National STEMI report

Te pūrongo STEMI ā-motu

Aotearoa New Zealand 2022/23

Hato Hone St John

WELLINGTON FREE AMBULANCE
kia ora te tangata

AUT

Contents

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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 72.0 deaths per 100,000 population [1].

ST-segment Elevation Myocardial Infarction (STEMI) is the most life-threatening manifestation of IHD and requires urgent revascularisation. 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.

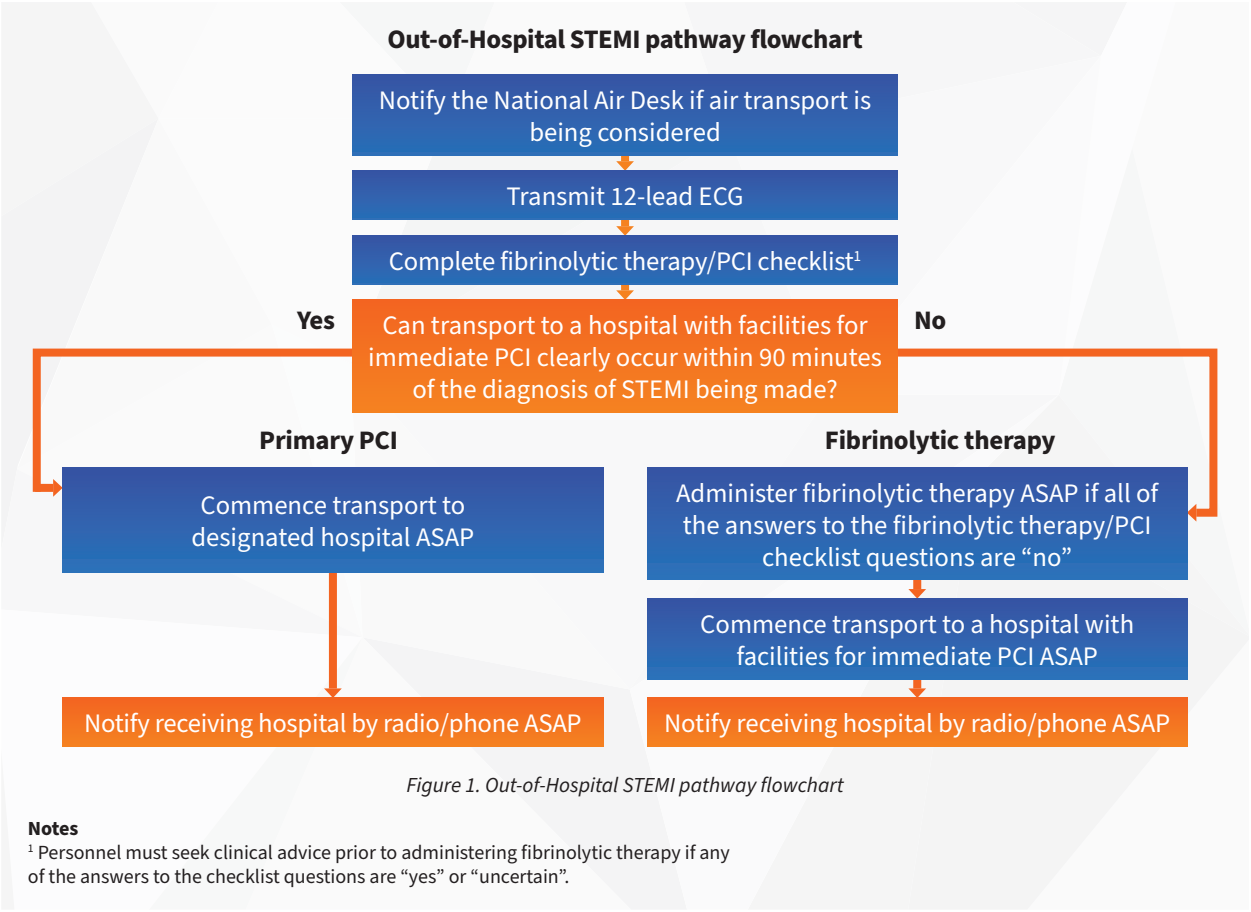


Figure 1. Out-of-Hospital STEMI pathway flowchart

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 third 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 and Wellington Free Ambulance services in the period from 1 July 2022 to 30 June 2023.

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 or 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 was not recorded in the ePRF.

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

(3) Confirmation of STEMI based on manual review of ePRF.

Exclusion criteria

- Cardiac arrest
- 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

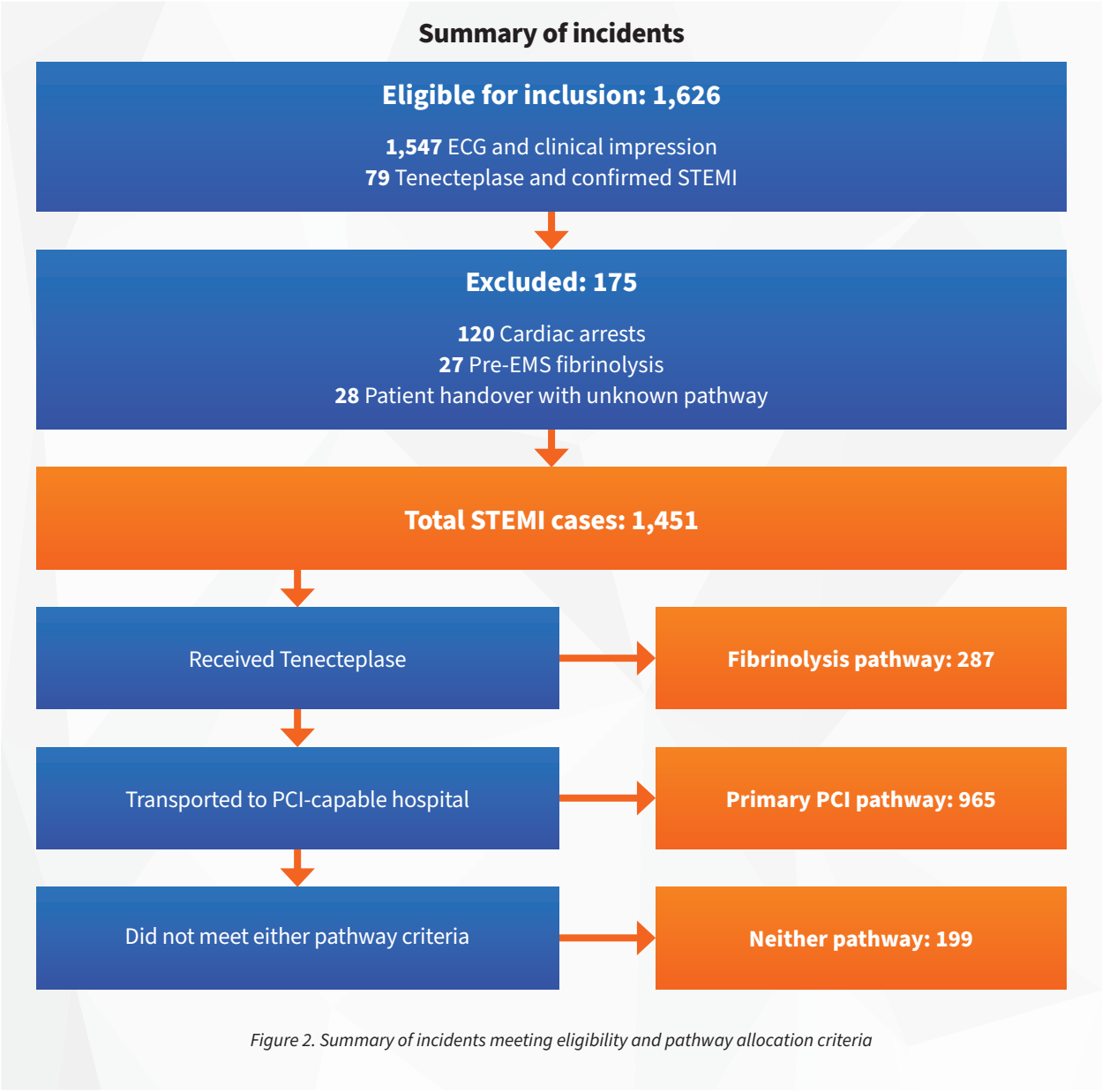


Figure 2. Summary of incidents meeting eligibility and pathway allocation criteria

Executive summary
Tuhinga whakarāpopoto nui

1,451 STEMI patients attended by emergency ambulance in the 12 month period

The median age was **69 years**

33% female
67% male

STEMI diagnosis

35%
of patients waited more than two hours from onset to calling 111

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

62%
of patients had first 12-lead ECG within 10 minutes

66%

20%

Primary PCI strategy

50 minutes
Median time from EAS arrival to PCI Hospital

96%
of patients arrived at a PCI capable hospital within 90 minutes of EAS arrival

Fibrinolysis strategy

33 minutes
Median time from EAS arrival to fibrinolysis

71%
of patients received fibrinolysis within 45 minutes of EAS arrival

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 20% underwent fibrinolysis. The remaining 13% did not meet the criteria of either strategy. The destination hospital of patients treated by either strategy are shown in Figure 3.

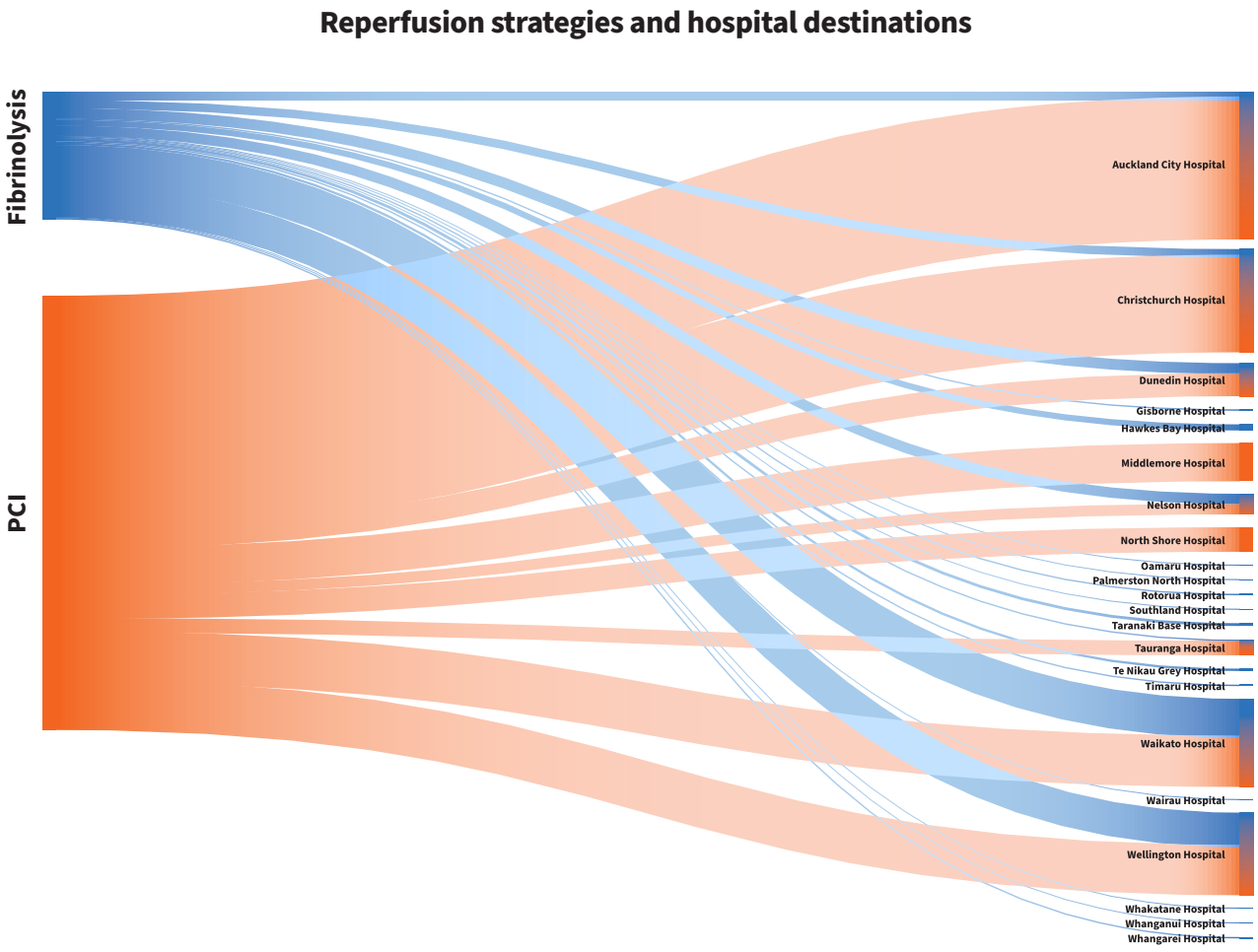


Figure 3. Sankey diagram of STEMI reperfusion strategies and hospital destinations

** Non PCI-capable hospital*

Time from ambulance arrival to reperfusion strategy

Fibrinolytic reperfusion therapy occurs earlier than in-hospital PCI services (Figures 4 and 5). 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.

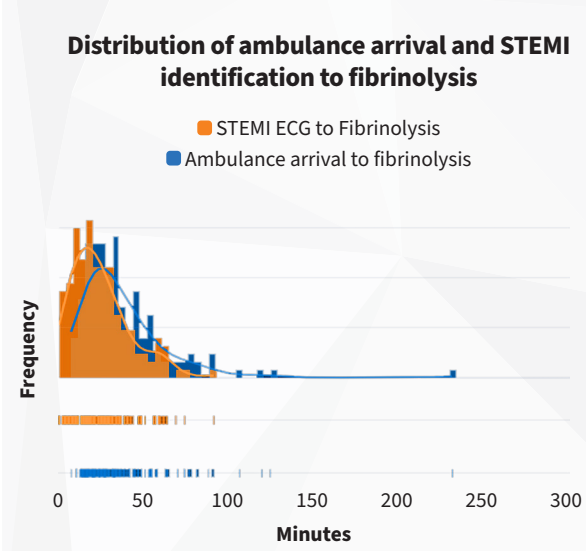


Figure 4. Distribution of ambulance arrival and STEMI identification to fibrinolysis

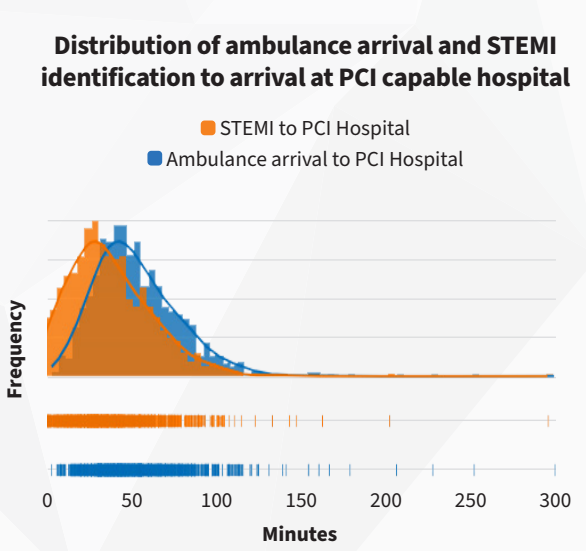


Figure 5. Distribution of ambulance arrival and STEMI identification to arrival at PCI capable hospital

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 60 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, 72% occurred in the patient's home (Figure 6). In 13% of cases the patient was located at a healthcare facility, indicating that they were assessed by another health professional prior to ambulance attendance.

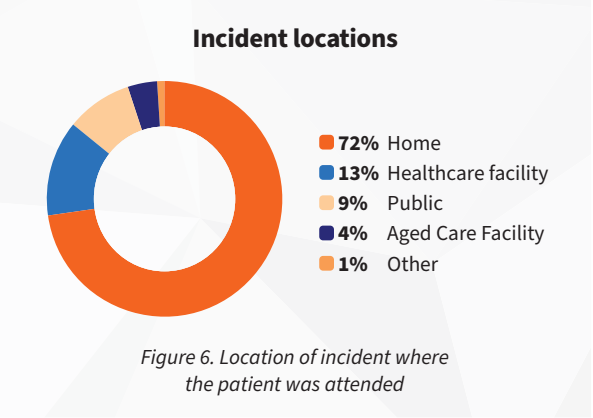
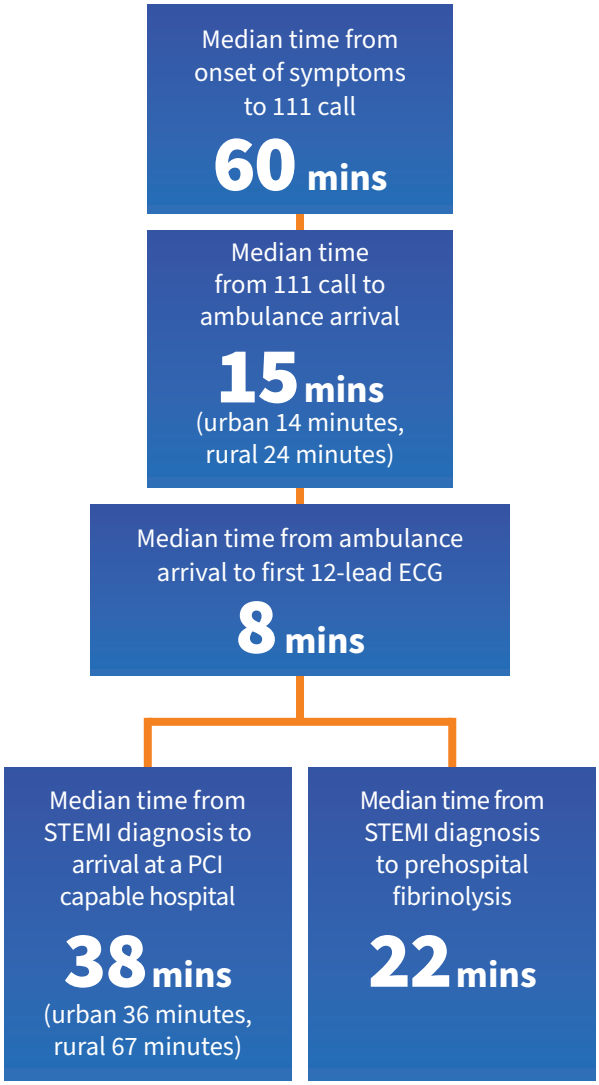


Figure 6. Location of incident where the patient was attended

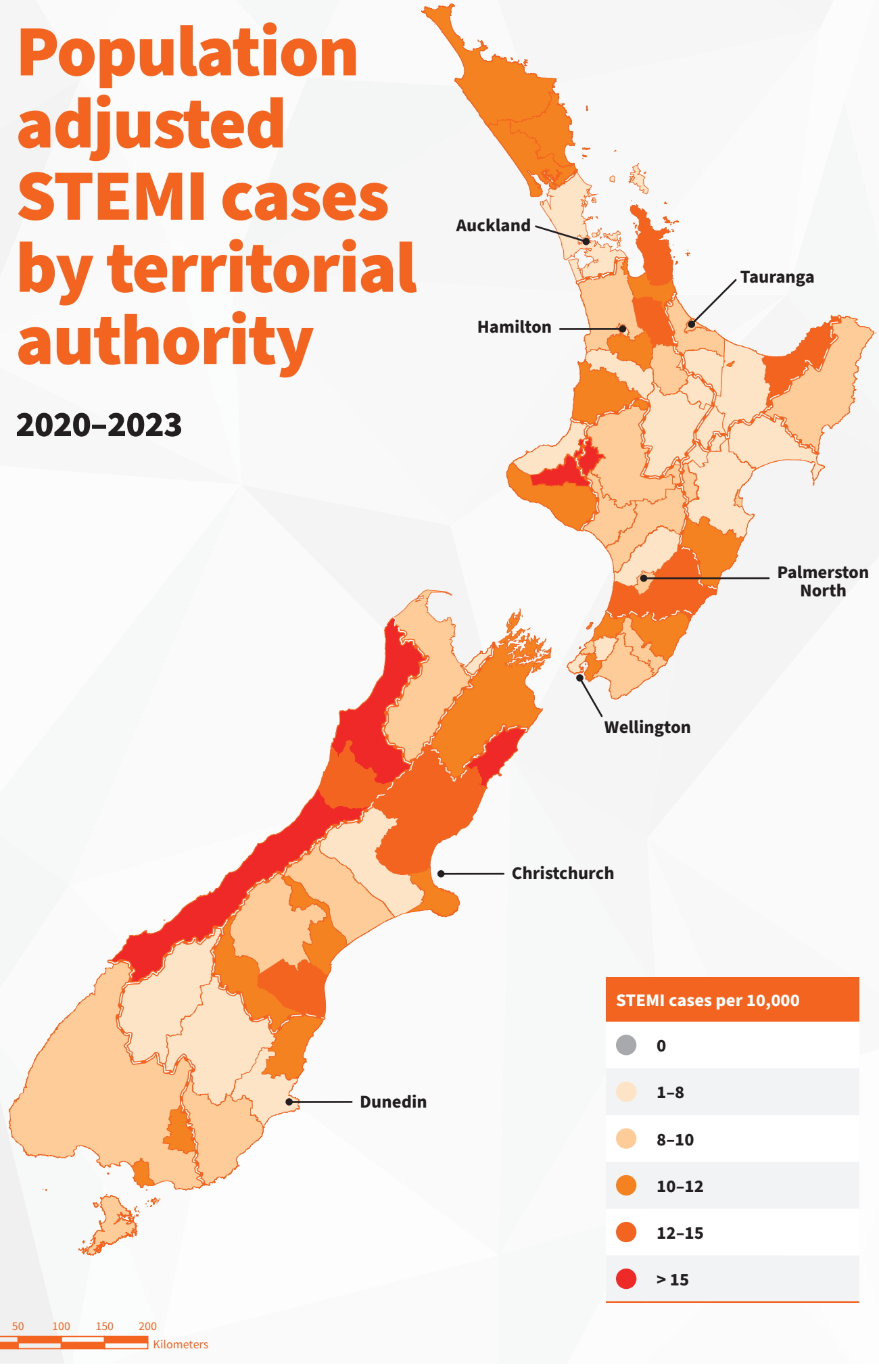


Year	2020/21	2021/22	2022/23
Total number of events	1,511	1,435	1,453
Primary PCI strategy	68%	74%	66%
Fibrinolysis strategy	16%	13%	20%
Neither strategy	16%	12%	14%
Median time from onset of symptoms to 111 call	63 mins	61 mins	60 mins
Median time from 111 call to ambulance arrival	13 mins	15 mins	15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

Table 4: Key figures for all patients

Population adjusted STEMI cases by territorial authority

2020–2023



Patient journey
Te Haerenga Tūroro

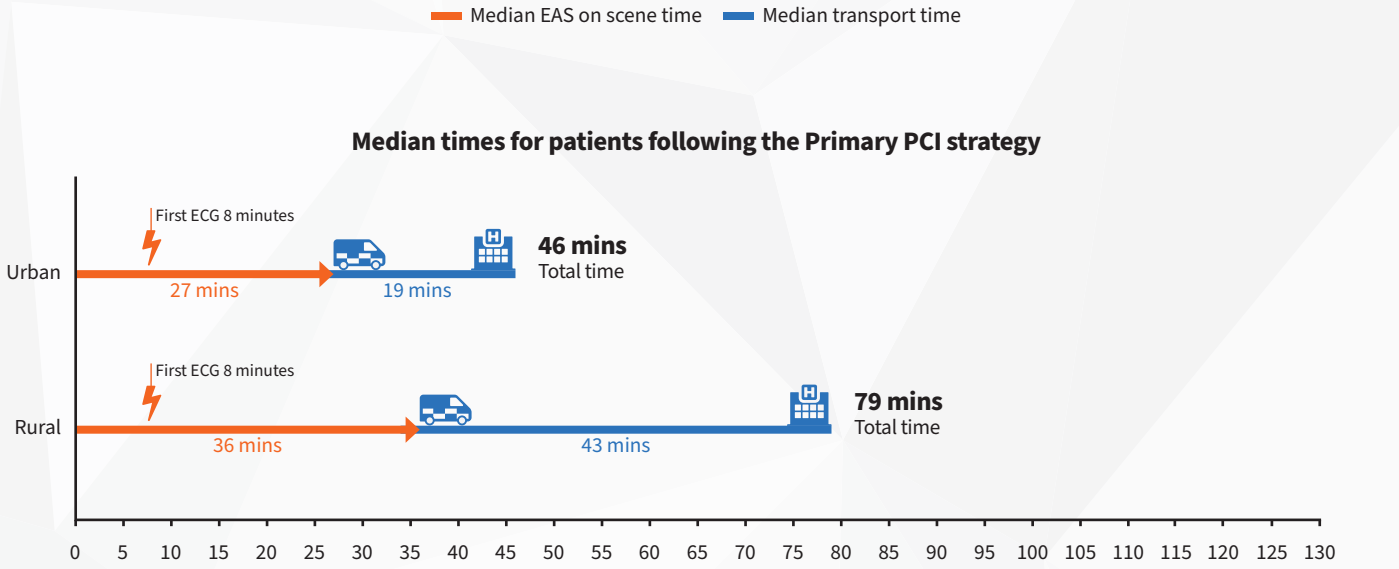


Figure 7. Median times for patients following the Primary PCI strategy

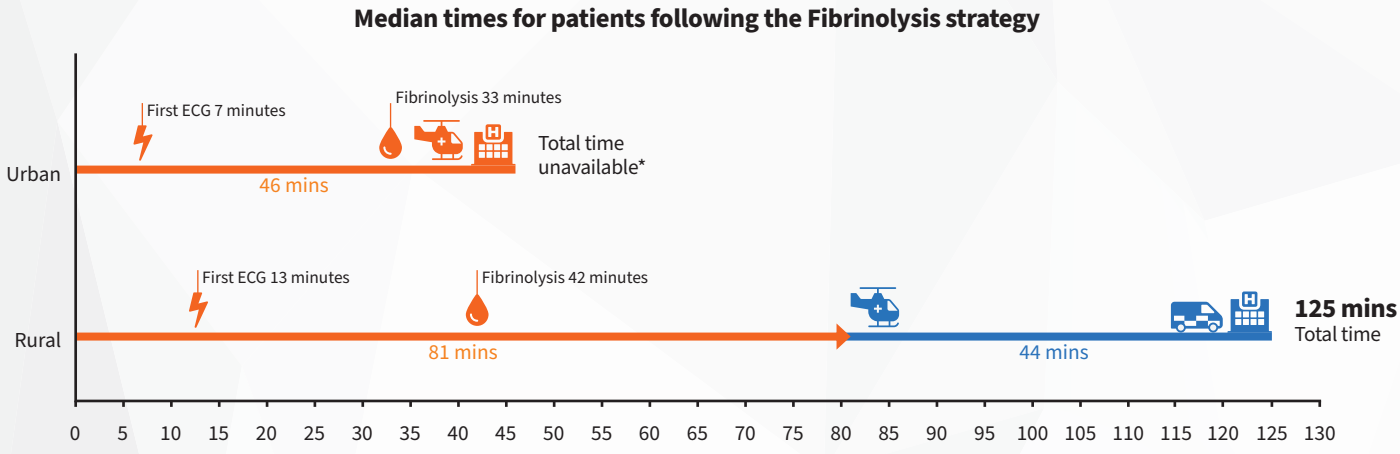


Figure 8. Median times for patients following the Fibrinolysis strategy

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

Patient demographics
Ngā hangapori tūroro

Given the propensity for small numbers among locality, ethnicity, and deprivation subgroups, this section includes cumulative cases from July 1, 2020 to June 30th, 2023.

Age

Māori and Pacific People experience STEMI at a younger age (Figure 9). Note that in all ethnicities, 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

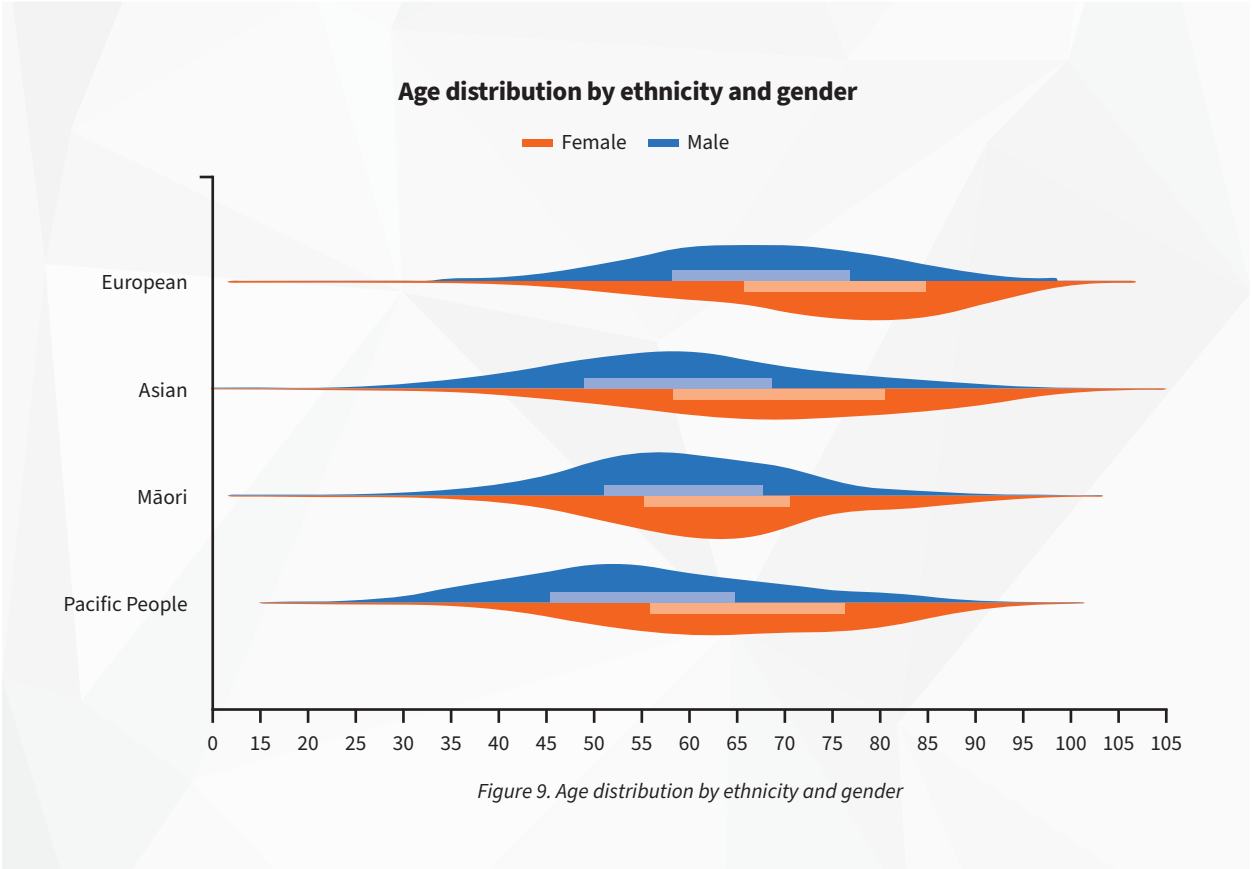


Figure 9. Age distribution by ethnicity and gender

Ethnicity

Europeans accounted for the majority of patients experiencing a STEMI (74%), followed by Māori (10%), Asian (9%) and Pacific People (6%) (Figure 11). The remaining 1% were Middle Eastern, Latin American, African, and other ethnicities.

Reperfusion strategies across different ethnicities demonstrate distinctive patterns. While Primary PCI remains the main reperfusion strategy across all ethnicities, Māori have the lowest proportion of Primary PCI, whilst Pacific People and Asians have the highest (presumably reflecting the predominance of urban living in these populations).

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 10).

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 9). The cumulative data over the last three reporting years shows a quarter of rural STEMI patients fall outside either reperfusion strategy.

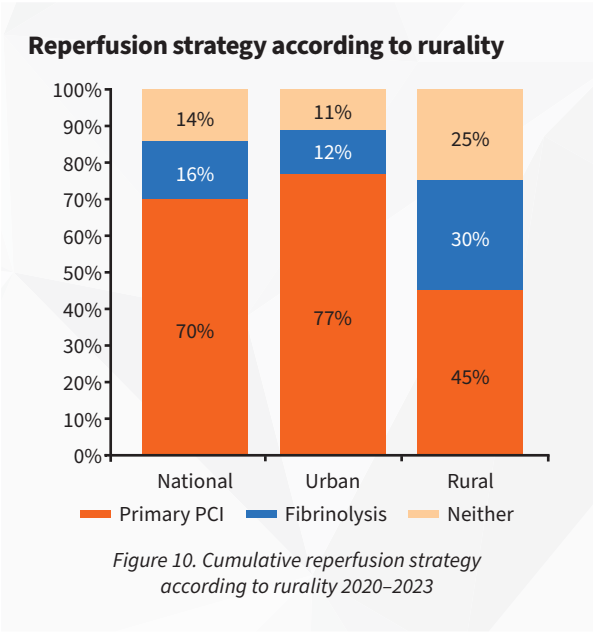


Figure 10. Cumulative reperfusion strategy according to rurality 2020–2023

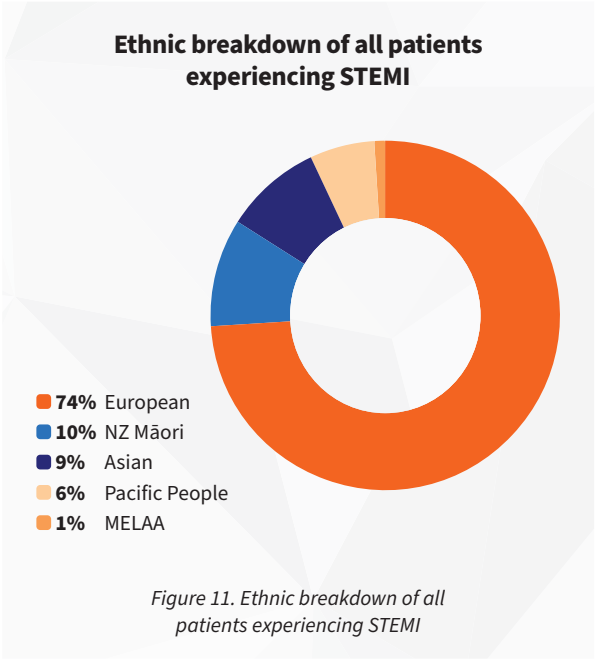


Figure 11. Ethnic breakdown of all patients experiencing STEMI

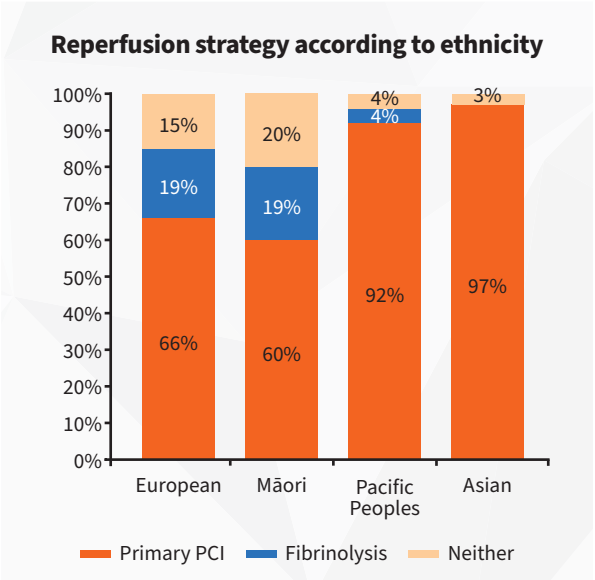


Figure 12. Cumulative reperfusion strategy according to ethnicity 2020–2023 (not including groups less than 1%)

Economic Deprivation

The NZDep2018 is an 'area-level' measure of socioeconomic deprivation calculated using census data [3]. Some of the factors included in this measurement of deprivation are:

- no access to the internet,
- receiving a means tested benefit,
- household income below an income threshold,
- being 18–64 years old and unemployed,
- being 18–64 years old with no qualifications,
- not living in own home,
- a single parent family,
- household bedrooms less than occupancy threshold,
- and no 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.

Not only does access to Primary PCI diminish with increasing deprivation, but the percentage of patients not receiving either reperfusion strategy increases strikingly.

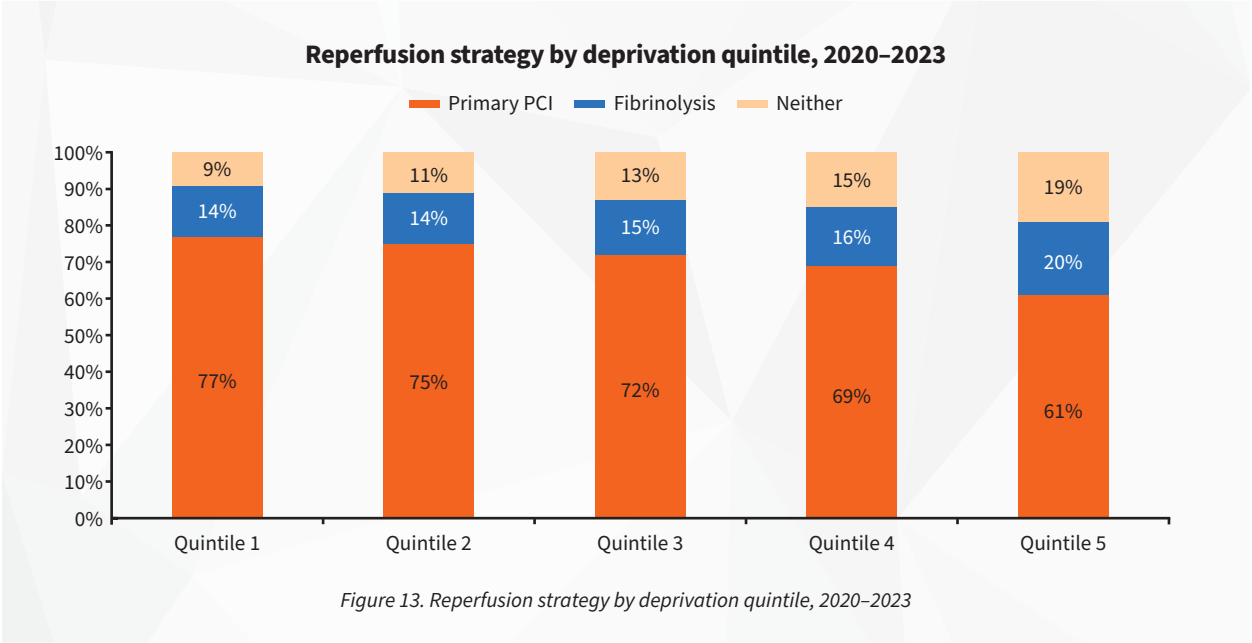


Figure 13. Reperfusion strategy by deprivation quintile, 2020–2023

Neither reperfusion group

Te rōpū kāore anō rānei kia whakarere anō toto

Out of 1,451 STEMI patients, 199 (14%) 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.

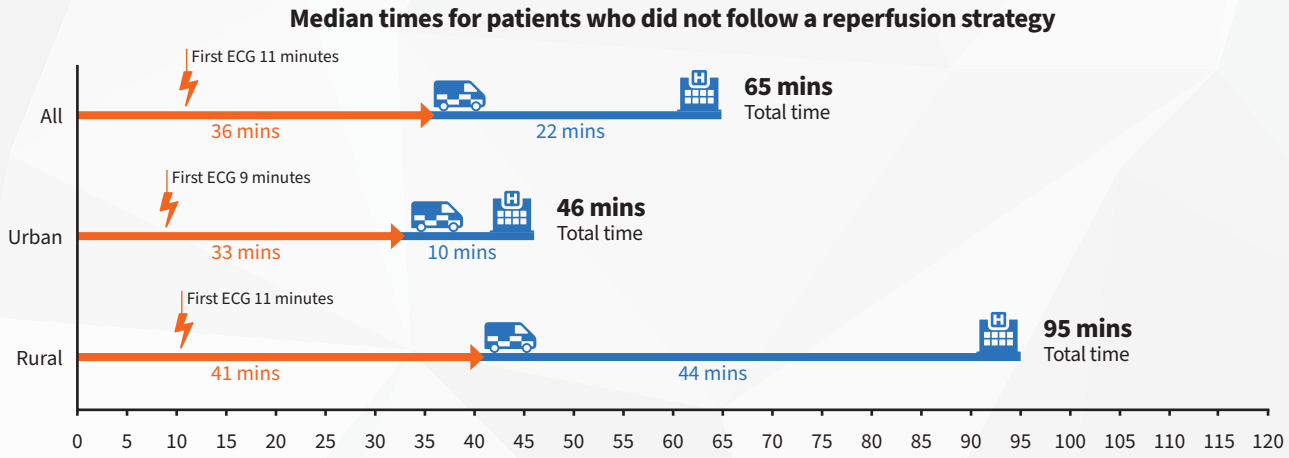


Figure 14. Median times for patients following neither strategy

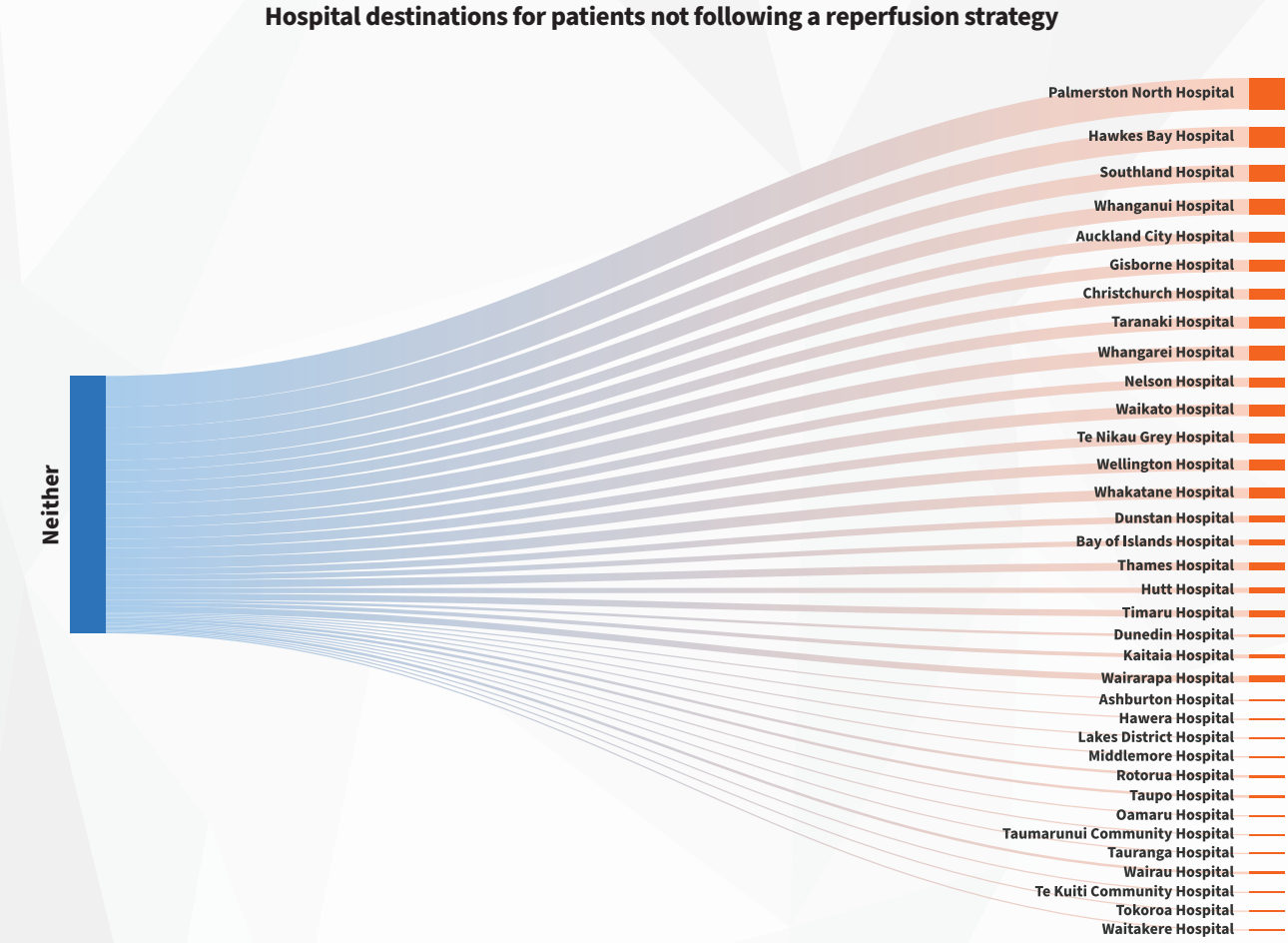


Figure 15. Sankey diagram of hospital destination for STEMI patients who did not follow one of the two reperfusion strategies

We used hospital's 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. Individual codes were grouped, and cases allocated. The adjacent table shows the allocation of cases. ICD 10 codes involving transmural infarctions were grouped under STEMI.

Out of this 199, only 81 were ultimately diagnosed as having STEMI. 12 cases were identified a non-STEMI, a less severe form of heart attack not amenable to urgent reperfusion. ICD 10 data was missing in 36 cases.

All 81 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).

Upgrouped ICD-10	Count	Percentage
STEMI (including transmural infarction)	81	40.70%
NSTEMI (Subendocardial infarction)	12	6.03%
Other heart related condition	33	16.58%
Other non-heart related	37	18.59%
No ICD-10 data available	36	18.09%
Grand Total	**199**	**100.00%**

Table 6: In-hospital diagnosis

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.

Reasons for no reperfusion	Count	Percentage
Absolute/Relative contraindication	24	30%
Criteria not met/ Evolving	23	28%
Transient STEMI	9	11%
Very frail/comorbid	7	9%
Very close to ED	6	7%
Operational factors	5	6%
Patient refusal	3	4%
No vascular access	2	2%
End of life/Hospice	2	2%
Grand Total	**81**	**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 transient 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.

Conclusion

Mutunga

This is the third Aotearoa New Zealand Out-of-Hospital STEMI report. The data presented in this report shows 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

ADL	Activities of daily living
Adult	Patients aged 15 years or older
EAS	Emergency ambulance service
ECG	12-lead electrocardiogram
ED	Emergency department
PCI	Percutaneous coronary intervention
STEMI	ST-elevation myocardial infarction

References

[1] Ministry of Health. 2021. Cardiovascular disease. https://www.tewhatuora.govt.nz/our-health-system/data-and-statistics/mortality-web-tool/#:~:text=For%20the%20total%20population%2C%20the,deaths%20per%20100%2C000%20population%20respectively

[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.

Notes:

Notes:


ZOLL
12/07/2023
10:22:03
Adult
00:00:30
Lead Fault
1.0 cm/mV
SYNC
SHOCK
PACER
ANALYZE
ENERGY SELECT
CHARGE
Searching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