



# A retrospective observational study of critically unwell patients retrieved from Thames Hospital between April 2018 and December 2020

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## ABSTRACT

**INTRODUCTION:** In New Zealand, critically ill patients who present to rural hospitals are typically treated, stabilised and transferred to facilities where more appropriate resources are available.

**AIM:** The aim of this study was to describe patients who presented critically unwell and required retrieval from Thames Hospital in the Waikato region.

**METHODS:** Notes were reviewed retrospectively for patients who were retrieved from Thames Hospital between 1 April 2018 and 31 December 2020. Patients were excluded if they were retrieved from the offsite birthing centre or their notes were not available to the authors.

**RESULTS:** During the study period, 56 patients were retrieved by intensive care teams based at Waikato, Starship or Auckland Hospitals. Patients had a median age of 57 years and most were female (60.7%). Māori patients were over-represented in the retrieval cohort compared with the population presenting to the emergency department (30.4% vs. 20.1%,  $P < 0.001$ ). We found that 41% of patients presented after-hours when there was only one senior medical officer available on site and 70 procedures were performed, including rapid sequence induction, which was required by 19.6% of patients.

**DISCUSSION:** This study describes a population of critically unwell patients who were retrieved from a rural hospital. The key finding is that nearly half of these patients presented after-hours when there was only one senior medical officer available on site. This doctor also has sole responsibility for all other patients in the hospital. We recommend that referral centres streamline the retrieval processes for rural hospitals.

**KEYWORDS:** Rural hospitals; critical illness; hospital transfers.

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## Introduction

In New Zealand, critically ill patients who present to rural hospitals are typically treated, stabilised and transferred to facilities (either secondary or tertiary levels hospitals) where more appropriate resources are available. Inter-hospital transfer of these critically unwell patients is usually performed by the

retrieval team from the accepting hospital's intensive care units.<sup>1,2</sup>

New Zealand's rural hospitals differ from metropolitan hospitals in that patient care is generally provided by generalist doctors and nurses, with no or limited coverage by specialist doctors.<sup>3</sup>

## WHAT GAP THIS FILLS

**What is already known:** There is no New Zealand research describing patients who require retrieval from a rural hospital due to a critical illness.

**What this study adds:** This study provides a detailed description of a cohort of critically unwell patients who required retrieval by an intensive care team. Nearly half of patients presented while there was only one senior doctor available at the rural hospital and many required at least one advanced intervention before the retrieval team arrived.

Rural hospitals also typically have fewer resources than urban hospitals, especially resources to care for patients who are critically unwell for any length of time.<sup>4</sup>

We are unaware of any published research about patients who are retrieved from New Zealand's rural hospitals. There is research about patients retrieved from metropolitan regional centres, although these are written from the perspective of retrieval teams and do not address the needs and experiences of rural hospitals.<sup>2</sup> International research focuses on specific conditions, especially the transfer of trauma patients, and also tends to take the perspective of retrieval teams.<sup>5,6</sup>

The aim of this study was to describe patients who presented critically unwell and required retrieval from Thames Hospital in the Waikato region of New Zealand. We also aimed to better understand the interventions performed by the local clinicians and the available staffing at the time of patients' presentations.

## Methods

This was a retrospective observational study of patients who were retrieved from Thames Hospital by an intensive care unit (ICU) team at Waikato, Starship or Auckland City Hospitals between 1 April 2018 and 31 December 2020.

Thames Hospital is a level three rural hospital in the Waikato District Health Board (DHB) region and is ~1.5 h by road and 30 min by helicopter transfer to Waikato Hospital.<sup>7</sup> Level three rural hospitals have

on-site 24-h medical cover with access to radiology and laboratory services, whereas levels one and two have limited medical cover or access to diagnostic services.<sup>7</sup> Thames Hospital has a 15-bed emergency department (ED) with two resuscitation bays. There are 33 in-patient beds, with an additional 10 beds reserved for rehabilitation.

The ED is staffed by senior medical officers (SMOs) in four overlapping shifts, with single coverage between 20:00 and 10:00 h. The medical staffing mix is of emergency physicians, rural hospital doctors and non-vocationally registered SMOs. Unlike many other rural hospitals, there are specialist SMOs (internal medicine physicians) on site in the inpatient unit between 08:00 and 16:30 h and one of these is available to receive phone calls after-hours, occasionally supporting the ED in person.

There are positions for five Resident Medical Officers (Senior House Officers and a Rural Hospital Registrar) between 08:00 and 16:30 h, with one available between 16:30 and 22:00 h. The Senior House Officers typically have limited critical care skills and are involved in the care of patients in the inpatient unit, without any formal responsibilities in the ED. The Rural Hospital Registrar works across the ED and the inpatient unit. There is no overnight Resident Medical Cover. Overnight, there are usually two nurses in the emergency department and three nurses on the ward.

Thames Hospital has ready access to on-site laboratory and radiography (plain x-ray and computed tomography (CT)) during working hours, with staff available for call-back after-hours. There is point-of-care ultrasound in addition to selected laboratory studies (blood gas, full blood count and troponin) available at all times. Visiting ultrasound and echocardiography services are available 2–3 days per week, with a few appointments held for acute imaging. There is an off-site primary birthing centre staffed by midwives.

Generally, patients are retrieved and transported to Waikato Hospital for further care by the ICU or other specialist teams based there; however, sometimes patients are transported to other more specialised centres; for example, some paediatric patients are transferred to Starship hospital.

## Study group

All patients retrieved and transported by air (helicopter) from Thames's ED or inpatient wards to Waikato, Starship or Auckland hospitals were included in this research. Patients were excluded if they did not leave with the retrieval team, were retrieved from the off-site primary birthing centre or their notes were unavailable to the authors.

## Data collection

Patients were identified by a hardcopy log-book that security orderlies use to document helicopter encounters (bringing patients in-bound as well as taking them out-bound). This log was started on 1 April 2018.

Paper and electronic notes of included patients were reviewed. Demographic data, including ethnicity, gender and age, were collated. Date and time of presentation and retrieval were recorded and the length of stay in the emergency department was calculated from the difference between these two times. The number of staff present in the emergency department was determined using the rostering matrix at Thames Hospital. Discharge diagnosis on transfer was used to determine the working diagnosis, and notes were reviewed for evidence of any intervention provided to each patient. Electronic notes were used to determine if patients had died, and whether deaths occurred during the ICU stay.

Data were organised in a Microsoft Excel Spreadsheet (Microsoft Corporation, version 16.45).

## Statistical analysis

The Mann–Whitney *U*-test was used to compare means as data were not normally distributed and the chi-squared test was used to compare categorical variables. Analysis was performed in R-studio using the R scripting language (version 4.0.2).<sup>8</sup>

Ethics approval was not required as this was an audit or audit-related activity.<sup>9</sup>

## Results

A total of 48,348 patients presented to Thames ED between 1 April 2018 and 31 December 2020. During

Table 1. Age, gender and ethnicity for patients presenting to Thames Emergency Department and were retrieved from Thames Hospital between 1 April 2018 and 31 December 2020

	Patients presenting to Thames Hospital Emergency Department	Patients retrieved from Thames Hospital Department to Waikato, Auckland or Starship Hospitals
Total number	48,348	56 (0.1%)
Age, years (median, inter-quartile range)	55 (26–72)	57 (48.5–75.3)
<16 years	7684 (15.9%)	6 (11%)
Gender		
Female	24,108 (49.9%)	34 (60.7%)
Male	24,227 (50.1%)	22 (39.3%)
Unknown	13 (0%)	0 (0%)
Ethnicity*		
NZ European/Pakeha	36,140 (74.7%)	32 (57.1%)
Māori	9715 (20.1%)	17 (30.4%)
Other	1349 (2.8%)	5 (8.9%)
Asian	1144 (2.4%)	2 (3.6%)

\* Chi squared  $P < 0.05$  (all other statistical tests were not statistically significant).

this period, 56 patients (0.1%) were identified as being retrieved by an ICU retrieval team. Two patients were excluded from the study. One was a newborn transfer from the offsite birthing suite and one patient did not leave with a retrieval team.

Further demographic information is presented in Table 1. Over half of the patients who were retrieved were of NZ European ethnicity (57.1%), with nearly one-third Māori (30.4%). Compared with the overall population presenting to the ED, Māori were significantly over-represented ( $P < 0.001$ ) among retrieved patients. There was a significant difference ( $P = 0.019$ ) in the median age of Māori patients (54 years, interquartile range [IQR] 11.2–64.2) and patients of NZ European ethnicity (64 years, IQR 55.5–77.5). Although female patients were 49.9% of all patients presenting to the ED, there was a higher percentage of females among retrieved patients (60.7%), but this was not statistically significant ( $P = 0.11$ ).

Most patients were transferred to the Waikato hospital (51/56, 91.1%), with low numbers

Table 2. Staff available locally while the patients requiring retrieval were at Thames Hospital between 1 April 2018 and 31 December 2020

	Patients retrieved from Thames Hospital Emergency Department to Waikato, Auckland or Starship Hospitals (n = 56) n (%)
Staffing at Thames Hospital	
One doctor	23 (41.1)
Two doctors	17 (30.4)
Three or more doctors	16 (28.6)
Nurse day shift	21 (37.5)
Nurse afternoon shift	27 (48.2)
Nurse night shift	8 (14.3)

transferred to Starship (1/56, 1.8%) and Auckland Hospitals (4/56, 7.1%). Three patients (3/56, 5.4%) were retrieved after being admitted to the inpatient ward at Thames Hospital with the rest (53/56, 94.6%) being retrieved from the ED. Over 40% of patients requiring retrieval presented when there was only one doctor (23/56, 41.1%) on duty in the ED. Just over one-quarter of patients (16/56, 28.6%) presented when the ED was fully staffed with three doctors. Further information is presented in Table 2. Thames Hospital clinical staff performed 70 advanced critical care procedures or interventions. One-fifth of transferred patients required intubation (11/56, 19.6%) and 10 patients (10/56, 17.9%) required central venous access. The most common reason for retrieval was sepsis (14/56, 25%). Further clinical information is presented in Table 3.

One-fifth of patients (11/56, 20%) died while they were in hospital. Nearly one-quarter of Māori patients (4/17, 23.5%) died in hospital, and although fewer patients identifying as of NZ European ethnicity died (5/32, 15.6%), this difference was not statistically significant ( $P = 0.77$ ).

## Discussion

The key finding from this study is that nearly half of patients who required retrieval (41%) presented and were managed at a time when there was a single SMO on duty. This single doctor not only needed to manage the patient with acute critical care needs for

long periods of time (median of 5 h), but also needed to assess and treat the remaining patients in the ED and cover acute issues on the inpatient ward.

Consensus Australasian guidelines state that 'Ideally, the referring doctor should have to make only one telephone call to initiate retrieval or patient transfer' and single phone-call policies exist in areas of Australia and New Zealand.<sup>10</sup> Waikato DHB does not have a 'single-call' policy and the main clinical and administrative burden to arrange retrieval lies with the treating clinician(s) at rural hospitals like Thames. Previous studies have highlighted considerable clinician frustration at making phone calls to arrange transport.<sup>1,11</sup> A recent study showed that in hospitalised rural patients, the only harm difference between rural and urban hospitals occurred in patients who required inter-hospital transfer.<sup>12</sup> Although further information was not available, critically unwell patients may have contributed to this finding, raising important questions about the burden placed on rural hospital clinicians caring for very sick patients.

This study also highlights that doctors who work in rural hospitals require advanced critical care skills. Nearly 20% of patients retrieved from Thames hospital required intubation and 18% of patients required arterial or central lines. These results are similar to a 2012 review of inter-hospital transfers performed by the Wellington Free Ambulance.<sup>2</sup> The Australia–New Zealand airway register also suggests that these airway procedures are not uncommonly performed by staff at regional and rural hospitals throughout Australasia.<sup>6,13</sup> To reflect the need for these skills, rotations through anaesthetics or intensive care are required in both the New Zealand Rural Hospital Medicine and the Australasian College of Emergency Medicine registrar training programmes, as well as completion of advanced cardiac and paediatric life support (ACLS, APLS) courses.<sup>7,14,15</sup> Vocationally registered doctors have an ongoing requirement through continued professional development programmes to keep these or equivalent courses up-to-date.

Māori patients were over-represented in this cohort of patients who required retrieval (30%) compared to the percentage of Māori patients presenting to Thames's ED (20%) in the same time period, as well

Table 3. Length of stay, interventions provided by the local team and the diagnosis or cause of critical illness in patients retrieved from Thames Hospital between 1 April 2018 and 31 December 2020

Length of stay, minutes (median, interquartile range)	297 (228.3–398.8)
Interventions ( <i>n</i> = 70) performed by the Thames medical team Patients ( <i>n</i> = 56) could have had more than one intervention performed	
	<i>n</i> (%)
Arterial line	10 (17.9)
Central venous access	10 (17.9)
Cardiopulmonary resuscitation	2 (3.6)
High-flow nasal oxygen	2 (3.6)
Intra-osseous needle	2 (3.6)
Laryngeal mask airway	1 (1.8)
Non-invasive ventilation	7 (12.5)
Other infusion	5 (8.9)
Vasopressor infusion	15 (26.8)
Rapid Sequence Intubation	11 (19.6)
Thrombolysis	5 (8.9)
Diagnosis or cause of critical illness	
	<i>n</i> (%)
Airway compromise	1 (1.8)
Respiratory	7 (12.5)
Bronchiolitis	2
Respiratory failure	5
Cardiac	8 (14.3)
Cardiac arrest	1
Cardiogenic shock	4
Other cardiac	3
Acute kidney injury	2 (3.6)
Sepsis	14 (25)
Neurological	18 (32.1)
Hypoxic brain injury	1
Intracranial haemorrhage	3
Stroke	7
Overdose	4
Seizures	3
Diabetic ketoacidosis	1 (1.8)
Upper gastrointestinal (GI) bleed	2 (3.6)
Trauma	3 (5.4)
Diagnosis or cause of critical illness	
Airway compromise	1 (1.8)

(Continued)

Table 3. (Continued)

Respiratory	7 (12.5)
Bronchiolitis	2
Respiratory failure	5
Cardiac	8 (14.3)
Cardiac arrest	1
Cardiogenic shock	4
Other cardiac	3
Acute kidney injury	2 (3.6)
Sepsis	14 (25)
Neurological	18 (32.1)
Hypoxic brain injury	1
Intracranial haemorrhage	3
Stroke	7
Overdose	4
Seizures	3
Diabetic ketoacidosis	1 (1.8)
Upper GI bleed	2 (3.6)
Trauma	3 (5.4)

as the percentage of Māori who live in the Thames Coromandel and Hauraki districts according to the 2018 Stats NZ census (20.1%).<sup>16</sup> We were unable to find any published data describing the ethnicity of critically unwell patients who are retrieved from rural or regional hospitals, but our results are similar to New Zealand research describing patients admitted to ICU for pancreatitis and trauma.<sup>17,18</sup> In our study, Māori patients were significantly younger (median age 54 years) than NZ European patients (median age 64 years) and, although not statistically significant, Māori died more frequently in hospital (23.5% vs. 15.6% respectively).

There are several limitations to this research. This was a small study and any robust comparisons, especially between ethnic groups, are difficult to draw transferable conclusions from. The assumptions to determine the number on staff on-site was based on the current ED rostering matrix, although due to frequent staffing shortages, the roster may not represent actual staffing. Likewise, due to the relatively long (5 h) median length of stay in Thames Hospital, there may have been additional SMOs start and some may have stayed beyond the finish of their shift. The extent of these deviations



from the rostering matrix could not be determined in this retrospective study.

A further limitation is that we could not be sure that all patients who were retrieved were included in the orderly logs. We were not given access to the retrieval records at Waikato Hospital, although we do not think that the number of missing patients is substantial. We were also not able to determine which patients were declined for retrieval by the retrieval team. These patients may also consume considerable local resources and even overwhelm small rural services. Likewise, patients may have been transported by road in times of inclement weather and these patients will not have shown in the orderlies' logs. Anecdotally, the ICU team does not offer retrieval services by road and, therefore, this resource will have been provided by the team at Thames. Further, we cannot be sure the interventions provided were successful or whether complications occurred.

This is the first study that we are aware of that describes a cohort of critically unwell patients, including the interventions performed locally, who required retrieval from a rural hospital in New Zealand. The results may not be applicable to other rural hospitals in New Zealand due to differences in geography, population, resources or staffing skill mixes, as well as local and regional policies around retrieval. Further studies reporting other New Zealand rural hospitals' experiences are required.

A prospective study is planned which will aim to quantify the administrative burden for clinical staff at Thames Hospital for patients who require retrieval. However, in lieu of this research, and our finding that 41% of patients are presenting when there is only single doctor coverage, we recommend that referral centres consider streamlining retrieval processes to ease the burden on rural hospitals. Further research is also required to determine why Māori were over-represented in this cohort of critically unwell patients requiring retrieval and determine if there were any local barriers to seeking earlier care that may have prevented critical care intervention.

In conclusion, this study shows that critically unwell patients often present to Thames Hospital when there is limited medical cover and these patients often require advanced resuscitative

procedures. Further work is needed to understand why Māori patients are over-represented in this cohort and how to reduce this inequity.

## Conflicts of interest

The authors of this study do not declare any conflicts of interest.

## Data availability statement

Data are not available as consent was not sought from patients for this purpose and this was an audit or audit-related study.

## Funding declaration

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