Point-of-care troponin use in New Zealand rural hospitals: a national survey
Rory Miller, Tim Stokes, Garry Nixon

ABSTRACT

AIMS: Accelerated diagnostic chest pain pathways (ADP) have become standard of care in urban emergency departments. It is, however, unknown how widely they are used in New Zealand’s rural hospitals because ADP require immediate access to contemporary or high-sensitivity troponin (hs-Tn). We aimed to determine for rural hospitals the troponin assay being used, if they were using an ADP and if they had access to on-site exercise tolerance testing (ETT).

METHODS: An online survey was sent to 27 rural hospitals providing acute care in New Zealand.

RESULTS: Most rural hospitals (23/27, 85%) responded to the survey. Most (17/23, 74%) used point-of-care cardiac troponin (POC-cTn) and the majority of these hospitals (15/17, 88%) were reliant on this assay 24-hours per day. All hospitals that had timely access to hs-Tn (8/23, 35%) used an ADP but only a minority (4/17, 24%) of hospitals using POC-cTn used an ADP. Only a minority of the larger rural hospitals (7/23, 30%) had access to on-site ETT.

CONCLUSIONS: Most New Zealand rural hospitals rely on POC-cTn to assess chest pain and are not using an ADP. There are limited data available to support this approach in rural settings especially with patients who are not low-risk.

Chest pain is a common reason to attend the emergency department (ED) accounting for up to 6% of all presentations. Although the vast majority of the causes of chest pain are due to benign causes, the consequences of missing a diagnosis of acute myocardial infarction (AMI) are potentially serious.

In line with a Ministry of Health (MoH) mandate, all of New Zealand's district health boards (DHBs) have adopted rapid accelerated diagnostic chest pain pathways (ADP) for their urban EDs in an effort to reduce the burden that chest pain assessment places on these already busy departments. ADPs currently being used in New Zealand combine an objective scoring system, an ECG and a laboratory-based highly sensitive (hs-Tn) or contemporary troponin assay. These ADPs have been shown to permit the safe early discharge of low-risk patients. ADPs also help ensure that necessary investigations and treatments are appropriately targeted towards the patients at higher risk of AMI or major adverse cardiac events (MACE). Anecdotally, many rural hospitals in New Zealand have been left behind in this national initiative. This is likely because they lack timely access to the laboratory-based assays that are incorporated into the current ADPs used by DHBs. Surveys reporting troponin use in New Zealand hospitals performed in 2010, 2011 and 2014 showed that the majority of rural hospitals do not have on-site access to laboratory-based troponin and instead rely on point-of-care cardiac troponin (POC-cTn) assays. These assays are less precise and sensitive than laboratory-based assays. The significance of this is often not fully appreciated by rural clinicians. As a consequence, in 2018 an ADP was published that uses POC-cTn that is designed for use in New Zealand rural hospitals and is based on available evidence and expert consensus. This rural ADP incorporates the Emergency Department Assessment of Chest Pain Score (EDACS) and POC-cTn ‘cut-offs’ that are lower than the levels recommended by the manufacturer. We are unaware of any ADPs using POC-cTn that have been...
validated in clinical trials for use in rural patients who are not low-risk (intermediate and high-risk patients).

The Medical Council of New Zealand defines a rural hospital as “a hospital staffed by suitably trained and experienced generalists (both medical officers and rural general practitioners), who take full clinical responsibility for a wide range of clinical presentations. While resident specialists may also work in these hospitals, specialist cover is limited to 24 hr/7 day cover in no more than one specialist area”. A broad range of cases are managed in these hospitals, many of which are several hours away from formal laboratory or specialist services.

There are 33 rural hospitals in New Zealand, serving approximately 20% of New Zealand’s population, although not all of these hospitals provide an acute service.

These rural hospitals are further categorised into level one, two or three based on available hospital staffing and resources.

Patients present to rural hospitals with chest pain at a similar rate to urban emergency departments and require a similar assessment. Patients with AMI are often managed for hours, or days before transfer to a base hospital for specialist intervention. In some instances the rural hospital will manage the patient with AMI for the entirety of their hospital stay.

We currently do not know what tools are being used and how they are applied to assess patients who present with chest pain in New Zealand’s rural hospitals. Therefore, we aimed to determine current (2018) use of POC-cTn, the cut-off used, whether ADP are used and what access to exercise tolerance testing (ETT) was available, for the assessment of chest pain in New Zealand rural hospitals.

Methods

We conducted a national survey of New Zealand’s rural hospitals that provide an acute service and contact details were available. In March 2018 a short 32-question online survey was sent to the person identified as the clinical leader, or the person nominated to lead research initiatives, in 27 of New Zealand’s rural hospitals with current contact details available.

The survey (see Appendix 1) was designed and distributed using the Qualtrics (Qualtrics, Provo, USA) platform. The survey was piloted in two rural hospitals prior to being distributed to the remaining rural hospitals. The survey consisted of a mixture of dichotomous (yes/no), multiple choice or free-text fields. Questions were asked about whether the rural hospital uses a point-of-care troponin assay, whether they are reliant on it 24-hours per day and what cut-off was used to determine a positive test. The nominated clinicians were also asked about access to high-sensitivity troponin assays, including test turnaround times (time from blood being drawn until result available). Information was gathered regarding the use of ADPs, and whether ETT was available on-site. If no response was received, or the response was inadequate, follow up was made to the clinician or the laboratory by email and/or phone.

Descriptive statistics were generated using Microsoft Excel (Microsoft Corporation, Seattle, USA).

The study was not reviewed by an ethics committee because it involved minimal risk according to the National Ethics Advisory Committee’s guidelines.

Results

Responses were received from most (23/27, 85%) of the surveyed rural hospitals. Four hospitals did not respond to the survey.

Most (17/23, 74%) rural hospitals used POC-cTn at some time during a 24-hour period. A majority (15/17, 88%) of these hospitals were reliant on POC-cTn 24-hours per day. Descriptive statistics are shown in Table 1.

A third (4/12, 33%) of rural hospitals that used the Abbott I-stat cTn were using the manufacturer’s cut-off of 0.08ug/L (99th centile of normal population). The remaining hospitals were using a cut-off...
below this (0.04ug/L). All three hospitals using the Radiometer AQT–90 FLEX use a cut-off lower (0.017ug/L) than that recommended by the manufacturer (0.03ug/L).11

Less than a third (8/23, 30%) of rural hospitals had on-site access to hs-Tn. The majority (5/8, 63%) used the Roche cobas e411 assay. The remaining three hospitals used either the Roche Cobas e601, the Abbott architect ci6200 hs-TnI or the Beckman Coulter Access hsTnI assay. One hospital used hs-Tn during normal working hours but used POC-cTn after-hours. Another hospital has POC-cTn available but did not ever use as had 24-hours per day access to on-site hs-Tn. All these hospitals also used an ADP. In contrast, only 24% (4/17) of hospitals that used a POC-cTn 24-hours per day were using an ADP. Only one of these are using an ADP adapted for use with POC-cTn. Three hospitals used the EDACS-ADP (Emergency Department Assessment of Chest Pain Score - Accelerated Diagnostic Pathway) and one hospital used an alternative based on a combination of the HEART (History, ECG, Age, Risk Factors, Troponin) and TIMI (Thrombolysis in Myocardial Infarction) scores; neither of these ADPs are intended for use with POC-cTn assays.

Only a minority of rural hospitals (7/23, 30%) had on-site access to ETT. Four hospitals provided access on the same or the next day and two others within two weeks. The remaining hospital has access to ETT once a month. In all other hospitals surveyed (16/23, 70%), patients had to travel or were transferred to a base hospital for this investigation.

**Discussion**

The principal finding of this survey is that the majority (17/23, 74%) of New Zealand’s rural hospitals do not have timely access to laboratory-based contemporary or hs-Tn assays and remain reliant on POC-cTn assays for assessing patients presenting with chest pain. As a consequence, these hospitals are unable to use the ADP that have been adopted by New Zealand’s DHBs in their urban emergency departments.6,19

In an attempt to improve the sensitivity of their POC-cTn assays, some rural hospitals have adopted a lower cut-off than the one
currently recommended by the manufacturer. As would be expected, the minority of rural hospitals (8/23, 30%) that have access to on-site laboratory hs-Tn assays have all adopted the ADPs developed for use within their DHB. Access to ETT is limited to a select few well-resourced level 3 rural hospitals, which makes further risk assessment difficult in rural hospitals without transfer to a larger centre for the majority of patients.

Three hospitals reliant on POC-cTn were using ADPs that were designed for use with laboratory-based contemporary or hs-Tn assays. This practice is not recommended and risks misclassifying and missing even greater numbers of AMI cases.

Using different assays during working and after-hours, as is the practice in a couple of hospitals, can also be problematic, especially if the same patient is tested on different assays during the same hospital stay. This is the case, even if the two assays have similar characteristics (eg, two different POC-cTn), but equally if one assay is more sensitive than another (eg, hs-Tn during working hours and POC-cTn after-hours). Even if the two different assays use the same units, the results between the two assays are not directly comparable.11 This could cause issues if the patient presented close to the changeover between working and after-hours. Care would be required to ensure that testing at two different time-points were done on the same assay.

The high response rate (85%) is a strength of this study which was achieved despite the absence of up-to-date contact details for all New Zealand rural hospitals. It proved difficult to contact the appropriate lead clinician and we cannot be the sure the nominated contact was in fact the best person to complete the survey on the hospitals’ behalf. The dispersed and fragmented rural health sector and the absence of any complete, up-to-date New Zealand rural hospital research database remains a barrier to undertaking rural hospital research in New Zealand.20 Responses to the survey may have been influenced by the publication of a letter suggesting a rural ADP and circulated among rural hospitals prior to the survey being undertaken.12

This survey updates previous surveys that document the use of troponin assays in New Zealand hospitals.8–10 However, this is the first study that records troponin use, ADP adoption and access to ETT, with a sole focus on rural hospitals. Our survey shows that the use of POC-cTn in rural hospitals is similar to what was found previously8–10 although the percentage of those using a lower cut-off has increased since 2014: from 31% (4/13) to 53% (9/17).8,10

The reduced precision combined with the low sensitivity at the manufacturer recommended cut-offs of POC-cTn when compared to the hs-Tn may have significant clinical implications.2,3,11 It is possible a number (up to 46%) of patients with small troponin rises, who would be diagnosed as AMI using a laboratory hs-Tn troponin, are being missed if the patient were to present at a rural hospital that uses a POC-cTn.2 While this may represent an apparent health inequity for some rural populations, the extent of the resulting health disadvantage remains unclear. In the recently published High-STEACS study, there was no evidence of improved patient outcomes in the 17% of patients that were reclassified as troponin positive after retesting with hs-Tn.21 This was likely because the majority of the reclassified patients had demand ischaemia (type-2 AMI) rather than acute coronary syndrome (type-1 AMI).21

One approach that can be used to address this issue is to lower the cut-off point for POC-TN assays. An Australian group showed that lowering the cut-off of the Abbott iSTAT POC-cTn from 0.08ug/L to 0.04ug/L reduced the number of false negative results (compared to hs-Tn) from 19.6% to 6.8%.2 Calculating sensitivity and specificity from these data,22 there is an increase in sensitivity from 34% (95% confidence interval (CI): 21–49%) to 81% (95% CI: 67–91%), with only a small decrease in specificity from 100% (95% CI: 97–100%) to 98% (95% CI: 93–100%).2 Importantly, the lower cut-off missed none of the patients who received a final diagnosis of AMI. Lowering the cut-off to 0.04ug/L is also a practice endorsed by the Australasian Association of Biochemists.11 When a POC-cTn with a reduced cut-off is combined with a clinical risk scoring system (eg, EDACS, TIMI) and a normal ECG, the resulting ADP has been shown to allow the safe early discharge of low-risk patients from urban emergency departments.23 A recently concluded pilot study produced
similar results in a New Zealand rural primary care population, although there are inadequate numbers to reach a firm conclusion.24,25

There are, however, no data on the use of POC-cTn based ADPs for the assessment of patients who are not at low-risk, even though this assessment is routinely undertaken in rural hospitals. To address this, an ADP was developed based on consensus reports and opinion.2,7,11,12,23,25 This pathway identifies low-risk and not low-risk patients and provides guidance for rural general practice and rural hospitals that rely on currently available POC-cTn.12 This is estimated to have a MACE rate similar to other ADPs using more sensitive troponin assays. The ADP would allow rural general practice and hospitals to expediently discharge low-risk patients as well as to identify with greater confidence, and in potentially greater numbers, those who are at higher risk of having, or have had, AMI. This should allow rural hospitals to appropriately target treatment and scarce resources to those patients who need it. This is seen as an interim solution until higher sensitivity assays are more widely available in rural hospitals. This solution currently has a limited evidence base and while there is a case for rural hospitals to use this approach, we suggest that any decision to make a strong national recommendation to use this rural ADP awaits the results of the ongoing validation study (commenced end of 2018) in rural hospitals and general practices throughout New Zealand. It is anticipated that once validation has been performed the ADP can then be adopted as National policy and will bring rural hospitals in-line with urban EDs.

In conclusion, the majority of rural hospitals in New Zealand are still reliant on POC-cTn when assessing patients with chest pain. There is limited evidence to support the use of these assays as part of an ADP for patients who are not low-risk. A study is underway to validate the consensus-based ADP using POC-cTn that many New Zealand rural hospitals have recently adopted. The results of this survey reinforce the importance of considering the context and resources of all New Zealand hospitals when making recommendations at a national level, such as the adoption of ADPs. Failure to do so can confuse clinical practice in our small rural hospitals that have access to fewer resources and risks exacerbating existing inequities.

Appendix 1

Rural hospital questionnaire
Contact details

Q1 Name of rural hospital?

________________________________________________________________________________________

Q2 Your rural hospital contact details
Address (1) ________________________________________________
Address 2 (2) ________________________________________________
Town (3) ________________________________________________
Region (4) ________________________________________________
Postal code (5) ________________________________________________
Phone number (6) ________________________________________________
Q3 Key contact details—person to contact re: further information and coordinating further study

First name (1) ________________________________________________
Second name (2) ________________________________________________
Email address (3) ________________________________________________
Phone number (4) ________________________________________________
Role (5) ________________________________________________

End of block: contact details

Start of block: patient demand

Q4 Number of patients presenting with acute chest pain per month? (best guess/approximate)
________________________________________________________________

Q5 Number of patients with NSTEMI per month? (best guess/approximate)
________________________________________________________________

Q6 Number of patients with STEMI per month? (best guess/approximate)
________________________________________________________________

Q7 Do you enroll patients with ACS in ANZACS-QI at your rural hospital?
Yes (1)
No (2)
Don’t know (3)

Q8 Do you currently use a chest pain pathway that incorporates an objective clinical score?
Yes (1)
No (2)

Skip to: end of block if do you currently use a chest pain pathway that incorporates an objective clinical score? = No

Q8a If so, which one?
EDACS-ADP (1)
ADAPT (2)
HEART (3)
TIMI (4)
Don’t know (5)
Other (6) ________________________________________________

End of block: patient demand

Start of block: laboratory services
Q9 Who is your local laboratory provider?

Q10 Is your laboratory on-site?
   Yes (1)
   No (2)

Q11 Can you centrifuge blood samples on site at your hospital?
   Yes (8)
   No (9)
   Don’t know (10)

Display this question:
If can you centrifuge blood samples on site at your hospital? = Yes

Q11 Can non-laboratory staff centrifuge samples?
   Yes (1)
   No (2)
   Don’t know (3)

Q12 Can you store blood samples?
   Yes (1)
   No (2)
   Don’t know (3)

End of block: laboratory services

Start of block: troponin

Q13 Do you use point-of-care troponin (POC-Tn) at any time in your rural hospital?
   Yes (1)
   No (2)

   Skip to: Q34 If do you use point-of-care troponin (POC-Tn) at any time in your rural hospital? = No

Q13a Do you rely on POC-Tn 24hrs/day?
   Yes (1)
   No (2)

   Skip to: Q15 If do you rely on POC-Tn 24hrs/day? = Yes
Q13b When are you reliant on POC-Tn?—Check all that apply
0800–1200 hrs (1)
1200–1600 hrs (2)
1600–2000 hrs (3)
2000–2400 hrs (4)
2400–0800 hrs (5)

Q13c What POC-Tn assay/device do you use?

________________________________________________________________

Q13d What is the upper limit of normal cut-off you use? (ie, above what value is considered abnormal or positive)

________________________________________________________________

Q13e Who is in charge of your quality assurance regarding POC-Tn?

________________________________________________________________

Q14 Do you have access to and routinely use/send samples for a laboratory based troponin assay?
Yes (1)
No (2)

Skip to: end of block if do you have access to and routinely use/send samples for a laboratory based troponin assay? = No

Q14a Is it a high-sensitivity assay?
Yes (1)
No (2)
Don't know (3)

Q14b What is the manufacturer/model/name of the assay you have access to?

________________________________________________________________

Q14c How many hours/day is this available? (please state if lab is required to come in on call back?)
________________________________________________________________
________________________________________________________________
________________________________________________________________
________________________________________________________________

Q14d Is this processed on-site?
Yes (1)
No (2)
Q14e What is the ‘turn around’ time from blood drawn to result during working hours (0800–2000)?
   (1) 1–4 hrs (2)
   4–8 hrs (3)
   8–24 hrs (4)
   >24 hrs (5)

Q14f What is the ‘turn around’ time from blood drawn to result after working hours (2000–0800hrs)?
   (1) 1–4 hrs (2)
   4–8 hrs (3)
   8–24 hrs (4)
   >24 hrs (5)

End of block: Troponin

Start of block: ETT

Q15 Do you have access to on-site exercise tolerance test?
   Yes (1)
   No (2)

Display this question:
If do you have access to on-site exercise tolerance test? = Yes

Q15a If so, how soon can this be offered for a patient presenting/admitted with chest pain at your rural hospital? (usually)
   Same day (1)
   Next day (2)
   Within 1–2 days (3)
   Within a week (4)
   Within 2 weeks (5)
   Within a month (6)
   Longer than a month (7)

Display this question:
If so, how soon can this be offered for a patient presenting/admitted with chest pain at your rur... = Within a week
Or if so, how soon can this be offered for a patient presenting/admitted with chest pain at your rur... = Within 2 weeks
Or if so, how soon can this be offered for a patient presenting/admitted with chest pain at your rur... = Within a month
Or if so, how soon can this be offered for a patient presenting/admitted with chest pain at your rur... = Longer than a month
Or do you have access to on-site exercise tolerance test? = No
Q15b If not, or is infrequently available, what is your current method of obtaining provocative testing?

________________________________________________________________
________________________________________________________________
________________________________________________________________
________________________________________________________________
________________________________________________________________
End of block: ETT

Start of block: other comments

Q16 Other comments: previous experience, issues

________________________________________________________________
________________________________________________________________
________________________________________________________________
________________________________________________________________
________________________________________________________________
End of block: other comments

Start of block: involved?

Q17 Is your rural hospital interested in being involved in a clinical trial regarding chest pain and the use of point-of-care troponin eventually utilising a newer highly sensitive assay in rural hospitals?

Yes (1)
Maybe (2)
No (3)

End of block: involved?

Appendix 2

Appendix Table 1: Troponin assays used by New Zealand rural hospitals.

<table>
<thead>
<tr>
<th>Rural hospital</th>
<th>Level</th>
<th>Type</th>
<th>Manufacturer</th>
<th>Assay</th>
<th>Comments</th>
</tr>
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<tr>
<td>Northland District Health Board (DHB)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kaitaia</td>
<td>3</td>
<td>hs-Tn*</td>
<td>Roche</td>
<td>Cobas e411</td>
<td></td>
</tr>
<tr>
<td>Bay of Islands</td>
<td>3</td>
<td>hs-Tn</td>
<td>Roche</td>
<td>Cobas e411</td>
<td></td>
</tr>
<tr>
<td>Rawene</td>
<td>2</td>
<td>POC-cTn†</td>
<td>Abbott</td>
<td>iSTAT cTn</td>
<td></td>
</tr>
<tr>
<td>Dargaville</td>
<td>2</td>
<td>hs-Tn</td>
<td>Roche</td>
<td>Cobas e411</td>
<td></td>
</tr>
<tr>
<td>Waikato DHB</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thames</td>
<td>3</td>
<td>hs-Tn</td>
<td>Roche</td>
<td>Cobas e411</td>
<td></td>
</tr>
<tr>
<td>Taumarunui</td>
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<td>hs-Tn</td>
<td>Roche</td>
<td>Cobas e411</td>
<td>Working-hours</td>
</tr>
<tr>
<td></td>
<td></td>
<td>POC-cTn</td>
<td>Radiometer</td>
<td>AQT90 FLEX</td>
<td>After-hours</td>
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</table>
**Appendix Table 1:** Troponin assays used by New Zealand rural hospitals (continued).

<table>
<thead>
<tr>
<th>Hospital</th>
<th>Level</th>
<th>Troponin Assay</th>
<th>Manufacturer</th>
<th>Location</th>
<th>Notes</th>
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<tr>
<td>Tokoroa</td>
<td>3</td>
<td>POC-cTn</td>
<td>Radiometer</td>
<td>AQT90 FLEX</td>
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<tr>
<td>Te Kuiti</td>
<td>2</td>
<td>POC-cTn</td>
<td>Abbott</td>
<td>iSTAT cTn</td>
<td>Working-hours</td>
</tr>
<tr>
<td></td>
<td></td>
<td>POC-cTn</td>
<td>Radiometer</td>
<td>AQT90 FLEX</td>
<td>After-hours</td>
</tr>
<tr>
<td>Lakes DHB</td>
<td></td>
<td>Te Kuiti 2</td>
<td>Beckman Coulter</td>
<td>Access hsTn</td>
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</tr>
<tr>
<td>Taupo</td>
<td>3</td>
<td>hs-Tn</td>
<td>Beckman Coulter</td>
<td>Access hsTn</td>
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<td>Taranaki DHB</td>
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<td>Hawera 3</td>
<td>Roche</td>
<td>Cobas 232</td>
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<tr>
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<td>Wairoa 2</td>
<td>Abbott</td>
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<td>Te Puia 1</td>
<td>Roche</td>
<td>Cobas 232</td>
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<td>Nelson Malborough DHB</td>
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<td>Golden Bay Community Hospital 2</td>
<td>Abbott</td>
<td>iSTAT cTn</td>
<td></td>
</tr>
<tr>
<td>Canterbury DHB</td>
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<td>Kaikoura 1</td>
<td>Abbott</td>
<td>iSTAT cTn</td>
<td></td>
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<tr>
<td>Ashburton</td>
<td>3</td>
<td>hs-Tn</td>
<td>Abbott</td>
<td>Architect Cl 4100</td>
<td>Bloods often sent to Christchurch after-hours</td>
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<td>West Coast DHB</td>
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<td>Buller 2</td>
<td>Abbott</td>
<td>iSTAT cTn</td>
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<td>Greymouth</td>
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<td>Roche</td>
<td>Cobas e601</td>
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<tr>
<td></td>
<td></td>
<td>POC-cTn</td>
<td>Abbott</td>
<td>iSTAT cTn</td>
<td>Not used in routine clinical practice</td>
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<td>iSTAT cTn</td>
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<td>Lakes 3</td>
<td>Abbott</td>
<td>iSTAT cTn</td>
<td></td>
</tr>
</tbody>
</table>

*High sensitivity troponin (hs-Tn)
†point-of-care troponin (POC-cTn)
‡Level 1 rural hospital: “Visiting cover once/day, with on-call medical cover at other times. Some of the after-hours on call may be supplied by appropriately trained nursing staff with medical backup at a distance. No on-site laboratory services. Acute inpatient beds.”
§Level 2 rural hospital: “On-site medical cover during normal working hours. On-call medical cover at other times. A combination of off-site laboratory services and point-of-care testing.”
¶Level 3 rural hospital: “On-site 24-hour medical cover. 24-hour access to radiology and laboratory services. There may be limited specialist cover.”
Competing interests:
Nil.

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