	
	N	%	N	%	N	%	N	%	N	%
Cork University Hospital	261	16%	258	15%	246	15%	227	15%	992	15%
Letterkenny University Hospital	55	3%	72	4%	58	3%	58	4%	243	4%
Mater Misericordiae University Hospital	376	22%	418	24%	391	23%	398	27%	1583	24%
St James's Hospital	459	27%	476	27%	447	26%	412	28%	1794	27%
University Hospital Galway	231	14%	260	15%	256	15%	137	9%	884	13%
University Hospital Limerick	260	15%	222	13%	234	14%	197	13%	913	14%
Beaumont Hospital	~	*	*	*	22	1%	19	1%	59	1%
St Vincent's University Hospital	*	*	26	1%	19	1%	19	1%	80	1%
Tallaght University Hospital	21	1%	20	1%	16	1%	11	1%	68	1%
Total	1681	100%	1768	100%	1689	100%	1478	100%	6616	100%

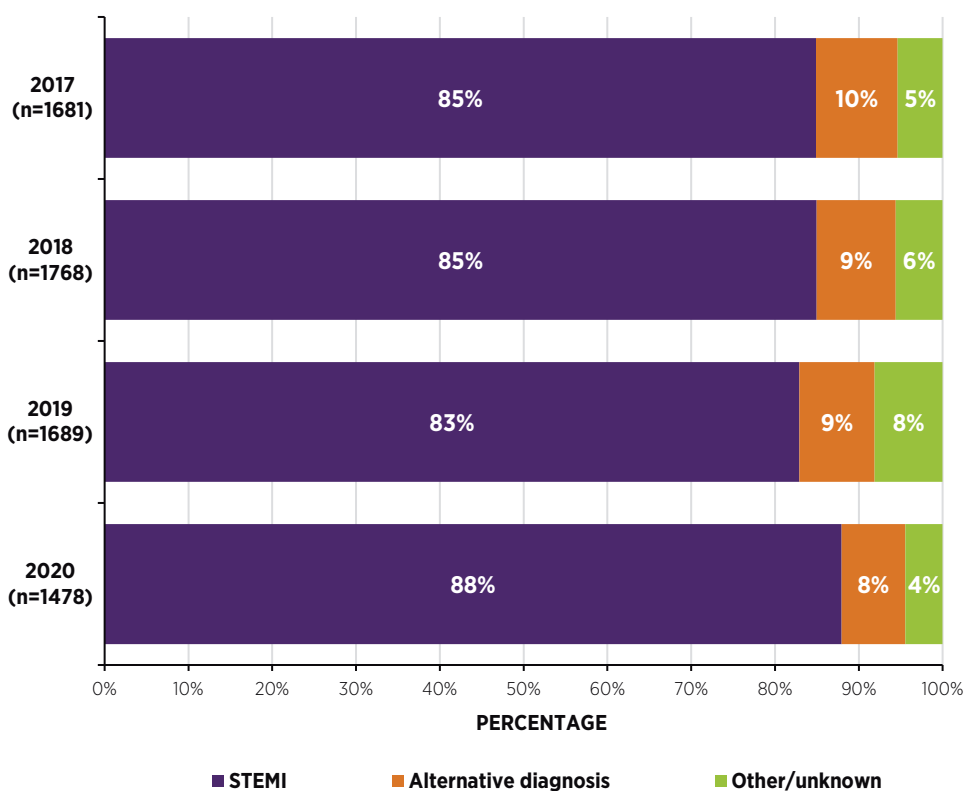
- Denotes five cases or fewer

\* Further suppression required in order to prevent disclosure of five cases or fewer

### CONFIRMED STEMI DIAGNOSIS AND ALTERNATIVE DIAGNOSES

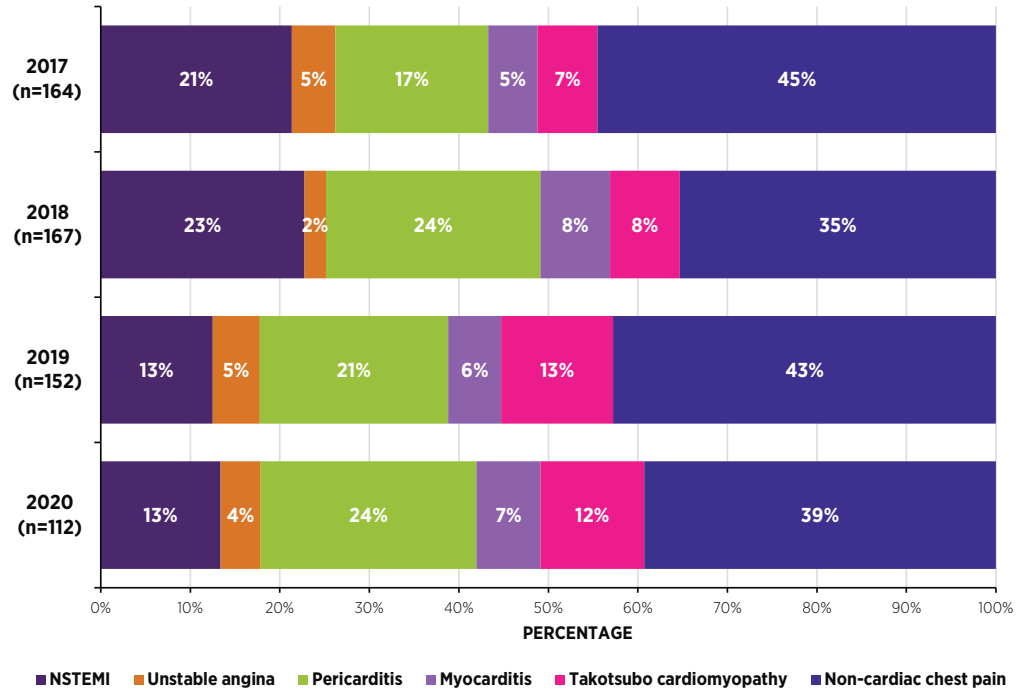
Each case submitted to the Heartbeat portal as a possible STEMI had a confirmed discharge diagnosis. The diagnoses recorded over the reporting period include: STEMI, non-ST elevation myocardial infarction (NSTEMI), unstable angina, pericarditis, myocarditis, takotsubo cardiomyopathy, non-cardiac chest pain, and other/unknown.

There was a total of 6,616 submissions from 2017 to 2020. Of these, 5,629 (85%) had a confirmed diagnosis of STEMI, 595 (9%) had an alternative diagnosis and 392 (6%) were reported as 'other/unknown' (Figure 4.2). The annual number of activations of the ORS protocol and confirmed STEMI diagnoses appeared stable over time and similar to 2016 figures (HSE, 2018a), except for 2020, when the number of submissions decreased to 1,478, compared with an average of 1,713 submissions annually for 2017–2019 (14% reduction). There was also a decrease in confirmed STEMI submissions to 1,300 cases in 2020, compared with an average of 1,443 cases annually for 2017–2019 (10% reduction). This decline is likely explained by the COVID-19 pandemic and is further discussed in the *NOCA COVID-19 Heart Attack Report Issue 1* (NOCA, 2021).



**FIGURE 4.2:** DISCHARGE DIAGNOSIS, BY YEAR (N=6616)

Figure 4.3 shows the distribution of alternative diagnoses on discharge annually over the reporting period, excluding STEMI and other/unknown diagnoses. The most common diagnosis was non-cardiac chest pain (n=241, 41%), followed by pericarditis (n=127, 21%). NSTEMI, takotsubo cardiomyopathy and myocarditis together accounted for 202 cases (34%).

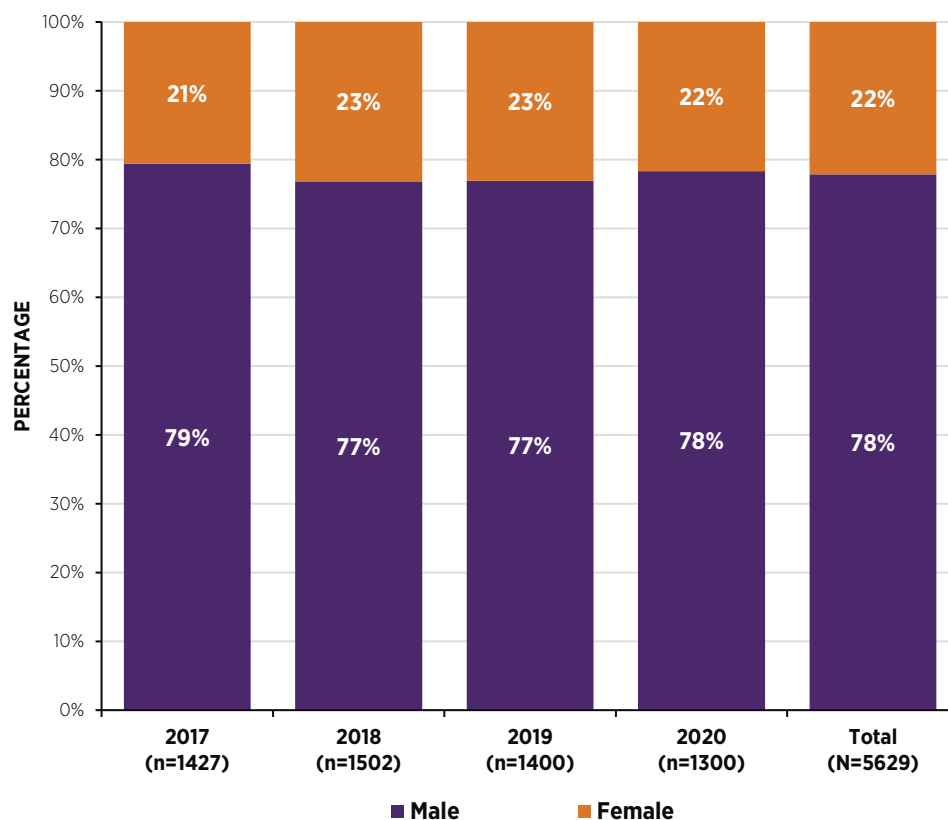


**FIGURE 4.3:** ALTERNATIVE DISCHARGE DIAGNOSIS, BY YEAR (n=595)

All further analysis within this report is based on patients with a confirmed STEMI diagnosis (N=5629) only.

### STEMI, SEX AND AGE

There was a total of 5,629 patients with a STEMI admitted to PCI centres from 2017 to 2020 (Figure 4.4). The majority were male (n=4382, 78.3%); this is similar to the 76.5% among cases treated in 2016 (HSE, 2018a). The proportion of males presenting with a STEMI in Ireland from 2017 to 2020 is higher than the 72% reported in the United Kingdom’s (UK’s) Myocardial Ischaemia National Audit Project (MINAP) audit (MINAP, 2020)



**FIGURE 4.4:** PERCENTAGE OF ST ELEVATION MYOCARDIAL INFARCTION CASES, BY SEX AND YEAR (N=5629)

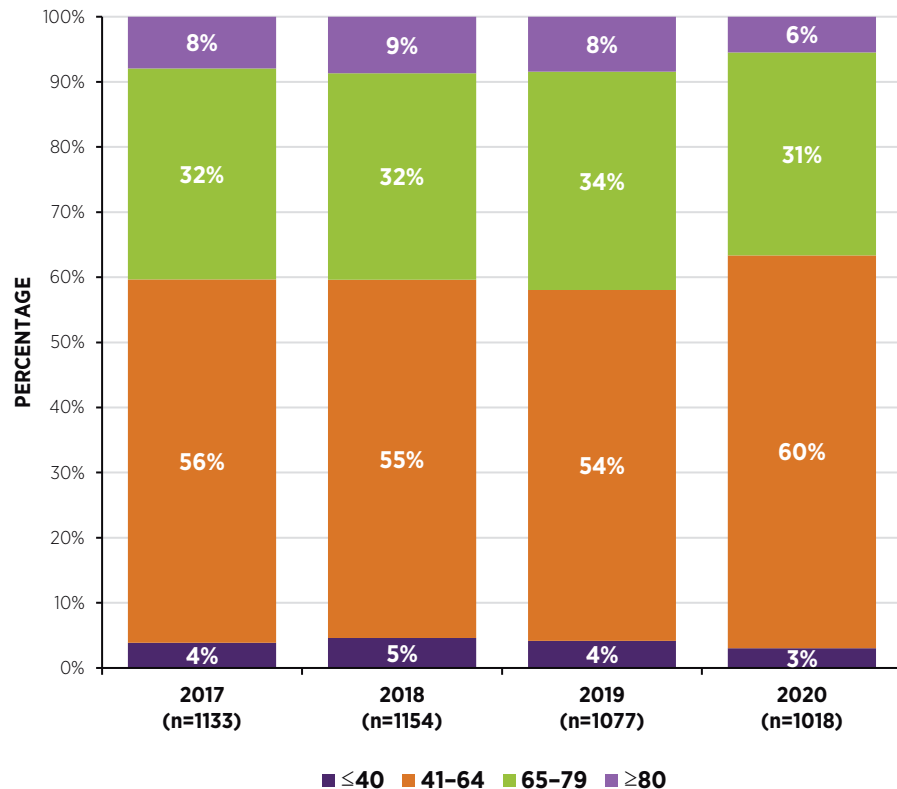


Both the mean and median age of patients presenting with a STEMI from 2017 to 2020 was 63 years (interquartile range (IQR): 54–72 years). This compares with a mean age of 62.9 years in 2016. The median age of patients presenting with a STEMI in the UK’s MINAP audit is 65 years (MINAP, 2020).

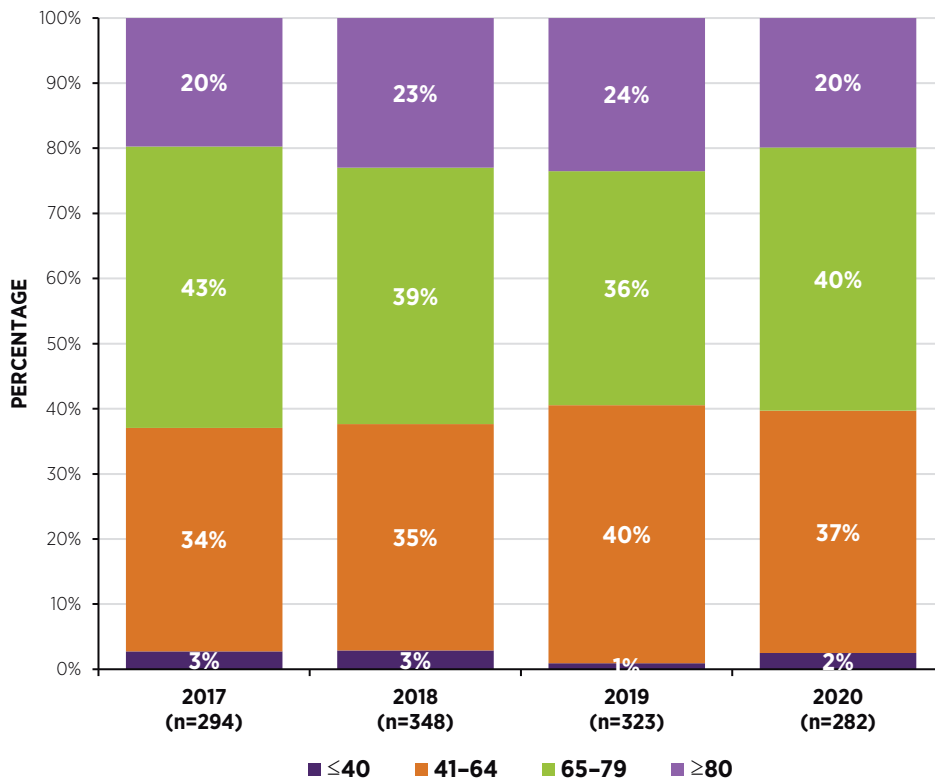
**56% of male patients with a STEMI were aged between 41 and 64 years**

In males presenting with a STEMI, the median age was 61 years (IQR: 53–70 years). Females were older, with a median age of 69.2 years (IQR: 58–78 years), representing a statistically significant difference compared with males ( $p < 0.01$ ), but this was slightly younger than the mean age for females in 2016 (69.2 years). The *Heart Attack Care Ireland 2016* report (HSE, 2018a) found a similar trend among females with a STEMI, who presented at an older age than males. It is consistent with international literature that females present with symptomatic coronary heart disease at an older age than males.

More than one-half of male patients with a STEMI from 2017 to 2020 were aged between 41 and 64 years ( $n=2461$ , 56%) compared with 37% ( $n=455$ ) of female patients (Figures 4.5 and 4.6). Figure 4.6 shows the distribution of age groups for female patients with a STEMI ( $n=1247$ , 22%). Nearly one-quarter ( $n=270$ , 22%) of female patients were aged 80 years and over; this compares with 8% ( $n=337$ ) of male patients ( $p < 0.05$ ). These differences highlight that females who present with a STEMI are older than males. As will be outlined in the cardiovascular disease history and known comorbidity profile of patients with a STEMI section below, females have higher rates of comorbidities on presentation, which may affect outcomes and survival. Similar age and sex trends are also seen in the UK’s MINAP audit (MINAP, 2020).



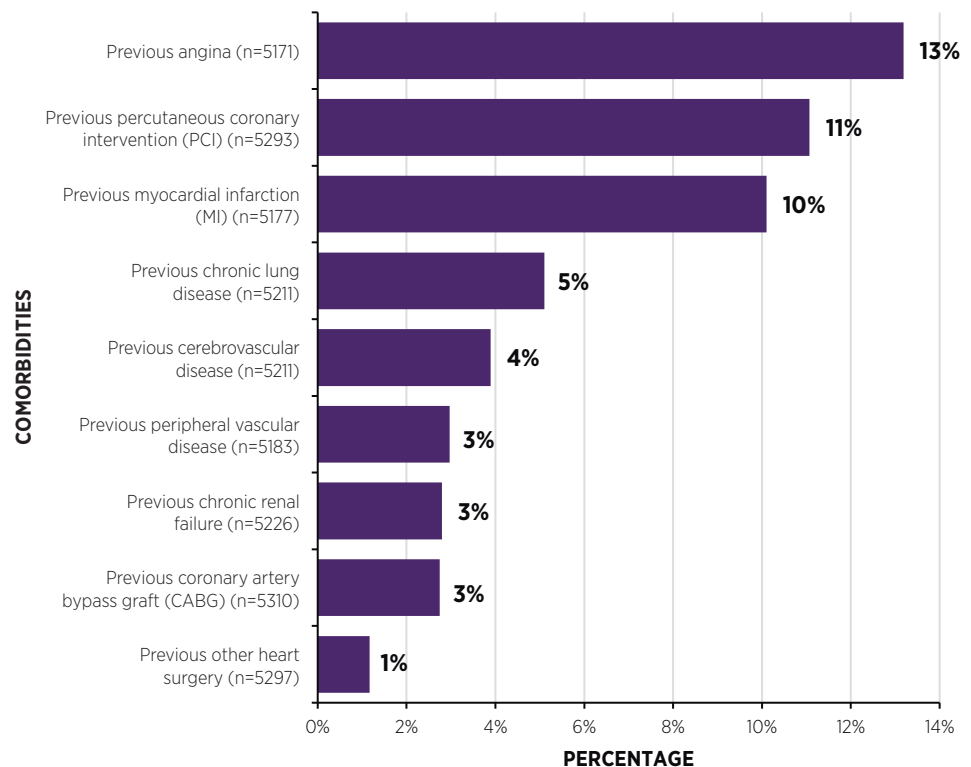
**FIGURE 4.5:** PERCENTAGE OF MALE PATIENTS WITH AN ST ELEVATION MYOCARDIAL INFARCTION, BY AGE GROUP AND YEAR ( $n=4382$ )



**FIGURE 4.6:** PERCENTAGE OF FEMALE PATIENTS WITH AN ST ELEVATION MYOCARDIAL INFARCTION, BY AGE GROUP AND YEAR (n=1247)

## CARDIOVASCULAR DISEASE HISTORY AND KNOWN COMORBIDITY PROFILE OF PATIENTS WITH A STEMI

Over the 4-year reporting period, 25% (n=1400) of patients with a STEMI had at least one known atherosclerotic cardiovascular disease or known major organ comorbidity. Figure 4.7 shows the distribution of atherosclerotic cardiovascular disease diagnoses and comorbidities in patients with a STEMI. The most frequently reported conditions were previous angina (n=682, 13%), previous PCI (n=586, 11%) and previous myocardial infarction (MI) (n=523, 10%). A small number of patients had no information recorded about their comorbidity status (n=299, 5%).



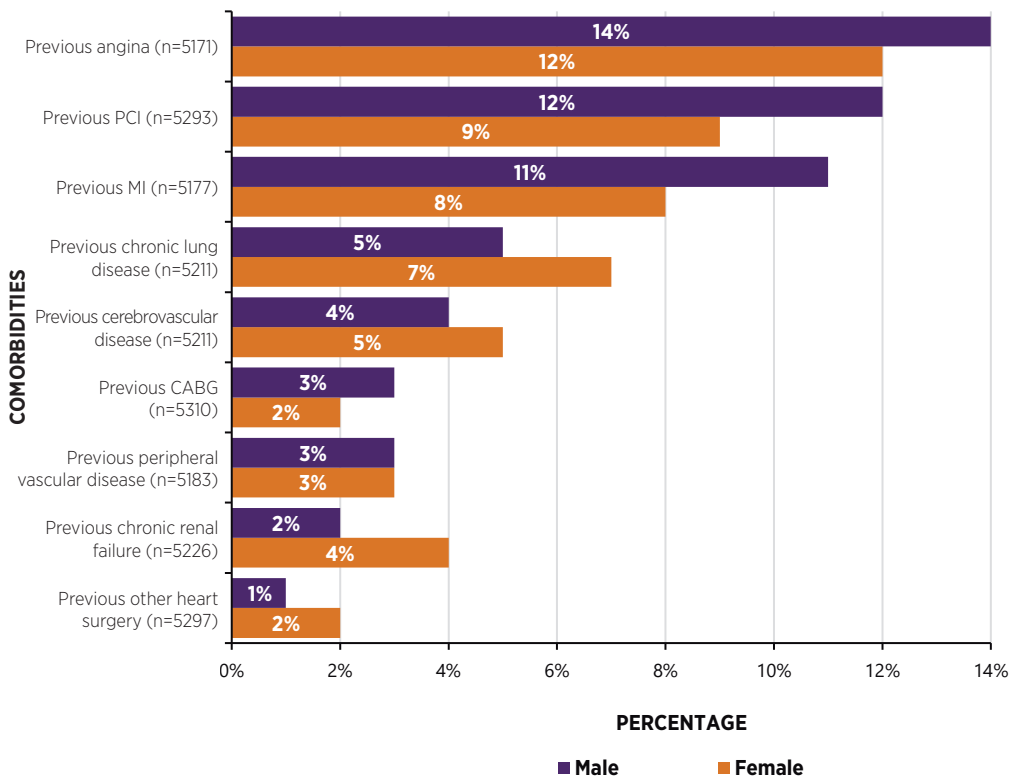
**FIGURE 4.7:** PRIOR CARDIOVASCULAR DISEASE AND MAJOR COMORBIDITIES IN PATIENTS WITH AN ST ELEVATION MYOCARDIAL INFARCTION, 2017-2020<sup>2</sup>

<sup>2</sup> The proportions were calculated separately (excluding cases where comorbidities were unknown) for each prior cardiovascular disease and comorbidity. One patient may have one or more cardiovascular disease and comorbidity; therefore, some patients are counted more than once.

Figure 4.7A demonstrates sex-related differences in prior cardiovascular disease and comorbidity rates. As previously outlined, female patients with a STEMI tended to be older on presentation and were more likely to have a documented history of a major comorbid diagnosis, either lung disease or renal disease or prior cerebrovascular disease. There was a larger proportion of female patients with a STEMI who had at least one comorbidity (n=339, 27%) compared with the male cohort (n=1061, 24%), which was a statistically significant difference.

There were similar rates of male and female patients with a STEMI who also had prior cerebrovascular disease, prior coronary artery bypass graft (CABG), prior peripheral vascular disease, or prior heart surgery. A larger proportion of male patients with a STEMI had previous angina (n=545, 14%) compared with female patients with a STEMI (n=137, 12%;  $p=0.12$ ). Similarly, a larger proportion of male patients than female patients with a STEMI had previous PCI (male: n=481, 12%; female: n=105, 9%;  $p<0.05$ ) and previous MI (male: n=428, 11%; female: n=95, 8%;  $p<0.05$ ).

There was a larger proportion of female patients with a STEMI who had previous chronic lung disease (female: n=82, 7%; male: n=184, 5%;  $p<0.05$ ) and previous chronic renal failure (female: n=45, 4%; male: n=101, 2%;  $p<0.05$ ).

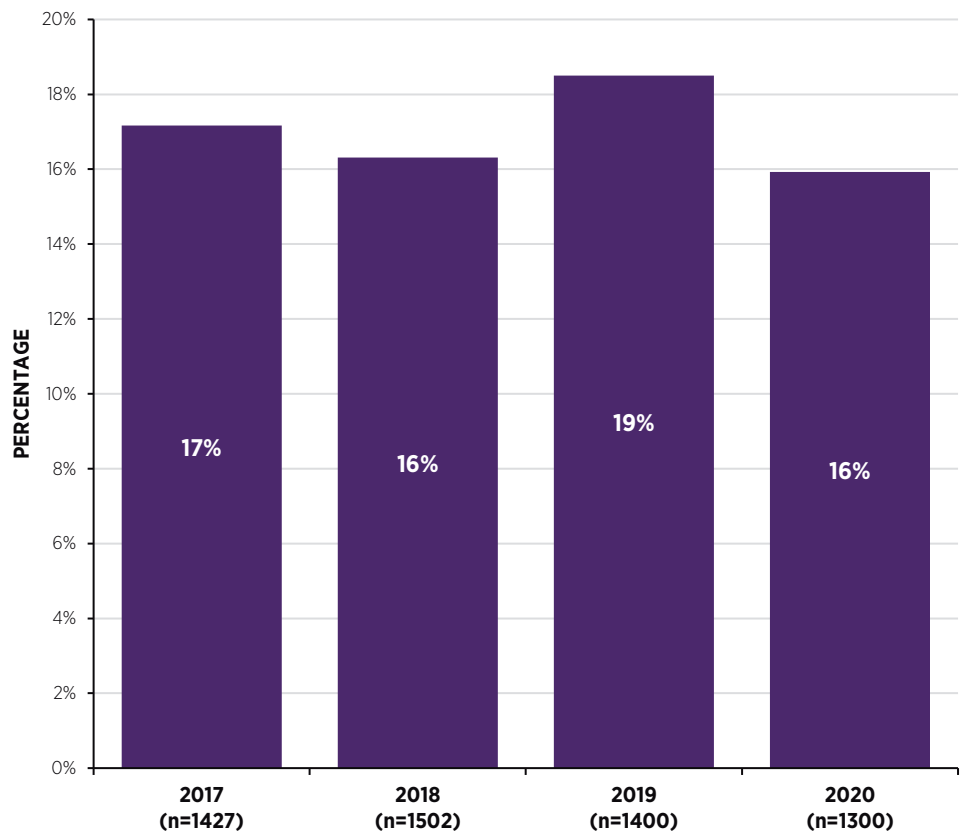


**FIGURE 4.7A:** PROPORTION OF PATIENTS WITH AN ST ELEVATION MYOCARDIAL INFARCTION WITH A COMORBIDITY, BY SEX, 2017–2020<sup>3</sup>

<sup>3</sup> The proportions were calculated separately (excluding cases where comorbidities were unknown) for each prior cardiovascular disease and comorbidity. One patient may have one or more cardiovascular disease and comorbidity; therefore, some patients are counted more than once.

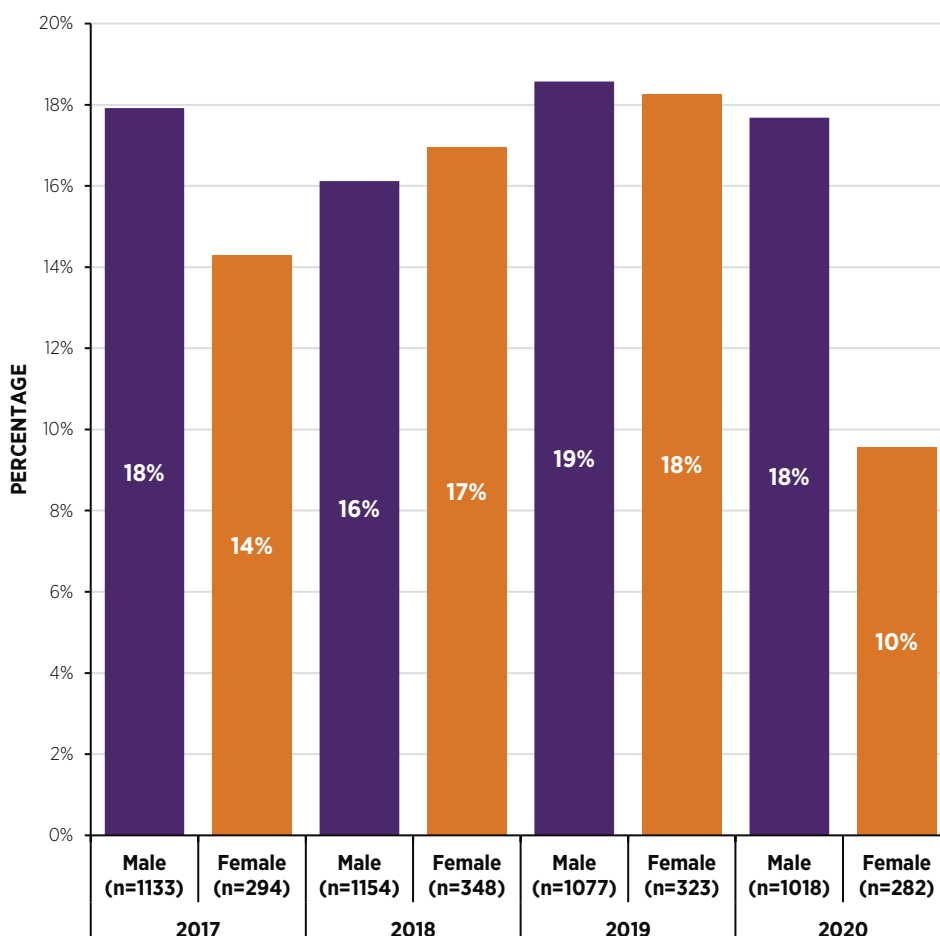
## PRIOR CORONARY HEART DISEASE

Over the 2017–2020 reporting period, the proportion of patients with a STEMI admitted with prior coronary heart disease (prior MI, prior angina, prior PCI, and/or prior CABG) was 17% (n=956). Figure 4.8 shows the proportion of patients with a STEMI with prior coronary heart disease for each of the reporting years. Seventy-five percent (n=4247) presented with a STEMI as their first manifestation of coronary heart disease, and in 8% (n=426) of cases, prior coronary heart disease was unknown.



**FIGURE 4.8:** PROPORTION OF PATIENTS WITH AN ST ELEVATION MYOCARDIAL INFARCTION WITH PRIOR CORONARY HEART DISEASE, BY YEAR (N=5629)

Figure 4.8A displays the proportion of patients with a STEMI admitted with prior coronary heart disease, by sex and year. Over the 4-year reporting period there was a larger proportion of male patients with a STEMI (n=769, 18%) as their first presentation of coronary heart disease compared with female patients with a STEMI (n=187, 15%). This may reflect the older age profile and higher number of comorbidities among female patients presenting with a STEMI. There was, however, a reduction in the proportion of female patients with a STEMI (n=27, 10%) with prior coronary heart disease in 2020 compared with the average over the previous 3 years (n=53, 17%). This reduction may be explained by a smaller proportion of female patients with a STEMI who were aged 65 years and over in 2020 (n=170, 60%) compared with the average from 2017 to 2019 (n=198, 62%), and particularly those aged 80 years and over, as discussed in the *NOCA COVID-19 Heart Attack Report Issue 1* (NOCA, 2021).



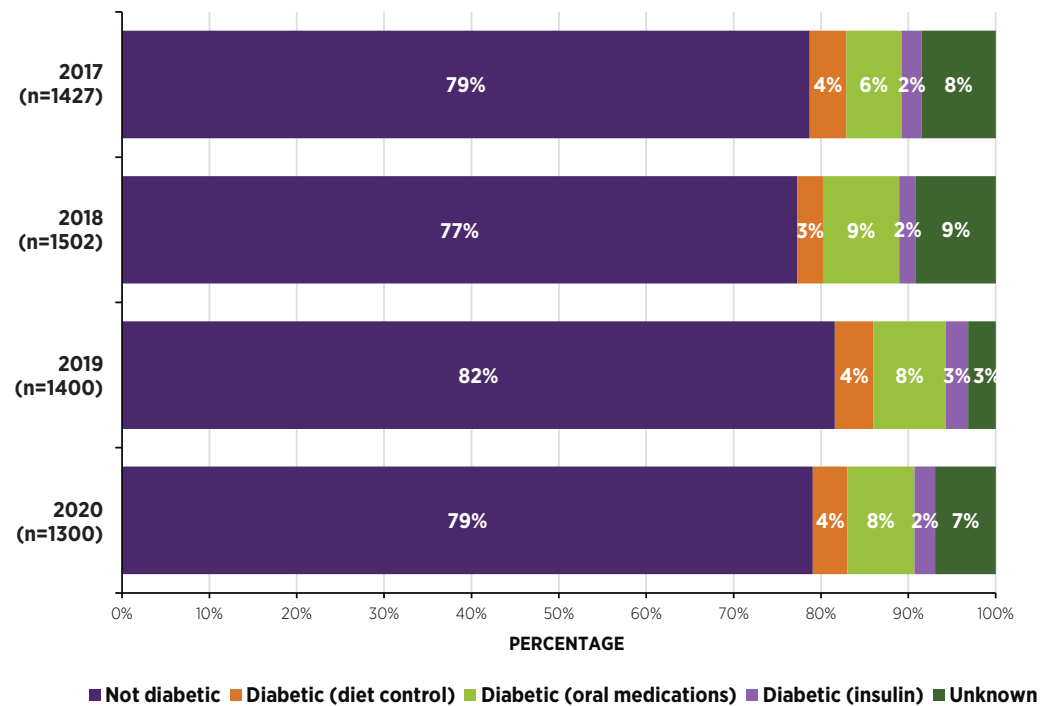
**FIGURE 4.8A:** PROPORTION OF PATIENTS WITH AN ST ELEVATION MYOCARDIAL INFARCTION WITH PRIOR CORONARY HEART DISEASE, BY SEX AND YEAR (N=5629)

### DIABETES PROFILE IN PATIENTS WITH A STEMI

The majority of patients with a STEMI during the 4-year reporting period did not have diabetes (n=4454, 79%), although 14% (n=783) were reported as having a diagnosis of diabetes either predating admission with a STEMI or diagnosed during admission. Seven percent (n=392) of patients with a STEMI had no information regarding diabetes recorded (Figure 4.9). Type 2 diabetes is not recorded as a specified variable in the Heartbeat dataset, but has been previously inferred from diabetes that is controlled either with diet or oral medication. There was a small trend towards an increase in patients with a STEMI with type 2 diabetes who were controlling it either through diet or oral medication, from 11% in 2017 to an average of 12% in 2018, 2019 and 2020.

The UK’s MINAP audit report (MINAP, 2020) also demonstrates a rising prevalence of diabetes in patients presenting with a STEMI, from 21% in 2010–2011 to 26% in 2018–2019. The *Heart Attack Care Ireland 2016* report (HSE, 2018a) recorded a rate of type 2 diabetes of 15.6% in patients presenting with a STEMI in 2016.

The results of this IHAA report may underestimate the true prevalence of type 2 diabetes in patients with STEMI, as the Heartbeat dataset does not record the subtype of diabetes as a specified variable.



**FIGURE 4.9:** DIABETES PROFILE OF PATIENTS WITH AN ST ELEVATION MYOCARDIAL INFARCTION, 2017–2020 (N=5629)<sup>4</sup>

<sup>4</sup> The 'Unknown' category includes instances of data recorded as 'Unknown' (n=368) and data not recorded (n=24).

## SMOKING PROFILE IN PATIENTS WITH A STEMI

Smoking is the leading cause of preventable death in Ireland. Each week, more than 100 people die from disease directly related to tobacco use, representing nearly one in five of all deaths annually (Malone and O’Connell, 2020). It is a national policy commitment to render Ireland tobacco free by 2025 (Department of Health, 2013).

The most recent trends from the Tobacco Free Ireland Programme (HSE, 2020) estimates that just under one in five adults in Ireland’s general population continues to smoke. There has been an incremental annual decline in smoking rates across the general population over time as a result of taxation and public health initiatives. Smoking rates in 2018 were reported at 23% (24% in males and 21% in females), with the largest age group that continued to smoke being those aged 25–34 years (35%). By 2020, the rate of smoking in the general population had declined to 17% (19% in males and 15% in females), and again, the largest age group still smoking was estimated to be those aged 25–34 years (22%).

Between 2017 and 2020, one-third (n=1922, 34%) of patients with a STEMI smoked at the time of admission. One-quarter of patients with a STEMI formerly smoked (n=1401, 25%) and one-quarter had never smoked (n=1483, 26%) (Figure 4.10). While this is a reduction from the *Heart Attack Care Ireland 2016* report (HSE, 2018a), which showed an active smoking rate of 38.3% (with a rate of 30.7% in persons who had already suffered an MI), these active smoking rates remain disproportionately higher than those of the general population and highlight the adverse impact of smoking on heart attack risk.

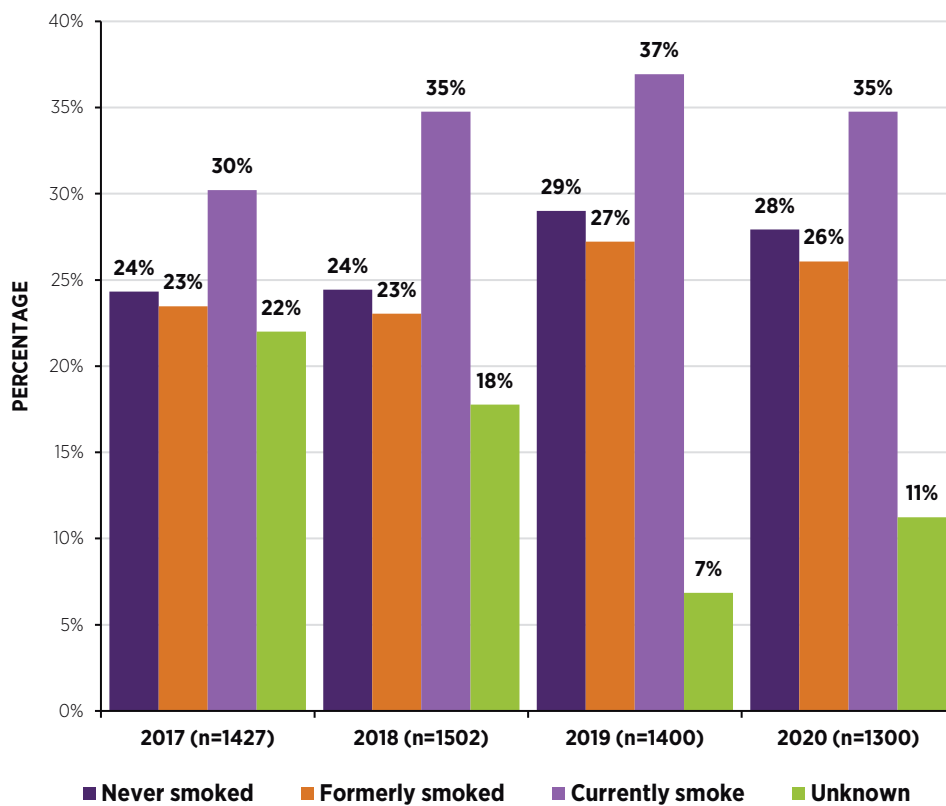
The UK’s MINAP report for 2018–2019 (MINAP, 2020) shows a national UK smoking rate of 33% in patients with a STEMI, although there is considerable regional variation within the UK, with Northern Ireland reporting a smoking rate of 35% in patients presenting with an MI.

Current active smoking rates in patients presenting with a STEMI have increased from 30% in 2017, to 37% in 2019, and decreased to 35% in 2020.



**Smoking rates are too high. One-third of patients with a STEMI smoked at the time of admission**

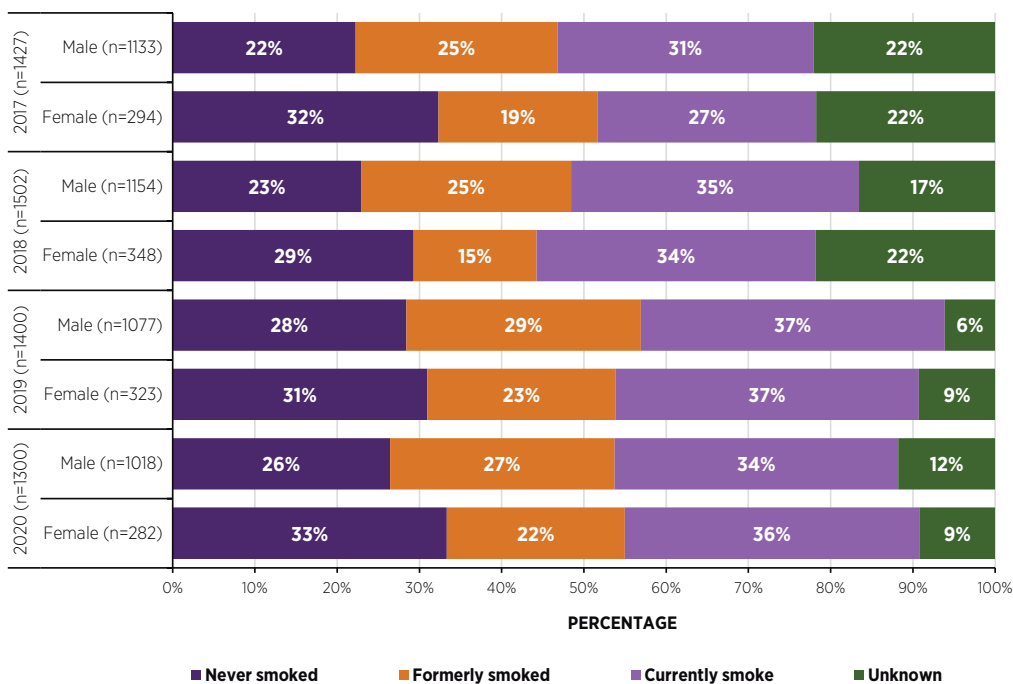




**FIGURE 4.10:** SMOKING PROFILE OF PATIENTS WITH AN ST ELEVATION MYOCARDIAL INFARCTION, 2017–2020 (N=5629)<sup>5</sup>

<sup>5</sup> The 'Unknown' category includes instances of data recorded as 'Unknown' (n=749) and data not recorded or recorded incorrectly (n=74).

Figure 4.10A shows the smoking profile of patients with a STEMI by sex and year. There was a larger proportion of female patients with a STEMI (n=391, 31%) compared with male patients with a STEMI (n=1092, 25%) who reported that they had never smoked. There was a smaller difference between the proportion of male and female patients with a STEMI in the current smoker category.



**FIGURE 4.10A:** SMOKING PROFILE OF PATIENTS WITH AN ST ELEVATION MYOCARDIAL INFARCTION, BY SEX AND YEAR (N=5629)<sup>6</sup>

<sup>6</sup> The 'Unknown' category includes instances of data recorded as 'Unknown' (n=749) and data not recorded or recorded incorrectly (n=74).

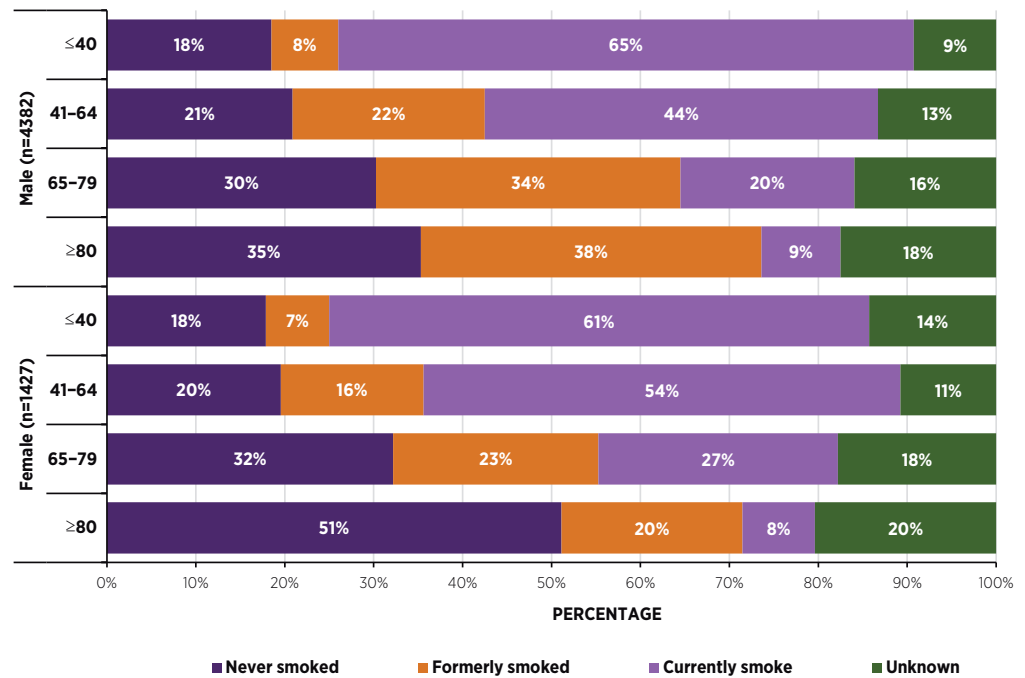
### Smoking and age profile of patients with a STEMI

**Smoking causes heart attack at a younger age. Smokers presented with a STEMI 10 years earlier than people who have never smoked**

When comparing patients presenting with a STEMI who currently smoke with patients presenting with a STEMI who have never smoked, on average, smokers presented with a STEMI 10 years earlier than people who have never smoked (mean age of current smokers with a STEMI: 57 years; mean age of never smokers with a STEMI: 67 years).

Among males, current smokers presenting with a STEMI had a median age of 56 years (IQR: 49–63 years) compared with a median age of 65 years for males with a STEMI who have never smoked (IQR: 56–73 years). Among females, current smokers presenting with a STEMI had a median age of 60 years (IQR: 53–68 years) compared with a median age of 76 years for females with a STEMI who have never smoked (IQR: 65–83 years).

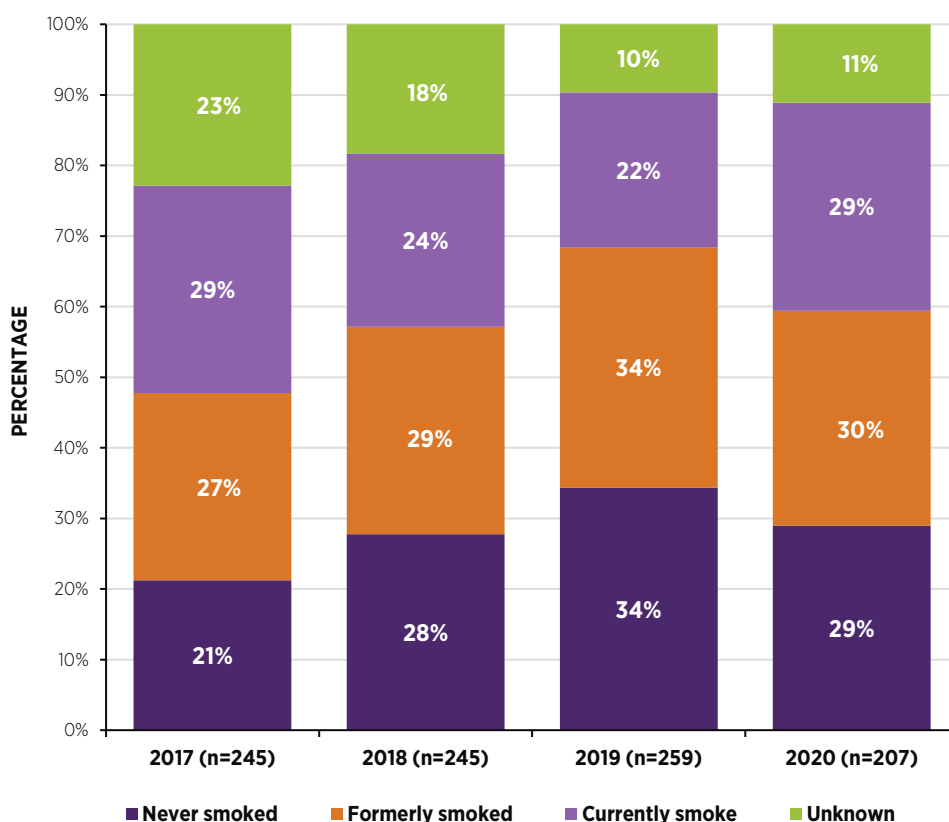
Figure 4.10B shows the age distribution of patients with a STEMI by sex. Between 2017 and 2020, the majority of patients aged under 40 years who presented with a STEMI were current smokers (n=129, 64%). Among patients with a STEMI aged 80 years and over, a larger proportion of females had never smoked (n=138, 51%) compared with males (n=119, 35%). This highlights the degree to which smoking causes premature coronary heart disease events, with patients of both sexes who have never smoked not experiencing a STEMI until they were much older compared with active smokers of both sexes.



**FIGURE 4.10B:** SMOKING PROFILE OF PATIENTS WITH AN ST ELEVATION MYOCARDIAL INFARCTION, BY SEX AND AGE GROUP, 2017-2020 (N=5629)

### Smoking relapses and recurrent heart attack

Between 2017 and 2020, of the 956 patients with a STEMI who had prior coronary heart disease, 30% (n=288) were described as former smokers and 26% (n=250) as current smokers. Figure 4.11 shows the distribution of smoking status for patients with a STEMI who had prior coronary heart disease for each of the reporting years. This remains significantly higher than the rate reported in the UK (MINAP, 2020), where the rate of continued smoking in persons presenting with a STEMI and a history of prior MI is 21%. This again highlights the importance of continuing supports for smokers who have experienced a STEMI in order to reinforce quitting and maintain abstinence from smoking.



**FIGURE 4.11:** SMOKING PROFILE OF PATIENTS WITH AN ST ELEVATION MYOCARDIAL INFARCTION WITH PRIOR CORONARY HEART DISEASE, BY YEAR (n=956)<sup>7</sup>

<sup>7</sup> The 'Unknown' category includes instances of data recorded as 'Unknown' (n=143) and data not recorded or recorded incorrectly (n=6).



The most common risk factors for heart attack included a previous history of hypertension (43%) and previous hypercholesterolaemia (43%)

## CARDIOVASCULAR RISK FACTOR PROFILE OF PATIENTS WITH A STEMI

Over the 4-year reporting period, 78% (n=4372) of patients with a STEMI had at least one cardiovascular risk factor and 13% (n=706) had none. Table 4.2 shows the distribution of cardiovascular risk factors. The most prevalent risk factors were previous hypertension (n=2427, 43%) and previous hypercholesterolaemia (n=2401, 43%). This is similar to European risk factor data, where hyperlipidaemia and hypertension are consistently the most frequently reported cardiovascular risk factors (Timmis *et al.*, 2020).

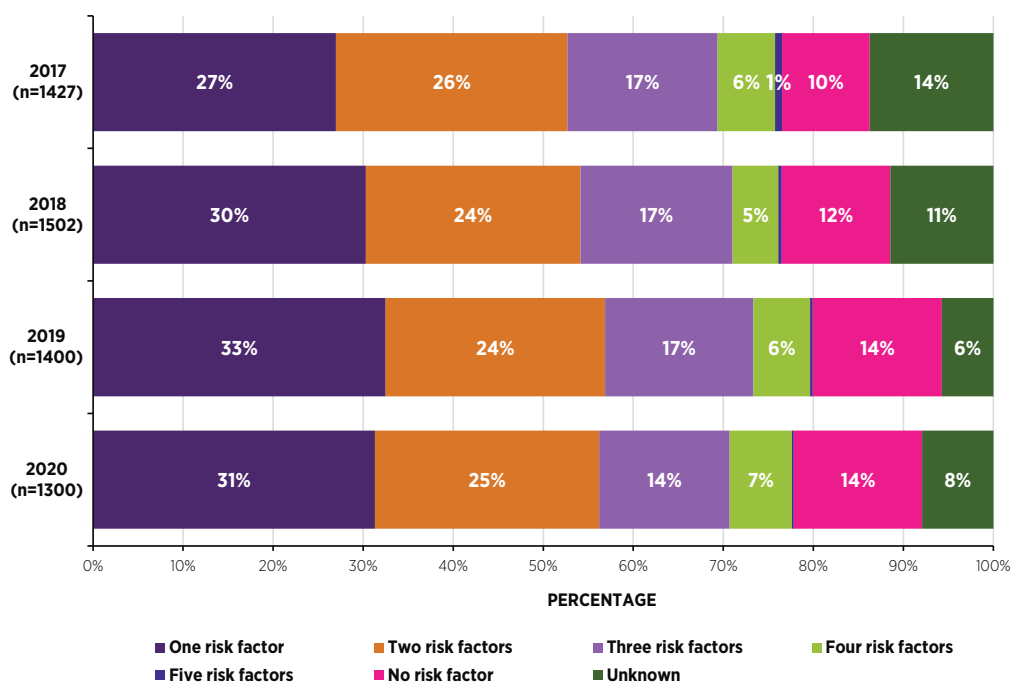
**TABLE 4.2: CARDIOVASCULAR RISK FACTOR PROFILE OF PATIENTS WITH AN ST ELEVATION MYOCARDIAL INFARCTION, 2017-2020 (N=5629)**

	Yes		No		Unknown		Total	
	N	%	N	%	N	%	N	%
Prior cardiovascular disease <sup>8</sup>	1182	21%	3999	71%	448	8%	5629	100%
Diabetes	783	14%	4454	79%	392	7%	5629	100%
Smoking (current)	1922	34%	2884 <sup>9</sup>	51%	823	15%	5629	100%
Previous hypercholesterolaemia	2401	43%	2344	42%	884	16%	5629	100%
Previous hypertension	2427	43%	2428	43%	774	14%	5629	100%

<sup>8</sup> Prior cardiovascular disease is defined diagnosed if a patient has had any of the following: previous MI, previous angina, previous peripheral vascular disease, previous cerebrovascular disease, previous PCI, previous CABG, or previous other heart surgery.

<sup>9</sup> The figure 2,884 includes patients who have never smoked (n=1483) and former smokers (n=1401).

Figure 4.12 shows the proportion of patients with a STEMI with one to five cardiovascular risk factors. More than one-half (n=3092, 55%) of patients with a STEMI who were admitted between 2017 and 2020 had one or two cardiovascular risk factors. A small number of patients with a STEMI (n=24, 0.4%) had all five risk factors (Figure 4.3), meaning that a substantial proportion of patients with a STEMI have multiple potentially modifiable cardiovascular risk factors on presentation. Identifying these individuals with multiple risk factors at an earlier stage in primary care and, most importantly, adequately addressing those modifiable risk factors provides an opportunity to help reduce the incidence of cardiovascular events.

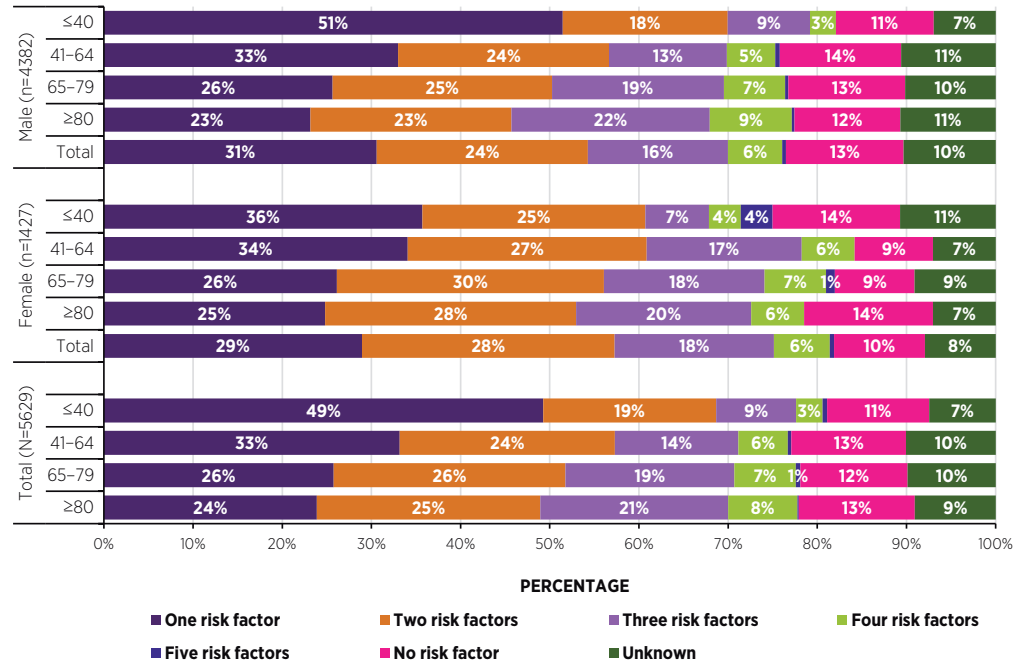


**FIGURE 4.12:** PREVALENCE OF RISK FACTORS FOR PATIENTS WITH AN ST ELEVATION MYOCARDIAL INFARCTION, BY YEAR (N=5629)<sup>10</sup>

<sup>10</sup> The 'Unknown' category includes instances of data recorded as 'Unknown' and data not recorded or recorded incorrectly.

Figure 4.12A shows the distribution of incidence of risk factors for patients with a STEMI by age group and sex. As the age of patients with a STEMI increased, the proportion of patients with one risk factor decreased and the proportion of patients with multiple risk factors increased.

Among patients aged under 40 years, there was a smaller proportion of female patients who had one risk factor (n=10, 36%) compared with male patients (n=89, 51%).



**FIGURE 4.12A:** PREVALENCE OF RISK FACTORS FOR PATIENTS WITH AN ST ELEVATION MYOCARDIAL INFARCTION, BY AGE GROUP AND SEX, 2017-2020 (N=5629)<sup>11</sup>

<sup>11</sup> The 'Unknown' category includes instances of data recorded as 'Unknown' and data not recorded or recorded incorrectly.

## KEY FINDINGS FROM CHAPTER 4

- A total of 6,616 cases were submitted to the Heartbeat portal during the 2017–2020 reporting period (2017: 1,681; 2018: 1,768; 2019: 1,689; 2020: 1,478).
- The annual number of cases has remained stable since 2016 (HSE, 2018a), with the exception of 2020, which was likely due to the impact of the COVID-19 pandemic on presentations to hospital with a STEMI.
- A STEMI diagnosis was confirmed in 85% (n=5629) of cases submitted to the Heartbeat portal.
- There was a decline in confirmed STEMI cases to 1,300 cases in 2020, compared with an average of 1,443 confirmed STEMI cases annually for the years 2017–2019 (10% reduction). This decline is likely explained by the COVID-19 pandemic.
- The majority of patients with a STEMI were male (n=4382, 78%), while 22% (n=1247) of patients with a STEMI were female.
- The median age of patients presenting with a STEMI was 63 years (IQR: 54–72 years). In males, the median age was 61 years (IQR: 53–70 years) and in females, the median age was 69 years (IQR: 58–78 years).
- More than one-half (n=2461, 56%) of male patients with a STEMI were aged between 41 and 64 years.
- Nearly one-quarter (n=270, 22%) of female patients with a STEMI were aged 80 years and over, compared with 8% (n=337) of male patients with a STEMI ( $p<0.05$ ).
- STEMI is more common in males, with females presenting at an older mean age and with a higher burden of comorbidities, which is in keeping with evidence from 2016 and from international registries.
- Three-quarters (n=4247, 75%) of patients with a STEMI presented with a STEMI as their first manifestation of coronary heart disease.
- One-quarter (n=1400, 25%) of patients with a STEMI had at least one known cardiovascular disease condition or known major organ comorbidity.
- Fourteen percent (n=783) of patients with a STEMI had a diagnosis of diabetes prior to admission. Type 2 diabetes rates are likely underestimated in this audit.
- Between 2017 and 2020, one-third (n=1922, 34%) of patients with a STEMI smoked at the time of admission. This is disproportionately higher than the smoking rate among the general population (17%), and highlights the adverse impact of smoking on heart attack risk.
- Active smoking remains disproportionately high in patients presenting with a STEMI (33% versus a national average of 17%) and is worryingly high (26%) in patients with a prior cardiovascular disease event.
- Current smokers present with a STEMI on average 10 years earlier than individuals who have never smoked. This difference is even more marked in females.
- Over the 4-year reporting period, 78% (n=4372) of patients with a STEMI had at least one cardiovascular risk factor. The most prevalent risk factors were previous hypertension (n=2427, 43%) and previous hypercholesterolaemia (n=2401, 43%).
- The majority (n=129, 64%) of patients aged under 40 years who presented with a STEMI were current smokers.



# CHAPTER 5 PATHWAY TO A PCI CENTRE



## CHAPTER 5: PATHWAY TO A PCI CENTRE

### SCOPE OF CHAPTER 5

This chapter describes the pathway to a PCI centre for all patients with a STEMI recorded on the Heartbeat portal who received care in a PCI centre (N=5629) from 2017 to 2020, including the key time intervals within the pathway. Measuring timeliness for different aspects of the pathway to a PCI centre is complex and varies depending on the treatment location and how a patient accessed STEMI care. Appendix 6 provides detailed definitions of each variable used to calculate time intervals presented in the figures described in this chapter. For the majority of patients with a STEMI, PCI was the primary reperfusion strategy. Patients who had thrombolysis performed as a primary reperfusion strategy and who were also transported to a PCI centre are included in this chapter. However, when reporting timeliness of the pathway to a PCI centre, these patients are excluded from the analysis.

### WHAT IS PRIMARY PCI?

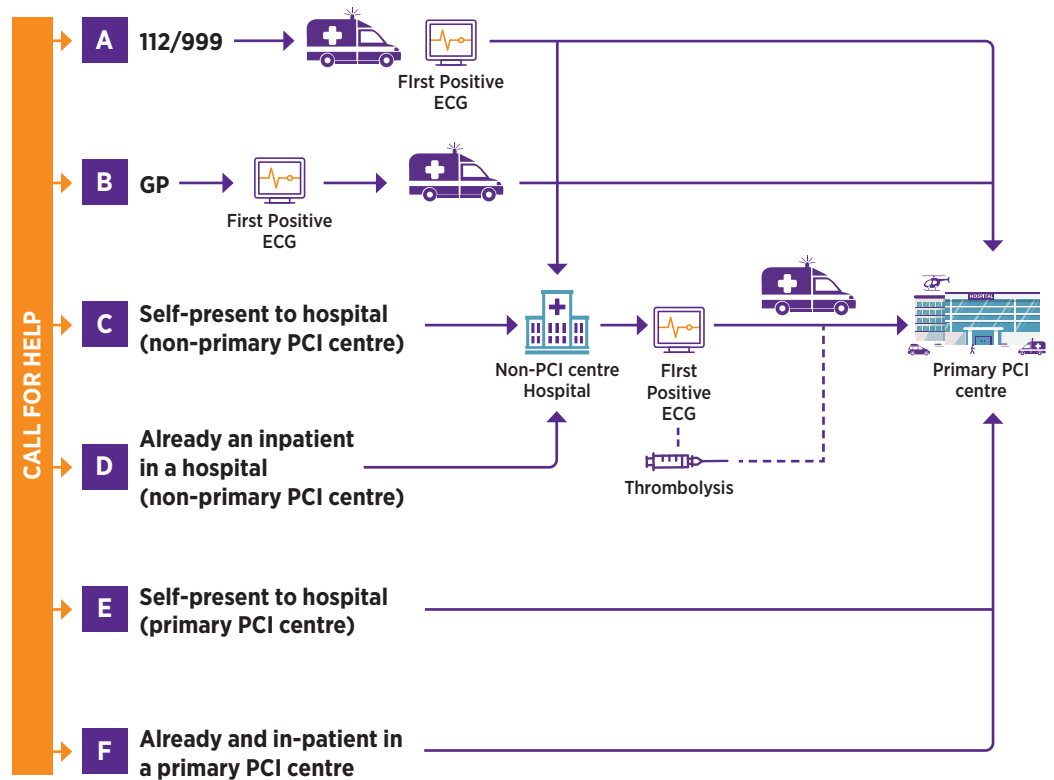
As described in Chapter 1, a STEMI is a total blockage of a coronary artery that can cause extensive damage to the heart muscle. Reperfusion is the term used to describe the unblocking of the artery and the restoration of blood flow to the heart muscle. There are two types of reperfusion therapy provided to patients with a STEMI:

1. PCI – a procedure performed in a catheterisation laboratory (cath lab) using balloon angioplasty, coronary stents, aspiration thrombectomy and other measures
2. thrombolysis – an intravenous treatment to dissolve blood clots in arteries.

Primary PCI refers to the strategy of taking a patient with a STEMI directly to a cath lab to undergo a PCI as the first (primary) treatment. A primary PCI centre is a designated hospital that provides a primary PCI service. This means that an emergency ambulance will bypass other hospitals in order to bring the patient to the nearest primary PCI centre, or that a patient with a STEMI will be transferred from another hospital for a primary PCI. Primary PCI is recognised internationally as the preferred treatment of STEMI when it can be performed in a timely fashion (Ibanez *et al.*, 2018). Where primary PCI cannot be delivered within a clinically acceptable time frame, thrombolysis is recommended, along with early transfer to a primary PCI centre for angiography (HSE, 2012).

## PATHWAY TO A PCI CENTRE

People with symptoms of heart attack are encouraged to call 112 or 999, which prompts an emergency ambulance response. Upon arrival of the emergency ambulance, a 12-lead electrocardiogram (ECG) can be performed by paramedics and, if this is positive for STEMI, the optimal reperfusion service (ORS) protocol is activated. Patients with heart attack symptoms can access care in other ways, such as presenting at their general practitioner (GP) surgery, where a STEMI can be diagnosed with an ECG, or by attending the emergency department (ED) of a hospital that does not provide primary PCI, thereby requiring transfer to a PCI centre. Figure 5.1 illustrates each of the pathways to a PCI centre. The image represents the most likely location where the first positive 12-lead ECG would be performed in each scenario.



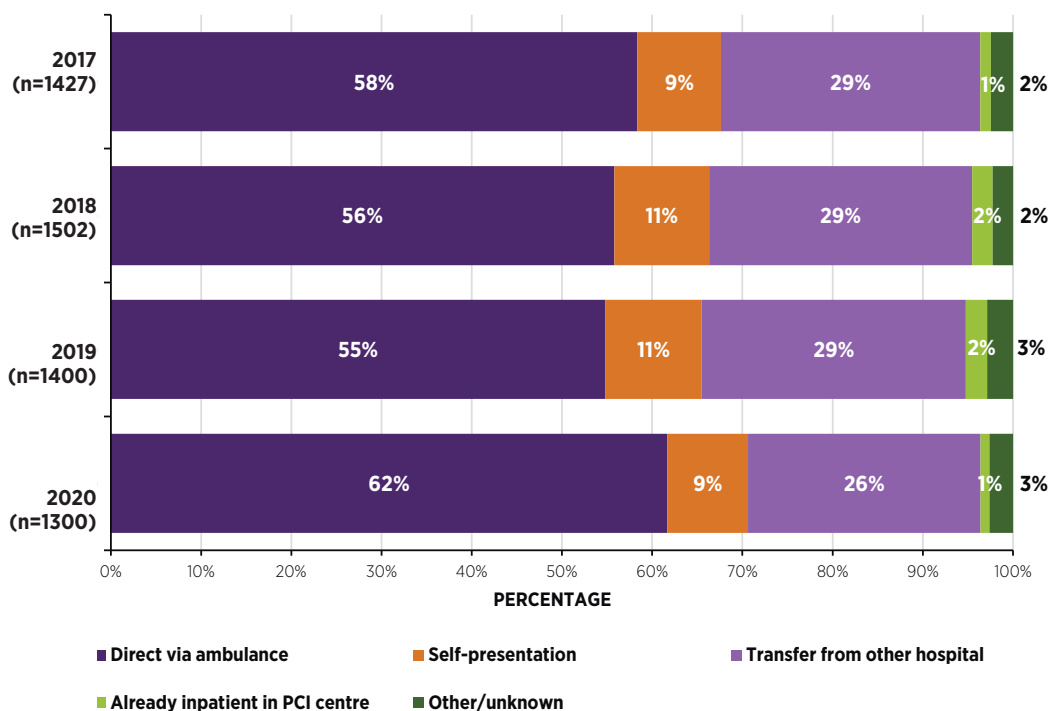
**FIGURE 5.1:** PATHWAYS TO A PERCUTANEOUS CORONARY INTERVENTION CENTRE

### SOURCE OF REFERRAL TO A PCI CENTRE

How a patient accesses care may influence the type of reperfusion therapy that they receive and the timeliness of reperfusion. Figure 5.2 shows the sources of referral to PCI centres from 2017 to 2020. Over the 4-year reporting period, the majority (n=3240, 58%) of patients with a STEMI arrived at a PCI centre directly by ambulance. Just under one-third (n=1593, 28%) of patients were transferred to a PCI centre from another hospital. This remains broadly unchanged since 2016 (HSE, 2018a).

In 2020, a larger proportion of patients with a STEMI arrived at a PCI centre directly by ambulance (n=802, 62%) compared with 2017–2019 (annual average: 56%, n=813;  $p < 0.01$ ). There was also a reduction in the proportion of patients who were transferred from another hospital in 2020 (n=335, 26%) compared with 2017–2019 (annual average: 29%, n=419;  $p < 0.05$ ). The proportion of patients who self-presented to a PCI centre remained relatively consistent over the 4-year reporting period.

A very small number of patients arrived at a PCI centre by helicopter over the reporting period. This mode of transport was occasionally used for patients who were brought directly to the PCI centre and for inter-hospital transfers. The proportion of patients with a STEMI who were transported by helicopter during the 4-year reporting period was 4% (n=220). The proportion declined over the reporting period, from 5% (n=75) in 2017 to 3% (n=40) in 2020 (2018: n=62, 4%; 2019: n=43, 3%). The actual number of patients with a STEMI who were transported by helicopter has also fallen since 2016 (n=83, 6%) (HSE, 2018a).



**FIGURE 5.2:** REFERRAL SOURCE TO A PERCUTANEOUS CORONARY INTERVENTION CENTRE FOR ALL PATIENTS, BY YEAR (N=5629)

## LOCATION WHERE FIRST STEMI-POSITIVE ECG WAS PERFORMED

The location where the first reported positive 12-lead ECG was performed for all patients brought to a PCI centre is displayed in Table 5.1. From 2017 to 2020, it was reported that most patients with a STEMI had their first positive ECG performed in a pre-hospital location by ambulance personnel (n=2919, 52%); this was an increase from 47% in 2016 (HSE, 2018a). Forty-one percent (n=2306) of first STEMI-positive ECGs were reported to have been performed in the ED (which was unchanged from 2016), and 3% (n=188) were performed in a GP surgery, a decline from 6% in 2016. The increase in pre-hospital ambulance ECG diagnoses in 2020, corresponding with a drop in ED and GP diagnoses, may reflect the impact of the COVID-19 pandemic.

**TABLE 5.1:** LOCATION WHERE FIRST POSITIVE ELECTROCARDIOGRAM WAS RECORDED, BY YEAR (N=5629)

	2017		2018		2019		2020	
	N	%	N	%	N	%	N	%
12-lead ECG performed pre-hospital by ambulance personnel	748	52%	747	50%	682	49%	742	57%
12-lead ECG performed in ED	580	41%	640	43%	604	43%	482	37%
12-lead ECG performed in GP office	48	3%	66	4%	*	*	31	2%
12-lead ECG performed in other location (hospital ward, Coronary Care Unit, etc.)	45	3%	*	*	69	5%	45	3%
Unknown	*	*	~	*	~	*	0	0%
Total	1427	100%	1502	100%	1400	100%	1300	100%

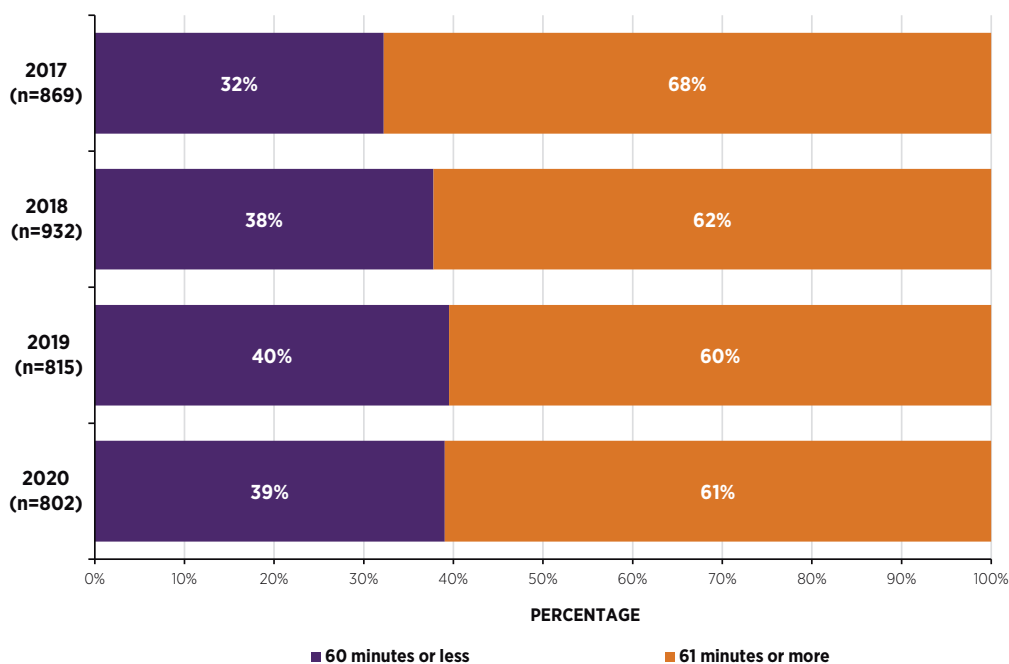
- Denotes five cases or fewer

\* Further suppression required in order to prevent disclosure of five cases or fewer

## INTERVAL FROM ONSET OF SYMPTOMS TO CALL FOR HELP

The quicker a person who is experiencing heart attack symptoms calls for help, the more likely they are to receive timely treatment, thereby reducing damage to the heart. For those who arrived at a PCI centre directly by ambulance, the call for help time is the time that the 112 or 999 call was received in the ambulance dispatch centre. For patients with a STEMI who were transferred from a hospital to a PCI centre, the call for help time is the time that the patient arrived at the first hospital. Patients who were already inpatients at the time of a STEMI diagnosis, or patients for whom one or both time variables needed in order to calculate this interval were missing, were excluded from this analysis (see Appendix 6).

Data on the interval from symptom onset to call for help were available for 3,418 patients with a STEMI. Figure 5.3 shows the proportion of patients with a STEMI whose interval between the time of symptom onset and the time of the call for help was within 60 minutes. Over the 4-year reporting period, the interval between symptom onset and call for help was within 60 minutes for 37% (n=1267) of patients with a STEMI. A larger proportion of male patients (n=1029, 38%) compared with female patients (n=238, 32%) had an interval between symptom onset and call for help within 60 minutes; this difference was statistically significant ( $p < 0.05$ ). There was an increase over the reporting period in the proportion of patients with a time interval of 60 minutes or less, from 32% (n=280; overall median time: 116 minutes; IQR: 50–270 minutes) in 2017 to 39% (n=313; overall median time: 93 minutes; IQR: 36–226 minutes) in 2020 ( $p < 0.05$ ).



**FIGURE 5.3:** PROPORTION OF PATIENTS WITH AN ST ELEVATION MYOCARDIAL INFARCTION WITH A SYMPTOM ONSET TO CALL FOR HELP INTERVAL WITHIN 60 MINUTES, BY YEAR (n=3418)<sup>12</sup>

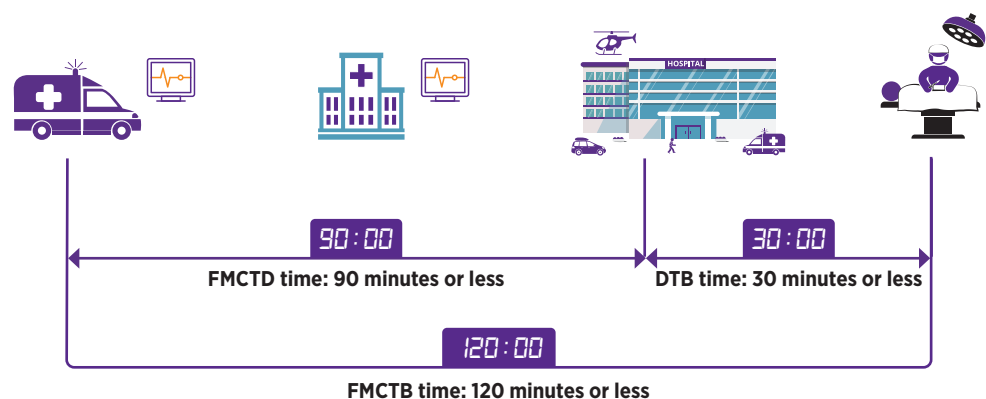
<sup>12</sup> Patients for whom time information was not recorded or was recorded incorrectly were excluded from Figure 5.3 (n=496). St James's Hospital was excluded (n=919) from the 'direct via ambulance' analysis due to differences in the method of data collection for call for help date and time, see specifications for composite variable in Appendix 6.

## INTERVAL FROM FIRST MEDICAL CONTACT TO ARRIVAL AT PCI CENTRE

It is recommended that all patients with a STEMI be considered for primary PCI unless the estimated interval between first medical contact (FMC) and arrival at a PCI centre exceeds 90 minutes. If the estimated travel time exceeds 90 minutes, thrombolysis should be administered (HSE, 2012). The National Clinical Programme for Acute Coronary Syndrome recommends transferring thrombolysed patients to a PCI centre as soon as possible in order to ensure that either rescue angioplasty can be performed in a timely manner if needed, or angiography can be performed within 3–24 hours. Patients who had thrombolysis as a primary reperfusion strategy were excluded from analysis of timeliness to a PCI centre. Timeliness for this group of patients will be discussed in Chapter 6.

Timeliness of reperfusion has been reported as a national key performance indicator since 2013. Timely primary PCI is considered to have been achieved when the time between FMC and balloon/wire cross is 120 minutes or less (HSE, 2012; Hamm *et al.*, 2011).

The target of 120 minutes or less includes two key time intervals. The first is the interval from FMC to arrival at the PCI centre, referred to as ‘FMC to door’ (FMCTD) time. The ORS goal for FMCTD is 90 minutes or less. The second is the interval between arrival at the PCI centre and the time of reperfusion (balloon/wire cross). This is referred to as the ‘door to balloon’ (DTB) time and the goal is 30 minutes or less. The complete patient pathway is referred to as ‘FMC to balloon’ (FMCTB) time, which has a goal of 120 minutes or less (Figure 5.4). Chapter 6 will report on the DTB and FMCTB times.



**FIGURE 5.4:** TIME INTERVAL GOALS

## FIRST MEDICAL CONTACT TO DOOR TIME

The median and IQR interval between FMC and arrival at a PCI centre by year and hospital are displayed in Figure 5.5B for those who arrived directly by ambulance, and are displayed in Figure 5.6B for those who were transferred to a PCI centre (see Appendix 6). For all patients transported to a PCI centre for primary PCI during the 4-year reporting period, the median FMCTD time was 74 minutes (IQR: 45–115 minutes).

**QUICKER IS BETTER**

## FMCTD TIME – DIRECT BY AMBULANCE

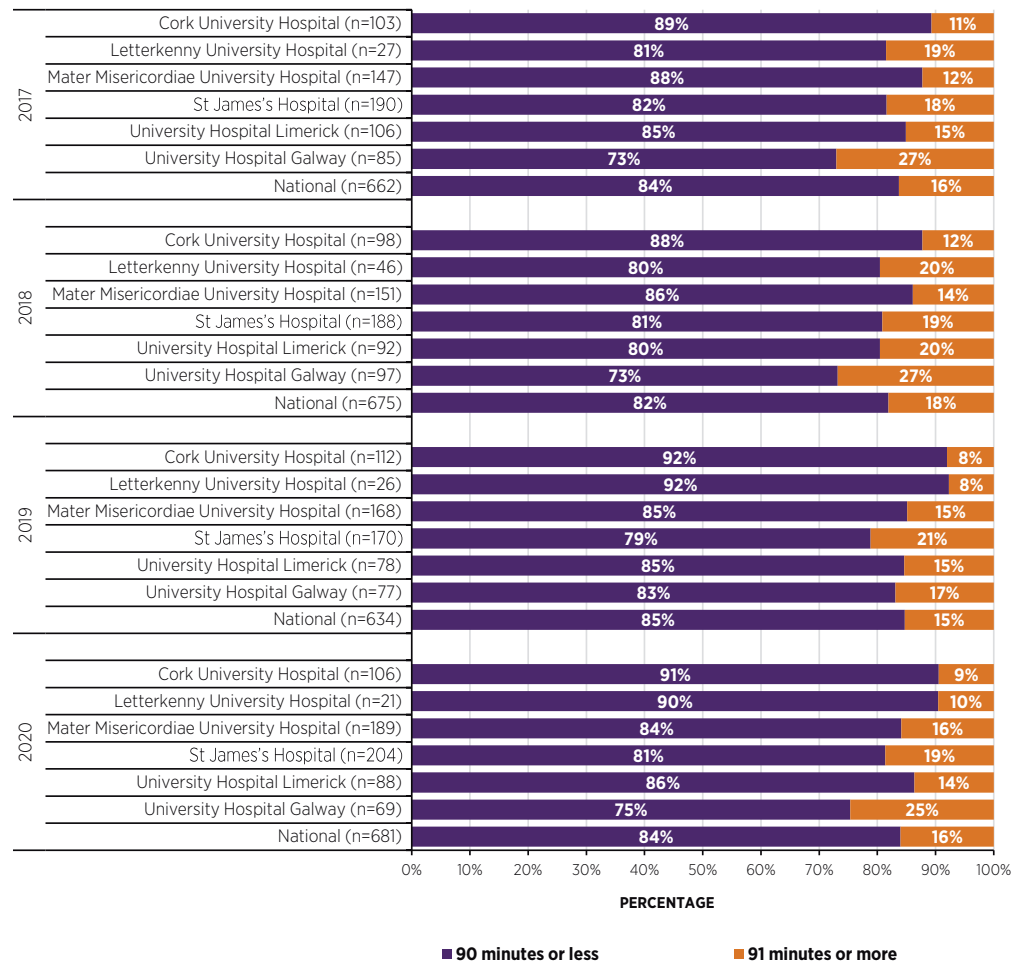
Patients with a STEMI who are brought directly by ambulance to a PCI centre should arrive at the PCI centre in 90 minutes or less (HSE, 2012). For patients with a STEMI who arrive directly by ambulance for primary PCI, the time of FMC is defined as the time of the first positive ECG performed by an ambulance practitioner. Of the patients who arrived at the PCI centre directly by ambulance over the reporting period (n=3225), 84% (n=2705) were reported to have had a 12-lead ECG performed by an ambulance practitioner. The date and time of FMC was recorded correctly for 98% (n=2652) of those patients. Figure 5.5A shows the proportion of patients with a STEMI who arrived at the PCI centre within the target of 90 minutes or less, by PCI centre and year. Between 2017 and 2020, a total of 84% (n=2216) of cases were recorded as having achieved a timely FMCTD time.

Figure 5.5B shows the median time between first positive 12-lead ECG and arrival at a PCI centre for patients arriving directly by ambulance. The national median for the 4-year reporting period was 55 minutes (IQR: 38–80 minutes). The median time interval increased over the reporting period, from 55 minutes in 2017 to 59 minutes in 2020 (2018: 54 minutes; 2019: 57 minutes).



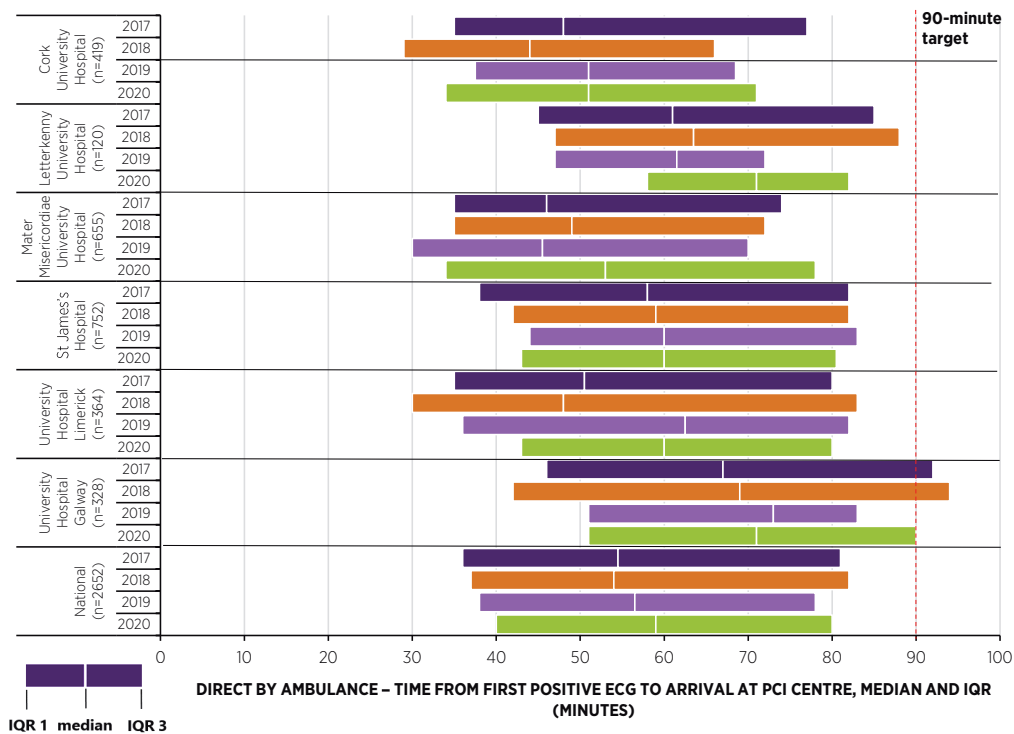
**84% of patients with STEMI brought directly to the PCI centre arrived within the 90 minute or less target**





**FIGURE 5.5A:** PROPORTION OF PATIENTS WITH AN ST ELEVATION MYOCARDIAL INFARCTION WHO ARRIVED DIRECTLY BY AMBULANCE WITHIN THE TARGET TIME OF 90 MINUTES, BY PERCUTANEOUS CORONARY INTERVENTION CENTRE AND YEAR (n=2652)<sup>13</sup>

<sup>13</sup> Patients who had hospital or pre-hospital thrombolysis (n=8), and patients for whom time information was not recorded or was recorded incorrectly (n=53), were excluded. Only patients who had their 12-lead ECG performed by ambulance practitioner are included in the analysis. Hospitals: Beaumont Hospital, St Vincent's University Hospital, and Tallaght University Hospital are not presented in Figure 5.5A, as they had fewer than five patients, but were included in the national figures for each year.



**FIGURE 5.5B:** FIRST MEDICAL CONTACT TO DOOR TIME FOR PATIENTS WHO ARRIVED DIRECTLY BY AMBULANCE, BY HOSPITAL AND YEAR (n=2652)<sup>14</sup>

<sup>14</sup> Patients who had hospital or pre-hospital thrombolysis (n=8), and patients for whom time information was not recorded or was recorded incorrectly (n=53), were excluded. Only patients who had their 12-lead ECG performed by an ambulance practitioner are included in the analysis. Hospitals: Beaumont Hospital, St Vincent's University Hospital, and Tallaght University Hospital are not presented in Figure 5.5B, as they had fewer than 10 patients, but were included in the national figures for each year.

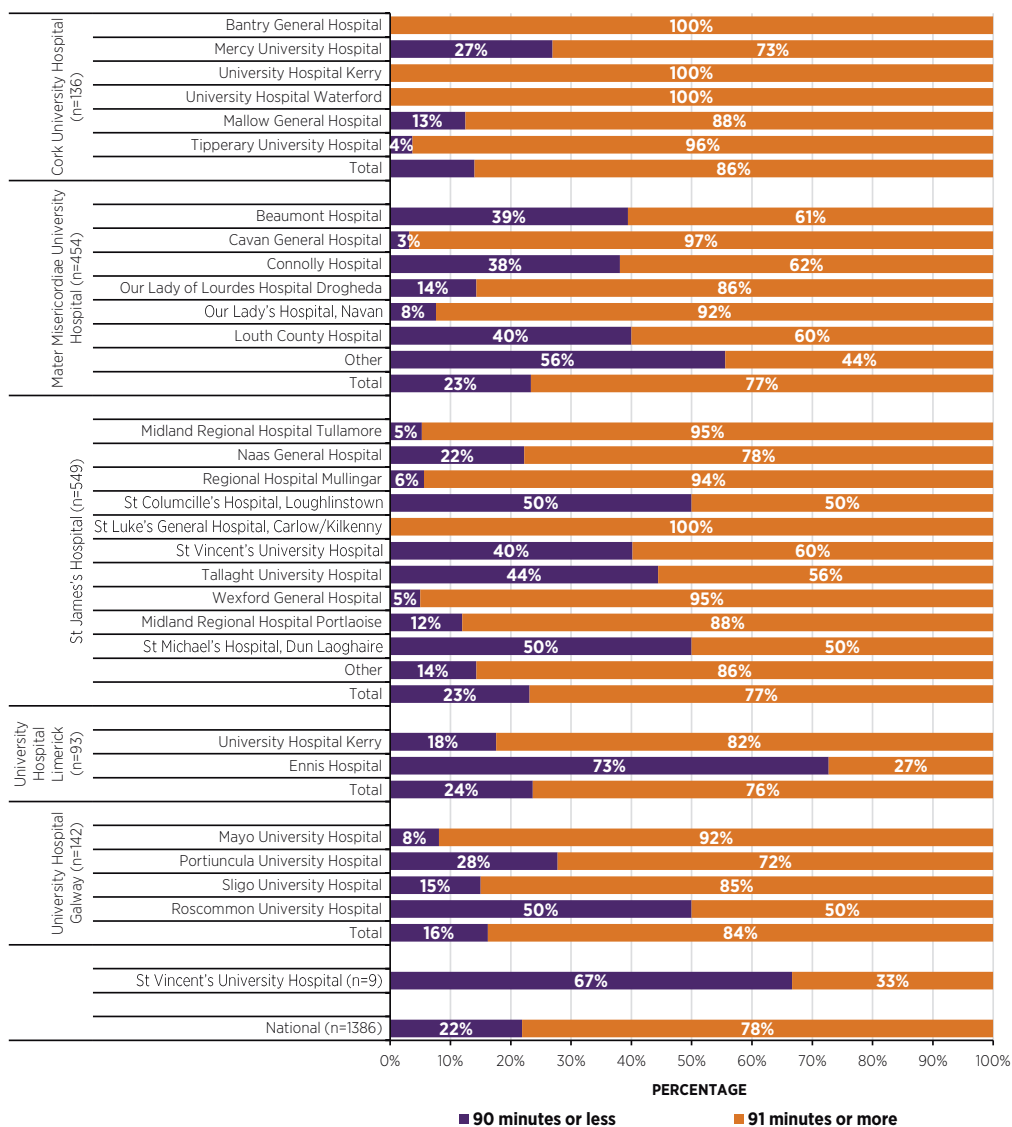
## FMCTD TIME – TRANSFERRED FROM FIRST HOSPITAL

Patients with a STEMI who are transferred from another hospital to a PCI centre should arrive at the PCI centre in 90 minutes or less (HSE, 2012). For the purposes of calculating this interval, the time a patient arrived at the first hospital was defined as the time of FMC. Over the 4-year reporting period, 22% (n=303) of transferred patients were transferred from their first hospital to a PCI centre within 90 minutes. Figure 5.6A shows the proportion of patients with a STEMI who were transferred from another hospital to a PCI centre by hospital, over the 4-year reporting period.



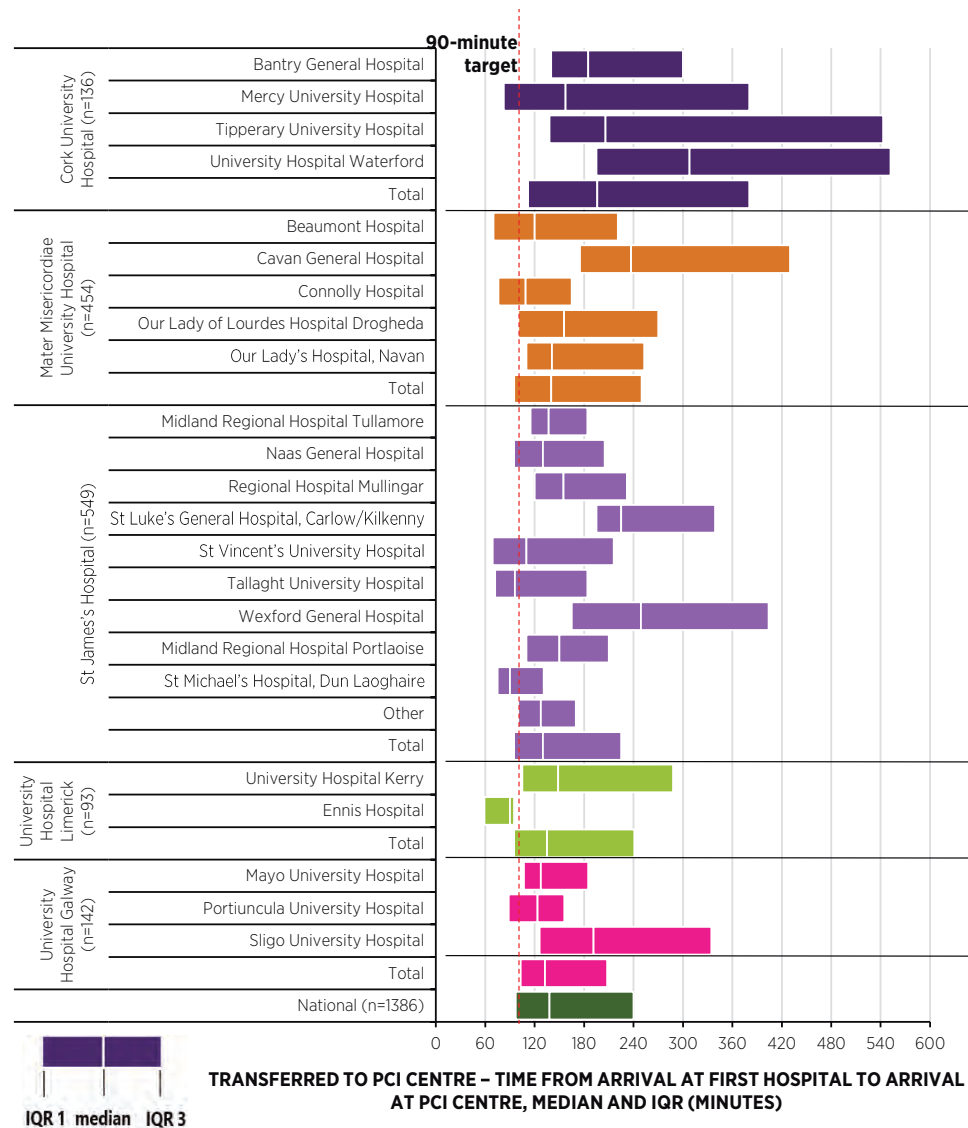
**Only 22% of patients with STEMI transferred to the PCI centre arrived within the 90 minute or less target**

As previously stated, the faster a patient is transferred to a PCI centre for primary PCI the more likely a timely reperfusion is to occur. The median FMCTD time for all transferred patients from 2017 to 2020 was 138 minutes. Figure 5.6B shows the median and IQR intervals for FMCTD time for transferred patients from 2017 to 2020. The median times and IQRs for each year were as follows: 2017: 132 minutes (IQR: 94–220 minutes); 2018: 142 minutes (IQR: 96–237 minutes); 2019: 145 minutes (IQR: 105–265 minutes); and 2020: 131 minutes (IQR: 95–245 minutes).



**FIGURE 5.6A:** PROPORTION OF PATIENTS WITH AN ST ELEVATION MYOCARDIAL INFARCTION WHO WERE TRANSFERRED, WHO ARRIVED WITHIN THE TARGET TIME OF 90 MINUTES, BY PERCUTANEOUS CORONARY INTERVENTION CENTRE, 2017-2020 (n=1386)<sup>15</sup>

<sup>15</sup> Patients who had hospital or pre-hospital thrombolysis (n=167), and patients for whom time information was not recorded or was recorded incorrectly (n=40), were excluded. Hospitals: Beaumont Hospital and Tallaght University Hospital were excluded individually from Figure 5.6A, as they had fewer than five patients, but were included in the national total.



**FIGURE 5.6B:** FIRST MEDICAL CONTACT TO DOOR TIME FOR PATIENTS WHO WERE TRANSFERRED, BY HOSPITAL, 2017–2020 (n=1386)<sup>16</sup>

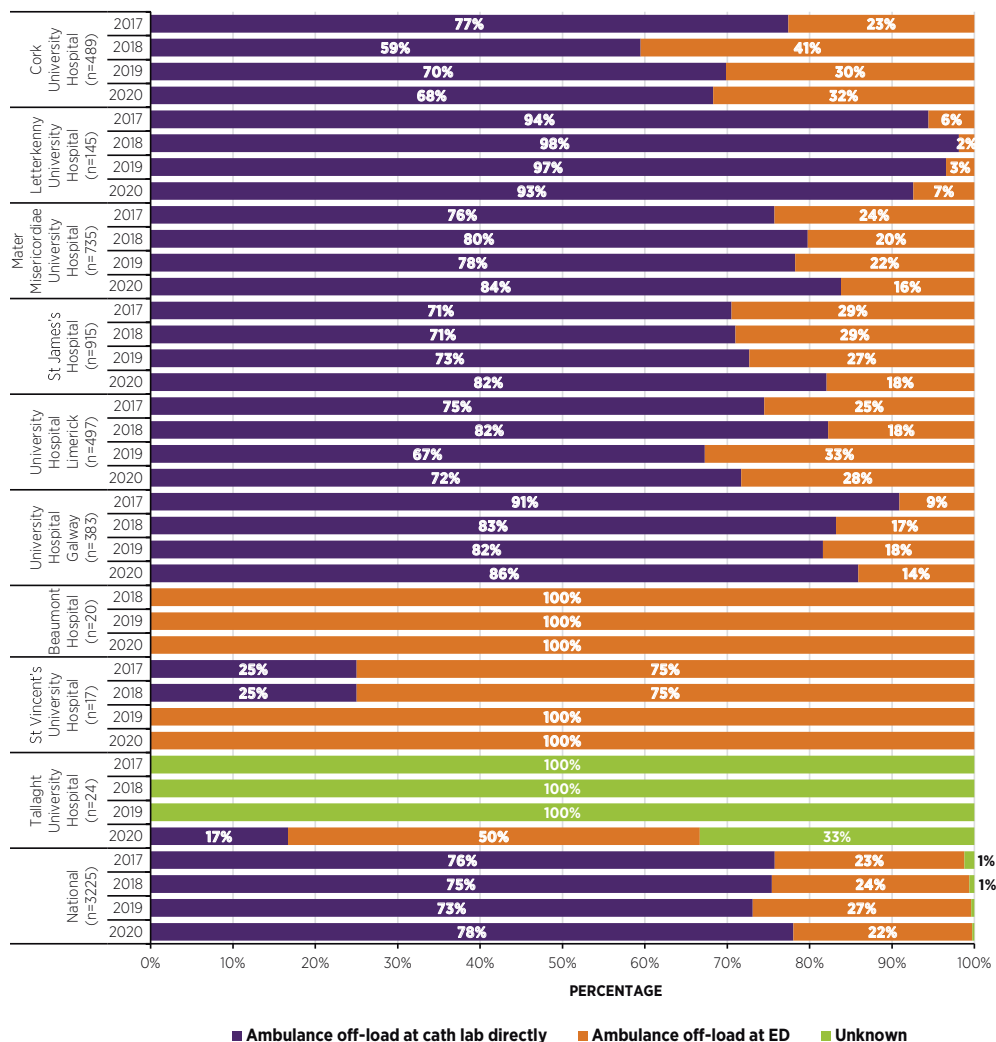
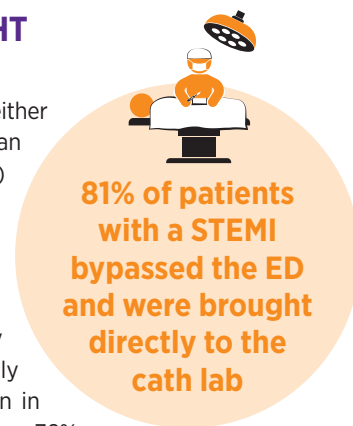
From the data presented in Figures 5.5A and 5.6A, it is clear that there are systematic issues with patient transfer between non-PCI hospitals and PCI centres. These delays cannot be explained purely on the basis of geographical distance. With the exceptions of West Cork, West Kerry, portions of the Southeast, Northern Mayo, and West Donegal, previous mapping exercises have demonstrated that most other locations are within a 90-minute drive of a PCI centre. Geographical distance therefore cannot explain why hospitals within the same city cannot achieve hospital-to-hospital transfer times of less than 90 minutes. Delays in ECG diagnosis, diagnosis recognition, communication delays between the non-PCI hospital clinical team and PCI centre clinical team, delayed ‘door in door out’ times from non-PCI hospitals, prioritisation of STEMI transfers by the ambulance service, ambulance response times, and ambulance transfer times are all likely contributors to these FMCTD time delays and should be the focus of quality improvement initiatives to improve the FMC to reperfusion times and are a recommendation of this report (see Chapter 9).

<sup>16</sup> Patients who had hospital or pre-hospital thrombolysis (n=167), and patients for whom time information was not recorded or was recorded incorrectly (n=40), were excluded. Hospitals: Beaumont Hospital and Tallaght University Hospital were excluded individually from Figure 5.6B, as they had fewer than 10 patients, but were included in the national total.

## AMBULANCE OFF-LOAD LOCATION FOR PATIENTS BROUGHT FOR PRIMARY PCI

Patients with a STEMI who are brought by ambulance for primary PCI can be brought either directly to the cath lab or to the ED. The European Society of Cardiology recommends an ED bypass direct to the cath lab (Ibanez *et al.*, 2018). From 2017 to 2020, 81% (n=3763) of patients with a STEMI were brought to the cath lab and 19% (n=868) were brought to the ED. Figure 5.7A shows the location of ambulance off-load, by hospital and year, for patients who arrived at the PCI centre directly by ambulance, and Figure 5.7B shows the location of ambulance off-load for patients who were transferred to a PCI centre.

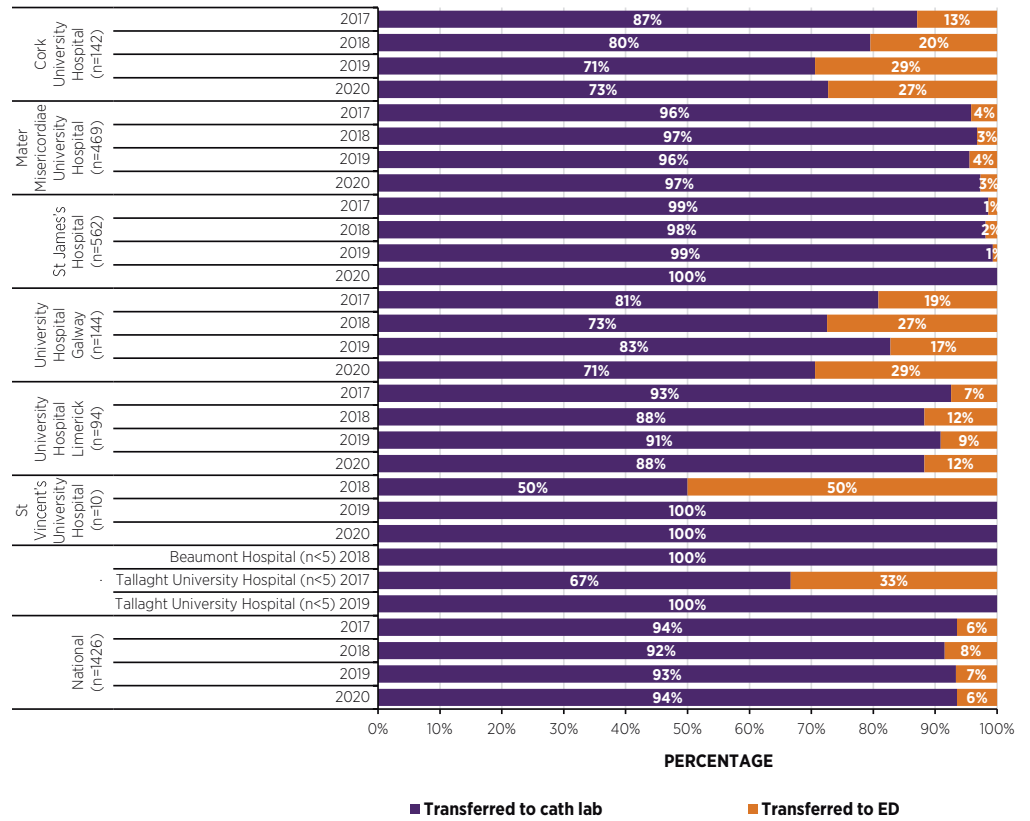
Between 2017 and 2020, a total of 3,225 patients with a STEMI were brought directly for primary PCI by ambulance. Of those patients, 2,438 (76%) were brought directly to the cath lab and 767 (24%) were brought to the ED. There was a small variation in the proportion of patients brought directly to a cath lab over the reporting period, from 76% (n=628) in 2017 to 75% (n=629) in 2018, 73% (n=560) in 2019, and 78% (n=621) in 2020.



**FIGURE 5.7A:** LOCATION OF AMBULANCE OFF-LOAD AT THE PERCUTANEOUS CORONARY INTERVENTION CENTRE FOR PATIENTS WHO ARRIVED DIRECTLY BY AMBULANCE, BY HOSPITAL AND YEAR (n=3225)<sup>17</sup>

<sup>17</sup> Patients who had hospital and pre-hospital thrombolysis were excluded from this analysis.

Figure 5.7B shows ambulance off-load location for patients who were transferred from another hospital to a PCI centre. Between 2017 and 2020, 93% (n=1325) of transferred patients with a STEMI were brought to the cath lab and 7% (n=101) were brought to the ED.

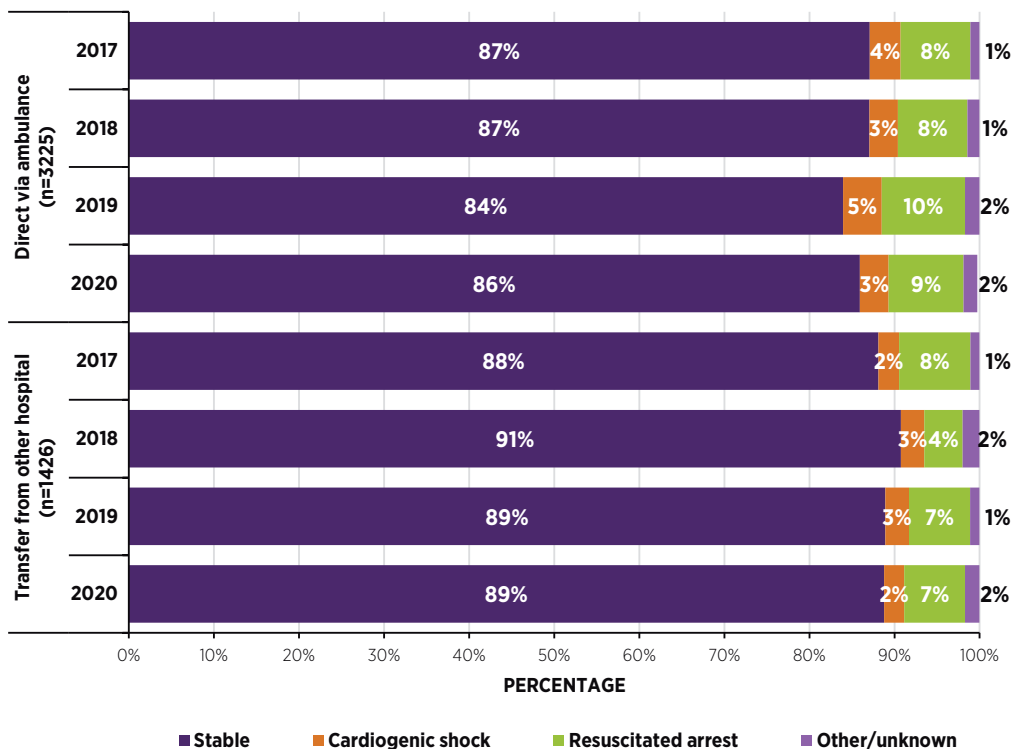


**FIGURE 5.7B:** LOCATION OF AMBULANCE OFF-LOAD AT THE PERCUTANEOUS CORONARY INTERVENTION CENTRE FOR PATIENTS WHO WERE TRANSFERRED, BY HOSPITAL AND YEAR (n=1426)<sup>18</sup>

<sup>18</sup> Patients who had hospital and pre-hospital thrombolysis were excluded from this analysis.

### CLINICAL STATUS ON ARRIVAL AT THE PCI CENTRE

During the 4-year reporting period, 4,651 patients with a STEMI were either admitted directly via ambulance or were transferred from other hospitals to a PCI centre for primary PCI. The majority (n=4047, 87%) of those patients were stable on admission to the PCI centre. Figure 5.8 shows clinical status on admission for patients with a STEMI who arrived directly via ambulance and for those who were transferred from other hospitals for each of the reporting years.



**FIGURE 5.8:** CLINICAL STATUS ON ARRIVAL AT A PERCUTANEOUS CORONARY INTERVENTION CENTRE FOR PATIENTS BROUGHT FOR PRIMARY PERCUTANEOUS CORONARY INTERVENTION, BY MODE OF ARRIVAL AND YEAR (n=4651)<sup>19</sup>

<sup>19</sup> Patients who had hospital and pre-hospital thrombolysis were excluded from this analysis.



## KEY FINDINGS FROM CHAPTER 5

- Over the 4-year reporting period, only 37% (n=1267) of patients with a STEMI called for help within 60 minutes of symptom onset.

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- The majority (n=3240, 58%) of patients with a STEMI arrived at a PCI centre directly by ambulance. A substantial proportion of patients (n=1593, 28%) were transferred to a PCI centre from another hospital.

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- For patients with a STEMI who were transported directly by ambulance to a PCI centre, 84% (n=2216) arrived within 90 minutes or less.

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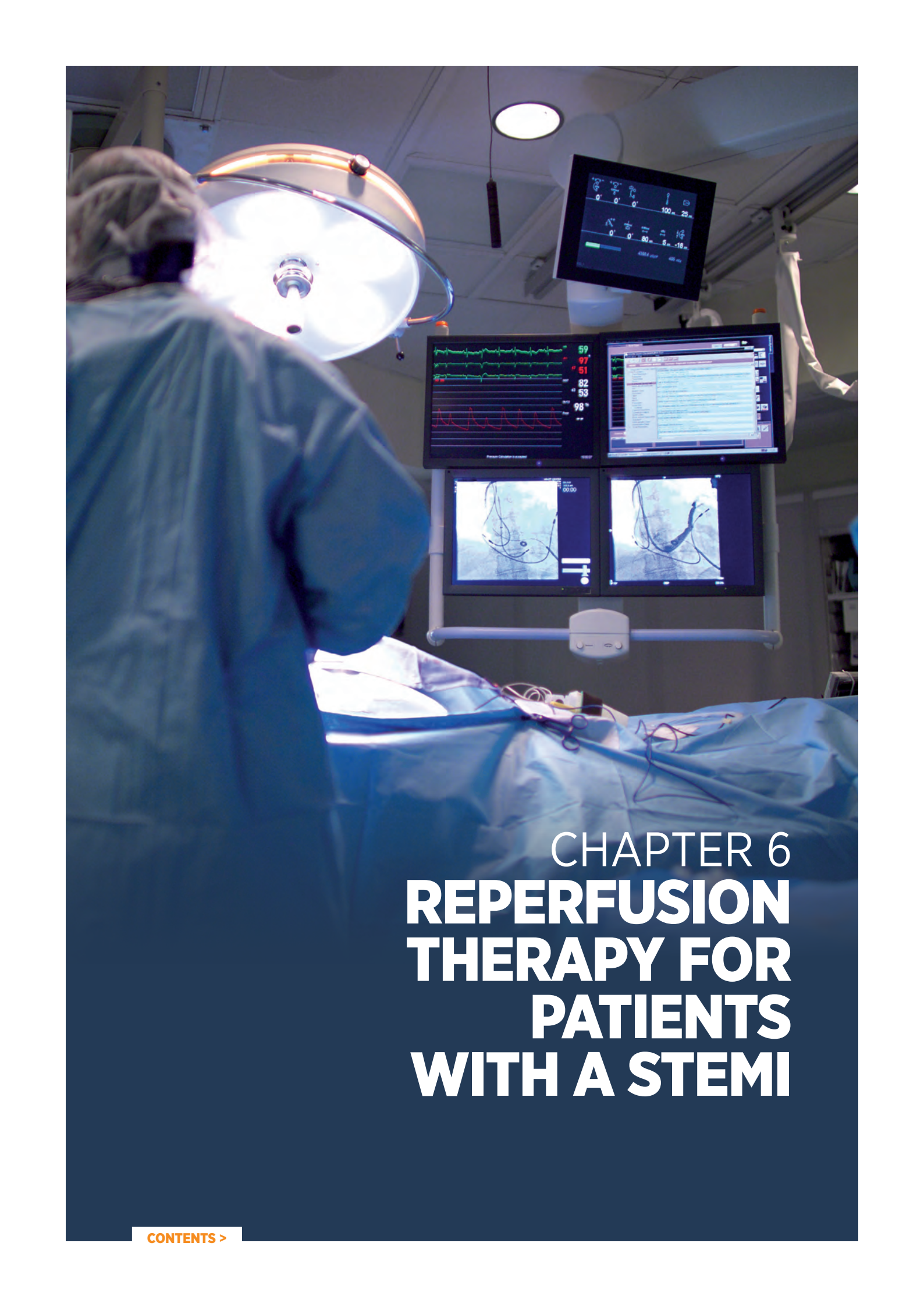
- For patients with a STEMI who were transferred from another hospital to a PCI centre, only 22% (n=303) arrived within 90 minutes or less.

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- From 2017 to 2020, 81% (n=3763) of patients with a STEMI who were transported by ambulance for primary PCI were brought to the cath lab and 19% (n=868) were brought to the ED.

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# CHAPTER 6 REPERFUSION THERAPY FOR PATIENTS WITH A STEMI

## CHAPTER 6: REPERFUSION THERAPY FOR PATIENTS WITH A STEMI

### SCOPE OF CHAPTER 6

Chapter 5 described the pathway that patients with a suspected STEMI follow to a PCI centre and the key time intervals from FMC to the door of the PCI centre. It highlighted differences in the time taken to reach a PCI centre depending on whether a patient is brought directly by ambulance to the PCI centre or transferred from another acute hospital. Chapter 6 will describe the reperfusion therapy received by all patients with a STEMI, as recorded on the Heartbeat portal. It includes an analysis of those cases where reperfusion was contraindicated and reports on the timeliness of the two types of reperfusion therapy: primary PCI and thrombolysis. Measuring the timeliness of reperfusion is complex and varies depending on how a patient accesses STEMI care. In this chapter, timeliness is also reported using two key time intervals: (1) 'door to balloon' time and (2) 'FMC to balloon' (FMCTB) time. This chapter will compare the difference in time intervals between patients who were admitted directly to the PCI centre (brought directly by ambulance, self-presented to the PCI centre, or had a STEMI while already an inpatient in the PCI centre) and patients who were transferred from another acute hospital to the PCI centre. Appendix 6 provides detailed definitions of the composite variables reported in this chapter.

### REPERFUSION THERAPY TYPE

As outlined in Chapter 1, reperfusion therapy is the treatment provided for patients with a STEMI that aims to reopen the occluded (blocked) artery responsible for the heart attack in a timely fashion, restoring blood flow and helping to minimise long-term heart injury. It can be delivered either as a drug therapy (thrombolysis) or as an interventional treatment using balloon/stent PCI. Primary PCI has been shown to be a more effective treatment than thrombolysis, provided that it can be delivered in a timely fashion. It is recommended that all patients with a STEMI be considered for primary PCI. Where primary PCI cannot be delivered within a clinically acceptable time frame (transfer to a PCI centre within 90 minutes; FMC to reperfusion target of 120 minutes or less), thrombolysis is recommended, with early transfer to a PCI centre for angiography (HSE, 2012). This target of 120 minutes or less is a key performance indicator (KPI) of the National Clinical Programme for Acute Coronary Syndrome optimal reperfusion service (ORS) protocol. From 2017 to 2020, a total of 5,629 patients were diagnosed with a STEMI and recorded on the Heartbeat portal. The vast majority (n=5111, 91%) of patients with a STEMI were eligible for reperfusion.

The type of reperfusion therapy performed for patients with a STEMI who were admitted to a PCI centre is displayed in Table 6.1. The majority of patients with a STEMI admitted from 2017 to 2020 received primary PCI (n=4743, 84%), while 3% (n=178) received thrombolysis and 9% (n=492) had an established medical contraindication to reperfusion therapy, most commonly due to late presentation with a STEMI (Figure 6.2). In some cases, angiography demonstrated normal coronary anatomy or non-obstructive coronary artery disease (narrowing/lesion  $\leq$ 50%). Mechanical reperfusion was not indicated in these cases. Other patients had severe triple vessel or left main disease; in these cases, where immediate reperfusion was not felt to be appropriate, a decision on the modality of revascularisation, if appropriate, was deferred. Three percent (n=190) of patients with a STEMI who had no contraindication to reperfusion therapy did not require reperfusion.

For the remainder of this chapter, the analysis of timeliness of reperfusion excludes patients with a contraindication to reperfusion therapy.

**TABLE 6.1: FIRST REPERFUSION THERAPY TYPE FOR PATIENTS ADMITTED TO A PERCUTANEOUS CORONARY INTERVENTION CENTRE WITH A CONFIRMED ST ELEVATION MYOCARDIAL INFARCTION, BY HOSPITAL & YEAR (N=5629)<sup>21</sup>**

		2017		2018		2019		2020	
		N	%	N	%	N	%	N	%
Cork University Hospital	Thrombolysis	*	*	16	7%	20	9%	20	10%
	Primary PCI	158	79%	140	64%	149	67%	135	65%
	No reperfusion required	0	0%	0	0%	~	*	*	*
	Contraindicated	29	15%	64	29%	52	23%	43	21%
	Unknown	~	*	0	0%	0	0%	0	0%
	<b>Total</b>	<b>200</b>	<b>100%</b>	<b>220</b>	<b>100%</b>	<b>222</b>	<b>100%</b>	<b>209</b>	<b>100%</b>
Letterkenny University Hospital	Primary PCI	45	100%	60	91%	*	*	*	*
	No reperfusion required	0	0%	~	*	0	0%	~	*
	Contraindicated	0	0%	~	*	~	*	0	0%
	<b>Total</b>	<b>45</b>	<b>100%</b>	<b>66</b>	<b>100%</b>	<b>44</b>	<b>100%</b>	<b>46</b>	<b>100%</b>
Mater Misericordiae University Hospital	Thrombolysis	0	0%	0	0%	~	*	~	*
	Primary PCI	266	82%	291	86%	268	81%	303	89%
	No reperfusion required	~	*	13	4%	35	11%	28	8%
	Contraindicated	45	14%	35	10%	*	*	*	*
	Unknown	*	*	0	0%	0	0%	~	*
	<b>Total</b>	<b>323</b>	<b>100%</b>	<b>339</b>	<b>100%</b>	<b>330</b>	<b>100%</b>	<b>342</b>	<b>100%</b>
St James's Hospital	Thrombolysis	6	1%	7	2%	9	2%	17	4%
	Primary PCI	389	93%	397	93%	374	92%	355	93%
	No reperfusion required	16	4%	11	3%	*	*	*	*
	Contraindicated	6	1%	11	3%	9	2%	~	*
	Unknown	0	0%	~	*	~	*	0	0%
	<b>Total</b>	<b>417</b>	<b>100%</b>	<b>427</b>	<b>100%</b>	<b>407</b>	<b>100%</b>	<b>383</b>	<b>100%</b>
University Hospital Galway	Thrombolysis	21	11%	18	8%	18	12%	9	8%
	Primary PCI	151	79%	166	78%	126	82%	86	75%
	No reperfusion required	*	*	11	5%	~	*	*	*
	Contraindicated	11	6%	19	9%	*	*	11	10%
	Unknown	~	*	0	0%	0	0%	~	*
	<b>Total</b>	<b>192</b>	<b>100%</b>	<b>214</b>	<b>100%</b>	<b>154</b>	<b>100%</b>	<b>115</b>	<b>100%</b>
University Hospital Limerick	Thrombolysis	0	0%	0	0%	~	*	0	0%
	Primary PCI	196	92%	169	92%	171	89%	143	89%
	No reperfusion required	0	0%	~	*	~	*	~	*
	Contraindicated	*	*	12	7%	16	8%	14	9%
	Unknown	~	*	*	*	~	*	*	*
	<b>Total</b>	<b>213</b>	<b>100%</b>	<b>183</b>	<b>100%</b>	<b>193</b>	<b>100%</b>	<b>160</b>	<b>100%</b>
Beaumont Hospital	Thrombolysis	n/a	n/a	0	0%	0	0%	~	*
	Primary PCI	n/a	n/a	*	*	13	59%	*	*
	No reperfusion required	n/a	n/a	~	*	0	0%	0	0%
	Contraindicated	n/a	n/a	8	50%	9	41%	10	56%
		<b>Total</b>	<b>n/a<sup>20</sup></b>	<b>n/a</b>	<b>16</b>	<b>100%</b>	<b>22</b>	<b>100%</b>	<b>18</b>
St Vincent's University Hospital	Primary PCI	*	*	*	*	*	*	13	81%
	No reperfusion required	0	0%	0	0%	~	*	~	*
	Contraindicated	~	*	~	*	0	0%	~	*
	<b>Total</b>	<b>16</b>	<b>100%</b>	<b>17</b>	<b>100%</b>	<b>13</b>	<b>100%</b>	<b>16</b>	<b>100%</b>
Tallaght University Hospital	Primary PCI	12	57%	14	70%	*	*	*	*
	No reperfusion required	~	*	0	0%	~	*	0	0%
	Contraindicated	*	*	6	30%	7	47%	~	*
	Total	21	100%	20	100%	15	100%	11	100%
Total	Thrombolysis	39	3%	*	*	50	4%	48	4%
	Primary PCI	1232	86%	1257	84%	1160	83%	1094	84%
	No reperfusion required	30	2%	42	3%	57	4%	*	*
	Contraindicated	113	8%	160	11%	126	9%	93	7%
	Unknown	13	1%	~	*	7	1%	~	*
	<b>Total</b>	<b>1427</b>	<b>100%</b>	<b>1502</b>	<b>100%</b>	<b>1400</b>	<b>100%</b>	<b>1300</b>	<b>100%</b>

Note: n/a = not applicable

Rows shaded in gray indicate primary PCI centres providing primary PCI from 9.00am to 5.00pm, Monday to Friday to patients with a STEMI who self-present to the PCI centre or are already inpatients.

~ Denotes five cases or fewer

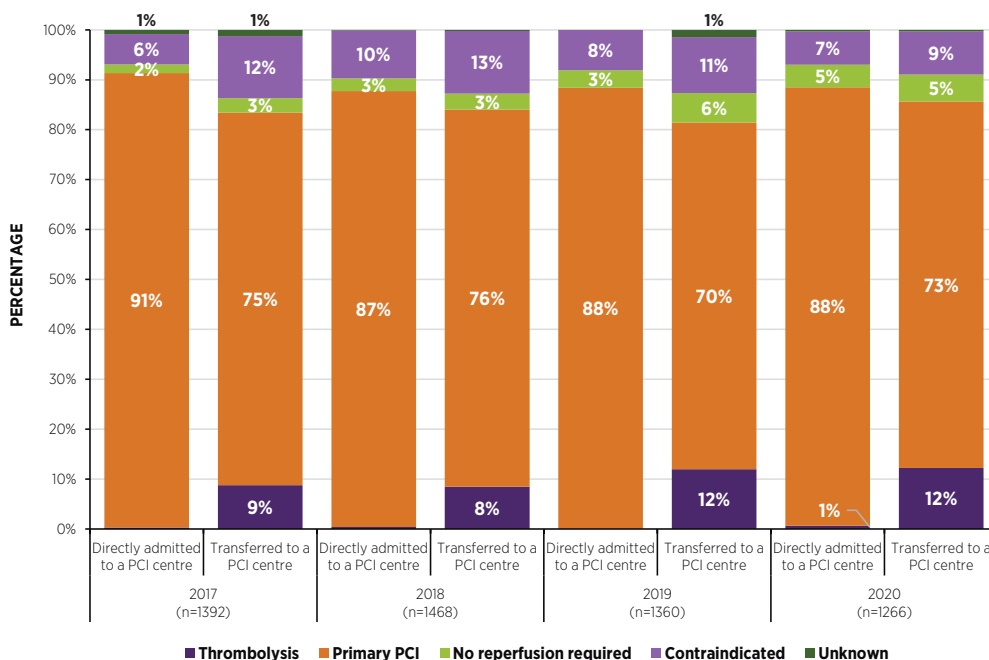
\* Further suppression required in order to prevent disclosure of five cases or fewer

<sup>20</sup> Beaumont Hospital had no data recorded during 2017.

<sup>21</sup> 24 cases were identified as contraindicated and had a reperfusion therapy recorded. Those cases were included in the 'Unknown' category.

Timely primary PCI is recognised internationally as the preferred treatment for STEMI (Ibanez *et al.*, 2018). Where primary PCI cannot be delivered within a clinically acceptable time frame, thrombolysis is recommended, with early transfer to a PCI centre for angiography (HSE, 2012). How a patient accesses care may influence the type of reperfusion therapy they receive. If a patient self-presents with a STEMI to a non-PCI hospital, and if an interhospital transfer cannot be achieved within a timely fashion (departure from transfer hospital within 30 minutes and reperfusion performed within 90 minutes), the patient should be treated with thrombolysis and subsequently transferred to a PCI centre (sometimes called the ‘drip-and-ship’ strategy). This is because up to one-third of patients will fail to reperfuse after thrombolysis and may need emergent rescue PCI. If a patient can be transferred to a PCI centre in 90 minutes or less, the European Society of Cardiology (ESC) recommends that the time between arrival at the hospital and departure to a PCI centre should be within 30 minutes (Ibanez *et al.*, 2018). This is known as the ‘door in door out’ (DIDO) time. The type of reperfusion therapy by referral source is displayed in Figure 6.1.

The vast majority of patients with a STEMI who presented directly to a PCI centre from 2017 to 2020 were treated with primary PCI (n=3451, 89%), while 10% (n=163) of patients presenting with a STEMI to non-PCI hospitals were treated with thrombolysis.



**FIGURE 6.1:** REPERFUSION THERAPY TYPE, BY REFERRAL SOURCE AND YEAR (n=5486)<sup>22,23,24</sup>

<sup>22</sup> Cases that were identified as contraindicated and had a reperfusion therapy recorded (n=24) were included in the ‘Unknown’ category.

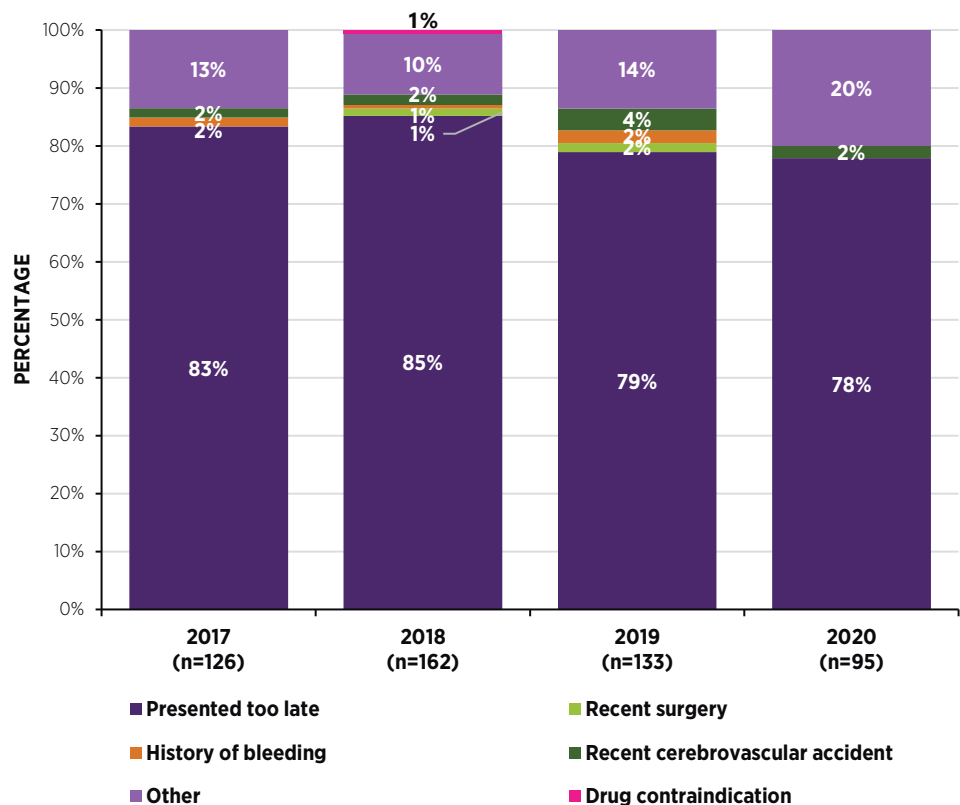
<sup>23</sup> ‘Directly admitted to a PCI centre’ includes patients who arrived at the PCI centre directly via ambulance, inpatients, and patients who self-presented to a PCI centre.

<sup>24</sup> Patients for whom the source of referral was not recorded, or was recorded as ‘Other’, were excluded from Figure 6.1 (n=143).

### REASONS FOR CONTRAINDICATION TO REPERFUSION THERAPY

The aim of the optimal reperfusion service (ORS) protocol, as described in Chapter 1, is to maximise the number of patients with a STEMI accessing reperfusion therapy following a heart attack and to optimise the timeliness of that reperfusion therapy. In some cases, patients with a STEMI are not eligible for reperfusion therapy and these cases are recorded as ‘contraindicated’. The percentage of patients who had contraindications to reperfusion therapy over the reporting period is displayed in Figure 6.1.

From 2017 to 2020, a total of 516 patients had contraindications to reperfusion therapy. Figure 6.2 shows the distribution of reasons for contraindication by year. In the majority of cases, reperfusion therapy was contraindicated because the patient presented to a PCI centre too late (n=422, 82%). The proportion of patients for whom reperfusion therapy was contraindicated because they presented too late decreased from 83% (n=105) in 2017 to 78% (n=74) in 2020. Late presentation may reflect delayed symptom recognition by the patient; delays in contacting the emergency ambulance service by the patient; delays in response by the emergency ambulance service, reflecting geographical and population density issues in certain remote areas of the country; delayed recognition of a STEMI in either non-PCI centres or PCI centres, or from the pre-hospital ECG; or delayed transfer of the patient from a non-PCI centre to a PCI centre. It is not possible to further expand on the potential cause of these late presentation cases based on our dataset.

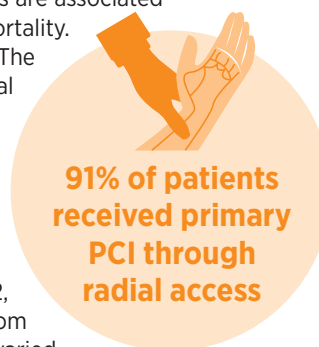


**FIGURE 6.2:** REASONS FOR CONTRAINDICATION TO REPERFUSION THERAPY, BY YEAR (n=516)

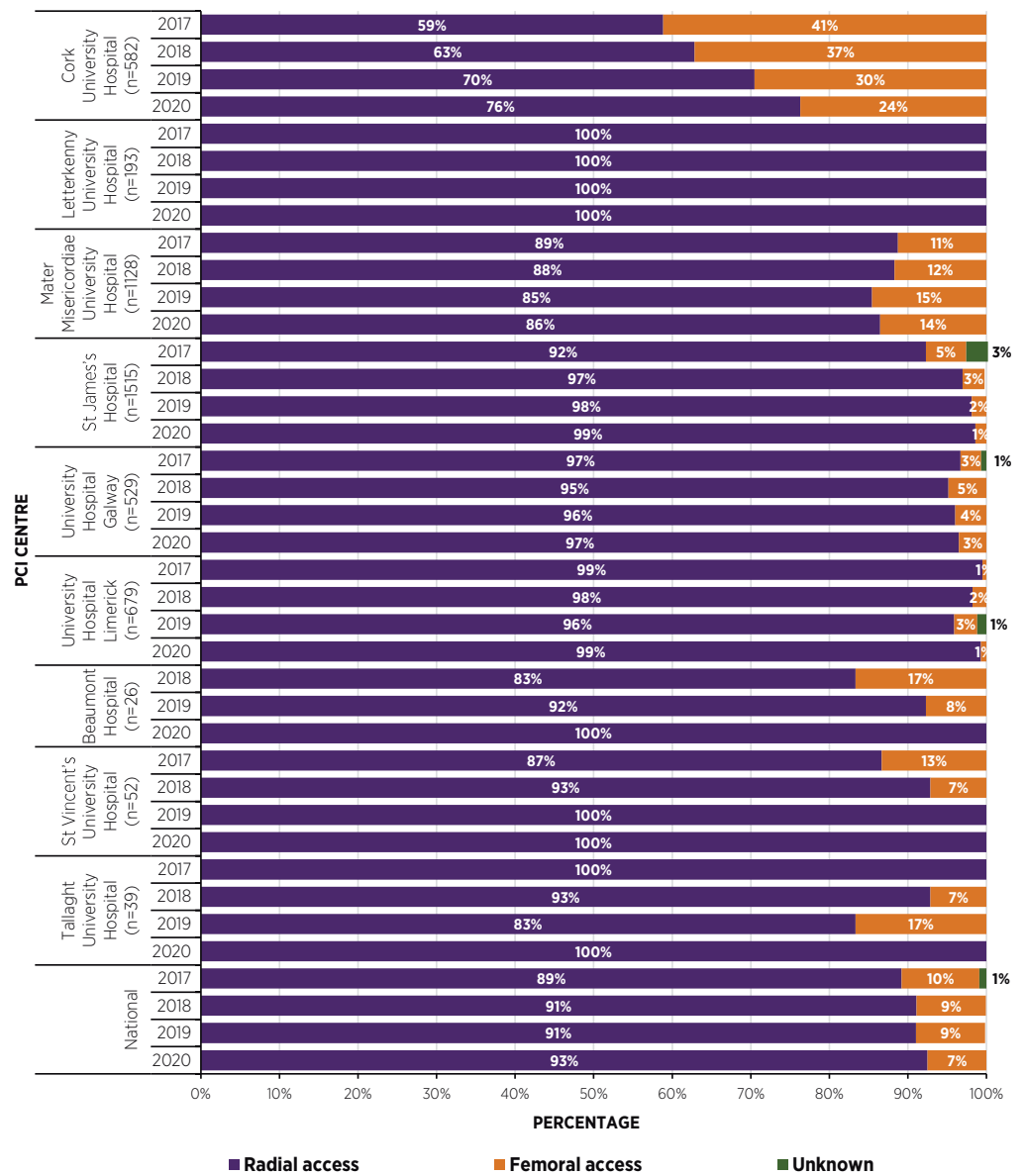
## ARTERIAL ACCESS

PCI requires arterial access in order to be performed, which carries risks of potential vascular injury and bleeding complications. It is well-established that bleeding complications are associated with a higher risk of future recurrent ischaemic events and with higher mortality.

Traditionally, PCI procedures were performed via a femoral artery approach. The ESC guidelines for STEMI management now recommend access using the radial artery approach for all patients undergoing a PCI procedure (Ibanez *et al.*, 2018). This enables early mobilisation and reduces the risk of vascular and bleeding complications based on clear clinical advantages demonstrated in a number of large-scale clinical trials of radial versus femoral arterial access. Figure 6.3 displays the type of arterial access used for each hospital and year over the reporting period. The rate of use of radial access has increased in Ireland since 2016 (HSE, 2018a). From 2017 to 2020, the majority (n=4312, 91%) of patients received primary PCI through radial access, an increase from 86% among patients treated in 2016 (HSE, 2018a). The type of arterial access varied between hospitals. All patients reported by Letterkenny University Hospital had radial access. Although Cork University Hospital had the lowest proportion of patients with radial access, the use of radial access there increased from 59% (n=93) in 2017 to 76% (n=103) in 2020.







**FIGURE 6.3:** TYPE OF ARTERIAL ACCESS, BY HOSPITAL AND YEAR (n=4743) <sup>25,26,27</sup>

<sup>25</sup> Figure 6.3 includes only patients who were not contraindicated and had primary PCI performed.  
<sup>26</sup> Percentages may not sum to 100% due to rounding.  
<sup>27</sup> Beaumont Hospital had no data recorded during 2017.

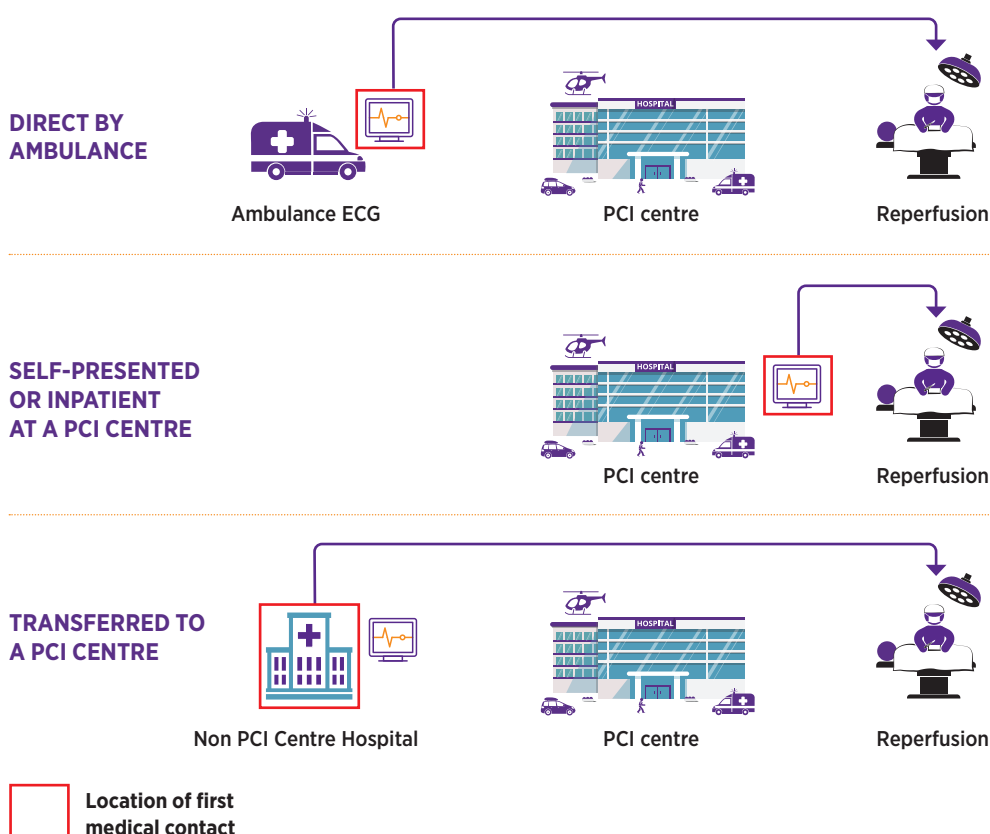
## WHAT IS TIMELY REPERFUSION?

Timeliness of reperfusion in both primary PCI and thrombolysis has been reported as a national KPI since 2013 and is defined below.

### Timely primary PCI

Timely primary PCI is defined as the time between FMC and balloon/wire cross being equal to, or less than, 120 minutes (HSE, 2012; Hamm *et al.*, 2011).

FMC is defined in one of two ways, depending on how the patient with a STEMI accesses the PCI centre. For patients who are directly admitted to a PCI centre,<sup>28</sup> FMC is the time of the first positive ECG. For patients who are transferred to a PCI centre from another hospital, FMC is the time of arrival at the first hospital (Figure 6.4)



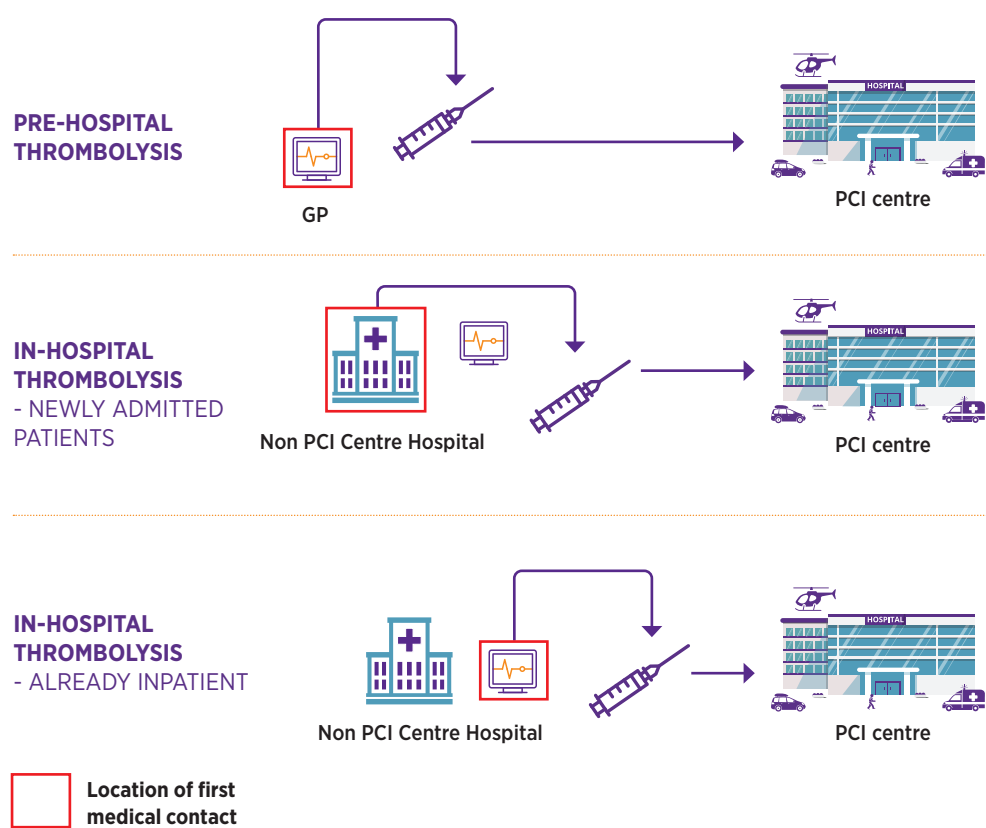
**FIGURE 6.4:** LOCATION OF FIRST MEDICAL CONTACT FOR PATIENTS WHO RECEIVE PRIMARY PERCUTANEOUS CORONARY INTERVENTION

<sup>28</sup> 'Directly admitted to a PCI centre' includes patients who arrived at a PCI centre directly via ambulance, inpatients in a PCI centre, and patients who self-presented at a PCI centre.

### Timely thrombolysis

Timely thrombolysis is defined as the time between FMC and the time of thrombolysis infusion (often known as ‘door to needle’ time) of 30 minutes or less (HSE, 2012; Hamm *et al.*, 2011).

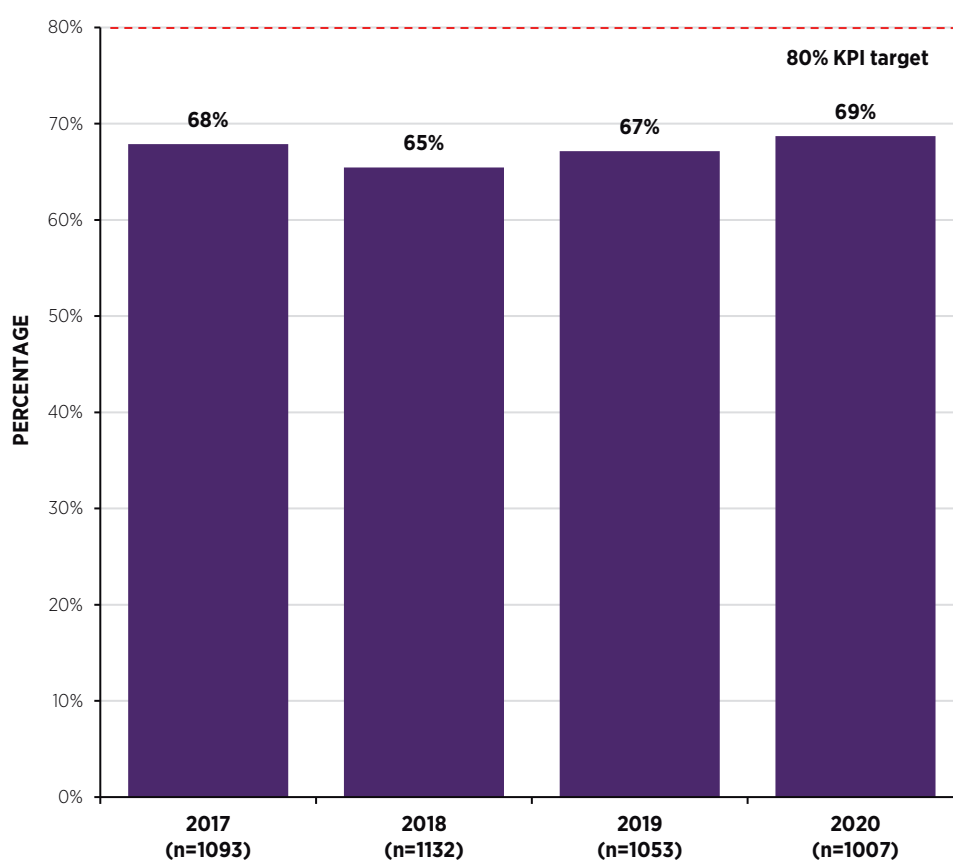
Thrombolysis can be given pre-hospital or in hospital. For thrombolysis given pre-hospital, FMC is defined as the first positive ECG. For thrombolysis given in hospital, FMC is defined as the time of arrival at the first hospital, except for inpatients, where the first positive ECG is used (Figure 6.5). The Acute Coronary Syndrome Model of Care (ACS MOC) has an agreed target that 80% of patients with a STEMI (who do not have a contraindication to reperfusion) should receive timely reperfusion (HSE, 2012).



**FIGURE 6.5:** LOCATION OF FIRST MEDICAL CONTACT FOR PATIENTS WHO RECEIVE THROMBOLYSIS

### TIMELY REPERFUSION IN ALL PATIENTS WITH A STEMI

Figure 6.6 shows the proportion of patients with a STEMI who received timely reperfusion, by year. Between 2017 and 2020, 67% (n=2882) of patients with a STEMI received timely reperfusion. The median time decreased from 97 minutes (interquartile range (IQR): 68–133 minutes) in 2017 to 95 minutes (IQR: 69–127 minutes) in 2020. Figures 6.6A and 6.6B display the timeliness of each reperfusion type for each of the reporting years. Timeliness of reperfusion has decreased compared with that reported in the *Heart Attack Care Ireland 2016* report (HSE, 2018a), which reported that timely reperfusion was achieved in 71% of patients, and the rates of timely reperfusion between 2017 and 2020 are closer to the 68% originally reported for patients treated in 2014 (HSE, 2016).



**FIGURE 6.6:** PROPORTION OF PATIENTS WHO RECEIVED TIMELY PRIMARY PERCUTANEOUS CORONARY INTERVENTION AND THROMBOLYSIS REPERFUSION, BY YEAR (n=4285)<sup>29</sup>

<sup>29</sup> Patients for whom time information was not recorded, or was recorded incorrectly, were excluded from Figure 6.6 (n=76).

## Timeliness of primary PCI therapy



**84% of patients who were admitted directly to a PCI centre had timely reperfusion**

Figure 6.6A shows the proportion of patients who received timely primary PCI reperfusion therapy, by referral source and year. Overall, 68% (n=2814) of patients with a STEMI who were admitted from 2017 to 2020 received primary PCI within 120 minutes. This is below the 80% target and has decreased from the 71% reported for patients who were treated in 2016 (HSE, 2018a).

Timeliness varied depending on whether the patient accessed the service directly (was an inpatient in a PCI centre, self-presented, or was transported directly by ambulance to a PCI centre) or was transferred (from a non-PCI centre, presumably after self-presenting).

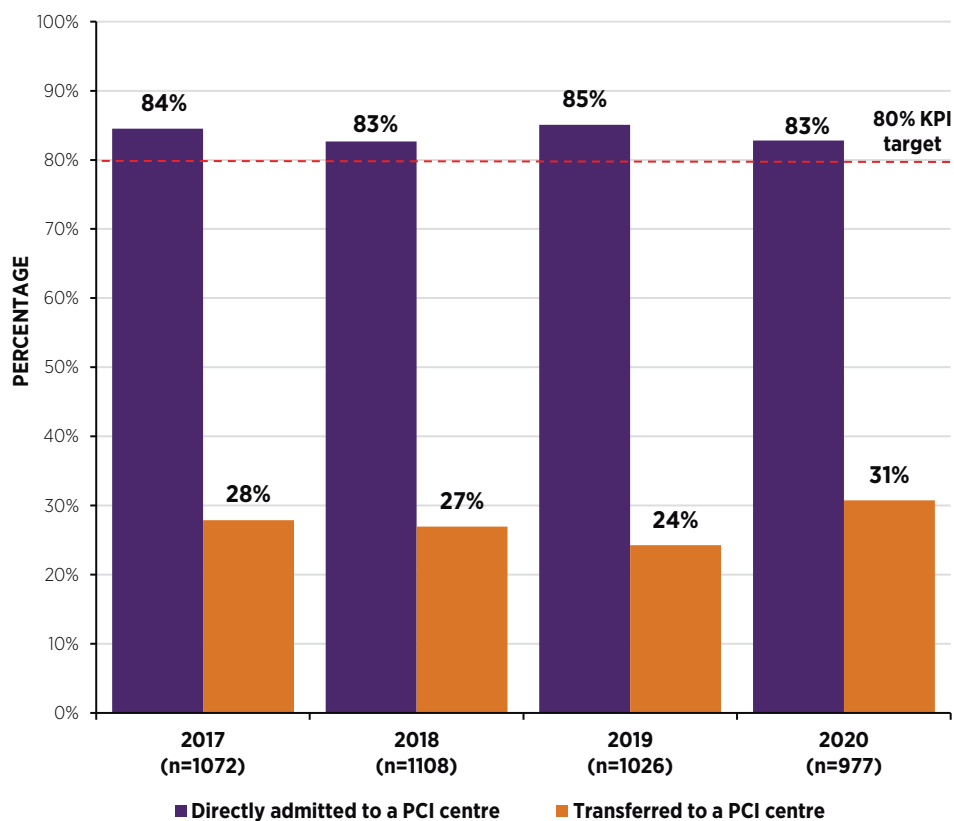
From 2017 to 2020, 84% (n=2509) of patients who were admitted directly to a PCI centre had timely reperfusion. This represents a slight improvement in this patient group compared with 2016, when 82.6% of directly admitted patients had timely reperfusion.

The number of patients transferred for primary PCI continues to fall, suggesting that more patients are admitted directly to PCI centres. In 2014, 44% of patients were transferred to PCI centres for primary PCI; this proportion fell to 34% in 2016 (HSE, 2018a), and in the current dataset, 28% (n=1593) of patients were transferred to a PCI centre from another hospital (see Figure 5.2).



**Only 27% of patients transferred to a PCI centre had timely reperfusion.**

Patients who were transferred to a PCI centre from another hospital had the lowest proportion of timely reperfusion (n=305, 27%). In 2020, 31% (n=72) of patients with a STEMI who were transferred received timely reperfusion, which is an increase from an average of 26% for 2017–2019 but which remains well below the 80% target. This increase may reflect ED bypass resulting in improved streamlining of patients directly to the cath lab in order to avoid possible viral contagion exposure during the COVID-19 pandemic. Overall, however, timeliness appears to have declined compared with 2016, when timely PCI for transferred patients ranged from 28% to 76% depending on the site. The national median time to primary PCI for all patients over the 4-year reporting period, regardless of mode of arrival at the PCI centres, was 98 minutes (IQR: 70–133 minutes).



**FIGURE 6.6A:** PROPORTION OF PATIENTS WHO RECEIVED TIMELY PRIMARY PERCUTANEOUS CORONARY INTERVENTION REPERFUSION, BY REFERRAL SOURCE AND YEAR (n=4111)<sup>30,31</sup>

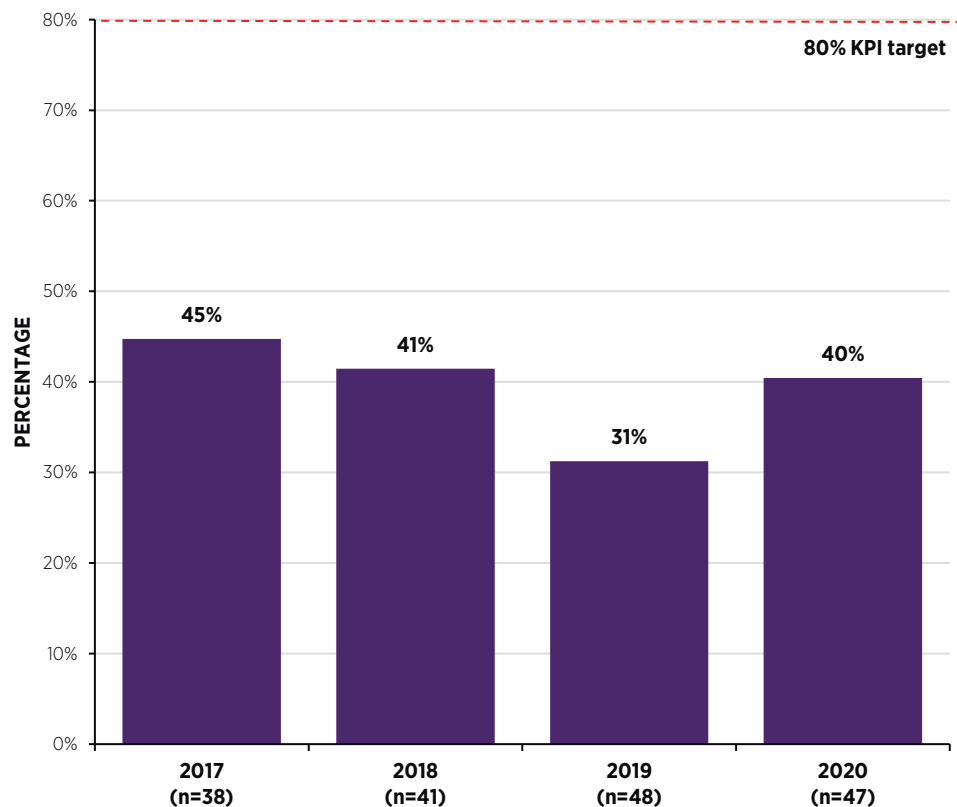
<sup>30</sup> Patients who did not have their referral source recorded (n=124); patients who arrived directly by ambulance and did not have their first ECG in the ambulance (n=436); and patients for whom reperfusion therapy information was not recorded or was recorded incorrectly (n=72) were excluded from Figure 6.6A.

<sup>31</sup> 'Directly admitted to a PCI centre' includes patients who arrived at a PCI centre directly via ambulance, inpatients, and patients who self-presented at a PCI centre.

## TIMELINESS OF THROMBOLYSIS THERAPY

Figure 6.6B shows the proportion of patients with a STEMI who received timely thrombolysis reperfusion therapy, by year. From 2017 to 2020, only 39% (n=68) of patients with a STEMI received timely thrombolysis. The majority (n=159, 91%) of patients with a STEMI who received thrombolysis were transferred to the PCI centre after receiving thrombolysis in the first hospital.

With the introduction of the ORS protocol in 2013, thrombolysis is only recommended when primary PCI cannot be delivered within 120 minutes. As a result, the majority (n=3240, 58%) of patients with a STEMI now bypass non-PCI centres and are brought directly by ambulance to PCI centres; however, almost one-third (n=1593, 28%) continue to present to non-PCI centres. In the non-PCI centres, the ORS protocol advocates for immediate transfer to a PCI centre within 90 minutes, if possible. The unintended consequence of this pathway is that there can be a delay in the delivery of thrombolysis and a subsequent reduction in the timeliness of receiving thrombolysis. No information is recorded for patients with a STEMI who receive thrombolysis and are not transferred to a PCI centre.

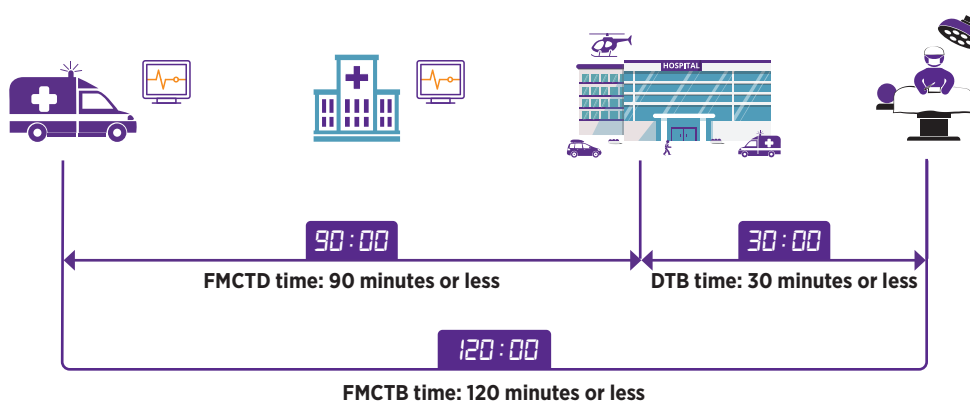


**FIGURE 6.6B:** PROPORTION OF PATIENTS WHO RECEIVED TIMELY THROMBOLYSIS REPERFUSION, BY YEAR (n=174)<sup>32</sup>

<sup>32</sup> Patients for whom thrombolysis reperfusion therapy information was not recorded, or was recorded incorrectly (n<5), were excluded from Figure 6.6B.

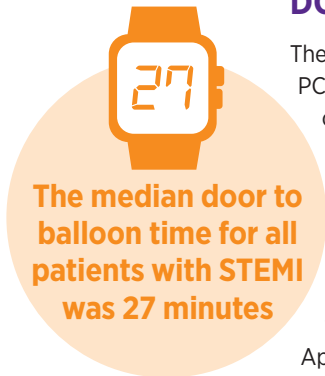
### PATHWAY TO PRIMARY PCI

In order to achieve timely primary PCI, two key time intervals can be monitored in order to measure any process delays to reperfusion with primary PCI. Chapter 5 explored the first interval, referred to as ‘FMC to door’ (FMCTD) time. The second interval is ‘door to balloon’ (DTB) time, as indicated in Figure 6.7, and will be outlined next. Following this, the entire ‘FMC to balloon’ (FMCTB) time interval will be presented.



**FIGURE 6.7:** TIME INTERVAL GOALS





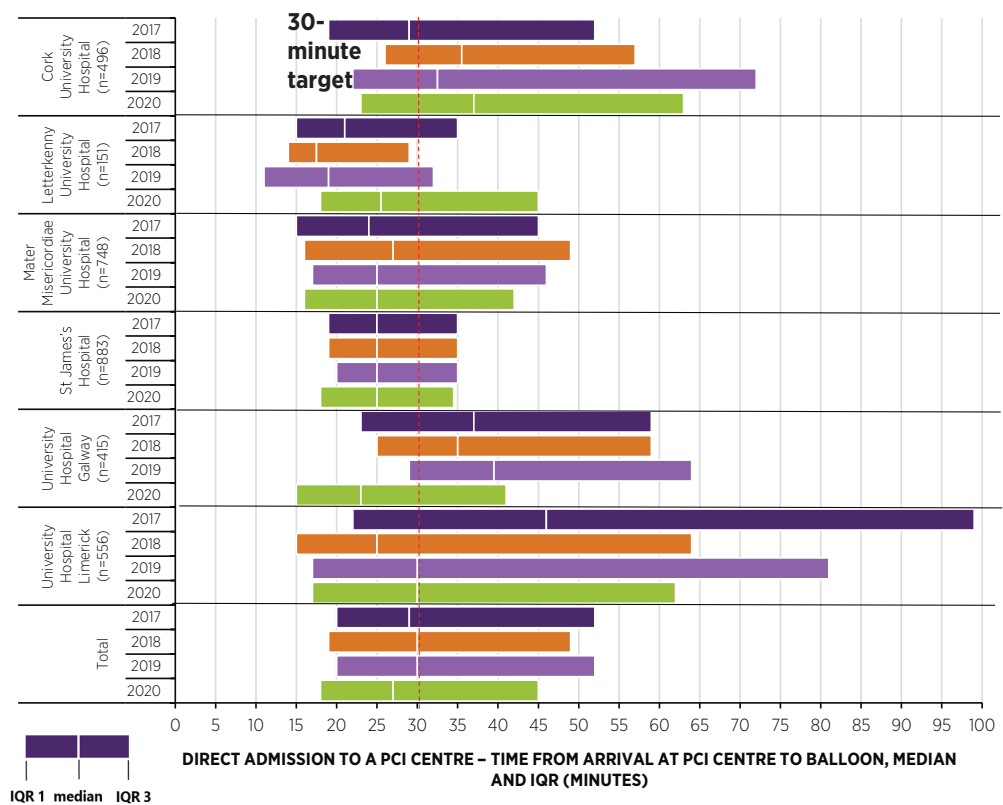
## DOOR TO BALLOON

The goal for the time from FMC to arrival at the PCI centre is 90 minutes or less. This allows the PCI centre 30 minutes to receive and provide the primary PCI within the target of 120 minutes or less, and this 30-minute interval is the DTB time. The DTB time interval is the time between arrival at the PCI centre and the time when the patient with a STEMI is reperfused by primary PCI. This is recorded as the time of wire cross or balloon inflation. This door to balloon section describes DTB times for patients with a STEMI who were admitted directly to a PCI centre or who were transferred from another hospital to a PCI centre from 2017 to 2020.

During the 4-year reporting period, the median DTB time for all patients with a STEMI who were brought to a PCI centre for primary PCI was 27 minutes (IQR: 19–44 minutes) (see Appendix 6 for detailed description of DTB calculation).

## DTB TIME: DIRECTLY ADMITTED TO A PCI CENTRE

Figure 6.8A shows the median DTB time and IQR in minutes for patients with a STEMI who were directly admitted to a PCI centre. The national median DTB time was 29 minutes (IQR: 19–50 minutes) for the 4-year reporting period, which was within the 30-minute target (HSE, 2012).



**FIGURE 6.8A:** DOOR TO BALLOON TIME FOR PATIENTS DIRECTLY ADMITTED TO A PERCUTANEOUS CORONARY INTERVENTION CENTRE, BY HOSPITAL AND YEAR (n=3343)<sup>33,34,35</sup>

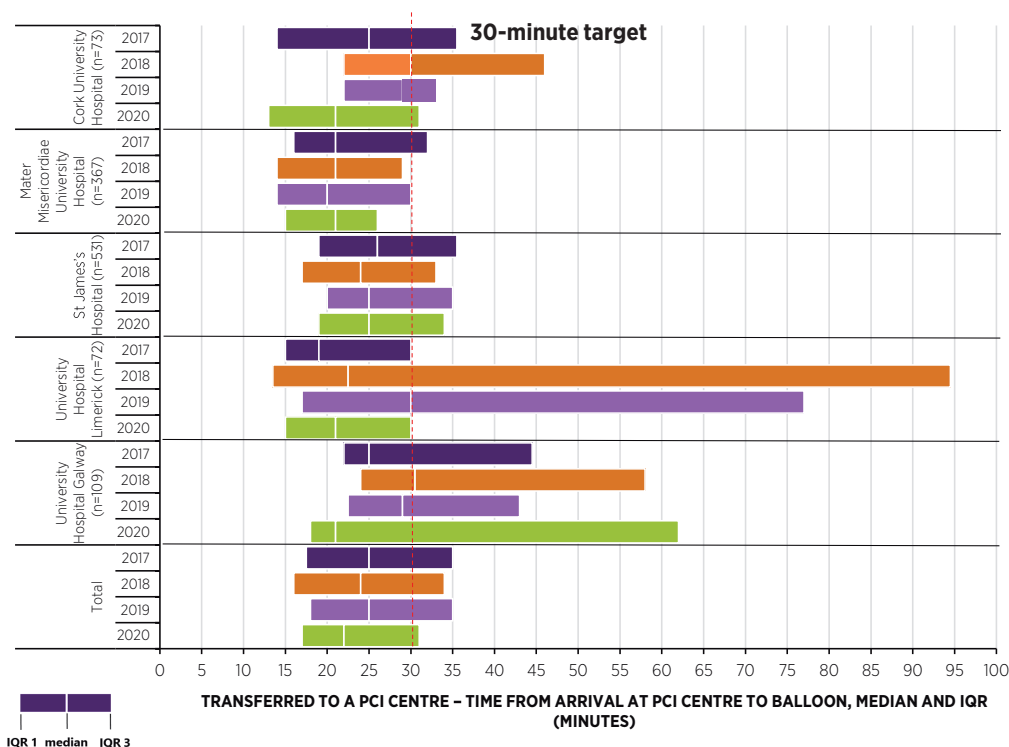
<sup>33</sup> Patients for whom time information was not recorded, or was recorded incorrectly, were excluded from Figure 6.8A (n=23). Hospitals: Beaumont Hospital, St Vincent’s University Hospital, and Tallaght University Hospital were not included in the Figure 6.8A, as they had fewer than 10 admissions per year, however they were included in the total figure.

<sup>34</sup> ‘Directly admitted to a PCI centre’ includes patients who arrived at a PCI centre directly via ambulance, inpatients, and patients who self-presented at a PCI centre.

<sup>35</sup> St James’s Hospital was excluded from the calculation of self-presented patients due to differences in data recording.

### DTB TIME: TRANSFERRED FROM ANOTHER HOSPITAL

Figure 6.8B shows the median DTB time and IQR in minutes for patients with a STEMI who were transferred to a PCI centre. The national median varied over the 4-year reporting period: it was 25 minutes in 2017, 24 minutes in 2018, 25 minutes in 2019, and 22 minutes in 2020.



**FIGURE 6.8B:** DOOR TO BALLOON TIME BY HOSPITAL AND YEAR (n=1162)<sup>36,37</sup>

These results demonstrate that once a patient with a STEMI reaches a PCI centre, the patient pathway and processes required for reaching the cath lab and opening the artery are working effectively. This report does not assess interhospital differences in DTB times, but would encourage each PCI centre to look at its median and IQR DTB times and assess whether local improvements can be made in order to shorten those times further. For example, as briefly outlined in Chapter 5, the current ESC treatment guidelines for STEMI endorse ED bypass with delivery of patients directly to the cath lab. Between 2017 and 2020, 19% (n=868) of patients with a STEMI were still brought to the ED. This percentage may represent a possible target for further shortening DTB times.

<sup>36</sup> Patients for whom time information was not recorded, or was recorded incorrectly, were excluded from Figure 6.8B (n=6). Hospitals: Beaumont Hospital, St Vincent’s University Hospital, and Tallaght University Hospital were excluded individually from Figure 6.8B, as they had fewer than 10 admissions per year. However, these admissions were included in the national annual totals.

<sup>37</sup> Letterkenny University Hospital is not present in the Figure 6.8B, as they had no transferred patients.

## FMCTB TIME FOR ALL PATIENTS WITH A STEMI

FMCTB time describes the complete patient pathway to timely reperfusion with primary PCI. The target time frame for FMCTB is 120 minutes. The time of FMC depends on how the patient accessed the PCI centre and was discussed in detail in Chapter 5. At the time of writing this report, the IHAA did not have access to the National Ambulance Service's electronic patient care records (ePCR) in order to confirm time of symptom onset, time of call for help, ambulance response time, and time of diagnostic ECG by the ambulance service, and to allow confirmation of time intervals recorded in hospital. It is anticipated that, from 2022, access to the National Ambulance Service's ePCRs will allow confirmation of these time intervals.

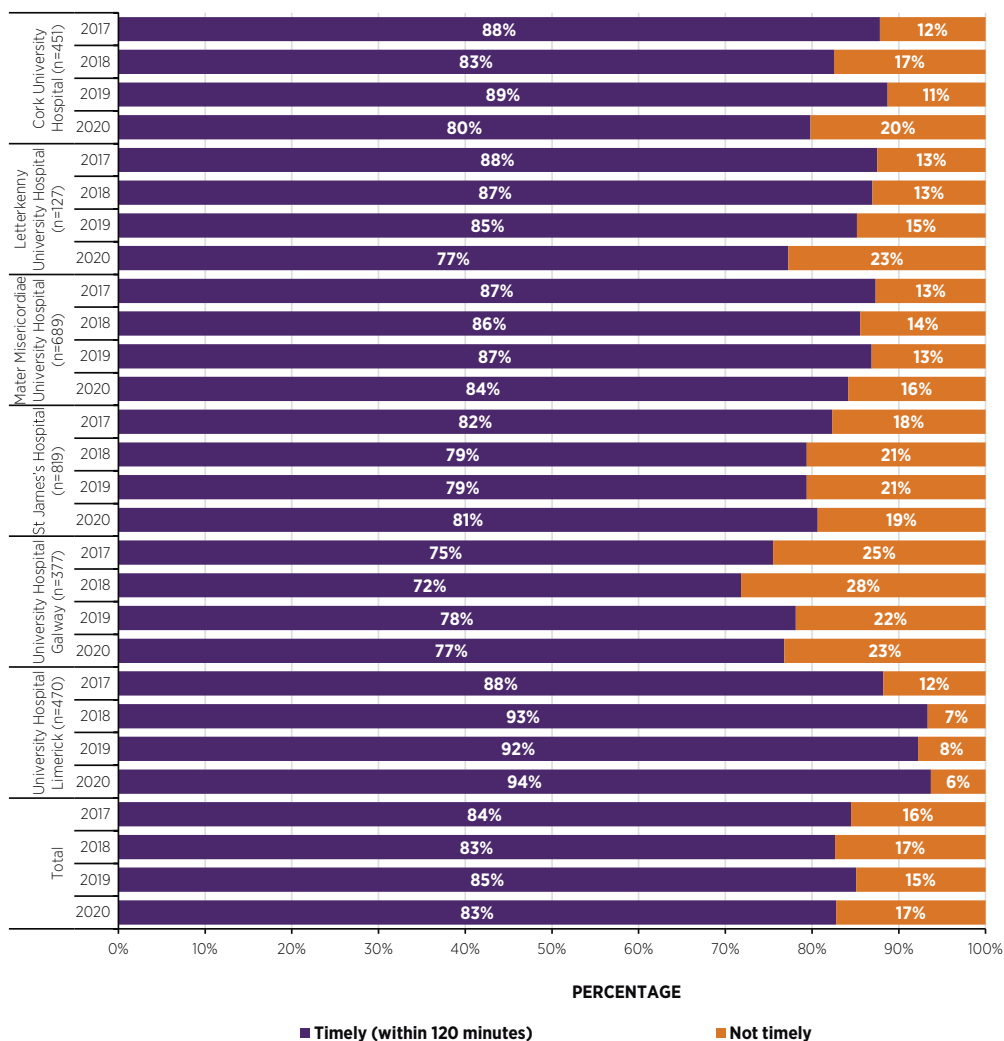
During the 4-year reporting period, the median FMCTB time for all patients with a STEMI who were brought to a PCI centre for primary PCI was 98 minutes (IQR: 70–133 minutes) (see Appendix 6 for detailed description of FMC calculation).



**The median first medical contact to balloon for patients admitted directly to the PCI centre was 84 minutes (Target within 120 minutes)**

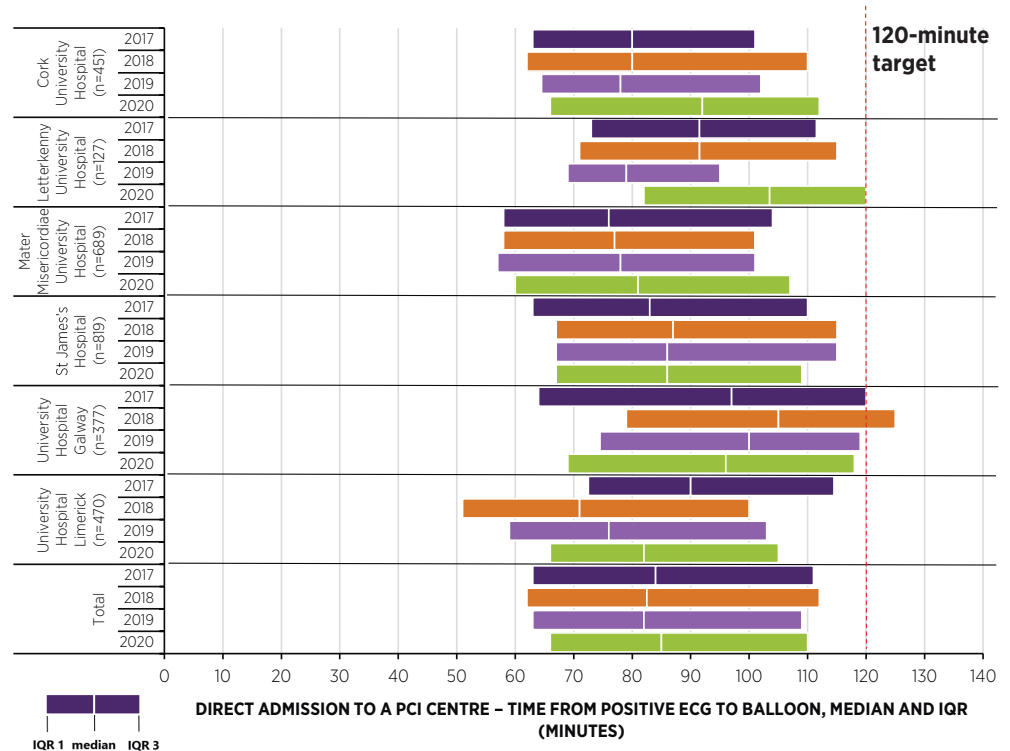
## FMCTB TIME: DIRECTLY ADMITTED TO A PCI CENTRE

FMC is defined as the time of the first positive ECG. For patients who were brought directly to a PCI centre by ambulance, this ECG was most often performed in the ambulance. For patients who self-presented, the first ECG was performed in the ED. This category also includes a smaller number of patients with a STEMI (n=405, 14%) who self-presented to the ED of a PCI centre and a very small number of hospital inpatients (n=76, 3%) in a PCI centre who had a STEMI while an inpatient. The majority of patients with a STEMI (n=2509, 84%) received timely primary PCI (Figure 6.9A). Figure 6.9B shows the median FMCTB time in minutes, by hospital and year, for patients who were directly admitted to a PCI centre. The national median FMCTB time was 84 minutes (IQR: 64–110 minutes) and varied over the 4-year reporting period: it was 84 minutes in 2017, 83 minutes in 2018, 82 minutes in 2019, and 85 minutes in 2020.



**FIGURE 6.9A:** PROPORTION OF TIMELY PRIMARY PERCUTANEOUS CORONARY INTERVENTION FOR PATIENTS ADMITTED DIRECTLY TO A PERCUTANEOUS CORONARY INTERVENTION CENTRE, BY HOSPITAL AND YEAR (n=2996) <sup>38,39,40,41</sup>

<sup>38</sup> Patients for whom time information was not recorded, or was recorded incorrectly, were excluded from Figure 6.9A (n=19).  
<sup>39</sup> Direct admissions to a PCI centre include patients who arrived at a PCI centre directly via ambulance, inpatients, and patients who self-presented to a PCI centre.  
<sup>40</sup> Hospitals: Beaumont Hospital, St Vincent’s University Hospital, and Tallaght University Hospital are not presented in Figure 6.9A, as they had 10 or fewer admissions per year. However, these admissions were included in the national annual totals, and in the frequency tables in Appendix 7.  
<sup>41</sup> Percentages may not sum to 100% due to rounding.



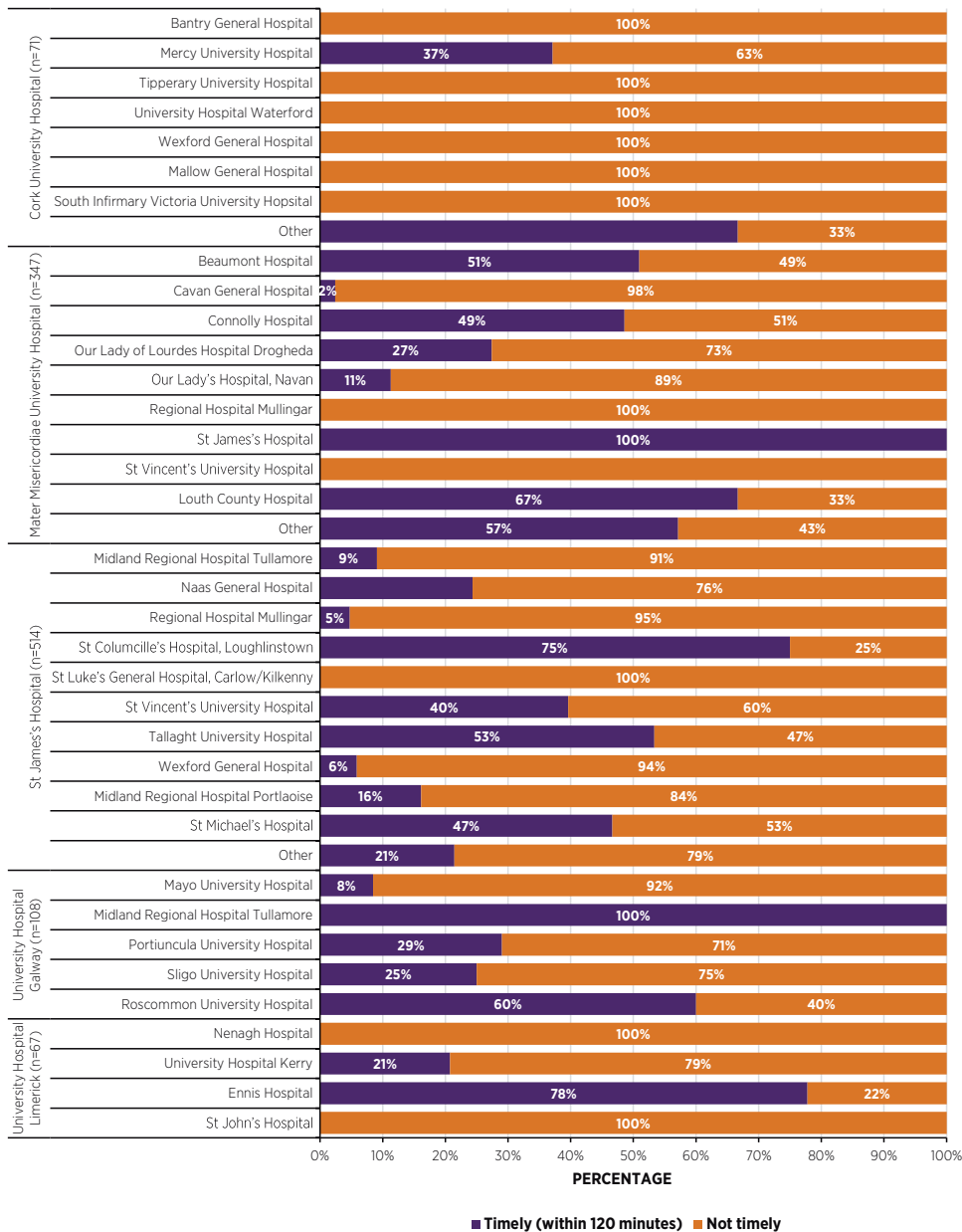
**FIGURE 6.9B:** FIRST MEDICAL CONTACT TO BALLOON TIME, BY HOSPITAL AND YEAR (n=2996)<sup>42,43</sup>

<sup>42</sup> Patients for whom time information was not recorded, or was recorded incorrectly, were excluded from Figure 6.9B (n=19). Hospitals: Beaumont Hospital, St Vincent’s University Hospital, and Tallaght University Hospital are not presented in Figure 6.9B, as they had 10 or fewer admissions per year. However, these admissions were included in the national annual totals.

<sup>43</sup> Direct admissions to a PCI centre include patients who arrived at a PCI centre directly via ambulance, inpatients, and patients who self-presented to a PCI centre.

### FMCTB TIME: TRANSFERRED FROM ANOTHER HOSPITAL

For patients with a STEMI who are transferred from another hospital to a PCI centre, the FMC time is the time the patient arrived at the first hospital. From 2017 to 2020, just over one-quarter (n=305, 27%) of patients who were transferred had timely primary PCI performed. Figure 6.10A shows the distribution of timely primary PCI by hospital and year. Figure 6.10B shows the median FMCTB time and IQR for patients who were transferred to a PCI centre. The national median FMCTB time was 155 minutes (IQR: 118–238 minutes) and varied annually, from 155 minutes in 2017 to 157 minutes in 2018, 160 minutes in 2019, and 148 minutes in 2020.

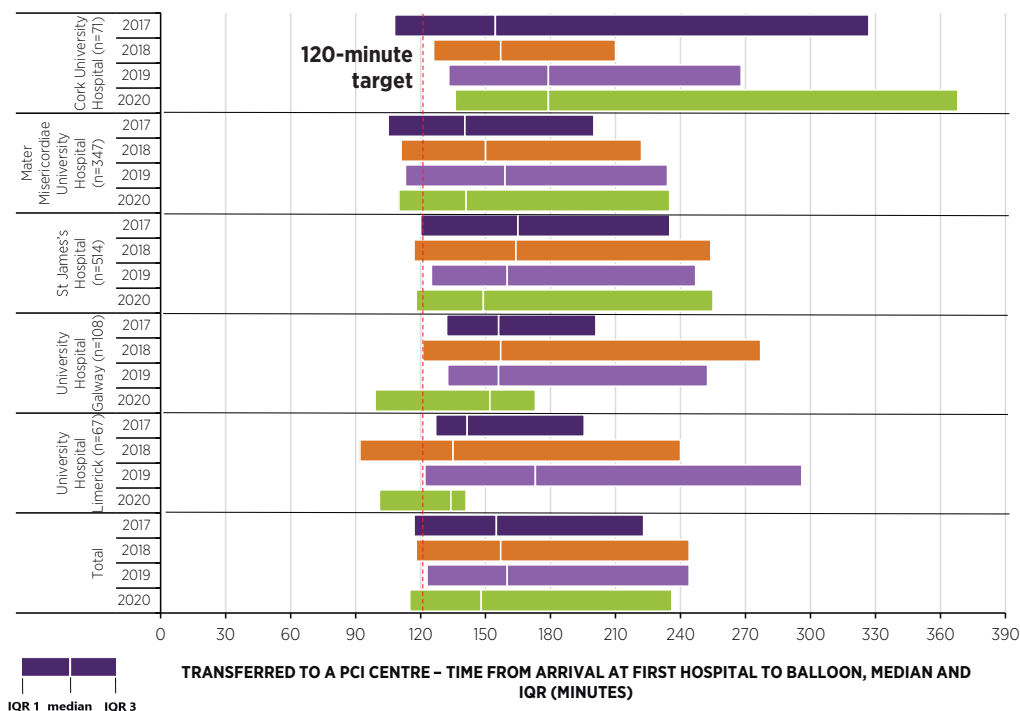


**FIGURE 6.10A:** PROPORTION OF TIMELY PRIMARY PERCUTANEOUS CORONARY INTERVENTION FOR PATIENTS WHO WERE TRANSFERRED TO A PERCUTANEOUS CORONARY INTERVENTION CENTRE, BY HOSPITAL AND YEAR (n=1115)<sup>44,45,46</sup>

<sup>44</sup> Patients for whom time information was not recorded, or was recorded incorrectly, were excluded from Figure 6.10A (n=53).

<sup>45</sup> From 2017 to 2020, Letterkenny University Hospital had no patients who were transferred.

<sup>46</sup> Hospitals: Beaumont Hospital, St Vincent's University Hospital, and Tallaght University Hospital are not present in Figure 6.10A, as they had fewer than 10 admissions per year, however, these admissions were included in the total figure and in the frequency tables in Appendix 7.



**FIGURE 6.10B:** FIRST MEDICAL CONTACT TO BALLOON TIME, BY HOSPITAL AND YEAR (n=1115)<sup>47,48</sup>

As discussed earlier, the DTB times did not differ significantly between patients who were admitted directly and those who were transferred from another hospital, suggesting that the reason for the delay of timely reperfusion in transfer patients is driven by prolonged FMCTD times. In Chapter 5, these delays in achieving transfer times to PCI sites of 90 minutes or less are highlighted by year and PCI site/transfer hospital in Figures 5.6A and 5.6B.

<sup>47</sup> Patients for whom time information was not recorded, or was recorded incorrectly, were excluded from Figure 6.10B (n=53). Hospitals: Beaumont Hospital, St Vincent’s University Hospital, and Tallaght University Hospital were excluded from Figure 6.10B, as they had fewer than 10 admissions per year. However, these admissions were included in the national annual totals.  
<sup>48</sup> From 2017 to 2020, Letterkenny University Hospital had no patients who were transferred.

## KEY FINDINGS FROM CHAPTER 6

- Ninety-one percent (n=5111) of patients diagnosed with a STEMI from 2017 to 2020 were deemed eligible for reperfusion therapy.

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- Contraindications to reperfusion were identified in 9% (n=492) of patients with a STEMI. For the majority of patients with a STEMI for whom reperfusion therapy was contraindicated, this was because they presented to PCI centres too late (n=422, 82%).

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- The majority of patients with a STEMI who were admitted between 2017 and 2020 who had no contraindications to reperfusion received primary PCI (n=4743, 92.8%), and 3.5% (n=178) received thrombolysis.

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- Between 2017 and 2020, the majority (n=4312, 91%) of patients received primary PCI through radial access, an increase from 86% among patients treated in 2016 (HSE, 2018a).

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- Between 2017 and 2020, 67% (n=2882) of patients with a STEMI received timely reperfusion (either thrombolysis within 30 minutes or primary PCI within 120 minutes). This is a decrease compared with the timeliness rate of 71% among patients who were treated in 2016.

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- The number of patients brought directly to a PCI centre continues to increase, from 71% (n=982) in 2017 to 74% (n=931) in 2020.

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- Sixty-eight percent (n=2814) of patients undergoing primary PCI had timely PCI, a decrease from the 71% reported for patients who were treated in 2016. However, there is variation depending on whether a patient is admitted directly to a PCI centre or is transferred from a non-PCI centre, with 84% (n=2509) of patients who were admitted directly to a PCI centre receiving timely primary PCI compared with 27% (n=305) of patients who were transferred from a non-PCI centre.

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- Among patients treated with thrombolysis from 2017 to 2020, only 39% (n=68) were timely.

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- The national median time to primary PCI, regardless of referral source, was 98 minutes (IQR: 70–133 minutes). Among patients who were admitted directly to PCI centres, the national median time was 84 minutes (IQR: 64–110 minutes), compared with 155 minutes (IQR: 118–238 minutes) for patients who were transferred from a non-PCI centre.

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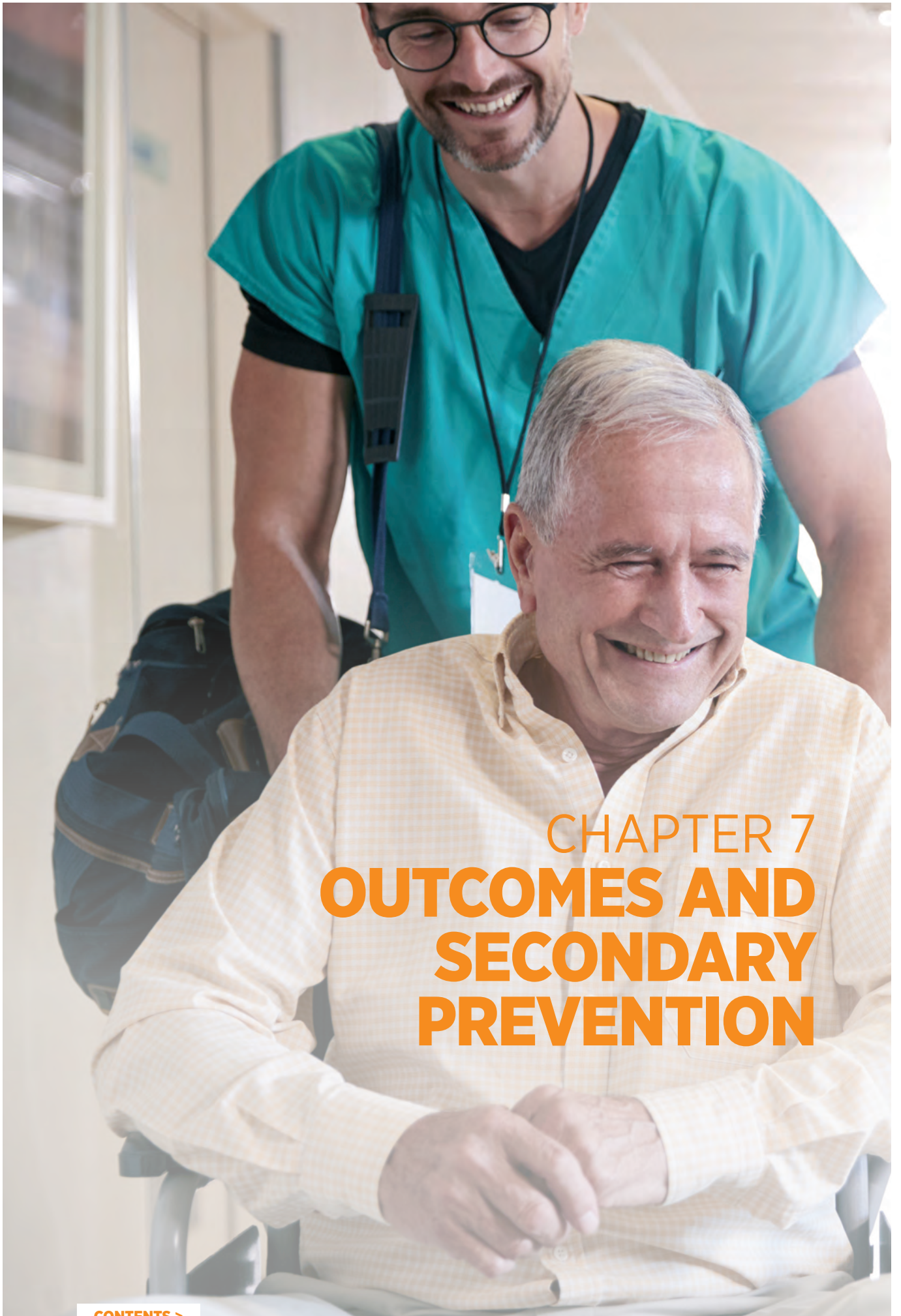
- Regardless of route of presentation, the median DTB times within PCI centres remain excellent, with a national median time of 27 minutes over the 4-year reporting period. This is within the recommended 30-minute window. ED bypass rates, with direct admission to the cath lab, continue to improve.

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- Overall, FMCTB times vary greatly depending on how the patient accesses the service. In patients who were directly admitted to a PCI centre from 2017 to 2020, the national median FMCTB time was 84 minutes (IQR: 64–110 minutes) (Figure 6.9B), with 84% (n=2509) receiving timely reperfusion. In patients who were transferred from non-PCI centres, the national median FMCTB time was 155 minutes (IQR: 118–238 minutes), with only 27% (n=305) receiving timely reperfusion. Geographical distance alone does not explain the variation in FMCTB times, and reducing delays in transferring patients with a STEMI should be prioritised.

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CHAPTER 7  
**OUTCOMES AND  
SECONDARY  
PREVENTION**

[CONTENTS >](#)

## CHAPTER 7: OUTCOMES AND SECONDARY PREVENTION

### SCOPE OF CHAPTER 7

This chapter presents the outcomes and secondary prevention care of all patients with a STEMI recorded on the Heartbeat portal from 2017 to 2020. The first section of this chapter, outcomes for patients with a STEMI, reports on patient outcomes, presenting data on unadjusted PCI centre in-hospital mortality, complications experienced by patients with a STEMI, discharge destination from the PCI centre, and length of stay (LOS) in the PCI centre. The Acute Coronary Syndrome Model of Care (ACS MOC) (HSE, 2012) sets a key performance indicator (KPI) for LOS, but not for mortality rate or complications. The ACS MOC, however, recommends that mortality data and complication rates be routinely collected and used to audit care delivery.

The second section of this chapter, secondary prevention, deals with secondary prevention measures. The ACS MOC sets a 90% target for referral to an early cardiac rehabilitation programme (within 4 weeks of the STEMI). Additionally, the ACS MOC sets a target of 90% of eligible patients receiving a discharge bundle comprising smoking cessation advice (when relevant) and a set of medications (including aspirin, a beta-blocker, a statin, and an angiotensin-converting enzyme (ACE) inhibitor/angiotensin receptor II blocker (ARB)). This chapter will present data on referral for cardiac rehabilitation, receipt of smoking cessation advice and on discharge prescriptions.

### OUTCOMES FOR PATIENTS WITH A STEMI

Chapter 6 reported data on reperfusion therapy for patients with a STEMI. Ninety-three percent (n=4743) of eligible patients with a STEMI received primary PCI as the initial reperfusion strategy between 2017 and 2020, exceeding the KPI of 80% set out in the ACS MOC (HSE, 2012) and comparing favourably with international experience. However, the 68% rate of timely reperfusion did not meet the target KPI of 80%. It was also found that patients who arrived at a PCI centre by transfer from another acute hospital were unlikely to receive timely primary PCI (n=305, 27%) (Figure 6.6A). More details regarding clinical and process outcomes are detailed within this chapter. But first, this chapter will explore the limitations of the outcome data available within the Heartbeat portal.

### LIMITATIONS OF OUTCOME DATA IN THE HEARTBEAT PORTAL

Survival status, defined as whether a patient with a STEMI is alive or dead, is assessed at two time points within the Heartbeat portal: at hospital discharge and at 30 days after the date of the STEMI. Data on readmissions are not collected in the Heartbeat portal. Deaths from heart attack occurring before the patient reaches the PCI centre are also not recorded in the database.

Data completeness for both survival status variables is low. For survival status at hospital discharge, data are missing or unknown in 24% (n=1353) of cases. The level of missing data for this variable by PCI centre is set out in Table 7.1. During the 4-year reporting period, the proportion of cases with known survival status increased from 72% (n=1032) in 2017 to 80% (n=1117) in 2019, but decreased to 74% (n=964) in 2020. Compounding matters, in cases where this variable is completed, it is not clear whether the data recorded refer to survival status at discharge from the PCI centre or following the complete hospital stay, including if a patient was transferred from a PCI centre to another acute hospital for ongoing heart attack care.

**TABLE 7.1** SURVIVAL STATUS ON DISCHARGE DATA COMPLETENESS (N=5629)

	Known outcome		Unknown outcome		Total	
	N	%	N	%	N	%
Cork University Hospital	848	100%	3	0%	851	100%
Letterkenny University Hospital	201	100%	0	0%	201	100%
Mater Misericordiae University Hospital	1105	83%	229	17%	1334	100%
St James's Hospital	573	35%	1061	65%	1634	100%
University Hospital Galway	622	92%	53	8%	675	100%
University Hospital Limerick	747	100%	2	0%	749	100%
Beaumont Hospital	55	98%	1	2%	56	100%
St Vincent's University Hospital	58	94%	4	6%	62	100%
Tallaght University Hospital	67	100%	0	0%	67	100%
<b>Total</b>	<b>4276</b>	<b>76%</b>	<b>1353</b>	<b>24%</b>	<b>5629</b>	<b>100%</b>

Similarly, data completeness of the 30-day mortality variable is also very low. Missing or unknown data points account for 51% (n=2854) of cases within the Heartbeat dataset for the reporting period. The proportion of cases with known 30-day survival status gradually increased each year, however, from 43% (n=614) in 2017 to 56% (n=727) in 2020. The level of missing data for this variable by PCI centre is set out in Table 7.2.

**TABLE 7.2** 30-DAY MORTALITY DATA COMPLETENESS (N=5629)<sup>49</sup>

	Known outcome		Unknown outcome		Total	
	N	%	N	%	N	%
Cork University Hospital	469	55%	382	45%	851	100%
Letterkenny University Hospital	21	10%	180	90%	201	100%
Mater Misericordiae University Hospital	1115	84%	219	16%	1334	100%
St James's Hospital	120	7%	1514	93%	1634	100%
University Hospital Galway	178	26%	497	74%	675	100%
University Hospital Limerick	711	95%	38	5%	749	100%
Beaumont Hospital	42	75%	14	25%	56	100%
St Vincent's University Hospital	54	87%	8	13%	62	100%
Tallaght University Hospital	65	97%	2	3%	67	100%
<b>Total</b>	<b>2775</b>	<b>49%</b>	<b>2854</b>	<b>51%</b>	<b>5629</b>	<b>100%</b>

<sup>49</sup> 30-day mortality includes known in-hospital deaths (n=305).

## THE HOSPITAL IN-PATIENT ENQUIRY DATASET

The Hospital In-Patient Enquiry (HIPE) system is the principal source of national data on discharges from acute hospitals in Ireland. HIPE collects demographic, clinical and administrative data on discharges from, and deaths in, acute public hospitals nationally (Healthcare Pricing Office, 2020). The HIPE dataset includes survival status on discharge for each episode of care, and has the important advantage of being 100% complete. However, it was not designed for the purpose of the IHAA. Given the absence of a national individual patient identifier, it is not possible to follow the patient journey across hospitals using the HIPE database. The HIPE database records survival status at time of discharge or transfer from the PCI centre. Events that occur during an in-hospital stay in a second hospital for a STEMI cannot be seamlessly reported on due to the lack of an individual patient identifier.

## MORTALITY REPORTING IN THIS AND FUTURE REPORTS

The mortality data presented in this chapter are derived from the HIPE dataset due to the data quality issues detailed above. This dataset has the important advantage of containing survival information for every patient with a STEMI. However, it comes with an important caveat: the length of follow-up is limited to the LOS at the PCI centre; it does not include any additional hospital stay in a second hospital for ongoing acute STEMI care following transfer from the PCI centre. This means that follow-up for patients with a STEMI who are transferred to a second hospital is truncated at the point of transfer from the PCI centre, leading to a potential underestimation of mortality.

The ACS MOC encourages early repatriation from the PCI centre to a second acute hospital to complete STEMI care, where possible. Over the 4-year reporting period, 47% (n=2524<sup>50</sup>) of patients with a STEMI were transferred in this manner after a median PCI centre LOS of 1 day (IQR: 1–2 days) (Table 7.4). For these transferred patients, it follows that mortality information is truncated at a median of 1 day of follow-up in this report. The median follow-up duration for the remaining patients (n=2818, 53%) who completed their acute care episode at the PCI centre was 4 days (IQR: 3–7 days) (Table 7.3). Given the short follow-up period for nearly one-half of patients with a STEMI, there is a risk that the mortality rate presented in this report underestimates the true mortality rate experienced by these patients. In addition, the lack of standardisation of follow-up limits our ability to make valid comparisons between groups of interest, as differences in mortality between groups may reflect differences in length of follow-up rather than true differences in mortality. For example, comparing outcomes experienced by patients transferred from a non-PCI hospital to a PCI centre for treatment with outcomes experienced by patients admitted directly to a PCI centre will be biased by a shorter length of follow-up in the first group.

The ESC recommends the Global Registry of Acute Coronary Events (GRACE) score, adjusted 30-day mortality, and 30-day readmission rates as the quality indicators to be used to measure outcomes in STEMI care (Ibanez *et al.*, 2018). The mortality data presented in this chapter are not adjusted to take account of pre-treatment prognostic factors using the GRACE score. These pre-treatment factors remain important predictors of outcomes in the optimum treatment setting. Non-risk-adjusted mortality rates are influenced by this pre-treatment risk and may not be a fair reflection of the quality of medical interventions. For this reason, and in light of the risk of confounding due to non-standardisation in length of follow-up, we present summary figures for the entire cohort in terms of mortality and do not make comparisons between PCI centres.

The lack of a robust, risk-adjusted mortality rate that is standardised in terms of follow-up is a quality improvement opportunity for the IHAA. Producing a reliable, risk-adjusted, standardised mortality rate would allow for comparisons in the outcomes experienced by patients with a STEMI across PCI centres. It would allow for the identification of outliers, an important quality

<sup>50</sup> Calculated out of the patients who were discharged alive (n=5,342).

improvement tool. It would also facilitate the benchmarking of outcomes experienced by patients with a STEMI in Ireland against international norms. This task presents a significant challenge in terms of data collection and analysis. It is hoped to move towards such reporting in subsequent audits. Implementation of a national individual patient identifier would facilitate this development and would capture the whole patient pathway, thus enabling measurement of the total LOS and survival status on discharge for all patients with a STEMI.

In the following sections, in all cases where the term ‘mortality rate’ is used, this is to be taken to refer to the in-hospital mortality rate observed during hospitalisation in the PCI centre only, and to mean that no adjustment has been made to account for the effect of pre-treatment prognostic factors.

## IN-HOSPITAL MORTALITY IN PCI CENTRES

During the 4-year period from 2017 to 2020, 287 of the 5,629 patients with a STEMI died during their in-hospital stay at a PCI centre. This figure of 287 deaths corresponds to an unadjusted mortality rate of 5.1% (Figure 7.2).

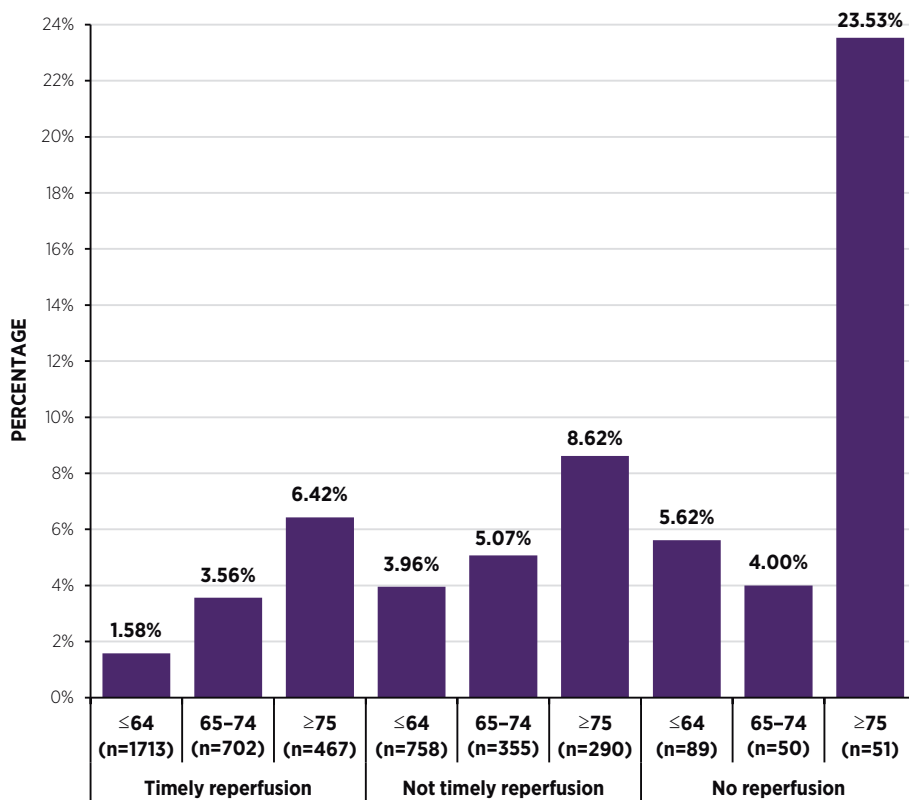
This in-hospital mortality rate compares favourably with international comparators; the unadjusted mortality rate of 5.1% (n=287) is similar to that reported in the United Kingdom’s (UK’s) Myocardial Ischaemia National Audit Project (MINAP) audit report (MINAP, 2020). The report covers heart attack care in England, Wales, and Northern Ireland, and reported an unadjusted in-hospital mortality rate of 5% in patients with a STEMI in 2018 and 2019 (MINAP, 2020). However, the statistics are not directly comparable; the MINAP figure refers only to patients who received reperfusion, whereas the IHAA figure includes patients who did not receive reperfusion. On the other hand, the MINAP figure reflects the entire acute hospitalisation, whereas the IHAA figure does not capture mortality occurring among patients who were transferred to a second hospital to complete their acute hospitalisation.

There was an increase in the unadjusted in-hospital mortality rate over the 4-year reporting period, from 4.3% (n=61) in 2017 to 4.6% (n=69) in 2018, 5.9% (n=83) in 2019, and 5.7% (n=74) in 2020 (Figure 7.2). In the *Heart Attack Care Ireland 2016* report (HSE, 2018a), a downward trend in in-hospital mortality was observed, from a rate of 6.6% in 2013 to 5.9% in 2014, 5.4% in 2015, and 4.9% in 2016. Overall, the in-hospital mortality rates reported in this first IHAA report are in keeping with those figures; however, the trend of gradually reducing in-hospital mortality was not maintained.

The unadjusted in-hospital mortality rate was higher in older people. A mortality rate of 12% (n=129) was seen in those aged 75 years and over, a rate of 5% (n=68) was seen in those aged 65–74 years, and a rate of 3% (n=90) was seen in those aged 64 years and under. Figure 7.3 presents these data and discharge destination by age group. These rates are in keeping with international experience, with MINAP reporting mortality rates among patients treated with reperfusion of 11.5% in patients aged 75 years and over, 6.2% in patients aged 65–74 years, and 4.1% in patients aged 64 years and under in the 2018–2019 reporting year (MINAP, 2020).

The unadjusted in-hospital mortality rate was 4.2% (n=199) for patients who received primary PCI, 5.1% (n=9) for those who received thrombolysis as an initial reperfusion strategy, and 10.0% (n=19) for those who received no reperfusion therapy. The comparison between patients who received primary PCI and those who received thrombolysis did not reach statistical significance ( $p=0.56$ ); however, there was a statistically significant difference between those who received reperfusion therapy and those who did not ( $p<0.01$ ).

Timeliness of reperfusion was associated with lower mortality rates. Patients who received timely reperfusion had an in-hospital mortality rate of 2.8% (n=82), whereas the in-hospital mortality rate for patients who did not receive timely reperfusion was 5.2% (n=73;  $p<0.05$ ). Figure 7.1 shows mortality by age group and timeliness of reperfusion. Among patients aged 64 years and under, a mortality rate of 1.6% (n=27) was observed for those who received timely reperfusion (primary PCI or thrombolysis) compared with 4.0% (n=30) for those who did not.



**FIGURE 7.1:** MORTALITY BY AGE GROUP AND TIMELINESS OF REPERFUSION THERAPY, 2017–2020 (n=4475)<sup>51</sup>

Considering the cohort of patients who received primary PCI, those who received timely primary PCI had an in-hospital mortality rate of 2.8% (n=79), whereas the patients who did not receive timely primary PCI had an in-hospital mortality rate of 5.2% (n=67;  $p < 0.05$ ). Patients aged 64 years and under who received timely primary PCI had a particularly favourable outcome. In this age group, an in-hospital mortality rate of 1.5% (n=25) was seen for those who received timely primary PCI. An almost threefold increase in mortality rate, at 4% (n=28), was seen among those in the same age group who did not receive timely primary PCI ( $p < 0.05$ ).

In Chapter 6, patients with a STEMI were divided into two groups: a transferred group comprising patients with a STEMI who were transferred by ambulance from an acute hospital (typically the ED at that hospital) to a PCI centre, and a direct group comprising those who came directly by ambulance to the PCI centre, self-presented directly to the PCI centre, or sustained a STEMI while already an inpatient in the PCI centre. Among the group who received primary PCI, the in-hospital mortality rate was 3.3% (n=39) for those who arrived at the PCI centre by transfer from another hospital and was 4.4% (n=151) for patients admitted directly to the PCI centre. This result is surprising given that transferred patients were unlikely to receive timely primary PCI. The discordance may be explained by a shorter follow-up period for patients in the transferred group. The median LOS at a PCI centre for these patients was 1 day (IQR: 1–3 days; number of patients=1593), compared with 3 days (IQR: 1–5 days; number of patients =3893) for the group who were admitted directly to the PCI centre. This statistic therefore represents mortality at a median of 1 day post-STEMI for the transferred group compared with a median of 3 days for the directly admitted group.

<sup>51</sup> Patients for whom time information was not recorded, or was recorded incorrectly, were excluded from Figure 7.1 (n=76).

## DISCHARGE DESTINATION FROM THE PCI CENTRE

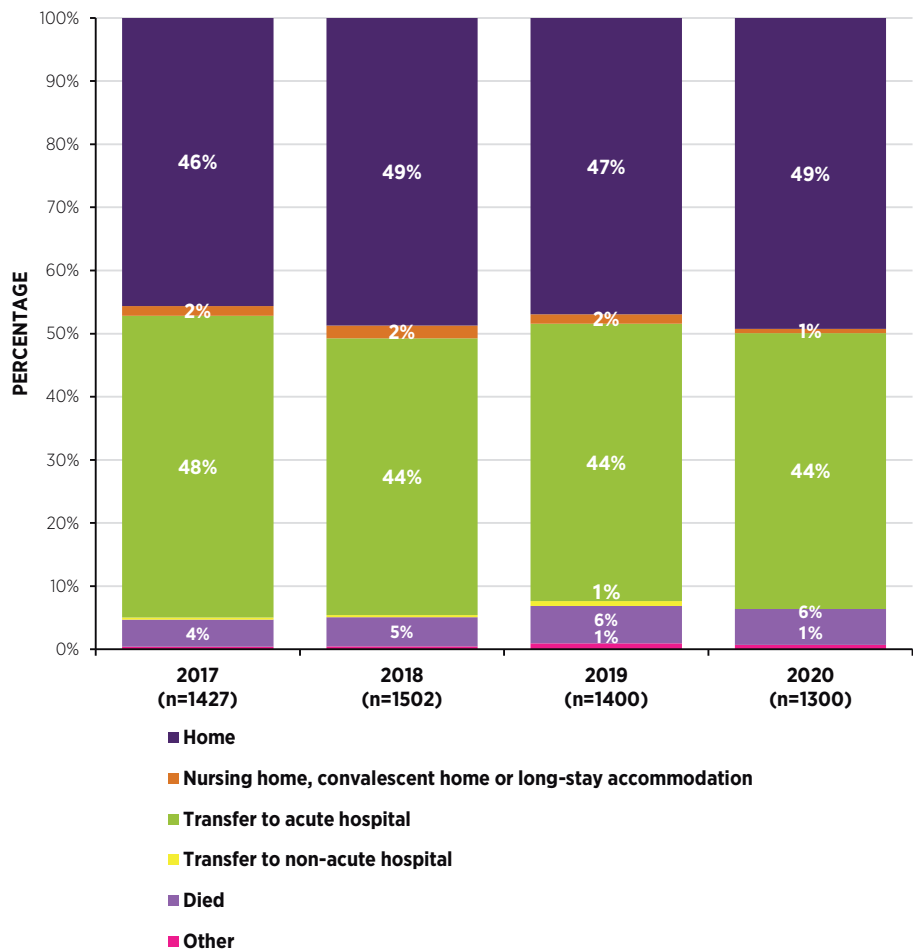
48% of patients were discharged directly home from PCI centre

45% of patients were transferred to another acute hospital for ongoing STEMI care



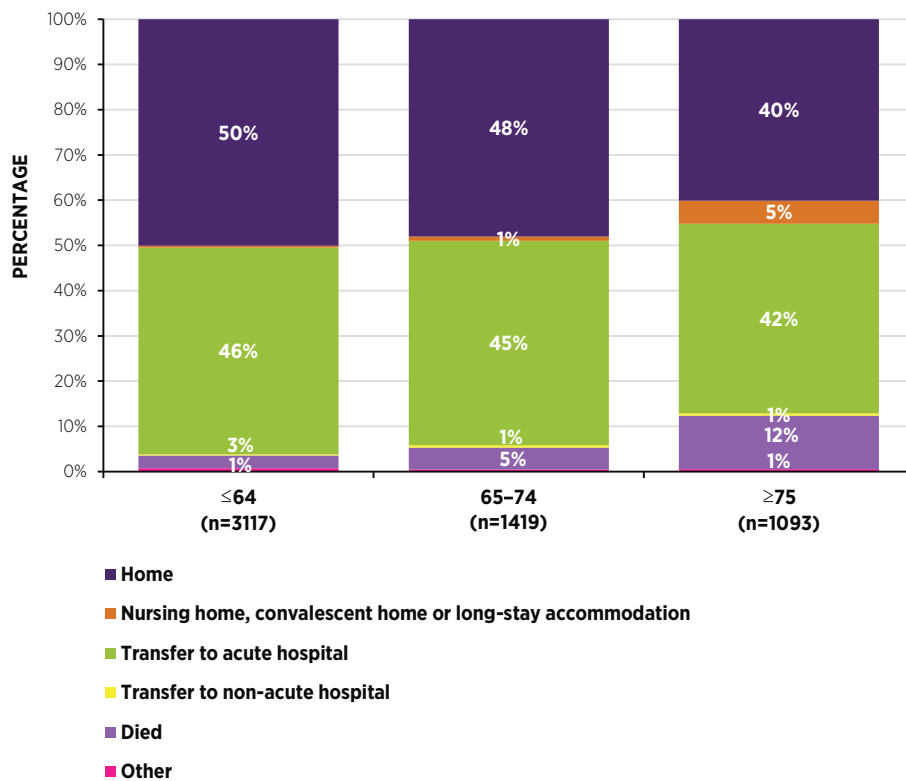
Between 2017 and 2020, 48% (n=2680) of patients with a STEMI were discharged directly home from PCI centres. Forty-five percent (n=2524) were transferred to another acute hospital for ongoing STEMI care. A small variation in the percentage of patients who were discharged home or transferred to another hospital was seen over the 4-year reporting period. Figure 7.2 displays discharge destination from PCI centres by year.

The ACS MOC recommends that, where appropriate, patients with a STEMI be transferred in a timely manner to complete their STEMI care in a more local acute hospital; however, no target is set in this area. Forty-five percent (n=2524) of all patients with a STEMI from 2017 to 2020 (and 47% of patients who survived to discharge) were transferred in this manner, and the median LOS in the PCI centre for this group was 1 day. These observations provide evidence of hospitals working together to provide care, and demonstrate efficient use of PCI centre and network resources.



**FIGURE 7.2:** DISCHARGE DESTINATION FROM PERCUTANEOUS CORONARY INTERVENTION CENTRES, BY YEAR (N=5629)

Figure 7.3 shows the discharge destination of patients with a STEMI by age group. Five percent (n=56) of patients aged 75 years and over were discharged to a nursing home, convalescent care, or long-stay accommodation. Marginally fewer patients in this age group, compared to the younger age groups, were transferred to a second acute hospital to complete their in-hospital stay.




**FIGURE 7.3:** DISCHARGE DESTINATION FROM PERCUTANEOUS CORONARY INTERVENTION CENTRES, BY AGE GROUP, 2017-2020 (N=5629)



## BLEEDING AND STROKE COMPLICATIONS

### INCIDENCE OF BLEEDING COMPLICATIONS

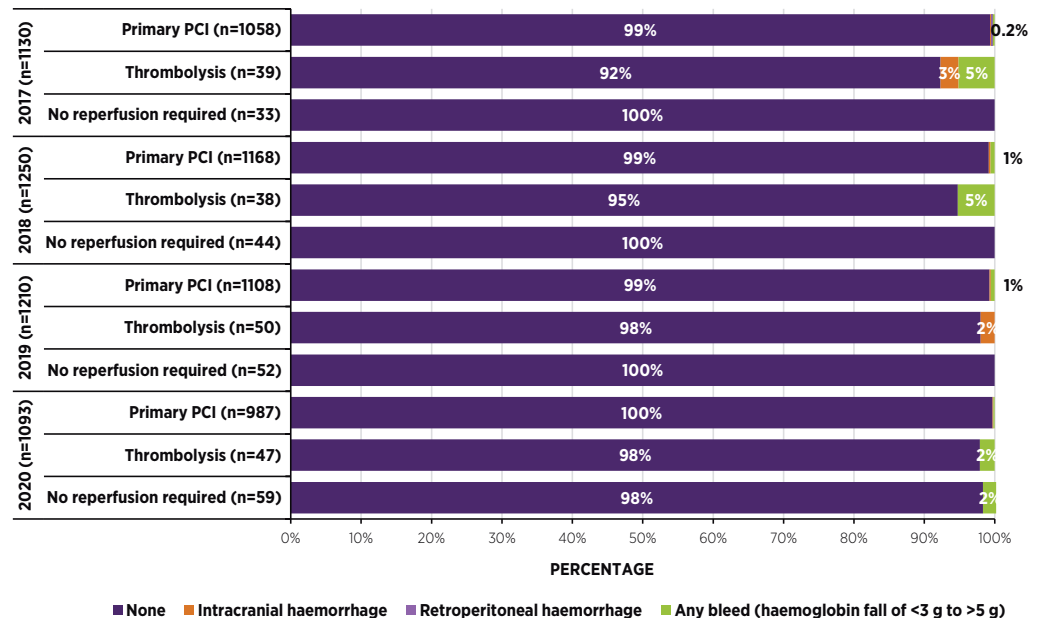
During the 4-year reporting period, a total of 35 (1%) patients with a STEMI who received reperfusion therapy had a bleeding complication (Figure 7.4). Bleeding complications were defined as intracranial haemorrhage, retroperitoneal haemorrhage, or other bleeding event (this last category was subdivided into three categories based on haemoglobin fall:  $\geq 5$  grams per decilitre (g/dL);  $\geq 3$  g/dL but  $< 5$  g/dL; and  $< 3$  g/dL). Bleeding complications were coded as missing or unknown for 438 (9%) patients; these patients are not included in Figure 7.4.



**1% of patients with a STEMI who received reperfusion therapy had a bleeding complication**

While this low rate of bleeding complications may reflect a short follow-up period, it is plausibly a result of the high use of radial access in order to perform primary PCI. Radial access is an ESC quality metric and is associated with a lower risk of puncture site complications and retroperitoneal haemorrhage. During the 4-year reporting period, 91% (n=4312) of patients who had primary PCI had radial access (Figure 6.3).

Intracranial haemorrhage was uncommon. There were 10 cases of intracranial haemorrhage in total over the reporting period, accounting for 0.2% of the entire cohort of patients with a STEMI and 28% of patients who had bleeding complications. The incidence of bleeding by reperfusion type and year is displayed in Figure 7.4. There was a higher incidence of bleeds in the thrombolysis group (n=7, 4%) compared with the primary PCI group (n=28, 1%). Intracranial haemorrhage occurred in two patients in the thrombolysis group, corresponding to an intracerebral haemorrhage rate of 1.1%, whereas this occurred in eight patients in the primary PCI group, corresponding to an intracerebral haemorrhage rate of 0.2%.




**FIGURE 7.4:** INCIDENCE OF BLEEDING BY REPERFUSION TYPE, BY YEAR (n=4683)<sup>52</sup>

<sup>52</sup> Cases that were identified as contraindicated and had a reperfusion therapy recorded (n=24), cases that did not have reperfusion therapy information recorded (n=484), and cases that did not have incidence of bleeding recorded (n=438) were excluded from Figure 7.4.

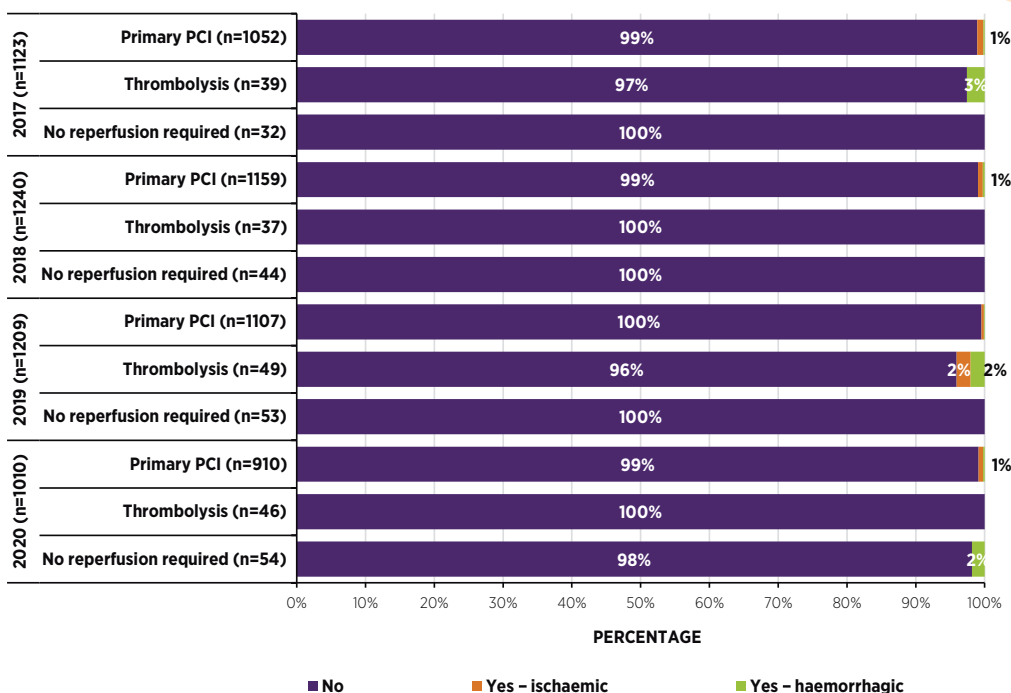
## INCIDENCE OF STROKE OVERALL AND BY REPERFUSION TYPE

During the 4-year reporting period, a total of 38 (1%) patients with a STEMI who received reperfusion therapy sustained a stroke, of which 10 were classified as haemorrhagic. This data point was coded as missing or unknown for 539 patients (11%); these patients were not included in Figure 7.5.

Figure 7.5 displays the incidence of stroke by reperfusion type and year. There was a similar proportion of stroke among patients receiving thrombolysis as the initial reperfusion strategy (n=3, 2%) and those receiving primary PCI as the initial reperfusion strategy (n=35, 1%). Regarding haemorrhagic stroke, 1.2% (n=2) of thrombolysis cases had a haemorrhagic stroke, compared with 0.2% (n=8) of primary PCI cases.



**1% of patients with a STEMI who received reperfusion therapy sustained a stroke**



**FIGURE 7.5:** INCIDENCE OF STROKE BY REPERFUSION TYPE, BY YEAR (n=4582)<sup>53</sup>

## LENGTH OF STAY AT A PCI CENTRE

The median LOS at a PCI centre was 3 days (IQR: 1–5 days) for all patients with a STEMI over the 4-year reporting period. This variable captures in-hospital stay in the PCI centre only. For patients who completed their inpatient stay at the PCI centre (Table 7.3), the median LOS was 4 days (IQR: 3–6 days). This meets the relevant KPI in the ACS MOC of a median LOS of 4 days.

Tables 7.3 and 7.4 present the LOS for patients with a STEMI who completed their acute STEMI care at a PCI centre and for patients who were transferred to another acute hospital to complete their inpatient care, respectively. In both tables, heterogeneity in the median LOS is observed.

<sup>53</sup> Cases that were identified as contraindicated and had a reperfusion therapy recorded (n=24), cases that did not have reperfusion therapy information recorded (n=484), and cases that did not have incidence of stroke recorded (n=539) were excluded from Figure 7.5.

**TABLE 7.3:** LENGTH OF STAY FOR PATIENTS WHO COMPLETED ACUTE HOSPITALISATION IN A PERCUTANEOUS CORONARY INTERVENTION CENTRE, BY HOSPITAL AND YEAR (N=2818)<sup>54</sup>

Year	Hospital	Number of patients	Number of days	Median LOS (days)	IQR	
					Percentile 25 (days)	Percentile 75 (days)
2017	Cork University Hospital	153	1058	5	3	6
	Letterkenny University Hospital	43	349	6	3	10
	Mater Misericordiae University Hospital	67	550	4	2	7
	St James's Hospital	132	1140	5	3	9
	University Hospital Galway	99	711	4	3	7
	University Hospital Limerick	157	658	4	3	5
	St Vincent's University Hospital	15	71	4	3	6
	Tallaght University Hospital	18	126	5	3	7
	<b>Total</b>	<b>684</b>	<b>4663</b>	<b>4</b>	<b>3</b>	<b>7</b>
2018	Cork University Hospital	151	1082	5	3	8
	Letterkenny University Hospital	63	471	5	3	9
	Mater Misericordiae University Hospital	102	1106	5	3	8
	St James's Hospital	129	1227	4	3	10
	University Hospital Galway	139	916	4	3	6
	University Hospital Limerick	141	1039	3	3	4
	Beaumont Hospital	13	81	6	2	6
	St Vincent's University Hospital	16	89	4	3	8
	Tallaght University Hospital	20	100	4	4	6
<b>Total</b>	<b>774</b>	<b>6111</b>	<b>4</b>	<b>3</b>	<b>7</b>	
2019	Cork University Hospital	162	1270	5	4	9
	Letterkenny University Hospital	38	230	5	4	7
	Mater Misericordiae University Hospital	80	730	5	3	11
	St James's Hospital	127	1232	5	4	9
	University Hospital Galway	95	576	4	3	8
	University Hospital Limerick	151	844	4	3	5
	Beaumont Hospital	22	188	6	3	9
	St Vincent's University Hospital	13	54	3	3	4
	Tallaght University Hospital	14	132	4	3	6
<b>Total</b>	<b>702</b>	<b>5256</b>	<b>4</b>	<b>3</b>	<b>8</b>	
2020	Cork University Hospital	155	1162	4	3	7
	Letterkenny University Hospital	42	280	5	3	8
	Mater Misericordiae University Hospital	85	753	5	3	9
	St James's Hospital	139	956	4	3	7
	University Hospital Galway	77	351	4	3	6
	University Hospital Limerick	122	550	4	3	5
	Beaumont Hospital	16	153	6	3	12
	St Vincent's University Hospital	14	48	3	3	4
	Tallaght University Hospital	8	108	5	5	15
<b>Total</b>	<b>658</b>	<b>4361</b>	<b>4</b>	<b>3</b>	<b>6</b>	

<sup>54</sup> Only includes patients who were alive on discharge.

**TABLE 7.4:** LENGTH OF STAY FOR PATIENTS WHO WERE TRANSFERRED TO AN ACUTE HOSPITAL TO COMPLETE INPATIENT CARE, BY HOSPITAL AND YEAR (N=2524)<sup>55, 56</sup>

Year	Hospital	Number of patients	Number of days	Median LOS (days)	IQR	
					Percentile 25 (days)	Percentile 75 (days)
2017	Cork University Hospital	38	90	1	1	3
	Letterkenny University Hospital	~	20	10	8	12
	Mater Misericordiae University Hospital	247	335	1	1	1
	St James's Hospital	267	495	1	1	2
	University Hospital Galway	88	234	2	1	3
	University Hospital Limerick	39	191	2	1	5
	Tallaght University Hospital	~	3	3	3	3
<b>Total</b>		<b>682</b>	<b>1368</b>	<b>1</b>	<b>1</b>	<b>2</b>
2018	Cork University Hospital	50	150	1	1	3
	Letterkenny University Hospital	~	6	3	1	5
	Mater Misericordiae University Hospital	228	385	1	1	1
	St James's Hospital	274	549	1	1	2
	University Hospital Galway	69	149	1	1	2
	University Hospital Limerick	33	96	1	1	4
	Beaumont Hospital	~	15	8	1	14
	St Vincent's University Hospital	~	12	12	12	12
<b>Total</b>		<b>659</b>	<b>1362</b>	<b>1</b>	<b>1</b>	<b>2</b>
2019	Cork University Hospital	45	167	2	1	4
	Letterkenny University Hospital	~	98	3	3	34
	Mater Misericordiae University Hospital	228	514	1	1	1
	St James's Hospital	253	656	1	1	2
	University Hospital Galway	49	147	2	1	3
	University Hospital Limerick	34	182	3	1	5
	Tallaght University Hospital	~	6	6	6	6
<b>Total</b>		<b>615</b>	<b>1770</b>	<b>1</b>	<b>1</b>	<b>2</b>
2020	Cork University Hospital	39	90	1	1	2
	Letterkenny University Hospital	~	18	4	2	8
	Mater Misericordiae University Hospital	242	380	1	1	1
	St James's Hospital	215	419	1	1	2
	University Hospital Galway	37	80	2	1	2
	University Hospital Limerick	27	80	2	1	4
	Beaumont Hospital	~	46	23	17	29
	Tallaght University Hospital	~	43	22	1	42
<b>Total</b>		<b>568</b>	<b>1156</b>	<b>1</b>	<b>1</b>	<b>2</b>

~ Denotes five cases or fewer

<sup>55</sup> Only includes patients who were alive on discharge.

<sup>56</sup> St Vincent's University Hospital had no patients who were transferred for the years 2017, 2019 and 2020. Beaumont Hospital had no patients who were transferred for the years 2017 and 2019. Tallaght University Hospital had no patients who were transferred for the year 2018.


## SECONDARY PREVENTION

The ACS MOC considers discharge medications in conjunction with smoking cessation advice as a composite KPI. It mandates that 90% of eligible (not contraindicated) patients with a STEMI should receive a care bundle on discharge, comprising medication (aspirin, beta-blockers, statins, and angiotensin-converting enzyme inhibitors (ACE) inhibitors)/angiotensin II receptor blockers (ARBs) and smoking cessation counselling. For the purposes of this audit, we have separated this composite KPI and reported on the provision of smoking cessation advice and discharge medications separately. Additionally, a second antiplatelet drug is included in the medication discharge bundle.

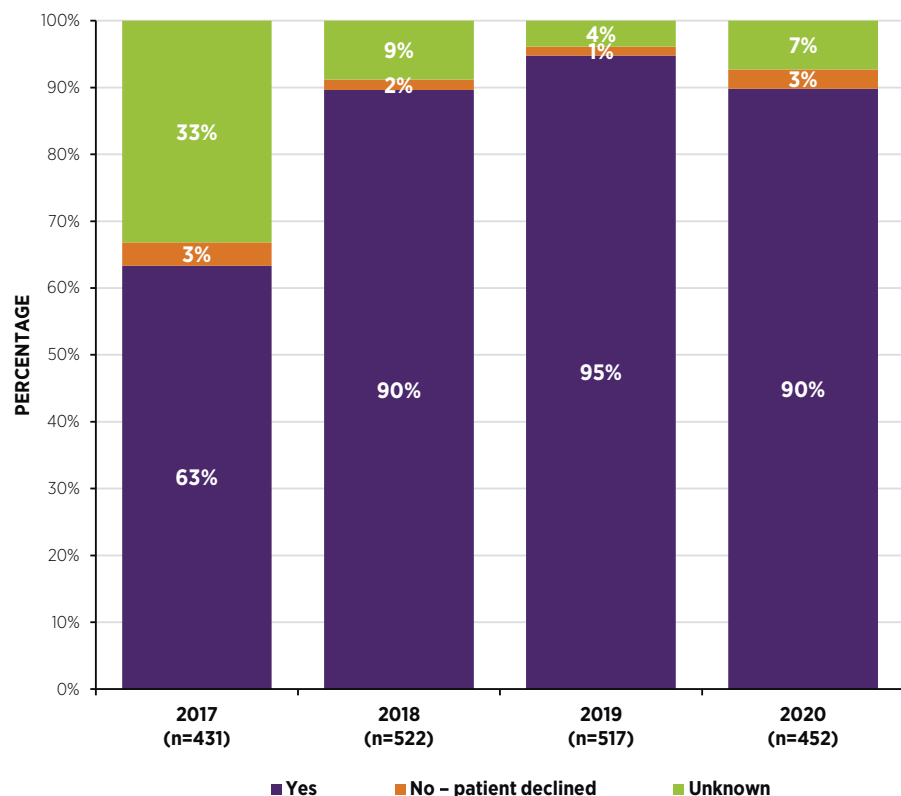
## SMOKING CESSATION

From 2017 to 2020, 34% (n=1922) of patients with a STEMI were recorded as current smokers.

Figure 7.6 displays the proportion of patients with a STEMI who were smokers who received smoking cessation advice for each of the reporting years. Throughout the 4-year reporting period, most actively smoking patients with a STEMI were given smoking cessation advice (n=1637, 85%). The ACS MOC mandates a target that 90% of patients with a STEMI who are current smokers should receive smoking cessation advice as a KPI. There was an increase in the proportion of patients who received smoking cessation advice over the reporting period, from 63% (n=273) in 2017 to 95% (n=490) in 2019, although this declined slightly to 90% (n=406) in 2020 due to the COVID-19 pandemic. The proportion of patients with a STEMI who smoke and received smoking cessation advice may have increased between 2017 and 2019 due to improved data collection quality. In 2017, 33% (n=143) of patients who were current smokers had no information on the provision of smoking cessation advice recorded, compared with only 4% (n=20) of patients who were current smokers in 2019.



**85% of actively smoking patients received smoking cessation advice**



**FIGURE 7.6:** SMOKING CESSATION ADVICE PROVIDED, BY YEAR (n=1922)<sup>57</sup>

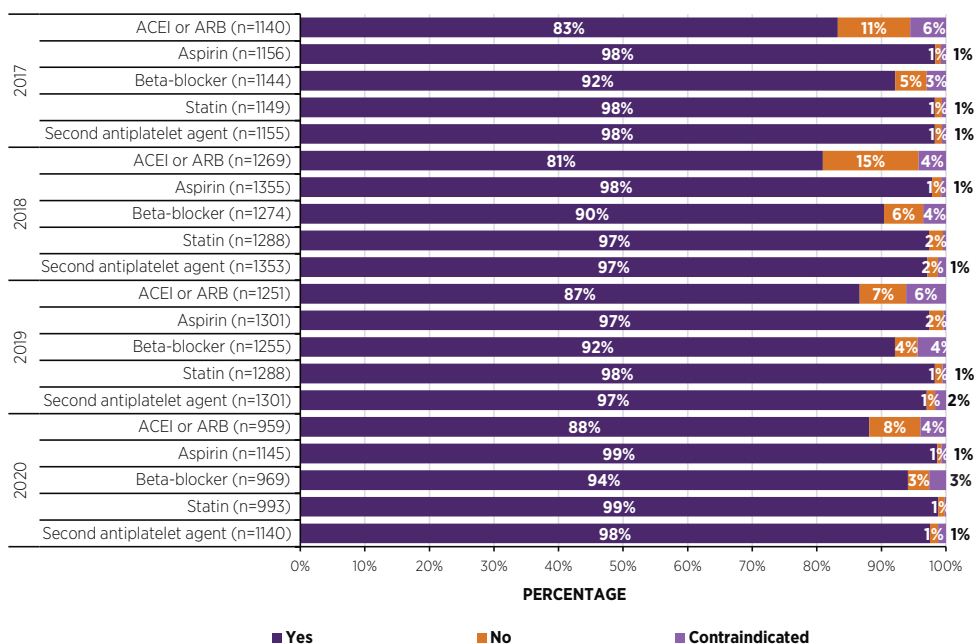
<sup>57</sup> Figure 7.6 includes patients reported as current smokers only.

## SECONDARY PREVENTION MEDICATION ON DISCHARGE

During the 4-year reporting period, 88% (n=4953) of patients with a STEMI had at least one secondary prevention medication prescribed on discharge. Twelve percent (n=672) of patients had no information recorded about any of the medications prescribed on discharge.

The proportion of patients with a STEMI who had no information recorded about any of the five medications prescribed on discharge varied over the 4 years. Missing data accounted for 19% (n=271) of STEMI cases in 2017; this decreased to 10% (n=147) in 2018 and 7% (n=99) in 2019, before rising again to 12% (n=155) in 2020. These cases were excluded from Figure 7.7.

Figure 7.7 shows the proportion of each of the secondary prevention medications prescribed on discharge for each of the 4 reporting years, excluding STEMI cases for which no information was recorded, for each of the medications. During the 4-year reporting period, aspirin (n=4861, 98%) and statins (n=4606, 98%) were the most prescribed secondary preventative medications. A second antiplatelet agent was prescribed in 97% (n=4823) of cases, followed by beta-blockers (n=4274, 92%) and ACEIs or ARBs (85%, n=3905). Of the cases that had data recorded for each of the five medications (n=4604), 76% (n=3515) had all five medications prescribed. This is below the KPI target of 90% mandated by the ACS MOC.



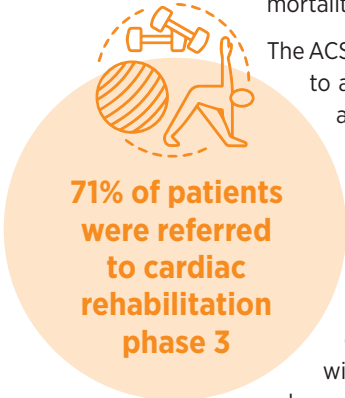
**FIGURE 7.7:** PROPORTION OF PATIENTS PRESCRIBED SECONDARY PREVENTION MEDICATION ON DISCHARGE, BY YEAR<sup>58,59</sup>

<sup>58</sup> Patients who had no information recorded were excluded from Figure 7.7. Each patient may have been prescribed one or more medications, and may therefore be counted more than once.

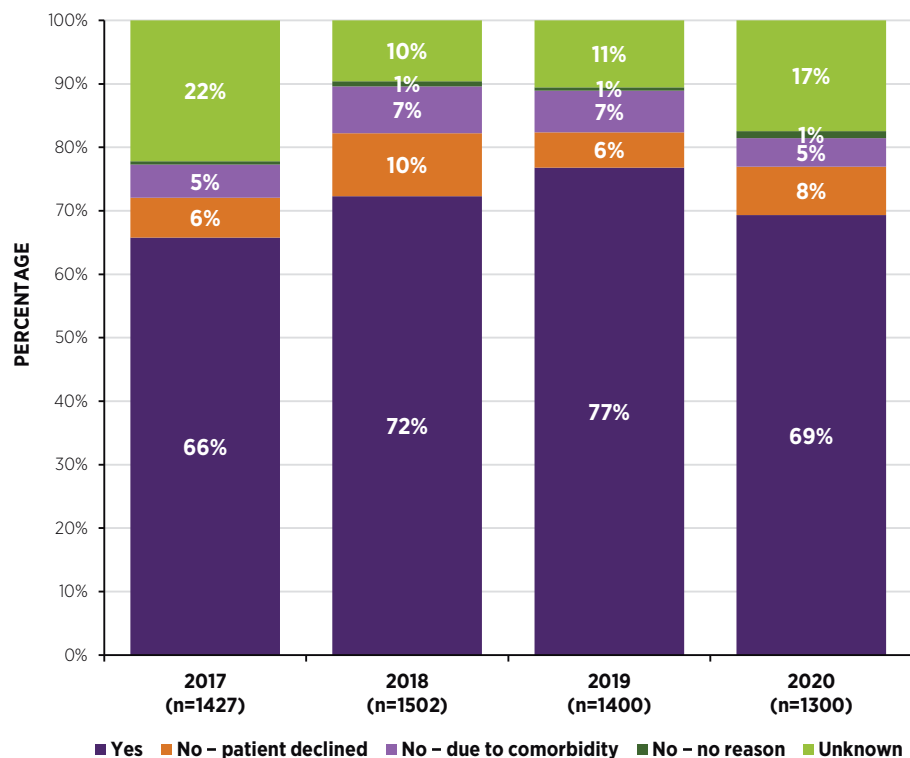
<sup>59</sup> The “n” in the Figure 7.7 represents total number of patients who had information about the medication recorded. For instance, in 2017, 1140 patients had information about whether ACEI or ARB was prescribed, and those who did not have that information recorded (n=1010) were not included in the calculation.

## CARDIAC REHABILITATION

Cardiac rehabilitation (CR) is a recognised standard of care for patients with a STEMI, as set out in the current Irish cardiovascular policy, *Changing Cardiovascular Health: National Cardiovascular Health Policy 2010 – 2019* (Department of Health, 2010) and in the ESC guidelines for STEMI management (Ibanez *et al.*, 2018). Exercise-based CR significantly reduces cardiovascular mortality, reduces the rate of hospitalisation, and improves health-related quality of life.



The ACS MOC target is for 90% of STEMI patients who are admitted as an emergency to be referred to an early CR programme/secondary prevention programme on discharge. Between 2017 and 2020, most (n=4001, 71%) patients with a STEMI were referred to CR phase 3. Phase 3 of CR comprises an exercise programme and educational classes, typically scheduled over 6–12 weeks. Figure 7.8 displays the CR referral rate by year. This variable records referrals to CR; it does not record whether CR was delivered for patients as planned, nor does it record whether it was delivered in a timely fashion. Heartbeat contains a variable intended to provide a more robust indicator of delivery of CR: ‘date of first phase 3 CR appointment’. This was completed in only 15% of cases and is therefore excluded from the analysis. The rate of CR referral recorded varied over the 4 years, with a higher proportion recorded in 2018 (n=1086, 72%) and 2019 (n=1075, 77%) and a lower proportion recorded in 2017 (n=939, 66%) and in 2020 (n=901, 69%), perhaps due to the impact of the COVID-19 pandemic, during which most CR programmes were suspended. The ACS MOC target of 90% was not reached in any of the 4 reporting years. Missing data for this variable accounted for 22% (n=317) of STEMI cases in 2017, decreasing to 10% (n=144) in 2018 and 11% (n=148) in 2019, before rising again to 17% (n=227) in 2020.



**FIGURE 7.8:** PROPORTION OF PATIENTS WITH AN ST ELEVATION MYOCARDIAL INFARCTION REFERRED FOR CARDIAC REHABILITATION PHASE 3, BY YEAR (N=5629)

## KEY FINDINGS FROM CHAPTER 7

- The 2017–2020 unadjusted in-hospital mortality rate was 5.1% (n=287) for patients with a STEMI. This unadjusted mortality rate refers to mortality recorded on discharge or transfer from a PCI centre and is an underestimate of the total in-hospital mortality rate for patients with a STEMI.
- Timely reperfusion was associated with a lower mortality rate. Patients who received timely reperfusion had an unadjusted in-hospital mortality rate at the PCI centre of 2.8% (n=82), compared with 5.2% (n=73) of those who did not receive timely reperfusion.
- Older age was associated with a higher mortality rate. A mortality rate of 12% (n=129) was seen in those aged 75 years and over, a rate of 5% (n=68) in those aged 65–74 years, and a rate of 3% (n=90) in those aged 64 years and under.
- Missing data precluded calculation of 30-day mortality rates; this variable was missing or recorded as unknown for 51% (n=2854) of patients
- Among patients who received reperfusion therapy, complication rates in terms of stroke (n=38, 1%) and bleeding (n=35, 1%) were low. Bleeding complications were more commonly seen in patients treated with thrombolysis (n=7, 4%) than in those who received primary PCI (n=28, 1%), but absolute risks were low in both groups.
- The ACS MOC sets a KPI of a median LOS of 4 days or fewer for patients with a STEMI. The median PCI centre LOS recorded was 1 day for patients who were transferred to another acute hospital in order to complete STEMI care and 4 days for patients who completed their acute hospitalisation at a PCI centre.
- The ACS MOC sets a KPI that 90% of patients with a STEMI should receive smoking cessation advice. Thirty-four percent (n=1922) of patients with a STEMI between 2017 and 2020 were current smokers, and 85% (n=1637) of these patients were recorded as receiving smoking cessation advice.
- The ACS MOC sets a KPI that 90% of patients with a STEMI should receive a discharge bundle of five medications. Seventy-six percent (n=3515) of the cases that had data recorded for each of the five medications were recorded as having all five medications prescribed on discharge.
- The ACS MOC sets a KPI that 90% of patients with a STEMI should receive referral for timely CR. Seventy-one percent (n=4001) of patients with a STEMI over the reporting period were referred to CR, however, it is not known how many actually received it.
- Missing data, including both missing or not recorded data and data recorded as unknown, were common. For example, missing data accounted for 9% (n=438) of records of bleeding complications, 11% (n=539) of records of stroke, 24% (n=1353) of records of survival status at discharge, 51% (n=2854) of records of 30-day survival status, and 85% (n=3399) of records of date of CR phase 3. Twelve percent (n=672) of patients had no data recorded on receipt of any discharge medications. The rates of missing data affect the quality of the conclusions that can be drawn from the dataset.



# CHAPTER 8

## AUDIT UPDATE



## CHAPTER 8: AUDIT UPDATE

### VALUE OF AUDIT



The transfer of governance of the Heartbeat portal from the National Clinical Programme for Acute Coronary Syndrome (NCP-ACS) to NOCA represents a commitment to quality improvement and audit in heart attack care as a core aspect of service delivery in our health service. This is NOCA's first report of Heartbeat data, and it follows on from two previous reports – *Heart attack care in Ireland 2014* (HSE, 2015) and *Heart Attack Care Ireland 2016* (HSE, 2018a) – which have informed clinical practice both locally and nationally. As described in Chapter 3, the reporting of national KPIs informs HSE operations and the *National Service Plan 2021* (HSE, 2021b). In addition, NOCA quarterly reports to the Hospital Groups based on the KPI results provide information at Hospital Group level.

The IHAA can now provide validated and published data and is able to make anonymised data available for research and service evaluation projects, following NOCA policies and procedures.

## AUDIT DEVELOPMENTS



### TRAINING, EDUCATION AND SUPPORT

A training manual incorporating a data dictionary is available for the audit coordinators in order to support data collection. During data analysis, it became clear that there are some variables within the IHAA dataset that may need further definition. A process to identify variables within the IHAA dataset that have the potential to lead to variability in data collection and accuracy across hospital sites commenced in 2021. This process will result in a revision of the training manual and additional training for the audit coordinators.

An audit coordinator workshop was delivered in Q4 2021 in addition to regular audit coordinator meetings with the IHAA Audit Manager and the Assistant Manager, who manages training for the audit coordinators. Supporting the collection of high-quality data was a focus of these meetings.

The National Ambulance Service (NAS) has an electronic patient care record (ePCR) that collects pre-hospital data. A pilot is underway to assess if this is a feasible way of confirming hospital records such as the first positive electrocardiogram (ECG) date and time. It may also allow accurate collection of pre-hospital data such as the call for help time of patients who arrive at a PCI centre by ambulance.

### DATA QUALITY INITIATIVES

#### Data Validation Report

In order to ensure that the data collected are complete and valid, the data analytical team has developed a Data Validation Report (DVR). The DVR was piloted in December 2020 and was implemented in all participating hospitals in 2021. Table 8.1 shows the reporting schedule for DVRs, as well as for the provision of quarterly reports to the HSE Business Intelligence Unit and of NOCA quarterly reports to Hospital Groups. The final data entry date is linked to the HIPE closure date for the reporting year.

**TABLE 8.1: IRISH HEART ATTACK AUDIT REPORTING SCHEDULE**

Submission dates	DVRs sent to hospitals	Data entry target	Data reporting date
Q1: 01/01/2021–31/03/2021	30/05/2021*	30/06/2021	14/07/2021**
Q2: 01/04/2021–31/06/2021	31/08/2021	30/09/2021	14/10/2021
Q3: 01/07/2021–30/09/2021	30/11/2021	31/12/2021	14/01/2022
Q4: 01/10/2021–31/12/2021	28/02/2022	31/03/2022	14/04/2022

\*DVR delayed due to HSE cyberattack on 15 May 2021

\*\*No Q1 report sent to Hospital Groups due to HSE cyberattack

### Data verification

The IHAA Governance Committee would like to develop a data verification process whereby an agreed percentage of cases would be verified for accuracy, either through the re-entry of data at the hospital or through a chart review by an independent person to compare against the case details on the Heartbeat portal. NOCA plans to investigate how this could be achieved for the IHAA.

### Dashboard

NOCA is implementing an interactive dashboard reporting system for the IHAA to visually track, analyse and display key quality indicators. Each participating hospital will have access to its own data along with national data. The functionality of the dashboard will facilitate the mining of previous years' data and the tracking of trends against national results.

The IHAA Governance Committee has agreed that a suite of key quality indicators will be reported, as follows:

1. the percentage of patients with a STEMI who had radial access for primary PCI
2. the percentage of eligible patients with a STEMI who were offered reperfusion
3. the percentage of patients with a STEMI who had timely reperfusion
4. the percentage completeness of the 30-day survival status data point
5. the percentage of patients with a STEMI who received an appropriate secondary prevention discharge bundle
6. the percentage of patients with a STEMI who smoke who were offered smoking cessation advice
7. the percentage of patients with a STEMI referred for CR phase 3.

### Review of dataset

The data analysis showed some areas where additional variables would provide the opportunity for more robust analysis in future reports. The IHAA Governance Committee will consider additional variables, such as the individual components of the Global Registry of Acute Coronary Events (GRACE) score, body mass index renal function, infarct location, estimation of ejection fraction, and updated bleeding complication definitions.

A blurred photograph of a hospital hallway. In the foreground, a person in blue scrubs is walking towards the camera. In the background, another person in white scrubs is walking away. The hallway has a light-colored floor and ceiling lights.

## CHAPTER 9 **RECOMMENDATIONS**

**CONTENTS >**

## CHAPTER 9: RECOMMENDATIONS

### RECOMMENDATIONS FOR THE IRISH HEART ATTACK AUDIT

#### RECOMMENDATION 1

**Implement a national ST elevation myocardial infarction (STEMI) transfer form for use when transferring patients from a non-percutaneous coronary intervention (PCI) hospital to a PCI centre.**

Rationale
<ul style="list-style-type: none"> <li>During the 2017–2020 reporting period, 1,593 patients with a STEMI were transferred to a PCI centre from another hospital. On arrival at the PCI centre, it is essential that a patient with a STEMI receive primary PCI as quickly as possible. In order to expedite patient treatment and facilitate effective audit, it is important that the information that accompanies a patient is comprehensive and consistent.</li> </ul>
What action should be taken?
<ul style="list-style-type: none"> <li>A national STEMI transfer form should be implemented, which should be developed in conjunction with the PCI centres and be inclusive of the necessary Heartbeat variables. All hospitals transferring patients with a STEMI should complete the form in full before transferring patients to the PCI centre. This form should be part of the clinical record in order to reduce duplication of data entry.</li> </ul>
Evidence that the action will be effective
<ul style="list-style-type: none"> <li>Mumma <i>et al.</i>, (2014) investigated how to minimise transfer time to PCI centres for patients with a STEMI and found that having established transfer protocols in place was key to reducing transfer times and should be considered in the development of STEMI systems of care. The introduction of a simple written template to augment communication between hospitals at the time of inter-hospital transfers has been found to increase the completeness of the health information that is forwarded with the patient (Szary <i>et al.</i>, 2010).</li> </ul>
Who will benefit from the recommendation?
<ul style="list-style-type: none"> <li>The PCI centres will benefit from accessing timely and accurate patient details from the referring hospital. Patients will benefit by not having to remember and repeat information. The audit coordinators will benefit from having IHAA variable data available to them and from having identified contact details from the referring hospital. The transfer form will allow calculation of the ‘door in door out’ (DIDO) time interval for patients with a STEMI presenting to non-PCI sites – the current European Society of Cardiology (ESC) STEMI guidelines define an optimal DIDO interval as being less than 30 minutes. The transfer form will help identify delays in transferring patients to PCI centres. This will feed into local audit and improve the provision of care for PCI transfers.</li> </ul>
Who is responsible for implementation?
<ul style="list-style-type: none"> <li>The IHAA should work with the National Heart Programme and the PCI centres to design a national STEMI transfer form. The IHAA should work collaboratively with the National Heart Programme to roll out the form to all hospitals that refer patients with a STEMI to PCI centres. All relevant hospitals should ensure that the roll-out of the transfer form is implemented locally.</li> </ul>
When should this be implemented?
<p>The national STEMI transfer form should be implemented from 2022 to 2024.</p>

## RECOMMENDATION 2

**Improve the data quality of the follow-up dataset within the Heartbeat portal.**

### Rationale

- The Heartbeat dataset contains key follow-up metrics, including survival status on discharge, discharge medication, CR phase 3 appointment date, and 30-day survival status. Data quality and completeness for these variables are poor. The percentages of missing or unknown data for each variable are 24% for survival status on discharge, 12% for discharge medication, 85% for CR phase 3 appointment date, and 51% for survival status at 30 days. In addition to a high level of missing or unknown data, there is uncertainty in relation to data on patients' discharge location when audit is completed. For example, it is unclear whether the survival status at discharge refers to the discharge from the PCI centre or the discharge from the hospital to which the patient was transferred for ongoing acute STEMI care. This data quality issue negatively impacted on the IHAA's ability to report on processes and outcomes. There is a degree of uncertainty regarding the analyses in Chapter 7 in this report due to the poor quality of outcome-related data.

### What action should be taken?

- The IHAA should revise the follow-up variables collected and update the definitions within the data dictionary in order to ensure clarity for audit coordinators. The IHAA team should deliver education and training related to these revisions. Strong professional links should be developed between the PCI centres and their referring hospitals in order to ensure that the follow-up data can be easily collected by the audit coordinator in each PCI centre. For high-volume PCI centres, additional resources should be made available to support the collection of follow-up data.

### Evidence that the action will be effective

- Measuring and reporting on outcomes is a key aspect of clinical audit. The Commission on Patient Safety and Quality Assurance, established by the Department of Health, has recognised clinical audit as a key component of clinical governance, stating that it "constitutes the single most important method which any healthcare organisation can use to understand and ensure the quality of the service that it provides" (Department of Health and Children, 2008, p. 151). The increasing sophistication of clinical audits has been accompanied by significant improvements in the care of patients, and, although not entirely attributable to the audits, the provision of high-quality comparative data has been a real stimulus for improvement (Stewart *et al.*, 2016).

### Who will benefit from the recommendation?

- The IHAA will benefit from being able to provide more accurate reporting on patient outcomes. The acute hospital system will have access to high-quality reporting and will be able to respond to any deteriorations or improvements within the system. Patients will benefit from care provision that views quality improvement as an important aspect of patient-centred care. Implementation of this recommendation will also strengthen links between the PCI centres and their referring hospitals.

### Who is responsible for implementation?

- The IHAA, in collaboration with the National Heart Programme, share responsibility for improving the quality of Heartbeat's follow-up dataset.

### When should this be implemented?

The process of improving the quality of Heartbeat's follow-up dataset should be implemented in 2023 and 2024.

**RECOMMENDATION 3**

**Develop a process for accessing accurate 30-day mortality rates in patients with a STEMI using the death register in the Central Statistics Office (CSO).**

<b>Rationale</b>
<ul style="list-style-type: none"> <li>The availability of accurate data on 30-day mortality rates is a key quality metric in STEMI care (HSE, 2012). In 2017–2020, 30-day mortality data were available for only 49% of cases (Appendix 5). These data are difficult to collect for many reasons, such as the short LOS for patients with a STEMI in PCI centres, transfer to a second hospital for ongoing STEMI care for a substantial proportion of the population (n=2524, 47%), and lack of access to a national individual patient identifier. The CSO holds the records on all deaths in Ireland, and the IHAA believes that access to the CSO death register at the PCI centres would assist in the accurate collection of data for this metric.</li> </ul>
<b>What action should be taken?</b>
<ul style="list-style-type: none"> <li>A process should be implemented that would allow audit coordinators at the PCI centres to access the CSO death register in order to cross-reference against the patients with a STEMI recorded in the Heartbeat portal. This process should be piloted in one site with a view to assessing its feasibility and the resourcing required in order to implement the process across all PCI centres in Ireland.</li> </ul>
<b>Evidence that the action will be effective</b>
<ul style="list-style-type: none"> <li>If this action proves effective, increased completeness of the data for this variable in the pilot site would be expected.</li> </ul>
<b>Who will benefit from the recommendation?</b>
<ul style="list-style-type: none"> <li>The IHAA will benefit by having access to accurate data, which will allow measurement of mortality against national and international norms.</li> </ul>
<b>Who is responsible for implementation?</b>
<ul style="list-style-type: none"> <li>The IHAA.</li> </ul>
<b>When should this be implemented?</b>
<p>The development of the process should be undertaken in 2022, with a view to piloting the process in 2023 and 2024.</p>



## RECOMMENDATIONS FOR THE HEALTH SERVICE EXECUTIVE

### RECOMMENDATION 4

**Introduce a key performance indicator that measures the ‘door in door out’ time with the aim of achieving the European Society of Cardiology’s guideline target of 30 minutes or less.**

#### Rationale

- Patients with a STEMI who require inter-hospital transfer do not receive timely reperfusion when compared with patients with a STEMI who are admitted directly to a PCI centre. This results in a difference in mortality rates between patients with a STEMI who are transferred to a PCI centre and those who are directly admitted to a PCI centre. Currently, patients are transferred to one of seven designated primary PCI centres; six of these provide a 24/7 primary PCI service, and one provides a primary PCI service from 9.00am to 5.00pm, Monday to Friday. Three additional hospitals provide a primary PCI service from 9.00am to 5.00pm, Monday to Friday for those who self-present to the hospital.

In 2017–2020, 1,593 patients with a STEMI were transferred to a PCI centre from another hospital 1,115 of whom were eligible for reperfusion and had all the correct information recorded. Out of these cases, only 27% (n=305) are reported as having received timely reperfusion. The ESC guidelines (Ibanez *et al.*, 2018) recommend a DIDO time of 30 minutes or less, i.e. the interval between the patient’s arrival at the referring hospital to the time the patient leaves the referring hospital in an ambulance to travel to the PCI centre.

It is clear from the data presented in Chapter 5 that there are systematic issues with patient transfer between non-PCI hospitals and PCI centres. These delays cannot be explained purely by geographical distance. With the exception of West Cork, West Kerry, Northern Mayo, West Donegal, and portions of the Southeast of Ireland, previous mapping exercises have demonstrated that most other locations are within a 90-minute drive of a PCI centre. Delays in ECG diagnosis and diagnosis recognition, communication delays between the non-PCI hospital clinical team and PCI centre clinical team, delayed DIDO times from non-PCI hospitals, prioritisation of STEMI transfers by the ambulance service, ambulance response times, and ambulance transfer times are all likely contributors to these delays.

Currently, there is no analysis of DIDO time in hospitals that transfer patients to PCI centres. Having this information would help to explain why timely reperfusion was not achieved for such a high percentage of transferred patients over the 4-year reporting period covered by this report.

#### What action should be taken?

- The information required to measure the DIDO time should be added to the IHAA dataset. Recording this time metric would improve understanding of where delays occur.
- A quality improvement initiative should be carried out in all referring hospitals to identify and implement the changes in processes that are needed in order to achieve a DIDO time of 30 minutes or less.
- A KPI should be developed to monitor the DIDO times in non-PCI centres.

**Evidence that the action will be effective**

- In the United States of America, Wang *et al.*, (2011) found that only 11% of patients with a STEMI who required inter-hospital transfer had a DIDO time of less than 30 minutes; this was due to multiple reasons, including age and sex demographics, transportation delays, and time of presentation. A DIDO time of less than 30 minutes was associated with fewer reperfusion delays and lower in-hospital mortality rates. Fordyce *et al.*, (2017) found that quality improvement (QI) initiatives focused on key care processes are associated with small improvements in timeliness to reperfusion.

**Who will benefit from the recommendation?**

- All patients with a STEMI requiring inter-hospital transfer to a PCI centre will benefit from care provision that views QI as an important aspect of patient-centred care. All hospitals will benefit from an increased understanding of the current process and will be able to make evidence-based changes for the benefit of the staff and patients. Organisations such as the NAS will benefit from the identification of delays that are due to transportation processes and procedures.

**Who is responsible for implementation?**

- The National Heart Programme, with access to the proper resources, should lead on the development of a national QI project for all hospitals that transfer patients with a STEMI to PCI centres, and all relevant hospitals should participate in this initiative. The National Heart Programme should also work with the HSE to develop a national KPI for monitoring the DIDO metric. The IHAA should ensure that the variables required to calculate the DIDO metric are recorded on the IHAA dataset.

**When should this be implemented?**

Development of a KPI to measure DIDO times should be implemented from 2022 to 2024.

## RECOMMENDATION 5

### Improve timeliness of reperfusion for patients with a STEMI presenting to non-PCI centres.

Rationale
<ul style="list-style-type: none"> <li>In 2017–2020, 1,593 patients with a STEMI were transferred to a PCI centre from another hospital of which 1,115 were eligible for reperfusion and had all the correct information recorded. Only 27% (n=305) of these cases are reported as having received timely reperfusion. The PCI centres, the NAS, and the non-PCI hospitals that refer patients to PCI centres are key stakeholders in this transfer process. Cooperation between these key stakeholders with a view to identifying areas for improvement in order to ensure that patients access timely reperfusion should form part of the governance of STEMI care. This will require regional and local audit QI initiatives in order to identify delays and target improvements, as well as to develop default thrombolysis protocols in the interim when transfer times of less than 90 minutes cannot be achieved.</li> </ul>
What action should be taken?
<ul style="list-style-type: none"> <li>The National Heart Programme, with access to the proper resources, should establish regional networks for each PCI centre, including stakeholders from referring hospitals and the NAS, in order to investigate the factors that lead to delays in transfer times.</li> <li>A regional QI initiative should be implemented in order to reduce delays in timely reperfusion. Where it is not possible to shorten transfer times to less than 90 minutes, regional protocols for timely thrombolysis and transfer should be developed.</li> <li>There is a need to perform an updated mapping exercise to assess transport times to PCI centres for the adult population.</li> </ul>
Evidence that the action will be effective
<ul style="list-style-type: none"> <li>The findings of Fordyce <i>et al.</i>, (2017), who investigated rapid care processes in STEMI care, support the importance of implementing regional networks. Mumma <i>et al.</i>, (2011) identified 18 key care processes that improved timely reperfusion in STEMI care, including improved communications throughout the patient pathway to reperfusion.</li> </ul>
Who will benefit from the recommendation?
<ul style="list-style-type: none"> <li>Healthcare teams involved in the care of patients with a STEMI will benefit through increased collaboration with colleagues. Patients will benefit from improved transfer pathways increasing their chance of receiving timely reperfusion. In circumstances where timely transfer cannot be achieved despite efforts to overcome system and process delays (such as geographical distance), thrombolysis protocols should reduce delays to timely thrombolysis in those clinical sites.</li> </ul>
Who is responsible for implementation?
<ul style="list-style-type: none"> <li>The National Heart Programme, in collaboration with the NAS, PCI site ACS clinical leads, cardiologists, clinical directors of non-PCI sites, and senior accountable healthcare managers in PCI centres and non-PCI hospitals.</li> </ul> <p>The IHAA will work with the HSE Health Information Unit to perform an updated mapping exercise to assess transport times to PCI centres for the adult population.</p>
When should this be implemented?
<p>This should be implemented in 2023 and 2024.</p>

**RECOMMENDATION 6**

**Develop a public awareness campaign to encourage people with heart attack symptoms to call 112 or 999 immediately for emergency help in order to facilitate pre-hospital electrocardiogram (ECG) diagnosis of a STEMI.**

<b>Rationale</b>
<ul style="list-style-type: none"> <li>Early diagnosis of a STEMI is key to timely intervention. Only 37% (n=1267) of patients with a STEMI during 2017–2020 called for help within 60 minutes of symptom onset. Nine percent (n=516) were ineligible for reperfusion, of whom 82% (n=442) were ineligible for primary PCI because they presented too late to the PCI centre. Once the patient has called for help, the optimal reperfusion service protocol is triggered with the aim of ensuring that all eligible patients with a STEMI are reperfused within 120 minutes. In order for this to be achieved, the patient with a STEMI must be transported to a PCI centre within 90 minutes. Over the reporting period, the majority (n=3240, 58%) of patients with a STEMI arrived at a PCI centre directly by ambulance, and 84% (n=2216) of those patients arrived at the PCI centre in less than 90 minutes and received timely reperfusion. However, just under one-third (n=1593, 28%) of patients with a STEMI were transferred to a PCI centre from another hospital. The majority of these patients are likely to have presented directly to their local hospital rather than calling 112 or 999. Only 22% (n=303) of this cohort of transferred patients arrived within the target of 90 minutes or less that would facilitate timely primary PCI.</li> </ul>
<b>What action should be taken?</b>
<ul style="list-style-type: none"> <li>Develop a public awareness campaign on the signs and symptoms of heart attack and encourage people to call 112 or 999 in order to facilitate pre-hospital ECG diagnosis of a STEMI and allow patients to be directly transported to PCI centres.</li> </ul>
<b>Evidence that the action will be effective</b>
<ul style="list-style-type: none"> <li>Studies show that increasing public awareness of the signs and symptoms of heart attack is associated with shorter pre-hospital decision-making (Bray <i>et al.</i>, 2015) and is associated with a reduction in the number of out-of-hospital cardiac arrests (Nehme <i>et al.</i>, 2017). However, public awareness can wane when campaigns end (Hickey <i>et al.</i>, 2018), necessitating the development of a regular campaign schedule.</li> </ul>
<b>Who will benefit from the recommendation?</b>
<ul style="list-style-type: none"> <li>All patients with symptoms of heart attack will benefit from early detection of a STEMI and direct transfer to PCI centres, and will therefore be more likely to receive timely reperfusion.</li> </ul>
<b>Who is responsible for implementation?</b>
<ul style="list-style-type: none"> <li>The National Heart Programme is responsible for developing a public awareness campaign, in conjunction with the NAS and the Irish Heart Foundation.</li> </ul>
<b>When should this be implemented?</b>
A public awareness campaign to encourage people with symptoms of heart attack to call 112 or 999 should be developed in 2023 and 2024.

## RECOMMENDATION 7

### Improve the identification and control of cardiovascular risks.

Rationale
<ul style="list-style-type: none"> <li>Cardiovascular risks have been defined in this dataset as previous cardiovascular disease, diabetes, smoking, hyperlipidaemia, and hypertension. From 2017 to 2020, 78% (n=4372) of patients with a STEMI had at least one cardiovascular risk, and more than one-half (55%, n=3092) of patients with a STEMI had one or two risk factors. The most prevalent risk factors were previous hypertension (n=2427, 43%) and previous hypercholesterolaemia (n=2401, 43%).</li> </ul>
What action should be taken?
<ul style="list-style-type: none"> <li>All healthcare professionals should utilise the HSE <i>Make Every Contact Count</i> framework (HSE, 2016) in order to support patients managing cardiovascular risks in the community. The IHAA supports the implementation of the <i>National Framework for the Integrated Prevention and Management of Chronic Disease in Ireland 2020-2025</i> (HSE, 2021a), which will be expanded on a phased basis and will become available to those aged 50 years and over in 2022 and to all adults by 2023. Integral to this is an effective identification and treatment process that targets hypertension and hyperlipidaemia.</li> </ul> <p>The National Heart Programme is integral to the development and implementation of the Integrated Care Programme for the Prevention and Management of Chronic Disease (ICPCD), which aims to improve population health and patient outcomes, and to reduce health inequalities and the burden of cardiovascular disease (CVD) in the population.</p>
Evidence that the action will be effective
<ul style="list-style-type: none"> <li>The ICPCD focuses on improving the standard of care for four major chronic diseases that affect more than 1,000,000 people in Ireland: CVD, diabetes, chronic obstructive pulmonary disease (COPD), and asthma. Evidence suggests that a well-designed model of care for the prevention and management of chronic disease that sits within an integrated health service is associated with positive outcomes. These outcomes include increased patient satisfaction; improved accessibility of health and social services; and reductions in waiting times, levels of utilisation of hospital services, and costs secondary to a reduction in hospital admissions (HSE, 2021).</li> </ul>
Who will benefit from the recommendation?
<ul style="list-style-type: none"> <li>All patients at risk of cardiovascular disease will benefit from a more coordinated approach to the management of their risk factors, thereby reducing the risk of heart attack.</li> </ul>
Who is responsible for implementation?
<ul style="list-style-type: none"> <li>The National Heart Programme and the ICPCD are responsible for identifying and controlling cardiovascular risks.</li> </ul>
When should this be implemented?
<p>This recommendation should be implemented in conjunction with the anticipated roll-out of the ICPCD.</p>

## RECOMMENDATION 8

**Improve public awareness of the adverse impact of smoking on heart attack risk.**

Rationale
<ul style="list-style-type: none"> <li>Between 2017 and 2020, one-third (n=1922, 34%) of patients with a STEMI were current smokers at the time of admission. This is double the current smoking rate of 17% among the general population (Malone and O'Connell, 2020) and highlights the adverse impact smoking has on heart attack risk. Smokers present with heart attack on average 10 years earlier than individuals who never smoked. Males who had a STEMI and were current smokers had a median age of 56 years compared with a median age of 65 years in males who had a STEMI but who never smoked. Females who had a STEMI and were current smokers had a median age of 60 years compared with a median age of 76 years in females who had a STEMI but who never smoked. The majority (n=129, 64%) of patients aged under 40 years who presented with a STEMI were current smokers and one-quarter (n=250, 26%) of patients with a STEMI who had a history of heart attack continued to smoke. The <i>Heart Attack Care Ireland 2016</i> report (HSE, 2018a) reported that 69% of patients with a STEMI who smoked received smoking cessation counselling. This increased to 90% (n=406) in 2020; however, neither the type of smoking cessation counselling received by patients nor the uptake of formal smoking cessation programmes that the HSE provided for this cohort is known.</li> </ul>
What action should be taken?
<ul style="list-style-type: none"> <li>Smoking cessation information should be provided to all patients with a STEMI prior to discharge from hospital.</li> </ul> <p>Ongoing public health messaging campaigns on the impact of smoking on heart health should be rolled out nationally and should highlight the risk of smokers having a heart attack at a much younger age than might otherwise be expected.</p>
Evidence that the action will be effective
<ul style="list-style-type: none"> <li>Smoking is the leading cause of preventable death in Ireland. Each week, 100 people die from disease directly related to tobacco use, representing nearly 1 in 5 of all deaths annually (Malone and O'Connell, 2020). Cessation of smoking after a first heart attack is related to a substantially lower risk of recurrent events and all-cause mortality (van den Berg <i>et al.</i>, 2019). Smoking cessation is more effective in reducing further cardiovascular risk than any pharmaceutical treatment of major risk factors, and should be a key objective for patients with cardiovascular vascular disease (van den Berg <i>et al.</i>, 2019). It is a national policy commitment to render Ireland tobacco free by 2025 (HSE, 2018b).</li> </ul>
Who will benefit from the recommendation?
<ul style="list-style-type: none"> <li>People who currently smoke will benefit from improved health promotional messaging, and ongoing public health messaging will minimise the uptake of smoking in the younger population.</li> </ul>
Who is responsible for implementation?
<ul style="list-style-type: none"> <li>All healthcare teams should provide information on smoking cessation and should utilise the HSE <i>Make Every Contact Count</i> framework (HSE, 2016) in order to support patients managing cardiovascular risks in the community.</li> </ul> <p>The HSE Tobacco Free Ireland should lead on health promotional messaging.</p>
When should this be implemented?
<p>This recommendation should be implemented in 2023 and 2024.</p>



# CHAPTER 10 **CONCLUSION**

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## CHAPTER 10: CONCLUSION

### STRENGTHS AND LIMITATIONS OF THE IRISH HEART ATTACK AUDIT NATIONAL REPORT, 2017–2020

#### STRENGTHS

- The report provides a good cross-sectional view of STEMI care provided in 9 of Ireland's 10 PCI centres.
- The report covered an estimated 88% of STEMI care activity in nine PCI centres.
- The report provides benchmarking between PCI centres, which is a powerful driver of QI.

#### LIMITATIONS

- The report only provides information on patients with a STEMI who accessed a PCI centre. In addition, one PCI centre was not included, as no Heartbeat data were collected in that hospital; therefore, the case mix and outcomes do not fully represent the national picture of STEMI care in Ireland.
- The absence of a national individual patient identifier makes following the patient pathway difficult to capture consistently. This includes capturing pre-hospital data and follow-up data for patients with a STEMI who receive ongoing STEMI care in another hospital. Therefore, mortality, outcomes, complications, LOS data, and some secondary prevention information may be truncated at the point of discharge from the primary PCI centre and may not reflect the entire patient journey.
- Data analysis has identified concerns around the completeness of data, particularly in the outcome-related variables. This report has identified areas for improvement in data collection in order to ensure national consistency in the interpretation of definitions for data entry.

Heart disease remains a significant cause of premature death in Ireland, and accounts for a large proportion of activity across all aspects of our health system. The transfer of the Heartbeat audit to NOCA and the development of the IHAA clearly highlights the importance of QI and robust audit in progressing heart attack care within our health service.

This first IHAA report presents a large volume of data on activity over 4 years and on outcomes for patients with a STEMI/heart attack in Ireland. Overall, the report highlights that while improvements have been made in standardising the process of care for STEMI, continued challenges and limitations in specific areas of care remain, as do concerning signs of regression in some areas, especially with regard to timeliness of reperfusion therapy in patients transferred from non-PCI sites and the completeness of follow-up data collection within the audit.

The IHAA is a testament to the volume of work delivered by our dedicated hospital ACS clinical leads, interventional cardiologists, and data collection audit coordinators, and we look forward to working closely with them in order to support ongoing improvements in the completeness of data collection and in the quality of care delivered to STEMI/heart attack patients in Ireland.

It is IHAA's stated aim that the data presented in this report and annually thereafter should serve as an impetus to facilitate ongoing change and improvement in the quality of care delivered to STEMI/heart attack patients within the health service at local, regional and national levels.





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# APPENDICES



# APPENDIX 1: IHAA GOVERNANCE COMMITTEE MEETING ATTENDANCE

NAME	ROLE	09.07 2020	29.10 2020	TOTAL 2020
<b>Dr Sean Fleming</b>	Chairperson, Irish Heart Attack Audit Governance Committee Consultant Cardiologist, Midland Regional Hospital Portlaoise	✓	Chair	2/2
<b>Dr Ronan Margey</b>	Clinical Lead, Irish Heart Attack Audit Consultant Interventional Cardiologist and Clinical Lead Cardiologist, Mater Private Hospital Cork	✓	✓	2/2
<b>Joan McCormack</b>	Cardiovascular Programme Audit Manager, National Office of Clinical Audit	✓	✓	2/2
<b>Yvonne McConnon</b>	Assistant Manager, Irish Heart Attack Audit, National Office of Clinical Audit	✓	✓	2/2
<b>Lucinda McNerney</b>	Public and Patient Interest Representative, Irish Heart Attack Audit Governance Committee Cardiac Patient and Irish Heart Foundation Advocate	✓	✓	2/2
<b>Michael Ryan</b>	Public and Patient Interest Representative, Irish Heart Attack Audit Governance Committee Cardiac Patient, Cardiopulmonary Resuscitation Trainer and First Responder	✓	✓	2/2
<b>Paul Gallagher</b>	Chief Director of Nursing and Midwifery, Ireland East Hospital Group	✓	✓	2/2
<b>Dr Jim Crowley</b>	Irish Cardiac Society Representative Consultant Cardiologist, University Hospital Galway	X	X	0/2
<b>Prof. Gavin Blake</b>	Consultant Cardiologist, Mater Misericordiae University Hospital	✓	X	1/2
<b>Prof. Andrew Maree</b>	Consultant Cardiologist, St James's Hospital	X	X	0/2
<b>Dr Mark Kennedy</b>	Consultant Cardiologist, Beaumont Hospital	✓	X	1/2
<b>Lorna Brophy</b>	Healthcare Professional Expert in Cardiac Rehabilitation and Clinical Nurse Specialist in Cardiac Rehabilitation, Naas General Hospital (stepped down in 2021)	✓	✓	2/2
<b>Stephen Giffney</b>	Healthcare Professional Expert in Cardiac Rehabilitation and Clinical Nurse Specialist in Cardiac Rehabilitation, Irish Association of Cardiac Rehabilitation, Irish Heart Foundation (became a member in 2021)	N/A	N/A	N/A
<b>Jonathan Gallagher</b>	Senior Psychologist, Department of Cardiology, Beaumont Hospital	✓	X	1/2
<b>Anne McShane</b>	Audit Coordinator, Irish Heart Attack Audit, National Office of Clinical Audit Chest Pain Clinical Nurse Specialist, Letterkenny University Hospital	✓	✓	2/2
<b>Jacqui Curley</b>	Coding Manager, Healthcare Pricing Office	✓	✓	2/2
<b>Dr Eugene McFadden</b>	Consultant Cardiologist, Cork University Hospital	✓	✓	2/2
<b>Prof. Robert Byrne</b>	Chair of Cardiovascular Research, Royal College of Surgeons in Ireland	X	X	0/2
<b>Dr Siobhan Jennings</b>	Consultant in Public Health Medicine, Health Service Executive (retired)	✓	✓	2/2
<b>Dr Cathal O'Donnell</b>	Clinical Director, National Ambulance Service (replaced by Siobhan Masterson in 2021)	X	X	0/2
<b>Dr Siobhán Masterson</b>	Clinical Strategy and Evaluation Lead, National Ambulance Service (became a member in 2021)	N/A	N/A	N/A



# APPENDIX 2: INTERNATIONAL PERFORMANCE INDICATORS FOR ST ELEVATION MYOCARDIAL INFARCTION REPERFUSION THERAPY

International performance indicators and targets for ST elevation myocardial infarction (STEMI) care vary both in terms of what is suggested to be reported on and what is considered acceptable, although some commonality can be seen across most indicators and targets.

The following are some of the main international indicators and/or targets, mainly for reperfusion therapy.

## **1. European Society of Cardiology (ESC) STEMI Guidelines 2012 (Steg et al., 2012):**

Quality targets:

- first medical contact (FMC)\* to first electrocardiogram (ECG): 10 minutes
- FMC\* to reperfusion therapy:
  - for fibrinolysis: 30 minutes
  - for primary percutaneous coronary intervention (PCI): 90 minutes (60 minutes if the patient presents within 120 minutes of symptom onset or directly to a PCI-capable hospital).

\*FMC is defined as the point at which the patient is either initially assessed by a paramedic or physician or other medical personnel in the pre-hospital setting, or at which the patient arrives at the hospital emergency department.

## **2. Myocardial Ischaemia National Audit Project 2012 report (MINAP, 2016) (United Kingdom):**

- 'call to balloon' (CTB) time: audit standard – up to 150 minutes
- 'door to balloon' (DTB) time: audit standard – up to 90 minutes
- 'call to needle' (CTN) time: audit standard – up to 60 minutes
- 'door to needle' (DTN) time: audit standard – up to 30 minutes

## **3. Danish national indicators:**

- primary PCI as a national reperfusion strategy
- 100% and accordingly no fibrinolysis = pre-hospital diagnosis in 90% of cases
- field triage in 60% of those diagnosed in a pre-hospital setting
- DTB time of 30 minutes.

## **4. 2013 American College of Cardiology Foundation (ACCF)/American Heart Association (AHA) Guideline for the Management of STEMI (O'Gara et al., 2013):**

- for direct emergency medical service (EMS) transport: FMC-to-device time system goal of 90 minutes or less
- for non-PCI to primary PCI centre transport: FMC-to-device time system goal of 120 minutes or less
- when indicated or chosen as the primary reperfusion strategy, fibrinolytic therapy should be administered within 30 minutes of hospital arrival.

## **5. Institute for Healthcare Improvement (IHI) (United States of America) method (2008):**

- thrombolytic agent received within 30 minutes of hospital arrival; goal: 100% of patients
- PCI received within 90 minutes of hospital arrival; goal: 100% of patients.

## **6. Safer Healthcare Now (SHN) (Canada) method:**

- thrombolytic agent received within 30 minutes of hospital arrival; goal: 85% of patients
- PCI received within 90 minutes of hospital arrival; goal: 90% of patients.

## **7. Canadian Cardiovascular Outcomes Research Team (CCORT) guidelines (Tu et al., 2008):**

- primary PCI within 90 minutes of hospital arrival\* and within 120 minutes of call for help
- thrombolysis within 30 minutes of hospital arrival\*
- ECG within 10 minutes of hospital arrival.\*

\* Triage time or registration time – whichever comes first.

## **8. Australia/New Zealand guidelines (Aroney et al., 2006) (with 2011 Addendum):**

- primary PCI within 60 minutes of presentation if patient presents within 1 hour of symptom onset
- primary PCI within 90 minutes of presentation if patient presents more than 1 hour after symptom onset
- if patient presents to facility without catheterisation laboratory (cath lab) (and symptoms between 3 and 12 hours), appropriate to transfer for primary PCI if primary PCI can be done within 120 minutes (including transport time)
- thrombolysis should be considered where there are major delays (>30 minutes) to hospitalisation
- ECG should, where possible, be done pre-hospital and transmitted to hospital
- ECG should otherwise be done within 5 minutes of hospital arrival.

## APPENDIX 3: KEY PERFORMANCE INDICATORS

1. Percentage of eligible ST elevation myocardial infarction (STEMI) patients (or left bundle branch block (LBBB)) who receive primary percutaneous coronary intervention (PCI)
2. Percentage of STEMI patients (or LBBB) who receive timely reperfusion therapy, as follows:
  - a. first medical contact (FMC) to balloon time:  $\leq 120$  minutesOR
  - b. 'door to balloon' (DTB) time:  $\leq 120$  minutesOR
  - c. 'door to needle' (DTN) time:  $\leq 30$  minutes.
3. Mean and median length of stay (LOS) and bed days for: (a) STEMI, and (b) non-ST elevation myocardial infarction (NSTEMI) patients
4. Number and percentage of STEMI patients referred to cardiac rehabilitation (CR) phase 3
5. Number and percentage of STEMI patients with a start date for a CR phase 3 programme within 4 weeks of discharge
6. Percentage of eligible (not contraindicated) STEMI patients who receive: (a) aspirin, and (b) a dual antiplatelet on discharge
7. Percentage of eligible (not contraindicated) STEMI patients who receive beta-blockers on discharge
8. Percentage of eligible (not contraindicated) STEMI patients who receive statin therapy on discharge
9. Percentage of eligible (not contraindicated) STEMI patients who receive angiotensin-converting enzyme (ACE) inhibitor/angiotensin II receptor blockers (ARBs) on discharge
10. Percentage of eligible (not contraindicated) STEMI patients who receive smoking cessation counselling on discharge.

## APPENDIX 4: IHAA DATASET

No.	Data element name	Definition	Code and Values
1	Previous myocardial infarction (MI)	Patient risk factor – previous MI	1. Yes, 2. No, 9. Unknown
2	Previous angina	Patient risk factor – previous angina	1. Yes, 2. No, 9. Unknown
3	Previous peripheral vascular disease	Patient risk factor – previous peripheral vascular disease	1. Yes, 2. No, 9. Unknown
4	Previous cerebrovascular disease	Patient risk factor – previous cerebrovascular disease	1. Yes, 2. No, 9. Unknown
5	Previous chronic renal failure	Patient risk factor – previous chronic renal failure	1. Yes, 2. No, 9. Unknown
6	Previous chronic lung disease	Patient risk factor – previous chronic lung disease	1. Yes, 2. No, 9. Unknown
7	Previous percutaneous coronary intervention (PCI)	Patient risk factor – previous PCI	1. Yes, 2. No, 9. Unknown
8	Previous coronary artery bypass graft (CABG)	Patient risk factor – previous CABG	1. Yes, 2. No, 9. Unknown
9	Previous other heart surgery	Patient risk factor – previous other heart surgery	1. Yes, 2. No, 9. Unknown
10	Diabetes mellitus	Patient risk factor – diabetes mellitus	1. Not diabetic 2. Diabetes (diet control) 3. Diabetes (oral medications) 4. Diabetes (insulin) 9. Unknown
11	Smoking status	Patient risk factor – smoking	1. Never 2. Former 3. Current 9. Unknown
12	Previous hypercholesterolaemia	Patient risk factor – previous hypercholesterolaemia	1. Yes, 2. No, 9. Unknown
13	Previous hypertension	Patient risk factor – previous hypertension	1. Yes, 2. No, 9. Unknown
14	Source of referral	Arrival information – how was the patient referred to the primary PCI (PPCI)/PCI centre?	1. Direct via ambulance 2. Self-presentation 4. Transfer from other hospital 5. Already inpatient in PCI/PPCI hospital 6. Inpatient transfer from other hospital 8. Other (please specify) 9. Unknown
14a		Arrival information – admission method (ambulance)	1. Code ST elevation myocardial infarction (STEMI) to catheterisation laboratory (cath lab) 2. Code STEMI to emergency department (ED)
14b		Arrival information – admission method (other hospital)	1. Other hospital to cath lab 2. Other hospital to ED/other

## APPENDIX 4: IHAA DATASET

No.	Data element name	Definition	Code and Values
14c		Arrival information – source of referral (other hospital)	0000 Not applicable 0941 Childrens Crumlin 0101 St Columcilles 0102 Naas General 0908 Mater Hospital 0910 SVUH 0925 Peamount Hospital 0955 Cappagh Orthopaedic 0940 Temple Street 0947 St Lukes Rathgar 0904 SJH Dublin 0108 Connolly Blanchardstown 0912 Michaels Dun Laoghaire 0950 RVEEH 0960 National Rehabilitation 0930 Coombe Hospital 0932 Rotunda Dublin 0931 National Maternity Hosp 1270 Tallaght Hospital 1762 Josephs Raheny 0954 Clontarf Orthopaedic 1001 Blackrock Hospice 0600 Waterford 0601 St Lukes KK 0605 Wexford 0602 Kilcreene 0607 Clonmel 0705 Finbarrs Cork 0704 Bantry 0913 Mercy Cork 0915 South Infirmary 0703 Mallow 0724 CUH 0726 Kerry 0301 Limerick Maternity 0300 Limerick 0302 Croom Limerick 0918 St Johns Limerick 0305 Ennis 0304 Nenagh 0803 Roscommon 0919 Portiuncula 0800 Galway 0802 Mayo 0801 Merlin Park 0203 Tullamore 0202 Mullingar 0201 Portlaoise 0500 Letterkenny 0501 Sligo 0922 Drogheda 0402 Cavan 0400 Louth County 0404 Monaghan 0403 Navan 8888 Other
14d	Arrival information – admission method (other)	Arrival information – admission method (other)	Enter free text
15	Helicopter transport	Used to state if helicopter used where patient came as Direct via Ambulance or transfer from other hospital.	1. Yes 2. No
16	Aspirin pre-admission/admission	Was the patient on aspirin pre-admission/on admission?	1. Yes 2. No 3. Contraindicated 9. Unknown
17	Other antiplatelet pre-admission/admission	Was the patient on any other antiplatelet medication pre-admission/admission?	1. Yes 2. No 3. Contraindicated 9. Unknown
18	Symptom onset date	What date did symptoms that required call for assistance start?	DD/MM/YYYY
19	Symptom onset time	What time did symptoms that required call for assistance start?	HH:MM
20	Call for help date	Date patient, relative or attendant called 999/112 for help, or for self-presenters, the ED arrival time.	DD/MM/YYYY

## APPENDIX 4: IHAA DATASET

No.	Data element name	Definition	Code and Values
21	Call for help time	Time patient, relative or attendant called 999/112 for help, or for self-presenters, the ED arrival time.	HH:MM
22	First positive electrocardiogram (ECG) date	Date of first diagnostic (of STEMI)	DD/MM/YYYY
23	First positive ECG time	Time of first diagnostic (of STEMI)	HH:MM
24	First positive ECG	Where was the first positive ECG performed?	1. Ambulance 2. Hospital ED 3. General practitioner (GP) practice 8 Other (please specify) 9. Unknown
25	First positive ECG location – other	Location of first positive ECG if not identified in question 24.	Free text
26	ECG transmission (by ambulance service)	Was the ECG transmitted via ECG machine (NOT via smartphone) to PPCI centre by the ambulance service?	1. Yes 2. No 9. Unknown
27	Arrival at 1 <sup>st</sup> hospital Date	Date patient arrives at 1 <sup>st</sup> hospital.	DD/MM/YYYY
28	Arrival at 1st Hospital Time	Time patient arrives at 1 <sup>st</sup> Hospital.	HH:MM
29	Arrival at PPCI centre hospital Date	Date patient arrives at PPCI centre hospital (which may be via ED or cath lab)	DD/MM/YYYY
30	Arrival at PPCI centre hospital Time	Time patient arrives at PPCI centre hospital (which may be via ED or cath lab)	HH:MM
31	Patient status on admission	What was the patient status on admission?	1. Stable 2. Cardiogenic shock 3. Resuscitated arrest 4. Cardiac arrest and died 8. Other 9. Unknown
32	Patient status on admission – other	What was the patient status on admission?	Free text
33	Contraindicated to reperfusion therapy	Was there a contraindication to reperfusion therapy?	1. Yes 2. No
34	Contraindication to reperfusion therapy reason	What was the contraindication to reperfusion therapy?	1. Presented too late 2. Recent surgery 3. History of bleeding 4. Recent cerebrovascular accident (CVA) 5. Drug contraindication 8. Other (please specify) 9. Unknown
35	Contraindication to reperfusion therapy reason – other	What was the contraindication to reperfusion therapy?	Free text

## APPENDIX 4: IHAA DATASET

No.	Data element name	Definition	Code and Values
36	Reperfusion therapy type	Type of reperfusion therapy received.	1. Pre-hospital thrombolysis 2. Hospital thrombolysis 3. Primary PCI 7. None
37	Reperfusion therapy date	Date of starting thrombolytic or PCI-mediated reperfusion using a guide wire to cross the occlusion. If none given, leave blank. Not to be used for rescue PCI of for a post-thrombolysis angiogram/PCI.	DD/MM/YYYY
38	Reperfusion therapy time	Time of starting thrombolytic or PCI-mediated reperfusion using a guide wire to cross the occlusion. If none given, leave blank. Not to be used for rescue PCI of for a post-thrombolysis angiogram/PCI.	HH:MM
39	Was angiogram performed?	Was a coronary angiogram performed?	1. Yes 2. No
40	Angiogram performed as part of?	What was the reason the angiogram was performed: as a primary PCI, continued symptoms in failed thrombolysis, or a routine procedure after STEMI and in those presenting too late.	1. Primary PCI 2. Rescue PCI 3. Routine angiogram/PCI
41	Outcome of angiogram/PCI	What was the outcome of the angiogram/PCI?	1. Successful PCI 2. Unsuccessful PCI (incomplete) 3. Unsuccessful PCI (patient deceased) 4. PCI not required 5. CABG 6. Other 9. Unknown
42	Percutaneous Arterial arterial access	Location of arterial access	1. Femoral 2. Brachial 3. Radial
43	Late reperfusion therapy (thrombolysis or PPCI)	Was reperfusion therapy delivered outside the target times of <30 minutes from door to needle or <120 minutes from first hospital arrival (or first diagnostic ECG if pre-hospital) to PCI (wire cross) for PPCI?	1. Yes 2. No

## APPENDIX 4: IHAA DATASET

No.	Data element name	Definition	Code and Values
44	Late reperfusion therapy reason (if reperfusion therapy is outside targets)	What was the reason why reperfusion therapy was delivered outside the target times of <30 minutes from door to needle or <120 minutes from first hospital arrival (or first diagnostic ECG if pre-hospital) to PCI (wire cross) for PPCI?	1. Delay in triage 2. Delay in ECG diagnosis 3. Hypertension 4. Evolving STEMI 5. Delay in transport 6. Delay in cath lab activation 8. Other (please specify) 9. Unknown
45	Late reperfusion therapy reason – other	What was the other reason reperfusion therapy was delivered outside targets listed if other is selected in question 44?	Free text
46	Discharge diagnosis	What was the discharge diagnosis?	1. STEMI 2. Non-ST elevation myocardial infarction (NSTEMI) 3. Unstable angina 4. Pericarditis 5. Myocarditis 6. Takotsubo Non-cardiac chest pain Other (please specify) 9. Unknown
47	Discharge diagnosis –other	Diagnosis on discharge if ‘other’ is selected in question 46.	Free text
48	Bleeding (following any intervention)	Did the patient have a bleeding episode after any intervention?	1. None 2. Intracranial bleed 3. Retroperitoneal haemorrhage 4. Any bleed with haemoglobin (Hb) fall of >5 grams (g) 5. Any bleed with Hb fall of >3 g and <5 g 6. Any bleed with Hb fall of <3 g 9. Unknown
49	Stroke during hospital stay	Did the patient have a stroke during the hospital stay?	1. Yes – ischaemic 2. No 3. Yes – haemorrhagic 9. Unknown

## APPENDIX 4: IHAA DATASET

No.	Data element name	Definition	Code and Values
50	Hospital of discharge	Which hospital was the patient discharged from?	0000 Not Applicable 0941 Childrens Crumlin 0101 St Columcilles 0102 Naas General 0908 Mater Hospital 0910 SVUH 0925 Peamount Hospital 0955 Cappagh Orthopaedic 0940 Temple Street 0947 St Lukes Rathgar 0904 SJH Dublin 0108 Connolly Blanchardstown 0912 Michaels Dun Laoghaire 0950 RVEEH 0960 National Rehabilitation 0930 Coombe Hospital 0932 Rotunda Dublin 0931 National Maternity Hosp 1270 Tallaght Hospital 1762 Josephs Raheny 0954 Clontarf Orthopaedic 1001 Blackrock Hospice 0600 Waterford 0601 St Lukes KK 0605 Wexford 0602 Kilcreene 0607 Clonmel 0705 Finbarrs Cork 0704 Bantry 0913 Mercy Cork 0915 South Infirmary 510703 Mallow 075224 CUH 0726 Kerry53 0301 Limerick54 Maternity 055300 Limerick 030256 Croom Limerick 570918 St Johns Li58merick 0305 Enni59s 0304 Nenagh 0803 Roscommon 0919 Portiuncula 0800 Galway 0802 Mayo 0801 Merlin Park 0203 Tullamore 0202 Mullingar 0201 Portlaoise 0500 Letterkenny 0501 Sligo 0922 Drogheda 0402 Cavan 0400 Louth County 0404 Monaghan 0403 Navan 8888 Other
51	Survival status on discharge home	Was the patient dead or alive on discharge?	1. Alive 2. Dead
52	Aspirin on discharge	Was the patient discharged on aspirin?	1. Yes 2. No 3. Contraindicated 9. Unknown
53	Other antiplatelet therapy on discharge	Was the patient on another antiplatelet treatment on discharge?	1. Yes 2. No 3. Contraindicated 9. Unknown
54	Beta-blocker on discharge	Was the patient on a beta-blocker on discharge?	1. Yes 2. No 3. Contraindicated 9. Unknown
55	Statin on discharge	Was the patient on a statin on discharge?	1. Yes 2. No 3. Contraindicated 9. Unknown



## APPENDIX 4: IHAA DATASET

No.	Data element name	Definition	Code and Values
56	Angiotensin-converting enzyme (ACE) inhibitor or angiotensin II receptor blocker (ARB) on discharge	Was the patient on an ACEI or ARB on discharge?	1. Yes 2. No 3. Contraindicated 9. Unknown
57	Smoking cessation counselling (for smokers)	For patients who are smokers, was smoking cessation counselling provided?	1. Yes 2. No – patient declined 3. Non-smoker 4. No – no reason 9. Unknown
58	Referral to cardiac rehabilitation (CR) phase 3	Was the patient referred to CR?	1. Yes 2. No – patient declined 3. No – due to comorbidity 4. No reason 9. Unknown
59	Hospital for CR	What hospital was the patient referred to for cardiac rehabilitation CR?	0000 Not Applicable 0941 Childrens Crumlin 0101 St Columcilles 0102 Naas General 0908 Mater Hospital 0910 SVUH 0925 Peamount Hospital 0955 Cappagh Orthopaedic 0940 Temple Street 0947 St Lukes Rathgar 0904 SJH Dublin 0108 Connolly Blanchardstown 0912 Michaels Dun Laoghaire 0950 RVEEH 0960 National Rehabilitation 0930 Coombe Hospital 0932 Rotunda Dublin 0931 National Maternity Hosp 1270 Tallaght Hospital 1762 Josephs Raheny 0954 Clontarf Orthopaedic 1001 Blackrock Hospice 0600 Waterford 0601 St Lukes KK 0605 Wexford 0602 Kilcreene 0607 Clonmel 0705 Finbarrs Cork 0704 Bantry 0913 Mercy Cork 0915 South Infirmary 0703 Mallow 0724 CUH 0726 Kerry 0301 Limerick Maternity 0300 Limerick 0302 Croom Limerick 0918 St Johns Limerick 0305 Ennis 0304 Nenagh 0803 Roscommon 0919 Portiuncula 0800 Galway 0802 Mayo 0801 Merlin Park 0203 Tullamore 0202 Mullingar 0201 Portlaoise 0500 Letterkenny 0501 Sligo 0922 Drogheda 0402 Cavan 0400 Louth County 0404 Monaghan 0403 Navan 8888 Other
60	Date of 1st phase 3 CR appointment	What was the date of 1st phase 3 CR appointment?	DD/MM/YYYY
61	Survival status at 30 days post-MI	What was the survival status of the patient 30 days after arrival at first hospital?	1. Alive 2. Dead 9. Unknown

## APPENDIX 4: IHAA DATASET

No.	Data element name	Definition	Code and Values
62	Cause of death	If the patient died, what was the cause of death?	1. Cardiovascular disease (CVD) 2. Non-CVD 9. Unknown
63	Comment	Optional text box to include any unusual cases or events associated with the patient episode.	Free text

## APPENDIX 5: DATA COMPLETENESS

Data Element ID			2017		2018		2019		2020		TOTAL	
			N	%	N	%	N	%	N	%	N	%
1.	<b>Previous myocardial infarction (MI)</b>	Recorded	1271	89.1%	1338	89.1%	1353	96.6%	1215	93.5%	5177	92.0%
		Unknown	143	10.0%	157	10.5%	46	3.3%	85	6.5%	431	7.7%
		Missing	13	0.9%	7	0.5%	1	0.1%	0	0.0%	21	0.4%
		Total	1427	100.0%	1502	100.0%	1400	100.0%	1300	100.0%	5629	100.0%
2.	<b>Previous angina</b>	Recorded	1262	88.4%	1328	88.4%	1350	96.4%	1231	94.7%	5171	91.9%
		Unknown	152	10.7%	155	10.3%	49	3.5%	68	5.2%	424	7.5%
		Missing	13	0.9%	19	1.3%	1	0.1%	1	0.1%	34	0.6%
		Total	1427	100.0%	1502	100.0%	1400	100.0%	1300	100.0%	5629	100.0%
3.	<b>Previous peripheral vascular disease</b>	Recorded	1269	88.9%	1324	88.1%	1361	97.2%	1229	94.5%	5183	92.1%
		Unknown	145	10.2%	158	10.5%	38	2.7%	71	5.5%	412	7.3%
		Missing	13	0.9%	20	1.3%	1	0.1%	0	0.0%	34	0.6%
		Total	1427	100.0%	1502	100.0%	1400	100.0%	1300	100.0%	5629	100.0%
4.	<b>Previous cerebrovascular disease</b>	Recorded	1270	89.0%	1337	89.0%	1367	97.6%	1237	95.2%	5211	92.6%
		Unknown	144	10.1%	146	9.7%	32	2.3%	63	4.8%	385	6.8%
		Missing	13	0.9%	19	1.3%	1	0.1%	0	0.0%	33	0.6%
		Total	1427	100.0%	1502	100.0%	1400	100.0%	1300	100.0%	5629	100.0%
5.	<b>Previous chronic renal failure</b>	Recorded	1282	89.8%	1345	89.5%	1365	97.5%	1234	94.9%	5226	92.8%
		Unknown	133	9.3%	139	9.3%	34	2.4%	66	5.1%	372	6.6%
		Missing	12	0.8%	18	1.2%	1	0.1%	0	0.0%	31	0.6%
		Total	1427	100.0%	1502	100.0%	1400	100.0%	1300	100.0%	5629	100.0%
6.	<b>Previous chronic lung disease</b>	Recorded	1274	89.3%	1339	89.1%	1364	97.4%	1234	94.9%	5211	92.6%
		Unknown	139	9.7%	145	9.7%	35	2.5%	66	5.1%	385	6.8%
		Missing	14	1.0%	18	1.2%	1	0.1%	0	0.0%	33	0.6%
		Total	1427	100.0%	1502	100.0%	1400	100.0%	1300	100.0%	5629	100.0%
7.	<b>Previous percutaneous coronary intervention (PCI)</b>	Recorded	1310	91.8%	1373	91.4%	1367	97.6%	1243	95.6%	5293	94.0%
		Unknown	103	7.2%	112	7.5%	32	2.3%	57	4.4%	304	5.4%
		Missing	14	1.0%	17	1.1%	1	0.1%	0	0.0%	32	0.6%
		Total	1427	100.0%	1502	100.0%	1400	100.0%	1300	100.0%	5629	100.0%
8.	<b>Previous coronary artery bypass graft (CABG)</b>	Recorded	1321	92.6%	1376	91.6%	1369	97.8%	1244	95.7%	5310	94.3%
		Unknown	91	6.4%	108	7.2%	30	2.1%	56	4.3%	285	5.1%
		Missing	15	1.1%	18	1.2%	1	0.1%	0	0.0%	34	0.6%
		Total	1427	100.0%	1502	100.0%	1400	100.0%	1300	100.0%	5629	100.0%

Data Element ID			2017		2018		2019		2020		TOTAL	
			N	%	N	%	N	%	N	%	N	%
9.	<b>Previous other heart surgery</b>	Recorded	1315	92.2%	1370	91.2%	1369	97.8%	1243	95.6%	5297	94.1%
		Unknown	97	6.8%	114	7.6%	30	2.1%	57	4.4%	298	5.3%
		Missing	15	1.1%	18	1.2%	1	0.1%	0	0.0%	34	0.6%
		Total	1427	100.0%	1502	100.0%	1400	100.0%	1300	100.0%	5629	100.0%
10.	<b>Diabetes mellitus</b>	Recorded	1306	91.5%	1365	90.9%	1356	96.9%	1210	93.1%	5237	93.0%
		Unknown	107	7.5%	128	8.5%	43	3.1%	90	6.9%	368	6.5%
		Missing	14	1.0%	9	0.6%	1	0.1%	0	0.0%	24	0.4%
		Total	1427	100.0%	1502	100.0%	1400	100.0%	1300	100.0%	5629	100.0%
11.	<b>Smoking status</b>	Recorded	1130	79.2%	1246	83.0%	1311	93.6%	1176	90.5%	4863	86.4%
		Unknown	288	20.2%	249	16.6%	88	6.3%	124	9.5%	749	13.3%
		Missing	9	0.6%	7	0.5%	1	0.1%	0	0.0%	17	0.3%
		Total	1427	100.0%	1502	100.0%	1400	100.0%	1300	100.0%	5629	100.0%
12.	<b>Previous hypercholesterolaemia</b>	Recorded	1142	80.0%	1195	79.6%	1268	90.6%	1140	87.7%	4745	84.3%
		Unknown	273	19.1%	300	20.0%	131	9.4%	160	12.3%	864	15.3%
		Missing	12	0.8%	7	0.5%	1	0.1%	0	0.0%	20	0.4%
		Total	1427	100.0%	1502	100.0%	1400	100.0%	1300	100.0%	5629	100.0%
13.	<b>Previous hypertension</b>	Recorded	1172	82.1%	1229	81.8%	1286	91.9%	1168	89.8%	4855	86.2%
		Unknown	243	17.0%	267	17.8%	113	8.1%	132	10.2%	755	13.4%
		Missing	12	0.8%	6	0.4%	1	0.1%	0	0.0%	19	0.3%
		Total	1427	100.0%	1502	100.0%	1400	100.0%	1300	100.0%	5629	100.0%
14.	<b>Source of referral</b>	Recorded	1422	99.6%	1500	99.9%	1398	99.9%	1297	99.8%	5617	99.8%
		Unknown	5	0.4%	2	0.1%	2	0.1%	3	0.2%	12	0.2%
		Missing	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
		Total	1427	100.0%	1502	100.0%	1400	100.0%	1300	100.0%	5629	100.0%
14a.	<b>Ambulance arrival information</b>	Recorded	823	98.8%	833	99.4%	764	99.6%	800	99.8%	3220	99.4%
		Unknown	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
		Missing	10	1.2%	5	0.6%	3	0.4%	2	0.2%	20	0.6%
		Total	833	100.0%	838	100.0%	767	100.0%	802	100.0%	3240	100.0%
14b.	<b>Arrival information, admission method (other hospital)</b>	Recorded	410	100.0%	438	100.0%	410	100.0%	335	100.0%	1593	100.0%
		Unknown	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
		Missing	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
		Total	410	100.0%	438	100.0%	410	100.0%	335	100.0%	1593	100.0%

Data Element ID			2017		2018		2019		2020		TOTAL	
			N	%	N	%	N	%	N	%	N	%
14c.	<b>Arrival information, source of referral (other hospital)</b>	Recorded	405	98.8%	435	99.3%	407	99.3%	335	100.0%	1582	99.3%
		Unknown	4	1.0%	3	0.7%	3	0.7%	0	0.0%	10	0.6%
		Missing	1	0.2%	0	0.0%	0	0.0%	0	0.0%	1	0.1%
		Total	410	100.0%	438	100.0%	410	100.0%	335	100.0%	1593	100.0%
14d.	<b>Source of referral (other)</b>	Recorded	30	100.0%	32	100.0%	38	100.0%	31	100.0%	131	100.0%
		Unknown	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
		Missing	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
		Total	30	100.0%	32	100.0%	38	100.0%	31	100.0%	131	100.0%
15.	<b>Helicopter</b>	Recorded	1235	99.4%	1276	100.0%	1174	99.7%	1131	99.5%	4816	99.6%
		Unknown	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
		Missing	8	0.6%	0	0.0%	3	0.3%	6	0.5%	17	0.4%
		Total	1243	100.0%	1276	100.0%	1177	100.0%	1137	100.0%	4833	100.0%
16.	<b>Aspirin pre-admission/admission</b>	Recorded	1417	99.3%	1501	99.9%	1398	99.9%	1297	99.8%	5613	99.7%
		Unknown	2	0.1%	1	0.1%	2	0.1%	3	0.2%	8	0.1%
		Missing	8	0.6%	0	0.0%	0	0.0%	0	0.0%	8	0.1%
		Total	1427	100.0%	1502	100.0%	1400	100.0%	1300	100.0%	5629	100.0%
17.	<b>Other antiplatelet pre-admission/admission</b>	Recorded	1410	98.8%	1497	99.7%	1397	99.8%	1296	99.7%	5600	99.5%
		Unknown	2	0.1%	3	0.2%	3	0.2%	3	0.2%	11	0.2%
		Missing	15	1.1%	2	0.1%	0	0.0%	1	0.1%	18	0.3%
		Total	1427	100.0%	1502	100.0%	1400	100.0%	1300	100.0%	5629	100.0%
18.	<b>Symptom onset date</b>	Recorded	1399	98.0%	1483	98.7%	1361	97.2%	1296	99.7%	5539	98.4%
		Unknown	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
		Missing	28	2.0%	19	1.3%	39	2.8%	4	0.3%	90	1.6%
		Total	1427	100.0%	1502	100.0%	1400	100.0%	1300	100.0%	5629	100.0%
19.	<b>Symptom onset time</b>	Recorded	1315	92.2%	1391	92.6%	1295	92.5%	1224	94.2%	5225	92.8%
		Unknown	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
		Missing	112	7.8%	111	7.4%	105	7.5%	76	5.8%	404	7.2%
		Total	1427	100.0%	1502	100.0%	1400	100.0%	1300	100.0%	5629	100.0%
20.	<b>Call for help date</b>	Recorded	1386	97.1%	1490	99.2%	1384	98.9%	1299	99.9%	5559	98.8%
		Unknown	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
		Missing	41	2.9%	12	0.8%	16	1.1%	1	0.1%	70	1.2%
		Total	1427	100.0%	1502	100.0%	1400	100.0%	1300	100.0%	5629	100.0%

Data Element ID			2017		2018		2019		2020		TOTAL	
			N	%	N	%	N	%	N	%	N	%
21.	<b>Call for help time</b>	Recorded	1314	92.1%	1463	97.4%	1346	96.1%	1273	97.9%	5396	95.9%
		Unknown	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
		Missing	113	7.9%	39	2.6%	54	3.9%	27	2.1%	233	4.1%
		Total	1427	100.0%	1502	100.0%	1400	100.0%	1300	100.0%	5629	100.0%
22.	<b>First positive electrocardiogram (ECG) date</b>	Recorded	1427	100.0%	1502	100.0%	1400	100.0%	1300	100.0%	5629	100.0%
		Unknown	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
		Missing	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
		Total	1427	100.0%	1502	100.0%	1400	100.0%	1300	100.0%	5629	100.0%
23.	<b>First positive ECG time</b>	Recorded	1427	100.0%	1502	100.0%	1400	100.0%	1300	100.0%	5629	100.0%
		Unknown	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
		Missing	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
		Total	1427	100.0%	1502	100.0%	1400	100.0%	1300	100.0%	5629	100.0%
24.	<b>First positive ECG location</b>	Recorded	1421	99.6%	1498	99.7%	1398	99.9%	1300	100.0%	5617	99.8%
		Unknown	6	0.4%	4	0.3%	2	0.1%	0	0.0%	12	0.2%
		Missing	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
		Total	1427	100.0%	1502	100.0%	1400	100.0%	1300	100.0%	5629	100.0%
25.	<b>First positive ECG location (other)</b>	Recorded	45	100.0%	45	100.0%	69	100.0%	45	100.0%	204	100.0%
		Unknown	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
		Missing	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
		Total	45	100.0%	45	100.0%	69	100.0%	45	100.0%	204	100.0%
26.	<b>ECG transmission (by ambulance service)</b>	Recorded	772	92.7%	787	93.9%	744	97.0%	782	97.5%	3085	95.2%
		Unknown	55	6.6%	49	5.8%	20	2.6%	11	1.4%	135	4.2%
		Missing	6	0.7%	2	0.2%	3	0.4%	9	1.1%	20	0.6%
		Total	833	100.0%	838	100.0%	767	100.0%	802	100.0%	3240	100.0%
27.	<b>Arrival at first hospital date</b>	Recorded	1427	100.0%	1502	100.0%	1399	99.9%	1300	100.0%	5628	100.0%
		Unknown	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
		Missing	0	0.0%	0	0.0%	1	0.1%	0	0.0%	1	0.0%
		Total	1427	100.0%	1502	100.0%	1400	100.0%	1300	100.0%	5629	100.0%
28.	<b>Arrival at first hospital time</b>	Recorded	1427	100.0%	1502	100.0%	1399	99.9%	1300	100.0%	5628	100.0%
		Unknown	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
		Missing	0	0.0%	0	0.0%	1	0.1%	0	0.0%	1	0.0%
		Total	1427	100.0%	1502	100.0%	1400	100.0%	1300	100.0%	5629	100.0%

Data Element ID			2017		2018		2019		2020		TOTAL	
			N	%	N	%	N	%	N	%	N	%
29.	<b>Arrival at PCI centre hospital date</b>	Recorded	1427	100.0%	1502	100.0%	1400	100.0%	1300	100.0%	5629	100.0%
		Unknown	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
		Missing	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
		Total	1427	100.0%	1502	100.0%	1400	100.0%	1300	100.0%	5629	100.0%
30.	<b>Arrival at PPCI centre hospital time</b>	Recorded	1427	100.0%	1502	100.0%	1400	100.0%	1300	100.0%	5629	100.0%
		Unknown	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
		Missing	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
		Total	1427	100.0%	1502	100.0%	1400	100.0%	1300	100.0%	5629	100.0%
31.	<b>Patient status on admission</b>	Recorded	1421	99.6%	1502	100.0%	1398	99.9%	1300	100.0%	5621	99.9%
		Unknown	6	0.4%	0	0.0%	1	0.1%	0	0.0%	7	0.1%
		Missing	0	0.0%	0	0.0%	1	0.1%	0	0.0%	1	0.0%
		Total	1427	100.0%	1502	100.0%	1400	100.0%	1300	100.0%	5629	100.0%
32.	<b>Patient status (other)</b>	Recorded	11	91.7%	22	100.0%	21	100.0%	23	100.0%	77	98.7%
		Unknown	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
		Missing	1	8.3%	0	0.0%	0	0.0%	0	0.0%	1	1.3%
		Total	12	100.0%	22	100.0%	21	100.0%	23	100.0%	78	100.0%
33.	<b>Contraindicated to reperfusion therapy</b>	Recorded	1427	100.0%	1502	100.0%	1400	100.0%	1298	99.8%	5627	100.0%
		Unknown	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
		Missing	0	0.0%	0	0.0%	0	0.0%	2	0.2%	2	0.0%
		Total	1427	100.0%	1502	100.0%	1400	100.0%	1300	100.0%	5629	100.0%
34.	<b>Contraindication to reperfusion therapy reason</b>	Recorded	126	100.0%	162	100.0%	133	100.0%	95	100.0%	516	100.0%
		Unknown	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
		Missing	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
		Total	126	100.0%	162	100.0%	133	100.0%	95	100.0%	516	100.0%
35.	<b>Contraindication to reperfusion therapy reason (other)</b>	Recorded	17	100.0%	17	100.0%	18	100.0%	19	100.0%	71	100.0%
		Unknown	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
		Missing	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
		Total	17	100.0%	17	100.0%	18	100.0%	19	100.0%	71	100.0%
36.	<b>Reperfusion therapy type</b>	Recorded	1318	92.4%	1345	89.5%	1275	91.1%	1207	92.8%	5145	91.4%
		Unknown	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
		Missing	109	7.6%	157	10.5%	125	8.9%	93	7.2%	484	8.6%
		Total	1427	100.0%	1502	100.0%	1400	100.0%	1300	100.0%	5629	100.0%

Data Element ID			2017		2018		2019		2020		TOTAL	
			N	%	N	%	N	%	N	%	N	%
37.	<b>Reperfusion therapy date</b>	Recorded	1275	99.3%	1299	99.9%	1216	99.9%	1143	99.9%	4933	99.8%
		Unknown	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
		Missing	9	0.7%	1	0.1%	1	0.1%	1	0.1%	12	0.2%
		Total	1284	100.0%	1300	100.0%	1217	100.0%	1144	100.0%	4945	100.0%
38.	<b>Reperfusion therapy time</b>	Recorded	1274	99.2%	1299	99.9%	1215	99.8%	1143	99.9%	4931	99.7%
		Unknown	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
		Missing	10	0.8%	1	0.1%	2	0.2%	1	0.1%	14	0.3%
		Total	1284	100.0%	1300	100.0%	1217	100.0%	1144	100.0%	4945	100.0%
39.	<b>Was angiogram performed?</b>	Recorded	1427	100.0%	1502	100.0%	1400	100.0%	1298	99.8%	5627	100.0%
		Unknown	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
		Missing	0	0.0%	0	0.0%	0	0.0%	2	0.2%	2	0.0%
		Total	1427	100.0%	1502	100.0%	1400	100.0%	1300	100.0%	5629	100.0%
40.	<b>Angiogram performed as part of?</b>	Recorded	1401	100.0%	1479	100.0%	1378	100.0%	1275	100.0%	5533	100.0%
		Unknown	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
		Missing	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
		Total	1401	100.0%	1479	100.0%	1378	100.0%	1275	100.0%	5533	100.0%
41.	<b>Outcome of angiogram/PCI</b>	Recorded	1400	99.9%	1478	99.9%	1378	100.0%	1275	100.0%	5531	100.0%
		Unknown	1	0.1%	1	0.1%	0	0.0%	0	0.0%	2	0.0%
		Missing	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
		Total	1401	100.0%	1479	100.0%	1378	100.0%	1275	100.0%	5533	100.0%
42.	<b>Percutaneous arterial access</b>	Recorded	1401	100.0%	1479	100.0%	1378	100.0%	1275	100.0%	5533	100.0%
		Unknown	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
		Missing	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
		Total	1401	100.0%	1479	100.0%	1378	100.0%	1275	100.0%	5533	100.0%
43.	<b>Late reperfusion therapy (thrombolysis or primary PCI)</b>	Recorded	1230	95.8%	1293	99.5%	1214	99.8%	1139	99.6%	4876	98.6%
		Unknown	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
		Missing	54	4.2%	7	0.5%	3	0.2%	5	0.4%	69	1.4%
		Total	1284	100.0%	1300	100.0%	1217	100.0%	1144	100.0%	4945	100.0%
44.	<b>Late reperfusion therapy reason (if reperfusion therapy outside targets)</b>	Recorded	174	70.7%	259	78.0%	204	73.4%	188	78.7%	825	75.3%
		Unknown	64	26.0%	69	20.8%	69	24.8%	48	20.1%	250	22.8%
		Missing	8	3.3%	4	1.2%	5	1.8%	3	1.3%	20	1.8%
		Total	246	100.0%	332	100.0%	278	100.0%	239	100.0%	1095	100.0%



Data Element ID			2017		2018		2019		2020		TOTAL	
			N	%	N	%	N	%	N	%	N	%
45.	<b>Late reperfusion therapy reason (other)</b>	Recorded	71	100.0%	90	97.8%	72	100.0%	86	97.7%	319	98.8%
		Unknown	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
		Missing	0	0.0%	2	2.2%	0	0.0%	2	2.3%	4	1.2%
		Total	71	100.0%	92	100.0%	72	100.0%	88	100.0%	323	100.0%
46.	<b>Discharge diagnosis</b>	Recorded	1427	100.0%	1502	100.0%	1400	100.0%	1300	100.0%	5629	100.0%
		Unknown	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
		Missing	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
		Total	1427	100.0%	1502	100.0%	1400	100.0%	1300	100.0%	5629	100.0%
47.	<b>Discharge diagnosis (other)</b>	Recorded	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
		Unknown	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
		Missing	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
		Total	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
48.	<b>Bleeding (following any intervention)</b>	Recorded	1104	86.0%	1208	92.9%	1165	95.7%	1036	90.6%	4513	91.3%
		Unknown	8	0.6%	84	6.5%	48	3.9%	108	9.4%	248	5.0%
		Missing	172	13.4%	8	0.6%	4	0.3%	0	0.0%	184	3.7%
		Total	1284	100.0%	1300	100.0%	1217	100.0%	1144	100.0%	4945	100.0%
49.	<b>Stroke during hospital stay</b>	Recorded	1217	85.3%	1386	92.3%	1334	95.3%	1102	84.8%	5039	89.5%
		Unknown	15	1.1%	108	7.2%	62	4.4%	196	15.1%	381	6.8%
		Missing	195	13.7%	8	0.5%	4	0.3%	2	0.2%	209	3.7%
		Total	1427	100.0%	1502	100.0%	1400	100.0%	1300	100.0%	5629	100.0%
50.	<b>Hospital of discharge</b>	Recorded	1402	98.2%	1489	99.1%	1394	99.6%	1299	99.9%	5584	99.2%
		Unknown	4	0.3%	4	0.3%	4	0.3%	0	0.0%	12	0.2%
		Missing	21	1.5%	9	0.6%	2	0.1%	1	0.1%	33	0.6%
		Total	1427	100.0%	1502	100.0%	1400	100.0%	1300	100.0%	5629	100.0%
51.	<b>Survival status on discharge home</b>	Recorded	1032	72.3%	1163	77.4%	1117	79.8%	964	74.2%	4276	76.0%
		Unknown	310	21.7%	330	22.0%	278	19.9%	334	25.7%	1252	22.2%
		Missing	85	6.0%	9	0.6%	5	0.4%	2	0.2%	101	1.8%
		Total	1427	100.0%	1502	100.0%	1400	100.0%	1300	100.0%	5629	100.0%
52.	<b>Aspirin on discharge</b>	Recorded	1154	89.7%	1355	95.7%	1296	99.3%	1144	94.3%	4949	94.8%
		Unknown	26	2.0%	60	4.2%	8	0.6%	69	5.7%	163	3.1%
		Missing	106	8.2%	1	0.1%	1	0.1%	0	0.0%	108	2.1%
		Total	1286	100.0%	1416	100.0%	1305	100.0%	1213	100.0%	5220	100.0%

Data Element ID			2017		2018		2019		2020		TOTAL	
			N	%	N	%	N	%	N	%	N	%
53.	<b>Other antiplatelet therapy on discharge</b>	Recorded	1153	89.7%	1353	95.6%	1296	99.3%	1139	93.9%	4941	94.7%
		Unknown	26	2.0%	62	4.4%	8	0.6%	74	6.1%	170	3.3%
		Missing	107	8.3%	1	0.1%	1	0.1%	0	0.0%	109	2.1%
		Total	1286	100.0%	1416	100.0%	1305	100.0%	1213	100.0%	5220	100.0%
54.	<b>Beta-blocker on discharge</b>	Recorded	1142	88.8%	1274	90.0%	1251	95.9%	968	79.8%	4635	88.8%
		Unknown	36	2.8%	140	9.9%	52	4.0%	245	20.2%	473	9.1%
		Missing	108	8.4%	2	0.1%	2	0.2%	0	0.0%	112	2.1%
		Total	1286	100.0%	1416	100.0%	1305	100.0%	1213	100.0%	5220	100.0%
55.	<b>Statin on discharge</b>	Recorded	1147	89.2%	1288	91.0%	1260	96.6%	992	81.8%	4687	89.8%
		Unknown	31	2.4%	127	9.0%	42	3.2%	221	18.2%	421	8.1%
		Missing	108	8.4%	1	0.1%	3	0.2%	0	0.0%	112	2.1%
		Total	1286	100.0%	1416	100.0%	1305	100.0%	1213	100.0%	5220	100.0%
56.	<b>angiotensin-converting enzyme inhibitor (ACEI) or angiotensin II receptor blocker (ARB) on discharge</b>	Recorded	1138	88.5%	1269	89.6%	1247	95.6%	958	79.0%	4612	88.4%
		Unknown	40	3.1%	146	10.3%	56	4.3%	255	21.0%	497	9.5%
		Missing	108	8.4%	1	0.1%	2	0.2%	0	0.0%	111	2.1%
		Total	1286	100.0%	1416	100.0%	1305	100.0%	1213	100.0%	5220	100.0%
57.	<b>Smoking cessation counselling (for smokers)</b>	Recorded	305	68.1%	487	91.4%	504	96.2%	441	93.0%	1737	87.8%
		Unknown	70	15.6%	26	4.9%	5	1.0%	11	2.3%	112	5.7%
		Missing	73	16.3%	20	3.8%	15	2.9%	22	4.6%	130	6.6%
		Total	448	100.0%	533	100.0%	524	100.0%	474	100.0%	1979	100.0%
58.	<b>Referral to cardiac rehabilitation (CR) phase 3</b>	Recorded	1110	77.8%	1358	90.4%	1252	89.4%	1073	82.5%	4793	85.1%
		Unknown	81	5.7%	55	3.7%	50	3.6%	139	10.7%	325	5.8%
		Missing	236	16.5%	89	5.9%	98	7.0%	88	6.8%	511	9.1%
		Total	1427	100.0%	1502	100.0%	1400	100.0%	1300	100.0%	5629	100.0%
59.	<b>Hospital for CR</b>	Recorded	883	94.0%	1064	98.0%	1042	96.9%	868	96.3%	3857	96.4%
		Unknown	3	0.3%	12	1.1%	17	1.6%	2	0.2%	34	0.8%
		Missing	53	5.6%	10	0.9%	16	1.5%	31	3.4%	110	2.7%
		Total	939	100.0%	1086	100.0%	1075	100.0%	901	100.0%	4001	100.0%
60.	<b>Date of first phase 3 CR appointment</b>	Recorded	150	16.0%	225	20.7%	154	14.3%	73	8.1%	602	15.0%
		Unknown	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
		Missing	789	84.0%	861	79.3%	921	85.7%	828	91.9%	3399	85.0%
		Total	939	100.0%	1086	100.0%	1075	100.0%	901	100.0%	4001	100.0%

Data Element ID			2017		2018		2019		2020		TOTAL	
			N	%	N	%	N	%	N	%	N	%
61.	<b>Survival status at 30 days post-MI</b>	Recorded	614	43.0%	781	52.0%	653	46.6%	727	55.9%	2775	49.3%
		Unknown	411	28.8%	473	31.5%	432	30.9%	448	34.5%	1764	31.3%
		Missing	402	28.2%	248	16.5%	315	22.5%	125	9.6%	1090	19.4%
		Total	1427	100.0%	1502	100.0%	1400	100.0%	1300	100.0%	5629	100.0%
62.	<b>Cause of death</b>	Recorded	47	83.9%	67	87.0%	79	87.8%	73	85.9%	266	86.4%
		Unknown	1	1.8%	4	5.2%	2	2.2%	3	3.5%	10	3.2%
		Missing	8	14.3%	6	7.8%	9	10.0%	9	10.6%	32	10.4%
		Total	56	100.0%	77	100.0%	90	100.0%	85	100.0%	308	100.0%

## APPENDIX 6: SPECIFICATIONS FOR COMPOSITE VARIABLES

**FIGURE 4.8: PROPORTION OF PATIENTS WITH AN ST ELEVATION MYOCARDIAL INFARCTION WITH PRIOR CORONARY HEART DISEASE, BY YEAR (N=5629)**

DATA POINT	SPECIFICATION
Prior coronary heart disease	<p>If patient has a previous medical history of one or more:</p> <ul style="list-style-type: none"> <li>• prior myocardial infarction (MI)</li> <li>• prior angina</li> <li>• prior percutaneous coronary intervention (PCI)</li> <li>• prior coronary artery bypass graft (CABG).</li> </ul>

**FIGURE 4.12: PREVALENCE OF RISK FACTORS FOR PATIENTS WITH AN ST ELEVATION MYOCARDIAL INFARCTION, BY YEAR (N=5629)**

AND

**FIGURE 4.12A: PREVALENCE OF RISK FACTORS FOR PATIENTS WITH AN ST ELEVATION MYOCARDIAL INFARCTION, BY AGE GROUP AND SEX, 2017–2020 (N=5629)**

DATA POINT	SPECIFICATION
Risk Factor	<p>If patient has a previous medical history of one or more:</p> <ul style="list-style-type: none"> <li>• prior cardiovascular disease (defined in Figure 4.8)</li> <li>• diabetes mellitus</li> <li>• current smoker</li> <li>• previous hypercholesterolaemia</li> <li>• previous hypertension.</li> </ul>

**FIGURE 5.3: PROPORTION OF PATIENTS WITH AN ST ELEVATION MYOCARDIAL INFARCTION WITH A SYMPTOM ONSET TO CALL FOR HELP INTERVAL WITHIN 60 MINUTES, BY YEAR (n=3418)**

DATA POINT	REFERRAL SOURCE	SPECIFICATION
Symptom onset to call for help	Patient arrived at a PCI centre directly by ambulance	<ul style="list-style-type: none"> <li>• If patient arrived at a PCI centre directly by ambulance</li> <li>• Time interval in minutes was calculated based on date and time of symptom onset and date and time of call for help</li> <li>• Admissions for whom time information was not recorded or was recorded incorrectly were excluded:               <ul style="list-style-type: none"> <li>- if time interval was more than 1 week apart</li> <li>- if date and time of call for help was recorded as before date and time of symptom onset.</li> </ul> </li> </ul>
	Patient transferred to a PCI centre	<ul style="list-style-type: none"> <li>• If patient was transferred to a PCI centre</li> <li>• Time interval in minutes was calculated based on date and time of symptom onset and date and time of arrival at the first hospital</li> <li>• Admissions for whom time information was not recorded or was recorded incorrectly were excluded:               <ul style="list-style-type: none"> <li>- if time interval was more than 1 week apart</li> <li>- if date and time of arrival at the first hospital was recorded as before date and time of symptom onset.</li> </ul> </li> </ul>

**FIGURE 5.5A: PROPORTION OF PATIENTS WITH AN ST ELEVATION MYOCARDIAL INFARCTION WHO ARRIVED DIRECTLY BY AMBULANCE WITHIN THE TARGET TIME OF 90 MINUTES, BY PERCUTANEOUS CORONARY INTERVENTION CENTRE AND YEAR (n=2652)**

AND

**FIGURE 5.5B: FIRST MEDICAL CONTACT TO DOOR TIME FOR PATIENTS WHO ARRIVED DIRECTLY BY AMBULANCE, BY HOSPITAL AND YEAR (n=2652)**

DATA POINT	SPECIFICATION
First medical contact (FMC) for patients who arrived at a PCI centre directly by ambulance	<ul style="list-style-type: none"> <li>• Only includes patients who arrived at a PCI centre directly by ambulance</li> <li>• Only includes patients who had their electrocardiogram (ECG) performed by ambulance personnel</li> <li>• Patients who had hospital or pre-hospital thrombolysis performed were excluded</li> <li>• Time interval in minutes was calculated based on date and time of first positive ECG and arrival at the PCI centre</li> <li>• Admissions for whom time information was not recorded or was recorded incorrectly were excluded:                             <ul style="list-style-type: none"> <li>- if time interval was more than 24 hours apart if date and time of arrival at the PCI centre was recorded as before date and time of first positive ECG.</li> </ul> </li> </ul>

**FIGURE 5.6A: PROPORTION OF PATIENTS WITH AN ST ELEVATION MYOCARDIAL INFARCTION WHO WERE TRANSFERRED, WHO ARRIVED WITHIN THE TARGET TIME OF 90 MINUTES, BY PERCUTANEOUS CORONARY INTERVENTION CENTRE, 2017-2020 (n=1386)**

AND

**FIGURE 5.6B: FIRST MEDICAL CONTACT TO DOOR TIME FOR PATIENTS WHO WERE TRANSFERRED, BY HOSPITAL, 2017-2020 (n=1386)**

DATA POINT	SPECIFICATION
FMC for patients who were transferred to a PCI centre	<ul style="list-style-type: none"> <li>• Only includes patients who were transferred to a PCI centre</li> <li>• Patients who had hospital or pre-hospital thrombolysis performed were excluded</li> <li>• Time interval in minutes was calculated based on date and time of arrival at the first hospital and arrival at the PCI centre</li> <li>• Admissions for whom time information was not recorded or was recorded incorrectly were excluded:                             <ul style="list-style-type: none"> <li>- if time interval was more than 48 hours apart</li> <li>- if date and time of arrival at the PCI centre was recorded as before date and time of arrival at the first hospital.</li> </ul> </li> </ul>

**FIGURE 6.1: REPERFUSION THERAPY TYPE, BY REFERRAL SOURCE AND YEAR (n=5486)**

DATA POINT	SPECIFICATION
Directly admitted to a PCI centre	Only includes patients who: <ul style="list-style-type: none"> <li>• arrived at a PCI centre directly via ambulance</li> <li>• were inpatients in a PCI centre</li> <li>• self-presented at a PCI centre.</li> </ul>
Transferred to a PCI centre	Only includes patients who were transferred to a PCI centre from another hospital.

**FIGURE 6.6: PROPORTION OF PATIENTS WHO RECEIVED TIMELY PRIMARY PERCUTANEOUS CORONARY INTERVENTION AND THROMBOLYSIS REPERFUSION, BY YEAR (n=4285)**

DATA POINT	REPERFUSION TYPE	SPECIFICATION
Timely primary PCI and thrombolysis reperfusion	Timeliness of primary PCI reperfusion	See <b>FIGURE 6.6A</b> : PROPORTION OF PATIENTS WHO RECEIVED TIMELY PRIMARY PERCUTANEOUS CORONARY INTERVENTION REPERFUSION, BY REFERRAL SOURCE AND YEAR (n=4111)
	Timeliness of thrombolysis	See <b>FIGURE 6.6B</b> : PROPORTION OF PATIENTS WHO RECEIVED TIMELY THROMBOLYSIS REPERFUSION, BY YEAR (n=174)

**FIGURE 6.6A: PROPORTION OF PATIENTS WHO RECEIVED TIMELY PRIMARY PERCUTANEOUS CORONARY INTERVENTION REPERFUSION, BY REFERRAL SOURCE AND YEAR (n=4111)**

AND

**FIGURE 6.9A: PROPORTION OF TIMELY PRIMARY PERCUTANEOUS CORONARY INTERVENTION FOR PATIENTS ADMITTED DIRECTLY TO A PERCUTANEOUS CORONARY INTERVENTION CENTRE, BY HOSPITAL AND YEAR (n=2996)**

AND

**FIGURE 6.9B: FIRST MEDICAL CONTACT TO BALLOON TIME, BY HOSPITAL AND YEAR (n=299)**

AND

**FIGURE 6.10A: PROPORTION OF TIMELY PRIMARY PERCUTANEOUS CORONARY INTERVENTION FOR PATIENTS WHO WERE TRANSFERRED TO A PERCUTANEOUS CORONARY INTERVENTION CENTRE, BY HOSPITAL AND YEAR (n=1115)**

AND

**FIGURE 6.10B: FIRST MEDICAL CONTACT TO BALLOON TIME, BY HOSPITAL AND YEAR (n=1115)**

DATA POINT	REFERRAL SOURCE	SPECIFICATION
Timeliness of primary PCI reperfusion	Timeliness for patients who arrived at a PCI centre directly by ambulance	<ul style="list-style-type: none"> <li>• Only includes patients who arrived at a PCI centre directly by ambulance</li> <li>• Only includes patients who had their ECG performed by ambulance personnel</li> <li>• Patients who had contraindications to PCI therapy were excluded</li> <li>• Only includes patients who had primary PCI therapy performed</li> <li>• Timely primary PCI reperfusion is defined as within 120 minutes or less</li> <li>• Time interval in minutes was calculated based on date and time of first positive ECG and date and time of primary PCI reperfusion</li> <li>• Admissions for whom time information was not recorded or was recorded incorrectly were excluded: <ul style="list-style-type: none"> <li>- if time interval was more than 24 hours apart</li> <li>- if date and time of primary PCI reperfusion was recorded as before date and time of first positive ECG.</li> </ul> </li> </ul>
	Timeliness for patients who self-presented to a PCI centre or who were already inpatients	<ul style="list-style-type: none"> <li>• Only includes patients who self-presented to a PCI centre or were already inpatients</li> <li>• Patients who had contraindications to PCI therapy were excluded</li> <li>• Only includes patients who had primary PCI therapy performed</li> <li>• Timely primary PCI reperfusion is defined as within 120 minutes or less</li> <li>• Time interval in minutes was calculated based on date and time of first positive ECG and date and time of primary PCI reperfusion</li> <li>• Admissions for whom time information was not recorded or was recorded incorrectly were excluded: <ul style="list-style-type: none"> <li>- if time interval was more than 24 hours apart</li> <li>- if date and time of primary PCI reperfusion was recorded as before date and time of first positive ECG.</li> </ul> </li> </ul>
	Timeliness for patients who were transferred to a PCI centre	<ul style="list-style-type: none"> <li>• Only includes patients who were transferred to a PCI centre</li> <li>• Patients who had contraindications to PCI therapy were excluded</li> <li>• Only includes patients who had primary PCI therapy performed</li> <li>• Timely primary PCI reperfusion is defined as within 120 minutes or less</li> <li>• Time interval in minutes was calculated based on date and time of arrival at the first hospital and date and time of primary PCI reperfusion therapy</li> <li>• Admissions for whom time information was not recorded or was recorded incorrectly were excluded: <ul style="list-style-type: none"> <li>- if time interval was more than 24 hours apart</li> <li>- if date and time of primary PCI reperfusion was recorded as before date and time of arrival at the first hospital.</li> </ul> </li> </ul>

**FIGURE 6.6B: PROPORTION OF PATIENTS WHO RECEIVED TIMELY THROMBOLYSIS REPERFUSION, BY YEAR (n=174)**

DATA POINT	REFERRAL SOURCE	SPECIFICATION
Timeliness of thrombolysis	Timeliness of pre-hospital thrombolysis	<ul style="list-style-type: none"> <li>• Only includes patients who had pre-hospital thrombolysis</li> <li>• Timely thrombolysis is defined as within 30 minutes or less</li> <li>• Time interval in minutes was calculated based on date and time of first positive ECG and date and time of thrombolysis</li> <li>• Admissions for whom time information was not recorded or was recorded incorrectly were excluded:                             <ul style="list-style-type: none"> <li>- if date and time of thrombolysis was recorded as before date and time of first positive ECG.</li> </ul> </li> </ul>
	Timeliness of hospital thrombolysis for inpatients and inpatient transfers from another hospital	<ul style="list-style-type: none"> <li>• Only includes patients who had hospital thrombolysis and were inpatients or inpatients transferred from another hospital</li> <li>• Timely thrombolysis is defined as within 30 minutes or less</li> <li>• Time interval in minutes was calculated based on date and time of first positive ECG and date and time of thrombolysis</li> <li>• Admissions for whom time information was not recorded or was recorded incorrectly were excluded:                             <ul style="list-style-type: none"> <li>- if date and time of thrombolysis was recorded as before date and time of first positive ECG.</li> </ul> </li> </ul>
	Timeliness of hospital thrombolysis for those who were not inpatients	<ul style="list-style-type: none"> <li>• Only includes patients who are not defined as inpatients</li> <li>• Timely thrombolysis is defined as within 30 minutes or less</li> <li>• Time interval in minutes was calculated based on date and time of arrival at the first hospital and date and time of thrombolysis</li> <li>• Admissions for whom time information was not recorded or was recorded incorrectly were excluded:                             <ul style="list-style-type: none"> <li>- if date and time of thrombolysis was recorded as before date and time of arrival at the first hospital.</li> </ul> </li> </ul>



**FIGURE 6.8A DOOR TO BALLOON TIME FOR PATIENTS DIRECTLY ADMITTED TO A PERCUTANEOUS CORONARY INTERVENTION CENTRE, BY HOSPITAL AND YEAR (n=3343)**

DATA POINT	REFERRAL SOURCE	SPECIFICATION
Door to balloon (DTB) time for patients admitted directly to a PCI centre	DTB time for patients who arrived at a PCI centre directly by ambulance or self-presented to a PCI centre	<ul style="list-style-type: none"> <li>• Only includes patients who arrived at a PCI centre directly by ambulance or self-presented to a PCI centre</li> <li>• Patients who had contraindications to PCI therapy were excluded</li> <li>• Only includes patients who had primary PCI therapy performed</li> <li>• Time interval in minutes was calculated based on date and time of arrival at the PCI centre and date and time of primary PCI reperfusion</li> <li>• Admissions for whom time information was not recorded or was recorded incorrectly were excluded:                             <ul style="list-style-type: none"> <li>- if time interval was more than 24 hours apart</li> <li>- if date and time of primary PCI reperfusion was recorded as before date and time of arrival at the PCI centre.</li> </ul> </li> </ul>
	DTB time for patients who were already inpatients in a PCI centre	<ul style="list-style-type: none"> <li>• Only includes patients who were already inpatients</li> <li>• Patients who had contraindications to PCI therapy were excluded</li> <li>• Only includes patients who had primary PCI therapy performed</li> <li>• Time interval in minutes was calculated based on date and time of first positive ECG and date and time of primary PCI reperfusion</li> <li>• Admissions for whom time information was not recorded or was recorded incorrectly were excluded:                             <ul style="list-style-type: none"> <li>- if time interval was more than 24 hours apart</li> <li>- if date and time of primary PCI reperfusion was recorded as before date and time of first positive ECG.</li> </ul> </li> </ul>

**FIGURE 6.8B: DOOR TO BALLOON TIME BY HOSPITAL AND YEAR (n=1162)**

DATA POINT	SPECIFICATION
DTB time for patients who were transferred to a PCI centre	<ul style="list-style-type: none"> <li>• Only includes patients who were transferred to a PCI centre</li> <li>• Patients who had contraindications to PCI therapy were excluded</li> <li>• Only includes patients who had primary PCI therapy performed</li> <li>• Time interval in minutes was calculated based on date and time of arrival at the PCI centre and date and time of primary PCI reperfusion</li> <li>• Admissions for whom time information was not recorded or was recorded incorrectly were excluded:                             <ul style="list-style-type: none"> <li>- if time interval was more than 48 hours apart</li> <li>- if date and time of primary PCI reperfusion was recorded as before date and time of arrival at the PCI centre.</li> </ul> </li> </ul>

**TABLE 7.2: 30-DAY MORTALITY (N=5629)**

DATA POINT	SPECIFICATION
30-day mortality	Includes the following data points: <ul style="list-style-type: none"> <li>• survival status on discharge home</li> <li>• survival status at 30 days post-MI.</li> </ul>

## APPENDIX 7: FREQUENCY TABLES

**FIGURE 4.2:** DISCHARGE DIAGNOSIS, BY YEAR (N=6616)

	2017		2018		2019		2020		Total	
	N	%	N	%	N	%	N	%	N	%
STEMI	1427	84.9%	1502	85.0%	1400	82.9%	1300	88.0%	5629	85.1%
Alternative Diagnosis	164	9.8%	167	9.4%	152	9.0%	112	7.6%	595	9.0%
Other/Unknown	90	5.4%	99	5.6%	137	8.1%	66	4.5%	392	5.9%
<b>Total</b>	<b>1681</b>	<b>100.0%</b>	<b>1768</b>	<b>100.0%</b>	<b>1689</b>	<b>100.0%</b>	<b>1478</b>	<b>100.0%</b>	<b>6616</b>	<b>100.0%</b>

**FIGURE 4.3:** ALTERNATIVE DISCHARGE DIAGNOSIS, BY YEAR (n=595)

	2017		2018		2019		2020		Total	
	N	%	N	%	N	%	N	%	N	%
NSTEMI	35	21.3%	38	22.8%	19	12.5%	15	13.4%	107	18.0%
Unstable angina	8	4.9%	~	*	8	5.3%	~	*	25	4.2%
Pericarditis	28	17.1%	40	24.0%	32	21.1%	27	24.1%	127	21.3%
Myocarditis	9	5.5%	13	7.8%	9	5.9%	*	*	39	6.6%
Takotsubo cardiomyopathy	11	6.7%	13	7.8%	19	12.5%	13	11.6%	56	9.4%
Non-cardiac chest pain	73	44.5%	59	35.3%	65	42.8%	44	39.3%	241	40.5%
<b>Total</b>	<b>164</b>	<b>100.0%</b>	<b>167</b>	<b>100.0%</b>	<b>152</b>	<b>100.0%</b>	<b>112</b>	<b>100.0%</b>	<b>595</b>	<b>100.0%</b>

- Denotes five cases or fewer

\* Further suppression required to prevent disclosure of five cases or fewer

**FIGURE 4.4:** PERCENTAGE OF ST ELEVATION MYOCARDIAL INFARCTION CASES, BY SEX AND YEAR (N=5629)

	2017		2018		2019		2020		Total	
	N	%	N	%	N	%	N	%	N	%
Male	1133	79.4%	1154	76.8%	1077	76.9%	1018	78.3%	4382	77.8%
Female	294	20.6%	348	23.2%	323	23.1%	282	21.7%	1247	22.2%
<b>Total</b>	<b>1427</b>	<b>100.0%</b>	<b>1502</b>	<b>100.0%</b>	<b>1400</b>	<b>100.0%</b>	<b>1300</b>	<b>100.0%</b>	<b>5629</b>	<b>100.0%</b>

**FIGURE 4.5:** PERCENTAGE OF MALE PATIENTS WITH AN ST ELEVATION MYOCARDIAL INFARCTION, BY AGE GROUP AND YEAR (n=4382)

	2017		2018		2019		2020		Total	
	N	%	N	%	N	%	N	%	N	%
≤40	44	3.9%	53	4.6%	45	4.2%	31	3.0%	173	3.9%
41-64	632	55.8%	635	55.0%	580	53.9%	614	60.3%	2461	56.2%
65-79	367	32.4%	366	31.7%	361	33.5%	317	31.1%	1411	32.2%
≥80	90	7.9%	100	8.7%	91	8.4%	56	5.5%	337	7.7%
<b>Total</b>	<b>1133</b>	<b>100.0%</b>	<b>1154</b>	<b>100.0%</b>	<b>1077</b>	<b>100.0%</b>	<b>1018</b>	<b>100.0%</b>	<b>4382</b>	<b>100.0%</b>

## APPENDIX 7: FREQUENCY TABLES

**FIGURE 4.6:** PERCENTAGE OF FEMALE PATIENTS WITH AN ST ELEVATION MYOCARDIAL INFARCTION, BY AGE GROUP AND YEAR (n=1247)

	2017		2018		2019		2020		Total	
	N	%	N	%	N	%	N	%	N	%
≤40	8	2.7%	10	2.9%	~	*	*	*	28	2.2%
41-64	101	34.4%	121	34.8%	128	39.6%	105	37.2%	455	36.5%
65-79	127	43.2%	137	39.4%	116	35.9%	114	40.4%	494	39.6%
≥80	58	19.7%	80	23.0%	*	*	56	19.9%	270	21.7%
<b>Total</b>	<b>294</b>	<b>100.0%</b>	<b>348</b>	<b>100.0%</b>	<b>323</b>	<b>100.0%</b>	<b>282</b>	<b>100.0%</b>	<b>1247</b>	<b>100.0%</b>

- Denotes five cases or fewer

\* Further suppression required to prevent disclosure of five cases or fewer

**FIGURE 4.7:** PRIOR CARDIOVASCULAR DISEASE AND MAJOR COMORBIDITIES IN PATIENTS WITH AN ST ELEVATION MYOCARDIAL INFARCTION, 2017-2020

	Yes		No		Total Known	
	N	%	N	%	N	%
Previous MI	523	10.1%	4654	89.9%	5177	100.0%
Previous angina	682	13.2%	4489	86.8%	5171	100.0%
Previous peripheral vascular disease	154	3.0%	5029	97.0%	5183	100.0%
Previous cerebrovascular disease	203	3.9%	5008	96.1%	5211	100.0%
Previous chronic renal failure	146	2.8%	5080	97.2%	5226	100.0%
Previous chronic lung disease	266	5.1%	4945	94.9%	5211	100.0%
Previous PCI	586	11.1%	4707	88.9%	5293	100.0%
Previous coronary artery bypass graft	146	2.7%	5164	97.3%	5310	100.0%
Previous other heart surgery	62	1.2%	5235	98.8%	5297	100.0%

## APPENDIX 7: FREQUENCY TABLES

**FIGURE 4.7A:** PROPORTION OF PATIENTS WITH AN ST ELEVATION MYOCARDIAL INFARCTION WITH A COMORBIDITY, BY SEX, 2017-2020

		Male		Female		Total	
		N	%	N	%	N	%
Previous MI	Yes	428	10.6%	95	8.2%	523	10.1%
	No	3592	89.4%	1062	91.8%	4654	89.9%
	<b>Total</b>	<b>4020</b>	<b>100.0%</b>	<b>1157</b>	<b>100.0%</b>	<b>5177</b>	<b>100.0%</b>
Previous angina	Yes	545	13.6%	137	11.8%	682	13.2%
	No	3468	86.4%	1021	88.2%	4489	86.8%
	<b>Total</b>	<b>4013</b>	<b>100.0%</b>	<b>1158</b>	<b>100.0%</b>	<b>5171</b>	<b>100.0%</b>
Previous peripheral vascular disease	Yes	116	2.9%	38	3.3%	154	3.0%
	No	3906	97.1%	1123	96.7%	5029	97.0%
	<b>Total</b>	<b>4022</b>	<b>100.0%</b>	<b>1161</b>	<b>100.0%</b>	<b>5183</b>	<b>100.0%</b>
Previous cerebrovascular disease	Yes	146	3.6%	57	4.9%	203	3.9%
	No	3902	96.4%	1106	95.1%	5008	96.1%
	<b>Total</b>	<b>4048</b>	<b>100.0%</b>	<b>1163</b>	<b>100.0%</b>	<b>5211</b>	<b>100.0%</b>
Previous chronic renal failure	Yes	101	2.5%	45	3.9%	146	2.8%
	No	3959	97.5%	1121	96.1%	5080	97.2%
	<b>Total</b>	<b>4060</b>	<b>100.0%</b>	<b>1166</b>	<b>100.0%</b>	<b>5226</b>	<b>100.0%</b>
Previous chronic lung disease	Yes	184	4.5%	82	7.0%	266	5.1%
	No	3863	95.5%	1082	93.0%	4945	94.9%
	<b>Total</b>	<b>4047</b>	<b>100.0%</b>	<b>1164</b>	<b>100.0%</b>	<b>5211</b>	<b>100.0%</b>
Previous PCI	Yes	481	11.7%	105	8.9%	586	11.1%
	No	3636	88.3%	1071	91.1%	4707	88.9%
	<b>Total</b>	<b>4117</b>	<b>100.0%</b>	<b>1176</b>	<b>100.0%</b>	<b>5293</b>	<b>100.0%</b>
Previous CABG	Yes	128	3.1%	18	1.5%	146	2.7%
	No	4002	96.9%	1162	98.5%	5164	97.3%
	<b>Total</b>	<b>4130</b>	<b>100.0%</b>	<b>1180</b>	<b>100.0%</b>	<b>5310</b>	<b>100.0%</b>
Previous other heart surgery	Yes	44	1.1%	18	1.5%	62	1.2%
	No	4076	98.9%	1159	98.5%	5235	98.8%
	<b>Total</b>	<b>4120</b>	<b>100.0%</b>	<b>1177</b>	<b>100.0%</b>	<b>5297</b>	<b>100.0%</b>

## APPENDIX 7: FREQUENCY TABLES

**FIGURE 4.8:** PROPORTION OF PATIENTS WITH AN ST ELEVATION MYOCARDIAL INFARCTION WITH PRIOR CORONARY HEART DISEASE, BY YEAR (N=5629)

	Prior coronary heart disease		No/Unknown		Total	
	N	%	N	%	N	%
2017	245	17%	1182	82.8%	1427	100.0%
2018	245	16%	1257	83.7%	1502	100.0%
2019	259	19%	1141	81.5%	1400	100.0%
2020	207	16%	1093	84.1%	1300	100.0%
<b>Total</b>	<b>956</b>	<b>17%</b>	<b>4673</b>	<b>83.0%</b>	<b>5629</b>	<b>100.0%</b>

**FIGURE 4.8A:** PROPORTION OF PATIENTS WITH AN ST ELEVATION MYOCARDIAL INFARCTION WITH PRIOR CORONARY HEART DISEASE, BY SEX AND YEAR (N=5629)

		Male		Female		Total	
		N	%	N	%	N	%
2017	At least one coronary heart disease	203	17.9%	42	14.3%	245	17.2%
	No coronary heart disease	803	70.9%	222	75.5%	1025	71.8%
	No/unknown	45	4.0%	10	3.4%	55	3.9%
	All unknown	82	7.2%	20	6.8%	102	7.1%
	<b>Total</b>	<b>1133</b>	<b>100.0%</b>	<b>294</b>	<b>100.0%</b>	<b>1427</b>	<b>100.0%</b>
2018	At least one coronary heart disease	186	16.1%	59	17.0%	245	16.3%
	No coronary heart disease	844	73.1%	253	72.7%	1097	73.0%
	No/unknown	30	2.6%	10	2.9%	40	2.7%
	All unknown	94	8.1%	26	7.5%	120	8.0%
	<b>Total</b>	<b>1154</b>	<b>100.0%</b>	<b>348</b>	<b>100.0%</b>	<b>1502</b>	<b>100.0%</b>
2019	At least one coronary heart disease	200	18.6%	59	18.3%	259	18.5%
	No coronary heart disease	847	78.6%	254	78.6%	1101	78.6%
	No/unknown	10	0.9%	0	0.0%	10	0.7%
	All unknown	20	1.9%	10	3.1%	30	2.1%
	<b>Total</b>	<b>1077</b>	<b>100.0%</b>	<b>323</b>	<b>100.0%</b>	<b>1400</b>	<b>100.0%</b>
2020	At least one coronary heart disease	180	17.7%	27	9.6%	207	15.9%
	No coronary heart disease	779	76.5%	245	86.9%	1024	78.8%
	No/unknown	16	1.6%	0	0.0%	16	1.2%
	All unknown	43	4.2%	10	3.5%	53	4.1%
	<b>Total</b>	<b>1018</b>	<b>100.0%</b>	<b>282</b>	<b>100.0%</b>	<b>1300</b>	<b>100.0%</b>
Total	At least one coronary heart disease	769	17.5%	187	15.0%	956	17.0%
	No coronary heart disease	3273	74.7%	974	78.1%	4247	75.4%
	No/unknown	101	2.3%	20	1.6%	121	2.1%
	All unknown	239	5.5%	66	5.3%	305	5.4%
	<b>Total</b>	<b>4382</b>	<b>100.0%</b>	<b>1247</b>	<b>100.0%</b>	<b>5629</b>	<b>100.0%</b>

## APPENDIX 7: FREQUENCY TABLES

**FIGURE 4.9:** DIABETES PROFILE OF PATIENTS WITH AN ST ELEVATION MYOCARDIAL INFARCTION, 2017-2020 (N=5629)

	2017		2018		2019		2020		Total	
	N	%	N	%	N	%	N	%	N	%
Not diabetic	1123	78.7%	1161	77.3%	1142	81.6%	1028	79.1%	4454	79.1%
Diabetes (diet control)	60	4.2%	44	2.9%	62	4.4%	51	3.9%	217	3.9%
Diabetes (oral medications)	90	6.3%	131	8.7%	116	8.3%	100	7.7%	437	7.8%
Diabetes (insulin)	33	2.3%	29	1.9%	36	2.6%	31	2.4%	129	2.3%
Unknown	121	8.5%	137	9.1%	44	3.1%	90	6.9%	392	7.0%
<b>Total</b>	<b>1427</b>	<b>100.0%</b>	<b>1502</b>	<b>100.0%</b>	<b>1400</b>	<b>100.0%</b>	<b>1300</b>	<b>100.0%</b>	<b>5629</b>	<b>100.0%</b>

**FIGURE 4.10:** SMOKING PROFILE OF PATIENTS WITH AN ST ELEVATION MYOCARDIAL INFARCTION, 2017-2020 (N=5629)

	2017		2018		2019		2020		Total	
	N	%	N	%	N	%	N	%	N	%
Never smoker	347	24.3%	367	24.4%	406	29.0%	363	27.9%	1483	26.3%
Former smoker	335	23.5%	346	23.0%	381	27.2%	339	26.1%	1401	24.9%
Current smoker	431	30.2%	522	34.8%	517	36.9%	452	34.8%	1922	34.1%
Unknown	314	22.0%	267	17.8%	96	6.9%	146	11.2%	823	14.6%
<b>Total</b>	<b>1427</b>	<b>100.0%</b>	<b>1502</b>	<b>100.0%</b>	<b>1400</b>	<b>100.0%</b>	<b>1300</b>	<b>100.0%</b>	<b>5629</b>	<b>100.0%</b>

**FIGURE 4.10A:** SMOKING PROFILE OF PATIENTS WITH AN ST ELEVATION MYOCARDIAL INFARCTION, BY SEX AND YEAR (N=5629)

		Never smoker		Former smoker		Current smoker		Unknown		Total	
		N	%	N	%	N	%	N	%	N	%
2017	Male	252	22.2%	278	24.5%	353	31.2%	250	22.1%	1133	100.0%
	Female	95	32.3%	57	19.4%	78	26.5%	64	21.8%	294	100.0%
	Total	347	24.3%	335	23.5%	431	30.2%	314	22.0%	1427	100.0%
2018	Male	265	23.0%	294	25.5%	404	35.0%	191	16.6%	1154	100.0%
	Female	102	29.3%	52	14.9%	118	33.9%	76	21.8%	348	100.0%
	Total	367	24.4%	346	23.0%	522	34.8%	267	17.8%	1502	100.0%
2019	Male	306	28.4%	307	28.5%	398	37.0%	66	6.1%	1077	100.0%
	Female	100	31.0%	74	22.9%	119	36.8%	30	9.3%	323	100.0%
	Total	406	29.0%	381	27.2%	517	36.9%	96	6.9%	1400	100.0%
2020	Male	269	26.4%	278	27.3%	351	34.5%	120	11.8%	1018	100.0%
	Female	94	33.3%	61	21.6%	101	35.8%	26	9.2%	282	100.0%
	Total	363	27.9%	339	26.1%	452	34.8%	146	11.2%	1300	100.0%
<b>Total</b>	<b>Male</b>	<b>1092</b>	<b>24.9%</b>	<b>1157</b>	<b>26.4%</b>	<b>1506</b>	<b>34.4%</b>	<b>627</b>	<b>14.3%</b>	<b>4382</b>	<b>100.0%</b>
	<b>Female</b>	<b>391</b>	<b>31.4%</b>	<b>244</b>	<b>19.6%</b>	<b>416</b>	<b>33.4%</b>	<b>196</b>	<b>15.7%</b>	<b>1247</b>	<b>100.0%</b>
	<b>Total</b>	<b>1483</b>	<b>26.3%</b>	<b>1401</b>	<b>24.9%</b>	<b>1922</b>	<b>34.1%</b>	<b>823</b>	<b>14.6%</b>	<b>5629</b>	<b>100.0%</b>

## APPENDIX 7: FREQUENCY TABLES

**FIGURE 4.10B:** SMOKING PROFILE OF PATIENTS WITH AN ST ELEVATION MYOCARDIAL INFARCTION, BY SEX AND AGE GROUP, 2017–2020 (N=5629)

		Never smoker		Former smoker		Current smoker		Unknown		Total	
		N	%	N	%	N	%	N	%	N	%
Male	≤40	32	18.5%	13	7.5%	112	64.7%	16	9.2%	173	100.0%
	41–64	514	20.9%	532	21.6%	1088	44.2%	327	13.3%	2461	100.0%
	65–79	427	30.3%	483	34.2%	276	19.6%	225	15.9%	1411	100.0%
	≥80	119	35.3%	129	38.3%	30	8.9%	59	17.5%	337	100.0%
	<b>Total</b>	<b>1092</b>	<b>24.9%</b>	<b>1157</b>	<b>26.4%</b>	<b>1506</b>	<b>34.4%</b>	<b>627</b>	<b>14.3%</b>	<b>4382</b>	<b>100.0%</b>
Female	≤40	~	*	~	*	17	60.7%	~	*	28	100.0%
	41–64	*	*	73	16.0%	244	53.6%	*	*	455	100.0%
	65–79	159	32.2%	114	23.1%	133	26.9%	88	17.8%	494	100.0%
	≥80	138	51.1%	*	*	22	8.1%	55	20.4%	270	100.0%
	<b>Total</b>	<b>391</b>	<b>31.4%</b>	<b>244</b>	<b>19.6%</b>	<b>416</b>	<b>33.4%</b>	<b>196</b>	<b>15.7%</b>	<b>1247</b>	<b>100.0%</b>
Total	≤40	37	18.4%	15	7.5%	129	64.2%	20	10.0%	201	100.0%
	41–64	603	20.7%	605	20.7%	1332	45.7%	376	12.9%	2916	100.0%
	65–79	586	30.8%	597	31.3%	409	21.5%	313	16.4%	1905	100.0%
	≥80	257	42.3%	184	30.3%	52	8.6%	114	18.8%	607	100.0%
	<b>Total</b>	<b>1483</b>	<b>26.3%</b>	<b>1401</b>	<b>24.9%</b>	<b>1922</b>	<b>34.1%</b>	<b>823</b>	<b>14.6%</b>	<b>5629</b>	<b>100.0%</b>

~ Denotes five cases or fewer

\* Further suppression required to prevent disclosure of five cases or fewer



## APPENDIX 7: FREQUENCY TABLES

**FIGURE 4.11:** SMOKING PROFILE OF PATIENTS WITH AN ST ELEVATION MYOCARDIAL INFARCTION WITH PRIOR CORONARY HEART DISEASE, BY YEAR (n=956)

	2017		2018		2019		2020		Total	
	N	%	N	%	N	%	N	%	N	%
Never smoker	52	21.2%	68	27.8%	89	34.4%	60	29.0%	269	28.1%
Former smoker	65	26.5%	72	29.4%	88	34.0%	63	30.4%	288	30.1%
Current smoker	72	29.4%	60	24.5%	57	22.0%	61	29.5%	250	26.2%
Unknown	56	22.9%	45	18.4%	25	9.7%	23	11.1%	149	15.6%
<b>Total</b>	<b>245</b>	<b>100.0%</b>	<b>245</b>	<b>100.0%</b>	<b>259</b>	<b>100.0%</b>	<b>207</b>	<b>100.0%</b>	<b>956</b>	<b>100.0%</b>

**FIGURE 4.12:** PREVALENCE OF RISK FACTORS FOR PATIENTS WITH AN ST ELEVATION MYOCARDIAL INFARCTION, BY YEAR (N=5629)

	2017		2018		2019		2020		Total	
	N	%	N	%	N	%	N	%	N	%
One risk factor	385	27.0%	455	30.3%	455	32.5%	407	31.3%	1702	30.2%
Two risk factors	367	25.7%	358	23.8%	341	24.4%	324	24.9%	1390	24.7%
Three risk factors	238	16.7%	254	16.9%	231	16.5%	188	14.5%	911	16.2%
Four risk factors	91	6.4%	76	5.1%	88	6.3%	90	6.9%	345	6.1%
Five risk factors	11	0.8%	6	0.4%	~	*	~	*	24	0.4%
No risk factor	139	9.7%	181	12.1%	201	14.4%	185	14.2%	706	12.5%
Unknown	196	13.7%	172	11.5%	*	*	*	*	551	9.8%
<b>Total</b>	<b>1427</b>	<b>100.0%</b>	<b>1502</b>	<b>100.0%</b>	<b>1400</b>	<b>100.0%</b>	<b>1300</b>	<b>100.0%</b>	<b>5629</b>	<b>100.0%</b>

- Denotes five cases or fewer

\* Further suppression required to prevent disclosure of five cases or fewer

## APPENDIX 7: FREQUENCY TABLES

**FIGURE 4.12A:** PREVALENCE OF RISK FACTORS FOR PATIENTS WITH AN ST ELEVATION MYOCARDIAL INFARCTION, BY AGE GROUP AND SEX, 2017-2020 (N=5629)

	Male									
	≤40		41-64		65-79		≥80		Total	
	N	%	N	%	N	%	N	%	N	%
One risk factor	89	51.4%	812	33.0%	362	25.7%	78	23.1%	1341	30.6%
Two risk factors	32	18.5%	582	23.6%	347	24.6%	76	22.6%	1037	23.7%
Three risk factors	16	9.2%	325	13.2%	272	19.3%	75	22.3%	688	15.7%
Four risk factors	~	*	134	5.4%	*	*	*	*	267	6.1%
Five risk factors	0	0.0%	12	0.5%	~	*	~	*	18	0.4%
No risk factor	19	11.0%	335	13.6%	185	13.1%	40	11.9%	579	13.2%
No/unknown	*	*	261	10.6%	143	10.1%	36	10.7%	452	10.3%
<b>Total</b>	<b>173</b>	<b>100.0%</b>	<b>2461</b>	<b>100.0%</b>	<b>1411</b>	<b>100.0%</b>	<b>337</b>	<b>100.0%</b>	<b>4382</b>	<b>100.0%</b>
	Female									
	≤40		41-64		65-79		≥80		Total	
	N	%	N	%	N	%	N	%	N	%
One risk factor	10	35.7%	155	34.1%	129	26.1%	67	24.8%	361	28.9%
Two risk factors	7	25.0%	122	26.8%	148	30.0%	76	28.1%	353	28.3%
Three risk factors	~	*	79	17.4%	89	18.0%	*	*	223	17.9%
Four risk factors	~	*	27	5.9%	34	6.9%	*	*	78	6.3%
Five risk factors	~	*	0	0.0%	~	*	0	0.0%	6	0.5%
No risk factor	~	*	40	8.8%	44	8.9%	*	*	127	10.2%
No/unknown	~	*	32	7.0%	45	9.1%	*	*	99	7.9%
<b>Total</b>	<b>28</b>	<b>100.0%</b>	<b>455</b>	<b>100.0%</b>	<b>494</b>	<b>100.0%</b>	<b>270</b>	<b>100.0%</b>	<b>1247</b>	<b>100.0%</b>
	Total									
	≤40		41-64		65-79		≥80		Total	
	N	%	N	%	N	%	N	%	N	%
One risk factor	99	49.3%	967	33.2%	491	25.8%	145	23.9%	1702	30.2%
Two risk factors	39	19.4%	704	24.1%	495	26.0%	152	25.0%	1390	24.7%
Three risk factors	18	9.0%	404	13.9%	361	19.0%	128	21.1%	911	16.2%
Four risk factors	6	3.0%	161	5.5%	131	6.9%	*	*	345	6.1%
Five risk factors	~	*	12	0.4%	10	0.5%	~	*	24	0.4%
No risk factor	23	11.4%	375	12.9%	229	12.0%	79	13.0%	706	12.5%
No/unknown	*	*	293	10.0%	188	9.9%	55	9.1%	551	9.8%
<b>Total</b>	<b>201</b>	<b>100.0%</b>	<b>2916</b>	<b>100.0%</b>	<b>1905</b>	<b>100.0%</b>	<b>607</b>	<b>100.0%</b>	<b>5629</b>	<b>100.0%</b>

- Denotes five cases or fewer

\* Further suppression required to prevent disclosure of five cases or fewer

## APPENDIX 7: FREQUENCY TABLES

**FIGURE 5.2:** REFERRAL SOURCE TO A PERCUTANEOUS CORONARY INTERVENTION CENTRE FOR ALL PATIENTS, BY YEAR (N=5629)

	2017		2018		2019		2020		Total	
	N	%	N	%	N	%	N	%	N	%
Direct via ambulance	833	58.4%	838	55.8%	767	54.8%	802	61.7%	3240	57.6%
Self-presentation	132	9.3%	158	10.5%	150	10.7%	116	8.9%	556	9.9%
Transfer from other hospital	410	28.7%	438	29.2%	410	29.3%	335	25.8%	1593	28.3%
Already inpatient in PCI centre	17	1.2%	34	2.3%	33	2.4%	13	1.0%	97	1.7%
Other/unknown	35	2.5%	34	2.3%	40	2.9%	34	2.6%	143	2.5%
<b>Total</b>	<b>1427</b>	<b>100.0%</b>	<b>1502</b>	<b>100.0%</b>	<b>1400</b>	<b>100.0%</b>	<b>1300</b>	<b>100.0%</b>	<b>5629</b>	<b>100.0%</b>

**FIGURE 5.3:** PROPORTION OF PATIENTS WITH AN ST ELEVATION MYOCARDIAL INFARCTION WITH A SYMPTOM ONSET TO CALL FOR HELP INTERVAL WITHIN 60 MINUTES, BY YEAR (n=3418)

	60 minutes or less		61 minutes or more		Total	
	N	%	N	%	N	%
2017	280	32.2%	589	67.8%	869	100.0%
2018	352	37.8%	580	62.2%	932	100.0%
2019	322	39.5%	493	60.5%	815	100.0%
2020	313	39.0%	489	61.0%	802	100.0%
<b>Total</b>	<b>1267</b>	<b>37.1%</b>	<b>2151</b>	<b>62.9%</b>	<b>3418</b>	<b>100.0%</b>

## APPENDIX 7: FREQUENCY TABLES

**FIGURE 5.5A:** PROPORTION OF PATIENTS WITH AN ST ELEVATION MYOCARDIAL INFARCTION WHO ARRIVED DIRECTLY BY AMBULANCE WITHIN THE TARGET TIME OF 90 MINUTES, BY PERCUTANEOUS CORONARY INTERVENTION CENTRE AND YEAR (n=2652)

		90 minutes or less		91 minutes or more		Total	
		N	%	N	%	N	%
2017	Cork University Hospital	92	89.3%	*	*	103	100.0%
	Letterkenny University Hospital	*	*	~	*	27	100.0%
	Mater Misericordiae University Hospital	129	87.8%	18	12.2%	147	100.0%
	St James's Hospital	155	81.6%	35	18.4%	190	100.0%
	University Hospital Limerick	90	84.9%	16	15.1%	106	100.0%
	University Hospital Galway	62	72.9%	23	27.1%	85	100.0%
	St Vincent's University Hospital	~	*	0	0.0%	~	*
	Tallaght University Hospital	~	*	0	0.0%	~	*
	<b>Total</b>	<b>554</b>	<b>83.7%</b>	<b>108</b>	<b>16.3%</b>	<b>662</b>	<b>100.0%</b>
2018	Cork University Hospital	86	87.8%	12	12.2%	98	100.0%
	Letterkenny University Hospital	37	80.4%	9	19.6%	46	100.0%
	Mater Misericordiae University Hospital	130	86.1%	21	13.9%	151	100.0%
	St James's Hospital	152	80.9%	36	19.1%	188	100.0%
	University Hospital Limerick	74	80.4%	18	19.6%	92	100.0%
	University Hospital Galway	71	73.2%	26	26.8%	97	100.0%
	St Vincent's University Hospital	~	*	0	0.0%	~	*
	Tallaght University Hospital	~	*	0	0.0%	~	*
	<b>Total</b>	<b>553</b>	<b>81.9%</b>	<b>122</b>	<b>18.1%</b>	<b>675</b>	<b>100.0%</b>
2019	Cork University Hospital	103	92.0%	9	8.0%	112	100.0%
	Letterkenny University Hospital	*	*	~	*	26	100.0%
	Mater Misericordiae University Hospital	143	85.1%	25	14.9%	168	100.0%
	St James's Hospital	134	78.8%	36	21.2%	170	100.0%
	University Hospital Limerick	66	84.6%	*	*	78	100.0%
	University Hospital Galway	64	83.1%	13	16.9%	77	100.0%
	Beaumont Hospital	~	*	0	0.0%	~	*
	<b>Total</b>	<b>537</b>	<b>84.7%</b>	<b>97</b>	<b>15.3%</b>	<b>634</b>	<b>100.0%</b>
2020	Cork University Hospital	96	90.6%	10	9.4%	106	100.0%
	Letterkenny University Hospital	19	90.5%	2	9.5%	21	100.0%
	Mater Misericordiae University Hospital	159	84.1%	30	15.9%	189	100.0%
	St James's Hospital	166	81.4%	38	18.6%	204	100.0%
	University Hospital Limerick	76	86.4%	12	13.6%	88	100.0%
	University Hospital Galway	52	75.4%	17	24.6%	69	100.0%
	Beaumont Hospital	~	*	0	0.0%	~	*
	St Vincent's University Hospital	~	*	0	0.0%	~	*
	Tallaght University Hospital	~	*	0	0.0%	~	*
	<b>Total</b>	<b>572</b>	<b>84.0%</b>	<b>109</b>	<b>16.0%</b>	<b>681</b>	<b>100.0%</b>
Total	Cork University Hospital	377	90.0%	42	10.0%	419	100.0%
	Letterkenny University Hospital	102	85.0%	18	15.0%	120	100.0%
	Mater Misericordiae University Hospital	561	85.6%	94	14.4%	655	100.0%
	St James's Hospital	607	80.7%	145	19.3%	752	100.0%
	University Hospital Limerick	306	84.1%	58	15.9%	364	100.0%
	University Hospital Galway	249	75.9%	79	24.1%	328	100.0%
	Beaumont Hospital	~	*	0	0.0%	~	*
	St Vincent's University Hospital	~	*	0	0.0%	~	*
	Tallaght University Hospital	~	*	0	0.0%	~	*
	<b>Total</b>	<b>2216</b>	<b>83.6%</b>	<b>436</b>	<b>16.4%</b>	<b>2652</b>	<b>100.0%</b>

- Denotes five cases or fewer

\* Further suppression required to prevent disclosure of five cases or fewer

## APPENDIX 7: FREQUENCY TABLES

**FIGURE 5.5B:** FIRST MEDICAL CONTACT TO DOOR TIME FOR PATIENTS WHO ARRIVED DIRECTLY BY AMBULANCE, BY HOSPITAL AND YEAR (n=2652)

		2017	2018	2019	2020	Total
Beaumont Hospital	N	0	0	~	~	~
	Percentile 25			18	38	20
	Median			20	39	26
	Percentile 75			26	40	38
Cork University Hospital	N	103	98	112	106	419
	Percentile 25	35	29	38	34	33
	Median	48	44	51	51	49
	Percentile 75	77	66	69	71	71
Letterkenny University Hospital	N	27	46	26	21	120
	Percentile 25	45	47	47	58	47
	Median	61	64	62	71	65
	Percentile 75	85	88	72	82	82
Mater Misericordiae University Hospital	N	147	151	168	189	655
	Percentile 25	35	35	30	34	34
	Median	46	49	46	53	48
	Percentile 75	74	72	70	78	75
St James's Hospital	N	190	188	170	204	752
	Percentile 25	38	42	44	43	42
	Median	58	59	60	60	60
	Percentile 75	82	82	83	81	82
St Vincent's University Hospital	N	~	~	0	~	~
	Percentile 25	21	20		31	21
	Median	38	20		31	26
	Percentile 75	55	20		31	43
Tallaght University Hospital	N	~	~	0	~	~
	Percentile 25	12	40		32	27
	Median	20	40		32	32
	Percentile 75	27	40		32	40
University Hospital Limerick	N	106	92	78	88	364
	Percentile 25	35	30	36	43	36
	Median	51	48	63	60	55
	Percentile 75	80	83	82	80	81
University Hospital Galway	N	85	97	77	69	328
	Percentile 25	46	42	51	51	45
	Median	67	69	73	71	70
	Percentile 75	92	94	83	90	90
National	N	662	675	634	681	2652
	Percentile 25	36	37	38	40	38
	Median	55	54	57	59	55
	Percentile 75	81	82	78	80	80

- Denotes five cases or fewer

## APPENDIX 7: FREQUENCY TABLES

**FIGURE 5.6A:** PROPORTION OF PATIENTS WITH AN ST ELEVATION MYOCARDIAL INFARCTION WHO WERE TRANSFERRED, WHO ARRIVED WITHIN THE TARGET TIME OF 90 MINUTES, BY PERCUTANEOUS CORONARY INTERVENTION CENTRE, 2017-2020 (n=1386)

		90 minutes or less		91 minutes or more		Total	
		N	%	N	%	N	%
Cork University Hospital	Bantry General Hospital	0	0.0%	15	100.0%	15	100.0%
	Mercy University Hospital	14	26.9%	38	73.1%	52	100.0%
	South Tipperary General Hospital	~	*	*	*	27	100.0%
	University Hospital Kerry	0	0.0%	7	100.0%	7	100.0%
	University Hospital Waterford	0	0.0%	21	100.0%	21	100.0%
	Wexford General Hospital	0	0.0%	~	*	~	*
	Mallow General Hospital	~	*	*	*	8	100.0%
	South Infirmity Victoria University Hospital	0	0.0%	~	*	~	*
	Other	~	*	~	*	~	*
	<b>Total</b>	<b>19</b>	<b>14.0%</b>	<b>117</b>	<b>86.0%</b>	<b>136</b>	<b>100.0%</b>
Mater Misericordiae University Hospital	Beaumont Hospital	28	39.4%	43	60.6%	71	100.0%
	Cavan General Hospital	~	*	*	*	63	100.0%
	Connolly Hospital	48	38.1%	78	61.9%	126	100.0%
	Our Lady of Lourdes Hospital Drogheda	14	14.3%	84	85.7%	98	100.0%
	Our Lady's Hospital, Navan	6	7.6%	73	92.4%	79	100.0%
	Regional Hospital Mullingar	~	*	0	0.0%	~	*
	St James's Hospital	0	0.0%	~	*	~	*
	St Vincent's University Hospital	0	0.0%	~	*	~	*
	Louth County Hospital	~	*	~	*	~	*
	Other	~	*	~	*	9	100.0%
	<b>Total</b>	<b>106</b>	<b>23.3%</b>	<b>348</b>	<b>76.7%</b>	<b>454</b>	<b>100.0%</b>
St James's Hospital	Midland Regional Hospital Tullamore	~	*	*	*	57	100.0%
	Naas General Hospital	18	22.2%	63	77.8%	81	100.0%
	Regional Hospital Mullingar	~	*	*	*	71	100.0%
	St Columcille's Hospital, Loughlinstown	~	*	~	*	8	100.0%
	St Luke's General Hospital, Carlow/Kilkenny	0	0.0%	27	100.0%	27	100.0%
	St Vincent's University Hospital	43	40.2%	64	59.8%	107	100.0%
	Tallaght University Hospital	36	44.4%	45	55.6%	81	100.0%
	Wexford General Hospital	~	*	*	*	20	100.0%
	Midland Regional Hospital Portlaoise	8	11.9%	59	88.1%	67	100.0%
	St Michael's Hospital, Dun Laoghaire	8	50.0%	8	50.0%	16	100.0%
	Other	~	*	*	*	14	100.0%
	<b>Total</b>	<b>127</b>	<b>23.1%</b>	<b>422</b>	<b>76.9%</b>	<b>549</b>	<b>100.0%</b>

## APPENDIX 7: FREQUENCY TABLES

University Hospital Limerick	Nenagh Hospital	0	0.0%	~	*	~	*
	University Hospital Kerry	13	17.6%	61	82.4%	74	100.0%
	Ennis Hospital	*	*	~	*	11	100.0%
	St John's Hospital	~	*	~	*	~	*
	<b>Total</b>	<b>22</b>	<b>23.7%</b>	<b>71</b>	<b>76.3%</b>	<b>93</b>	<b>100.0%</b>
University Hospital Galway	Letterkenny University Hospital	0	0.0%	3	100.0%	3	100.0%
	Mayo University Hospital	6	8.1%	68	91.9%	74	100.0%
	Midland Regional Hospital Tullamore	~	*	0	0.0%	~	*
	Portiuncula University Hospital	10	27.8%	26	72.2%	36	100.0%
	Sligo University Hospital	~	*	*	*	20	100.0%
	Roscommon University Hospital	~	*	~	*	6	100.0%
	Other	0	0.0%	~	*	~	*
	<b>Total</b>	<b>23</b>	<b>16.2%</b>	<b>119</b>	<b>83.8%</b>	<b>142</b>	<b>100.0%</b>
Beaumont Hospital	Cavan General Hospital	0	0.0%	~	*	~	*
	<b>Total</b>	<b>0</b>	<b>0.0%</b>	~	*	~	*
St Vincent's University Hospital	St Columcille's Hospital, Loughlinstown	~	*	0	0.0%	~	*
	St Michael's Hospital, Dun Laoghaire	~	*	~	*	~	*
	Other	~	*	0	0.0%	~	*
	<b>Total</b>	<b>6</b>	<b>66.7%</b>	~	*	<b>9</b>	<b>100.0%</b>
Tallaght University Hospital	Other	0	0.0%	~	*	~	*
	<b>Total</b>	<b>0</b>	<b>0.0%</b>	~	*	~	*
<b>Total</b>		<b>303</b>	<b>21.9%</b>	<b>1083</b>	<b>78.1%</b>	<b>1386</b>	<b>100.0%</b>

- Denotes five cases or fewer

\* Further suppression required in order to prevent disclosure of five cases or fewer

## APPENDIX 7: FREQUENCY TABLES

**FIGURE 5.6B:** FIRST MEDICAL CONTACT TO DOOR TIME FOR PATIENTS WHO WERE TRANSFERRED, BY HOSPITAL, 2017–2020 (n=1386)

		N	Percentile 25	Median	Percentile 75
Beaumont Hospital	Cavan General Hospital	~	565	565	565
	<b>Total</b>	~	<b>565</b>	<b>565</b>	<b>565</b>
Cork University Hospital	Bantry General Hospital	15	140	185	300
	Mercy University Hospital	52	83	158	381
	South Tipperary General Hospital	27	138	206	543
	University Hospital Kerry	7	271	1401	2431
	University Hospital Waterford	21	195	308	552
	Wexford General Hospital	~	105	105	105
	Mallow General Hospital	8	98	111	213
	South Infirmary Victoria University Hospital	~	105	105	105
	Other	~	39	82	109
<b>Total</b>	<b>136</b>	<b>112</b>	<b>196</b>	<b>381</b>	
Mater Misericordiae University Hospital	Beaumont Hospital	71	70	120	221
	Cavan General Hospital	63	175	237	430
	Connolly Hospital	126	76	109	165
	Our Lady of Lourdes Hospital Drogheda	98	100	156	270
	Our Lady's Hospital, Navan	79	110	141	253
	Regional Hospital Mullingar	~	65	65	65
	St James's Hospital	~	95	95	95
	St Vincent's University Hospital	~	264	264	264
	Louth County Hospital	~	90	110	175
	Other	9	53	90	255
<b>Total</b>	<b>454</b>	<b>95</b>	<b>140</b>	<b>250</b>	
St James's Hospital	Midland Regional Hospital Tullamore	57	115	137	184
	Naas General Hospital	81	95	130	205
	Regional Hospital Mullingar	71	120	155	232
	St Columcille's Hospital, Loughlinstown	8	72	90	113
	St Luke's General Hospital, Carlow/Kilkenny	27	195	225	339
	St Vincent's University Hospital	107	69	110	216
	Tallaght University Hospital	81	72	96	184
	Wexford General Hospital	20	165	249	404
	Midland Regional Hospital Portlaoise	67	110	150	210
	St Michael's Hospital, Dun Laoghaire	16	75	90	131
	Other	14	100	128	170
<b>Total</b>	<b>549</b>	<b>95</b>	<b>130</b>	<b>225</b>	



## APPENDIX 7: FREQUENCY TABLES

University Hospital Limerick	Nenagh Hospital	~	116	137	199
	University Hospital Kerry	74	105	149	288
	Ennis Hospital	11	59	90	95
	St John's Hospital	~	60	150	1112
	<b>Total</b>	<b>93</b>	<b>95</b>	<b>135</b>	<b>241</b>
University Hospital Galway	Letterkenny University Hospital	~	460	583	1314
	Mayo University Hospital	74	107	128	185
	Midland Regional Hospital Tullamore	~	0	0	0
	Portiuncula University Hospital	36	89	124	156
	Sligo University Hospital	20	126	192	335
	Roscommon University Hospital	6	50	99	965
	Other	~	252	741	1229
	<b>Total</b>	<b>142</b>	<b>103</b>	<b>133</b>	<b>208</b>
St Vincent's University Hospital	St Columcille's Hospital, Loughlinstown	~	62	65	76
	St Michael's Hospital, Dun Laoghaire	~	101	128	170
	Other	~	0	0	0
	<b>Total</b>	<b>9</b>	<b>62</b>	<b>76</b>	<b>115</b>
Tallaght University Hospital	Other	~	223	749	1275
	<b>Total</b>	~	<b>223</b>	<b>749</b>	<b>1275</b>
<b>Total</b>		<b>1386</b>	<b>97</b>	<b>138</b>	<b>240</b>

~ Denotes five cases or fewer

## APPENDIX 7: FREQUENCY TABLES

**FIGURE 5.7A:** LOCATION OF AMBULANCE OFF-LOAD AT THE PERCUTANEOUS CORONARY INTERVENTION CENTRE FOR PATIENTS WHO ARRIVED DIRECTLY BY AMBULANCE, BY HOSPITAL AND YEAR (n=3225)

		Ambulance off-load at cath lab directly		Ambulance off-load at ED		Unknown		Total	
		N	%	N	%	N	%	N	%
Cork University Hospital	2017	96	77.4%	28	22.6%	0	0.0%	124	100.0%
	2018	69	59.5%	47	40.5%	0	0.0%	116	100.0%
	2019	88	69.8%	38	30.2%	0	0.0%	126	100.0%
	2020	84	68.3%	39	31.7%	0	0.0%	123	100.0%
	<b>Total</b>	<b>337</b>	<b>68.9%</b>	<b>152</b>	<b>31.1%</b>	<b>0</b>	<b>0.0%</b>	<b>489</b>	<b>100.0%</b>
Letterkenny University Hospital	2017	*	*	~	*	0	0.0%	36	100.0%
	2018	*	*	~	*	0	0.0%	53	100.0%
	2019	*	*	~	*	0	0.0%	29	100.0%
	2020	*	*	~	*	0	0.0%	27	100.0%
	<b>Total</b>	<b>139</b>	<b>95.9%</b>	<b>6</b>	<b>4.1%</b>	<b>0</b>	<b>0.0%</b>	<b>145</b>	<b>100.0%</b>
Mater Misericordiae University Hospital	2017	128	75.7%	41	24.3%	0	0.0%	169	100.0%
	2018	142	79.8%	36	20.2%	0	0.0%	178	100.0%
	2019	144	78.3%	40	21.7%	0	0.0%	184	100.0%
	2020	171	83.8%	33	16.2%	0	0.0%	204	100.0%
	<b>Total</b>	<b>585</b>	<b>79.6%</b>	<b>150</b>	<b>20.4%</b>	<b>0</b>	<b>0.0%</b>	<b>735</b>	<b>100.0%</b>
St James's Hospital	2017	165	70.5%	69	29.5%	0	0.0%	234	100.0%
	2018	164	71.0%	67	29.0%	0	0.0%	231	100.0%
	2019	157	72.7%	59	27.3%	0	0.0%	216	100.0%
	2020	192	82.1%	42	17.9%	0	0.0%	234	100.0%
	<b>Total</b>	<b>678</b>	<b>74.1%</b>	<b>237</b>	<b>25.9%</b>	<b>0</b>	<b>0.0%</b>	<b>915</b>	<b>100.0%</b>
University Hospital Limerick	2017	114	74.5%	39	25.5%	0	0.0%	153	100.0%
	2018	102	82.3%	22	17.7%	0	0.0%	124	100.0%
	2019	72	67.3%	35	32.7%	0	0.0%	107	100.0%
	2020	81	71.7%	32	28.3%	0	0.0%	113	100.0%
	<b>Total</b>	<b>369</b>	<b>74.2%</b>	<b>128</b>	<b>25.8%</b>	<b>0</b>	<b>0.0%</b>	<b>497</b>	<b>100.0%</b>
University Hospital Galway	2017	90	90.9%	9	9.1%	0	0.0%	99	100.0%
	2018	99	83.2%	20	16.8%	0	0.0%	119	100.0%
	2019	71	81.6%	16	18.4%	0	0.0%	87	100.0%
	2020	67	85.9%	11	14.1%	0	0.0%	78	100.0%
	<b>Total</b>	<b>327</b>	<b>85.4%</b>	<b>56</b>	<b>14.6%</b>	<b>0</b>	<b>0.0%</b>	<b>383</b>	<b>100.0%</b>

## APPENDIX 7: FREQUENCY TABLES

Beaumont Hospital	2017	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	2018	0	0.0%	~	*	0	0.0%	~	*
	2019	0	0.0%	10	100.0%	0	0.0%	10	100.0%
	2020	0	0.0%	*	*	0	0.0%	*	*
	<b>Total</b>	<b>0</b>	<b>0.0%</b>	<b>20</b>	<b>100.0%</b>	<b>0</b>	<b>0.0%</b>	<b>20</b>	<b>100.0%</b>
St Vincent's University Hospital	2017	~	*	~	*	0	0.0%	~	*
	2018	~	*	~	*	0	0.0%	~	*
	2019	0	0.0%	~	*	0	0.0%	~	*
	2020	0	0.0%	~	*	0	0.0%	~	*
	<b>Total</b>	<b>~</b>	<b>*</b>	<b>15</b>	<b>88.2%</b>	<b>0</b>	<b>0.0%</b>	<b>17</b>	<b>100.0%</b>
Tallaght University Hospital	2017	0	0.0%	0	0.0%	10	100.0%	10	100.0%
	2018	0	0.0%	0	0.0%	~	*	~	*
	2019	0	0.0%	0	0.0%	~	*	~	*
	2020	~	*	~	*	~	*	6	100.0%
	<b>Total</b>	<b>~</b>	<b>*</b>	<b>~</b>	<b>*</b>	<b>20</b>	<b>83.3%</b>	<b>24</b>	<b>100.0%</b>
Total	2017	628	75.8%	191	23.0%	10	1.2%	829	100.0%
	2018	629	75.4%	*	*	~	*	834	100.0%
	2019	560	73.1%	*	*	~	*	766	100.0%
	2020	621	78.0%	*	*	~	*	796	100.0%
	<b>Total</b>	<b>2438</b>	<b>75.6%</b>	<b>*</b>	<b>*</b>	<b>~</b>	<b>*</b>	<b>3225</b>	<b>100.0%</b>

- Denotes five cases or fewer

\* Further suppression required in order to prevent disclosure of five cases or fewer

## APPENDIX 7: FREQUENCY TABLES

**FIGURE 5.7B:** LOCATION OF AMBULANCE OFF-LOAD AT THE PERCUTANEOUS CORONARY INTERVENTION CENTRE FOR PATIENTS WHO WERE TRANSFERRED, BY HOSPITAL AND YEAR (n=1426)

		Transferred to cath lab		Transferred to ED		Total	
		N	%	N	%	N	%
Cork University Hospital	2017	*	*	~	*	31	100.0%
	2018	35	79.5%	9	20.5%	44	100.0%
	2019	24	70.6%	10	29.4%	34	100.0%
	2020	24	72.7%	9	27.3%	33	100.0%
	<b>Total</b>	<b>110</b>	<b>77.5%</b>	<b>32</b>	<b>22.5%</b>	<b>142</b>	<b>100.0%</b>
Mater Misericordiae University Hospital	2017	*	*	~	*	120	100.0%
	2018	*	*	~	*	124	100.0%
	2019	*	*	~	*	112	100.0%
	2020	*	*	~	*	113	100.0%
	<b>Total</b>	<b>452</b>	<b>96.4%</b>	<b>17</b>	<b>3.6%</b>	<b>469</b>	<b>100.0%</b>
St James's Hospital	2017	*	*	~	*	141	100.0%
	2018	*	*	~	*	160	100.0%
	2019	*	*	~	*	149	100.0%
	2020	112	100.0%	0	0.0%	112	100.0%
	<b>Total</b>	<b>556</b>	<b>98.9%</b>	<b>*</b>	<b>*</b>	<b>562</b>	<b>100.0%</b>
University Hospital Limerick	2017	*	*	~	*	27	100.0%
	2018	*	*	~	*	17	100.0%
	2019	*	*	~	*	33	100.0%
	2020	*	*	~	*	17	100.0%
	<b>Total</b>	<b>85</b>	<b>90.4%</b>	<b>9</b>	<b>9.6%</b>	<b>94</b>	<b>100.0%</b>
University Hospital Galway	2017	38	80.9%	9	19.1%	47	100.0%
	2018	37	72.5%	14	27.5%	51	100.0%
	2019	*	*	~	*	29	100.0%
	2020	*	*	~	*	17	100.0%
	<b>Total</b>	<b>111</b>	<b>77.1%</b>	<b>33</b>	<b>22.9%</b>	<b>144</b>	<b>100.0%</b>
Beaumont Hospital	2017	0	0.0%	0	0.0%	0	0.0%
	2018	~	*	0	0.0%	~	*
	2019	0	0.0%	0	0.0%	0	0.0%
	2020	0	0.0%	0	0.0%	0	0.0%
	<b>Total</b>	<b>~</b>	<b>*</b>	<b>0</b>	<b>0.0%</b>	<b>~</b>	<b>*</b>

## APPENDIX 7: FREQUENCY TABLES

St Vincent's University Hospital	2017	0	0.0%	~	*	~	*
	2018	~	*	~	*	~	*
	2019	~	*	0	0.0%	~	*
	2020	~	*	0	0.0%	~	*
	<b>Total</b>	<b>7</b>	<b>70.0%</b>	<b>3</b>	<b>30.0%</b>	<b>10</b>	<b>100.0%</b>
Tallaght University Hospital	2017	~	*	~	*	~	*
	2018	0	0.0%	0	0.0%	0	0.0%
	2019	~	*	0	0.0%	~	*
	2020	0	0.0%	0	0.0%	0	0.0%
	<b>Total</b>	~	*	~	*	~	*
Total	2017	346	93.5%	24	6.5%	370	100.0%
	2018	367	91.5%	34	8.5%	401	100.0%
	2019	337	93.4%	24	6.6%	361	100.0%
	2020	275	93.5%	19	6.5%	294	100.0%
	<b>Total</b>	<b>1325</b>	<b>92.9%</b>	<b>101</b>	<b>7.1%</b>	<b>1426</b>	<b>100.0%</b>

- Denotes five cases or fewer

\* Further suppression required in order to prevent disclosure of five cases or fewer

## APPENDIX 7: FREQUENCY TABLES

**FIGURE 5.8:** CLINICAL STATUS ON ARRIVAL AT A PERCUTANEOUS CORONARY INTERVENTION CENTRE FOR PATIENTS BROUGHT FOR PRIMARY PERCUTANEOUS CORONARY INTERVENTION, BY MODE OF ARRIVAL AND YEAR (n=4651)

Direct via ambulance												
	Stable		Cardiogenic shock		Resuscitated arrest		Cardiac arrest and died		Other/unknown		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
2017	722	87.1%	30	3.6%	68	8.2%	0	0.0%	9	1.1%	829	100.0%
2018	726	87.1%	28	3.4%	68	8.2%	0	0.0%	12	1.4%	834	100.0%
2019	643	83.9%	35	4.6%	75	9.8%	0	0.0%	13	1.7%	766	100.0%
2020	684	85.9%	27	3.4%	70	8.8%	~	*	*	*	796	100.0%
<b>Total</b>	<b>2775</b>	<b>86.0%</b>	<b>120</b>	<b>3.7%</b>	<b>281</b>	<b>8.7%</b>	~	*	*	*	<b>3225</b>	<b>100.0%</b>
Transfer from other hospital												
	Stable		Cardiogenic shock		Resuscitated arrest		Cardiac arrest and died		Other/unknown		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
2017	326	88.1%	*	*	31	8.4%	0	0.0%	~	*	370	100.0%
2018	364	90.8%	11	2.7%	18	4.5%	0	0.0%	8	2.0%	401	100.0%
2019	321	88.9%	*	*	26	7.2%	0	0.0%	~	*	361	100.0%
2020	261	88.8%	*	*	21	7.1%	0	0.0%	~	*	294	100.0%
<b>Total</b>	<b>1272</b>	<b>89.2%</b>	<b>37</b>	<b>2.6%</b>	<b>96</b>	<b>6.7%</b>	<b>0</b>	<b>0.0%</b>	<b>21</b>	<b>1.5%</b>	<b>1426</b>	<b>100.0%</b>
Total												
	Stable		Cardiogenic shock		Resuscitated arrest		Cardiac arrest and died		Other/unknown		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
2017	1048	87.4%	39	3.3%	99	8.3%	0	0.0%	13	1.1%	1199	100.0%
2018	1090	88.3%	39	3.2%	86	7.0%	0	0.0%	20	1.6%	1235	100.0%
2019	964	85.5%	45	4.0%	101	9.0%	0	0.0%	17	1.5%	1127	100.0%
2020	945	86.7%	34	3.1%	91	8.3%	~	*	*	*	1090	100.0%
<b>Total</b>	<b>4047</b>	<b>87.0%</b>	<b>157</b>	<b>3.4%</b>	<b>377</b>	<b>8.1%</b>	~	*	*	*	<b>4651</b>	<b>100.0%</b>

~ Denotes five cases or fewer

\* Further suppression required in order to prevent disclosure of five cases or fewer

## APPENDIX 7: FREQUENCY TABLES

**FIGURE 6.1:** REPERFUSION THERAPY TYPE, BY REFERRAL SOURCE AND YEAR (n=5486)

		Directly admitted to a PCI centre		Transferred to a PCI centre		Total	
		N	%	N	%	N	%
2017	Thrombolysis	~	*	*	*	39	2.8%
	Primary PCI	894	91.0%	306	74.6%	1200	86.2%
	No reperfusion required	17	1.7%	*	*	29	2.1%
	Contraindicated	60	6.1%	51	12.4%	111	8.0%
	Unknown	*	*	~	*	13	0.9%
	<b>Total</b>	<b>982</b>	<b>100.0%</b>	<b>410</b>	<b>100.0%</b>	<b>1392</b>	<b>100.0%</b>
2018	Thrombolysis	~	*	*	*	41	2.8%
	Primary PCI	900	87.4%	331	75.6%	1231	83.9%
	No reperfusion required	26	2.5%	14	3.2%	40	2.7%
	Contraindicated	99	9.6%	55	12.6%	154	10.5%
	Unknown	~	*	~	*	~	*
	<b>Total</b>	<b>1030</b>	<b>100.0%</b>	<b>438</b>	<b>100.0%</b>	<b>1468</b>	<b>100.0%</b>
2019	Thrombolysis	~	*	*	*	50	3.7%
	Primary PCI	839	88.3%	285	69.5%	1124	82.6%
	No reperfusion required	*	*	24	5.9%	57	4.2%
	Contraindicated	77	8.1%	46	11.2%	123	9.0%
	Unknown	0	0.0%	6	1.5%	6	0.4%
	<b>Total</b>	<b>950</b>	<b>100.0%</b>	<b>410</b>	<b>100.0%</b>	<b>1360</b>	<b>100.0%</b>
2020	Thrombolysis	*	*	41	12.2%	*	*
	Primary PCI	818	87.9%	246	73.4%	1064	84.0%
	No reperfusion required	42	4.5%	18	5.4%	60	4.7%
	Contraindicated	62	6.7%	*	*	91	7.2%
	Unknown	~	*	~	*	~	*
	<b>Total</b>	<b>931</b>	<b>100.0%</b>	<b>335</b>	<b>100.0%</b>	<b>1266</b>	<b>100.0%</b>
Total	Thrombolysis	14	0.4%	163	10.2%	177	3.2%
	Primary PCI	3451	88.6%	1168	73.3%	4619	84.2%
	No reperfusion required	118	3.0%	68	4.3%	186	3.4%
	Contraindicated	298	7.7%	181	11.4%	479	8.7%
	Unknown	12	0.3%	13	0.8%	25	0.5%
	<b>Total</b>	<b>3893</b>	<b>100.0%</b>	<b>1593</b>	<b>100.0%</b>	<b>5486</b>	<b>100.0%</b>

~ Denotes five cases or fewer

\* Further suppression required in order to prevent disclosure of five cases or fewer

## APPENDIX 7: FREQUENCY TABLES

**FIGURE 6.2: REASONS FOR CONTRAINDICATION TO REPERFUSION THERAPY, BY YEAR (n=516)**

	2017		2018		2019		2020		Total	
	N	%	N	%	N	%	N	%	N	%
Presented too late	105	83.3%	138	85.2%	105	78.9%	74	77.9%	422	81.8%
Recent surgery	0	0.0%	~	*	~	*	0	0.0%	~	*
History of bleeding	~	*	~	*	~	*	0	0.0%	6	1.2%
Recent cerebrovascular accident	~	*	~	*	~	*	~	*	12	2%
Drug contraindication	0	0.0%	~	*	~	0.0%	0	0.0%	~	*
Other	17	13.5%	17	10.5%	18	13.5%	19	20.0%	71	13.8%
<b>Total</b>	<b>126</b>	<b>100.0%</b>	<b>162</b>	<b>100.0%</b>	<b>133</b>	<b>100.0%</b>	<b>95</b>	<b>100.0%</b>	<b>516</b>	<b>100.0%</b>

- Denotes five cases or fewer

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**FIGURE 6.3: TYPE OF ARTERIAL ACCESS, BY HOSPITAL AND YEAR (n=4743)**

		2017		2018		2019		2020		Total	
		N	%	N	%	N	%	N	%	N	%
Beaumont Hospital	Radial access	0	0.0%	~	*	*	*	*	*	24	92.3%
	Femoral access	0	0.0%	~	*	~	*	0	0.0%	~	*
	<b>Total</b>	<b>0</b>	<b>0.0%</b>	<b>6</b>	<b>100.0%</b>	<b>13</b>	<b>100.0%</b>	*	*	<b>26</b>	<b>100.0%</b>
Cork University Hospital	Radial access	93	58.9%	88	62.9%	105	70.5%	103	76.3%	389	66.8%
	Femoral access	65	41.1%	52	37.1%	44	29.5%	32	23.7%	193	33.2%
	<b>Total</b>	<b>158</b>	<b>100.0%</b>	<b>140</b>	<b>100.0%</b>	<b>149</b>	<b>100.0%</b>	<b>135</b>	<b>100.0%</b>	<b>582</b>	<b>100.0%</b>
Letterkenny University Hospital	Radial access	45	100.0%	60	100.0%	43	100.0%	45	100.0%	193	100.0%
	<b>Total</b>	<b>45</b>	<b>100.0%</b>	<b>60</b>	<b>100.0%</b>	<b>43</b>	<b>100.0%</b>	<b>45</b>	<b>100.0%</b>	<b>193</b>	<b>100.0%</b>
Mater Misericordiae University Hospital	Radial access	236	88.7%	257	88.3%	229	85.4%	262	86.5%	984	87.2%
	Femoral access	30	11.3%	34	11.7%	39	14.6%	41	13.5%	144	12.8%
	<b>Total</b>	<b>266</b>	<b>100.0%</b>	<b>291</b>	<b>100.0%</b>	<b>268</b>	<b>100.0%</b>	<b>303</b>	<b>100.0%</b>	<b>1128</b>	<b>100.0%</b>
St James's Hospital	Radial access	359	92.3%	385	97.0%	367	98.1%	*	*	1461	96.4%
	Femoral access	20	5.1%	*	*	7	1.9%	~	*	43	2.8%
	Unknown	10	2.6%	~	*	0	0.0%	0	0.0%	11	0.7%
	<b>Total</b>	<b>389</b>	<b>100.0%</b>	<b>397</b>	<b>100.0%</b>	<b>374</b>	<b>100.0%</b>	*	*	<b>1515</b>	<b>100.0%</b>



## APPENDIX 7: FREQUENCY TABLES

St Vincent's University Hospital	Radial access	*	*	*	*	10	100.0%	13	100.0%	*	*
	Femoral access	~	*	~	*	0	0.0%	0	0.0%	~	*
	<b>Total</b>	<b>15</b>	<b>100.0%</b>	<b>14</b>	<b>100.0%</b>	<b>10</b>	<b>100.0%</b>	<b>13</b>	<b>100.0%</b>	<b>52</b>	<b>100.0%</b>
Tallaght University Hospital	Radial access	12	100.0%	*	*	~	*	7	100.0%	37	94.9%
	Femoral access	0	0.0%	~	*	~	*	0	0.0%	~	*
	<b>Total</b>	<b>12</b>	<b>100.0%</b>	<b>14</b>	<b>100.0%</b>	<b>6</b>	<b>100.0%</b>	<b>7</b>	<b>100.0%</b>	<b>39</b>	<b>100.0%</b>
University Hospital Limerick	Radial access	195	99.5%	166	98.2%	164	95.9%	142	99.3%	667	98.2%
	Femoral access	~	*	~	*	~	*	~	*	10	1.5%
	Unknown	0	0.0%	0	0.0%	~	*	0	0.0%	~	*
	<b>Total</b>	<b>196</b>	<b>100.0%</b>	<b>169</b>	<b>100.0%</b>	<b>171</b>	<b>100.0%</b>	<b>143</b>	<b>100.0%</b>	<b>679</b>	<b>100.0%</b>
University Hospital Galway	Radial access	146	96.7%	158	*	*	96.0%	*	*	508	96.0%
	Femoral access	~	*	8	4.8%	~	*	~	*	*	*
	Unknown	~	*	0	0.0%	0	0.0%	0	0.0%	~	*
	<b>Total</b>	<b>151</b>	<b>100.0%</b>	<b>166</b>	<b>100.0%</b>	<b>126</b>	<b>100.0%</b>	<b>86</b>	<b>100.0%</b>	<b>529</b>	<b>100.0%</b>
Total	Radial access	1099	89.2%	1145	91.1%	1056	91.0%	1012	92.5%	4312	90.9%
	Femoral access	122	9.9%	*	*	*	*	82	7.5%	417	8.8%
	Unknown	11	0.9%	~	*	~	*	0	0.0%	14	0.3%
	<b>Total</b>	<b>1232</b>	<b>100.0%</b>	<b>1257</b>	<b>100.0%</b>	<b>1160</b>	<b>100.0%</b>	<b>1094</b>	<b>100.0%</b>	<b>4743</b>	<b>100.0%</b>

- Denotes five cases or fewer

\* Further suppression required in order to prevent disclosure of five cases or fewer

**FIGURE 6.6:** PROPORTION OF PATIENTS WHO RECEIVED TIMELY PRIMARY PERCUTANEOUS CORONARY INTERVENTION AND THROMBOLYSIS REPERFUSION, BY YEAR (n=4285)

	Not timely		Timely		Total	
	N	%	N	%	N	%
2017	351	32.1%	742	67.9%	1093	100.0%
2018	391	34.5%	741	65.5%	1132	100.0%
2019	346	32.9%	707	67.1%	1053	100.0%
2020	315	31.3%	692	68.7%	1007	100.0%
<b>Total</b>	<b>1403</b>	<b>32.7%</b>	<b>2882</b>	<b>67.3%</b>	<b>4285</b>	<b>100.0%</b>

## APPENDIX 7: FREQUENCY TABLES

**FIGURE 6.6A:** PROPORTION OF PATIENTS WHO RECEIVED TIMELY PRIMARY PERCUTANEOUS CORONARY INTERVENTION REPERFUSION, BY REFERRAL SOURCE AND YEAR (n=4111)

		2017		2018		2019		2020		Total	
		N	%	N	%	N	%	N	%	N	%
Directly admitted to a PCI centre	Not timely	118	15.5%	134	17.4%	110	14.9%	125	17.2%	487	16.3%
	Timely/within 120 minutes	643	84.5%	638	82.6%	627	85.1%	601	82.8%	2509	83.7%
	<b>Total</b>	<b>761</b>	<b>100.0%</b>	<b>772</b>	<b>100.0%</b>	<b>737</b>	<b>100.0%</b>	<b>726</b>	<b>100.0%</b>	<b>2996</b>	<b>100.0%</b>
Transferred to a PCI centre	Not timely	212	72.1%	233	73.0%	203	75.7%	162	69.2%	810	72.6%
	Timely/within 120 minutes	82	27.9%	86	27.0%	65	24.3%	72	30.8%	305	27.7%
	<b>Total</b>	<b>294</b>	<b>100.0%</b>	<b>319</b>	<b>100.0%</b>	<b>268</b>	<b>100.0%</b>	<b>234</b>	<b>100.0%</b>	<b>1115</b>	<b>100.0%</b>
Total	Not timely	330	31.3%	367	33.6%	175	19.2%	287	29.9%	1297	31.5%
	Timely/within 120 minutes	725	68.7%	724	66.4%	895	98.1%	673	70.1%	2814	68.5%
	<b>Total</b>	<b>1055</b>	<b>100.0%</b>	<b>1091</b>	<b>100.0%</b>	<b>912</b>	<b>100.0%</b>	<b>960</b>	<b>100.0%</b>	<b>4111</b>	<b>100.0%</b>

**FIGURE 6.6B:** PROPORTION OF PATIENTS WHO RECEIVED TIMELY THROMBOLYSIS REPERFUSION, BY YEAR (n=174)

	Timely thrombolysis		Not timely thrombolysis		Total	
	N	%	N	%	N	%
2017	17	44.7%	21	55.3%	38	100.0%
2018	17	41.5%	24	58.5%	41	100.0%
2019	15	31.3%	33	68.8%	48	100.0%
2020	19	40.4%	28	59.6%	47	100.0%
<b>Total</b>	<b>68</b>	<b>39.1%</b>	<b>106</b>	<b>60.9%</b>	<b>174</b>	<b>100.0%</b>

## APPENDIX 7: FREQUENCY TABLES

**FIGURE 6.8A:** DOOR TO BALLOON TIME FOR PATIENTS DIRECTLY ADMITTED TO A PERCUTANEOUS CORONARY INTERVENTION CENTRE, BY HOSPITAL AND YEAR (n=3343)

		2017	2018	2019	2020	Total
Cork University Hospital	N	130	114	134	118	496
	Percentile 25	19	26	22	23	22
	Median	29	36	33	37	33
	Percentile 75	52	57	72	63	63
Letterkenny University Hospital	N	41	52	30	28	151
	Percentile 25	15	14	11	18	14
	Median	21	18	19	26	21
	Percentile 75	35	29	32	45	34
Mater Misericordiae University Hospital	N	173	191	186	198	748
	Percentile 25	15	16	17	16	16
	Median	24	27	25	25	25
	Percentile 75	45	49	46	42	45
St James's Hospital	N	229	219	207	228	883
	Percentile 25	19	19	20	18	19
	Median	25	25	25	25	25
	Percentile 75	35	35	35	35	35
University Hospital Galway	N	111	127	102	75	415
	Percentile 25	23	25	29	15	23
	Median	37	35	40	23	35
	Percentile 75	59	59	64	41	59
University Hospital Limerick	N	165	143	123	125	556
	Percentile 25	22	15	17	17	19
	Median	46	25	30	30	31
	Percentile 75	99	64	81	62	75
Beaumont Hospital	N	0	-	13	7	24
	Percentile 25		94	59	51	57
	Median		142	67	90	78
	Percentile 75		339	90	147	127
St Vincent's University Hospital	N	7	*	*	10	35
	Percentile 25	34	43	67	89	60
	Median	162	70	94	138	93
	Percentile 75	354	112	193	180	180
Tallaght University Hospital	N	10	13	-	7	35
	Percentile 25	74	84	75	27	64
	Median	90	89	90	60	87
	Percentile 75	105	108	91	82	105
National	N	866	873	808	796	3343
	Percentile 25	20	19	20	18	19
	Median	29	30	30	27	29
	Percentile 75	52	49	52	45	50

- Denotes five cases or fewer

\* Further suppression required in order to prevent disclosure of five cases or fewer

## APPENDIX 7: FREQUENCY TABLES

**FIGURE 6.8B:** DOOR TO BALLOON TIME BY HOSPITAL AND YEAR (n=1162)

		2017	2018	2019	2020	Total
Cork University Hospital	N	20	23	13	17	73
	Percentile 25	14	22	22	13	19
	Median	25	30	29	21	25
	Percentile 75	36	46	33	31	34
Mater Misericordiae University Hospital	N	90	99	81	97	367
	Percentile 25	16	14	14	15	15
	Median	21	21	20	21	21
	Percentile 75	32	29	30	26	30
St James's Hospital	N	132	154	137	108	531
	Percentile 25	19	17	20	19	19
	Median	26	24	25	25	25
	Percentile 75	36	33	35	34	35
University Hospital Galway	N	36	38	24	11	109
	Percentile 25	22	24	23	18	21
	Median	25	31	29	21	29
	Percentile 75	45	58	43	62	48
University Hospital Limerick	N	24	12	26	10	72
	Percentile 25	15	14	17	15	15
	Median	19	23	30	21	20
	Percentile 75	30	95	77	30	41
Beaumont Hospital	N	0	~	0	0	~
	Percentile 25		10			10
	Median		10			10
	Percentile 75		10			10
St Vincent's University Hospital	N	~	~	~	~	7
	Percentile 25	77	10	20	10	10
	Median	77	37	20	35	37
	Percentile 75	77	208	20	60	77
Tallaght University Hospital	N	~	0	~	0	~
	Percentile 25	17		50		17
	Median	17		50		34
	Percentile 75	17		50		50
Total	N	304	330	283	245	1162
	Percentile 25	18	16	18	17	17
	Median	25	24	25	22	24
	Percentile 75	35	34	35	31	34

~ Denotes five cases or fewer

## APPENDIX 7: FREQUENCY TABLES

**FIGURE 6.9A:** PROPORTION OF TIMELY PRIMARY PERCUTANEOUS CORONARY INTERVENTION FOR PATIENTS ADMITTED DIRECTLY TO A PERCUTANEOUS CORONARY INTERVENTION CENTRE, BY HOSPITAL AND YEAR (n=2996)

		Not timely		Timely (within 120 minutes)		Total	
		N	%	N	%	N	%
Cork University Hospital	2017	14	12.2%	101	87.8%	115	100.0%
	2018	18	17.5%	85	82.5%	103	100.0%
	2019	14	11.3%	110	88.7%	124	100.0%
	2020	22	20.2%	87	79.8%	109	100.0%
	<b>Total</b>	<b>68</b>	<b>15.1%</b>	<b>383</b>	<b>84.9%</b>	<b>451</b>	<b>100.0%</b>
Letterkenny University Hospital	2017	~	*	*	*	32	100.0%
	2018	6	13.0%	*	*	46	100.0%
	2019	~	*	23	85.2%	27	100.0%
	2020	~	*	17	77.3%	22	100.0%
	<b>Total</b>	<b>19</b>	<b>15.0%</b>	<b>108</b>	<b>85.0%</b>	<b>127</b>	<b>100.0%</b>
Mater Misericordiae University Hospital	2017	20	12.7%	138	87.3%	158	100.0%
	2018	25	14.5%	148	85.5%	173	100.0%
	2019	23	13.1%	152	86.9%	175	100.0%
	2020	29	15.8%	154	84.2%	183	100.0%
	<b>Total</b>	<b>97</b>	<b>14.1%</b>	<b>592</b>	<b>85.9%</b>	<b>689</b>	<b>100.0%</b>
St James's Hospital	2017	37	17.7%	172	82.3%	209	100.0%
	2018	41	20.6%	158	79.4%	199	100.0%
	2019	40	20.6%	154	79.4%	194	100.0%
	2020	42	19.4%	175	80.6%	217	100.0%
	<b>Total</b>	<b>160</b>	<b>19.5%</b>	<b>659</b>	<b>80.5%</b>	<b>819</b>	<b>100.0%</b>
University Hospital Galway	2017	25	24.5%	77	75.5%	102	100.0%
	2018	31	28.2%	79	71.8%	110	100.0%
	2019	21	21.9%	75	78.1%	96	100.0%
	2020	16	23.2%	53	76.8%	69	100.0%
	<b>Total</b>	<b>93</b>	<b>24.7%</b>	<b>284</b>	<b>75.3%</b>	<b>377</b>	<b>100.0%</b>
University Hospital Limerick	2017	16	11.8%	120	88.2%	136	100.0%
	2018	8	6.7%	112	93.3%	120	100.0%
	2019	8	7.8%	95	92.2%	103	100.0%
	2020	7	6.3%	104	93.7%	111	100.0%
	<b>Total</b>	<b>39</b>	<b>8.3%</b>	<b>431</b>	<b>91.7%</b>	<b>470</b>	<b>100.0%</b>
Beaumont Hospital	2018	~	*	0	0.0%	~	100.0%
	2019	0	0.0%	*	*	10	100.0%
	2020	~	*	~	*	*	100.0%
	<b>Total</b>	<b>6</b>	<b>31.6%</b>	<b>13</b>	<b>68.4%</b>	<b>19</b>	<b>100.0%</b>

## APPENDIX 7: FREQUENCY TABLES

St Vincent's University Hospital	2017	~	*	~	*	~	100.0%
	2018	~	*	*	*	7	100.0%
	2019	0	0.0%	~	*	~	100.0%
	2020	~	*	6	85.7%	7	100.0%
	<b>Total</b>	~	*	<b>21</b>	<b>87.5%</b>	<b>24</b>	<b>100.0%</b>
Tallaght University Hospital	2017	~	*	~	*	~	100.0%
	2018	~	*	10	90.9%	11	100.0%
	2019	0	0.0%	~	*	~	100.0%
	2020	0	0.0%	~	*	~	100.0%
	<b>Total</b>	~	*	<b>18</b>	<b>90.0%</b>	<b>20</b>	<b>100.0%</b>
Total	2017	118	15.5%	643	84.5%	761	100.0%
	2018	134	17.4%	638	82.6%	772	100.0%
	2019	110	14.9%	627	85.1%	737	100.0%
	2020	125	17.2%	601	82.8%	726	100.0%
	<b>Total</b>	<b>487</b>	<b>16.3%</b>	<b>2509</b>	<b>83.7%</b>	<b>2996</b>	100.0%

~ Denotes five cases or fewer

\* Further suppression required to prevent disclosure of five cases or fewer

## APPENDIX 7: FREQUENCY TABLES

**FIGURE 6.9B: FIRST MEDICAL CONTACT TO BALLOON TIME, BY HOSPITAL AND YEAR (n=2996)**

		2017	2018	2019	2020	Total
Cork University Hospital	N	115	103	124	109	451
	Percentile 25	63	62	65	66	64
	Median	80	80	78	92	81
	Percentile 75	101	110	102	112	105
Letterkenny University Hospital	N	32	46	27	22	127
	Percentile 25	73	71	69	82	74
	Median	92	92	79	104	91
	Percentile 75	112	115	95	120	110
Mater Misericordiae University Hospital	N	158	173	175	183	689
	Percentile 25	58	58	57	60	58
	Median	76	77	78	81	78
	Percentile 75	104	101	101	107	104
St James's Hospital	N	209	199	194	217	819
	Percentile 25	63	67	67	67	65
	Median	83	87	86	86	86
	Percentile 75	110	115	115	109	112
University Hospital Galway	N	102	110	96	69	377
	Percentile 25	64	79	75	69	72
	Median	97	105	100	96	99
	Percentile 75	120	125	119	118	120
University Hospital Limerick	N	136	120	103	111	470
	Percentile 25	73	51	59	66	61
	Median	90	71	76	82	81
	Percentile 75	115	100	103	105	106
Beaumont Hospital	N	0	~	10	*	19
	Percentile 25		134	44	89	50
	Median		149	54	110	85
	Percentile 75		519	75	140	134
St Vincent's University Hospital	N	~	*	~	7	24
	Percentile 25	56	43	60	60	52
	Median	98	72	70	70	71
	Percentile 75	102	93	75	80	96
Tallaght University Hospital	N	~	11	~	~	20
	Percentile 25	66	43	45	59	50
	Median	95	59	58	60	60
	Percentile 75	123	75	61	60	75
Total	N	761	772	737	726	2996
	Percentile 25	63	62	63	66	64
	Median	84	83	82	85	84
	Percentile 75	111	112	109	110	110

- Denotes five cases or fewer

\* Further suppression required in order to prevent disclosure of five cases or fewer

## APPENDIX 7: FREQUENCY TABLES

**FIGURE 6.10A:** PROPORTION OF TIMELY PRIMARY PERCUTANEOUS CORONARY INTERVENTION FOR PATIENTS WHO WERE TRANSFERRED TO A PERCUTANEOUS CORONARY INTERVENTION CENTRE, BY HOSPITAL AND YEAR (n=1115)

		Timely (within 120 minutes)		Not timely		Total	
		N	%	N	%	N	%
Cork University Hospital	Bantry General Hospital	0	0.0%	8	100.0%	8	100.0%
	Mercy University Hospital	*	*	*	*	35	100.0%
	South Tipperary General Hospital	0	0.0%	13	100.0%	13	100.0%
	University Hospital Waterford	0	0.0%	~	*	~	*
	Wexford General Hospital	0	0.0%	~	*	~	*
	Mallow General Hospital	0	0.0%	~	*	~	*
	South Infirmary Victoria University Hospital	0	0.0%	~	*	~	*
	Other	~	*	~	*	~	*
	<b>Total</b>	<b>15</b>	<b>21.1%</b>	<b>56</b>	<b>78.9%</b>	<b>71</b>	<b>100.0%</b>
Mater Misericordiae University Hospital	Beaumont Hospital	27	50.9%	26	49.1%	53	100.0%
	Cavan General Hospital	~	*	*	*	41	100.0%
	Connolly Hospital	51	48.6%	54	51.4%	105	100.0%
	Our Lady of Lourdes Hospital Drogheda	20	27.4%	53	72.6%	73	100.0%
	Our Lady's Hospital, Navan	7	11.3%	55	88.7%	62	100.0%
	Regional Hospital Mullingar	0	0.0%	~	*	~	*
	St James's Hospital	~	*	0	0.0%	~	*
	St Vincent's University Hospital	0	0.0%	~	*	~	*
	Louth County Hospital	~	*	~	*	~	*
	Other	~	*	~	*	7	100.0%
<b>Total</b>	<b>113</b>	<b>32.6%</b>	<b>234</b>	<b>67.4%</b>	<b>347</b>	<b>100.0%</b>	
St James's Hospital	Midland Regional Hospital Tullamore	~	*	50	90.9%	55	100.0%
	Naas General Hospital	19	24.4%	59	75.6%	78	100.0%
	Regional Hospital Mullingar	~	*	60	95.2%	63	100.0%
	St Columcille's Hospital, Loughlinstown	*	*	~	*	8	100.0%
	St Luke's General Hospital, Carlow/Kilkenny	0	0.0%	26	100.0%	26	100.0%
	St Vincent's University Hospital	40	39.6%	61	60.4%	101	100.0%
	Tallaght University Hospital	40	53.3%	35	46.7%	75	100.0%
	Wexford General Hospital	~	*	16	94.1%	17	100.0%
	Midland Regional Hospital Portlaoise	10	16.1%	52	83.9%	62	100.0%
	St Michael's Hospital, Dun Laoghaire	7	46.7%	8	53.3%	15	100.0%
	Other	~	*	*	*	14	100.0%
<b>Total</b>	<b>134</b>	<b>26.1%</b>	<b>380</b>	<b>73.9%</b>	<b>514</b>	<b>100.0%</b>	



## APPENDIX 7: FREQUENCY TABLES

University Hospital Limerick	Nenagh Hospital	0	0.0%	~	*	~	*
	University Hospital Kerry	11	20.8%	42	79.2%	53	100.0%
	Ennis Hospital	*	*	~	*	9	100.0%
	St John's Hospital	0	0.0%	~	*	~	*
	<b>Total</b>	<b>18</b>	<b>26.9%</b>	<b>49</b>	<b>73.1%</b>	<b>67</b>	<b>100.0%</b>
Beaumont Hospital	Cavan General Hospital	0	0.0%	~	*	~	*
	<b>Total</b>	<b>0</b>	<b>0.0%</b>	~	*	~	*
St Vincent's University Hospital	St Columcille's Hospital, Loughlinstown	~	*	~	*	~	*
	St Michael's Hospital, Dun Laoghaire	~	*	0	0.0%	~	*
	Other	~	*	~	*	~	*
	<b>Total</b>	~	*	~	*	<b>6</b>	<b>100.0%</b>
Tallaght University Hospital	Other	0	0.0%	~	*	~	*
	<b>Total</b>	<b>0</b>	<b>0.0%</b>	~	*	~	*
University Hospital Galway	Mayo University Hospital	~	*	54	91.5%	59	100.0%
	Midland Regional Hospital Tullamore	~	*	~	*	~	*
	Portiuncula University Hospital	9	29.0%	22	71.0%	31	100.0%
	Sligo University Hospital	~	*	9	75.0%	12	100.0%
	Roscommon University Hospital	~	*	~	*	~	*
	<b>Total</b>	<b>21</b>	<b>19.4%</b>	<b>87</b>	<b>80.6%</b>	<b>108</b>	<b>100.0%</b>

- Denotes five cases or fewer

\* Further suppression required in order to prevent disclosure of five cases or fewer

## APPENDIX 7: FREQUENCY TABLES

**FIGURE 6.10B:** FIRST MEDICAL CONTACT TO BALLOON TIME, BY HOSPITAL AND YEAR (n=1115)

		2017	2018	2019	2020	Total
Cork University Hospital	N	18	23	13	17	71
	Percentile 25	108	126	133	136	126
	Median	155	157	179	179	171
	Percentile 75	327	210	268	368	268
Mater Misericordiae University Hospital	N	86	93	77	91	347
	Percentile 25	105	111	113	110	110
	Median	141	150	159	141	148
	Percentile 75	200	222	234	235	222
St James's Hospital	N	129	151	131	103	514
	Percentile 25	120	117	125	118	120
	Median	165	164	160	149	160
	Percentile 75	235	254	247	255	245
University Hospital Galway	N	35	38	24	11	108
	Percentile 25	132	121	133	99	127
	Median	156	157	156	152	155
	Percentile 75	201	277	253	173	243
University Hospital Limerick	N	24	11	22	10	67
	Percentile 25	127	92	122	101	120
	Median	142	135	173	134	143
	Percentile 75	196	240	296	141	225
Beaumont Hospital	N	0	-	0	0	-
	Percentile 25		575			575
	Median		575			575
	Percentile 75		575			575
St Vincent's University Hospital	N	~	~	~	~	6
	Percentile 25	77	113	82	96	82
	Median	77	161	82	111	105
	Percentile 75	77	208	82	125	125
Tallaght University Hospital	N	~	0	0	0	~
	Percentile 25	240				240
	Median	240				240
	Percentile 75	240				240
Total	N	294	319	268	234	1115
	Percentile 25	117	118	123	115	118
	Median	155	157	160	148	155
	Percentile 75	223	244	244	236	238

- Denotes five cases or fewer

## APPENDIX 7: FREQUENCY TABLES

**FIGURE 7.1: MORTALITY BY AGE GROUP AND TIMELINESS OF REPERFUSION THERAPY, 2017–2020 (n=4475)**

		Alive		Died		Total	
		N	%	N	%	N	%
≤64	Not timely reperfusion	728	96.0%	30	4.0%	758	100.0%
	Timely reperfusion	1686	98.4%	*	*	1713	100.0%
	No reperfusion	*	*	~	*	89	100.0%
	<b>Total</b>	<b>2498</b>	<b>97.6%</b>	<b>62</b>	<b>2.4%</b>	<b>2560</b>	<b>100.0%</b>
65–74	Not timely reperfusion	*	*	18	5.1%	355	100.0%
	Timely reperfusion	677	96.4%	25	3.6%	702	100.0%
	No reperfusion	*	*	~	*	50	100.0%
	<b>Total</b>	<b>1062</b>	<b>95.9%</b>	<b>45</b>	<b>4.1%</b>	<b>1107</b>	<b>100.0%</b>
≥75	Not timely reperfusion	265	91.4%	25	8.6%	290	100.0%
	Timely reperfusion	437	93.6%	30	6.4%	467	100.0%
	No reperfusion	39	76.5%	12	23.5%	51	100.0%
	<b>Total</b>	<b>741</b>	<b>91.7%</b>	<b>67</b>	<b>8.3%</b>	<b>808</b>	<b>100.0%</b>
Total	Not timely reperfusion	1330	94.8%	73	5.2%	1403	100.0%
	Timely reperfusion	2800	97.2%	82	2.8%	2882	100.0%
	No reperfusion	171	90.0%	19	10.0%	190	100.0%
	<b>Total</b>	<b>4301</b>	<b>96.1%</b>	<b>174</b>	<b>3.9%</b>	<b>4475</b>	<b>100.0%</b>

- Denotes five cases or fewer

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**FIGURE 7.2: DISCHARGE DESTINATION FROM PERCUTANEOUS CORONARY INTERVENTION CENTRES, BY YEAR (N=5629)**

	2017		2018		2019		2020		Total	
	N	%	N	%	N	%	N	%	N	%
Home	651	45.6%	732	48.7%	657	46.9%	640	49.2%	2680	47.6%
Nursing home, convalescent home, or long-stay accommodation	22	1.5%	30	2.0%	21	1.5%	9	0.7%	82	1.5%
Transfer to acute hospital	682	47.8%	659	43.9%	615	43.9%	568	43.7%	2524	44.8%
Transfer to non-acute hospital	~	*	~	*	11	0.8%	0	0.0%	21	0.4%
Died	61	4.3%	69	4.6%	83	5.9%	74	5.7%	287	5.1%
Other	*	*	*	*	13	0.9%	9	0.7%	35	0.6%
<b>Total</b>	<b>1427</b>	<b>100.0%</b>	<b>1502</b>	<b>100.0%</b>	<b>1400</b>	<b>100.0%</b>	<b>1300</b>	<b>100.0%</b>	<b>5629</b>	<b>100.0%</b>

- Denotes five cases or fewer

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## APPENDIX 7: FREQUENCY TABLES

**FIGURE 7.3:** DISCHARGE DESTINATION FROM PERCUTANEOUS CORONARY INTERVENTION CENTRES, BY AGE GROUP, 2017–2020 (N=5629)

	≤64		65–74		≥75		Total		Total	
	N	%	N	%	N	%	N	%	N	%
Home	1560	50.0%	682	48.1%	438	40.1%	2680	47.6%	2680	47.6%
Nursing home, convalescent home, or long-stay accommodation	13	0.4%	13	0.9%	56	5.1%	82	1.5%	82	1.5%
Transfer to acute hospital	1425	45.7%	641	45.2%	458	41.9%	2524	44.8%	2524	44.8%
Transfer to non-acute hospital	7	0.2%	8	0.6%	6	0.5%	21	0.4%	21	0.4%
Died	90	2.9%	68	4.8%	129	11.8%	287	5.1%	287	5.1%
Other	22	0.7%	7	0.5%	6	0.5%	35	0.6%	35	0.6%
<b>Total</b>	<b>3117</b>	<b>100.0%</b>	<b>1419</b>	<b>100.0%</b>	<b>1093</b>	<b>100.0%</b>	<b>5629</b>	<b>100.0%</b>	<b>5629</b>	<b>100.0%</b>

## APPENDIX 7: FREQUENCY TABLES

**FIGURE 7.4:** INCIDENCE OF BLEEDING BY REPERFUSION TYPE, BY YEAR (n=4683)

		Thrombolysis		Primary PCI		No reperfusion required		Total	
		N	%	N	%	N	%	N	%
2017	None	36	92.3%	1051	99.3%	33	100.0%	1120	99.1%
	Intracranial haemorrhage	~	*	~	*	0	0.0%	~	*
	Retroperitoneal haemorrhage	0	0.0%	~	*	0	0.0%	~	*
	Any bleed (haemoglobin fall of <3 g to >5 g)	~	*	~	0.3%	0	0.0%	~	*
	<b>Total</b>	<b>39</b>	<b>100.0%</b>	<b>1058</b>	<b>100.0%</b>	<b>33</b>	<b>100.0%</b>	<b>1130</b>	<b>100.0%</b>
2018	None	*	*	1158	99.1%	*	*	1238	99.0%
	Intracranial haemorrhage	0	0.0%	~	*	0	0.0%	~	*
	Retroperitoneal haemorrhage	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Any bleed (haemoglobin fall of <3 g to >5 g)	~	*	*	*	0	0.0%	9	0.7%
	<b>Total</b>	<b>38</b>	<b>100.0%</b>	<b>1168</b>	<b>100.0%</b>	<b>44</b>	<b>100.0%</b>	<b>1250</b>	<b>100.0%</b>
2019	None	*	*	1100	99.3%	52	100.0%	1201	99.3%
	Intracranial haemorrhage	~	*	~	*	0	0.0%	~	*
	Retroperitoneal haemorrhage	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Any bleed (haemoglobin fall of <3 g to >5 g)	0	0.0%	*	*	0	0.0%	*	*
	<b>Total</b>	<b>50</b>	<b>100.0%</b>	<b>1108</b>	<b>100.0%</b>	<b>52</b>	<b>100.0%</b>	<b>1210</b>	<b>100.0%</b>
2020	None	*	*	984	99.7%	*	*	1088	99.5%
	Intracranial haemorrhage	0	0.0%	~	*	0	0.0%	~	*
	Retroperitoneal haemorrhage	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Any bleed (haemoglobin fall of <3 g to >5 g)	~	*	~	*	~	*	~	*
	<b>Total</b>	<b>47</b>	<b>100.0%</b>	<b>987</b>	<b>100.0%</b>	<b>59</b>	<b>100.0%</b>	<b>1093</b>	<b>100.0%</b>
Total	None	167	96.0%	4293	99.4%	*	*	4647	99.2%
	Intracranial haemorrhage	~	*	*	*	0	0.0%	*	*
	Retroperitoneal haemorrhage	0	0.0%	~	*	0	0.0%	~	*
	Any bleed (haemoglobin fall of <3 g to >5 g)	~	*	18	0.4%	~	*	24	0.5%
	<b>Total</b>	<b>174</b>	<b>100.0%</b>	<b>4321</b>	<b>100.0%</b>	<b>188</b>	<b>100.0%</b>	<b>4683</b>	<b>100.0%</b>

- Denotes five cases or fewer

\* Further suppression required in order to prevent disclosure of five cases or fewer

## APPENDIX 7: FREQUENCY TABLES

**FIGURE 7.5: INCIDENCE OF STROKE BY REPERFUSION TYPE, BY YEAR (n=4582)**

		Thrombolysis		Primary PCI		No reperfusion required		Total	
		N	%	N	%	N	%	N	%
2017	No	*	*	1041	99.0%	32	100.0%	1111	98.9%
	Yes – ischaemic	0	0.0%	*	*	0	0.0%	*	*
	Yes – haemorrhagic	~	*	~	*	0	0.0%	~	*
	<b>Total</b>	<b>39</b>	<b>100.0%</b>	<b>1052</b>	<b>100.0%</b>	<b>32</b>	<b>100.0%</b>	<b>1123</b>	<b>100.0%</b>
2018	No	37	100.0%	1148	99.1%	44	100.0%	1229	99.1%
	Yes – ischaemic	0	0.0%	*	*	0	0.0%	*	*
	Yes – haemorrhagic	0	0.0%	~	*	0	0.0%	~	*
	<b>Total</b>	<b>37</b>	<b>100.0%</b>	<b>1159</b>	<b>100.0%</b>	<b>44</b>	<b>100.0%</b>	<b>1240</b>	<b>100.0%</b>
2019	No	47	95.9%	1102	99.5%	53	100.0%	1202	99.4%
	Yes – ischaemic	~	*	~	*	0	0.0%	~	*
	Yes – haemorrhagic	~	*	~	*	0	0.0%	~	*
	<b>Total</b>	<b>49</b>	<b>100.0%</b>	<b>1107</b>	<b>100.0%</b>	<b>53</b>	<b>100.0%</b>	<b>1209</b>	<b>100.0%</b>
2020	No	46	100.0%	902	99.1%	*	*	1001	99.1%
	Yes – ischaemic	0	0.0%	*	*	0	0.0%	*	*
	Yes – haemorrhagic	0	0.0%	~	*	~	*	~	*
	<b>Total</b>	<b>46</b>	<b>100.0%</b>	<b>910</b>	<b>100.0%</b>	<b>54</b>	<b>100.0%</b>	<b>1010</b>	<b>100.0%</b>
Total	No	168	98.2%	4193	99.2%	182	99.5%	4543	99.1%
	Yes – ischaemic	~	*	*	*	0	0.0%	28	0.6%
	Yes – haemorrhagic	~	*	8	0.2%	~	*	11	0.2%
	<b>Total</b>	<b>171</b>	<b>100.0%</b>	<b>4228</b>	<b>100.0%</b>	<b>183</b>	<b>100.0%</b>	<b>4582</b>	<b>100.0%</b>

- Denotes five cases or fewer

\* Further suppression required in order to prevent disclosure of five cases or fewer

**FIGURE 7.6: SMOKING CESSATION ADVICE PROVIDED, BY YEAR (n=1922)**

	Yes		No – patient declined		Unknown		Total	
	N	%	N	%	N	%	N	%
2017	273	63.3%	15	3.5%	143	33.2%	431	100.0%
2018	468	89.7%	8	1.5%	46	8.8%	522	100.0%
2019	490	94.8%	7	1.4%	20	3.9%	517	100.0%
2020	406	89.8%	13	2.9%	33	7.3%	452	100.0%
<b>Total</b>	<b>1637</b>	<b>85.2%</b>	<b>43</b>	<b>2.2%</b>	<b>242</b>	<b>12.6%</b>	<b>1922</b>	<b>100.0%</b>

## APPENDIX 7: FREQUENCY TABLES

**FIGURE 7.7:** PROPORTION OF PATIENTS PRESCRIBED SECONDARY PREVENTION MEDICATION ON DISCHARGE, BY YEAR

		2017		2018		2019		2020		Total	
		N	%	N	%	N	%	N	%	N	%
ACEI or ARB	Yes	949	83.2%	1027	80.9%	1084	86.7%	845	88.1%	3905	84.5%
	No	128	11.2%	188	14.8%	90	7.2%	76	7.9%	482	10.4%
	Contraindicated	63	5.5%	54	4.3%	77	6.2%	38	4.0%	232	5.0%
	<b>Total</b>	<b>1140</b>	<b>100.0%</b>	<b>1269</b>	<b>100.0%</b>	<b>1251</b>	<b>100.0%</b>	<b>959</b>	<b>100.0%</b>	<b>4619</b>	<b>100.0%</b>
Aspirin	Yes	1137	98.4%	1326	97.9%	1268	97.5%	1130	98.7%	4861	98.1%
	No	10	0.9%	19	1.4%	*	*	7	0.6%	64	1.3%
	Contraindicated	9	0.8%	10	0.7%	~	*	*	*	32	0.6%
	<b>Total</b>	<b>1156</b>	<b>100.0%</b>	<b>1355</b>	<b>100.0%</b>	<b>1301</b>	<b>100.0%</b>	<b>1145</b>	<b>100.0%</b>	<b>4957</b>	<b>100.0%</b>
Beta-blocker	Yes	1054	92.1%	1152	90.4%	1156	92.1%	912	94.1%	4274	92.1%
	No	56	4.9%	77	6.0%	44	3.5%	32	3.3%	209	4.5%
	Contraindicated	34	3.0%	45	3.5%	55	4.4%	25	2.6%	159	3.4%
	<b>Total</b>	<b>1144</b>	<b>100.0%</b>	<b>1274</b>	<b>100.0%</b>	<b>1255</b>	<b>100.0%</b>	<b>969</b>	<b>100.0%</b>	<b>4642</b>	<b>100.0%</b>
Statin	Yes	1129	98.3%	1254	97.4%	1242	98.3%	981	98.8%	4606	98.1%
	No	13	1.1%	28	2.2%	15	1.2%	10	1.0%	66	1.4%
	Contraindicated	7	0.6%	6	0.5%	7	0.6%	2	0.2%	22	0.5%
	<b>Total</b>	<b>1149</b>	<b>100.0%</b>	<b>1288</b>	<b>100.0%</b>	<b>1264</b>	<b>100.0%</b>	<b>993</b>	<b>100.0%</b>	<b>4694</b>	<b>100.0%</b>
Second antiplatelet agent	Yes	1135	98.3%	1314	97.1%	1262	97.0%	1112	97.5%	4823	97.5%
	No	13	1.1%	22	1.6%	17	1.3%	14	1.2%	66	1.3%
	Contraindicated	7	0.6%	17	1.3%	22	1.7%	14	1.2%	60	1.2%
	<b>Total</b>	<b>1155</b>	<b>100.0%</b>	<b>1353</b>	<b>100.0%</b>	<b>1301</b>	<b>100.0%</b>	<b>1140</b>	<b>100.0%</b>	<b>4949</b>	<b>100.0%</b>

- Denotes five cases or fewer

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**FIGURE 7.8:** PROPORTION OF PATIENTS WITH AN ST ELEVATION MYOCARDIAL INFARCTION REFERRED FOR CARDIAC REHABILITATION PHASE 3, BY YEAR (N=5629)

	2017		2018		2019		2020		Total	
	N	%	N	%	N	%	N	%	N	%
Yes	939	65.8%	1086	72.3%	1075	76.8%	901	69.3%	4001	71.1%
No - patient declined	89	6.2%	149	9.9%	78	5.6%	99	7.6%	415	7.4%
No - due to comorbidity	75	5.3%	111	7.4%	92	6.6%	59	4.5%	337	6.0%
No - no reason	7	0.5%	12	0.8%	7	0.5%	14	1.1%	40	0.7%
Unknown	317	22.2%	144	9.6%	148	10.6%	227	17.5%	836	14.9%
<b>Total</b>	<b>1427</b>	<b>100.0%</b>	<b>1502</b>	<b>100.0%</b>	<b>1400</b>	<b>100.0%</b>	<b>1300</b>	<b>100.0%</b>	<b>5629</b>	<b>100.0%</b>











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