NOCA National Office of Clinical Audit

IHAA Irish Heart Attack Audit

IRISH HEART ATTACK AUDIT
NATIONAL REPORT 2021

NATIONAL OFFICE OF CLINICAL AUDIT (NOCA)

ACKNOWLEDGEMENT OF KEY PARTNERS

ACKNOWLEDGING SIGNIFICANT CONTRIBUTIONS FROM THE FOLLOWING:

NOCA National Office of
Clinical Audit

IHAA Irish Heart
Attack Audit

Irish Heart Attack Audit
National Report 2021

Dr Ronan Margey
Clinical Lead
Irish Heart Attack Audit
National Office of Clinical Audit
2nd Floor, Ardilaun House
111 St. Stephen's Green, Dublin 2

5th July 2023

Dear Dr Margey,
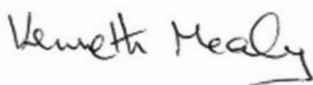
I wish to acknowledge receipt of the *Irish Heart Attack Audit 2021.*

Following your presentation to the NOCA Governance Board on the 22nd June 2023 and feedback garnered from our membership, we are delighted to endorse this report.

I wish to congratulate you, Audit Manager Joan McCormack and your governance committee in the development of this report which is a valuable quality improvement initiative.

Please accept this as formal endorsement from the NOCA Governance Board of the *Irish Heart Attack Audit 2021* and we wish you every success in your ongoing commitment to improving the care of Irish heart attack patients.

Yours sincerely,

Mr Ken Mealy
Chair
National Office of Clinical Audit Governance Board

FOREWORD

I am delighted to welcome the publication of the Irish Heart Attack Audit National Report 2021. This report has entailed a huge amount of work from the National Office of Clinical Audit (NOCA) and the Irish Heart Attack Audit (IHAA) led by Dr Ronan Margey, supported by the IHAA governance committee chaired by Dr Sean Fleming and all those involved in the preparation of this document. This work builds on the previous reports covering data from 2014 and 2016 (which were published under the governance of the National Clinical Programme for Acute Coronary Syndrome) and the 2017- 2020 report (NOCA 2022).

The report is based on data collected in hospitals providing primary percutaneous coronary intervention (primary PCI) therapy for patients following a major heart attack (ST elevation myocardial infarction (STEMI)). The 2013 establishment of a monitoring system for the Optimal Reperfusion Service (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 over this time. This has required immense support and commitment from the senior cardiology nurses and others working as audit coordinators – without them this report would not be possible.

The results in this report present data on the care received by 1,491 patients who suffered a STEMI and received care in a hospital providing primary PCI therapy.

The Acute Coronary Syndrome Model of Care (HSE, 2012) sets out very specific KPIs for timely reperfusion and post discharge care, these goals provide a standard to which we aspire to. The results of the report clearly identify key areas for continued improvement.

One worrying fact is that only 44% of individuals called 112 or 999 for help within 60 minutes of having symptoms. We know that those patients who go directly to a PCI centre undergo more rapid reperfusion and have a significant reduction in mortality compared to those patients who don't go directly to the PCI centre (3.5% vs 5.1%). Furthermore there is variation in treatment time between hospitals with only 69% of patients receiving timely reperfusion, which hasn't improved since the previous report and is well below the KPI of 90% set but the ACS Model of Care. Data from this audit will enable hospitals to compare themselves with each other, improve their patient flows and identify any barriers to rapid primary PCI.

Smoking rates have declined in the population as a whole but remain high at 39% in those presenting with a STEMI, these patients also present at a younger age (about 10 years earlier). Despite this only 85% of patients were offered smoking cessation advice.

Though there have been improvements in the awareness and treatment of hypertension and hypercholesterolaemia they remain important risk factors for STEMI. We know that 2 out of 3 people in Ireland over 50 years old have high blood pressure, half of these individuals don't know they have hypertension. Unfortunately only 66% of patients were referred on to cardiac rehabilitation despite the fact that there are significant benefits in terms of quality of life, morbidity and mortality. The report therefore highlights variations in hospital process of care and gaps both in public knowledge and in post discharge patient support. 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 crucial in addition to information that symptoms can be atypical both in men and particularly in women and in diabetic patients.

The authors have developed concise recommendations to address issues raised by the audit. On behalf of the Irish Heart Foundation, I fully endorse these recommendations. We look forward to working with all the relevant stakeholders to deliver the quality improvement initiatives necessary in order for us to provide better healthcare to the people of Ireland.

Dr Angie Brown,
Medical Director Irish Heart Foundation.

CONTENTS

TABLES

FIGURES

GLOSSARY OF TERMS AND DEFINITIONS

ACRONYM	FULL TERM
ACS	acute coronary syndrome
ARB	angiotensin II receptor blocker; oral medication sometimes used in treatment of high blood pressure, heart attack, heart failure, and diabetes
CABG	coronary artery bypass graft
cath lab	catheterisation laboratory
CHD	coronary heart disease
COVID-19	coronavirus disease; the disease caused by the severe acute respiratory syndrome coronavirus 2
CR	cardiac rehabilitation
CSO	Central Statistics Office
DIDO	door in door out
dL	decilitre
DTB	door to balloon
ECG	electrocardiogram
ED	emergency department
ESC	European Society of Cardiology
FMC	first medical contact
FMCTB	first medical contact – to balloon
FMCTD	first medical contact – to door
g	gram
GP	general practitioner
GRACE	Global Registry of Acute Coronary Events
Heartbeat	A web-based data collection tool
HIPE	Hospital In-Patient Enquiry
HPO	Healthcare Pricing Office
HSE	Health Service Executive
ICD-10-AM	International Statistical Classification of Diseases, Tenth Revision, Australian Modification
IHAA	Irish Heart Attack Audit
IQR	interquartile range
KPI	key performance indicator
KQI	key quality indicator
LOS	length of stay
MI	myocardial infarction
NAS	National Ambulance Service

ACRONYM	FULL TERM
NCP-ACS	National Clinical Programme for Acute Coronary Syndrome
NOCA	National Office of Clinical Audit
NSTEMI	non-ST elevation myocardial infarction
ORS	optimal reperfusion service
PCI	percutaneous coronary intervention
primary PCI	primary percutaneous coronary intervention
QI	quality improvement
statins	A group of oral medications that work to reduce level of cholesterol in blood
STEMI	ST elevation myocardial infarction
Thrombolysis	Intravenous medication therapy to treat heart attack by pharmacologically dissolving arterial clots
UHL	University Hospital Limerick

EXECUTIVE SUMMARY

The *Irish Heart Attack Audit National Report 2021* includes data from 1,491 patients with an ST elevation myocardial infarction (STEMI) who received treatment in a percutaneous coronary intervention (PCI) centre during 2021. STEMI was more common in males (n=1154, 77%), with females presenting at an older median age (67 years versus 61 years in males) and with a higher burden of comorbidities. The data provide detailed information about the care, processes and outcomes received by patients with a STEMI, and enable each participating hospital to benchmark itself against comparable hospitals in Ireland. The quality of care delivered is measured against national and international key quality indicators (KQIs), and opportunities for quality improvement (QI) are identified.

In 2021, data from University Hospital Waterford (UHW) were included; thus, data from all hospitals eligible to participate in the audit are included in this report. This report also shows the ongoing commitment of staff to provide high-quality patient care and clinical audit despite the Health Service Executive (HSE) ransomware attack in May 2021 and the ongoing disruption to the health service due to the COVID-19 pandemic.

As in the *Irish Heart Attack Audit National Report 2017-2020* (NOCA, 2022), this report indicates that the likelihood of achieving national targets in relation to the timeliness of reperfusion therapy is highly dependent on how a patient accesses a percutaneous coronary intervention (PCI) centre. Patients who access a PCI centre directly (brought directly by ambulance, self-presented or already an inpatient) receive timely primary PCI in 82% of cases, compared with only 41% of those who are transferred to a PCI centre. Timely reperfusion was associated with a lower mortality rate (3.5% versus 5.1%). The HSE Health Intelligence Unit provided us with an updated cardiac services mapping report (Appendix 1), which indicates that 92% of the population aged 55 years and over live within a 90-minute drive of one of the six 24/7 primary PCI centres (95% if UHW were included in the analysis). However, 29% of all patients were transferred from a non-PCI centre to a primary PCI centre. Further analysis is required in order to understand why so many patients do not access care in the right place at the right time. Furthermore, in 2021, only 44% (n=381) of those who called 112 or 999 for help did so within 60 minutes of symptom onset. It is imperative to fund a public health campaign identifying the symptoms of heart attack and the importance of calling 112/999 to receive prompt pre-hospital electrocardiogram (ECG) diagnosis of a STEMI, which will allow direct transfer of STEMI cases to PCI centres.

The establishment of multidisciplinary PCI networks that include stakeholders from referring hospitals and the National Ambulance Service (NAS) is a key recommendation. Access to data by such networks through the Irish Heart Attack Audit (IHAA) and the NAS will assist in identifying areas for improvement, particularly with regard to patients who continue to present initially to non-PCI centres. Variation in results between PCI centres is evident in, for example, 'door to balloon' (DTB) times and bypass rates of the emergency department (ED) to the catheterisation laboratory (cath lab), which require further exploration. The capture of follow-up data to report on outcomes after discharge remains a challenge but improved PCI network links and the forthcoming Individual Health Identifier should facilitate the process.

As identified in the *Irish Heart Attack Audit National Report 2017-2020* (NOCA, 2022), this report also highlights that smoking rates in persons presenting with a STEMI remain disproportionately high compared with the background general population smoking rates (39% of patients with a STEMI were active smokers). On average, patients who smoke have a heart attack a decade earlier than non-smokers. It is imperative that a public health campaign is developed that specifically highlights the heart attack risks of smoking, with particular emphasis on the risks of premature heart attack.

KEY FINDINGS

RISK FACTORS

> Eighty-two percent (n=1222) of patients with an ST elevation myocardial infarction (STEMI) had at least one known cardiovascular risk factor on presentation, the commonest being hypercholesterolaemia (46%) and hypertension (44%).

> Smoking is a risk factor in the development of a STEMI. Thirty-nine percent (n=578) of patients with a STEMI were active smokers at the time of their heart attack. This is higher than reported for 2017–2020 (NOCA, 2022) and is more than double the population rate of smoking (18%). Smoking causes premature heart attacks, with 70% (n=31) of patients with a STEMI aged 40 years and under being active smokers at the time of their heart attack. More detailed information on these and other risk factors can be found in Chapter 4.

CALL FOR HELP

> Only 44% (n=381) of patients with a STEMI who arrived at a percutaneous coronary intervention (PCI) centre directly by ambulance had called for help within 60 minutes of onset of symptoms.

> Patients who transferred from another hospital continue to account for a substantial proportion of all patients who received primary PCI (n=429, 29%). The 'first medical contact to door' (FMCTD) of the PCI centre within the recommended 90-minute time frame was achieved for only one-third of patients. See Chapter 5 for more detailed information.

KEY FINDINGS

KEY FINDINGS

NEED FOR IMPROVEMENT IN SERVICE DELIVERY

> Overall, 69% (n=852) of patients with a STEMI received timely reperfusion, which was unchanged from 2020 (69%; NOCA, 2022). This is well below the key performance indicator (KPI) of 90% stipulated in the *Acute Coronary Syndromes Programme Model of Care* (HSE, 2012), as the following points illustrate:

- Timely (<120 minutes) primary PCI was achieved in 73% (n=832) of patients with a STEMI. Timely primary PCI was higher in patients admitted directly to a PCI centre (82%, n=722) compared with those transferred from a non-PCI centre (41%, n=110).
- Timely (<30 minutes) thrombolysis was only achieved in 25% (n=20) of cases.
- Timely reperfusion was associated with reduced mortality (3.5% versus 5.1%).
- Variation exists between PCI centres with timely reperfusion; see chapters 5–6.

NEED FOR SERVICE IMPROVEMENT ON DISCHARGE FROM HOSPITAL

> The health service needs to support patients who have had a STEMI to reduce their risk of further heart attack. Currently, the recorded rate of delivery of smoking cessation advice was 85%, below the KPI of 90% mandated by the *Acute Coronary Syndromes Programme Model of Care* (HSE, 2012). Seventy-four percent (n=1038) of patients with a STEMI had an appropriate secondary prevention discharge bundle recorded below the *Acute Coronary Syndromes Programme Model of Care* target of 90% (HSE, 2012).

> Referral to cardiac rehabilitation (CR) at 66% was below the *Acute Coronary Syndromes Programme Model of Care* target of 90% (HSE, 2012). All of these can improve longer-term patient outcomes. See Chapter 7 for more detailed information.

RECOMMENDATIONS

RECOMMENDATION 1

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 2

There should be national and regional focus on QI in the STEMI care pathway.

RECOMMENDATION 3

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

RECOMMENDATION 4

Support patients with a STEMI to reduce the risk of further heart attack by increasing the rate of referral to cardiac rehabilitation phase 3.

KEY HIGHLIGHTS 2021

How are people with heart attack treated in Ireland?

All patients with a major heart attack, known as an ST elevation myocardial infarction (STEMI) should have specialist treatment to unblock clogged arteries. There are two types of treatment - thrombolysis, which is a clot-dissolving drug and primary percutaneous coronary intervention (primary PCI) which involves inserting a wire into the blocked artery in order to open it with a balloon and stent. There are 10 hospitals in Ireland, known as PCI centres, who carry out primary PCI.

10 specialist centres

1491 confirmed STEMI recorded in 2021

77% Male with median* age **61**

23% Female with median age **67**

RISK FACTORS

82% had at least one known cardiovascular risk factor.

46% had high cholesterol (hypercholest-erolaemia).

46%

44% had high blood pressure (hypertension).

44%

18% had diabetes.

18%

SMOKING

39% were smokers at the time of their heart attack, more than double the population rate of smoking **(18%)**. Smokers present with a heart attack 9 years earlier than people who have never smoked.

*The median is the middle number in a list of numbers.

GETTING TO THE SPECIALIST CARDIAC CENTRE

58% of patients were brought directly by ambulance to the PCI centre and **29%** were transferred from another hospital to the PCI centre.

44% of patients called 112 or 999 for help within 60 minutes of onset of symptoms.

29%

44%

80%

33%

90

80% of patients brought directly to the PCI centre by ambulance arrived within the recommended time frame of 90 minutes.

33% of patients who were transferred from another hospital to a PCI centre arrived within the recommended time frame of 90 minutes.
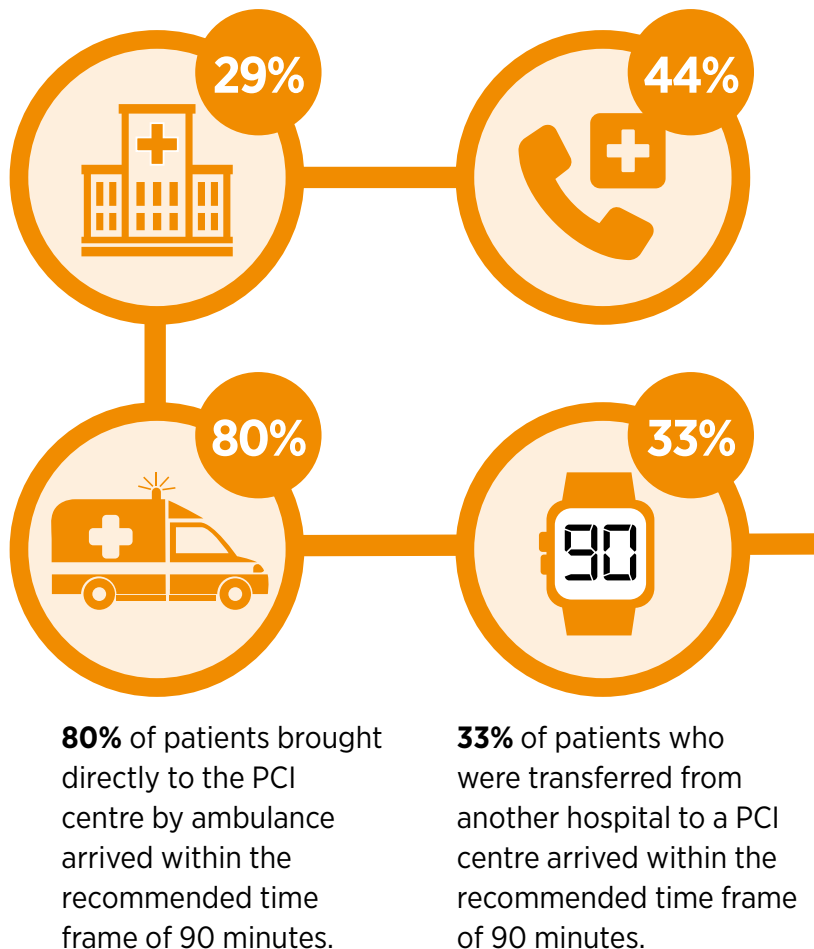
HEART ATTACK TREATMENT

79% of patients with a STEMI received treatment with primary PCI.

5% received treatment with thrombolysis but only **25%** received it within the recommended 30 minute timeframe.

Timely primary PCI was higher in patients admitted directly by ambulance to a PCI centre **(82%)** compared to those transferred to a PCI centre from another hospital **(41%)**.

79%

25%

82%

PREVENTING ANOTHER HEART ATTACK

Quit smoking advice was given in **85%** of cases before discharge.

66% of eligible patients were referred to cardiac rehabilitation (target is 90%).

74% of patients with a STEMI had an appropriate secondary prevention medication prescribed (target is 90%).

85%

66%

74%

OUTCOMES

The rate of complications associated with treatment for heart attack was low.

The unadjusted in-hospital mortality rate was **5.6%**. Timely treatment was associated with reduced mortality **(3.5% vs 5.1%)**.

5.6%

THE PATIENT PERSPECTIVE

PAT LEE PATIENT STORY

My name is Dr Pat Lee. I am 70 years of age and live with my wife, Mary, in Limerick. In August 2022, I had a major heart attack (ST elevation myocardial infarction (STEMI)) and this is my story.

I have been medically well down the years, and if I missed any days due to illness in my 40 years as a general practitioner (GP) and a doctor in occupational health, I could count them on one hand. I do have mild adult-onset asthma but it has always been well controlled. I suffered from high blood pressure for about 7 years but for the past 3 years my blood pressure has been normal. I do blood tests every January and for the last 3 or 4 years they have all been normal, including cholesterol. I am generally fit, exercise reasonably regularly – walking and golfing – and I do some muscle strengthening exercises as well.

I do have a family history of heart disease, so about 3 years ago, I decided to get myself checked out with a cardiologist. My friend Dr Arnous saw me and although everything was normal he did an angiogram due to the family history of heart disease. The results showed some mild to moderate plaque in one of the vessels. He put me on aspirin and a statin in order to reduce the risk of a heart attack and I continued the mild dose of blood pressure medication that I had been taking.

I discontinued the blood pressure medication in 2021, having discussed it with Dr Arnous, as my blood pressure was low to normal.

So, fast-forward to mid-August, 2022, on a Tuesday night. I had worked as usual that day: it had been non-strenuous with nothing major awry. That evening at home, I got a bit annoyed with the computer because I was going to Boston the next day and I was trying to get Aer Lingus VeriFLY set up on my computer and my mobile phone. This felt challenging and took me a considerable amount of time to achieve. Maybe I got a bit upset about that and maybe it was an exacerbating factor with regard to the events that followed later that evening. After dinner I went to my bedroom to get something, at around 10pm. When I went downstairs I felt an uneasiness in my upper tummy; no pain. At one stage I wasn't sure if it was in the upper tummy or the lower chest. I lay down on the bed, trying to see if I could get some ease and I twisted and turned.

I FELT AN UNEASINESS IN MY UPPER TUMMY; NO PAIN. AT ONE STAGE I WASN'T SURE IF IT WAS IN THE UPPER TUMMY OR THE LOWER CHEST.

After a minute or two, it wasn't easing and I said, 'Jeepers, I think I'm having an atypical coronary or something.' I took some aspirin and because it wasn't easing after another minute I decided that I had better call 999. Just as I got through to the Emergency Call Taker, the discomfort suddenly eased. I apologised and said, 'My discomfort has eased but I'll ring you back if it recurs' and, true to form, no sooner had I put down the phone than the discomfort returned. I immediately got back on to 999 and the call went like this – 'My name is Dr Pat Lee, my address is X; my Eircode is Y. I believe I am having a heart attack – please send someone quickly.' The operator asked me to stay on the line and requested that my wife, who was present, open the gates, put on all the lights and open the front door (which my wife did, of course).

I CALLED 999 'MY NAME IS DR PAT LEE, MY ADDRESS IS X; MY EIRCODE IS Y. I BELIEVE I AM HAVING A HEART ATTACK - PLEASE SEND SOMEONE QUICKLY'.

After a short period of being on the line, the operator said that the paramedic would be with me in 2 minutes. Before I knew where I was,

he was at my bedside, hooking me up to the electrocardiogram (ECG) and asking me questions. He performed the ECG and then asked me if he could level with me as I was a doctor. He said, 'You are after having an inferior STEMI: you need to get to the cath lab [catheterisation laboratory] in University Hospital Limerick [UHL] as quickly as possible.' The ambulance arrived, the paramedic gave me some tablets, and I was whisked off in the ambulance to the cath lab in UHL.

I began vomiting in the lift on the way up to the cath lab and I continued to vomit as I was being transferred from the trolley to the table. I met Professor Tom Kiernan and his team on my arrival in the cath lab and they were excellent in dealing with me. Professor Kiernan immediately put me at ease by saying that he knew exactly what was wrong and that the vomiting was due to irritation of the phrenic nerve. He quickly went to work and inserted a stent through my wrist into my right coronary artery. After this, he told me that I had had a complete blockage of the main right coronary artery, two-thirds of the way down, and showed me before and after pictures onscreen. My discomfort abated immediately after the procedure.

PROFESSOR KIERNAN IMMEDIATELY PUT ME AT EASE BY SAYING THAT HE KNEW EXACTLY WHAT WAS WRONG AND HE QUICKLY WENT TO WORK AND INSERTED A STENT THROUGH MY WRIST INTO MY RIGHT CORONARY ARTERY.

I was then transferred to the state-of-the-art coronary care unit. I cannot speak highly enough of it and, again, the doctors and nurses were wonderful. They did an echocardiogram and my results were practically normal; I had some slight stunning of the right ventricle, which should recover fully in time. My post-operative care progressed satisfactorily. Normally, I understand that they keep people in the coronary care unit for 5 days, but, as I was considered a doctor and "sensible" (although some might argue with that), I was sent home after 3 days.

I went home on multiple medications, which I continue to take, to help prevent another cardiac event. I was curious to know, later, as to whether or not I could have done anything else to prevent it. Dr Arnous said that if he had seen me the day before my coronary, he wouldn't have done anything differently. So that was reassuring from my point of view. What was against me was the family history of heart disease: we cannot change that one factor. All the other factors we can change where needed.

After I went home, I took it easy for a few days but I quickly increased my exercise and was back playing golf within 4 to 6 weeks. I did cardiac rehabilitation twice per week for 6 weeks and I found that very helpful. Catriona, Cliona and Breda in the Physiotherapy Department were excellent in supervising my rehabilitation. It took about 4 or 5 weeks to be offered a place on this programme. Essentially, I am continuing to exercise regularly, including gardening and walking; I am probably exercising 5 or 6 days per week. I am a bit more diligent with my diet although I do slip occasionally. I continue to attend Professor Kiernan for follow-up; he altered my medication in January and will review me again in August when I will have a repeat echo.

I spoke to somebody recently who reminded me of another person we know who had also had atypical symptoms, "almost exactly like yours". Heart attacks may not present with typical chest pain radiating to the left arm or up to the jaw, or out the back of your chest, etc.

HEART ATTACKS MAY NOT PRESENT WITH TYPICAL CHEST PAIN RADIATING TO THE LEFT ARM OR UP TO THE JAW, OR OUT THE BACK OF YOUR CHEST, ETC. ERR ON THE SIDE OF CAUTION. PHONE 112 OR 999

Therefore, my final message is: Err on the side of caution, and if you have any concern about any symptoms that may or may not be cardiac in nature, do not waste time, phone 112 or 999 and let the paramedic make that call, and, if it is a STEMI, you will be treated in the right place at the right time and hopefully with as good an outcome as I had.

CHAPTER 1
INTRODUCTION

CHAPTER 1: **INTRODUCTION**

INTRODUCTION

In the European Union (EU), ischaemic heart disease remains the single largest cause of death, responsible for more than 860,000 deaths (19% of all deaths) among men and almost 880,000 deaths (20% of all deaths) among women each year (European Heart Network, 2017). There are two broad types of heart attack, classified by findings on the electrocardiogram (ECG): ST elevation myocardial infarction (STEMI) and non-ST elevation myocardial infarction (NSTEMI). In Ireland, heart attacks affect an estimated 6,000 people per year (NOCA, 2022).

WHAT IS A HEART ATTACK?

A heart attack is a life-threatening medical emergency in which the blood supply to the heart is suddenly cut off, usually by a blood clot (thrombosis) forming at the site of a pre-existing narrowing or blockage, which can be relatively mild. 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 amount of muscle supplied by the blocked artery and the length of time the muscle is deprived of blood. After a finite time, this damage is irreversible.

Symptoms of a heart attack include:

- new, persistent 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
- new, persistent shortness of breath.

In female patients, older patients, or patients with diabetes, heart attacks can present with different symptoms, milder symptoms, or vague symptoms such as abdominal pain, confusion, or sweatiness. These are sometimes called atypical symptoms and can make it more difficult to diagnose a heart attack (Ibanez *et al.,* 2018).

Healthy artery

The plaque formation

Thrombosis
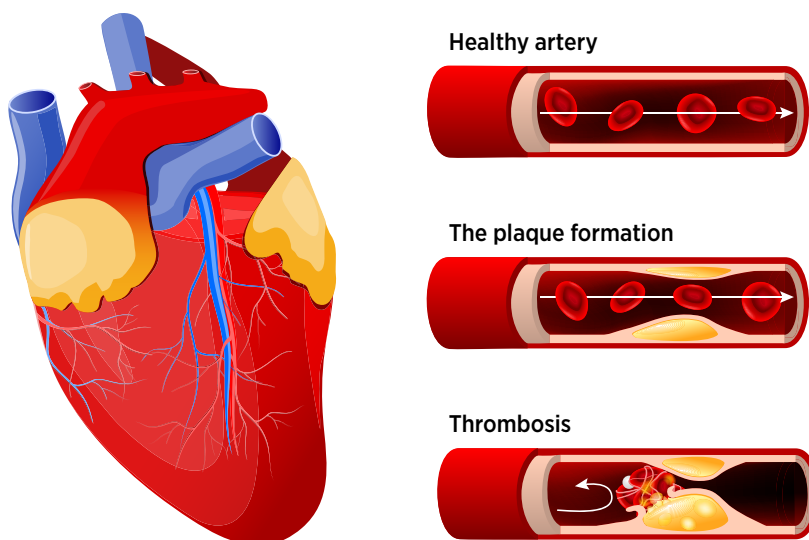
FIGURE 1.1: HEART ATTACK CAUSED BY PLAQUE RUPTURE WITH THROMBUS FORMATION

Risk factors for coronary heart disease (CHD) include:

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

Several 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.

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). STEMIs account for about one-quarter of all heart attacks each year in Ireland.

NSTEMIs are different from STEMIs 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 and are initially treated medically. The management of NSTEMIs is currently outside the scope of the Irish Heart Attack Audit (IHAA).

HOW ARE PEOPLE WHO HAVE A STEMI TREATED IN IRELAND?

Early recognition and treatment of heart attack is critical to the outcome. 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 (FMC). 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). In 2013, the National Clinical Programme for Acute Coronary Syndrome (NCP-ACS) implemented an optimal reperfusion service (ORS) (Figure 1.2) protocol for care of patients with a STEMI, with the aim of saving lives by standardising care across the country. Further information on the ORS and the indicators underpinning the Heartbeat dataset is provided in in the *Irish Heart Attack Audit National Report 2017-2020* (NOCA, 2022).
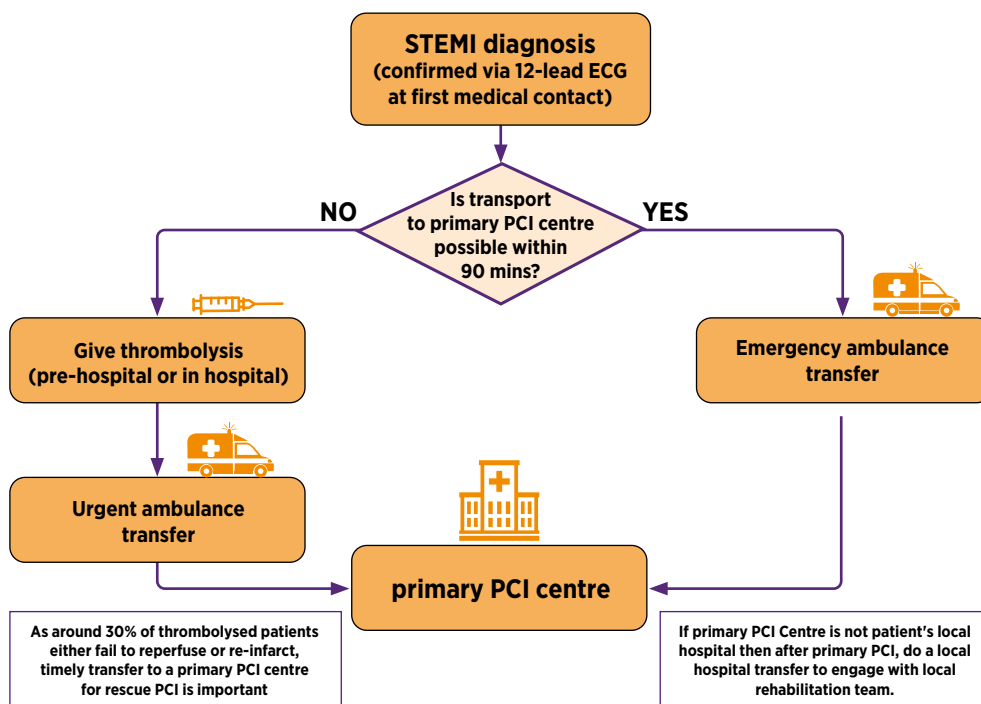
FIGURE 1.2: OPTIMAL REPERFUSION SERVICE PROTOCOL (HSE 2012)

In 2010, a mapping exercise was undertaken by the NCP-ACS in conjunction with the HSE Health Intelligence Unit and established that 81% of the population aged 55 years and over lived within a 90-minute drive of the major cities of Dublin, Cork and 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. In 2023, a similar mapping exercise was repeated by the IHAA in conjunction with the HSE National Health Intelligence Unit (Appendix 1). This indicates that 92% of the population aged 55 years and over lived within a 90-minute drive of one of the six 24/7 primary PCI centres; this figure was 95% if University Hospital Waterford (UHW) were included in the analysis. Appendix 1 describes the methodology and the projections based on speed limits and population changes up to 2035.

Currently, seven primary PCI centres are designated to receive patients with a STEMI brought directly by emergency ambulance. Six provide 24/7 access and one provides access from 8.00am to 8.00pm, Monday to Friday. For parts of Donegal, Altnagelvin Hospital in Derry provides 24/7 coverage as part of a cross- border care arrangement between the HSE and the United Kingdom's National Health Service. A further three hospital PCI centres provide primary PCI from 9.00am to 5.00pm, Monday to Friday, for patients with a STEMI who self-present to the PCI centre or who already are inpatients (Table 1.1). The term 'PCI centre' is used in this report to refer to designated primary PCI centres and non-designated, 9.00am to 5.00pm weekday PCI centres.

TABLE 1.1: 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: 8.00am–8.00pm, 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.

** UHW commenced participation in the IHAA on 1 January 2021. UHW increased the primary PCI service to 8.00am to 8.00pm, Monday to Friday, in September 2022. Prior to that, UHW provided STEMI primary PCI from 8.00am to 5.00pm, Monday to Friday.

PURPOSE OF THIS REPORT

This report both describes the quality of care provided to patients with a STEMI in 2021 from all 10 hospitals providing primary PCI, using Heartbeat data, and measures the quality of care provided against best practice standards and key quality indicators (KQIs) to inform recommendations for improvement.

This report compares hospital-to-hospital performance, and future reporting will build to a risk-adjusted modelling site comparison in 2023. The report was prepared by a multidisciplinary writing group and overseen by the IHAA Governance Committee.

WHO IS THIS REPORT AIMED AT?

The *Irish Heart Attack Audit National Report 2021* 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 2021* presents the key findings of the IHAA, case mix, patient pathway and outcomes.
2. The *Irish Heart Attack Audit National Report 2021: Summary Report* will be of particular interest to patients, patient organisations and the public.
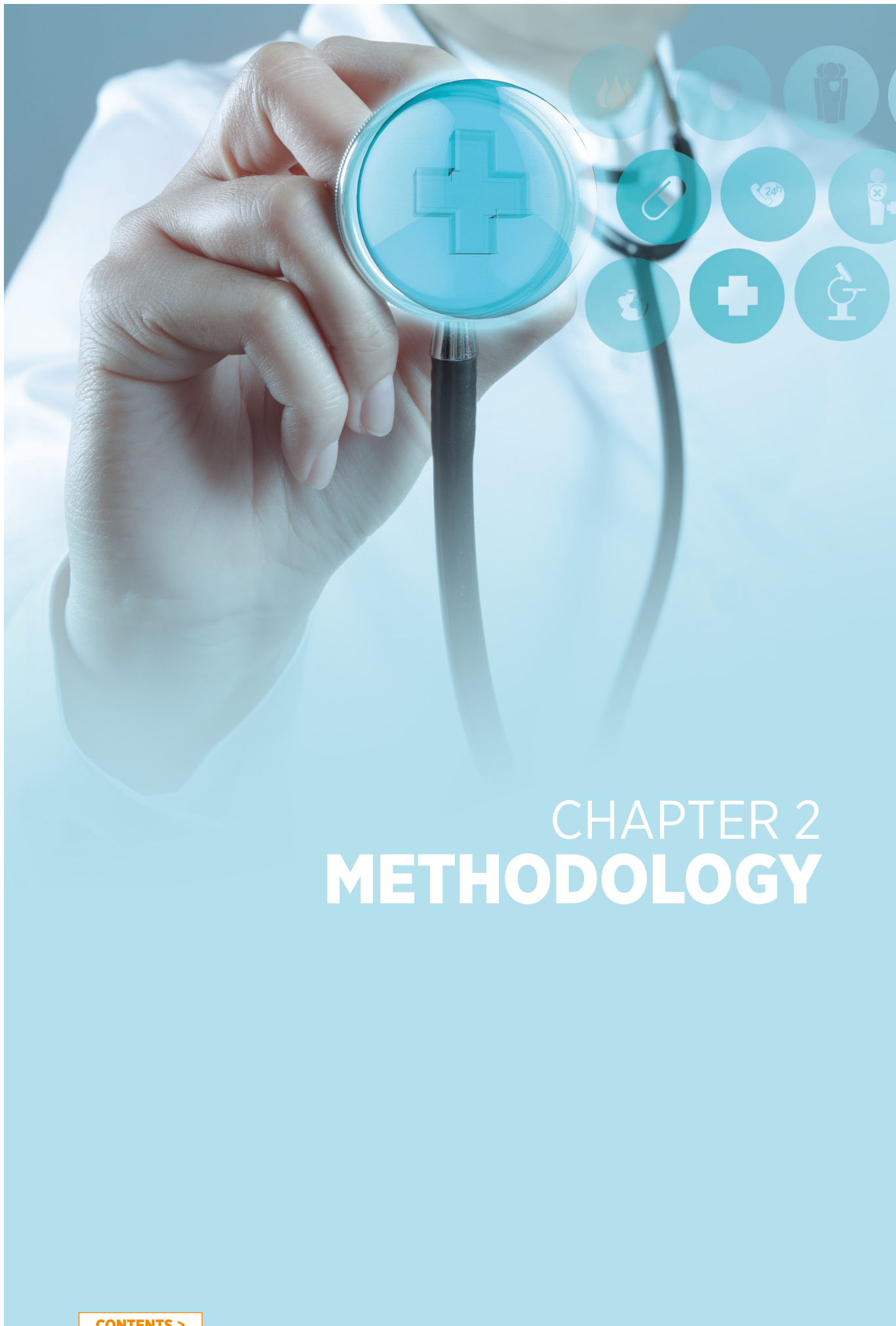
CHAPTER 2
METHODOLOGY

CHAPTER 2: **METHODOLOGY**

THE IRISH HEART ATTACK AUDIT

The IHAA is a clinically led audit using the Heartbeat dataset developed in 2012 by the NCP-ACS to monitor the care provided to patients with a STEMI. The origins of the monitoring programme were described in the *Irish Heart Attack Audit National Report 2017-2020* (NOCA, 2022). Governance of Heartbeat was transferred to the National Office of Clinical Audit (NOCA) in 2019 and the IHAA Governance Committee was established. Table 2.1 outlines the aim and objectives of the IHAA.

TABLE 2.1: AIM AND OBJECTIVES OF THE IRISH HEART ATTACK AUDIT

AIM

To conduct an audit of acute coronary syndrome (ACS) care.

OBJECTIVES

▶ To integrate the existing Heartbeat audit of STEMI into the IHAA within NOCA and to encompass STEMI, NSTEMI, and unstable angina hospital admissions.

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; National Cardiovascular Data Registry Myocardial Infarction Percutaneous Coronary Intervention Registry; and Myocardial Ischaemia National Audit Project datasets).

▶ To maintain a database of all inpatients with an ACS in Ireland in order to support/promote continuous QI initiatives at local and national level and to deliver the best patient outcomes.

▶ 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.

▶ To disseminate the outputs from the data to all relevant stakeholders in a timely manner.

▶ To benchmark ACS care and outcomes against national and international standards.

▶ To develop appropriate risk-adjusted modelling of outcomes in order to facilitate national, regional Hospital Group, and individual hospital- and physician-level QI, and to develop patient-reported outcome measures for ACS.

▶ To provide data to support and inform national policies for ACS and related cardiovascular conditions.

The IHAA Governance Committee oversees the IHAA, and 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 (Appendix 2).

DATA SOURCES

Heartbeat data are entered into the Hospital In-Patient Enquiry (HIPE) system. Heartbeat data (Appendix 3) were collected on all cases admitted to a PCI centre following activation of the ORS protocol (Figure 1.2) and were submitted from each hospital to the HIPE system via the Heartbeat portal. HIPE is the principal source of national data on discharges from acute hospitals in Ireland. It collects demographic, clinical and administrative data on discharges from, and deaths in, acute public hospitals nationally.

The reference population for the national report is limited to patients aged 18 years and over. The HIPE data and the Heartbeat data were merged within HIPE to form an anonymised dataset and sent to NOCA.

DATA COLLECTION

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 2.1). 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 PCI centre and 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. 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. All data related to cross-border care are submitted by the audit coordinator in Letterkenny University Hospital.

DATA VALIDATION

Several validations are built into the design of the Heartbeat portal to display messages when an apparently illogical sequence is encountered. In addition, a number of mandatory fields (mainly admission and reperfusion data) require 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 quarterly to the audit coordinators, who amend the record.

DATA ANALYSIS

NOCA received the Heartbeat data for the 2021 reporting period from the HPO on 15 November 2022. The NOCA Data Analyst completed the analysis following data checks with the HPO. The analysis was conducted using Statistical Package for the Social Sciences 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.

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 2021 and 31 December 2021, 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 (ED) before treatment could be initiated.

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 4). 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. In 2021, the following nine KQIs were agreed by the IHAA Governance Committee to be reported quarterly via the NOCA dashboard reporting system:

1.   percentage of eligible patients with a STEMI who were offered reperfusion
2.   percentage of patients with a STEMI who had timely primary PCI; i.e. who arrived directly to a primary PCI-capable hospital
3.   percentage of patients with a STEMI who had timely primary PCI; i.e. who were transferred from a non-primary PCI-capable hospital to a primary PCI-capable hospital
4.   percentage of patients with a STEMI who had radial access for primary PCI
5.   percentage of patients with a STEMI who were discharged with an appropriate secondary prevention discharge bundle of medication
6.   percentage of patients with a STEMI who actively smoke who were offered smoking cessation advice
7.   percentage of eligible patients with a STEMI referred for cardiac rehabilitation phase 3
8.   percentage completeness of survival status at 30 days
9.   proportion of patients who have cardiac rehabilitation phase 3 date recorded.

The dashboard is available in each PCI centre and the results for 2021 are highlighted throughout this report. The metadata for each KQI are available in Appendix 5, and the result of each KQI for 2021 is reported within the findings. Frequency tables for each figure are available in Appendix 6.

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, for 2021, it is unclear whether the discharge status is from the PCI centre or, where the patient was transferred to a second hospital for ongoing STEMI care, whether this status reflects survival at discharge from the second hospital. Therefore, mortality results in this report are limited to survival status on discharge from the PCI centre only.

EVIDENCE SYNTHESIS AND RECOMMENDATION FORMATION

A writing group – comprising the IHAA Clinical Lead; the IHAA Chairperson; one interventional cardiologist participating in primary PCI; one consultant in public health medicine; one representative from the National Ambulance Service (NAS); one representative from the HPO; the IHAA Audit Manager; the IHAA Assistant Audit manager; and the NOCA Data Analyst – was established to plan and write this report. Following data analysis, the Data Analyst provided the IHAA writing group with figures and analytical commentary while the Audit Manager provided additional clinical commentary, and meetings were held to review, edit and interpret the results. The key findings were agreed on by the writing group and recommendations were developed by consensus. Once recommendations were agreed, owners of the recommendation were identified to aid implementation of each recommendation. The two public and patient interest representatives from the IHAA Governance Committee were provided with a final draft of the report and, in collaboration with the Audit Manager and the writing group, they agreed on the findings to be highlighted in the summary report.

The methodology for this report was the same as that used in the *Irish Heart Attack Audit National Report 2017-2020* (NOCA, 2022), with one exception. In the *Irish Heart Attack Audit National Report 2017-2020* (NOCA, 2022), the FMC time for patients with a STEMI who presented to a non-PCI centre was defined as the time of arrival at the non-PCI centre hospital and for all others it was defined as the first positive ECG that established the diagnosis of a STEMI. In this report, the FMC for all patients who receive primary PCI was the time of the first positive ECG, in line with the European Society of Cardiology's (ESC's) 2017 STEMI guidelines (Ibanez *et al.,* 2018).

FIGURE 2.1

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

CONTENTS >
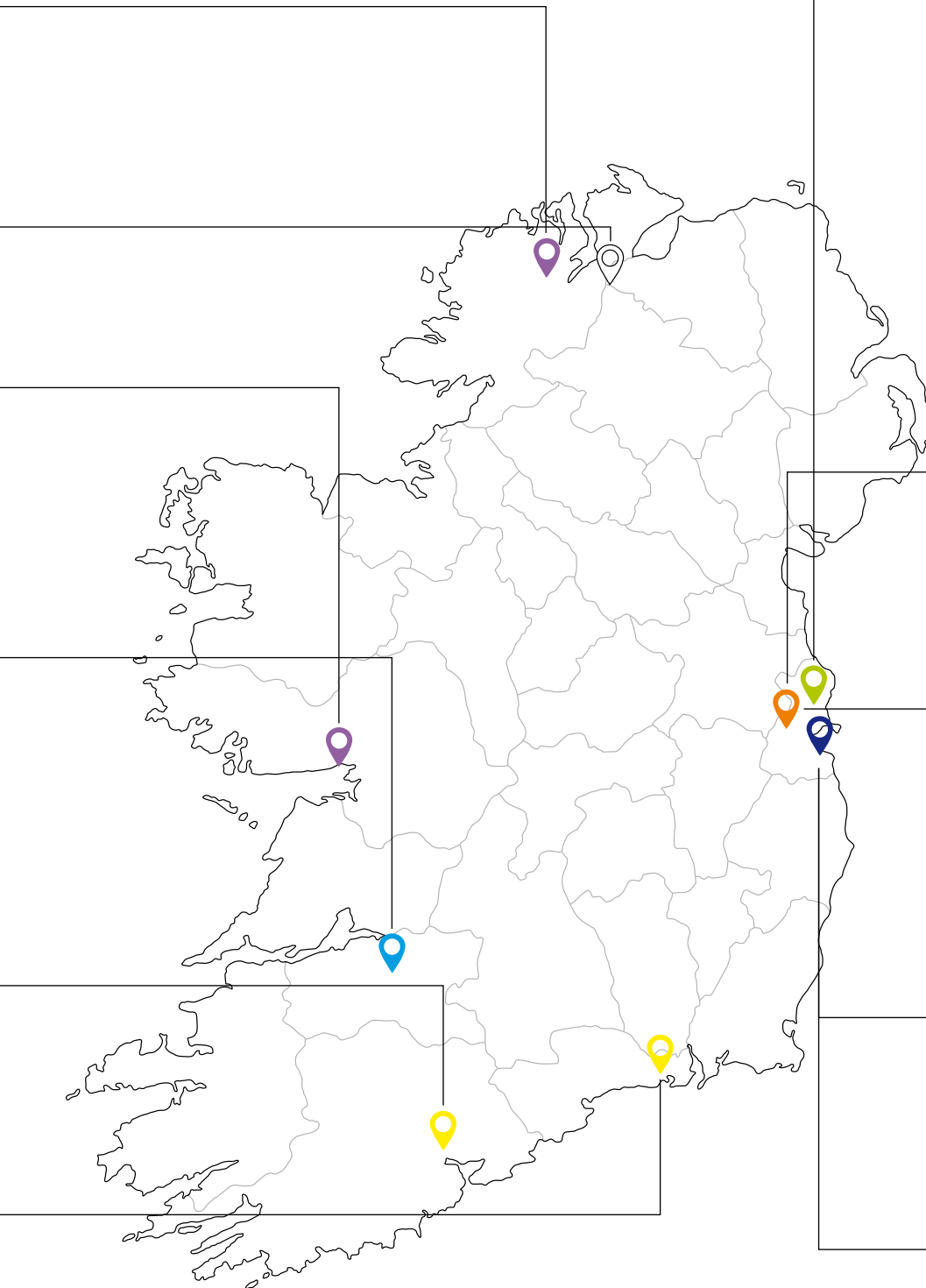
BEAUMONT HOSPITAL
IHAA CLINICAL LEAD: Dr Mark Kennedy
IHAA AUDIT COORDINATOR: Susan Reynolds   Gillian Miller   Grace Muldoon

MATER MISERICORDIAE UNIVERSITY HOSPITAL
IHAA CLINICAL LEAD: Prof. Gavin Blake
IHAA AUDIT COORDINATOR: 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

**Coverage of
Data Release**

**Completeness of
Data Release**

**Accuracy of
Data Release**

CHAPTER 3: **DATA QUALITY STATEMENT**

This chapter provides an assessment of the quality of the IHAA data in this report using internationally agreed dimensions of data quality (Health Information and Quality Authority, 2018). Table 3.1 describes the context of the data in this report, Table 3.2 outlines the characteristics of the data quality within this report, and Table 3.3 provides an overall assessment of the quality of the data in this report.

TABLE 3.1: CONTEXT OF DATA IN THIS REPORT	
SCOPE	This data quality statement provides an assessment of the Heartbeat data released for this report in 2021. This statement solely focuses on the data quality dimension of 'accuracy and reliability', and specifically on the characteristics of: • coverage of data release • completeness of data release • accuracy of data release.
PURPOSE	This will help the reader decide whether the data are fit for the user's specific purpose.
DATA SOURCE	Data for this report have been extracted from the HIPE system, which includes data submitted to the Heartbeat portal within HIPE.
TIMEFRAME OF DATA RELEASE	The data released in this report are based on data reported between 1 January 2021 and 31 December 2021.
TYPE OF DATA	Final

TABLE 3.2: CHARACTERISTICS OF DATA QUALITY

Coverage of data release

DEFINITION

Coverage refers to calculating the number of patients with a STEMI 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.

Calculating coverage can be approached in two ways:

1. COVERAGE ACROSS THE COUNTRY

For this report, data are included from all PCI centres, for both designated primary PCI and non-designated, 9.00am to 5.00pm weekday PCI centres (Table 1.1).

2. DEGREE OF COVERAGE

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 instead records:

a) all episodes of STEMI, including patients who may not have accessed a PCI centre for reasons such as age and/or major comorbidities

b) patients who are transferred back to their local hospital from a PCI centre following treatment. These cases may each first be counted once as a case at the PCI centre, and then a second time as a case at the non-PCI centre.

As such, HIPE is likely to have a higher number of episodes of STEMI nationally than the number recorded in the Heartbeat portal.

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.
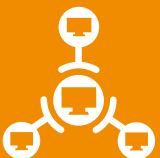
However, quantifying the number of cases with a principal diagnosis of a STEMI (International Classification of Diseases, Tenth Revision, Australian Modification (ICD-10-AM) codes I21.0, I21.1, I21.2 and I21.3) on HIPE in the PCI centres as a proportion of those recorded on Heartbeat does give an indication of coverage for the reporting period

Table 3.4 indicates the annual coverage for each PCI centre. There are two important points to highlight:

1) If a PCI centre had more STEMI cases recorded on Heartbeat than on HIPE, the PCI centre was recorded as having 100% coverage. This may occur due to variance in coding between hospitals. There is a coding standard agreed in St James's Hospital where the hospital codes transfer patients admitted to the PCI centre as a principal diagnosis of I25.11 (atherosclerotic heart disease of native coronary artery with angina pectoris) and uses STEMI as a secondary diagnostic diagnosis. To calculate the coverage in St James's Hospital, the sum of the number of STEMIs as a principal diagnosis and the number of STEMIs as the first secondary diagnosis were reported as the total number of HIPE STEMIs in St James's Hospital.

TABLE 3.2: CHARACTERISTICS OF DATA QUALITY *CONTINUED*

Coverage of data release	2) In non-designated, 9.00am to 5.00pm weekday PCI centres, HIPE STEMI cases include those who had a primary PCI in their own hospital and those who had their primary PCI in another PCI centre and were transferred back. In order to estimate Heartbeat coverage in the non- designated PCI centres,[1] the number of cases submitted to Heartbeat (for primary PCIs performed in the hospital), plus the number of cases transferred to the hospital following primary PCI (whose data were recorded on Heartbeat in the PCI centre where the PCI was performed), were reported as the total number on Heartbeat. This total was then calculated as a proportion of the total HIPE cases (Table 3.4). Seven out of ten PCI centres had a coverage of >80%; the remaining three had coverage of >70%. Coverage of <80% was flagged in each figure when reporting by hospital (Table 3.4). The absence of an audit coordinator impacted on coverage in two hospitals. Developing a reconciliation process between Heartbeat data and HIPE data is a recommendation in this report.
Completeness of data release	In 2021, there were 66 variables on Heartbeat and the completeness of each variable is presented in Appendix 7. The majority of variables are completed in more than 90% of cases (n=53). In the Irish Heart Attack Audit National Report 2017-2020 (NOCA, 2022), follow-up variables were found to be the least complete. This continues to be a challenge as a large proportion (n=626, 42%) of cases are transferred, following successful primary PCI from the PCI centre where the data are captured, for ongoing STEMI care, to another hospital. The information required to capture follow-up data requires the audit coordinators to gather the data from another hospital. Without adequate resources for data collection and good networks between hospitals to collect the data, follow-up data can be missing. In 2021, bi-monthly audit coordinator meetings and a workshop were held in order to improve data quality. In this reporting period, the recording of the 'Date of phase 3 cardiac rehabilitation' has increased from 8% in 2020 to 25% in 2021, while 'Survival status at 30 days post-MI [myocardial infarction]' has increased from 56% in 2020 to 78% in 2021. Appendix 8 displays the completeness of variables where completeness is less than 90%, by hospital. While there are improvements, the implementation of the Individual Health Identifier will facilitate data collection, and the recommended establishment of PCI networks to monitor the data will enhance data quality.
Accuracy of data release	All data were reported, including missing or unknown data.

[1] UHW is included in this as it is providing primary PCI between 9.00am and 5.00pm on weekdays only.

TABLE 3.3: ASSESSMENT OF DATA IN THIS REPORT

Strengths of data in this report	All hospitals eligible to participate in the audit are included. All hospitals have access to their own data and can run reports locally. In 2020, the IHAA established a data validation process to improve data quality. This was implemented in all participating hospitals in 2021. Any commonly found validations were discussed at the bi-monthly audit coordinator meetings in order to maximise compliance. A data dictionary and user manual are available and updated annually in order to support submission of accurate data. The bi-monthly audit coordinator meetings to discuss data quality enhanced the collection of high-quality data in 2021. This is the second report from the IHAA. As the previous report covered 4 years from 2017 to 2020 (NOCA, 2022), the writing group was able to explore some areas in more detail in the current report, such as age and sex.
Limitations of data in this report	The dataset was reviewed in 2021 to determine whether the data are fit for purpose. In addition, the reporting process for the *Irish Heart Attack Audit National Report 2017-2020* (NOCA, 2022) identified variables where there was a need for improvement in the data definitions, such as 'survival status at discharge'. In this example, it was unclear if 'survival status at discharge' was recorded based on discharge home from the final hospital (for patients transferred to another hospital after a PCI) or on discharge from the PCI centre. This and other items were clarified at a workshop held in November 2021; however, it remains uncertain for the data in this report. Items related to follow- up of patients continue to be challenging to collect. Any items of concern related to data quality are addressed in this report. Three hospitals have less than 80% coverage and this was flagged in all figures where hospital level results are reported.

TABLE 3.4: COVERAGE OF HEARTBEAT CASES

Hospital	Cases with a HIPE principal diagnosis of a STEMI	Heartbeat cases with a discharge diagnosis of a STEMI	Heartbeat data with a discharge diagnosis of a STEMI transferred back to another PCI Centre	Total STEMI cases with Heartbeat data recorded	Coverage on Heartbeat as a percentage of HIPE cases
DESIGNATED PRIMARY PCI CENTRES					
Cork University Hospital*	215	226	0	226	100%
Galway University Hospitals	252	196	0	196	78%
Letterkenny University Hospital	47	45	0	45	96%
Mater Misericordiae University Hospital	398	352	0	352	88%
St James's Hospital	336*/**	390	0	390	100%
University Hospital Limerick*	156	189	0	189	100%
University Hospital Waterford***/+	92	51	14	65	71%
9.00AM–5.00PM WEEKDAY PCI CENTRES					
Beaumont Hospital+	107	13	63	76	71%
St Vincent's University Hospital	91	15	61	76	84%
Tallaght University Hospital	68	14	44	58	85%
TOTAL	**1426**	**1491**	**182**	**1673**	**100%**

+ These hospitals had audit coordinator resource issues during the reporting period.

* PCI centres that have more cases submitted to Heartbeat than the number of HIPE cases are counted as having 100% coverage.

** St James's Hospital code cases that are transferred to the hospital with STEMI as a secondary diagnosis; therefore, HIPE cases included cases with a STEMI as either a principal diagnosis or the first secondary diagnosis.

***UHW was a designated primary PCI centre from 9.00am to 5.00pm, Monday to Friday, during the reporting period.

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 in 2021. The data include only cases that triggered the ORS protocol (Figure 1.2) and subsequent admission to a PCI centre. Comparisons with the *Irish Heart Attack Audit National Report 2017-2020* (NOCA, 2022) and other international reports were made where applicable. Emerging trends in age and sex demographics, comorbidities and cardiovascular risk factors, including smoking, are outlined and discussed.

HEARTBEAT CASE SUBMISSIONS, 2021

A total of 1,742 cases were submitted to the Heartbeat portal during 2021 and includes data from UHW (n=70).[2] Although comparable with submissions in 2017, 2018 and 2019, respectively (NOCA, 2022), this was an increase from 1,478 cases in 2020. Figure 4.1 displays the total number of cases submitted by participating hospitals during the reporting period. St James's Hospital (n=416, 24%) and the Mater Misericordiae University Hospital (n=444, 25%) continue to receive almost one-half of all admissions to PCI centres.
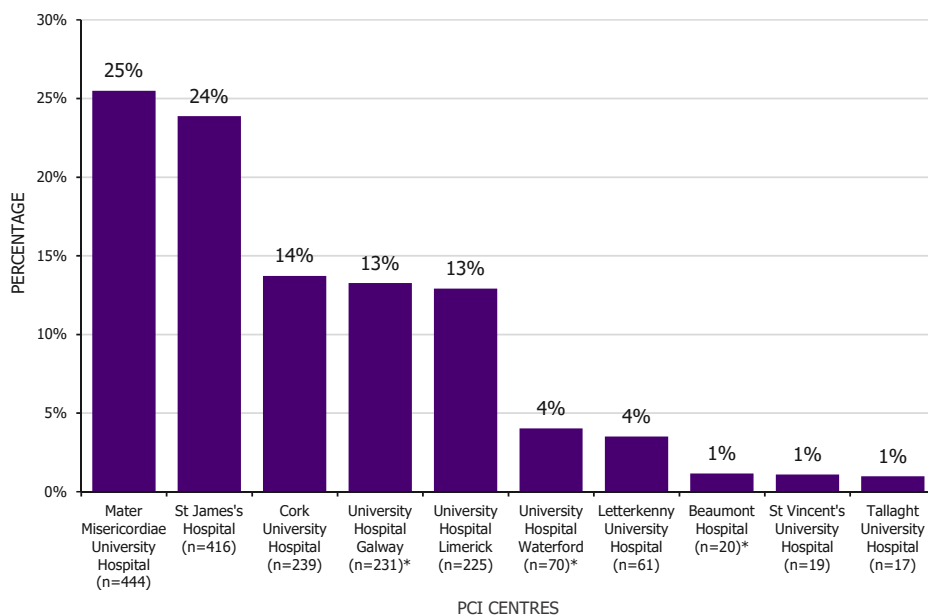
* Coverage was below 80%.

FIGURE 4.1: PROPORTION OF HEARTBEAT CASE SUBMISSIONS, BY PERCUTANEOUS CORONARY INTERVENTION CENTRE, 2021 (N=1742)

[2] UHW data were not reported in the *Irish Heart Attack Audit National Report 2017-2020* (NOCA, 2022).

CONFIRMED STEMI DIAGNOSIS AND ALTERNATIVE DIAGNOSES

Each case submitted to the Heartbeat portal as a possible STEMI had a confirmed discharge diagnosis. The potential diagnostic categories that could be recorded included: STEMI, NSTEMI, unstable angina, pericarditis, myocarditis, takotsubo cardiomyopathy, non-cardiac chest pain, and other/unknown. In 2021, 1,491 (86%) cases had a confirmed diagnosis of a STEMI, 171 (10%) had an alternative diagnosis, and 80 (5%) were reported as 'other/unknown' (Table 4.1).

The most common 'alternative' diagnosis was non-cardiac chest pain (n=64, 37%), followed by pericarditis (n=36, 21%). NSTEMI, takotsubo cardiomyopathy and myocarditis together accounted for 65 cases (38%). The breakdown of alternative discharge diagnoses is available by hospital in Appendix 9 (Table 9.1). The frequency of these alternative diagnoses was similar to previous years. The proportion of STEMI diagnosis varied between hospitals, from 95% (n=226) in Cork University Hospital to 65% (n=13) in Beaumont Hospital.

TABLE 4.1: DISCHARGE DIAGNOSIS (N=1742)[3]

PCI Centres	STEMI		Alternative diagnosis		Other/ unknown		Total	
	N	%	N	%	N	%	N	%
Cork University Hospital	226	95%	*	*	~	*	239	100%
Letterkenny University Hospital	45	74%	*	*	~	*	61	100%
Mater Misericordiae University Hospital	352	79%	65	15%	27	6%	444	100%
St James's Hospital	390	94%	12	3%	14	3%	416	100%
University Hospital Galway	196	85%	23	10%	12	5%	231	100%
University Hospital Limerick	189	84%	*	*	~	*	225	100%
University Hospital Waterford	51	73%	*	*	~	*	70	100%
Non-designated 9–5 PCI centres	42	75%	~	*	*	*	56	100%
Total	**1491**	**86%**	**171**	**10%**	**80**	**5%**	**1742**	**100%**

~ Denotes five cases or fewer
* Coverage was below 80%.

[3] Non-designated, 9.00am to 5.00pm weekday PCI centres include Beaumont Hospital (n=20), St Vincent's University Hospital (n=19) and Tallaght University Hospital (n=17). Discharge diagnosis for these hospitals are included in Appendix 6.

STEMI, SEX AND AGE

Of the 1,491 patients with a confirmed diagnosis of a STEMI treated in PCI centres in 2021 (Figure 4.2), the majority were male (n=1154, 77%), unchanged from 2017 to 2020 (NOCA, 2022).

The mean age of patients with a STEMI in 2021 was 63 years (interquartile range (IQR): 54–71 years), and the median age was 62 years, unchanged from 2017 to 2020 (NOCA, 2022). For males, the median age was 61 years (IQR: 53–69 years), unchanged from 2017 to 2020 (NOCA, 2022). The median age of females with a STEMI was 67 years (IQR: 58–76 years), slightly younger than reported for 2017–2020 (NOCA, 2022) where the median age was 69 years. There was a larger proportion of older females aged 65 years and over (n=197, 58%) compared with males (n=458, 40%).

57% of male patients with a STEMI were aged between 41 and 64 years
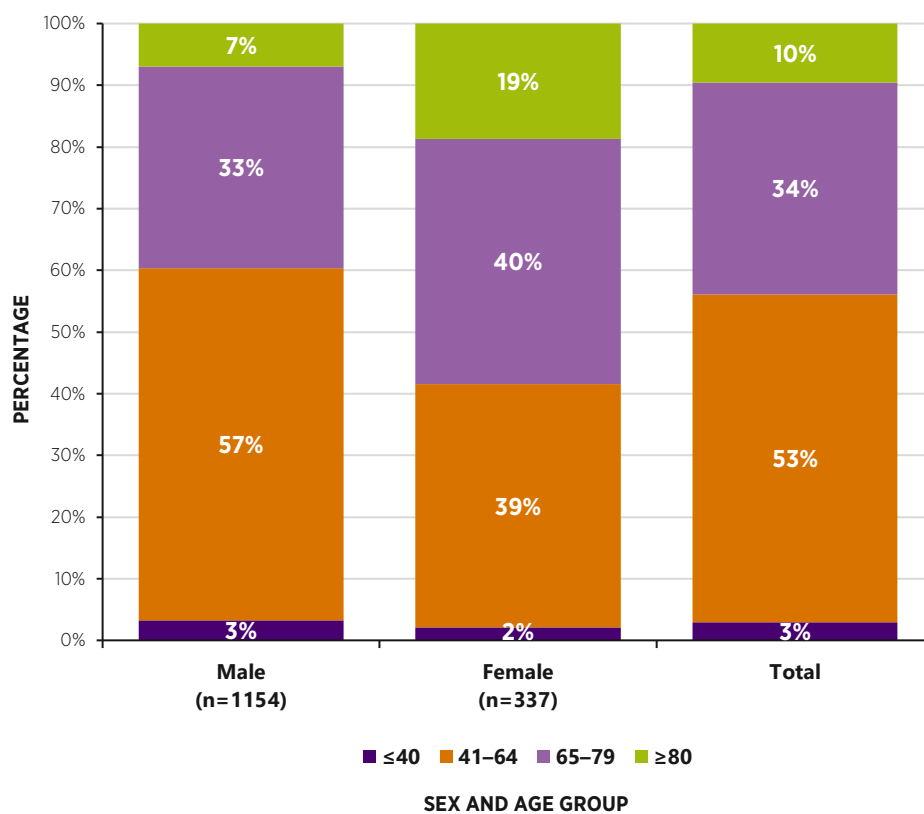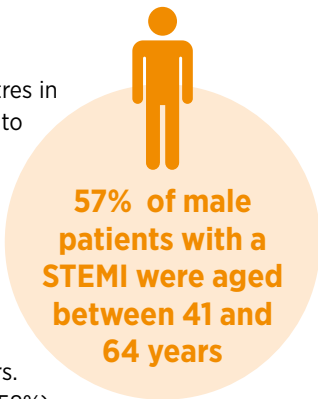
FIGURE 4.2: PERCENTAGE OF ST ELEVATION MYOCARDIAL INFARCTION CASES, BY SEX AND AGE GROUP (N=1491)

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

In 2021, 27% (n=398) of patients with a STEMI had at least one known atherosclerotic cardiac diagnosis such as angina, a prior cardiovascular event such as an MI, a PCI, or a known non-cardiac comorbidity. This was slightly higher than the 25% noted in 2017–2020 (NOCA, 2022). The most frequently reported conditions were previous angina (n=181, 12%), previous PCI (n=174, 12%) and previous MI (n=148, 10%). A small number of patients had no information recorded about their comorbidity status (n=35, 2%).

Figure 4.3 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 cardiac or other relevant comorbidity.
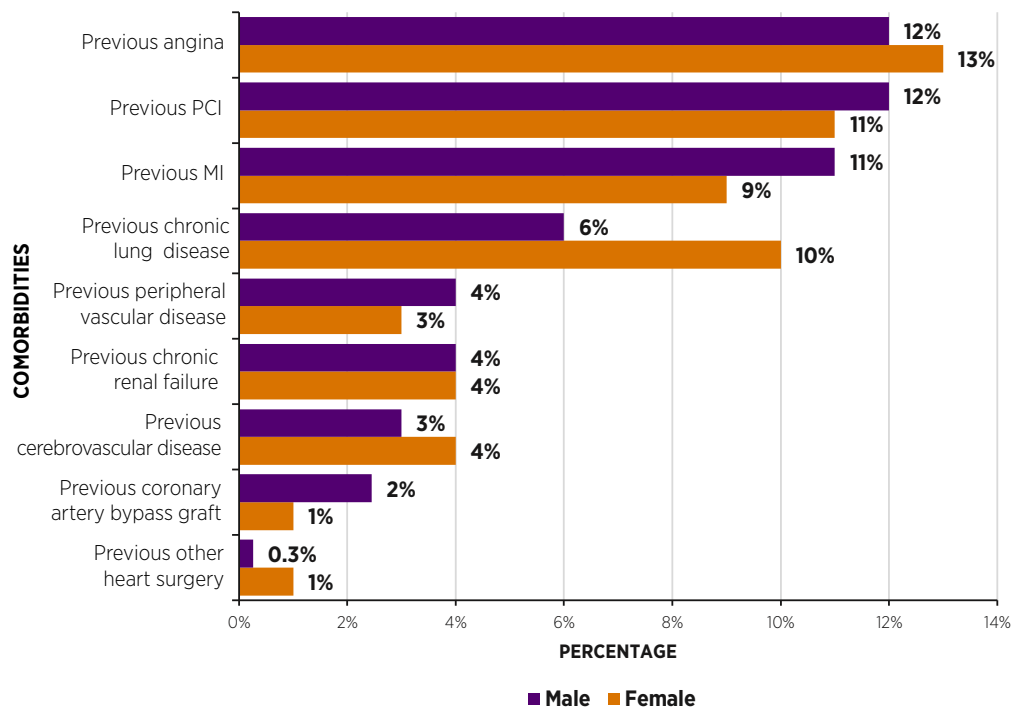
FIGURE 4.3: PRIOR CARDIOVASCULAR DISEASE AND MAJOR COMORBIDITIES IN PATIENTS WITH AN ST ELEVATION MYOCARDIAL INFARCTION, BY SEX[4]

[4] 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

In 2021, the proportion of patients with a STEMI who had a pre-existing diagnosis of coronary artery disease (prior MI, prior angina, prior PCI, and/or prior coronary artery bypass graft (CABG)) was 17% (n=249), unchanged from 2017 to 2020 (NOCA, 2022). Figure 4.4 displays the proportion of patients with a STEMI admitted with prior coronary heart disease, by sex and age group. A larger proportion of male patients had a STEMI as their first presentation of coronary heart disease in every age group, apart from the 80 years or over age group, where the proportion (24%) was similar in both sexes, even though the small numbers within this age group limit any statement regarding this.
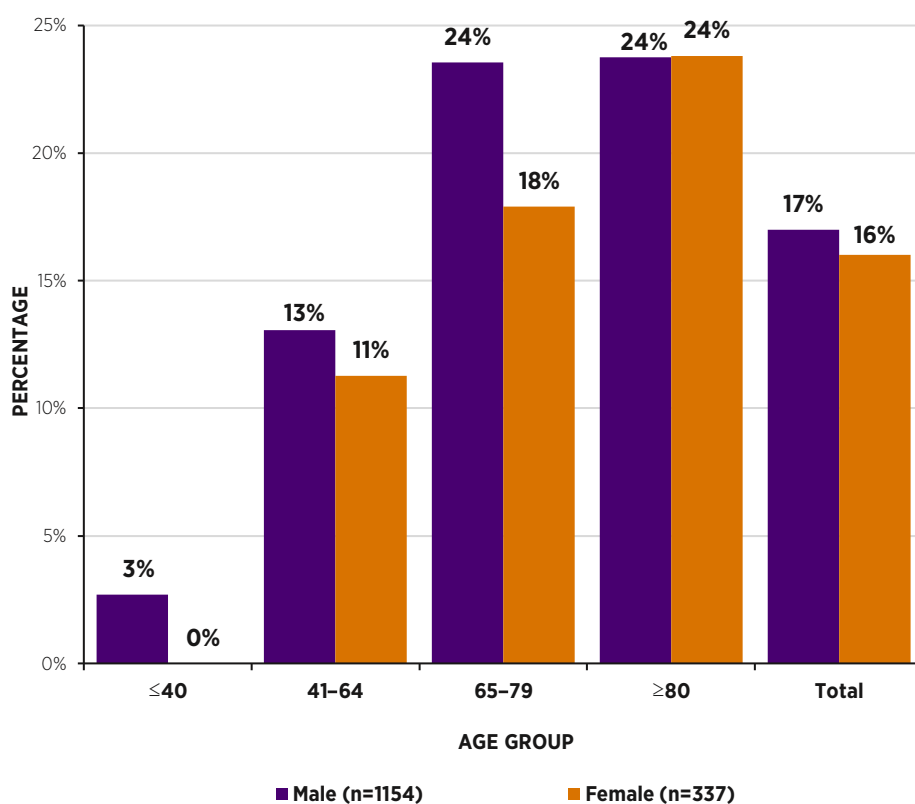
FIGURE 4.4: PROPORTION OF PATIENTS WITH AN ST ELEVATION MYOCARDIAL INFARCTION WITH PRIOR CORONARY HEART DISEASE, BY SEX AND AGE GROUP (N=1491)

DIABETES PROFILE IN PATIENTS WITH A STEMI

While most patients with a STEMI in 2021 did not have diabetes (n=1158, 78%), 18% (n=263) of patients had a diagnosis of diabetes before or during admission, an increase from 14% in 2020 (NOCA, 2022). Type 2 diabetes is not recorded as a specified variable in the Heartbeat dataset but has been previously inferred from 'diabetes controlled with diet or oral medication'. This report may underestimate the true prevalence of type 2 diabetes in patients with a STEMI, as the Heartbeat dataset does not record the subtype of diabetes as a specified variable. The HIPE system captures data on diabetes based on the type. The IHAA is working with the HPO to assess the congruence between the two and the option to report on diabetes from HIPE data only.

Figure 4.5 shows distribution of patients with a STEMI diagnosed with diabetes, by sex and age group. Male patients with a STEMI had a lower rate of diabetes (n=193, 17%), compared with female patients (n=70, 21%).
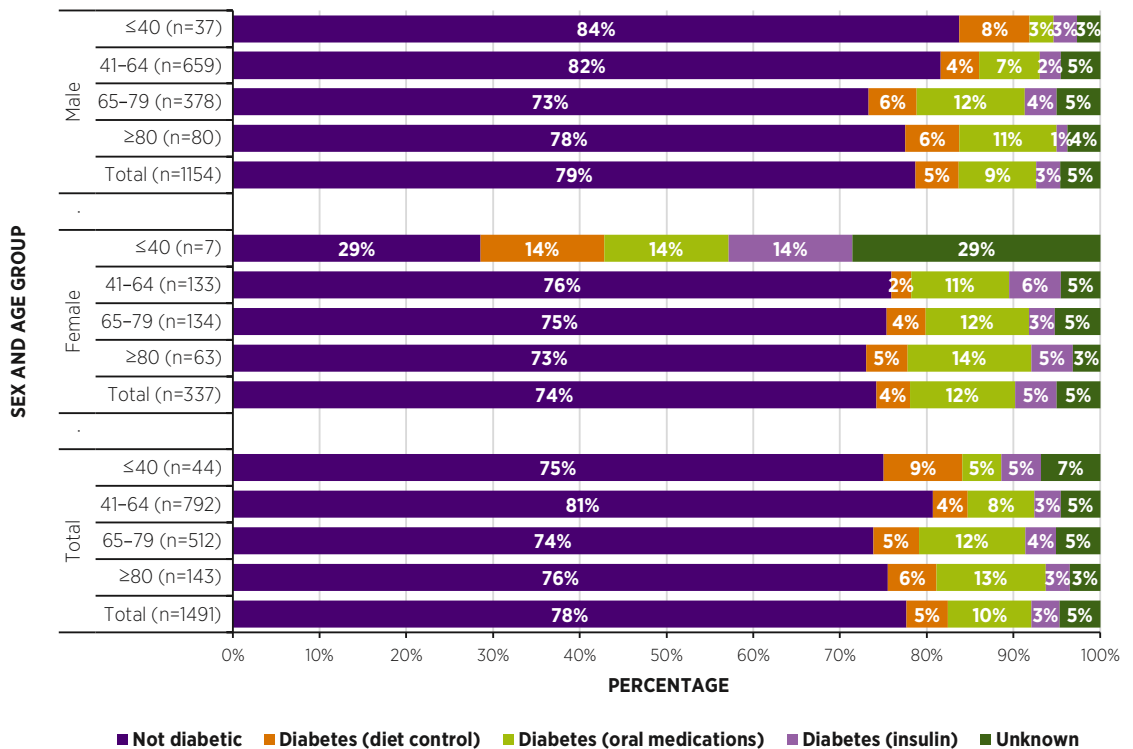
FIGURE 4.5: DIABETES PROFILE OF PATIENTS WITH AN ST ELEVATION MYOCARDIAL INFARCTION, BY SEX AND AGE GROUP (N=1491)

SMOKING AND AGE PROFILE OF PATIENTS WITH A STEMI

In 2021, 39% (n=578) of patients with a confirmed diagnosis of a STEMI were current smokers, with no proportional difference between the sexes (male: n=445, 39%; female: n=133, 39%). This was higher than was reported in 2017–2020 (34%) (NOCA, 2022) and remains substantially higher than the national population average for current smoking, reported at 18% in 2021 (Department of Health, 2021).

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

Smoking causes heart attack at a younger age. On average, smokers present with a STEMI 9 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: 66 years).

This premature heart attack risk was even more pronounced in female smokers. Among males, current smokers presenting with a STEMI had a median age of 56 years (IQR: 49–62 years) compared with a median age of 65 years for males with a STEMI who have never smoked (IQR: 57–74 years). Among females, current smokers presenting with a STEMI had a median age of 62 years (IQR: 55–70 years) compared with a median age of 73 years for females with a STEMI who have never smoked (IQR: 63–82 years).

Figure 4.6 shows the age distribution of patients with a STEMI by sex and age group. The majority of patients aged under 40 years with a STEMI were current smokers (n=31, 70%). Among patients with a STEMI aged 80 years and over, a larger proportion of females had never smoked (n=31, 49%) compared with males (n=33, 41%). 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.

In 2021, of the 249 patients with a STEMI who had prior coronary heart disease, 30% (n=74) were described as former smokers and 34% (n=84) as current smokers. This highlights the importance of continuing supports for smokers who have experienced a STEMI in order to reinforce quitting and to maintain abstinence from smoking, and it highlights smoking relapse as a cause of higher future risk of a second heart attack.
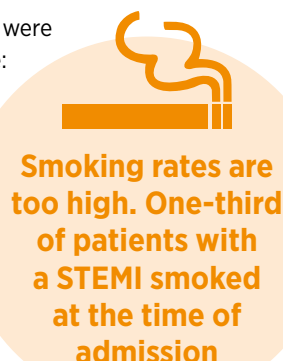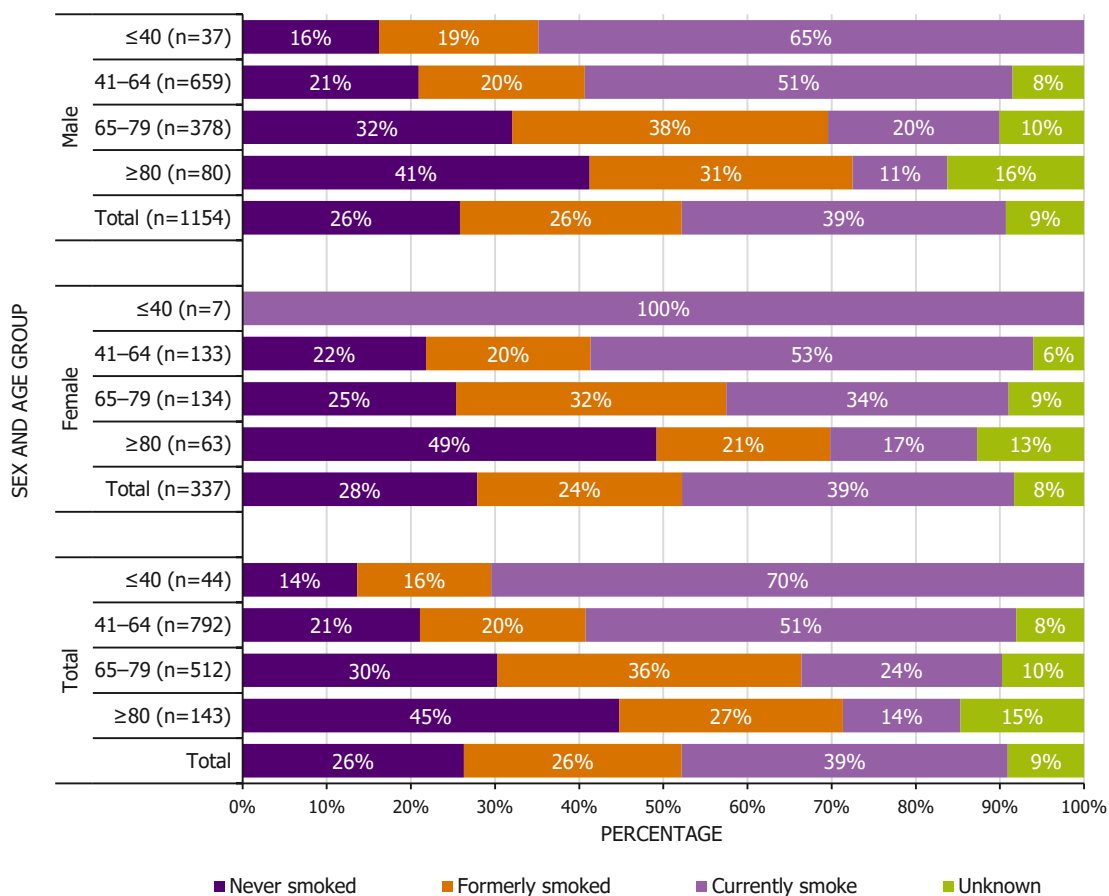
FIGURE 4.6: SMOKING PROFILE OF PATIENTS WITH AN ST ELEVATION MYOCARDIAL INFARCTION, BY SEX AND AGE GROUP (N=1491)[5]

5 The 'Unknown' category includes instances of data recorded as 'Unknown' (n=120) and data not recorded or recorded incorrectly (n=15).

CARDIOVASCULAR RISK FACTOR PROFILE OF PATIENTS WITH A STEMI

In 2021, 82% (n=1222) of patients with a STEMI had at least one cardiovascular risk factor and 12% (n=180) had none. Table 4.2 shows the distribution of cardiovascular risk factors. The most prevalent risk factors were hypercholesterolaemia (n=686, 46%) and hypertension (n=661, 44%).

The most common risk factors for heart attack included a previous history of hypertension (44%) and previous hypercholesterolaemia (46%)

TABLE 4.2: CARDIOVASCULAR RISK FACTOR PROFILE OF PATIENTS WITH AN ST ELEVATION MYOCARDIAL INFARCTION, 2021 (N=1491)

	Yes		No		Unknown		Total	
	N	%	N	%	N	%	N	%
Prior cardiovascular disease	309	21%	1147	77%	35	2%	1491	100%
Diabetes	263	18%	1158	78%	70	5%	1491	100%
Smoking	578	39%	778	52%	135	9%	1491	100%
Previous hypercholesterolaemia	686	46%	695	47%	110	7%	1491	100%
Previous hypertension	661	44%	743	50%	87	6%	1491	100%

Figure 4.7 shows the proportion of patients with a STEMI who have one to five cardiovascular risk factors. More than one-half (n=855, 57%) of patients in 2021 had one or two cardiovascular risk factors. Twenty-three percent (n=265) of male patients with a STEMI had at least three or more cardiovascular risk factors and 30% (n=102) of female patients with a STEMI had at least three or more cardiovascular risk factors. A small number of patients (n=16, 1%) had all five risk factors. A substantial proportion of patients have multiple (>3) potentially modifiable cardiovascular risk factors on presentation. Identifying these individuals with multiple risk factors at an earlier stage in primary care, chronic disease management programmes, the Making Every Contact Count programme and, most importantly, adequately addressing those modifiable risk factors, provides an opportunity to help reduce the incidence of cardiovascular events.
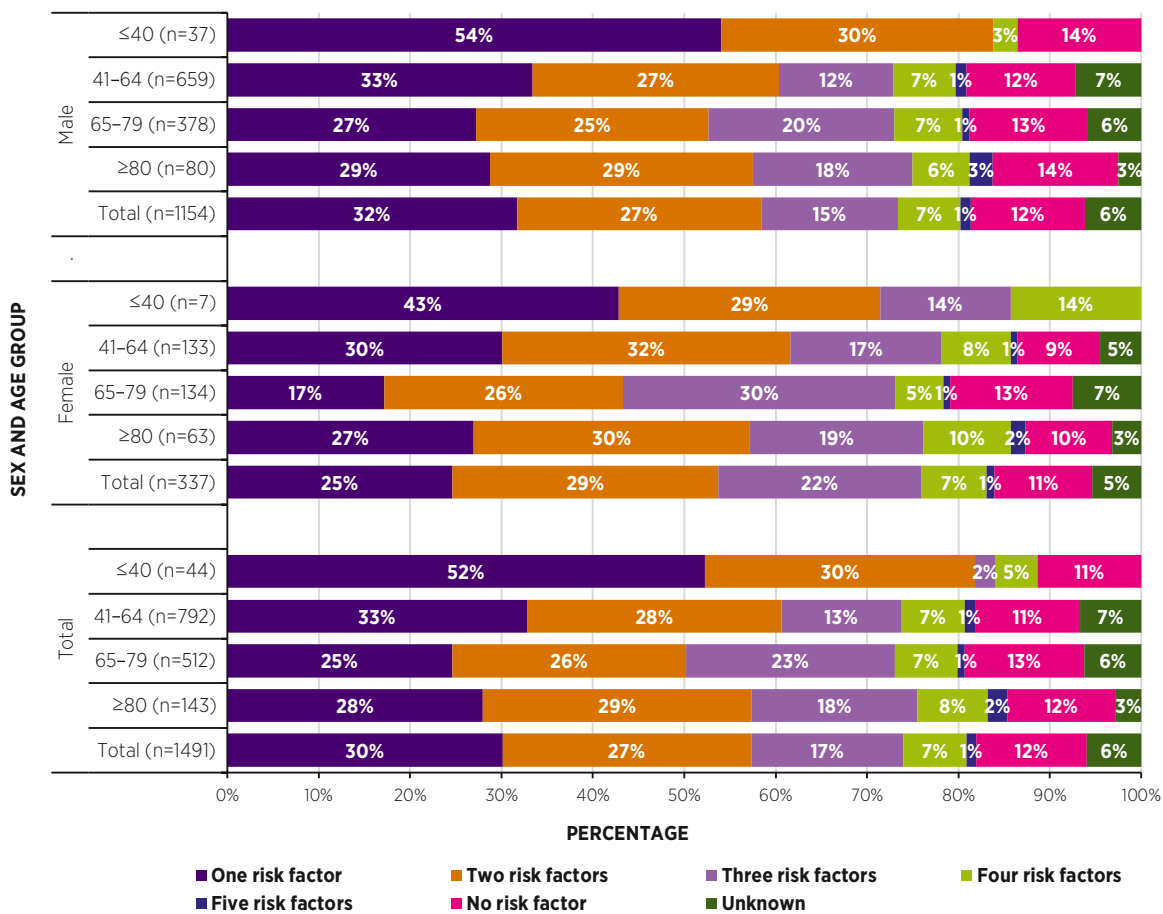
FIGURE 4.7: PREVALENCE OF RISK FACTORS FOR PATIENTS WITH AN ST ELEVATION MYOCARDIAL INFARCTION, BY SEX AND AGE GROUP (N=1491)

KEY FINDINGS FROM CHAPTER 4

- A total of 1742 cases were submitted to the Heartbeat portal in 2021, with 1,491 confirmed STEMI cases (86% of the overall total).

- STEMI was more common in males (n=1154, 77%) with females presenting at an older median age (67 years versus 61 years in males) and with a higher burden of comorbidities.

- Eighty-two percent (n=1222) of patients with a STEMI had at least one known cardiovascular risk factor on presentation, the commonest being hypercholesterolaemia and hypertension, at 46% and 44%, respectively.

- In four out of five cases (n=1214, 81%), STEMI was the initial manifestation of coronary heart disease.

- Eighteen percent (n=263) of patients had a diagnosis of diabetes before or during admission, an increase from 14% in 2020 (NOCA, 2022).

- Thirty-nine percent (n=578) of patients with a STEMI were active smokers at the time of their heart attack. This is higher than reported in 2017–2020 (NOCA, 2022) and is more than double the population rate of smoking (18%).

- Smoking causes premature heart attack, with 70% (n=31) of persons with a STEMI aged 40 years and under actively smoking at the time of their heart attack.

OPPORTUNITY FOR FURTHER QUALITY IMPROVEMENT

Public awareness of the risk factors for heart attack could be improved through an awareness campaign.

Public awareness of the detrimental effect of smoking on heart attack risk could be improved through the diffusion of IHAA results in public awareness campaigns.

CHAPTER 5
PATHWAY TO A PCI CENTRE

CHAPTER 5: **PATHWAY TO A PCI CENTRE**

SCOPE OF CHAPTER 5

This chapter reports the key time intervals for all patients with a STEMI recorded on the Heartbeat portal (N=1491) on the pathway from the initial call for help to arrival at the PCI centre in 2021.

Measuring timeliness for different aspects of the pathway to a PCI centre is complex and varies depending on treatment location and how a patient accessed STEMI care. Appendix 10 provides detailed definitions of each variable used to calculate the time intervals described in this chapter. For most patients with a STEMI, PCI was the primary reperfusion strategy. Patients who had thrombolysis performed as a primary reperfusion strategy but who were also transported to a PCI centre are included in this chapter. However, for timeliness of the pathway to a PCI centre, only patients who had PCI as a primary reperfusion strategy are included.

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 5.1 shows the sources of referral to PCI centres in 2021. Most (n=868, 58%) patients with a STEMI were brought directly by ambulance to a PCI centre. This was a reduction from 66% in 2016 (HSE, 2018a) and 62% in 2020, but was similar to 2017 (58%), 2018 (56%) and 2019 (55%) (NOCA, 2022).

Almost one-third (n=429, 29%) of patients were transferred to a PCI centre from another hospital. This remained broadly unchanged in comparison with 2017–2019 (29%) but was higher than in 2020 (26%) (NOCA, 2022). Excluding Letterkenny University Hospital and UHW, where particular circumstances apply, the proportion of patients with a STEMI who arrived directly by ambulance ranged from 53% (n=187) in Mater Misericordiae University Hospital to 70% (n=133) in University Hospital Limerick (UHL). The location of primary PCI sites and the number of hospitals with an ED service nearby may impact on the proportion of patients who access a PCI centre directly. Non-designated, 9.00am to 5.00pm weekday PCI centres have been amalgamated in this analysis as each treated a small number of patients and the ORS protocol does not recommend transfer to these sites for primary PCI.
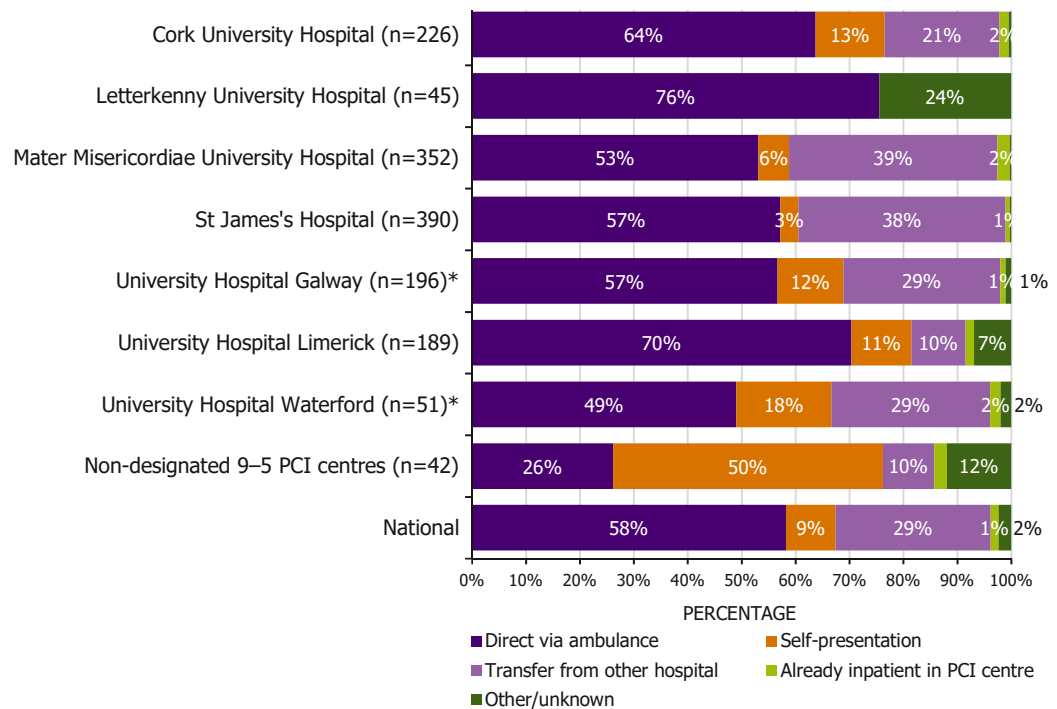
* Coverage was below 80%.

FIGURE 5.1: REFERRAL SOURCE TO A PERCUTANEOUS CORONARY INTERVENTION CENTRE FOR ALL PATIENTS, BY HOSPITAL (N=1491)[6]

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[6] Non-designated, 9.00am to 5.00pm weekday PCI centres include Beaumont Hospital* (n=13), St Vincent's University Hospital (n=15) and Tallaght University Hospital (n=14). Referral sources for these hospitals are included in Appendix 6.

INTERVAL FROM ONSET OF SYMPTOMS TO CALL FOR HELP FOR PATIENTS WHO ARRIVE DIRECTLY BY AMBULANCE

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 112/999 call was received in the ambulance dispatch centre. Figure 5.2 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, by sex. In 2021, the interval between symptom onset and call for help was within 60 minutes for 44% (n=381) of patients with a STEMI who arrived at a PCI centre directly by ambulance. A similar proportion of male patients (n=299, 44%) compared with female patients (n=82, 42%) had an interval between symptom onset and call for help of within 60 minutes.

Only 44% of patients with a STEMI called for help within 60 minutes
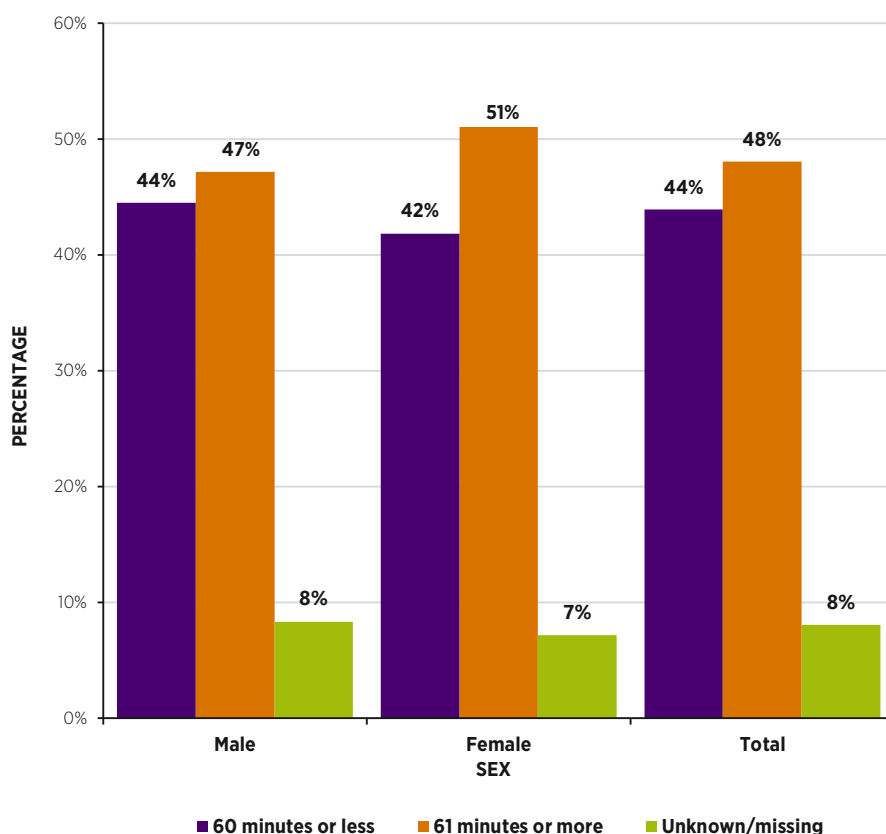
FIGURE 5.2: PROPORTION OF PATIENTS WITH AN ST ELEVATION MYOCARDIAL INFARCTION WITH A SYMPTOM ONSET TO CALL FOR HELP INTERVAL WITHIN 60 MINUTES, BY SEX (n=868)[7]

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[7]   Figure 5.2 only includes patients who arrived at a PCI centre directly by ambulance

INTERVAL FROM FMC TO ARRIVAL AT PCI CENTRE

Standard: It is recommended that all patients with a STEMI be considered for primary PCI unless the estimated interval between FMC and arrival at a PCI centre exceeds 90 minutes. If the estimated travel time exceeds 90 minutes, thrombolysis should be administered (HSE, 2012).

Patients who had thrombolysis as a primary reperfusion strategy were excluded from analysis of timeliness to a PCI centre.[8] Timeliness for this group of patients will be discussed in Chapter 6.

Timeliness of reperfusion has been reported as a national KPI 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).
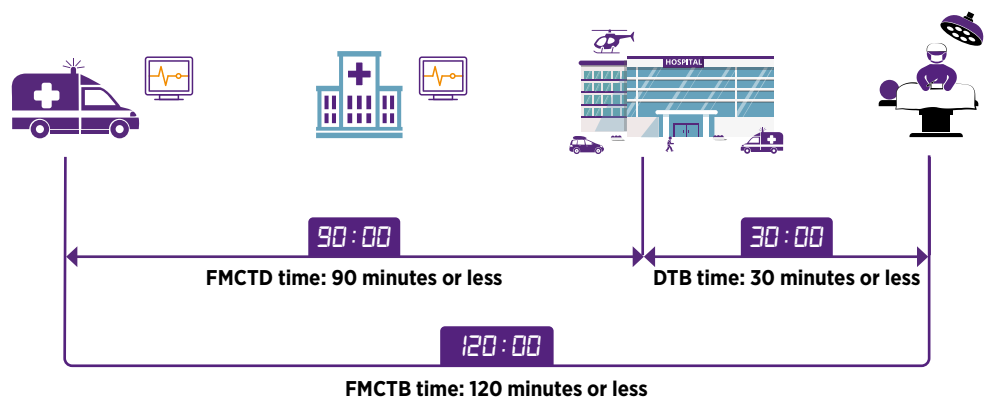
FIGURE 5.3: TIME INTERVAL GOALS

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 5.3). Chapter 6 reports on the DTB and FMCTB times.

As described in Chapter 2: Methodology, the FMC for all patients with a STEMI is the time of the first diagnostic ECG. Most (n=815, 55%) patients had the first positive 12-lead ECG performed in a pre-hospital location by ambulance personnel; 38% (n=573) were performed in the ED; and 3% (n=46) of patients had the first positive 12-lead ECG performed in a general practitioner (GP) surgery. For further information on the location where the first positive 12-lead ECG was recorded, see Appendix 9 (Table 9.2).

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8   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.

FIRST MEDICAL CONTACT TO DOOR TIME

For the overall population with a STEMI, the median FMCTD time was 70 minutes (IQR: 45–105 minutes).

FMCTD TIME – DIRECT BY AMBULANCE TO A PCI CENTRE

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. Figure 5.4 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 sex. A total of 80% (n=597) of patients achieved a timely FMCTD time. A similar proportion of male patients (n=464, 81%) and female patients (n=133, 79%) achieved a timely FMCTD time. When 2020 data were adjusted for the slight difference in methodology used in 2021,[9] this interval did not differ from that reported in 2020. The median FMCTD time for all patients who arrived at a PCI centre by ambulance was 58 minutes (IQR: 38–82 minutes) and did not differ from that reported in 2020 (median: 59 minutes, IQR: 40–80 minutes).

80% of patients with a STEMI brought directly to the PCI centre arrived within the 90 minute or less target

* Coverage was below 80%.

■ 90 minutes or less   ■ 91 minutes or more   ■ Unknown/missing
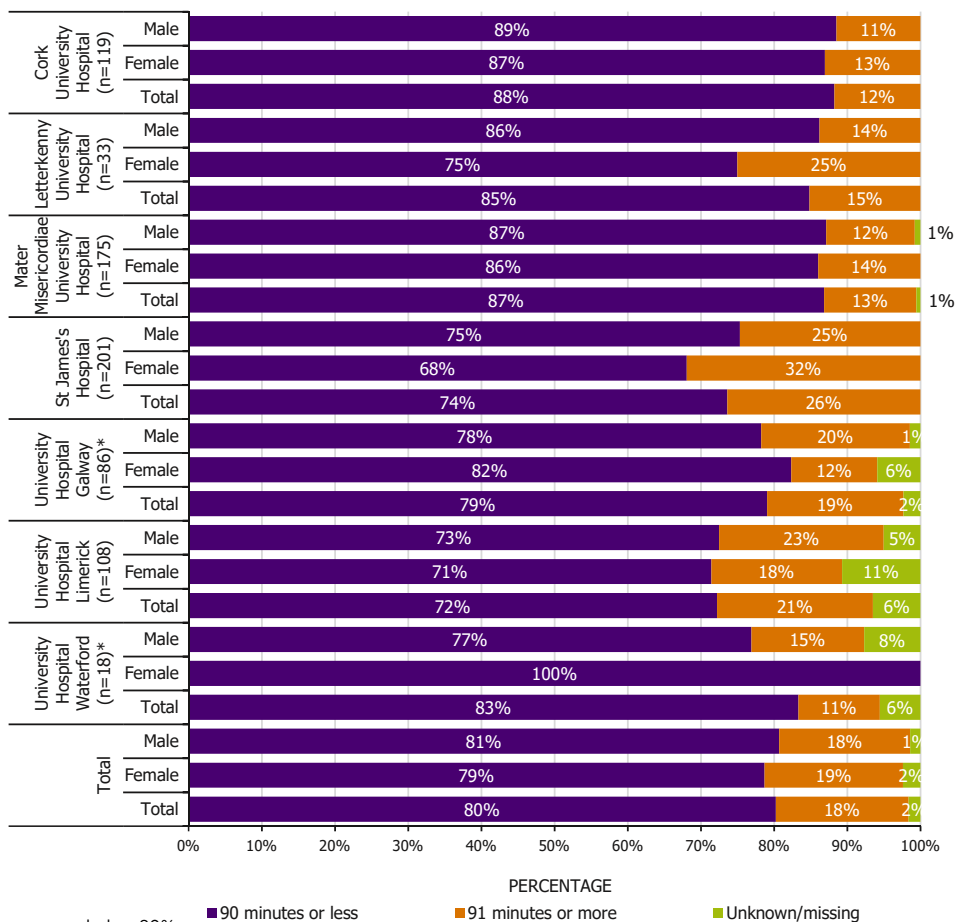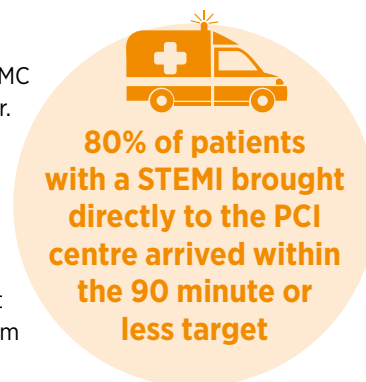
FIGURE 5.4: PROPORTION OF PATIENTS WITH AN ST ELEVATION MYOCARDIAL INFARCTION WHO ARRIVED DIRECTLY BY AMBULANCE WITHIN THE TARGET TIME OF 90 MINUTES, BY PERCUTANEOUS CORONARY INTERVENTION CENTRE (n=744)[10,11]

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9   In the NOCA (2022) report, patients for whom time information was not recorded or was recorded incorrectly (n=53) were excluded.

10 Hospitals: Beaumont Hospital*, St Vincent's University Hospital and Tallaght University Hospital are not presented in Figure 5.4 as they had fewer than five patients, but are included in the national figure.

11 Patients who had hospital or pre-hospital thrombolysis (n≤1) were excluded. Only patients who had their 12-lead ECG performed by an ambulance practitioner are included in the analysis.

FMCTD TIME – TRANSFERRED TO A PCI CENTRE FROM FIRST HOSPITAL

Only 33% of patients with a STEMI transferred to the PCI centre arrived within the 90 minute or less target

In 2021, 33% (n=117) of patients with a STEMI were transferred from the first hospital of arrival to a PCI centre within 90 minutes (Figure 5.5). The median FMCTD time for patients with a STEMI transferred to a PCI centre for primary PCI was 115 minutes (IQR: 81–170 minutes). Note that results in Figure 5.5 are not comparable with 2020 results, due to a difference in methodology; i.e. in the *Irish Heart Attack Audit National Report 2017-2020* (NOCA, 2022), the FMC for patients with a STEMI who were transferred to a PCI centre for primary PCI was defined as the time a patient arrived at the first hospital, not as the time of the first positive ECG.
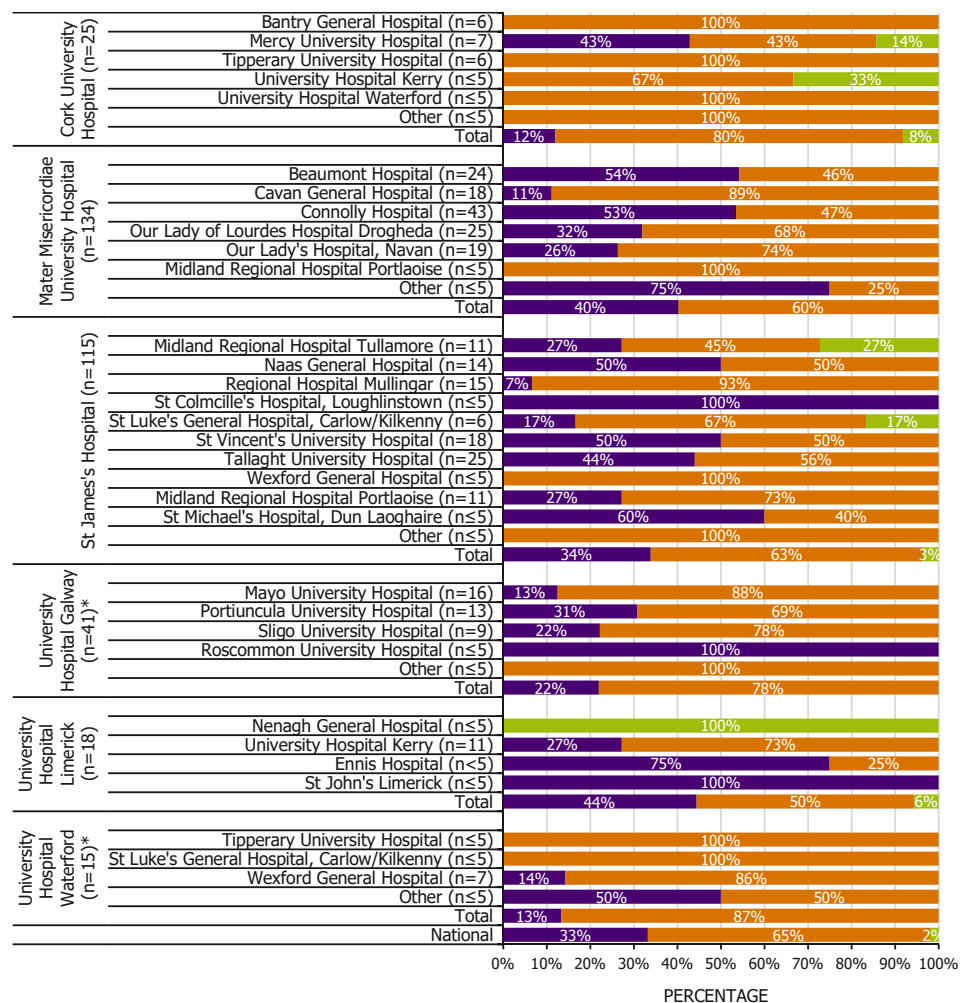
* Coverage was below 80%.

■ 90 minutes or less ■ 91 minutes or more ■ Unknown/missing

FIGURE 5.5: PROPORTION OF PATIENTS WITH AN ST ELEVATION MYOCARDIAL INFARCTION WHO WERE TRANSFERRED TO A PCI CENTRE, WHO ARRIVED WITHIN THE TARGET TIME OF 90 MINUTES, BY PERCUTANEOUS CORONARY INTERVENTION CENTRE (n=352)[12]

[12] Patients who had hospital or pre-hospital thrombolysis (n=77) were excluded. Tallaght University Hospital and St Vincent's University Hospital were excluded individually from Figure 5.5, as they had fewer than five patients, but are included in the national figure. There were no patients transferred from other hospitals to Beaumont Hospital or Letterkenny University Hospital.

AMBULANCE OFF-LOAD LOCATION FOR PATIENTS BROUGHT FOR PRIMARY PCI

For patients with a STEMI, the European Society of Cardiology (ESC) recommends an ED bypass direct to the cath lab in >80% of cases (Ibanez *et al.,* 2018). Figure 5.6 shows the ambulance off-load location for patients who arrived at the PCI centre directly by ambulance and for patients who were transferred from another hospital to a PCI centre. For those who arrived directly by ambulance, 73% (n=635) were brought directly to the cath lab, bypassing the ED. This was consistent with 2019 results (73%) but was a decline from 78% in 2020 (NOCA, 2022). Direct arrival at the cath lab may not be possible for valid reasons such as staff availability outside normal working hours (e.g. where the anticipated arrival time of the patient is below the 30-minute threshold for the on-call staff to arrive on site) or because the cath lab may be occupied (out of hours) by another patient. In such circumstances, it may be safer for the patient to be managed in the ED with nursing, medical care and monitoring prior to transferring to the cath lab.

For patients who were transferred to a PCI centre, 94% (n=331) went directly to the cath lab while 5% (n=19) went first to the ED. This did not differ from reported 2020 results (cath lab: 94%; ED: 6%) (NOCA, 2022).

For all patients with a STEMI admitted directly via ambulance or transferred from another hospital to a PCI centre for primary PCI (n=1217), the majority (n=1029, 85%) were stable on admission to the PCI centre, compared with 87% in 2020 (NOCA, 2022). For more detailed information on clinical status on arrival at the PCI centre, by hospital, see Appendix 9 (Table 9.3).
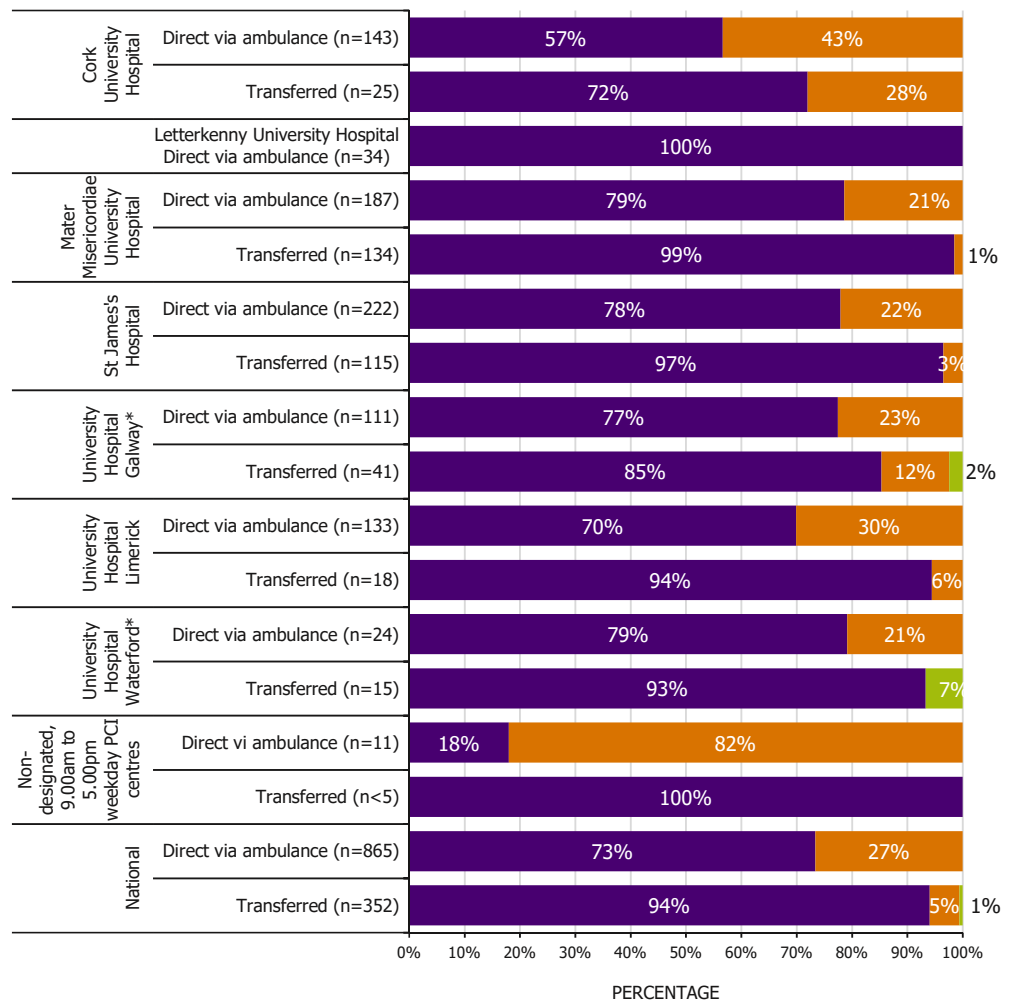
* Coverage was below 80%.

Legend: ■ Ambulance off-load at cath lab   ■ Ambulance off-load at ED   ■ Unknown

FIGURE 5.6: LOCATION OF AMBULANCE OFF-LOAD AT THE PERCUTANEOUS CORONARY INTERVENTION CENTRE FOR PATIENTS WHO ARRIVED DIRECTLY BY AMBULANCE, BY HOSPITAL (n=1217)[13,14,15]

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[13] Patients who had hospital and pre-hospital thrombolysis were excluded from this analysis.
[14] Non-designated, 9.00am to 5.00pm weekday PCI centres: Beaumont Hospital, St Vincent's University Hospital and Tallaght University Hospital were not included in Figure 5.6 due to small number of admissions (n=15). However, they are included in the national figure.
[15] There were no patients transferred from other hospitals to Letterkenny University Hospital.

KEY FINDINGS FROM CHAPTER 5

- The proportion of patients brought directly by ambulance to a PCI centre did not improve in 2021 (n=868, 58%) compared with 2017–2020 (average 58%). Moreover, this indicator has disimproved since the 2016 report (66%) (HSE, 2018a).

- Most patients (n=597, 80%) brought directly to a PCI centre by ambulance arrived within the recommended time frame of 90 minutes.

- Patients transferred from another hospital continue to account for a substantial proportion of all patients who received primary PCI (n=29%). The FMCTD time to a PCI centre within the recommended 90-minute time frame was achieved for only one-third of patients. This ultimately impacted the timeliness of their reperfusion and remained consistently below target. The reasons for this persistent problem are not clear.

- Only 44% (n=381) of patients with a STEMI who arrived at a PCI centre directly by ambulance called for help within 60 minutes of onset of symptoms.

OPPORTUNITY FOR FURTHER QUALITY IMPROVEMENT

Public awareness of the importance of calling 112/999 could be improved through an awareness campaign.

Develop a quality improvement (QI) project to improve the pathway to a primary PCI centre for patients with a STEMI who arrive at a non-PCI hospital and are transferred to a primary PCI centre.

CHAPTER 6: REPERFUSION THERAPY FOR PATIENTS WITH A STEMI

SCOPE OF CHAPTER 6

This chapter describes the reperfusion therapy, as recorded on the Heartbeat portal, received by all patients with a STEMI. It focuses on the analysis of the cohort where reperfusion was not contraindicated and reports on the timeliness of the two types of reperfusion therapy: primary PCI and thrombolysis. The results of four key quality indicators (KQIs) as reported in the IHAA dashboard are also highlighted. Appendix 10 provides detailed definitions of the composite variables reported in this chapter.

REPERFUSION THERAPY TYPE

Overall, 1,491 patients with a STEMI were recorded on the Heartbeat portal. Seventy-nine percent (n=1175) had primary PCI and 5% (n=81) had thrombolysis as the primary reperfusion strategy; 12% (n=178) had a contraindication to reperfusion; 4% where the primary strategy was primary PCI did not require reperfusion after angiography (Table 6.1).

In 2021, a lower proportion of patients with a STEMI received primary PCI (79%) as their initial reperfusion therapy, compared with the 84% of patients reported in 2020 (NOCA, 2022). There was also an increase in the proportion of patients with contraindications to reperfusion therapy (n=178, 12%), compared with 7% (n=93) in 2020; this difference was also statistically significant (NOCA, 2022). The most common contraindication was late (>12 hours) presentation (n=160, 90%; see Table 9.4 in Appendix 9). The type of reperfusion therapy performed, categorised by hospital and sex, is displayed in Table 6.1. There was no difference in the type of reperfusion therapy between male and female patients with a STEMI.

Analysis of timeliness of reperfusion excludes patients with a contraindication to reperfusion therapy. The IHAA dashboard reports on the percentage of eligible patients with a STEMI who were also offered reperfusion.

KQI 1: The percentage of eligible patients with a STEMI who were offered reperfusion.

TARGET: 95% RESULT: 96%

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 AND SEX (N=1491)

		MALE		FEMALE		TOTAL	
		N	%	N	%	N	%
Cork University Hospital	Thrombolysis	*	*	~	*	*	*
	Primary PCI	130	71%	23	52%	153	68%
	No reperfusion required	~	*	~	*	~	*
	Contraindicated	27	15%	14	32%	41	18%
	Total	**182**	**100%**	**44**	**100%**	**226**	**100%**
Letterkenny University Hospital	Thrombolysis	0	0%	0	0%	0	0%
	Primary PCI	*	*	6	100%	*	*
	No reperfusion required	~	*	0	0%	~	*
	Contraindicated	0	0%	0	0%	0	0%
	Total	**39**	**100%**	**6**	**100%**	**45**	**100%**
Mater Misericordiae University Hospital	Thrombolysis	~	*	0	0%	~	*
	Primary PCI	227	87%	76	84%	303	86%
	No reperfusion required	~	*	~	*	14	4%
	Contraindicated	~	*	*	*	32	9%
	Unknown	~	*	0	0%	~	*
	Total	**262**	**100%**	**90**	**100%**	**352**	**100%**
St James's Hospital	Thrombolysis	*	*	*	*	36	9%
	Primary PCI	234	80%	77	80%	311	80%
	No reperfusion required	*	*	~	*	8	2%
	Contraindicated	24	8%	11	11%	35	9%
	Total	**294**	**100%**	**96**	**100%**	**390**	**100%**
University Hospital Galway**	Thrombolysis	*	*	~	*	16	8%
	Primary PCI	110	69%	27	75%	137	70%
	No reperfusion required	*	*	~	*	12	6%
	Contraindicated	*	*	~	*	31	16%
	Total	**160**	**100%**	**36**	**100%**	**196**	**100%**
University Hospital Limerick	Thrombolysis	0	0%	~	*	~	*
	Primary PCI	128	88%	38	88%	166	88%
	No reperfusion required	~	*	0	0%	~	*
	Contraindicated	*	*	~	*	21	11%
	Total	**146**	**100%**	**43**	**100%**	**189**	**100%**
University Hospital Waterford**	Thrombolysis	~	*	0	0%	~	*
	Primary PCI	23	64%	8	53%	31	61%
	No reperfusion required	~	*	~	*	~	*
	Contraindicated	*	*	*	*	15	29%
	Total	**36**	**100%**	**15**	**100%**	**51**	**100%**
Beaumont Hospital**	Thrombolysis	~	*	0	0%	~	*
	Primary PCI	*	*	~	*	10	77%
	No reperfusion required	0	0%	0	0%	0	0%
	Contraindicated	~	*	0	0%	~	*
	Total	**11**	**100%**	**~**	*****	**13**	**100%**
St Vincent's University Hospital	Thrombolysis	0	0%	0	0%	0	0%
	Primary PCI	*	*	~	*	11	73%
	No reperfusion required	~	*	*	*	4	27%
	Contraindicated	0	0%	0	0%	0	0%
	Total	*****	*****	**~**	*****	**15**	**100%**
Tallaght University Hospital	Thrombolysis	0	0%	0	0%	0	0%
	Primary PCI	*	*	~	*	11	79%
	No reperfusion required	~	*	~	*	~	*
	Contraindicated	~	*	0	0%	~	*
	Total	*****	*****	**~**	*****	**14**	**100%**
Total	Thrombolysis	69	6%	12	4%	81	5%
	Primary PCI	914	79*	261	77%	1175	79%
	No reperfusion required	*	*	16	5%	*	*
	Contraindicated	130	11%	48	14%	178	12%
	Unknown	~	*	0	0%	~	*
	Total	**1154**	**100%**	**337**	**100%**	**1491**	**100%**

Non-designated Monday – Friday 9-5 PCI centres

~ Denotes five cases or fewer

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

** Coverage was below 80%.

REPERFUSION THERAPY TYPE BY REFERRAL SOURCE

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, the patient should be treated with thrombolysis and subsequently transferred to a PCI centre (sometimes called the 'drip-and-ship' strategy). In that scenario, the ORS recommends administration of thrombolysis within 30 minutes of diagnosis of a STEMI. If a patient can be transferred to a PCI centre in 90 minutes or less, the ESC recommends that the time between arrival at the first hospital (for thrombolysis) 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 had primary PCI (n=879, 86%), similar to the percentage in 2020 (88%) (NOCA, 2022). However, 18% (n=77) of patients presenting to non-PCI hospitals had thrombolysis, an increase (p<.05) from 12% in 2020 (NOCA, 2022).

PERCENTAGE

- Thrombolysis
- Primary PCI
- No reperfusion required
- Contraindicated
- Unknown
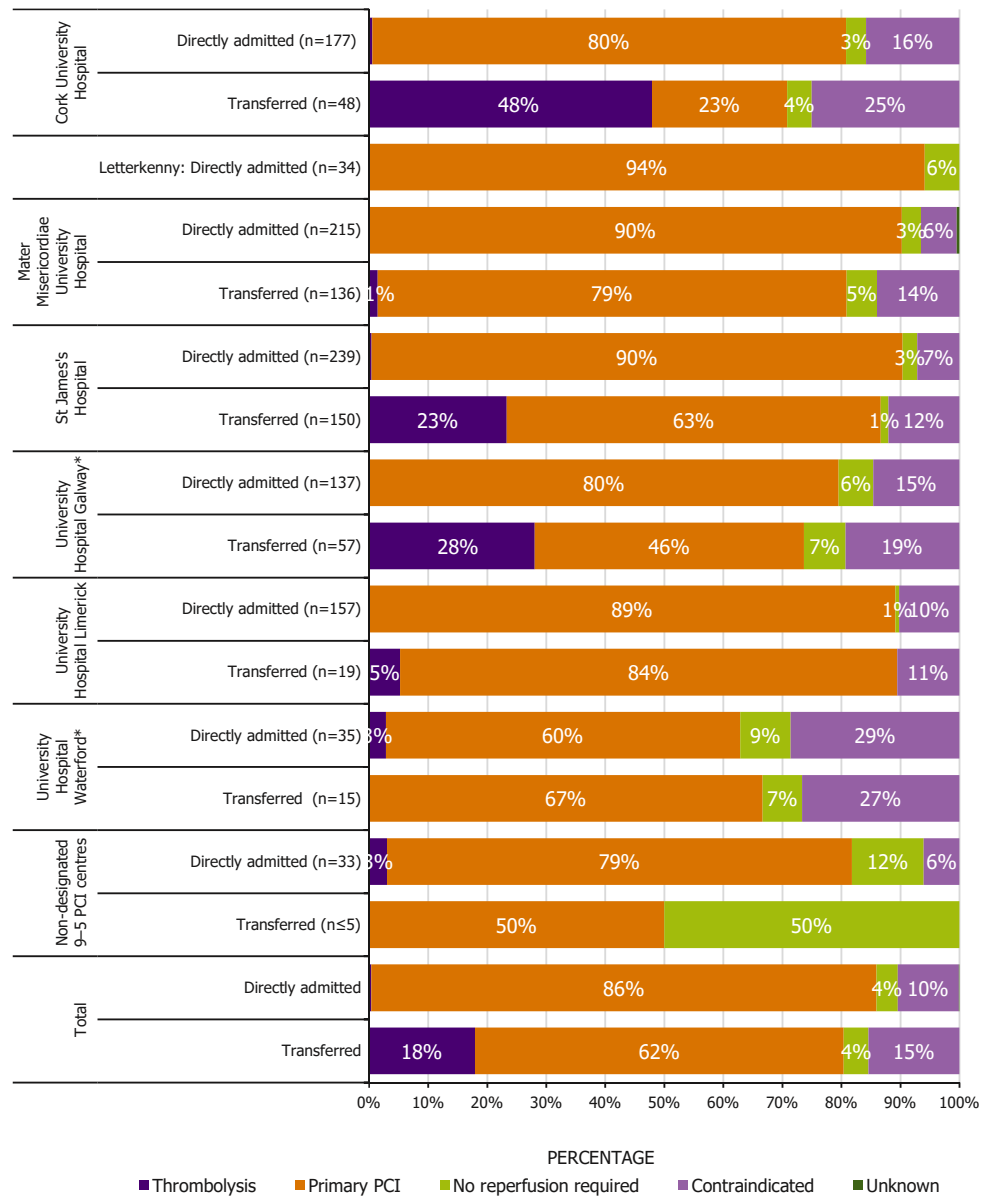
* Coverage was below 80%.

FIGURE 6.1: REPERFUSION THERAPY TYPE, BY REFERRAL SOURCE AND PERCUTANEOUS CORONARY INTERVENTION CENTRE (n=1456)[16,17]

16 'Directly admitted to a PCI centre' includes patients who arrived at the PCI centre directly via ambulance, inpatients in a PCI centre, and patients who self-presented to a PCI centre. Non-designated, 9.00am to 5.00pm weekday PCI centres include Beaumont Hospital*, St Vincent's University Hospital and Tallaght University Hospital. Reperfusion therapy type for these hospitals are included in Appendix 6.
17 Patients for whom the source of referral was not recorded, or was recorded as 'Other', were excluded from Figure 6.1 (n=35).

TIMELINESS OF REPERFUSION

DOOR TO BALLOON

Chapter 5 described the first part of the pathway to timely primary PCI, namely first medical contact to door (FMCTD), with a target from FMC to arrival at the door of the PCI centre of 90 minutes or less. The second part of the pathway is the time interval from arrival at the PCI centre to reopening the artery responsible for the heart attack by primary PCI. This is described as the DTB time and the target is 30 minutes or less (HSE, 2012), allowing the PCI centre 30 minutes to receive the patient and provide primary PCI within the target of 120 minutes or less (Figure 6.2).

FMCTD time: 90 minutes or less

DTB time: 30 minutes or less

FMCTB time: 120 minutes or less
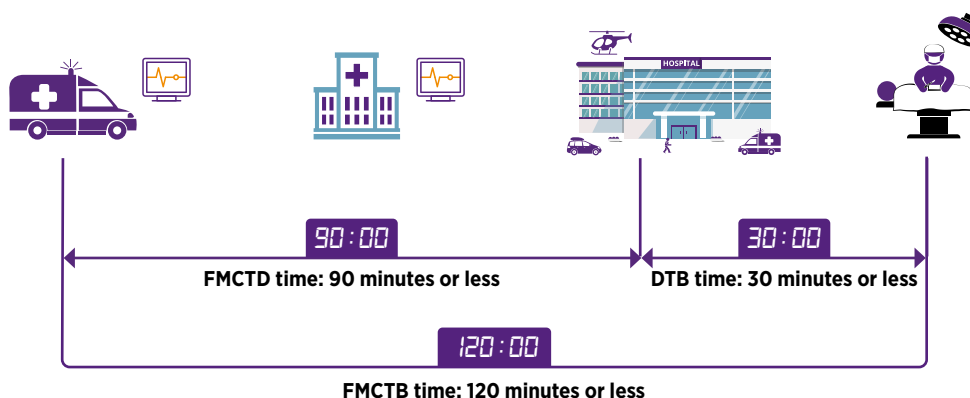
FIGURE 6.2: TIME INTERVAL GOALS

In total, 59% (n=673) of all patients with a STEMI who received primary PCI had a DTB time within 30 minutes. A larger proportion of patients who were transferred to a PCI centre had a DTB time within 30 minutes (n=192, 72%) in comparison with patients who arrived directly at a PCI centre (n=481, 55%) (Figure 6.3). This is because the longer transfer times allowed the cath lab team time to arrive on site prior to the patient's arrival compared to patients brought directly, where rapid ambulance transfer, especially in urban areas, may mean that the patient arrives before the clinical team. There is variation between PCI centres, with 73% (n=221) of cases in the Mater Misericordiae University Hospital achieving a DTB time within 30 minutes compared with just 35% (n=54) of cases in Cork University Hospital. This variation warrants further attention within each PCI centre in order to try and understand and identify delays/local factors contributing to this variation. Within the non-designated, 9.00am to 5.00pm weekday PCI centres, only 4% (n≤5) of patients achieved a DTB time within 30 minutes. The median DTB time for all patients with a STEMI who received primary PCI was 25 minutes (IQR: 17–48 minutes), similar to the 27 minutes DTB (IQR: 19–44 minutes) achieved in 2017–2020 (NOCA, 2022). For those admitted directly to a PCI centre, this was 28 minutes (IQR: 18–52 minutes), and for those who were transferred to a PCI centre, it was 21 minutes (IQR: 15–34 minutes). Appendix 9 (Table 9.5) displays the median DTB times and IQRs, by referral source and hospital.

30 minutes or less ■   **31 minutes or more** ■   **Unknown** ■
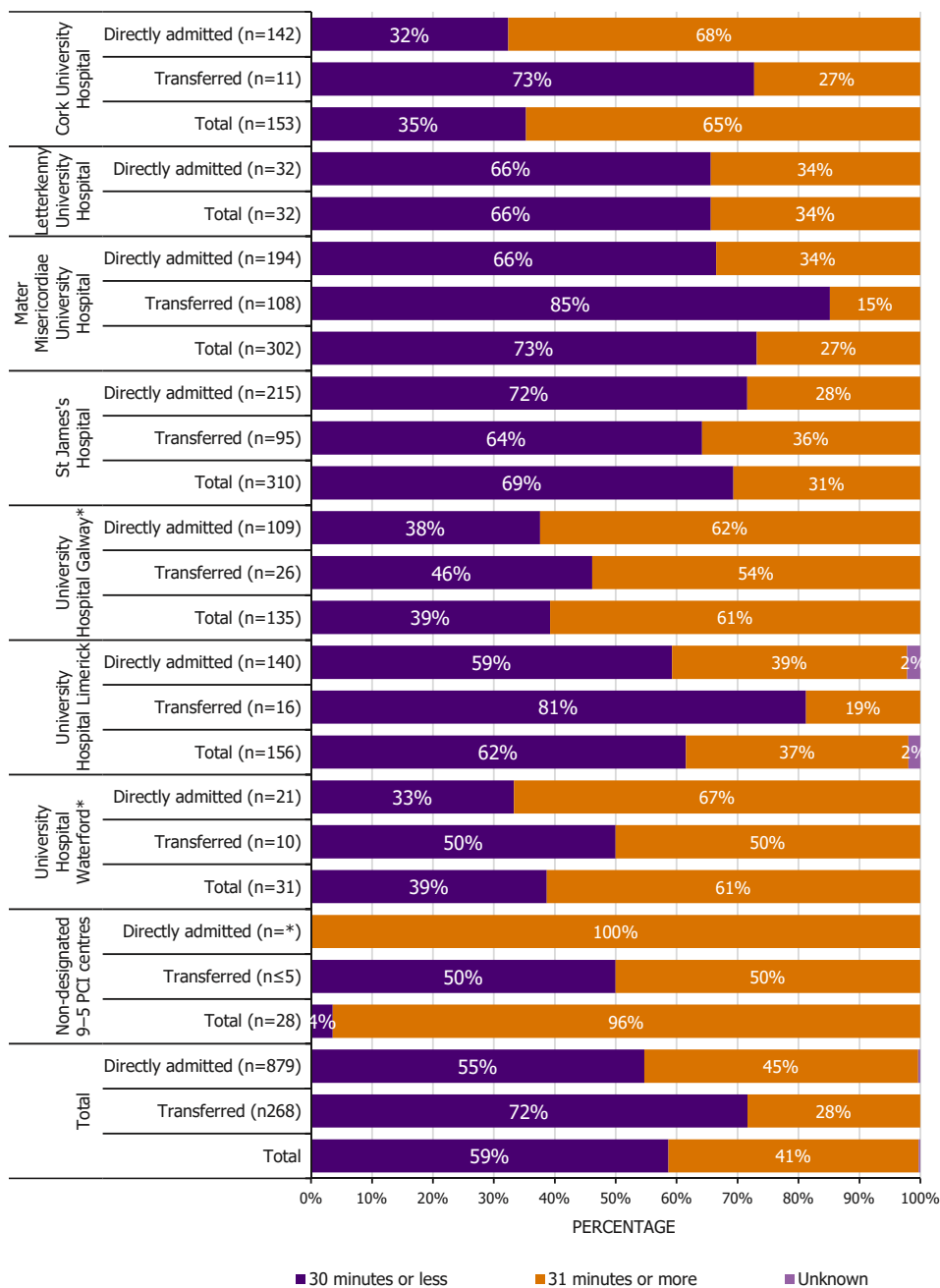
* Coverage was below 80%.

FIGURE 6.3: DOOR TO BALLOON TIME FOR PATIENTS DIRECTLY ADMITTED OR TRANSFERRED TO A PERCUTANEOUS CORONARY INTERVENTION CENTRE, BY HOSPITAL (n=1147)[18]

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[18]   Non-designated, 9.00am to 5.00pm weekday PCI centres include Beaumont Hospital*, St Vincent's University Hospital and Tallaght University Hospital. DTB times for these hospitals are included in Appendix 6.

DEFINING TIMELY REPERFUSION

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). Table 6.2 displays definitions for timely thrombolysis and timely primary PCI. The *Acute Coronary Syndromes Model of Care* (HSE, 2012) has an agreed target that 90% of patients with a STEMI (who do not have a contraindication to reperfusion) should receive timely reperfusion (HSE, 2012).

TABLE 6.2: DEFINITION OF TIMELY THROMBOLYSIS AND TIMELY PRIMARY PERCUTANEOUS CORONARY INTERVENTION	
Timely thrombolysis	Timely thrombolysis is defined as an interval between FMC and initiation of thrombolysis (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 time of the first positive ECG. For thrombolysis given in hospital, the FMC is defined as the time of arrival at the first hospital, except for inpatients, where the first positive ECG is used.
Timely primary PCI	Timely primary PCI is defined as an interval between FMC and balloon/wire cross of 120 minutes or less (HSE, 2012; Hamm *et al.,* 2011). From 2021 onwards, FMC is defined as the time of the first diagnostic ECG in all cases.

TIMELY REPERFUSION IN ALL PATIENTS WITH A STEMI

Figure 6.4 shows the proportion of patients with a STEMI who received timely reperfusion, either thrombolysis or primary PCI. Overall, 69% (n=852) of patients with a STEMI received timely reperfusion, well below the target of 90%. Although there was a slight change in methodology,[19] this remains unchanged from 2020 (69%; NOCA, 2022). The median time to reperfusion (primary PCI and thrombolysis) was 94 minutes (IQR: 68–125 minutes). There is variation between PCI centres, with only two PCI centres reaching the 90% target.

* Coverage was below 80%.
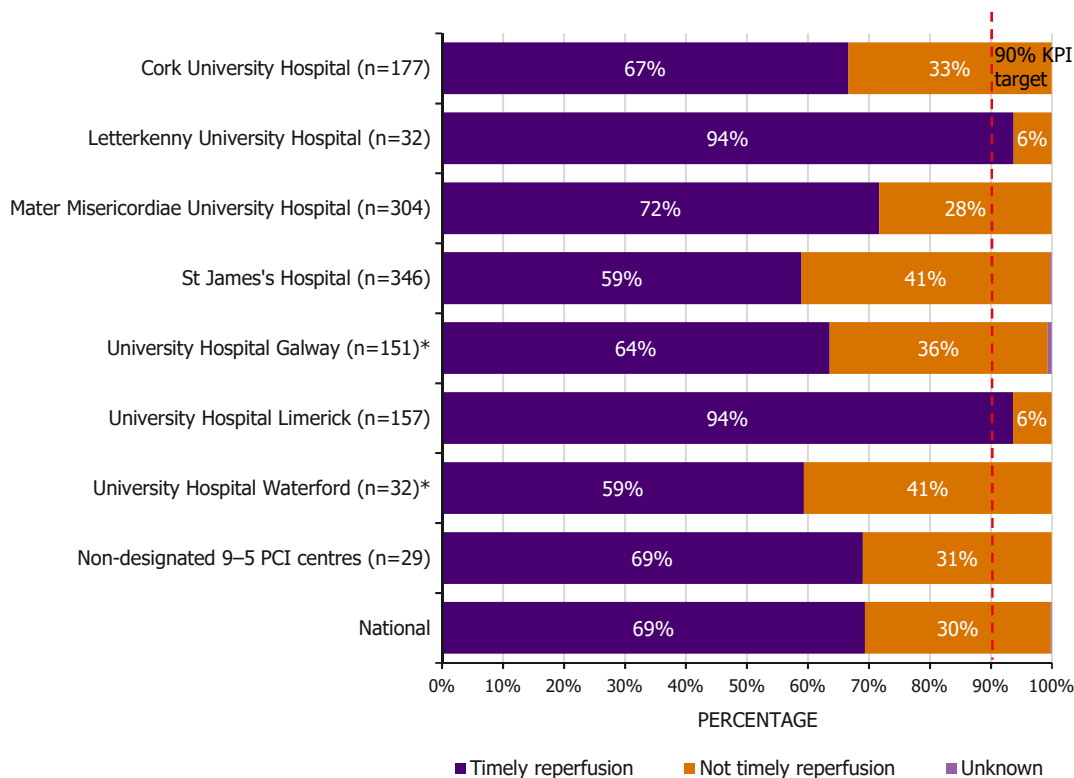
FIGURE 6.4: PROPORTION OF PATIENTS WHO RECEIVED TIMELY PRIMARY PERCUTANEOUS CORONARY INTERVENTION AND THROMBOLYSIS REPERFUSION BY HOSPITAL (n=1228)[20]

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[19] In the 2017–2020 report (NOCA, 2022), patients who arrived directly by ambulance and did not have their first ECG in the ambulance were excluded. Timeliness of patients who were transferred to a PCI centre was calculated using the date and time of arrival at the first hospital, as opposed to the first positive ECG.

[20] Non-designated, 9.00am to 5.00pm weekday PCI centres include Beaumont Hospital*, St Vincent's University Hospital and Tallaght University Hospital. Timeliness for these hospitals is included in Appendix 6.

TIMELINESS OF THROMBOLYSIS THERAPY

Figure 6.5 shows the proportion of patients with a STEMI who received timely thrombolysis. One-quarter (n=20, 25%) of patients with a STEMI received timely thrombolysis in 2021.

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=686, 58%) of patients with a STEMI are brought directly by ambulance to PCI centres, bypassing non-PCI centres; however, almost one-third (n=429, 29%) still present to non-PCI centres (Figure 5.1). In the non-PCI centres, the ORS protocol advocates immediate transfer to a PCI centre within 90 minutes, if possible. No information is recorded for patients with a STEMI who receive thrombolysis and are not transferred to a PCI centre.

Only 25% of patients with a STEMI received timely thrombolysis in 2021

The number of cases treated by thrombolysis has increased in 2021 compared with 2017–2020 (NOCA, 2022). This may reflect a greater focus on delivery of thrombolysis for patients who cannot be transferred in a timely transfer for primary PCI. However, only 25% (n=20) of patients receive timely thrombolysis. The reasons for this are unclear, may differ among PCI centres, and should be further clarified. Improving the timeliness of thrombolysis is a recommendation in this report.

■ **Timely (within 30 minutes)** ■ **Not timely** ■ **Unknown**
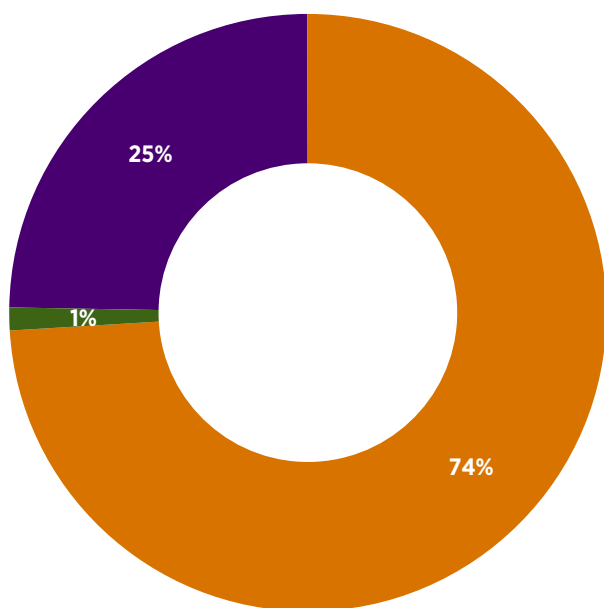
FIGURE 6.5: PROPORTION OF PATIENTS WHO RECEIVED TIMELY REPERFUSION WITH THROMBOLYSIS (n=81)

TIMELINESS OF PRIMARY PCI THERAPY

Overall, 73% (n=832) of patients with a STEMI received primary PCI within 120 minutes of first medical contact (FMC), which is below the 90% target. Although there was a slight change in methodology,[21] 2021 results show an increase from 68% in 2017–2020 (NOCA, 2022). Only two primary PCI centres, University Hospital Limerick and Letterkenny University Hospital, achieved the 90% target.

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). Eighty-two percent (n=722) of patients with a STEMI who were admitted directly to a PCI centre had timely reperfusion.

KQI 2: Percentage of patients with a STEMI who had timely primary PCI – Arrived directly to PCI centre

TARGET: 90% RESULT: 82%

Patients who were transferred to a PCI centre from another hospital achieved this target in 41% (n=110) of cases. Due to a change in methodology,[22] the results are not comparable with those of 2020, where timeliness for patients who were transferred to a PCI centre was reported at 27% (NOCA, 2022). Figure 6.6 shows the proportion of patients who received timely primary PCI, by referral source and PCI centre.

Figure 6.7 displays the timeliness of primary PCI, by PCI centre and referring hospital. Due to small numbers, caution should be applied when interpreting results.

KQI 3: Percentage of patients with a STEMI who had timely primary PCI – Transferred to PCI centre

TARGET: 90% RESULT: 41%

[21] In 2017–2020 (NOCA, 2022), patients who arrived directly by ambulance and did not have their first ECG in the ambulance were excluded.
[22] In 2017–2020 (NOCA, 2022), timeliness of patients who were transferred to a PCI centre was calculated using the date and time of arrival at the first hospital, as opposed to the first positive ECG.
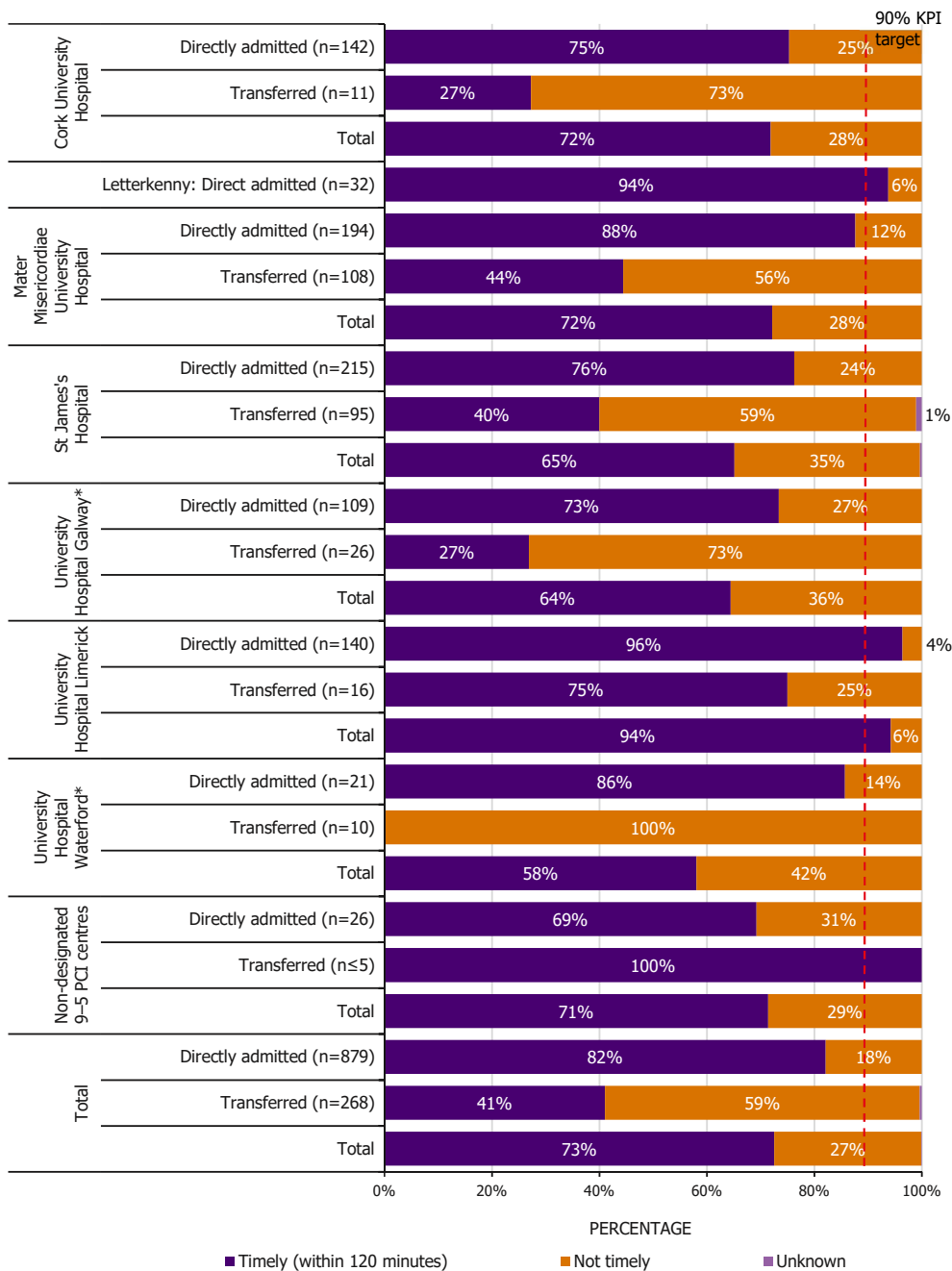
FIGURE 6.6: PROPORTION OF TIMELY PRIMARY PERCUTANEOUS CORONARY INTERVENTION FOR PATIENTS ADMITTED DIRECTLY OR TRANSFERRED TO A PERCUTANEOUS CORONARY INTERVENTION CENTRE, BY PCI CENTRE (n=1147)[23,24]

* Coverage was below 80%.

[23] '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.

[24] Non-designated, 9.00am to 5.00pm weekday PCI centres include Beaumont Hospital*, St Vincent's University Hospital and Tallaght University Hospital. Timeliness for these hospitals is included in Appendix 6.

CONTENTS >

**Legend:** ■ Timely (within 120 minutes) ■ Not timely ■ Unknown
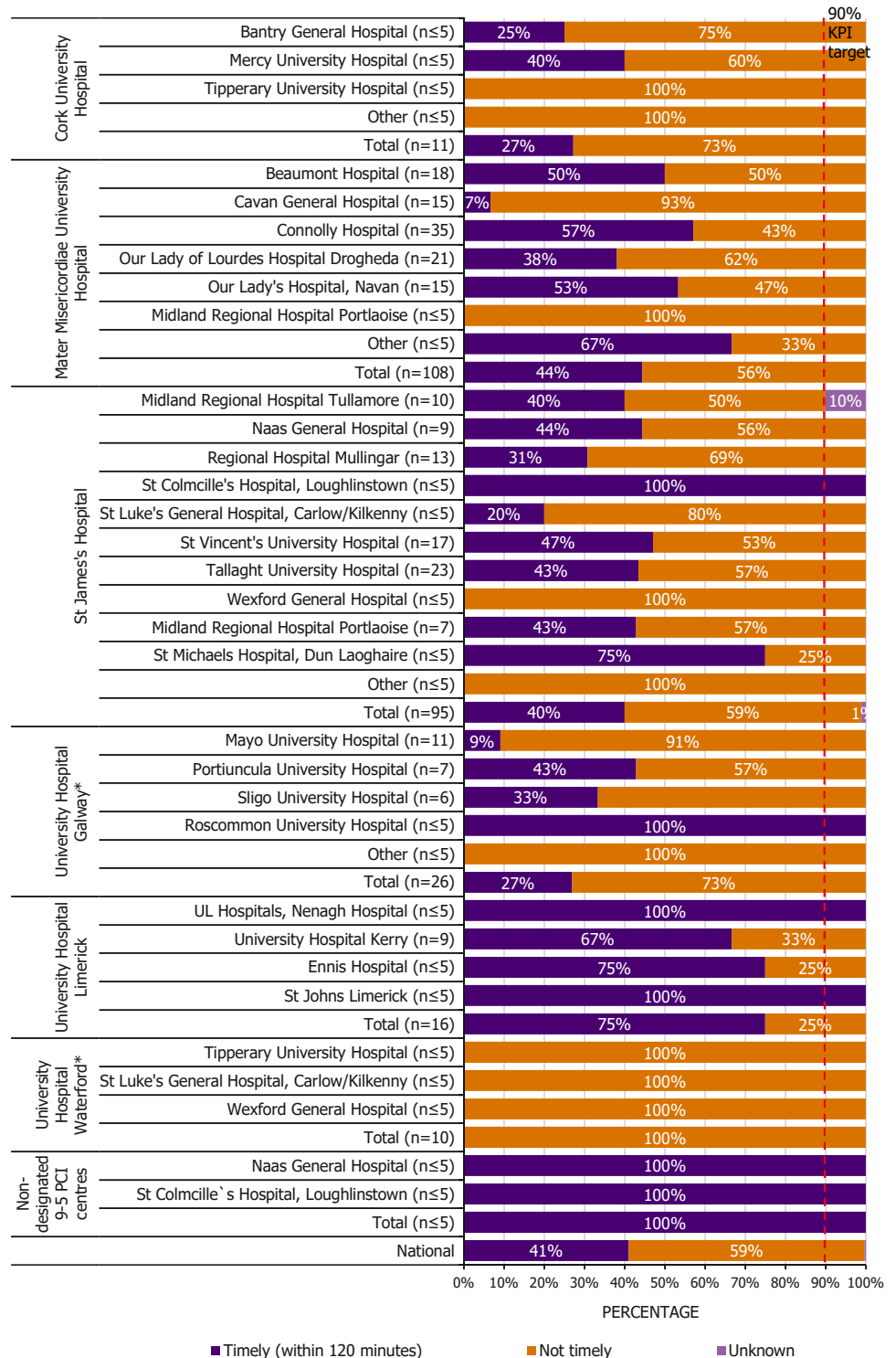
* Coverage was below 80%.

FIGURE 6.7: PROPORTION OF TIMELY PRIMARY PERCUTANEOUS CORONARY INTERVENTION FOR PATIENTS WHO WERE TRANSFERRED TO A PERCUTANEOUS CORONARY INTERVENTION CENTRE, BY REFERRING HOSPITAL (n=268)[25]

[25] There were no patients transferred from other hospitals to Letterkenny University Hospital. Non-designated, 9.00am to 5.00pm weekday PCI centres include St Vincent's University Hospital and Tallaght University Hospital. Timeliness for these hospitals is included in Appendix 6.

Overall, the median FMCTB was 96 minutes (IQR: 70–126 minutes). For patients who arrived directly at a PCI centre, the median FMCTB time was 88 minutes (IQR: 65–113 minutes). For patients who were transferred to a PCI centre, the median FMCTB was 135 minutes (IQR: 103–185 minutes) (Table 6.3).

TABLE 6.3: FIRST MEDICAL CONTACT TO BALLOON BY REFERRAL SOURCE, MEDIAN AND INTERQUARTILE RANGE (N=1146)[26]

	Number of patients	Median	IQR 1	IQR 3
Directly admitted to a PCI centre	879	88	65	113
Transferred to PCI centre	267	135	103	185
Total	**1146**	**96**	**70**	**126**

ARTERIAL ACCESS

Primary PCI requires arterial access, which carries an inherent risk of vascular injury or bleeding complications. 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 the clear clinical advantages demonstrated in several large-scale clinical trials of radial versus femoral arterial access. Figure 6.8 displays the type of arterial access used in each PCI centre. The majority (n=1092, 93%) of patients received primary PCI through radial access, similar to 2020 (93%; NOCA, 2022). The type of arterial access varied slightly between hospitals.

KQI 4: Percentage of patients with a STEMI who had radial access for primary PCI

TARGET: 95% RESULT: 93%

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[26] Patients for whom the source of referral was not recorded, or was recorded as 'Other', were excluded from Table 6.3 (n=28).
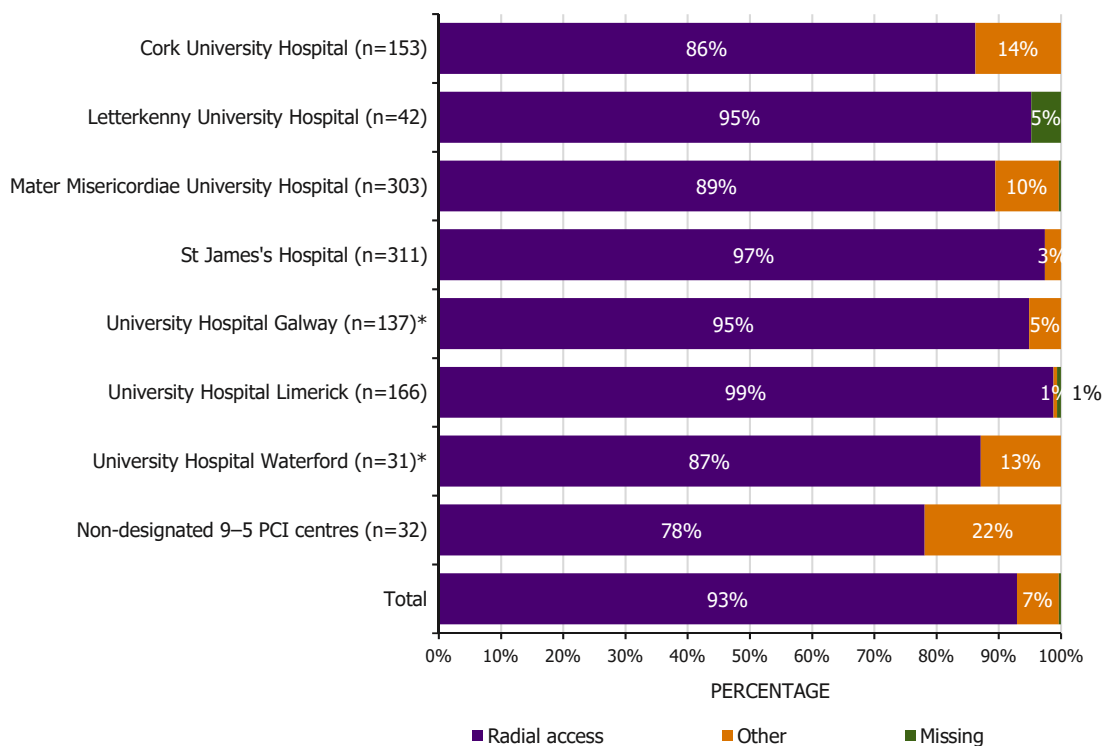
* Coverage was below 80%.

FIGURE 6.8: TYPE OF ARTERIAL ACCESS, BY HOSPITAL (n=1175)[27,28]

[27] Figure 6.8 includes only patients who were not contraindicated and had primary PCI performed.
[28] Non-designated, 9.00am to 5.00pm weekday PCI centres include Beaumont Hospital*, St Vincent's University Hospital
and Tallaght University Hospital. DTB times for these hospitals are included in Appendix 6.

KEY FINDINGS FROM CHAPTER 6

- Seventy-nine percent of patients with a STEMI received primary PCI (n=1175) and 5% (n=81) received thrombolysis as the initial reperfusion therapy.

- Eight-six percent of patients with a STEMI presenting directly to a PCI centre had primary PCI (n=879); this was similar to 2020 (88%; NOCA, 2022).

- Thrombolysis was given to 18% (n=77) of patients with a STEMI presenting to non-PCI hospitals, an increase from 12% in 2020 (NOCA, 2022).

- Overall, 69% (n=852) of patients with a STEMI received timely reperfusion, unchanged from 2020 (69%; NOCA, 2022).

- Timely (<120 minutes) primary PCI was achieved in 73% (n=832) of patients with a STEMI. Timely primary PCI was higher in patients admitted directly to a PCI centre (82%, n=722) compared with those transferred from a non-PCI centre (41%, n=110).

- Timely thrombolysis was only achieved in 25% (n=20) of cases.

OPPORTUNITY FOR FURTHER QUALITY IMPROVEMENT

Develop a QI project to improve the timeliness of thrombolysis.

Develop a QI project to improve the DTB time in hospitals not reaching the target of 30 minutes.

Develop a QI project to increase the use of radial arterial access for primary PCI.
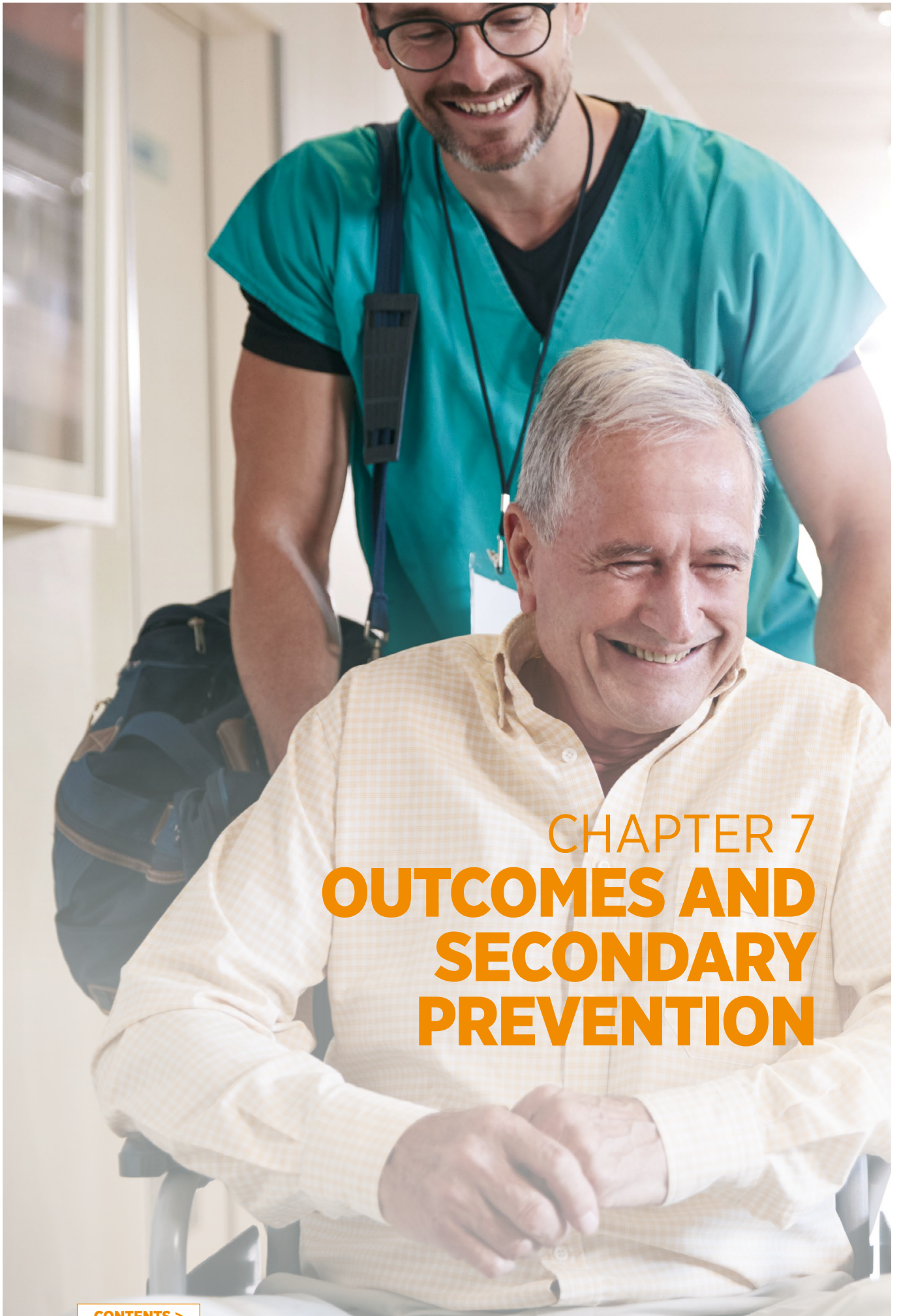
CHAPTER 7
OUTCOMES AND SECONDARY PREVENTION

CHAPTER 7: **OUTCOMES AND SECONDARY PREVENTION**

SCOPE OF CHAPTER 7

This chapter presents the outcomes of care and key treatments aimed at secondary prevention of further cardiovascular events for patients with a STEMI recorded on the Heartbeat portal in 2021.

LIMITATIONS OF OUTCOME DATA IN THE HEARTBEAT PORTAL

NOCA (2022) detailed the limitations of outcome data in the Heartbeat portal. The ESC STEMI guidelines (Ibanez *et al.,* 2018) recommend that 30-day risk-adjusted mortality be adopted as an outcome measure QI for STEMI care. In 2022, the IHAA outlined a strategic aim to adopt this metric. With this aim in mind, the completeness of recording 30-day mortality, with a target of 90% completeness, was established as a KQI. These data are presented in Figure 7.1, broken down by hospital. In the 2021 dataset, completeness of 'survival status at 30 days' was 61%, up from 56% in 2020 (NOCA, 2022). While there has been progress, the level of completeness of this data point remains too low for meaningful analysis and presentation. In this audit, where mortality data are presented, it reflects unadjusted mortality rates at the point of discharge or transfer from the primary PCI centre as extracted from the Hospital In-Patient Enquiry (HIPE) dataset.
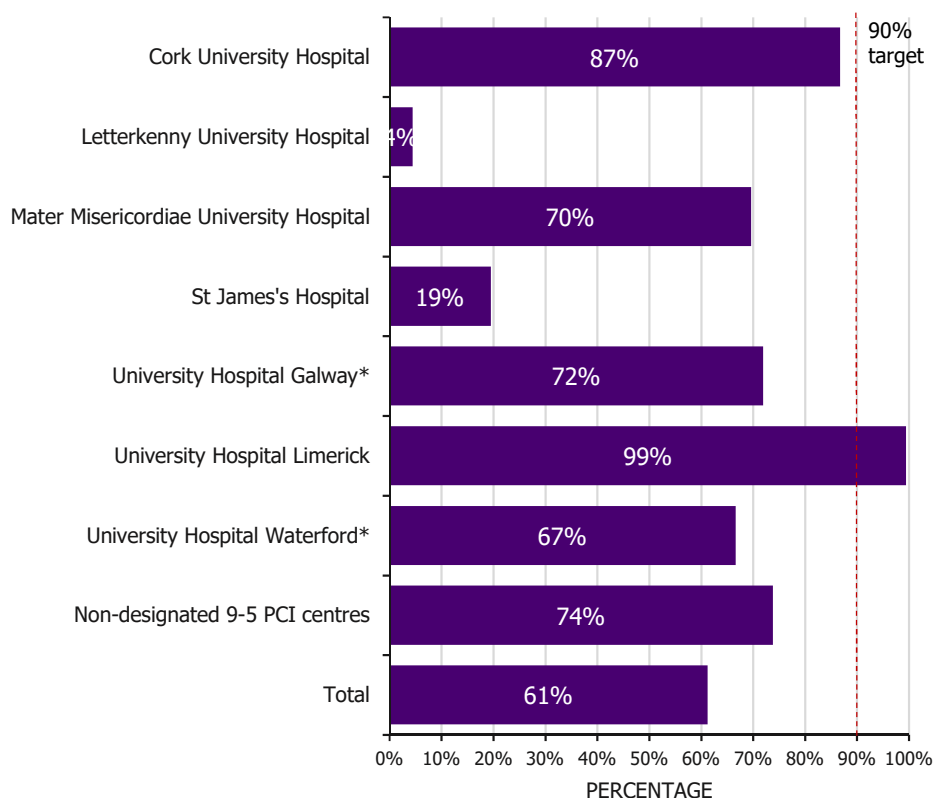
* Coverage was below 80%.

FIGURE 7.1: PERCENTAGE COMPLETENESS OF SURVIVAL STATUS AT 30 DAYS (N=1491)[29,30]

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[29] Non-designated, 9.00am to 5.00pm weekday PCI centres include Beaumont Hospital, St Vincent's University Hospital and Tallaght University Hospital. Completeness for these hospitals is included in Appendix 7.
[30] Those who died while in hospital were categorised as complete.

KQI 8: Percentage completeness of survival status at 30 days

TARGET: 90% RESULT: 61%

30 DAYS

In 2022, a data quality initiative was implemented. Among its aims was improving the completeness of survival status at 30 days. Furthermore, in 2022, additional variables were added to the Heartbeat dataset to facilitate the calculation of the Global Registry of Acute Coronary Events (GRACE) score as recommended by NOCA (2022), and the development of a model to report on adjusted mortality by PCI centre is currently in progress.

OUTCOMES

UNADJUSTED IN-HOSPITAL MORTALITY IN PCI CENTRES

In 2021, 84 of the 1,419 patients with a STEMI died during their in-hospital stay at a PCI centre, which corresponds to an unadjusted in-hospital mortality rate of 5.6%. This figure was in keeping with the 5.1% reported for the 2017–2020 period (NOCA, 2022).

The unadjusted in-hospital mortality rate was higher in older people. In those aged 75 years and over, mortality was 14.8% (n=40), compared with 5.5% (n=21) in those aged 65–74 years and 2.8% (n=23) in those aged 64 years. The unadjusted in-hospital mortality rate was 3.5% (n=30) for patients who received timely reperfusion.[31] If a slight change in methodology is taken into account,[32] this compares with a rate of 2.8% in 2017–2020 (NOCA, 2022). The unadjusted in-hospital mortality rate for patients who did not receive timely reperfusion was 5.1% (n=19), similar to the 5.2% recorded in 2017–2020 (NOCA, 2022). The unadjusted in-hospital mortality rate in patients receiving thrombolysis as the initial reperfusion strategy, at discharge from the PCI centres, was 1.2% (n≤5), compared with the 5.1% reported in 2017–2020; for primary PCI, it was 4.2% (n=49), consistent with the 4.2% reported in 2017–2020 (NOCA, 2022). For those who received no reperfusion therapy, the unadjusted in-hospital mortality rate was 16.1% (n=9), reported at 10.0% (n=19) in 2017–2020 (NOCA, 2022).

51% of patients were discharged directly home from PCI centres

42% were transferred to another acute hospital for ongoing STEMI care

DISCHARGE DESTINATION FROM THE PCI CENTRE

One-half (n=755, 51%) of patients with a STEMI were discharged directly home from a PCI centre, similar to the 49% reported in 2020 (NOCA, 2022). Forty-two percent (n=629) were transferred to another acute hospital for ongoing STEMI care; again, similar to the 44% reported in 2020 (NOCA, 2022). The 'Other' 7% (n=107) represents discharge to an alternative destination: nursing home, died, and other. Figure 7.2 displays the discharge destination by PCI centre and sex. A larger proportion (n=599, 52%) of male patients with a STEMI were discharged directly home from a PCI centre, compared with female patients (n=156, 46%). There was variation in discharge destination between PCI centres. Some centres, such as Letterkenny University Hospital, are single entities for primary PCI and hospital care, while the other primary PCI centres serve a network of non-PCI hospitals and therefore repatriate/transfer at a higher rate.

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[31] The unadjusted mortality of timely reperfusion excluded cases that were contraindicated, and did not have source of referral and/or contraindication recorded (n=207).

[32] In 2017–2020 (NOCA, 2022), primary PCI timeliness of patients who were transferred to a PCI centre was calculated using date and time of arrival at the first hospital, as opposed to the first positive ECG, and patients who arrived directly by ambulance and did not have their first ECG in the ambulance were excluded.

		Home	Transferred	Other
Cork University Hospital	Male (n=182)	70%	20%	10%
	Female (n=44)	77%	5%	18%
	Total (n=226)	71%	17%	12%
Letterkenny University Hospital	Male (n=39)	85%	10%	5%
	Female (n=6)	83%	17%	
	Total (n=45)	84%	11%	4%
Mater Misericordiae University Hospital	Male (n=262)	24%	71%	5%
	Female (n=90)	18%	71%	11%
	Total (n=352)	23%	71%	6%
St James's Hospital	Male (n=294)	33%	61%	6%
	Female (n=96)	26%	60%	14%
	Total (n=390)	31%	61%	8%
University Hospital Galway*	Male (n=160)	70%	26%	4%
	Female (n=36)	69%	28%	3%
	Total (n=196)	70%	27%	4%
University Hospital Limerick	Male (n=146)	77%	18%	5%
	Female (n=43)	81%	9%	9%
	Total (n=189)	78%	16%	6%
University Hospital Waterford*	Male (n=36)	64%	22%	14%
	Female (n=15)	60%	33%	7%
	Total (n=51)	63%	25%	12%
Non-designated 9-5 PCI centres	Male (n=35)	89%	6%	6%
	Female (n=7)	100%		
	Total (n=42)	90%	5%	5%
Total	Male (n=1154)	52%	42%	6%
	Female (n=337)	46%	43%	11%
	Total (n=1491)	51%	42%	7%

PERCENTAGE

■ Home   ■ Transferred   ■ Other

* Coverage was below 80%.

FIGURE 7.2: DISCHARGE DESTINATION FROM PERCUTANEOUS CORONARY INTERVENTION CENTRES, BY SEX AND HOSPITAL (N=1491)[33]

[33] Non-designated, 9.00am to 5.00pm weekday PCI centres include Beaumont Hospital, St Vincent's University Hospital and Tallaght University Hospital. Discharge destination for these hospitals are included in Appendix 6.

BLEEDING AND STROKE COMPLICATIONS

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: ≥5 grams per decilitre (g/dL); ≥3 g/dL but <5 g/dL; and <3 g/dL).

The rate of intracranial haemorrhage was low. A total of 12 (1%) patients with a STEMI who received reperfusion therapy had a bleeding complication. Although there was a slight difference in methodology,[34] this remained unchanged from 2017 to 2020 (1%; NOCA, 2022). There were two episodes of intracranial haemorrhage (0.2%) recorded among patients treated with primary PCI and no episodes among those receiving thrombolysis. Incidence of bleeding by reperfusion type and hospital is presented in Appendix 9 (Table 9.6).

A total of 23 (2%) patients with a STEMI who received primary PCI sustained a stroke, of which 6 were classified as haemorrhagic stroke. No patients who received thrombolysis sustained a stroke. The incidence of stroke by reperfusion type and hospital is presented in Appendix 9 (Table 9.7).

LENGTH OF STAY AT A PCI CENTRE

Of all patients with a STEMI discharged alive from a PCI centre, the median length of stay (LOS) at the PCI centre was 3 days (IQR: 1–5 days). For patients who completed their inpatient stay at the PCI centre, the median LOS was 4 days (IQR: 3–7 days), unchanged from 2020 (NOCA, 2022). This meets the relevant key performance indicator (KPI) in the *Acute Coronary Syndromes Programme Model of Care* (HSE, 2012) of a median LOS of 4 days. However, LOS ranged between PCI centres from 4 days to 6 days.

For patients who were transferred to another acute hospital for ongoing STEMI care, the LOS in the PCI centre was 1 day (IQR: 1–2 days) (Table 7.1). In these cases, the LOS of the complete inpatient stay is unknown.

TABLE 7.1 LENGTH OF STAY IN THE PERCUTANEOUS CORONARY INTERVENTION CENTRE, BY HOSPITAL (n=1407)[35]

		Transfer to another hospital for ongoing STEMI care	Completed STEMI care in the PCI centre	Total
Cork University Hospital	Number of patients	39	167	206
	Number of days	175	1137	1312
	Median LOS (days)	2	5	4
	Percentile 25 (days)	1	3	3
	Percentile 75 (days)	3	6	6
Letterkenny University Hospital	Number of patients	~	*	44
	Number of days	29	293	322
	Median LOS (days)	5	6	6
	Percentile 25 (days)	1	3	3
	Percentile 75 (days)	6	9	9

34 In 2017–2020 (NOCA, 2022), cases that did not have incidence of bleeding recorded were excluded.
35 Only includes patients who were alive on discharge.

		Transfer to another hospital for ongoing STEMI care	Completed STEMI care in the PCI centre	Total
Mater Misericordiae University Hospital	Number of patients	250	84	334
	Number of days	438	774	1212
	Median LOS (days)	1	5	1
	Percentile 25 (days)	1	3	1
	Percentile 75 (days)	1	9	3
St James's Hospital	Number of patients	283	129	367
	Number of days	602	1179	1781
	Median LOS (days)	1	5	2
	Percentile 25 (days)	1	4	1
	Percentile 75 (days)	2	10	5
University Hospital Galway**	Number of patients	52	138	190
	Number of days	159	805	964
	Median LOS (days)	2	4	3
	Percentile 25 (days)	1	3	2
	Percentile 75 (days)	3	6	5
University Hospital Limerick	Number of patients	30	149	179
	Number of days	104	815	919
	Median LOS (days)	2	4	4
	Percentile 25 (days)	1	3	3
	Percentile 75 (days)	4	5	5
University Hospital Waterford**	Number of patients	13	34	47
	Number of days	36	240	276
	Median LOS (days)	1	6	5
	Percentile 25 (days)	1	4	2
	Percentile 75 (days)	1	7	7
Non-designated, 9.00am to 5.00pm weekday PCI centres[36]	Number of patients	~	*	42
	Number of days	30	266	296
	Median LOS (days)	15	4	4
	Percentile 25 (days)	7	3	3
	Percentile 75 (days)	23	6	7
Total	Number of patients	629	778	1407
	Number of days	1573	5509	7082
	Median LOS (days)	1	4	3
	Percentile 25 (days)	1	3	1
	Percentile 75 (days)	2	7	5

~ Denotes five cases or fewer.
* Further suppression required to prevent disclosure of five cases or fewer.
** Coverage was below 80%.

[36] Non-designated, 9.00am to 5.00pm weekday PCI centres include Beaumont Hospital**, St Vincent's University Hospital and Tallaght University Hospital. LOS times for these hospitals are included in Appendix 6.

SECONDARY PREVENTION

Secondary prevention of further cardiovascular or coronary heart disease event is key to the *Acute Coronary Syndromes Programme Model of Care* (HSE, 2012). The IHAA reports on this under three headings: (1) smoking cessation, (2) secondary prevention medication and (3) cardiac rehabilitation (CR). Each is reported as a KQI in the IHAA dashboard.

SMOKING CESSATION

As described in Chapter 4, 39% (n=578) of patients with a STEMI were classified as current smokers (Figure 4.6), an increase from 34% in 2017–2020 (NOCA, 2022). Figure 7.3 displays the proportion of patients with a STEMI who were smokers and who received smoking cessation advice. Eighty-five percent (n=493) of actively smoking patients with a STEMI were recorded as receiving smoking cessation advice, a decrease from 90% in 2020 and from 95% in 2019 (NOCA, 2022); this is now below the target of 90% (HSE, 2012).

KQI 6: Percentage of patients with a STEMI who smoke who were offered smoking cessation advice

TARGET: 90% RESULT: 85%
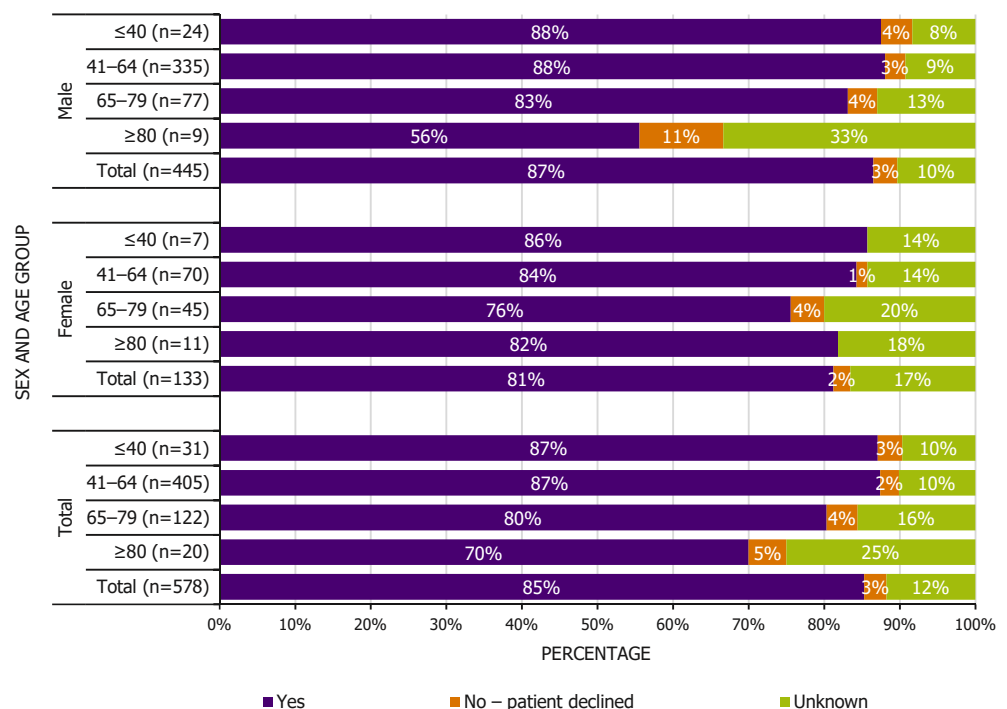
FIGURE 7.3: SMOKING CESSATION ADVICE PROVIDED, BY SEX AND AGE GROUP (n=578)[37]

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[37] Figure 7.3 includes patients reported as current smokers only.

SECONDARY PREVENTION MEDICATION ON DISCHARGE

Overall, 74% (n=1038) of patients with a STEMI had an appropriate secondary prevention discharge bundle recorded, below the target of 90% (HSE, 2012). Appendix 9 (Table 9.8) presents these data by PCI centre.

Figure 7.4 shows the proportion of each of the secondary prevention medications prescribed on discharge, excluding cases for which no information was recorded,[38] for each of the medications. Statins (n=1222, 99%) and aspirin (n=1252, 98%) were the most prescribed secondary prevention medications. A second antiplatelet agent was prescribed in 97% (n=1245) of cases, followed by beta-blockers (n=1110, 94%) and angiotensin-converting enzyme inhibitors (ACEIs) or angiotensin II receptor blockers (ARBs) (n=1028, 87%). These findings are consistent with the 2017–2020 report (NOCA, 2022).

KQI 6: Percentage of patients with a STEMI who had an appropriate secondary prevention discharge bundle

TARGET: 90%   RESULT: 74%
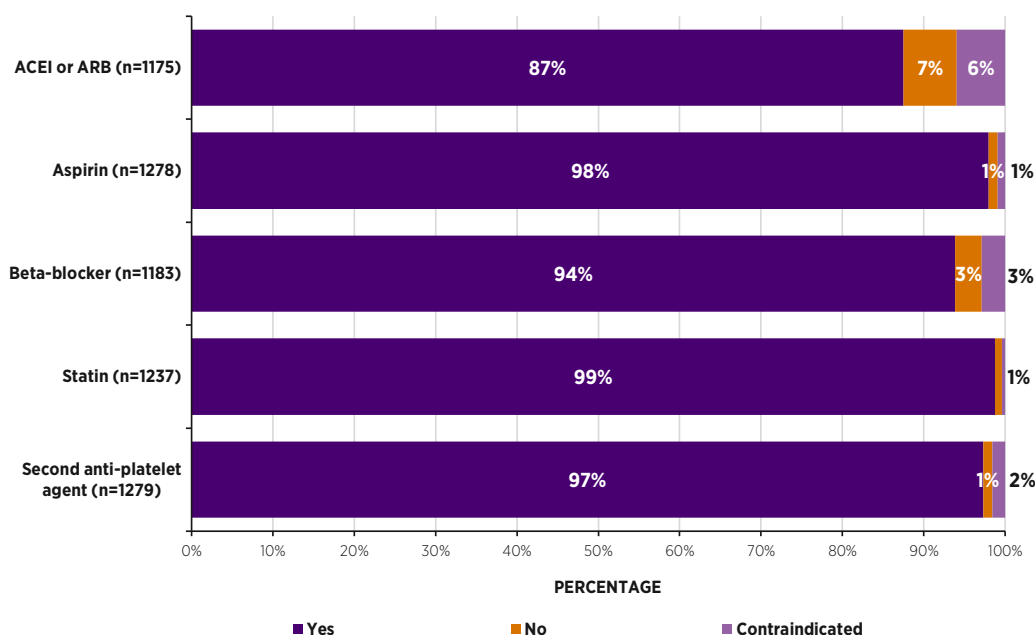
FIGURE 7.4: PROPORTION OF PATIENTS PRESCRIBED SECONDARY PREVENTION MEDICATION ON DISCHARGE[39]

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[38] Rate of the unknown and missing information: Second anti-platelet agent (n=129, 9%); statin (n=171, 12%); beta- blocker (n=225, 16%); aspirin (n=130, 9%); ACEI or ARB (n=233, 17%).

[39] Patients who had no information recorded were excluded from Figure 7.4. Each patient may have been prescribed one or more medications, and may therefore be counted more than once. Excludes patients who were dead on discharge.

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). The *Acute Coronary Syndromes Programme Model of Care* (HSE, 2012) target is for 90% of eligible patients with a STEMI[40] to be referred to an early CR programme/ secondary prevention programme on discharge. Cardiac rehabilitation phase 3 consists of an exercise programme and educational classes, typically scheduled over 6–12 weeks.

Sixty-six percent (n=782) of eligible patients with a STEMI were referred to cardiac rehabilitation phase 3. Figure 7.5 displays the phase 3 CR recorded referral rate by sex and hospital. Male patients (n=648, 68%) had a higher proportion of referral to cardiac rehabilitation phase 3, compared with female patients (n=134, 57%). There was a large variation between PCI centres in the proportion of patients recorded as being referred for cardiac rehabilitation phase 3. With regard to the larger primary PCI hospitals, namely St James's Hospital and Mater Misericordiae University Hospital, the high proportion of unknown status reflects a higher level of repatriation and the difficulty capturing follow-up data from these hospitals is reflected in disproportionately lower results in this KQI. Monitoring the rate of referral to cardiac rehabilitation phase 3 has been included in the IHAA dashboard as a KQI.

KQI 7: Percentage of eligible patients with a STEMI referred for cardiac rehabilitation phase 3

TARGET: 90% RESULT: 66%

[40] Patients who declined referral to cardiac rehabilitation phase 3 and patients who were not referred to cardiac rehabilitation phase 3 due to comorbidities are excluded in this analysis. This was a change in methodology from the previous report (NOCA, 2022).

Yes   **No**   **Unknown**
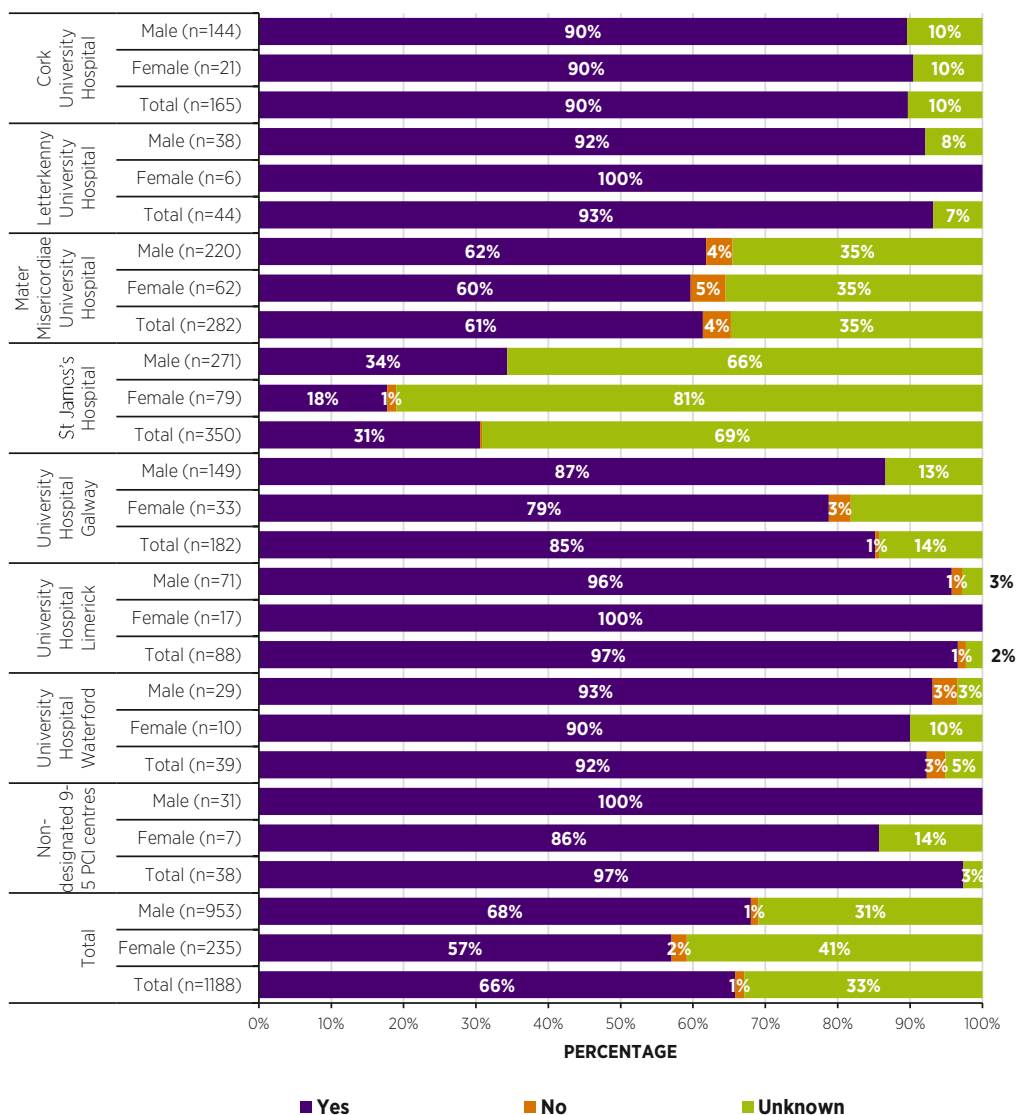
* Coverage was below 80%.

FIGURE 7.5: PROPORTION OF ELIGIBLE PATIENTS WITH AN ST ELEVATION MYOCARDIAL INFARCTION REFERRED FOR CARDIAC REHABILITATION PHASE 3, BY HOSPITAL AND SEX (n=1188)[41]

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41   Non-designated, 9.00am to 5.00pm weekday PCI centres include Beaumont Hospital*, St Vincent's University Hospital and Tallaght University Hospital. Cardiac rehabilitation phase 3 referral for these hospitals are included in Appendix 6. Excludes patients who were dead on discharge.

Heartbeat contains a variable intended to provide a robust indicator of delivery of cardiac rehabilitation phase 3: 'date of first phase 3 cardiac rehabilitation appointment'. In 2022, the IHAA set out, as a strategic aim, to collect data on the timeliness and delivery of cardiac rehabilitation phase 3. With this aim in mind, the completeness of recording of this data point 'date of first phase 3 cardiac rehabilitation appointment', with a target of 90% completeness, was established as a KQI on the IHAA dashboard. The completeness of the data point 'date of cardiac rehabilitation phase 3' has improved from 8% in 2020 (NOCA, 2022) to 25% in 2021 (Figure 7.6).
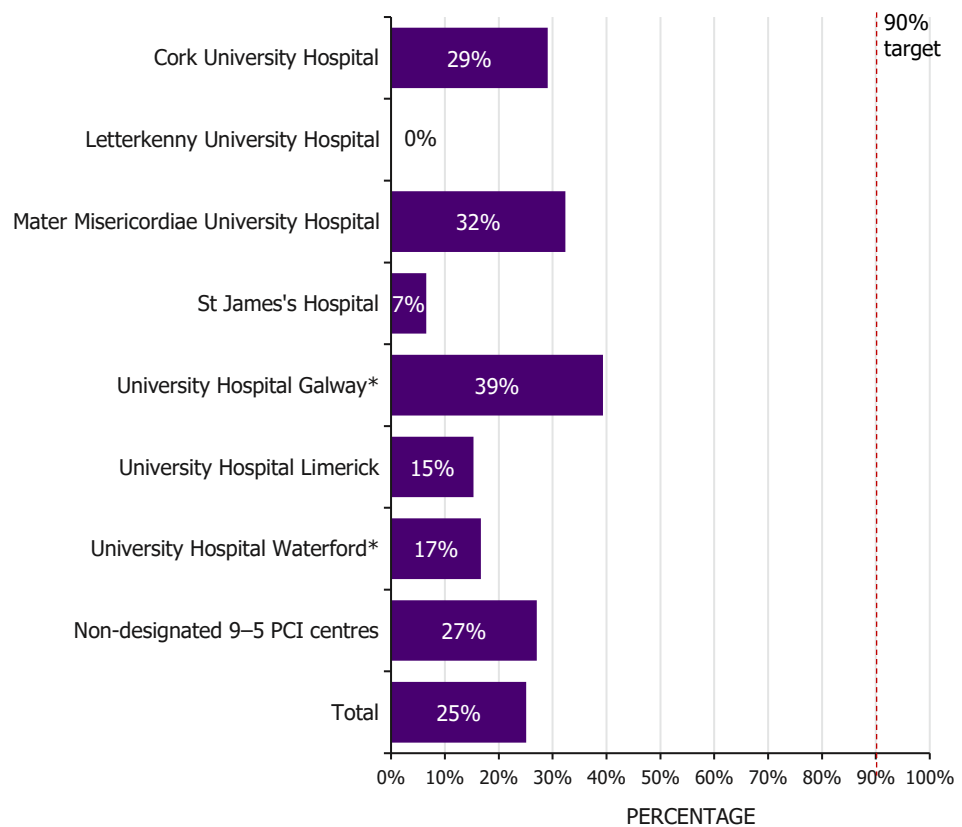
* Coverage was below 80%.

FIGURE 7.6: PERCENTAGE COMPLETENESS OF DATE OF FIRST PHASE 3 CARDIAC REHABILITATION APPOINTMENT (n=782)

KEY FINDINGS FROM CHAPTER 7

• The rates of complication associated with reperfusion therapy were low.

• The unadjusted in-hospital mortality rate was 5.6%. Timely reperfusion was associated with reduced mortality rate (3.5% versus 5.1%). The unadjusted in-hospital mortality rate increased with increasing age.

• The recorded rate of delivery of smoking cessation advice was 85%, below the KPI of 90% set out in the *Acute Coronary Syndromes Programme Model of Care*.

• 74% (n=1038) of patients with a STEMI had an appropriate secondary prevention discharge bundle recorded below the 90% target set out in the *Acute Coronary Syndromes Programme Model of Care*.

• Referral to CR at 66% was below the 90% target set out in the *Acute Coronary Syndromes Programme Model of Care*. Additionally, it is not clear whether CR was delivered in a timely fashion, if at all.

OPPORTUNITY FOR FURTHER QUALITY IMPROVEMENT

Develop a QI project to improve the capture of 30-day mortality status.

Develop a QI project to improve the rate of referral to, and uptake of, cardiac rehabilitation phase 3.

Develop a QI project to increase the delivery of smoking cessation programmes

CHAPTER 8: **QUALITY IMPROVEMENT**

The purpose of this chapter is to highlight and promote quality improvement (QI) in the national clinical audit. Clinical audit can provide data to support QI at all levels, from the local clinical team through to organisation management and national policy-making. In 2023, NOCA published the *National Office of Clinical Audit: Impact Report 2023* (NOCA, 2023), highlighting the key outcomes each NOCA audit has delivered. The IHAA wishes to ensure that the findings of the audit support QI at local, national and policy levels.

THE IHAA DASHBOARD

In 2021, the IHAA Governance Committee agreed nine KQIs. Seven were based on the KPIs published in the *Acute Coronary Syndromes Programme Model of Care* (HSE, 2012) and two data QIs were agreed in order to support improved collection of follow-up data. The implementation of the IHAA dashboard (Figure 8.1) will allow individual hospital teams and hospital management access to timely data with the aim of driving QI locally.

FIGURE 8.1: IRISH HEART ATTACK AUDIT DASHBOARD, 2021

IHAA DASHBOARD TRENDS

Table 8.1 displays annual IHAA dashboard results from 2016 to 2021. Only one metric, KQI 1 (the percentage of eligible patients with a STEMI who were offered reperfusion), achieved the 95% target annually. The percentage of patients with a STEMI who had timely primary PCI remained consistently below the target of 90%, particularly for those who are transferred to a PCI centre. This has been reported in detail in Chapter 6 and supports the evidence for "Recommendation 2. There should be a national and regional focus on QI in the STEMI care pathway." Use of the radial artery during primary PCI does appear to be improving each year. There is variation, however, between PCI centres (Figure 6.8), which may need to be reviewed at local level. Secondary prevention measures, both appropriate medication bundles and smoking cessation advice, remain below target in most years. Trends related to CR and the recording of 30-day mortality remain consistently below target.

TABLE 8.1: IRISH HEART ATTACK AUDIT DASHBOARD RESULTS, 2017–2021

KEY QUALITY INDICATORS	2016*	2017	2018	2019	2020	2021
KQI 1: Percentage of eligible patients with a STEMI who were offered reperfusion **Target: 95%**	**97%**	98% ★	97% ★	96% ★	95% ★	96% ★
KQI 2: Percentage of patients with a STEMI who had timely primary PCI – arrived directly at a primary PCI centre **Target: 90%**	**81%**	82% ↑	79% ↓	83% ↑	81% ↓	82% ↑
KQI 3: Percentage of patients with a STEMI who had timely primary PCI – transferred to a primary PCI centre **Target: 90%**	**40%**	43% ↓	43% ▬	45% ↑	49% ↑	41% ↓
KQI 4: Percentage of patients with a STEMI who had radial access for primary PCI **Target: 95%**	**86%**	89% ↑	91% ↑	91% ↑	93% ↑	93% ▬
KQI 5: Percentage of patients with a STEMI who had an appropriate secondary prevention discharge bundle prescribed **Target: 90%**	**74%**	71% ↓	71% ▬	84% ↑	69% ↓	74% ↑
KQI 6: Percentage of patients with a STEMI who smoke and who were offered smoking cessation advice **Target: 90%**	**71%**	63% ↓	90% ★	95% ★	89% ↓	85% ↓
KQI 7: Percentage of eligible patients with a STEMI referred for cardiac rehabilitation phase 3 **Target: 90%**	**64%**	78% ↑	93% ★	94% ★	85% ↓	66% ↓
KQI 8: Percentage completeness of survival status at 30 days **Target: 90%**	**54%**	43% ↓	52% ↑	47% ↓	56% ↑	61% ↑
KQI 9: Percentage of patients who have cardiac rehabilitation phase 3 date recorded **Target: 90%**	**34%**	43% ↑	21% ↓	14% ↓	8% ↓	25% ↑

✱ Baseline	★ Target was Agreed
▬ Did not meet target - results remained static but >80%	↑ Did not meet target - results improving but <80%
↑ Did not meet target - results improving but >80%	↓ Did not meet target - results deteriorating and <80%
↓ Did not meet target - results deteriorating but >80%	▬ Did not meet target - results remained static and <80%

HOW CAN THE IHAA DRIVE QUALITY IMPROVEMENT?

Throughout this report, opportunities for QI have been highlighted based on findings and supported by the annual IHAA dashboard trends (Table 8.1). Clinical audit projects are listed and other QI initiatives such as public awareness campaigns are listed as recommendations in Chapter 10. The suggested clinical audits could be developed at local hospital level using IHAA data to monitor impacts and reported back to other centres in order to drive QI. Larger-scale collaborative QI projects, such as 'Door to Decision in under 30' (National Thrombectomy Service, 2022), could be championed by a PCI centre as a means of encouraging process improvement at national level. Policy decisions, such as rolling out public awareness campaigns in relation to educating people on the symptoms of heart attack and the importance of calling 112/999, could be evaluated using the IHAA data.

Clinical audit projects

• Develop a 'door in door out' (DIDO) QI project to improve the pathway to a primary PCI centre for patients with a STEMI who arrive at a non-PCI hospital and are transferred to a primary PCI centre.
• Develop a QI project to improve the timeliness of thrombolysis.
• Develop a QI project to improve the DTB time in hospitals not reaching the target of 30 minutes.
• Develop a QI project to increase the use of radial arterial access for primary PCI.
• Develop a QI project to improve the capture of 30-day mortality status.
• Develop a QI project to improve the rate of referral and uptake on cardiac rehabilitation phase 3.
• Develop a QI project to increase the delivery of smoking cessation programmes.

HOW TO DELIVER QUALITY IMPROVEMENT

Clinical audit is a clinically led quality improvement process that seeks to improve patient care and outcomes through systematic review of care against explicit criteria and acting to improve care when standards are not met. The process involves the selection of aspects of the structure, processes and outcomes of care which are then systematically evaluated against explicit criteria. If required, improvements should be implemented at an individual, team or organisation level and then the care re-evaluated to confirm improvements.

Department of Health and Children (2008, p. 152)

The HSE National Centre for Clinical Audit was established in 2021 to implement the recommendations of the National Review of Clinical Audit Report (HSE, 2019). The HSE National Centre for Clinical Audit provides a national focus for clinical audit in order to ensure that those who are conducting local, regional and national audits have access to best practice information. Clinical audit training is provided to support clinical teams to develop and run QI projects.

The IHAA recommends that all clinical teams should participate in a QI project and that all learnings can be shared through the NOCA Quality Improvement Champion Award, in workshops and meetings as well as in future IHAA annual reports.

CHAPTER 9
AUDIT UPDATE

CHAPTER 9: **AUDIT UPDATE**

Table 9.1 displays an update on recommendations from the *Irish Heart Attack Audit National Report 2017-2020* (NOCA, 2022).

UPDATE ON AUDIT RECOMMENDATIONS FROM 2017-2020

RECOMMENDATION	STATUS
Implement a national STEMI transfer form for use when transferring patients from a non-PCI hospital to a PCI centre.	**Action on this recommendation is in progress.** • **The IHAA has established links with the National Emergency Medicine Programme, which is designing an emergency, interhospital transfer document that includes all data necessary to expedite patient treatment and facilitate effective audit. It is currently in the pilot phase in a Dublin hospital.**
Improve the data quality of the follow-up dataset within the Heartbeat portal.	**Action on this recommendation is in progress. The following initiatives have been implemented in order to improve collection of follow-up data:** • **IHAA audit coordinator workshop held in November 2021.** • **The completeness of 30-day mortality data and date of CR have been identified as KQIs on the IHAA dashboard.** • **The IHAA has supported any request for additional data collection support in hospitals where data collection is challenging.** • **Bi-monthly IHAA audit coordinator meetings were held (as a support and information-sharing forum).**
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).	**Action on this recommendation has been completed.** • **The CSO is unable to conduct any microdata linkages across CSO datasets and non-CSO datasets.** • **The IHAA understands that the implementation of the Individual Health Identifier through the HSE, and an associated death register, will ensure accurate collection of these data. Further information on the Individual Health Identifier is available at: https://www.hse.ie/eng/about/who/national-services/individual-health-identifier/.**
Introduce a KPI that measures the DIDO time with the aim of achieving the ESC's guideline target of 30 minutes or less.	**Action on this recommendation is in progress.** • **Data variables required to capture the DIDO time have been added to the Heartbeat dataset from 1 January 2022.** • **When data are available, analysis will inform any future QI initiatives.** • **The development of a national KPI to monitor the DIDO time has not commenced.**

Improve timeliness of reperfusion for patients with a STEMI presenting to non- PCI centres.	**Action on this recommendation is in progress.** • **Primary PCI centres have informally established links with their referring hospital networks. No formalised audit networks have been created.** • **No multidisciplinary PCI networks have been established to monitor data and implement change.** • **The HSE National Health Intelligence Unit has completed a cardiac mapping process (Appendix 1).**
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 ECG diagnosis of a STEMI.	**No public awareness campaign has been completed.**
Improve the identification and control of cardiovascular risks.	**The Integrated Care Programme for the Prevention and Management of Chronic Disease has begun the implementation of the recommendations set out in the *National Framework for the Integrated Prevention and Management of Chronic Disease in Ireland 2020-2025* (HSE, 2020).**
Improve public awareness of the adverse impact of smoking on heart attack risk.	**The IHAA has informed HSE Quit of the findings of the *Irish Heart Attack Audit National Report 2017-2020* (NOCA, 2022) in relation to the impact of smoking and how it might inform future quit smoking campaigns.**

TABLE 9.1: UPDATE OF RECOMMENDATIONS FROM *THE IRISH HEART ATTACK AUDIT NATIONAL REPORT 2017-2020*

VALUE OF AUDIT

It takes many years to embed the capture of high-quality data into practice. Increasing visibility of the quality of STEMI care in hospitals in Ireland through the publication of the IHAA annual reports has led to increased participation and improved data quality. All hospitals that provide a primary PCI service are now participating in the audit.

In April 2022, NOCA launched the *Irish Heart Attack Audit National Report 2017-2020* (NOCA, 2022) online.

The IHAA data inform the national acute coronary syndrome (ACS) KPIs, which in turn inform the HSE's annual National Service Plan. In addition, the national KPIs are included in the quarterly NOCA reports that are sent to Hospital Group managers.

The recommendations within the IHAA and the follow-up on previous recommendations will, if implemented, lead to improved outcomes for patients by increasing heart attack awareness in the population; improve the timeliness of reperfusion therapies; support the reporting of risk-adjusted outcomes; and provide information to support the roll-out of QI initiatives.

AUDIT ACTIVITY

In 2021, virtual audit coordinator meetings were held every 2 months in order to support the audit coordinators with data collection, training, and identification of areas for improvement. In 2021, the HSE ransomware attack affected the ability of HIPE staff and clinical teams to input data. However, workarounds were identified locally in order to ensure that data were submitted for 2021.

In November 2021, an IHAA audit coordinator workshop was held virtually and 7 of the 10 PCI centres were represented. The agenda included the vision of the IHAA, review of the current dataset and definitions, agreement of additional Heartbeat variables, and data QI initiatives. Continuous professional development points were also provided.

Data validation processes have been finalised and will be reviewed continuously as the IHAA dataset evolves. In 2021, the data validation report was sent to each audit coordinator quarterly.

AUDIT DEVELOPMENT PLAN

Providing access to timely data remains a priority for the IHAA and, as described in Chapter 8, the IHAA dashboard will provide quarterly reports on 9 KQIs.

The audit has four additional projects underway to enhance the value of the audit.

1. Risk-adjustment modelling project

At present, the IHAA reports on unadjusted in-hospital mortality. The IHAA Governance Committee has agreed that the audit should develop a risk-adjusted model for reporting on mortality. The GRACE risk score was developed for assessing the risk of death among patients with acute coronary syndrome (ACS) and will be used to measure mortality risk within the audit. The IHAA has added 11 new variables to the Heartbeat dataset to support the calculation of the GRACE score. The IHAA core team[42] is working with the Data Analytics and Research team in NOCA to develop a risk-adjustment model for IHAA.

2. Measuring the DIDO metric

Two additional variables have been added to the Heartbeat dataset to capture the DIDO time for patients with a STEMI who access care in a hospital that does not provide primary PCI and who are then transferred to a primary PCI centre. The DIDO should be within 30 minutes. This information will be reported in 2022.

3. HIPE reconciliation project

As described in Chapter 3, calculating coverage – i.e. are all the STEMIs that should be entered on Heartbeat captured? – is complicated, partly due to the transfer of patients to appropriate hospitals. The IHAA core team is working with the Healthcare Pricing Office (HPO) to establish an accurate model for measuring coverage and a way of reconciling HIPE and Heartbeat data. The ability to add a coverage report to the IHAA dashboard would be the ideal outcome of this project.

4. Diabetes and heart attack

The Heartbeat portal captures data on diabetes based on treatment type. The HIPE system captures data on diabetes based on the type of diabetes; e.g. type 1. The IHAA core team is working with the HPO to assess the congruence between the two data collections and the option to report on diabetes from HIPE data only.

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[42] IHAA core team is the Clinical Lead, the Audit Manager and the Assistant Audit Manager.

RECOMMENDATIONS

CHAPTER 10: **RECOMMENDATIONS**

RECOMMENDATION 1

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 ECG diagnosis of a STEMI.

Rationale
• Early diagnosis of a STEMI is key to timely intervention. The quicker the diagnosis, the more likely it is that treatment will be timely, thereby reducing damage to the heart. The symptoms of a heart attack and the importance of seeking help urgently need to be reinforced among the general public. In 2021, only 44% (n=381) of those who called 112 or 999 for help did so within 60 minutes of symptom onset.

Early call for help in response to symptoms will facilitate pre-hospital ECG diagnosis of a STEMI by the National Ambulance Service (NAS). This early confirmation of a STEMI diagnosis will allow transport directly to primary PCI centres.

The optimal reperfusion service (ORS) protocol, triggered by the call, aims to ensure that the blocked artery in all eligible patients with a STEMI is reopened within 120 minutes. To achieve this, the patient must arrive at a PCI centre within 90 minutes. In 2021, 58% (n=868) of patients with a STEMI went directly by ambulance to a PCI centre and 80% (n=597) of those patients arrived at the PCI centre in less than 90 minutes. However, among patients transferred from a non-PCI capable hospital to a PCI centre, only 33% (n=117) arrived within 90 minutes.

Overall, twice as many (n=722, 82%) patients with a STEMI admitted directly by ambulance to a PCI centre had timely reperfusion compared with those who were transferred from a non-PCI capable hospital to a PCI centre (n=110, 41%). In addition, 90% (n=160) of those eligible for reperfusion (n=178) did not benefit from primary PCI because they presented too late, with a likely significant impact on their prognosis.

What actions should be taken?	Who is responsible for implementation?	When should this be implemented?
• 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 to allow a greater proportion of patients with a STEMI to be directly transported to PCI centres.	The National Ambulance Service in conjunction with the National Heart Programme and the Irish Heart Foundation	As soon as possible.

Evidence that the action will be effective
• Studies show that increasing public awareness of the signs and symptoms of heart attack is associated with shorter pre-hospital decision-making (Bray *et al.,* 2015) and with a reduction in the number of out-of-hospital cardiac arrests (Nehme *et al.,* 2017). However, public awareness can wane when campaigns end (Hickey *et al.,* 2018), emphasising the need for regular recurrent campaigns.

Who will benefit from the recommendation?
• All patients with symptoms of heart attack will benefit from early detection of a STEMI and direct transfer to a PCI centre as they will be more likely to receive timely reperfusion, with a positive impact on both individual prognosis and overall healthcare costs.

RECOMMENDATION 2

There should be a national and regional focus on QI in the STEMI care pathway.

Rationale
• In 2013, the National Clinical Programme for Acute Coronary Syndrome (NCP-ACS) implemented an optimal reperfusion service (ORS) for the care of patients with a STEMI, with the aim of saving lives by standardising care across the country. In 2019, the NCP-ACS was incorporated into the National Heart Programme, which has a broad remit that aims to improve population health, reduce health inequalities, improve patient outcomes, and reduce the burden of cardiovascular disease in the population. The results of this report and the *Irish Heart Attack Audit National Report 2017-2020* (NOCA, 2022) indicate that national KQI targets were not achieved; e.g. 73% (n=832) of patients with a STEMI received primary PCI within 120 minutes, which is below the 90% target. There is variation depending on how a patient accesses treatment; e.g. 82% (n=722) of patients with a STEMI who were admitted directly to a PCI centre had timely reperfusion; this compares with 41% (n=110) of patients who were transferred to a PCI centre from another hospital. There is also variation between PCI centres; e.g. 73% (n=221) of cases in the Mater Misericordiae University Hospital achieved a DTB time within 30 minutes; this compares with 35% (n=54) of cases in Cork University Hospital. There is a need for clinical leadership at national and regional level to drive the change initiated by the NCP-ACS through the *Acute Coronary Syndromes Programme Model of Care* (HSE, 2012). The National Review of Specialist Cardiac Services commissioned by the Department of Health in 2018 is due to be released, and based on the recommendations of same, clinical leadership within the National Heart Programme will be reorganised.

What actions should be taken?	Who is responsible for implementation?	When should this be implemented?
• Leadership of the National Heart Programme should be extended to ensure a specific focus on acute coronary syndrome.	The National Heart Programme in conjunction with the Office of the Chief Clinical Officer.	As soon as possible.
• The ACS/Cardiology clinical Lead in each primary PCI centre should lead on the establishment of multidisciplinary PCI networks in their region, including stakeholders from referring non-PCI hospitals and the NAS. These PCI networks should utilise the data available to them through the IHAA and the NAS to prioritise areas for improvement.	ACS/Cardiology clinical leads in primary PCI centres, hospital managers and quality and patient safety managers in all hospitals providing STEMI care NAS	As soon as possible.

What actions should be taken?	Who is responsible for implementation?	When should this be implemented?
• All PCI centres should be resourced to enable them to deliver QI projects at local, regional and/or national level. Chapter 8 lists a series of QI projects that could be undertaken and the IHAA recommends that the following QI projects should be prioritised in order to meet national targets for timely treatment: 1. Develop a DIDO QI project to improve the pathway to a primary PCI centre for patients with a STEMI who arrive at a non-PCI hospital and are transferred to a primary PCI centre. **Target:** 30 minutes 2. Develop a 'door to needle' QI project to improve the timeliness of thrombolysis in cases where transport delays are anticipated. **Target:** 30 minutes 3. Develop a DTB QI project to improve the DTB time in PCI centres. **Target:** 30 minutes	National Centre for Clinical Audit ACS/Cardiology clinical leads in primary PCI centres Hospital managers and quality and patient safety managers in all hospitals providing STEMI care NAS	As soon as possible.

Evidence that the action will be effective

• The findings of Fordyce *et al.* (2017), who investigated rapid care processes in STEMI care, support the importance of implementing regional networks. Mumma *et al.* (2014) identified 18 key care processes that improved timely reperfusion in STEMI care, including improved communications throughout the patient pathway to reperfusion. In the United States, Wang *et al.* (2011) found that only 11% of patients with a STEMI who required interhospital 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 QI initiatives that focus on key care processes are associated with small improvements in timeliness to reperfusion.

Who will benefit from the recommendation?

• Patients with a STEMI will benefit from the establishment of PCI networks that work towards identifying areas for improvement and implementing and monitoring the effect of change. Healthcare teams involved in the care of patients with a STEMI will benefit through increased collaboration with colleagues.

RECOMMENDATION 3

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

Rationale
● In 2021, 39% (n=578) of patients with a confirmed diagnosis of a STEMI were current smokers on admission, an increase from 34% in 2017–2020 (NOCA, 2022) and more than double the current smoking rate of 18% among the general population (Department of Health, 2021). This highlights the adverse impact that smoking has on heart attack risk. On average, smokers suffer from heart attacks 1 decade earlier than those who never smoked. In the current report, men who were current smokers had a median age of 57 years at STEMI presentation, compared with a median age of 66 years in men who never smoked. Women who were current smokers had a median age of 62 years at STEMI presentation, compared with a median age of 73 years in women who never smoked. The majority (n=31, 70%) of patients aged under 40 years with a STEMI were current smokers. Surprisingly, 34% (n= 84) of patients with a STEMI who had a previous heart attack continued to smoke. Eighty-five percent (n=493) of actively smoking patients with a STEMI were recorded as receiving smoking cessation advice, a steady decrease from 90% in 2020 and 95% in 2019 (NOCA, 2022) and now below the target of 90% (HSE, 2012). 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.

What actions should be taken?	Who is responsible for implementation?	When should this be implemented?
● Smoking cessation information should be provided to all patients with a STEMI prior to discharge from hospital. IHAA data should be utilised to monitor the delivery of smoking cessation education.	ACS/Cardiology clinical leads in all hospitals providing care to patients with a STEMI	As soon as possible.
● 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.	The HSE Tobacco Free Ireland Programme should lead on health promotional messaging.	As soon as possible.

Evidence that the action will be effective
● Smoking is the leading cause of preventable death in Ireland. Each week, 100 people die from diseases directly related to tobacco use, representing nearly 1 in 5 of all deaths annually (Malone and O'Connell, 2020). Stopping smoking after a first heart attack results in a substantially lower risk of a further heart attack or death (van den Berg *et al.,* 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 *et al.,* 2019). It is a national policy commitment to render Ireland tobacco free by 2025 (HSE, 2018b).

Who will benefit from the recommendation?
● 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.

RECOMMENDATION 4

Support patients with a STEMI to reduce the risk of further heart attack by increasing the rate of referral to cardiac rehabilitation phase 3.

Rationale
• 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), which aim to maximise recovery after a heart attack and prevent further cardiac events. In 2021, the proportion of patients with a STEMI who had a pre-existing diagnosis of coronary artery disease (prior MI, prior angina, prior PCI, and/or prior coronary artery bypass graft (CABG)) was 17% (n=249), which was unchanged from 2017 to 2020 (NOCA, 2022). The *Acute Coronary Syndromes Programme Model of Care* (HSE, 2012) target is for 90% of patients with a STEMI to be referred to an early CR programme/ secondary prevention programme on discharge. Cardiac rehabilitation phase 3 comprises an exercise programme and educational classes, typically scheduled over 6–12 weeks. Sixty-six percent (n=782) of patients with a STEMI were referred to cardiac rehabilitation phase 3.

What actions should be taken?	Who is responsible for implementation?	When should this be implemented?
• All patients should be referred to cardiac rehabilitation phase 3 before discharge from hospital and encouraged to participate when a place is offered.	ACS/Cardiology clinical leads in all hospitals providing care to patients with a STEMI	As soon as possible.
• All primary PCI centres should monitor the rate of referral to cardiac rehabilitation phase 3 using the IHAA dashboard and, if the target of 90% is not met, a QI initiative should be developed to identify the reasons why this is not achieved.	ACS/Cardiology clinical lead in the primary PCI centre Quality and patient safety managers	As soon as possible.
• NOCA should report on the time interval between the date of referral to cardiac rehabilitation phase 3 and date of commencement of cardiac rehabilitation phase 3. Data quality in relation to the capture of this information is poor and has been added to the IHAA dashboard as a KQI.	NOCA	As soon as possible.
• Primary PCI centres should establish a process to ensure that this information is captured.	ACS/Cardiology clinical leads in PCI centres	As soon as possible.

Evidence that the action will be effective
• A Cochrane review (Bellman *et al.,* 2020) confirms the findings of Anderson *et al.* (2016) that exercise-based CR reduces cardiovascular mortality and provides important data showing reductions in hospital admissions and improvements in quality of life. These benefits appear to be consistent across patients and intervention types and were independent of study quality, setting, and publication date.

Who will benefit from the recommendation?
• All patients with a STEMI will benefit from CR.

LEARNINGS/CONSIDERATIONS

Primary prevention of heart attack

In 2021, 82% (n=1222) of patients with a STEMI had at least one cardiovascular risk factor and 12% (n=180) had none. The most prevalent risk factors were hypercholesterolaemia (n=686, 46%) and hypertension (n=661, 44%). A substantial proportion of patients had multiple (>3) potentially modifiable cardiovascular risk factors on presentation. Identifying individuals with multiple risk factors at an earlier stage in primary care, the use of chronic disease management programmes and the Making Every Contact Count programme and, most importantly, adequately addressing those modifiable risk factors, provide an opportunity to help reduce the incidence of cardiovascular events.

CHAPTER 11: **CONCLUSIONS**

Heart attack remains a major cause of premature death in both men and women in Ireland. Ten years after the introduction of the standardised ORS protocol for STEMI management, it is important to recognise how successful the National Clinical Programme for ACS has been in establishing primary PCI as the default treatment of choice for STEMI.

However, a number of challenges remain and it is both timely and necessary for the IHAA to highlight these approaching the tenth anniversary of the ORS protocol, so that the clinical leaders responsible for the design and implementation of the protocol can reflect on how the learnings from the IHAA can drive modifications and improvements of the ORS protocol over the next decade.

Patients still respond too slowly to the symptoms of heart attack and/or attend the wrong clinical location to receive timely reperfusion; only 44% of patients with a STEMI seek help within 60 minutes of symptom onset. Pre-hospital ECG diagnosis of a STEMI facilitates prompt transport to designated, 24/7, primary PCI centres. Modelling from the HSE Health Intelligence Unit confirms that 92% of the adult population aged over 55 years can reach the current 24/7 primary PCI centres within 90 minutes at submaximal transport speeds. Therefore, with prompt pre-hospital ECG diagnosis by the NAS, the majority of patients should transfer to a primary PCI centre within 90 minutes. However, 29% of patients with a STEMI are still diagnosed or attend non-PCI-capable hospital emergency departments (EDs) with symptoms in order to obtain their diagnosis. This leads to delays in transport and subsequent delays in timely reperfusion.

Moreover, where transport delays are anticipated (i.e. transport times over 90 minutes), timely administration of thrombolysis should take place, if no contraindication exists. However, timely thrombolysis is only achieved in 25% of eligible cases.

Time is muscle. Delays in timely reperfusion lead to higher mortality and the IHAA again demonstrates that unadjusted in-hospital mortality with timely primary PCI is 3.5%, compared with 5.2% with non-timely primary PCI.

QI initiatives at local PCI centre/network and national level need to focus on increasing direct admission/transport to PCI centres as it is much more likely that timely reperfusion will be achieved in these cases. This will require education of the wider population regarding symptom recognition, the importance of pre-hospital diagnosis and the importance of accessing PCI centres in a timely fashion rather than local EDs. The local PCI centre/network need to understand where delays occur in the process of transferring patients between clinical sites for primary PCI by tracking DIDO times, including ambulance response, transport times for protocol 37 interhospital transfers for STEMI, and education of non-PCI hospital EDs on thrombolysis protocols where timely transport is simply not achievable.

Within PCI centres and their referring network of non-PCI hospitals, considerable variation remains between centres regarding the process of care for patients with a STEMI, with varying DTB times, radial artery access utilisation, secondary prevention discharge medication bundle prescribing, and CR referral. This variation should be the focus of local QI initiatives within PCI centres and their network of non-PCI capable referring hospitals when trying to understand their local variation and in order to drive continuous improvement.

This audit analyses the outcome data of a large volume of highly complex emergent patient care delivered by our dedicated PCI centres, and reflects the dedication and hard work of all the site clinical leads, interventional cardiologists, clinical nurse specialists, doctors, and health and social care professional teams involved in the care of patients with a STEMI. Their continued commitment to patient care and continuous improvement is central to the continued process of clinical audit and we are grateful for their participation in, and support of, the national audit. The IHAA looks forward, in its next report in 2024, to demonstrating risk-adjusted mortality modelling in patients with a STEMI that will allow and facilitate more detailed site-by-site comparison of STEMI heart attack care and timely reperfusion performance in order to drive continued clinical improvements.

REFERENCES

REFERENCES

Anderson, L., Oldridge, N., Thompson, D. R., Zwisler, A. D., Rees, K., Martin, N., & Taylor, R. S. (2016). Exercise-Based Cardiac Rehabilitation for Coronary Heart Disease: Cochrane Systematic Review and Meta-Analysis. *Journal of the American College of Cardiology, 67*(1), 1–12. Available from: https://doi.org/10.1016/j.jacc.2015.10.044 [Accessed 5 May 2023].

Bellmann, B., Lin, T., Greissinger, K., Rottner, L., Rillig, A., & Zimmerling, S. (2020). The Beneficial Effects of Cardiac Rehabilitation. *Cardiology and therapy, 9*(1), 35–44. Available from: https://doi.org/10.1007/s40119-020-00164-9 [Accessed 5 May 2023].

Bray, J.E., Stub, D., Ngu, P., Cartledge, S., Sraney, L., Stewart, M., Keech, W., Patsamanis, H., Shaw, J. and Finn, J. (2015) Mass Media Campaigns' Influence on Prehospital Behavior for Acute Coronary Syndromes: An Evaluation of the Australian Heart Foundation's Warning Signs Campaign. J*ournal of the American Heart Association,* 4(7). Available from: https://www.ahajournals.org/doi/10.1161/JAHA.115.001927[Accessed 9 March 2023].

Department of Health (2021) *Healthy Ireland Survey 2021 Summary Report*. Dublin: Department of Health. Available from: https://www.gov.ie/en/publication/9ef45-the-healthy-ireland-survey-2021/ [Accessed 6 March 2023].

Department of Health (2010) Changing Cardiovascular Health: National Cardiovascular Health Policy 2010 – 2019. Dublin: Department of Health. Available from: https://www.gov.ie/en/publication/481948-changing-cardiovascular-health-national-cardiovascular-health-policy/ [Accessed 5 May 2023].

Department of Health and Children (2008) R*eport of the Commission on Patient Safety and Quality: Building a Culture of Patient Safety.* Dublin: Safety Office. Available from: https://www.gov.ie/en/publication/5d9570-building-a-culture-of-patient-safety-report-of-the-commission-on-pat/ [Accessed 9 March 2023].

European Heart Network (2017) *European Cardiovascular Disease Statistics 2017 edition*. European Heart Network: Brussels. Available from: https://ehnheart.org/cvd-statistics/cvd-statistics-2017.html [Accessed on 10 May 2023].

Fordyce, C.B., Al-Khalidi, H.R., Jollis, J.G., Roettig, M.L., Gu, J., Bagai, A., Berger, P.B., Corbett, C.C., Dauerman, H.L., Fox, K., Garvey, J.L., Henry, T.D., Rokos, I.C., Sherwood, M.W., Wilson, B.H., Granger, C.B. and STEMI Systems Accelerator Project (2017) Association of Rapid Care Process Implementation on Reperfusion Times Across Multiple ST-Segment-Elevation Myocardial Infarction Networks. *Circulation: Cardiovascular Interventions,* 10(1), p. e004061. Available from: https://pubmed.ncbi.nlm.nih.gov/28082714/ [Accessed 10 May 2023]

Hamm, C.W., Bassand, J.P., Agewall, S., Bax, J., Boersma, E., Bueno, H., Caso, P., Dudek, D., Gielen, S., Huber, K., Ohman, M., Petrie, M.C., Sonntag, F., Uva, M.S., Storey, R.F., Wijns, W. and Zahger, D. (2011) ESC Guidelines for the management of acute coronary syndromes in patients presenting without persistent ST-segment elevation: The Task Force for the management of acute coronary syndromes (ACS) in patients presenting without persistent ST-segment elevation of the European Society of Cardiology (ESC). European Heart Journal, 32(23), pp. 2999-3054. Available from: https://doi.org/10.1093/eurheartj/ehr236 [Accessed 9 May 2023].

Health Information and Quality Authority (2018) *Guidance on a data quality framework for health and social care*. Dublin: Health Information and Quality Authority. Available from: https://www.hiqa.ie/sites/default/files/2018-10/Guidance-for-a-data-quality-framework.pdf   [Accessed   9 March 2023].

Health Service Executive (2012) *Acute Coronary Syndromes Programme Model of Care*. Dublin: Health Service Executive. Available from: https://www.hse.ie/eng/services/publications/clinical-strategy-and-programmes/acute-coronary-syndrome-prog-moc.pdf [Accessed 9 March 2023].

Health Service Executive (2018a) H*eart Attack Care Ireland 2016: Report of the National Clinical Programme for Acute Coronary Syndrome (ACS) on standardising treatment of patients with STEMI in 2016*. Dublin: Health Service Executive. Available from: https://www.lenus.ie/handle/10147/623098 [Accessed 9 March 2023].

Health Service Executive (2018b) *HSE Tobacco Free Ireland Programme Implementation Plan 2018-2021*. Dublin: Health Service Executive. Available from: https://www.drugsandalcohol.ie/30819/ [Accessed 2 November 2021].

Health Service Executive (2019) N*ational Review of Clinical Audit November 2019*. Dublin: Health Service Executive Available from: https://www2.healthservice.hse.ie/organisation/ncca/ [Accessed 9 March 2023].

Health Service Executive (2020) *National Framework for the Integrated Prevention and Management of Chronic Disease in Ireland 2020-2025*. Dublin: Health Service Executive. Available from: https://www.hse.ie/eng/about/who/cspd/icp/chronic-disease/documents/national-framework-integrated-care.pdf [Accessed 9 May 2023].

Hickey, A., Mellon, L., Williams, D., Shelley, E. and Conroy, R.M. (2018) Does stroke health promotion increase awareness of appropriate behavioural response? Impact of the face, arm, speech and time (FAST) campaign on population knowledge of stroke risk factors, warning signs and emergency response. European Stroke Journal, 3(2), pp. 117-125. Available from: https://pubmed.ncbi.nlm.nih.gov/31008344/ [Accessed 9 March 2023].

Ibanez, B., James, S., Agewall, S., Antunes, M.J., Bucciarelli-Ducci, C., Bueno, H., Caforio, A.L.P., Crea, F., Goudevenos, J.A., Halvorsen, S., Hindricks, G., Kastrati, A., Lenzen, M.J., Prescott, E., Roffi, M., Valgimigli, M., Varenhorst, C., Vranckx, P., Widimský, P. and ESC Scientific Document Group (2018) 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation: The Task Force for the management of acute myocardial infarction in patients presenting with ST-segment elevation of the European Society of Cardiology (ESC). *European Heart Journal*, 39(2), pp. 119-177. Available from: https://academic.oup.com/eurheartj/article/39/2/119/4095042 [Accessed 9 March 2023].

Malone, P. and O'Connell, P. (2020) Trends in Smoking Prevalence and Tobacco Consumption. Public policy. Available from: https://publicpolicy.ie/downloads/papers/2020/Trends_in_Smoking_Prevalence_and_Tobacco_Consumption.pdf [Accessed 6 March 2023].

Mumma, B.E., Williamson, C., Khare, R.K., Mackey, K.E. and Diercks, D.B. (2014) Minimizing transfer time to an ST segment elevation myocardial infarction-receiving center: a modified Delphi consensus. *Critical pathways in cardiology,* 13(1), 20–24. Available from: https://pubmed.ncbi.nlm.nih.gov/24526147/ [Accessed 9 March 2023].

National Clinical Effectiveness Committee (2015) Framework for Endorsement of National Clinical Audit. Dublin: Department of Health. Available from: https://assets.gov.ie/11677/189a669fe1a84f4a953998560ebdbc4c.pdf [Accessed 8 May 2023].

National Office of Clinical Audit (2022) *Irish Heart Attack Audit National Report 2017-2020*. Dublin: National Office of Clinical Audit. Available from: https://www.noca.ie/audits/irish-heart-attack-audit [Accessed 6 March 2023].

National Office of Clinical Audit (2023) *National Office of Clinical Audit: Impact Report 2023*. Dublin: National Office of Clinical Audit. Available from: https://www.noca.ie/publications/ publications- listing/P0/category/3 [Accessed 6 March 2023].

National Thrombectomy Service (2022) *National Thrombectomy Service Annual Report 2021*. Dublin: National Thrombectomy Service. Available from: chrome-extension:// efaidnbmnnnibpcajpcglclefindmkaj/https://www.hse.ie/eng/about/who/cspd/ncps/stroke/ resources/national-thrombectomy-service-2021-annual-report.pdf [Accessed 10 March 2023].

Nehme, Z., Andrew, E., Bernard, S., Patsamanis, H., Cameron, P., Bray, J.E., Meredith, I.T. and Smith, K. (2017) Impact of a public awareness campaign on out-of-hospital cardiac arrest incidence and mortality rates. *European Heart Journal,* 38(21), pp. 1666-1673. Available from: https://academic. oup.com/eurheartj/article/38/21/1666/2452311 [Accessed 10 May 2023].

van den Berg, M.J., van der Graaf, Y., Deckers, W.J., de Kanter, W., Algra, A., Kappelle, L.J., de Borst, G.J., Cramer, M.J.M. and Visseren, F.L.J. (2019) Smoking cessation and risk of recurrent cardiovascular events and mortality after a first manifestation of arterial disease. *American Heart Journal,* 213, pp. 112-122. Available from: https://doi.org/10.1016/j.ahj.2019.03.019 [Accessed 26 October 2021].

Wang, T.Y., Nallamothu, B.K., Krumholz, H.M., Li, S., Roe, M.T., Jollis, J. G., Jacobs, A.K., Holmes, D.R., Peterson, E.D. and Ting, H.H. (2011) Association of door-in to door-out time with reperfusion delays and outcomes among patients transferred for primary percutaneous coronary intervention. *JAMA*, 305(24), 2540–2547. Available from: https://doi.org/10.1001/jama.2011.862 [Accessed 9 March 2023].

ACCESSING REPORT APPENDICES

National Office of Clinical Audit (2023)
Irish National Heart Attack Audit 2021
Dublin: National Office of Clinical Audit.

Available at: https://s3-eu-west-1.amazonaws.com/noca-uploads/general/IHAA_2021_Appendices.pdf

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