



New cardiac models of care reduce patient access to specialist nurses: A Victorian cross-sectional pilot study



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ABSTRACT

Background: Several studies have shown that the acuity and complexity of patients admitted to coronary care units is rising. Advances in medical technology and management of these patients have resulted in shorter lengths of hospital stay. Together, these changing care patterns have led to an emergence of new models of care delivery that differ from traditional coronary care units (CCU). The effect of these new models on workforce and resources in this area is unknown.

Aim: To describe the workforce and workplace resources of adult CCUs in Victoria, Australia.

Method: This pilot study used an investigator-developed survey to audit all adult CCUs operating in Victoria in 2010.

Results: A total of 24 CCUs participated in the audit of which the majority were located in metropolitan public hospitals. In terms of model of care of CCUs: 25% (6) of CCUs were a combination of a CCU/cardiology ward, 17% (4) a combined CCU/ICU or combined CCU/ICU/HDU and 12.5% (3) of CCUs were a dedicated unit. Only 15% (4) of all units met the international standards for a nursing workforce with critical care qualifications. The CCU/day procedure/HDU models had 24% of critical care qualified staff followed by CCU/cardiology ward model with 35% compared to an average of 54–80% of qualified staff in the other models of care of CCU.

Conclusions: This pilot study has highlighted the heterogeneity in models of CCU and a shortage of qualified critical care nurses, particularly in the CCU/cardiology ward model. This may have implications for the quality of care delivered in CCUs.

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Introduction

Coronary care units (CCU) have changed dramatically over half a century. Dedicated CCUs that were developed in the 1960s¹ have been transformed into combined units, such as CCU and cardiology ward, CCU and day procedure unit or CCU and high dependency unit (HDU), with very few dedicated CCUs remaining.² Several

important drivers have contributed to this transformation: advances in medical management, such as the advent of percutaneous coronary interventions, implantable defibrillator, and new valvular interventions appropriate for the elderly, as well as a shorter length of hospital stay. This has placed new stressors on the critical care nursing workforce in their efforts to provide high quality care.

It has been predicted that the workload of the CCU in the next decade will increase,^{3,4} highlighting the need to ensure a qualified critical care nursing workforce. International guidelines recommend that at least 75% of the nursing workforce in CCU should have a postgraduate critical care qualification.^{3,4} Considering the projected shortage of nurses,⁵ recruitment and retention of qualified critical care nurses is vital. However, the effect that combined CCUs have on the critical care nursing workforce is unknown.

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The hospital environment has been shown to play an important role in the recruitment and retention of staff.^{6–9} International guidelines recommend that CCUs are a dedicated or independent ward with their own staff and nurse unit manager.³ The nurse-to-patient ratio should be no higher than 1:2 during the day and 1:3 at night with the flexibility to be 1:1 when patient acuity demands.³ The aim of this pilot study is to describe the current workforce and workplace resources of adult CCUs throughout Victoria.

Methods

This pilot study utilised a cross-sectional survey design to audit all Victorian CCUs operating in 2010. The investigator-developed survey was designed to examine the resources and workforce of Victorian CCUs (Appendix A).

Sample

All adult CCUs operating in Victoria during 2010 were identified from the Victorian Department of Health website.¹⁰ Ninety two adult Victorian hospitals, excluding day and psychiatric hospitals, were contacted by telephone to ascertain if the hospital had an in-patient critical care service for cardiac patients. There were 37 hospitals with critical care facilities to manage hospitalised patients with an acute life-threatening cardiac condition.

The Directors of Nursing from the identified 37 hospitals with CCUs were contacted and sent a letter requesting permission to contact the Nurse Unit Manager (NUM) of their CCU (Fig. 1). Thirty-one Directors of Nursing, responded to the written request to contact the respective NUM. Four Directors of Nursing did not allow us to contact the NUM; two did not respond to the letter despite two reminder telephone calls and a follow-up letter asking them to return the permission form. Of the 31 NUMs that were contacted, 24 consented to participate in the study resulting in a 77% participation rate.

Ethics approval for the study was granted from Monash University. Twenty two hospitals accepted the ethics approval from Monash University. However nine hospitals required ethics approval from their hospital Human Research in Ethics Committee. The NUM in each CCU completed the survey (Appendix A). The CCU roster was used to access staff data. Patient data were abstracted from the CCU admission and discharge register located within each unit.

Statistical analysis

Descriptive statistics was used to describe the sample, and chi-square and Fishers exact test were used for discrete variables. SPSS for Windows version 20.0 was used to analyse the data. The level of significance was accepted at the 0.05 level (two-sided).

Results

Of the 24 CCUs surveyed, 58% (14) were located in metropolitan areas. Overall 25% (6) were in private hospitals. The median hospital bed numbers was 233 beds (interquartile range (IQR) 155–402 beds).

Characteristics of CCUs

Fig. 1 shows the different models of CCU. The most common (25%, 6) of CCUs was a combination of a CCU/cardiology ward; 17% (4) were a combined CCU/Intensive Care Unit (ICU) or a combined CCU/ICU/HDU and 12.5% (3) of CCUs were a dedicated unit. All the dedicated units were located in the metropolitan area; two units were in tertiary public hospitals.

The level of service provided in each hospital with a CCU was analysed, based on a national definition used in critical care services¹¹ (Fig. 2). The criteria used include the number of critically ill patients and the amount of resources, staffing and support services.¹¹ More than half of the hospitals with a CCU were defined as Level 2. As a Level 2 CCU, the unit must be capable of providing life support for several days.¹¹

Patients admitted to CCU

Over a one week period, 542 patients were admitted to the CCUs (median: 16 patients/week; IQR: 11–40 patients/week). More than one quarter of regional hospitals (39%, 7) performed elective percutaneous coronary interventions (PCIs) ($p=0.001$). More than half of elective and emergency PCIs (72%, 13) were performed in public hospitals ($p=0.009$).

The discharge diagnosis of patients admitted to CCU varied (Fig. 3). The most common discharge diagnoses were: ST elevation myocardial infarction (STEMI), unstable angina, arrhythmias and non-cardiac causes. The patients without a primary cardiac

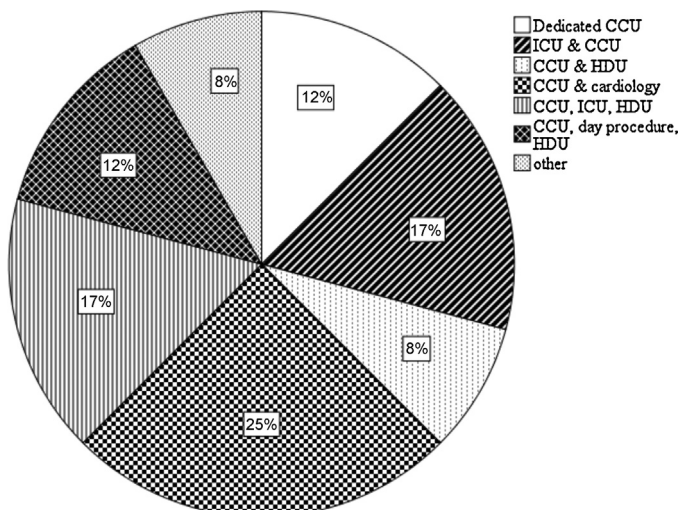


Figure 1. CCU model of care.

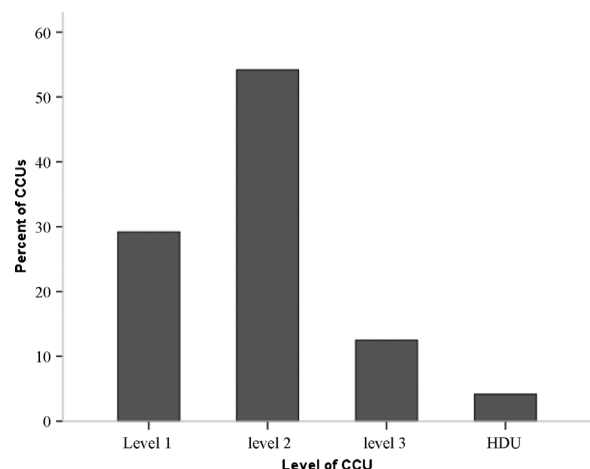


Figure 2. Level of CCUs. Level 3: the Unit must be capable of providing complex, multi-system life support for an indefinite period. It must have extensive back-up laboratory and clinical service facilities. Level 2: the Unit must be capable of providing complex, multi-system life support for several days. Level 1: the Unit must be capable of providing basic, multi-system life support usually for less than a 24 hour period¹⁴.

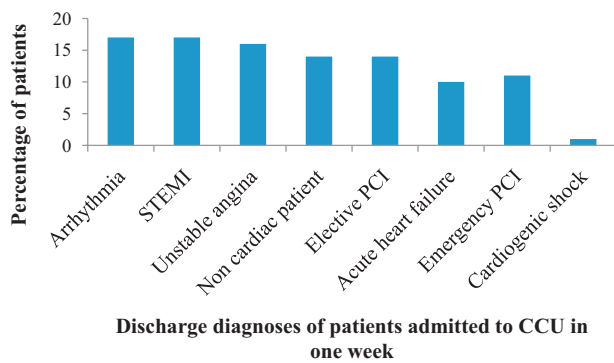


Figure 3. Discharge diagnoses of patients admitted to CCU between 5th and 11th July 2010. STEMI = ST elevation myocardial infarction. PCI = percutaneous coronary intervention.

diagnosis included those with acute renal failure, septic shock and pre-ICU admission.

Workforce

In regards to the medical workforce, more than half of the CCUs (12) had a cardiologist as the dedicated director of the unit. Of these units, 83% were located in metropolitan hospitals (10). Half of the regional CCUs (5) had a medical specialist as the Director. Vacant medical positions at registrar or consultant levels existed in 11% (3) of units.

In regards to the nursing workforce, a quarter (6) of the units had a clinical support nurse but the majority (79%, 19) had a dedicated supernumerary Clinical Nurse Educator. More than half (58%, 14) of the units had a supernumerary Nurse Unit Manager but the majority (57%, 8) of these CCUs were located in metropolitan areas. The median number of hours that a registered nurse was employed was 32 hours (interquartile range (IQR): 18–39 hours/week).

The CCU/cardiology ward model had the highest number of nursing vacancies (45%, equivalent to 12.5 full-time EFT) compared to the other CCU models. There was no significance difference in nursing job vacancies based on locality of CCU.

The international standards for critical care recommend that at least 75% of the nursing workforce should have a critical care qualification.³ Only 15% (4) of units met this standard. The different models of CCUs and number of staff with a critical care qualification were also analysed. Only critical care bed numbers and the number of staff required for these beds were included; the HDU and general cardiology ward beds were excluded. The CCU/day procedure/HDU model and CCU/cardiology ward model had 24% and 35% of critical care qualified nurses respectively. This is compared to 54–80% of critical care qualified staff in the other CCU models of care (Fig. 4).

Resources

Each unit had the equipment to support various patient management interventions. More than 90% of the CCUs had the capacity to support temporary pacing, continuous positive airway pressure (CPAP)/bilevel inspiratory positive airway pressure (BiPAP), vasoactive drugs, telemetry and haemodynamic monitoring (Fig. 5).

Discussion

This pilot study investigated the workforce and resources of CCUs throughout Victoria. The findings indicate that CCUs have changed significantly since they were first implemented over half a century ago. The number of dedicated CCUs has drastically reduced, despite international guidelines advocating for their

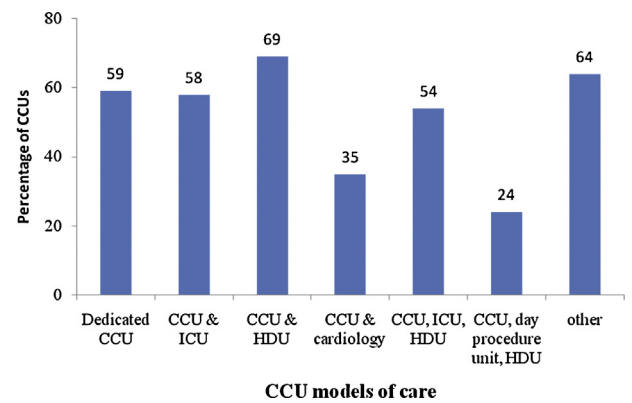


Figure 4. Percentage of registered nurses with a critical care qualification according to model of care.

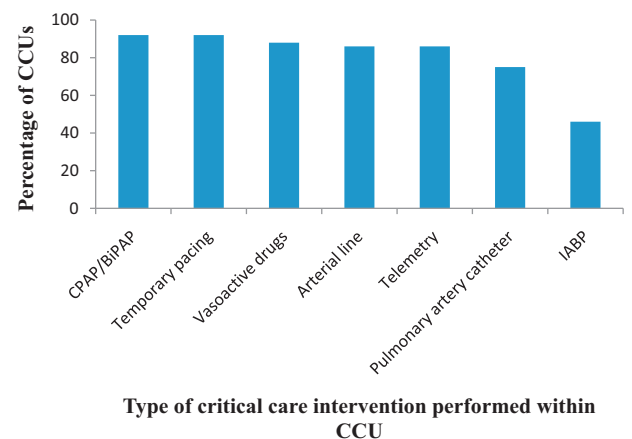


Figure 5. Resources within the CCU. IABP = intra-aortic balloon pump. CPAP = continuous positive airway pressure. BiPAP = bilevel inspiratory positive airway pressure.

continued implementation.³ International guidelines stipulate that CCUs should be an independent ward and comprise of: a workforce where at least 75% of staff have a critical care qualification, a nurse unit manager with the authority and responsibility of managing staff working within the unit, nurse-to-patient ratio of 1:2 during the day and 1:3 at night, bedside monitoring with the capacity for invasive haemodynamic monitoring, intra-aortic balloon pump, temporary pacing, and a five-channel ECG. In contrast to the international guidelines, the current study found that the majority of CCUs had merged with a cardiology ward. The CCU/day procedure/HDU and CCU/cardiology ward models had the lowest number of nursing staff with a critical care qualification in the workforce (24% and 35% respectively). Only four CCUs met the national workforce standard of 75% of staff possessing a critical care qualification³ and this included the dedicated CCU models. However, less than 15% of CCUs were defined as a dedicated unit, and all were located in metropolitan hospitals. Almost all of the CCUs had the resource capacity to support temporary pacing, vasoactive drugs, haemodynamic monitoring and telemetry. One of the most common discharge diagnostic group from CCU was a non-cardiac diagnosis, indicating that a large proportion of CCU beds continue to be utilised for patients without a primary cardiac diagnosis.

CCUs are facing a shortage of critical care nurses. The CCU/day procedure/HDU and CCU/cardiology ward model of care had 20–35% of critical care nursing staff compared to dedicated units with nearly 60% of critical care nursing staff. Several studies have found an association between the number of qualified critical care nurses and adverse events¹² including mortality,^{13–16} and

in-hospital complications.^{17,18} Person and colleagues¹⁹ investigated the association between staffing and in-hospital mortality. They recruited 118,940 patients from 6668 hospitals who had been admitted with a diagnosis of acute myocardial infarction. They found that higher staffing levels were associated with a 9% reduction in in-hospital mortality in patients admitted for acute myocardial infarction.¹⁹ A meta-analysis by Kane and colleagues¹² investigated the association between workforce and patient outcomes in critical care units. Kane et al. found that if critical care units increased their staffing by one full-time equivalent critical care qualified nurse per day, there would be a 60% reduction in respiratory failure, a 28% reduction in cardiac arrests and a 9% reduction in mortality.¹² Almost 25% of all unanticipated adverse events that resulted in death or permanent injury were due to inexperienced and/or inadequate nursing staff.²⁰

Despite the results of this pilot study identifying a shortage of critical care nurses, 90% of CCUs said that they had the technological capacity to support several invasive interventions requiring critical care monitoring and management, such as temporary pacing, intra-aortic balloon pump, haemodynamic monitoring, and vasoactive drug administration and monitoring. However, given the shortage of critical care qualified nursing staff to manage these patients, these interventions may not be utilised in CCU resulting in the transfer of patients to the intensive care unit (ICU), placing even greater demand on ICU resources. Katz and colleagues²¹ examined an administrative dataset of all hospital admissions to CCU from 1989 to 2006 in the Duke University hospital in USA. Over a 17 year period, they found a 19% decrease in utilisation of temporary pacing, a 6% decrease use in pulmonary artery catheters and a 4% decrease in use of intra-aortic balloon pumps (IABP).²¹ However it

is unknown in their study if patients requiring these interventions were transferred to ICU.

Limitations

A limitation of this pilot study was the condition placed on the recruitment of units to participate in the study by the Human Research in Ethics Committee. It required hospital Directors of Nursing to be contacted in order to give the study investigator permission to contact CCU Nurse Managers. Anecdotally, there was a lot of support for the survey from nurses working within CCU. However, several DONs refused to participate in the study so their Nurse Managers were unable to be contacted. It was anticipated that there would have been a higher response rate if the researchers were able to contact the NUM directly to ask them for their participation.

Further research is warranted as this pilot study has highlighted the need for a larger national study regarding the recruitment and retention of critical care qualified nurses in CCU.

Conclusion

CCUs have changed significantly since they were first established over half a century ago. Several new models of CCU have emerged and the number of dedicated CCUs has significantly reduced. However these changes to CCUs have serious workforce implications. These new models of CCU are facing a shortage of critical care nurses with less than a third of their staff having a postgraduate critical care qualification. This has the potential to adversely impact on the quality of care delivered within the unit and the rate of adverse events.

Appendix A.

CCU survey.

Site ID: **CCU resource survey**Name of hospital:

Please complete the following questions:

1. Number of total hospital beds:

2. What type of hospital is your CCU located in:

☐ Private hospital☐ Public hospital☐ Other (please specify) **Model of care of your CCU**

3. Type of CCU:

☐ Dedicated CCU☐ Combined CCU and High Dependency Unit (HDU)☐ Combined ICU & CCU☐ Combined CCU & general cardiology ward☐ Combined CCU & Cardiothoracic Unit☐ Other (please specify) ☐ Combined CCU and day procedure unit

4. Functional level of CCU (see definitions below)

☐ Level 3☐ Level 1☐ Level 2☐ HDU**Definitions of functional levels of CCU:**

Level 3: the Unit must be capable of providing complex, multi-system life support for an indefinite period. It must have extensive back-up laboratory and clinical service facilities

Level 2: the Unit must be capable of providing complex, multi-system life support for several days.

Level 1: the Unit must be capable of providing basic, multi-system life support usually for less than a 24 hour period.

Site ID:

Bed capacity

5. How many physical beds does your CCU have?

6. How many beds are currently opened in your CCU?

Questions 7-10 only relate to combined ICU and CCU units. If you don't have this type of unit please go to question 12

7. How many protected ICU beds does your unit have?

8. How many protected CCU beds does your unit have?

9. How many interchangeable ICU/CCU beds does your unit have?

10. Are the ICU beds included in the number of CCU beds in question 5?

☐ Yes☐ No

Questions 11-14 only relate to combined HDU and CCU units. If you don't have this type of unit please go to question 15

11. How many protected HDU beds does your unit have?

12. How many protected CCU beds does your unit have?

13. How many interchangeable HDU/CCU beds does your unit have?

14. Are the HDU beds included in the number of CCU beds in question 5?

☐ Yes☐ No

Questions 15-18 only relate to combined Cardiothoracic and CCU units. If you don't have this type of unit please go to question 19

15. How many protected Cardiothoracic beds does your unit have?

16. How many protected CCU beds does your unit have?

Site ID: 17. How many interchangeable Cardiothoracic/CCU beds does your unit have? 18. Are the Cardiothoracic beds included in the number of CCU beds in question 5? ☐ Yes ☐ No**Questions 19-22 only relate to combined Cardiology and CCU units. If you don't have this type of unit please go to question 23**19. How many protected Cardiology beds does your unit have? 20. How many protected CCU beds does your unit have? 21. How many interchangeable Cardiology/CCU beds does your unit have? 22. Are the Cardiology beds included in the number of CCU beds in question 5? ☐ Yes ☐ No**Questions 23-26 only relate to combined CCU and day procedure units. If you don't have this type of unit please go to question 27**23. How many protected CCU beds does your unit have? 24. How many protected day procedure beds does your unit have? 25. How many interchangeable day procedure/CCU beds does your unit have? 26. Are the day procedure beds included in the number of CCU beds in question 5? ☐ Yes ☐ No**Can you please answer the following questions:**23. How many additional beds have been opened in the previous 3 months? 24. How many beds have been closed in the previous 3 months?

Site ID:

Staffing of your Coronary Care Unit

25. How many dedicated CCU medical specialist FTE* does your unit have?

*FTE=full time equivalent

26. How many non-cardiology medical specialist FTE does your unit have?

27. How many vacant CCU medical specialist FTE funded but unfilled positions?

28. How many registrars FTE does your CCU have?

29. How many resident FTE does your CCU have?

30. Is your Nurse Unit manager supernumary ?

☐ Yes☐ No

31. Do you have a dedicated Clinical Nurse educator for your CCU?

☐ Yes☐ No

If yes, are they supernumary?

☐ Yes☐ No

32. Do you have a clinical support nurse?

☐ Yes☐ No

33. How many rostered hours per week is the clinical educator employed?

34. How many registered nurses FTE have a critical care qualification?

35. How many registered nurses FTE have no critical care qualification?

36. How many critical care nursing course students are rotating through your unit?

37. How many registered nurses FTE employed by an agency, do you use over 24 h?

38. How many vacant registered nurses FTE positions do you currently have?

Site ID:

Patients admitted to your Coronary Care Unit

39. How many patients were admitted to CCU last week (Mon-Sun):

40. In the patients that were admitted to CCU last week (Mon-Sun), how many had a primary diagnosis of :

Elective PCI:

Emergency PCI:

Acute MI:

Unstable angina:

Arrhythmia:

Heart failure:

APO:

Cardiogenic shock:

Non CCU patient:

Other (please specify diagnosis and number):

41. Does your hospital have a cardiac rehabilitation program? ☐ Yes ☐ No

42. Does your Unit have the resources (excluding staff) to manage a patient with:

a. Temporary pacing ☐ Yes ☐ No

b. Intra-aortic balloon pump ☐ Yes ☐ No

c. Measurement of cardiac output ☐ Yes ☐ No

d. Haemodynamic monitoring of a Swan-Ganz catheter ☐ Yes ☐ No

Site ID:

- e. Monitoring of an arterial line ☐ Yes ☐ No
- f. Telemetry beds ☐ Yes ☐ No
- g. Invasive ventilation ☐ Yes ☐ No
- h. Non-invasive ventilation
eg CPAP, BiPAP ☐ Yes ☐ No
- i. Continuous vasoactive IV inotropes ☐ Yes ☐ No

43. What are your three main concerns regarding your CCU?
(please list them in order of priority so your greatest concern to be listed first)

44. What are your three main concerns regarding your staff?
(please list them in order of priority so your greatest concern to be listed first)

45. What are your three main concerns regarding cardiovascular nursing?
(please list them in order of priority so your greatest concern to be listed first)

Thank you very much for completing the questionnaire. Could you please fax it to Josh Allen fax: 9244 6159 or fax it to Andrea Driscoll fax: 9903 0556

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