National STEMI report

Te pūrongo STEMI ā-motu

Aotearoa New Zealand 2023–24

Hato Hone St John

WELLINGTON FREE AMBULANCE
kia ora te tangata

AUT

Contents

Clinical Evaluation Research and Insights
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Introduction
Whakatakinga

Ischaemic heart disease (IHD) in Aotearoa New Zealand carries a large burden of disease.

In 2021 IHD was the second leading cause of death for all New Zealanders, with 42.9 deaths per 100,000 population. The risk of death from IHD is considerably higher for Māori, who have a rate of 68.4 deaths per 100,000 population [1].

ST-segment Elevation Myocardial Infarction (STEMI) is the most life-threatening manifestation of IHD and requires urgent revascularisation to prevent progression to cardiac arrest (see page 18). Revascularisation is achieved with either intravenous fibrinolysis and/or percutaneous coronary intervention (PCI). Intravenous fibrinolysis can be performed by paramedics in an out-of-hospital setting, whereas PCI must be performed in a PCI-capable hospital (Table 1).

NZ PCI-capable hospitals
• North Shore Hospital (restricted times)
• Auckland City Hospital
• Middlemore Hospital (restricted times)
• Waikato Hospital
• Tauranga Hospital (restricted times)
• Wellington Hospital
• Nelson Hospital (restricted times)
• Christchurch Hospital
• Dunedin Hospital

Table 1: List of PCI-capable hospitals
Unless stated, PCI is available 24/7.

Overview of the New Zealand Out-of-Hospital STEMI Pathway

Te tirohanga whānui o te ara STEMI whakaora tara ā-whare Aotearoa

The New Zealand Out-of-Hospital STEMI Pathway (STEMI pathway) aims to shorten the time to reperfusion therapy for patients experiencing out-of-hospital STEMI, Figure 1.

The STEMI pathway guides paramedics' decision making between the two reperfusion strategies (fibrinolysis and PCI). If the patient can be transported to a PCI-capable hospital within 90 minutes of a STEMI diagnosis being made, then the Primary PCI reperfusion strategy is followed. If transport is expected to take longer than 90 minutes, fibrinolytic therapy is the reperfusion strategy followed.

In New Zealand, paramedics can autonomously administer fibrinolytic therapy when STEMI criteria is met and the patient has no clinical contraindications. If relative contraindications are present or the STEMI diagnosis is unclear, consultation with an on-call doctor is required. Following out-of-hospital fibrinolysis, patients are transported to a hospital capable of providing rescue PCI.

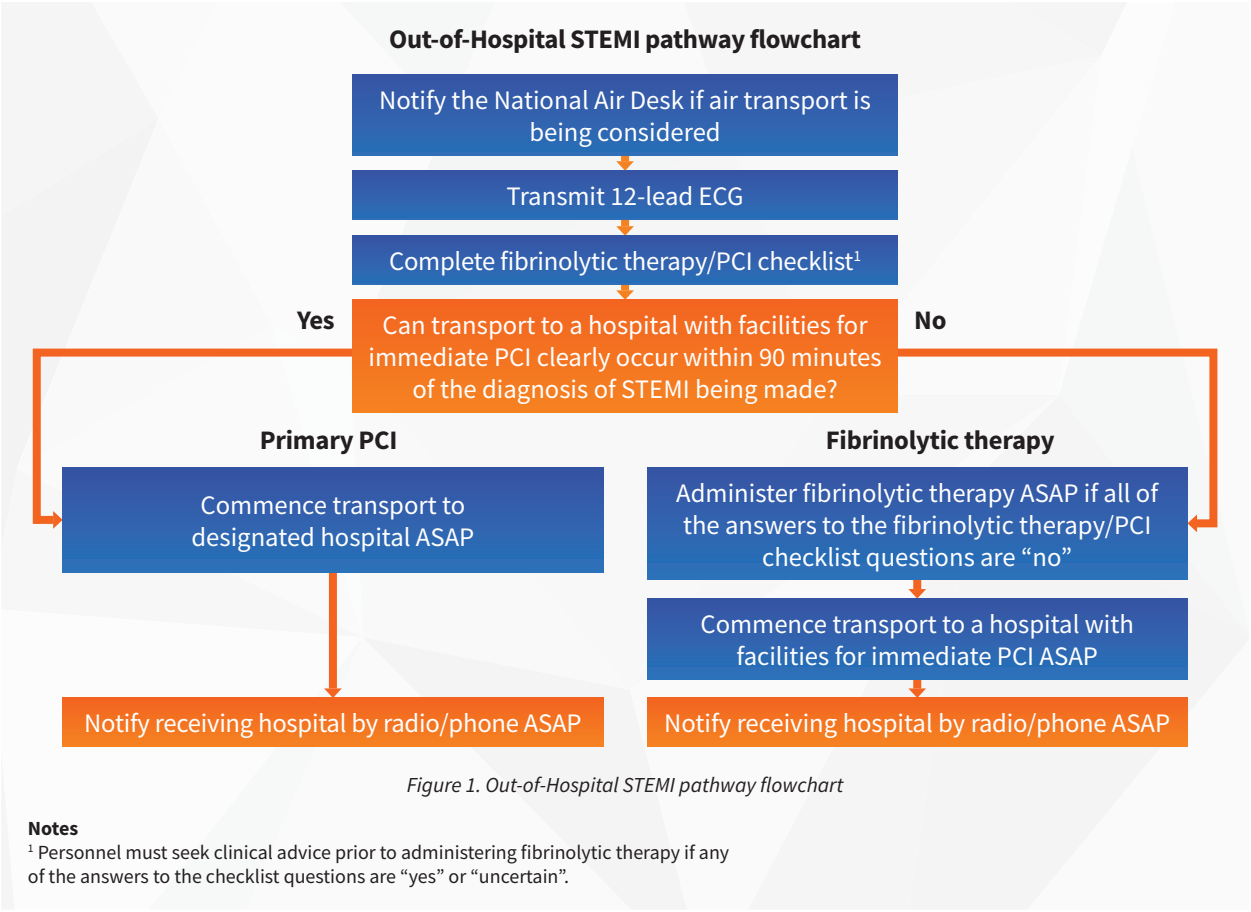


Figure 1. Out-of-Hospital STEMI pathway flowchart

Notes

[1] Personnel must seek clinical advice prior to administering fibrinolytic therapy if any of the answers to the checklist questions are "yes" or "uncertain".

About this report
Mō tēnei pūrongorongo

This is New Zealand's fourth annual National Out-of-Hospital ST Elevation Myocardial Infarction (STEMI) report.

Ambulance officers attending a STEMI incident record patient data in an electronic Patient Report Form (ePRF). A STEMI is diagnosed at the scene based on a clinical presentation consistent with STEMI and an ECG meeting STEMI diagnostic criteria. ePRF data was used to identify all STEMI incidents attended by the Hato Hone St John, Wellington Free Ambulance and South Island air ambulance service (HEMS) in the period from 1 July 2023 to 30 June 2024.

Eligibility

Case selection was based on either (1) the presence of both a diagnostic 12-lead ECG and a selected clinical impression or (2) Tenecteplase administration with a manual review to confirm STEMI. (Table 2). Tenecteplase is a fibrinolytic drug that is only used by EAS in Aotearoa New Zealand when a STEMI is diagnosed, and the patient meets criteria for the fibrinolytic pathway. Therefore, any ePRF where tenecteplase was documented but the initial selection criteria were not met was manually reviewed to confirm whether a STEMI occurred.

Cases that progressed to cardiac arrest were excluded from the general analysis but are reviewed in the dedicated section. Cases where fibrinolysis was administered prior to EAS arrival (i.e. at a medical centre) were excluded from this report, as well as patients outside of a primary PCI catchment area whose care was handed over to air ambulance and the reperfusion strategy could not be determined.

Inclusion criteria

(1) A clinical impression from the list below:

- ST-elevation myocardial infarction
- Cardiac chest pain
- Myocardial ischaemia

and

Documented STEMI on ECG.

Or

(2) Tenecteplase administration

and

Confirmation of STEMI based on manual review of ePRF.

Exclusion criteria

- Pre-EMS Fibrinolysis
- Patient handover with unknown outcome

Table 2: Out-of-Hospital STEMI patient inclusion and exclusion criteria

Pathway allocation

In this report, patients were allocated to the fibrinolysis pathway if tenecteplase administration was documented in their ePRF. A primary PCI reperfusion strategy was designated if prehospital fibrinolysis did not occur and the patient was transported directly from the scene to a PCI-capable hospital within the hospital's designated primary PCI catchment area (Table 3), or from outside the catchment area by helicopter with clear ePRF documentation of a primary PCI pathway. In cases where a patient was transported to a hospital offering PCI capabilities only during specific hours, we have assumed that PCI was available at the time of transport.

Hospital	Catchment area (radial kms)
Auckland City Hospital	60
Christchurch Hospital	60
Dunedin Hospital	70
Middlemore Hospital	60
Nelson Hospital	30
North Shore Hospital	60
Tauranga Hospital	60
Waikato Hospital	50
Wellington Hospital	70

Table 3: Catchment area of PCI-capable hospitals

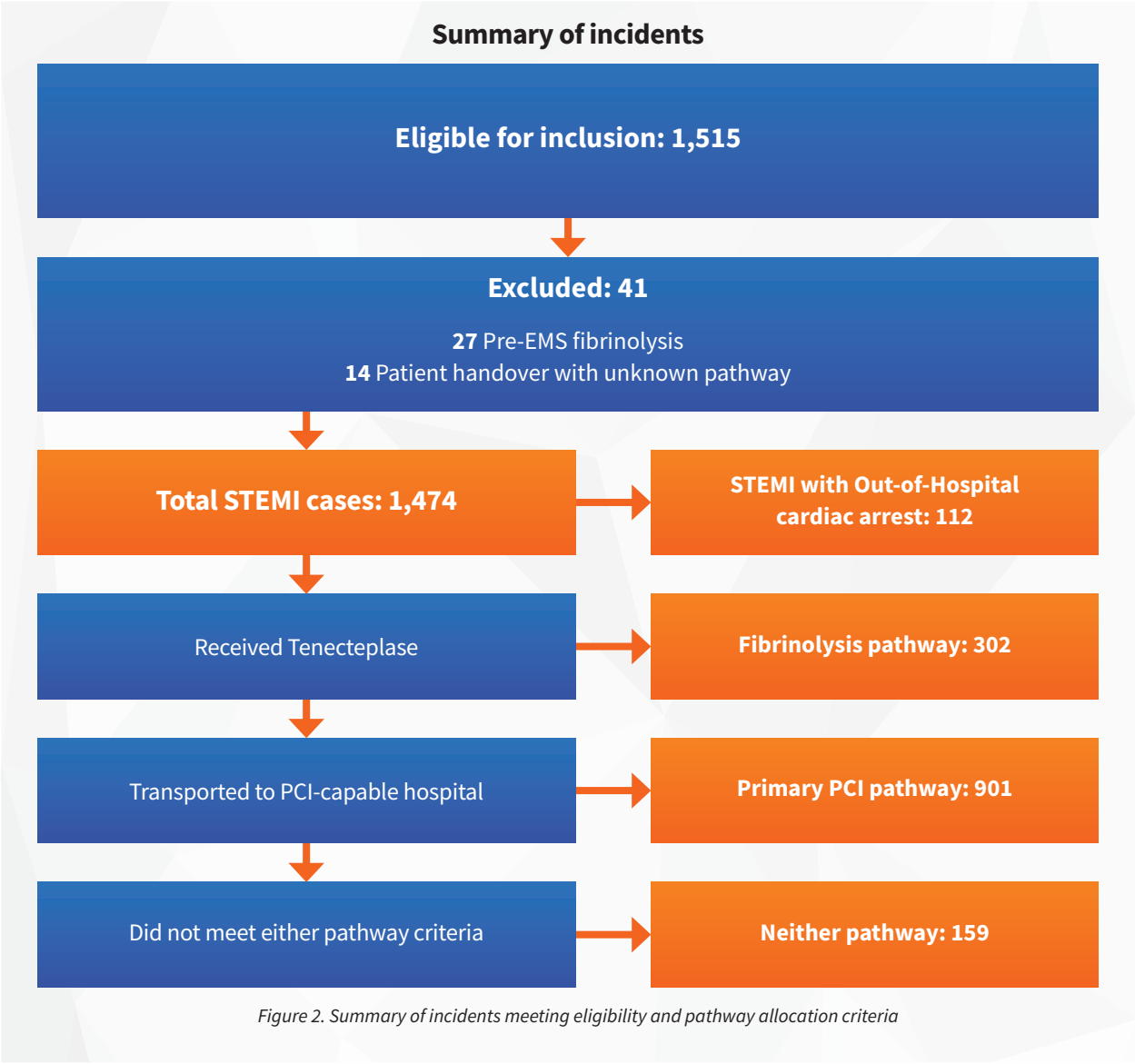


Figure 2. Summary of incidents meeting eligibility and pathway allocation criteria

Executive summary
Tuhinga whakarāpopoto nui

1,362 *STEMI patients attended by emergency ambulance in the 12 month period

The median age was **68 years**

33% female
67% male

STEMI diagnosis

34%
of patients waited more than two hours from onset to calling 111

8 minutes
Median time from EAS arrival to 12-lead ECG

65%
of patients had first 12-lead ECG within 10 minutes

66% → **Primary PCI strategy**

49 minutes
Median time from EAS arrival to PCI Hospital

95%
of patients arrived at a PCI capable hospital within 90 minutes of EAS arrival

22% → **Fibrinolysis strategy**

33 minutes
Median time from EAS arrival to fibrinolysis

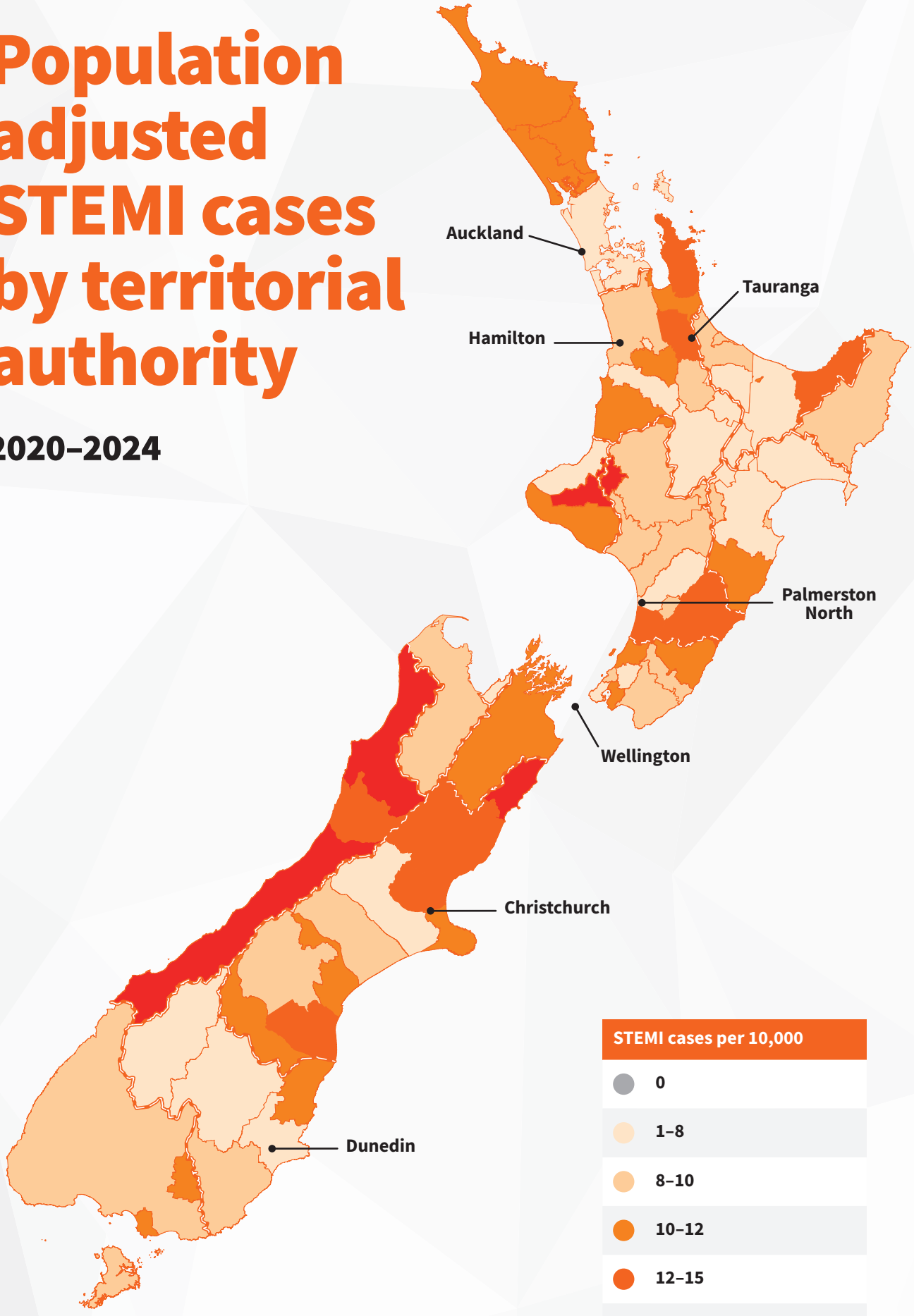
74%
of patients received fibrinolysis within 45 minutes of EAS arrival

12% → **Neither**

*Excludes patients that experienced a cardiac arrest.

Population adjusted STEMI cases by territorial authority

2020–2024



Reperfusion strategies
Ngā rautaki whakarere anō toto

Primary PCI is the preferred reperfusion strategy for patients experiencing STEMI. Nationwide, 66% of out-of-hospital STEMI cases followed the primary PCI reperfusion strategy while 22% underwent fibrinolysis. The remaining 12% did not meet the criteria of either strategy. The destination hospital of patients treated by either strategy are shown on page 11.

Time from ambulance arrival to reperfusion strategy

Fibrinolytic reperfusion therapy occurs earlier than in-hospital PCI services (Figures 3 and 4). Tenecteplase is the fibrinolytic drug used by New Zealand emergency ambulance service. While paramedics can provide fibrinolytic therapy without consultation, sometimes when STEMI diagnosis is unclear or cautions exist, consultation with the on-call doctor is required. Consultation is likely to delay fibrinolytic therapy. However, this delay was unable to be quantified as we currently cannot distinguish between autonomous and consulted fibrinolytic therapy.

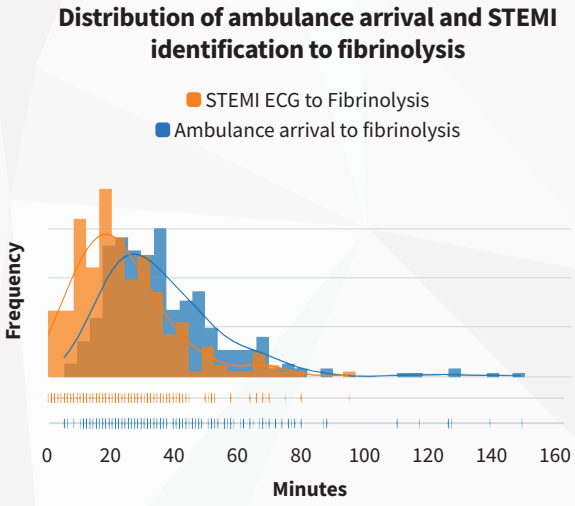


Figure 3. Distribution of ambulance arrival and STEMI identification to fibrinolysis

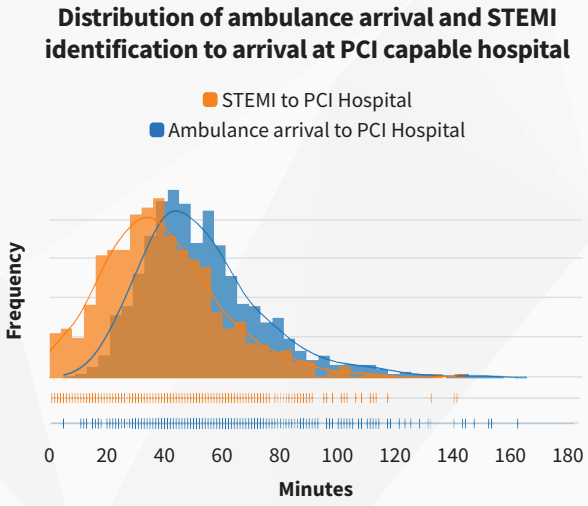


Figure 4. Distribution of ambulance arrival and STEMI identification to arrival at PCI capable hospital

Timeline

The flowchart on the right shows the timeline of events for a typical out-of-hospital STEMI patient.

There is often a considerable delay in patients seeking care after the onset of their symptoms. The median time calculation of 57 minutes from onset of symptoms to 111 call includes patients who are assessed at other healthcare facilities prior to ambulance attendance.

Location

Of the STEMI incidents, 71% occurred in the patient's home (Figure 5). In 14% of cases the patient was located at a healthcare facility, indicating that they were assessed by another health professional prior to ambulance attendance.

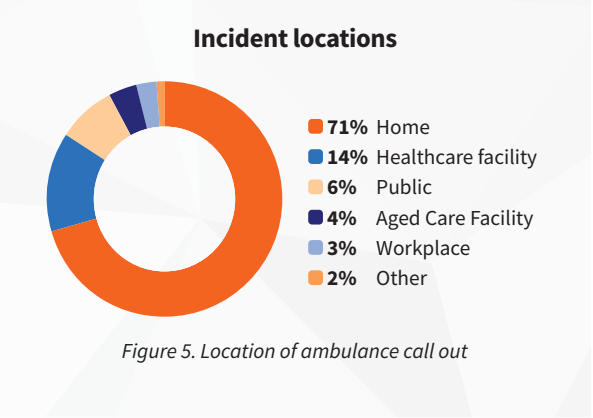
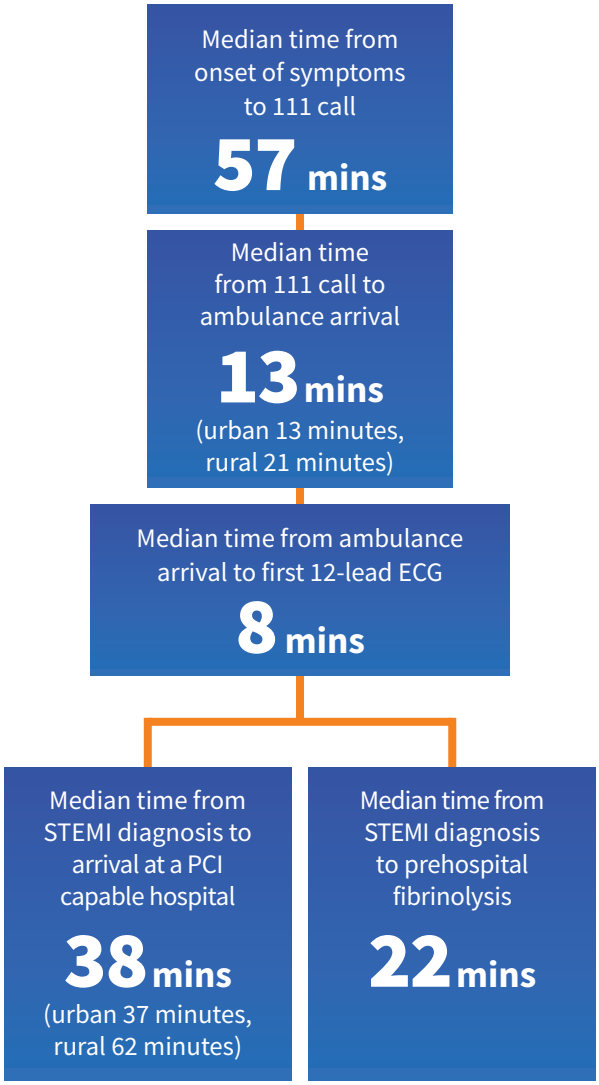


Figure 5. Location of ambulance call out



Year	2020/21	2021/22	2022/23	2023/24
Total number of events	1,511	1,435	1,453	1,362
Primary PCI strategy	68%	74%	66%	66%
Fibrinolysis strategy	16%	13%	20%	22%
Neither strategy	16%	12%	14%	12%
Median time from onset of symptoms to 111 call	63 mins	61 mins	60 mins	57 mins
Median time from 111 call to ambulance arrival	13 mins	15 mins	15 mins	13 mins
Median time from ambulance arrival to first 12-lead ECG	7 mins	7 mins	8 mins	8 mins
Median time from STEMI diagnosis to arrival at a PCI-capable hospital	36 mins	38 mins	38 mins	38 mins
Median time from STEMI diagnosis to prehospital fibrinolysis	25 mins	21 mins	22 mins	22 mins

Table 4: Key figures for all patients, excluding cardiac arrest

Patient journey
Te Haerenga Tūroro

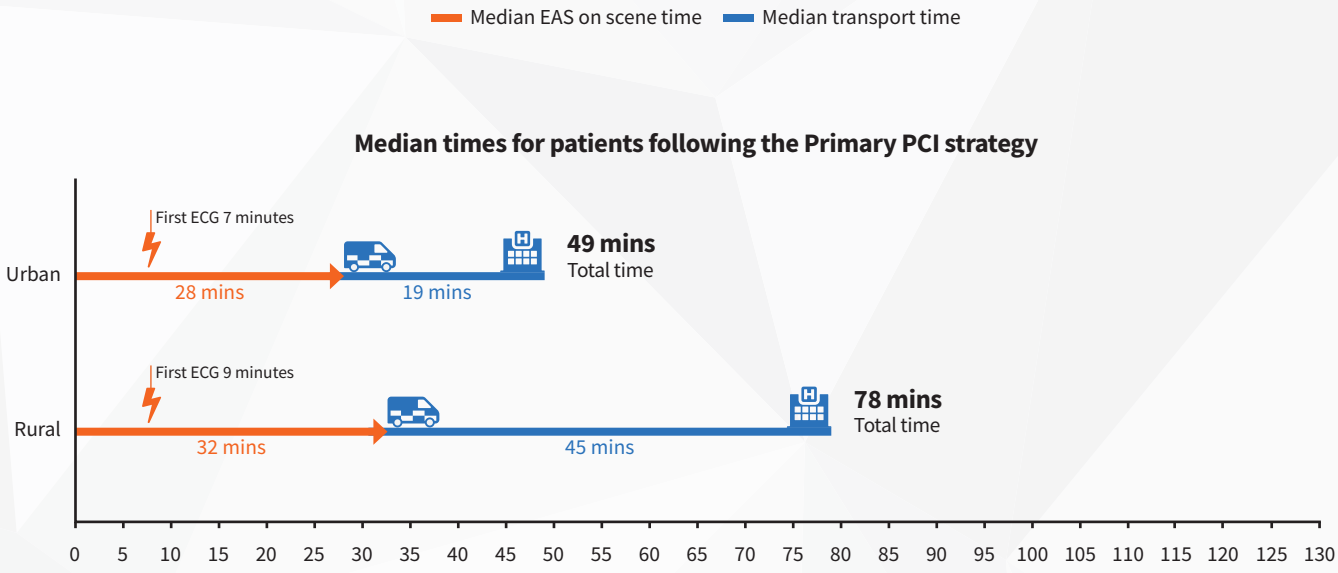


Figure 6. Median times for patients following the Primary PCI strategy

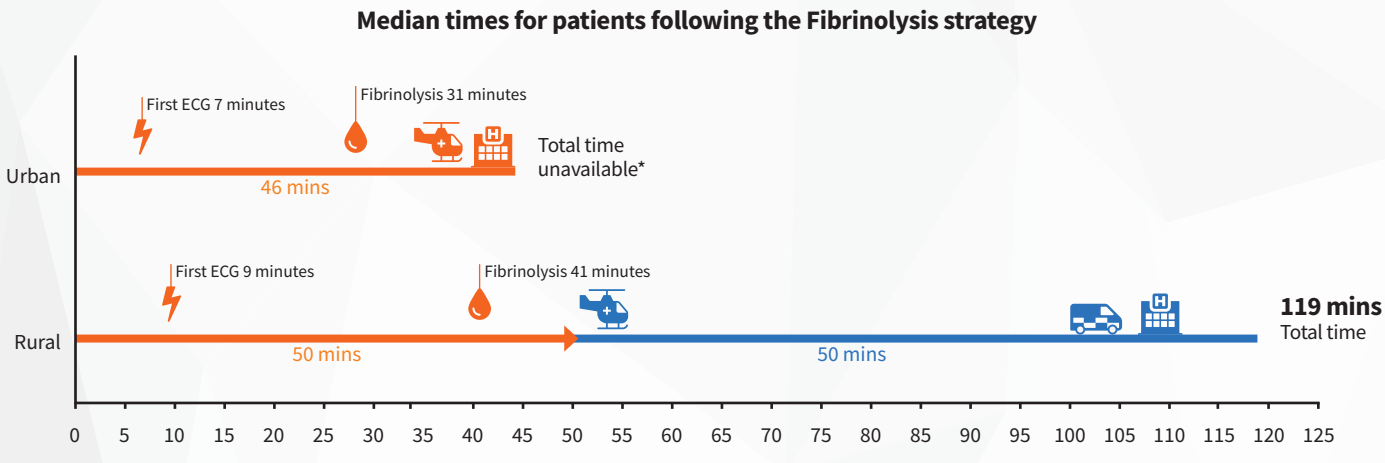
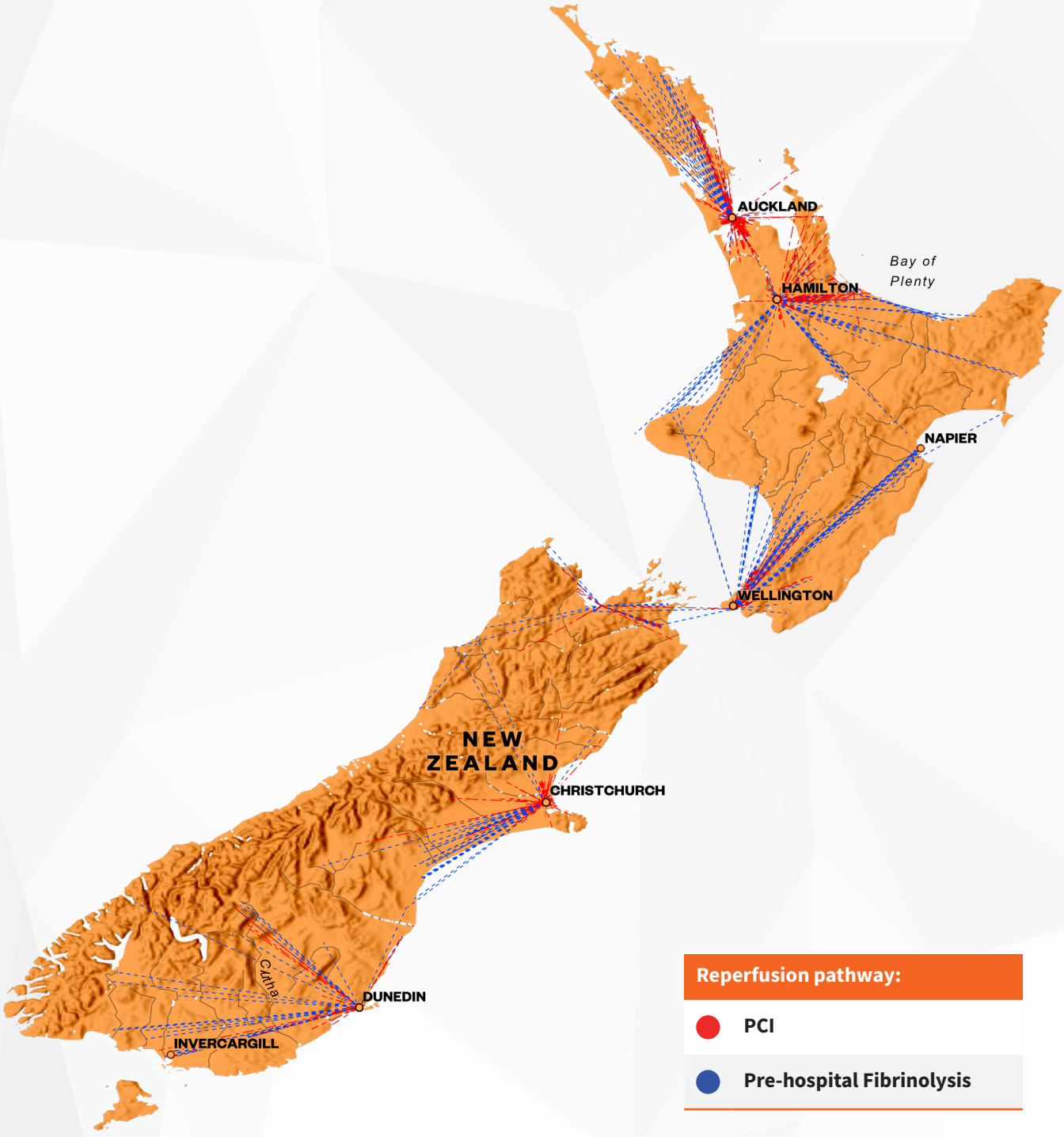


Figure 7. Median times for patients following the Fibrinolysis strategy

** Post fibrinolysis patients can be transported via ambulance to helicopter landing zone or directly to PCI capable hospital.*

STEMI Patient Destinations by Reperfusion Pathway



Patient demographics
Ngā hangapori tūroro

Given the propensity for small numbers within location, ethnicity, and deprivation subgroups, this section includes cumulative cases from July 1, 2020 to June 30th, 2024.

Age

Māori and Pacific peoples experience STEMI at a younger age (Figure 8). In all ethnicity groups examined, males experience STEMI at younger ages than females – with a median age difference of ten years.

The median ages amongst the no reperfusion strategy group were higher than both the Primary PCI and fibrinolysis strategy groups.

Strategy	Median age (years)
Primary PCI	66
Fibrinolysis	68
Neither	74

Table 5: Median patient age according to perfusion strategy

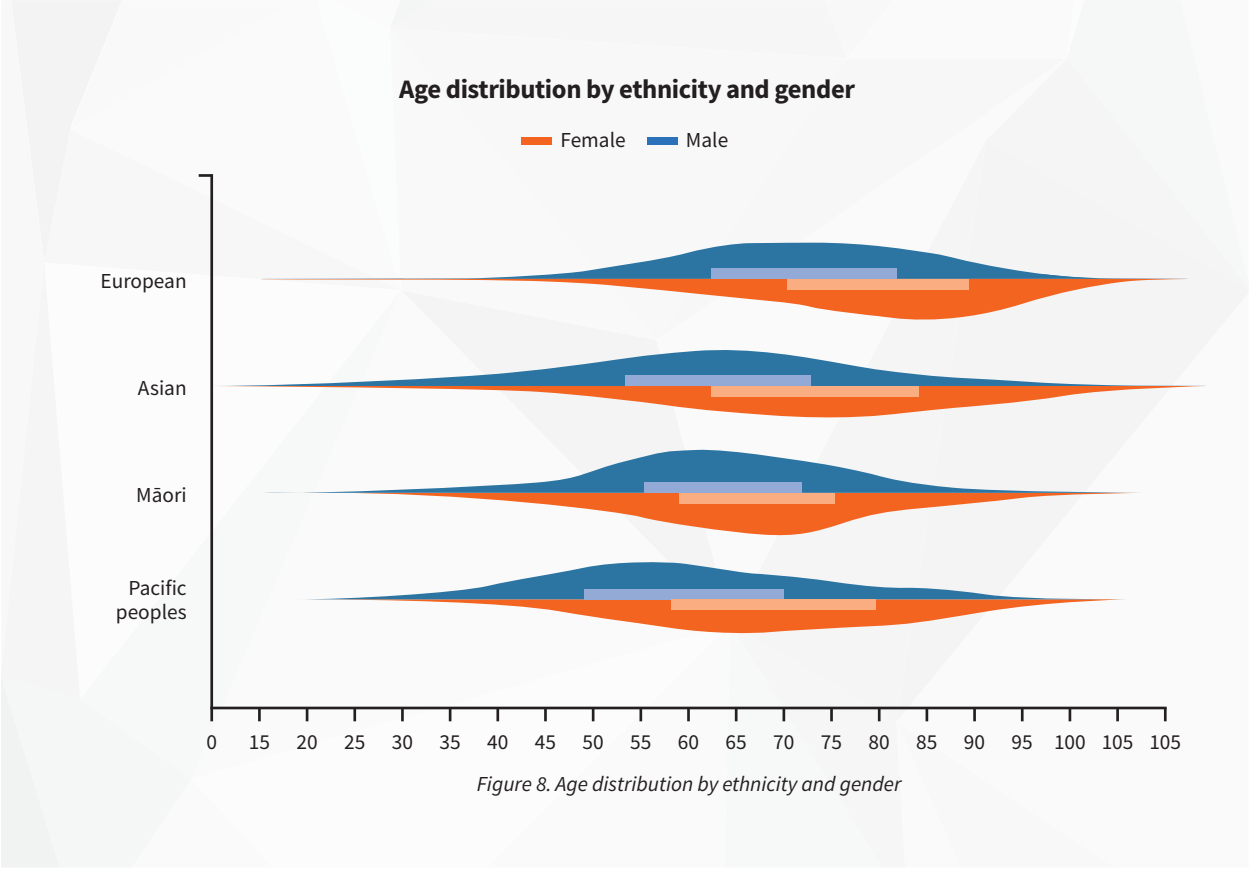


Figure 8. Age distribution by ethnicity and gender

Ethnicity

Europeans accounted for the majority of patients experiencing a STEMI (73%), followed by Māori (10%), Asian (9%) and Pacific peoples (6%) (Figure 9). The remaining 1% were Middle Eastern, Latin American, African, and other ethnicities.

While Primary PCI remains the main reperfusion strategy across all ethnicities, Māori have the lowest proportion of Primary PCI, whilst Pacific peoples and Asians have the highest likely reflecting the predominance of urban living in these populations (Figure 10).

Rurality

Primary PCI and other specialised definitive cardiac interventions are only available in major urban hospitals throughout Aotearoa New Zealand. Populations living in rural communities are at especially high risk of geographical inequity in coronary care.

Rurality was defined using the Geographic Classification for Health proposed by Whitehead et. al [2]

While most patients in large urban centers access Primary PCI pathways, a meaningful number of patients living in smaller cities throughout New Zealand (particularly around the central North Island) still depend on prehospital fibrinolysis as their main reperfusion strategy (Figure 11).

Reperfusion strategies among rural populations have the expected lower proportion of patients following the Primary-PCI strategy, with the corresponding increase in patients undergoing pre-hospital fibrinolysis (Figure 11). The cumulative data over the last three reporting years shows a quarter of rural STEMI patients fall outside either reperfusion strategy.

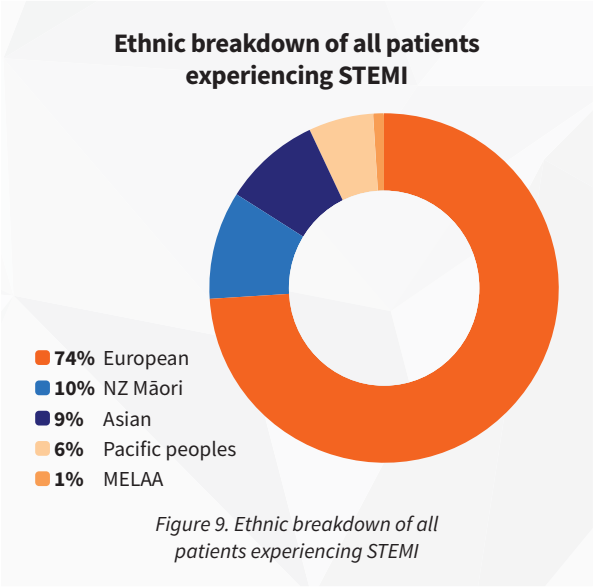


Figure 9. Ethnic breakdown of all patients experiencing STEMI

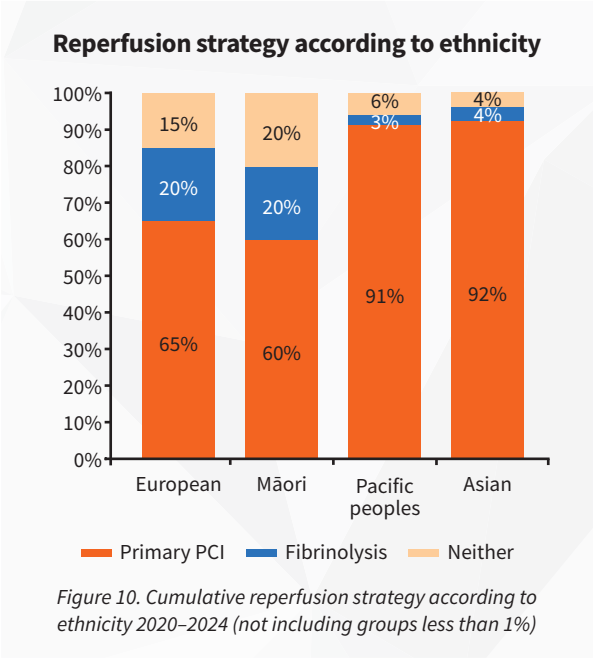


Figure 10. Cumulative reperfusion strategy according to ethnicity 2020–2024 (not including groups less than 1%)

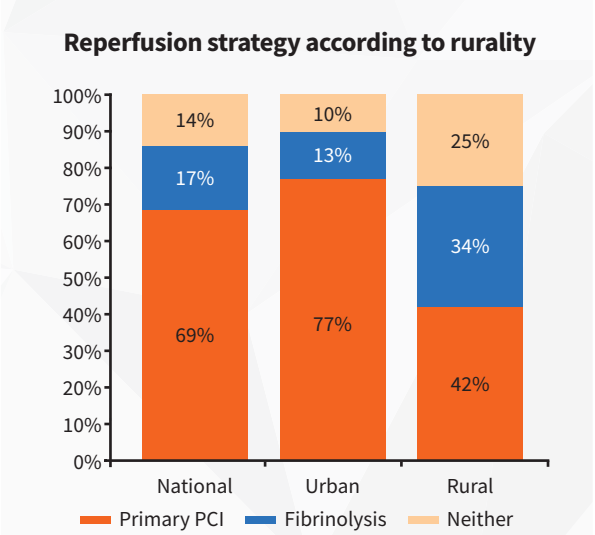


Figure 11. Cumulative reperfusion strategy according to rurality 2020–2024

Economic Deprivation

The NZDep2018 is an 'area-level' measure of socioeconomic deprivation calculated using census data [3]. Some of the factors used to indicate higher deprivation are:

- access to the internet,
- receiving a means tested benefit,
- household income,
- employment (18–64 years age group),
- qualifications (18–64 years age group),
- not living in own home,
- a single parent family,
- household bedrooms in relation to occupancy threshold,
- and access to a car.

The NZDep2018 quintiles range from Q1 – 5, where the least deprived 20% of areas are scored as Q1, and the most deprived 20% are scored as Q5.

Higher levels of socioeconomic deprivation are widely associated with worse access to care and health outcomes, and data presented in our reports appear to confirm this paradigm.

Overall trends continue to show diminishing Primary PCI usage and increasing rates of no reperfusion as socioeconomic deprivation rises. However, this year's data indicate modest improvements in the proportion of patients receiving no reperfusion across most quintiles, as well as a mild shift from PCI reperfusion toward Fibrinolysis compared to previous years.

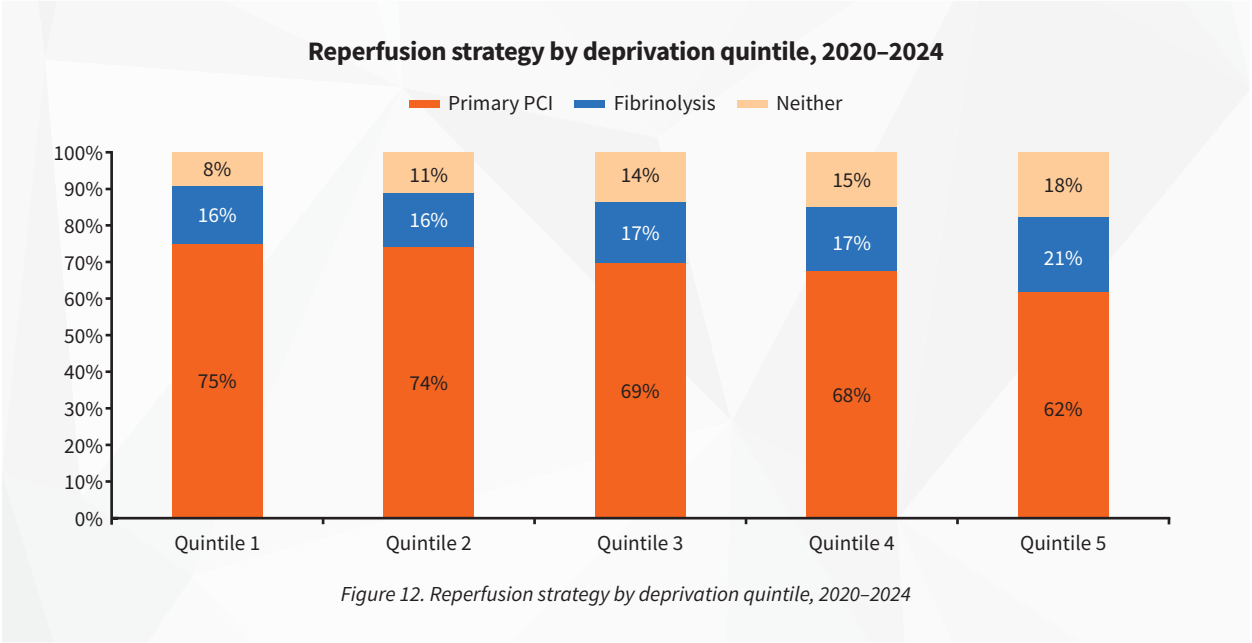


Figure 12. Reperfusion strategy by deprivation quintile, 2020–2024

Neither reperfusion group

Te rōpū kāore anō rānei kia whakarere anō toto

Out of 1,362 STEMI patients, 159 (12%) were not enrolled in either of the reperfusion pathways. Most of these patients were transported to their domiciled hospital that did not have PCI-capability.

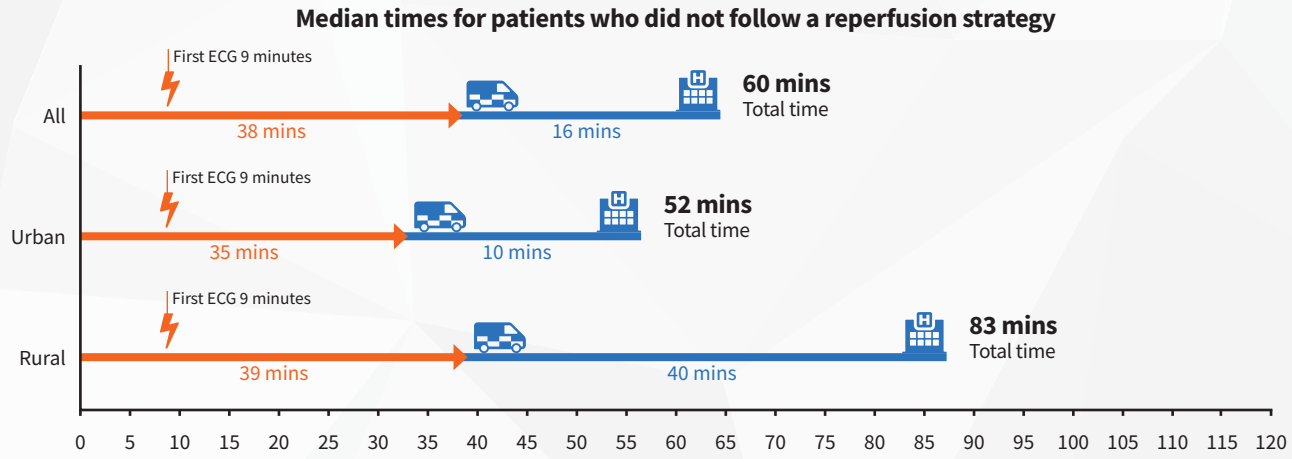


Figure 13. Median times for patients following neither strategy

We used International Classification of Disease, tenth revision (ICD-10) codes obtained from Ministry of Health to attempt to establish the principal hospital diagnosis for patients in the Neither group.

Out of the 159 patients, only 53 were ultimately diagnosed as having STEMI. 15 cases were identified a non-STEMI, a less severe form of heart attack not amenable to urgent reperfusion. ICD-10 data was missing in 42 cases.

The majority of cases with a STEMI ICD-10, were outside Primary PCI catchment areas and were geographical candidates for pre-hospital fibrinolysis (greater than 90 minutes transport time from PCI capable hospital). Manual review of the ambulance care records identified the main reason why fibrinolysis was not administered by ambulance personnel (Table 7).

Contraindications

Pre-hospital fibrinolytic therapy can quickly restore blood flow to the heart during a STEMI, a severe type of heart attack. This can significantly improve outcomes for patients who are far from hospitals equipped for primary PCI. Generally, this treatment is safe, but it may lead to complications such as internal bleeding in certain patients.

To minimize these risks, paramedics use a detailed checklist to assess each patient's risk before giving fibrinolytic therapy. If they find any "orange" or "red" flags, which indicate higher risks, they consult with regional STEMI coordinators to decide the best approach. Sometimes, flags like high blood pressure can be managed by the ambulance team. However, in cases where patients have certain conditions, like vulnerable blood vessels or are on blood thinners, fibrinolytic therapy might be avoided. Instead, these patients are taken to a suitable hospital for further care and assessment.

Upgrouped ICD-10	Count	Percentage
STEMI (including transmural infarction)	53	33%
NSTEMI (Subendocardial infarction)	15	9%
Other heart related condition	28	18%
Other non-heart related	21	13%
No ICD-10 data available	42	26%
Grand Total	**159**	**100.00%**

Table 6: In-hospital diagnosis

Reasons for no reperfusion	Count	Percentage
Criteria not met/ Evolving	15	28%
Absolute/Relative contraindication	13	25%
Vacillating STEMI presentation	6	11%
Very frail/comorbid	6	11%
End of life/Hospice	5	9%
Unclear Reason	4	8%
Very close to ED	2	4%
Operational factors	1	2%
Patient refusal	1	2%
Grand Total	**53**	**100.00%**

Table 7: Reasons for no perfusion

Unclear ECG and/or clinical presentation findings

Clinical diagnostic criteria for identifying a STEMI rely on specific electrocardiogram (ECG) changes, as defined by the New Zealand National Cardiac Network. The emergence of these ECG changes largely depends on the extent and duration of blood flow restriction to the heart, often evolving over time. Consequently, patients presenting early in the course of their condition may exhibit initial signs of an infarction that does not yet fulfil the established STEMI diagnostic criteria. Given the uncertainty of progression to full STEMI criteria, such patients are typically transported to the nearest regional hospital for ongoing monitoring and management.

STEMI Criteia

- More than or equal to 2 mm (200 µV) of ST elevation in two or more leads V1-3, OR
- More than or equal to 1 mm (100 µV) of ST elevation in two or more contiguous leads in any other area.

In instances where the ECG does not confirm STEMI but clinical assessment indicates a high likelihood of progression to STEMI, ambulance personnel, in consultation with regional STEMI coordinators, may choose to transport the patient to a tertiary care centre. This decision is made while withholding prehospital fibrinolytic therapy until a more definitive assessment can be made.

Transient or self-resolving STEMI criteria

Just as ECG changes can evolve to meet STEMI criteria, they can also progress into non-STEMI criteria. Clinical guidelines and evidence around aetiology and management of STEMI is very limited. Evidence suggests spontaneous reperfusion is behind transient STEMI and as a result, the patients appear to have better outcomes. Because of this, pre-hospital fibrinolysis is not indicated.

High frailty and co-morbidities

Very frail, comorbid patients are at a high risk of complications from prehospital fibrinolysis. Nuanced decision making often takes place under consultation with regional STEMI coordinators. In some cases, the balance of risk is in favour of withholding fibrinolytics.

STEMI and Out of Hospital Cardiac Arrest (OHCA)

STEMI me te Mate Manawa Tū i waho o te Hōhipera

Cardiac arrest is the sudden loss of heart function, where the heart cannot effectively pump blood. The most common cause is ischemic heart disease. Without rapid intervention, cardiac arrest will always result in death.

When cardiac arrest occurs prior to ambulance arrival, survival is strongly dependent on timely bystander CPR, early defibrillation, and emergency responder arrival. Cardiac arrests witnessed by ambulance teams have better survival rates because critical interventions can be performed immediately following the sudden loss of heart function.

Cardiac arrest in patients with STEMI most commonly occurs when an occluded vessel causes significant disruption to heart function leading to lethal heart dysrhythmia.

Treatment during a cardiac arrest following STEMI prioritises restoration of a sustainable heart rhythm producing adequate cardiac output, reopening the blocked vessel, supportive care after return of spontaneous circulation (ROSC), and transport to a PCI-capable hospital.

In the 2023/24 year, 112 STEMIs cases involved cardiac arrest. 36% of these patients experienced cardiac arrest before ambulance arrival. In 79% of cases, chest pain preceded the cardiac arrest and was the reason for the 111 call. Only 15% of individuals collapsed without any prior symptoms, while the remaining 6% experienced atypical symptoms.

Summary statistics	
112	STEMI patients experienced cardiac arrest
72	cardiac arrests witnessed by paramedics
64	with lethal shockable rhythm
58	successfully defibrillated by paramedic to a non-lethal rhythm

Table 8: Summary statistics for STEMI cardiac arrest patients

Restoration of Heart Function

The reversibility of cardiac arrest is closely related to the underlying dysrhythmia. Out of the 112 patients in cardiac arrest, 83% presented with a heart rhythm known to be responsive to defibrillation (Table 8). 13% of these patients were unable to be resuscitated by ambulance crews, but most attempts resulted in ROSC, including 91% of those with a shockable presenting heart rhythm. In cases where ROSC was achieved, ambulance crews performed CPR for a median of two cycles (approximately 4 minutes) between arrest and ROSC.

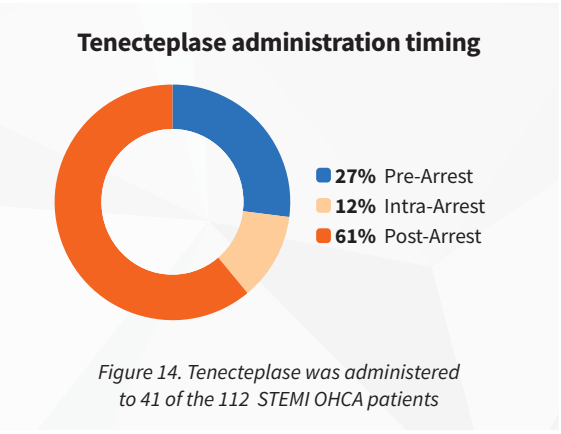


Figure 14. Tenecteplase was administered to 41 of the 112 STEMI OHCA patients

Reperfusion Post-Cardiac Arrest

Of the 94 patients who survived to hospital arrival, 88% were taken to a PCI-capable hospital. Tenecteplase was administered in 37% of cases, with most administrations occurring post-ROSC. Previously, Tenecteplase was not authorised for use during cardiac arrest, but the NZ Ambulance Service Clinical Practice Guidelines were updated in November 2023 to include this usage if STEMI was diagnosed prior to the onset of cardiac arrest. Five cases of intra-arrest Tenecteplase were identified in this group, administered alongside CPR, defibrillation, and other cardiac arrest medications. ROSC occurred in two of these cases.

Cardiovascular Support

After the return of heart function following cardiac arrest, overall blood flow can still be reduced. Cardiogenic shock occurs when a beating heart struggles to pump blood effectively, resulting in a state of systemic shock. Management of cardiogenic shock requires nuanced clinical decision-making, as too little support can lead to organ system damage, while overly aggressive support can also harm the patient. Paramedics may use fluids or vasoactive medications to achieve adequate support en route to the hospital.

Out of the 94 patients with sustained ROSC, 35% were identified as being in cardiogenic shock. Of these 33 cases, 8 (24%) received no active management, 3 (9%) required intravenous fluids only, and 22 (67%) received both fluids and vasoactive medications.

Survival

Overall, 30-day survival is reported at 65%. 30-day survival was 69% for patients whose cardiac arrest was witnessed by paramedics. 77% of patients who went into cardiac arrest with paramedics present and a shockable heart rhythm survived to 30 days.

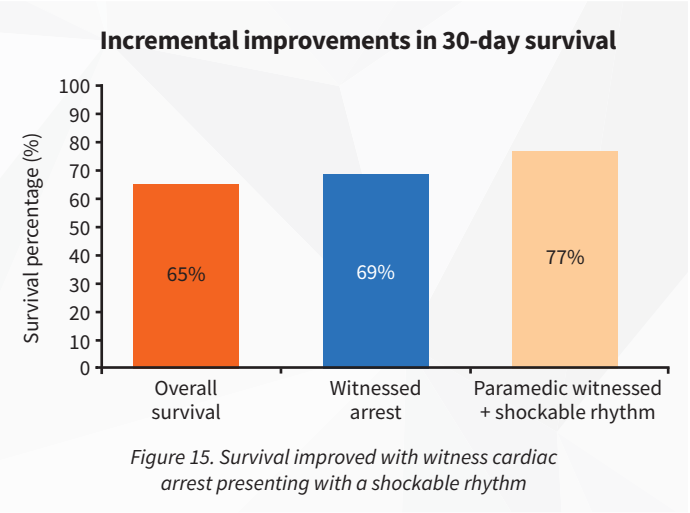


Figure 15. Survival improved with witness cardiac arrest presenting with a shockable rhythm

Conclusion

Mutunga

This is the fourth Aotearoa New Zealand Out-of-Hospital STEMI report. The data presented in this report show that paramedics continue to deliver lifesaving coronary reperfusion to STEMI patients across the motu. Our report continues to build on our Aotearoa New Zealand Out-of-Hospital STEMI registry, identifying both successes and areas for improvement in prehospital STEMI care.

Glossary of terms

Adult	Patients aged 15 years or older
EAS	Emergency ambulance service
ECG	12-lead electrocardiogram
ED	Emergency department
ICD-10	International Statistical Classification of Disease 10th revision
NSTEMI	Non ST-elevation myocardial infarction
OHCA	Out-of-Hospital cardiac arrest
PCI	Percutaneous coronary intervention
ROSC	Return of spontaneous circulation
STEMI	ST-elevation myocardial infarction

References

[1] Health New Zealand, 2025. Mortality (numbers and rates) from common causes of death by sex and ethnicity, 2022. Accessed 24 April 2025 from https://tewhatuora.shinyapps.io/mortality-web-tool/

[2] Whitehead J, Davie G, de Graaf B, Crengle S, Fearnley D, Smith M, Lawrenson R, Nixon G. Defining rural in Aotearoa New Zealand: a novel geographic classification for health purposes. New Zealand Medical Journal. 2022 Aug 5;135(1559):24-40.

[3] Atkinson, J., C. Salmond, and P. Crampton, NZDep2018 index of deprivation. Wellington: Department of Public Health, University of Otago, 2019.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