



## HEALTH WORKFORCE PROJECTIONS MODELLING 2010

### CRITICAL CARE NURSING WORKFORCE

Prepared for Health Workforce New Zealand: Contracting Support

By Health Workforce Information Programme (HWIP)

*A sector collaborative activity*

## CRITICAL CARE NURSING AT A GLANCE

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	Number of Nurses	Growth in Supply (per-annum)	Growth in Demand (per-annum)
2009	1612	2.5%	2.0%
2029	1863	0.2%	1.3%

*The Health Workforce Information Programme (HWIP) has prepared these estimates of the size of the New Zealand critical care nursing workforce for Health Workforce New Zealand Contracting Support (formerly the Clinical Training Agency).*

*Projections from the forecasting model of the future balance of the critical care nursing workforce supply compared with demand are made 20 years into the future using a forecast model based on the HWIP forecasting framework.*

*The Nursing Council of New Zealand's Annual Practising Certificate database provided the main source of data for the forecast.*

## EXECUTIVE SUMMARY

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This report has been written for Health Workforce New Zealand – Contracting Support (formerly the Clinical Training Agency) in conjunction with the national Nursing and Midwifery Workforce Strategy Group. It includes a forecasting model for critical care nurses in New Zealand. It has an emphasis upon cardiac demand and associated critical care nursing service delivery.

The demand for critical care nursing is estimated to double over the next 20 years.

The supply of nurses is expected to gradually increase until 2018 with little extra growth thereafter. Demand is expected to grow at a much faster rate. From 2014 the demand for critical care nursing services will begin to outstrip supply and continue to increase thereafter.

Critical care nurses, work in Intensive and coronary care units. In New Zealand there are separate intensive care units, such as paediatric and cardiovascular, mixed ICU and CCU units and discrete CCU units, which collectively are critical care units. Nurses, require on-the-job training when they enter the area practice for the first time. Due to the high level of skill required to function within critical care units, a nurse's first introduction is most often as a Registered Nurse who has secured a job within a unit.

This means that all nurses rely on orientation, in-house training and experience to gain a skill level adequate for the requirements of the job as an advanced beginner. Post-graduate education further develops nurses skills and knowledge. Of the current cohort 42 percent have been in the job less than four years. Rising demand for critical care nursing services coupled with limited potential for support services from non-Registered Nurses means that a high rate of educational preparation will be needed to sustain a skill level appropriate to increasing complex demands.

Critical care numbers were determined from the Nursing Council of New Zealand Annual Practising Certificate database. In particular, patterns of entry to and exits from the critical care nursing workforce have contributed to the model's development. .

Demand indicators included population growth projections, historical, current and anticipated demand for intensive services and the way critical care services are delivered. Changing models of critical care nursing delivery in the context of current and emerging technologies also contributed to the model's development.

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## BACKGROUND

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*Critical care nurses provide nursing care for patients and their families, within critical care, intensive care, combined intensive care/high dependency/coronary care, or high dependency care units.*

Critical Care Nurses' Section New Zealand Nurses Organisation (NZNO), (2009)

### Definition of critical care nursing

Historically in New Zealand, intensive and high dependency care have been included in the concept of critical care. Over time the need for high dependency units became apparent as hospital patients required progressively more complex care delivery. As a result the Critical Care Nurses' Section of the New Zealand Nurses Organisation (2009) has defined the differences between intensive care and high dependency under the umbrella of critical care. Intensive care units can be level I, II or III and must comply with the Joint Faculty of Intensive Medicine (1997) standards<sup>i</sup>.

A high dependency unit (HDU) is also a discrete unit within a hospital that is able to provide critical care expertise. The difference between ICU and HDU is that the latter provides care at a less intensive level and at a level that falls between ICU and the general ward. The HDU monitors and supports patients but does not manage patients requiring multiple organ support or invasive mechanical ventilation.

Nurses who select the practice code number 48 – intensive care/coronary care in the survey that accompanies the Nursing Council of New Zealand Annual Practising Certificate (APC) application - are considered critical care nurses according to this definition.

Nurses working in an HDU unit associated with and staffed by ICU

*An intensive care unit (ICU) is a specially staffed and equipped, separate and self contained section of a hospital for the management of patients with life threatening or potentially life threatening conditions. Such conditions should be compatible with recovery and have the potential for an acceptable future quality of life. An ICU provides special expertise and facilities for the support of vital functions and utilises the skills of medical, nursing and other staff experienced in the management of these problems.*

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<sup>i</sup> New Zealand Nurses Organisation: Critical Care Nurses Section (2009) Critical Care Nurse's Section Position Statement on the Definition of Critical Care Nursing. Available at:

<http://www.nzno.org.nz/LinkClick.aspx?fileticket=vD9SFn0GcFI%3d&tabid=317>

nurses would most likely select ICU/CCU while nurses in a ward with a higher acuity component would most likely not. Therefore the HDU nursing workforce is implicit within the critical care nursing workforce.

ICU nurses are currently not a defined discrete nursing workforce group within the NCNZ data collection. According to the Australian and New Zealand Standard Classification of Occupations (ANZSCO), (2009) ICU nurses are included within the critical care/emergency workforce group. Nurses who work in an ICU are defined by the Nursing Council of New Zealand (NCNZ) areas of practice as within the ICU/ CCU group. Coronary Care Unit (CCU) is a medical service, rather than a surgical service. It is not known whether nurses who work in a paediatric intensive care setting would select ICU/CCU in the APC survey or the neonatal/child health category.

Because of the nature of workforce forecasting, neonatal nurses working in a neonatal intensive care unit are excluded from this study. Neonatal nurses have been considered as a separate workforce.

### **Definition of cardio-thoracic nursing**

The HWIP team was also asked to develop a forecast model for a cardio-thoracic nursing workforce, which has overlaps with critical care nursing. As the NCNZ does not collect specific cardio-thoracic nursing data, discrete supply numbers could not be elicited (current numbers and historical entries/exits) from the data collection. In the Cardiac Surgery Services Development Working Group<sup>ii</sup> report a recommendation is made to establish a cardio-thoracic nursing workforce to address supply issues.

The term 'cardio-thoracic' refers to surgery involving the heart and associated great vessels (cardiac surgery) as well as surgery involving the lungs and other thoracic organs (thoracic surgery). Although these two surgical areas are mostly treated as separate specialties in medicine in New Zealand, specialist nursing skills are involved in the care of patients from both specialties within intensive care units. These nurses are part of the critical care workforce.

What is clear is that the term is used as it relates to cardiac and thoracic surgical procedures where the chest (thorax) is opened, in contrast to minor cardiac and thoracic procedures that may be undertaken in a less intensive environment, such as cardiac catheterisation in a cardiac catheterisation laboratory.

One District Health Board (DHB), Auckland, has a post-operative cardio-thoracic unit. The unit is not dedicated specifically to cardio-thoracic as it also caters for cardio-vascular patients. All other DHBs provide cardio-thoracic post-operative nursing services within ICUs. The nurses working within ICUs

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<sup>ii</sup> Ministry of Health (2008) Cardiac surgery services in New Zealand. Cardiac Surgery Service Development Working Group Report. Available at: <http://www.moh.govt.nz/moh.nsf/0/6A0AF72DABC7C2C4CC2574DA00148D1E>

are specialist intensive/high dependency nurses, not confined to working with cardio-thoracic surgical patients or patients from other surgical services (Cardiac Surgery Service Development Workgroup Report, (2008).

Specifically cardio-thoracic nurses work in ICU/HDU and in high acuity ward settings. These nurses also work with other patients and therefore are not able to be seen as a workforce group distinct from their colleagues.

### **Structure of this report**

A forecasting model for the critical care nursing workforce is presented in this report. Critical care nursing is the part of the regulated nursing workforce concerned with the ICU (including associated HDU) and CCU environments.

Although a distinct cardio-thoracic nursing workforce (for supply numbers) cannot be defined from within the ICU/HDU/CCU nursing workforce, demand considerations are discussed following the critical care forecast model.

### **The patient journey through ICU/CCU/HDU**

The supply and demand for critical care nursing service depends on adequately skilled staff, unit availability, surgical complexity and severe events, which may be external acute events or in-hospital events (medical or surgical). There is often a flow between medical ward and critical care units as patient condition changes.

Patients may be admitted to a unit as the result of an acute event in the community through Emergency Department services, without admission to a general ward (for example Myocardial Infarction (MI) to CCU). Another pathway for patients to and from these units is immediately post-operatively, either as an expected transfer as a result of complex surgery (such as cardio-thoracic procedures), or acutely as a result of unexpected surgical complications. While mostly surgical patients are admitted post-operatively to critical care units, sometimes patients are admitted pre-operatively for specialised stabilisation prior to operating theatre.

Patients requiring critical care nursing may be from any part of New Zealand, due to the nature of acute events, especially trauma. Therefore units in tertiary hospitals provide critical care nursing outreach and patient retrieval services to provincial and outlying areas.

The critical care nursing workforce delivers care to patients within units that are not part of a setting staffed by general ward staff, such as intensive care, high dependency and coronary care units. These units cater for many different diagnoses across the spectrum of care. Most of the patients have some cardiac condition, as all patients in CCU are included. Some CCU patients, but not all, will go onto require cardiothoracic surgery which will necessitate ICU admission. Although cardio-thoracic

surgeries are the largest group of patients receiving ICU care, the majority of ICU patients do not have cardiac conditions.

Patient entry to critical care units is based upon medical assessment of patient condition and need for critical care. Patients may require critical care nursing support while transferring from the point of trauma, primary care and peripheral hospitals into units. When the need for intensive care has passed patients may be transferred to general wards or discharged to the care of their General Practitioner. Sometimes ICU patients will transfer to general wards via a high acuity ward. Changes in patient conditions at ward level may necessitate transfers to and from wards and ICU/CCU at any point.

Patients entering critical care nursing services must have a chance of survival. An exception to this is when a patient is invasively ventilated before this clinical assessment is made. In such cases the patient remains in critical care. All invasively ventilated patients are cared for in ICU except for occasional long term invasively ventilated patients (such as high spinal injured patients) who may be cared for out of the hospital environment.

The top five events for ICU admission in 2008 were coronary artery bypass graft (CABG) and heart valve surgery (13 percent), drug overdose (five percent), bacterial pneumonia (four percent) and head trauma/multi trauma (four percent)<sup>iii</sup>. The criteria for entry to an ICU depend on the need for higher intensity care because of the degree to which the conditions threaten life (or have the potential to threaten life) rather than by diagnosis alone. This means that the patient is severely ill and may have conditions to do with any of the body systems and associated organs such as circulatory, neurological, pulmonary, renal, endocrine, and gastro-intestinal.

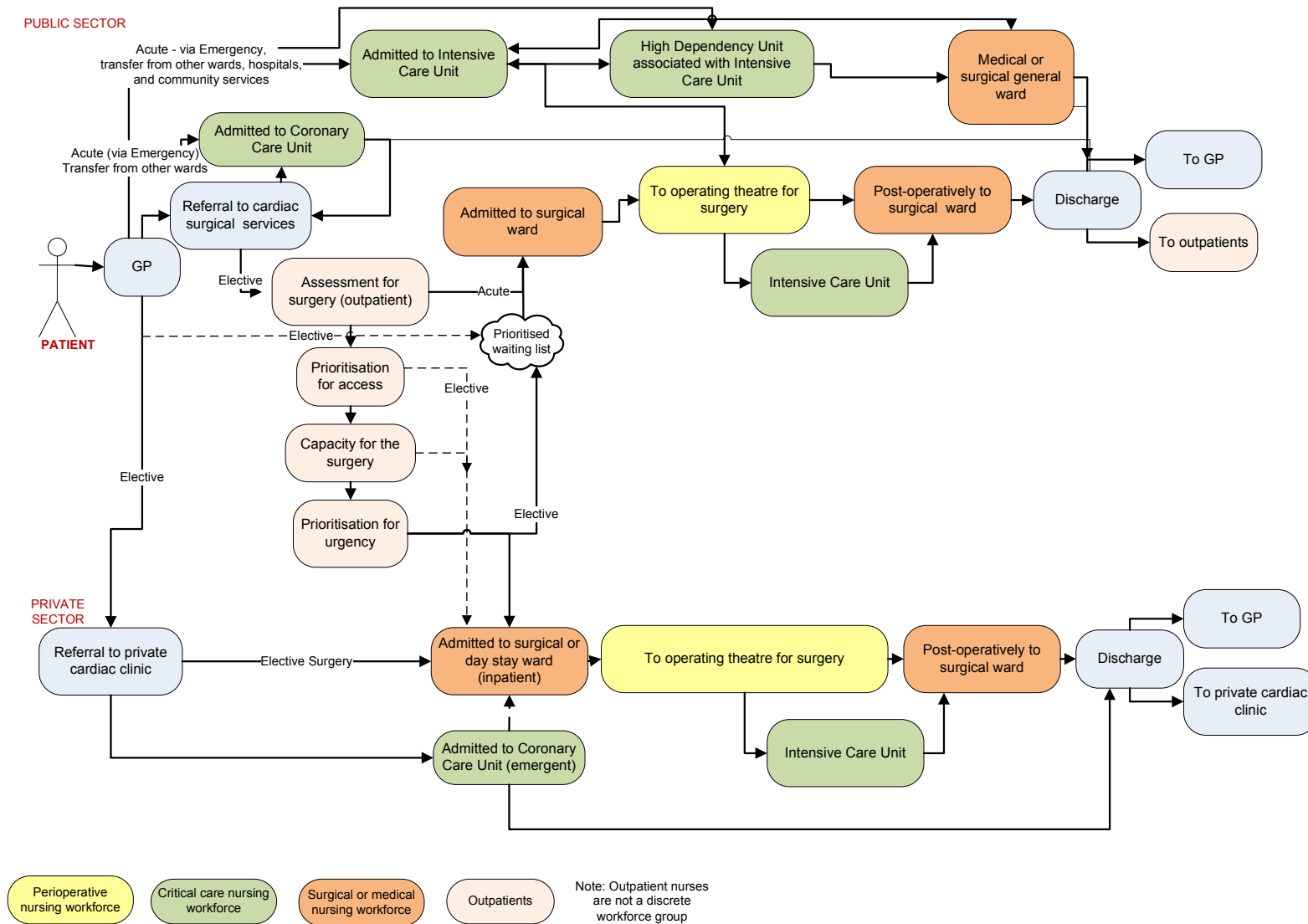
In figure one the ICU/CCU/HDU patient journey is presented as relevant to nursing workforces. In particular the service division between CCU and ICU is demonstrated. A patient may be admitted to one service (for example ICU) and may or may not go onto the other service, such as CCU. There may or may not be shared nursing between the services. In some cases, particularly in provincial areas, intensive care and coronary care units are co-located, but usually they are separate units with separate staffing. The Intensive Care Services in New Zealand report (2005) and the Cardiac Surgery Service Development Working Group report (2009) recommend a greater level of co-location for the future.

There is a clear division between the private and public critical care nursing workforces. The critical care nursing forecasting model presented here refers to the part of the regulated nursing workforce concerned with critical care delivery in a specialised unit regardless of whether that is an intensive care unit, a coronary care unit or a high dependency unit that is associated with an intensive care unit.

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<sup>iii</sup> Australian and New Zealand Intensive Care Society (2008). Centre for outcomes and resource evaluation - 2008 Annual Report. Available at: <http://www.anzics.com.au/core>

**Figure 1: The critical care patient journey**

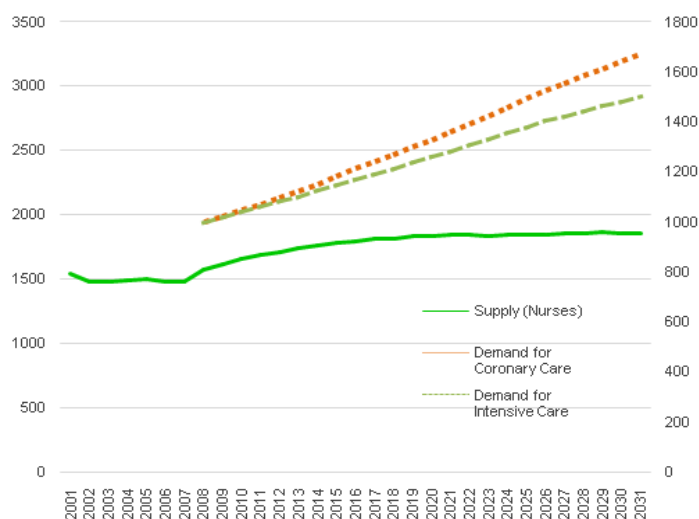


## FORECASTS

### Main finding

Demand for critical care nursing will begin to outstrip supply of critical care nurses from 2014. By 2029 the need for critical care nurses will have doubled. Demand for the service shows no sign of abating in the future (graph 1). As demonstrated in graph one, the supply of nurses (ICU and CCU) is estimated to gradually increase until 2018 and flatten thereafter with little growth.

Graph 1: Critical Care nursing supply and demand



Demand however is estimated to increase along a much steeper trajectory.

### Demand

The demand for critical care nursing over the next 20 years is determined by considering the need for ICU/CCU/HDU care within the whole population (past and present) as well as the expected population projection for the future, including age, gender and ethnicity.

Other demand indicators include historical and future critical care nursing service configurations, past and emerging models of care delivery and anticipated impact of new technologies.

*Patients who are cared for by critical care nurses have a high level of need depending upon clinical assessment within the relevant unit.*

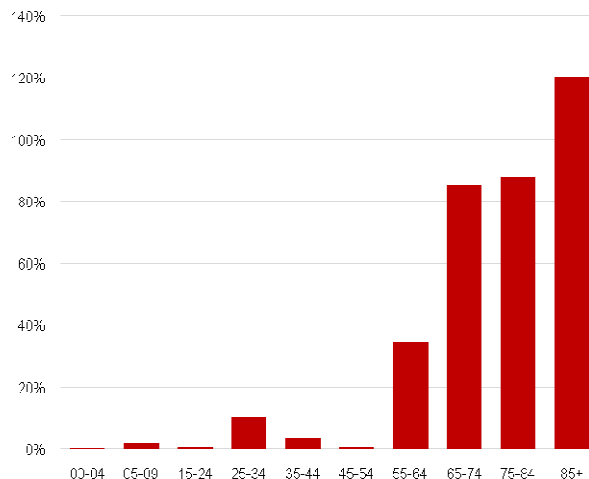
- *Intensive care patients require a standard nurse-patients ratio of at least 1:1 at all times*
- *High dependency patients require a standard nurse/patient ratio of at least 1:2. Often high dependency patients need a higher nurse to patient ratio.*
- *Acute coronary care patients require a standard nurse patient ratio of at least 1:2.*
- *Additional nursing requirements are needed beyond specific nurse patient ratios, especially in units which provide services such as outreach, patient retrieval, telemetry, large teaching courses, major research projects, quality projects, dedicated equipment nurses, and practice development,*

Critical Care Nurses' Section New Zealand Nurses Organisation (NZNO), (2009)

## Population Growth

Most of New Zealand's population growth is in age groups over 55 years, with the fastest growth rate in the 85+ year age band. This 85+ year population will more than double in the next 20 years. However, the population of people under 55 will remain almost static over the same period (graph 2). This age projection will be reflected by rising demand for critical care services, especially for those over 65 years, who are already the major users of critical care services.

**Graph 2: Population growth 2008-2029**



Older people are more likely to have pre-existing conditions, particularly associated with cardiac related disorders, increasing diabetes and obesity rates. Members of the EAG reported that anecdotally there seemed to be increasing amounts of patients in CCU who also had co-morbid conditions, which resulted in longer stays. The more co-morbid conditions a person has the greater the likelihood they will need critical care services, especially CCU with exacerbations of acute cardiac disorders and ICU postoperatively. An aging population means that rising chronic disease rates, greater amounts of co-morbidities and higher expectation of health services will increase demand in all types of critical care services.

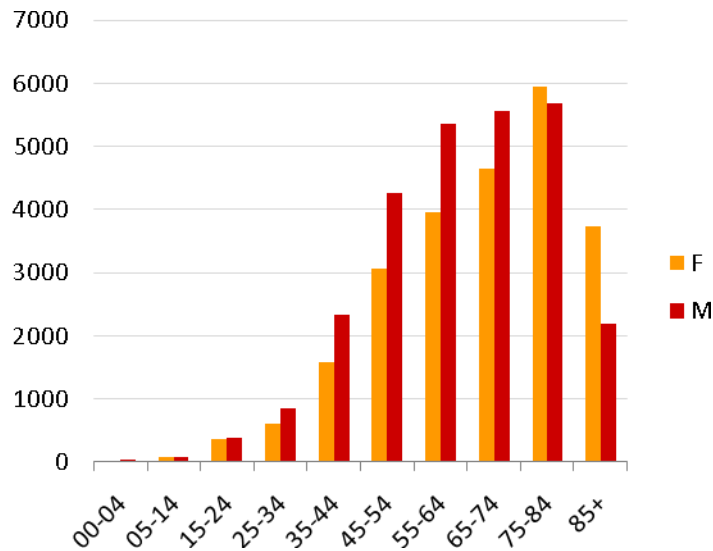
Trauma patients are also likely to have co-morbidities. An Auckland study found 73 percent of trauma patients admitted had co-morbidities, 23 percent of which were major. Pre-existing conditions increase length of stay, resulting in greater need for critical care services<sup>iv</sup>.

Of all admissions for coronary events, 55 percent involve people over 65 years of age. In each adult age band less than 74 years, the coronary care event rate for men is about 24 percent greater than for women. After that the gender need reverses and in the 85+ year age group the coronary care event rate for women is 57 percent greater than for men (graph 3).

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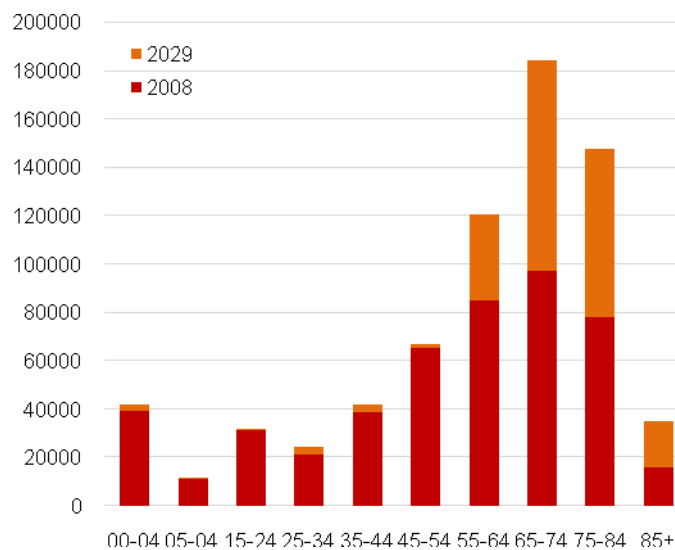
<sup>iv</sup> Tan CP, Ng A, Civil I. (2004) Co-morbidities in trauma patients: common and significant in the New Zealand Medical Journal Vol 117 No 1201 Available at: <http://www.nzma.org.nz/journal/117-1201/1044/>

**Graph 3: Coronary events by gender and age band**



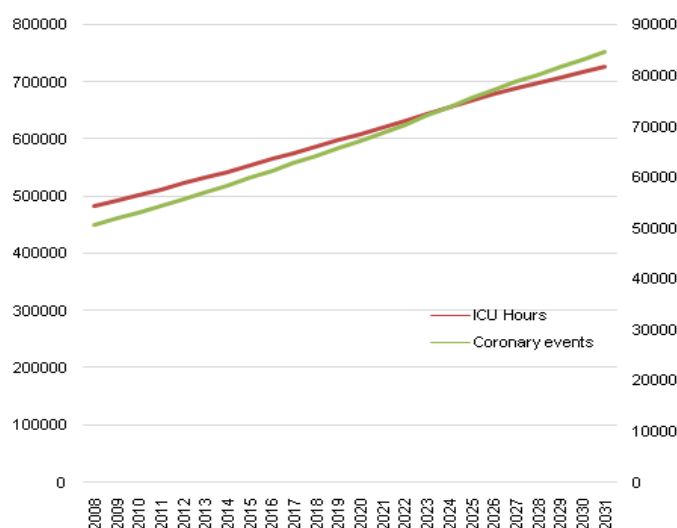
As presented in graph four the demand for ICU hours for over 65 year old patients is estimated to at least double over the forecast period.

**Graph 4: Growth in ICU hours**



Because the critical care nursing workforce includes both ICU and CCU, demand measurement needs to concern both services together rather than separately. Analysis of demand for both coronary events and ICU hours indicates these will almost double over the next 20 years, with demand for coronary events increasing slightly faster than ICU hours from 2024. The need for early and appropriate cardiac intervention, such as PCI, in order to reduce the need for cardio-thoracic ICU hours is implicated by this finding.

**Graph 5: ICU hours and coronary care demand (2008-2029)**



As the doubling in demand over the next 20 years is based on ICU hours it does not estimate the number of nurses needed for ICU patients. The growth in ICU hours will only represent growth in need for nurses if the ratio of nurses to ICU hours remains constant. There are many variables that may alter the ratio of nurses to ICU hours, depending on supply trajectory over the forecasted period.

As the report is based on ICU nurses and CCU nurses as a combined critical care nursing group, nurses per each unit (ICU and CCU) cannot be determined.

### **Service delivery and outputs**

As discussed the critical care nursing workforce crosses several services, depending on how services are named and defined. There are differences between how nurses define themselves, according to the APC survey, and the nursing services that are delivered. There is also a difference in measurement of critical care nurse supply by NCNZ APC numbers and the distribution of those numbers across discrete services. For instance:

- The demand for public sector coronary care nursing services is measured from diagnostic related groupings (DRGs) of in-patients with coronary conditions
- This does not necessarily account for patients who are admitted to hospital with the qualifying DRGs who are not admitted to a CCU environment
- The baseline demand for public sector ICU nursing services is derived from demographic profiles (age, gender and ethnicity) of patients receiving ICU care (determined from ICU hours recorded in NMDS), adjusted for population growth in the relevant demographic groups. This produces an estimate of the future number of ICU hours that would be required for the future population; assuming that the health needs of people of similar demographic characteristics remain the same.

- CCU hours are not recorded within the NMDS. Therefore the numbers of CCU nurses for CCU patients has not been measured.

In the past ICU and CCU has been mostly confined to the public sector. Recently ICU and CCU services have become available in the private sector. Although the demand for total critical care nurses in the private sector is not known some assumptions can be made to establish ICU demand in the private sector (refer to p.39 for these assumptions and weighting)

The capacity for critical care nursing service demand measurement by patient need is compromised by an already expressed unmet demand, particularly with respect to cardiac intervention. *“New Zealand has a high incidence of ischaemic heart disease (IHD) and is above the 75<sup>th</sup> percentile for male and female deaths from IHD compared to other OECD countries. IHD is the basis for about two thirds of cardio-thoracic surgery”<sup>v</sup> (p.13).*

Notwithstanding the high incidence of IHD the provision of cardiac surgery in New Zealand is lower than that of comparable countries. In particular, cardiac intervention rates in New South Wales, Australia, per population are 85 percent above New Zealand. Waiting times for publicly funded cardiac surgery have not reduced to clinically acceptable levels as they have in other countries. The key recommendation of the Cardiac Surgery Service Development Working Group Report (2008) is that the national intervention rate for cardiac surgery be increased by 35 percent over the next five years, represented as an equivalent rise in cardiac surgery discharge rates.

According to the Cardiac Surgery Service Development Working Group Report (2008) the most significant impediments toward achieving this recommendation include the availability of ICU beds and skilled nurses.

ICU services however provide services other than cardiac surgery related. Head/multiple trauma and drug overdose are also within the top five reasons for admission to an ICU. As these are both acute conditions increase in these two groups constrains ICU bed availability for post-operative surgical need, including neurosurgery.

### **Service configuration**

The major difference between public and private critical care nursing need is that in the private sector the critical care units are mostly for post-operative elective patients<sup>1</sup>, especially patients who have undergone elective cardio-thoracic surgery or neurosurgery. In the public sector, the number of post-operative beds depends on the number of acute admissions. Drug overdose and head/multiple trauma diagnoses feature in the top five reasons for admission to ICUs in New Zealand. Any rise in acute admissions to ICUs in the public sector will reduce the number of, or extend the wait for, beds available for elective surgery.

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<sup>v</sup> Ministry of Health (2008) Cardiac surgery services in New Zealand. Cardiac Surgery Service Development Working Group Report. Available at: <http://www.moh.govt.nz/moh.nsf/0/6A0AF72DABC7C2C4CC2574DA00148D1E>

Likewise CCU beds are driven by acute coronary demand and resource availability for early cardiac intervention. For instance, there is evidence that primary PCI (during acute CCU admission) increases survival amongst AMI patients. However, PCI requires the availability of an ICU at the same location in case a secondary acute event occurs during the procedure. This means that patients from areas without ICU facilities will be referred to cardiology services elsewhere. The procedure is then performed as an elective procedure with a priority rating at a later date.

ICU and cardiology services are now being offered in the private sector. In 2008, there was a 15 percent increase in cardiac interventions, excluding cardio-thoracic surgery, performed in the private sector. These cardiac interventions accounted for almost three percent of all private sector surgical procedures. The demand for critical care nursing services, which has occurred mostly in the public sector in the past, is likely to grow in the private sector. This will affect the public sector critical care nursing workforce as skilled critical care nurses will flow from the public to private sector, possibly exacerbating supply issues in the public service.

Regional centres tend to have either co-located or shared CCU and ICU services, whereas separation between the units is more common in tertiary hospitals. The critical care nursing service as a single entity is constrained at the moment by the separation of units into ICU, including HDU and CCU, often located and managed separately including staff. Co-location enables better distribution of intensive nursing skills across the units according to shifting patient demand. It also enables critical care nurses to be up-skilled and trained across the services, resulting in a larger pool of nurses from which to draw for staffing.

The critical care nursing service is likely to be reconfigured as surgical options become less invasive and safer for at risk patients of increasing age. This will result in less use of the ICU post-operatively for the major surgical procedures using ICU such as neurosurgery and cardio-thoracic.

Demand for critical care nursing services is determined by bed availability. In turn this depends on resource availability to provide greater ICU space and to purchase and use more sophisticated equipment for earlier diagnosis, intervention enabling faster stability and capacity for faster transfer to general wards and primary services.

As long as bed space is an issue in the public sector, the higher the acuity of patients being transferred to general wards.

### **Technology Developments**

Technology advances are another factor requiring consideration. In particular surgical robotics<sup>vi</sup>, which enables progressively less invasive procedures over time<sup>2</sup>, will reduce the need for ICU care post operatively. Surgery is expected to become less invasive but more complex. What we now

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<sup>vi</sup> Central Region District Health Boards, (2008), *Regional Clinical Services Plan*. Available at: <http://www.midcentraldhb.govt.nz/NR/rdonlyres/A01751DC-1653-4935-9914-5F919E88040E/0/RCSPFinalDraft.pdf>

consider invasive will most likely become minimally invasive. The less invasive the surgery, the less likely patients will need ICU hours post-operatively.

Likewise, the earlier coronary related conditions are diagnosed and the more use that is made of less invasive techniques as cardiac intervention, the less demand there will be for CCU beds. For instance, the success of PCI and development of keyhole surgery for cardiac bypass and heart valve surgery may make cardiothoracic surgery a thing of the past.

Conversely, as equipment becomes more technologically advanced, more patients will survive and expect high technology intervention. Patients with no chance of survival currently may achieve greater quality life in 20 years time due to emergent technology. This will increase demand for critical care nursing services.

Many of the reasons for admission to ICU and CCU are driven from social factors. For example, the growing prevalence of increasingly more harmful drug use in society along with faster and more powerful vehicles on roads suggests rising acuity and numbers of drug overdose and head/multiple trauma. In 2008, drug overdoses accounted for the second largest diagnostic group of ICU admission. Head/multiple trauma accounted for the fourth largest group. This suggests the need for greater numbers and higher skill levels for critical nursing service delivery to match growing demand.

As technology develops, patients tend to have greater expectations. In particular, people will expect more intervention despite being sicker, which is likely to stretch critical care services more.

### ***Model of care***

The model of critical care nursing may need to become reconfigured to better distribute skills to areas of most demand. The shift toward less demand for post operative beds in ICU may be offset by the demand for greater intervention in trauma, drug overdose, and other conditions from an increasing risk taking population. Patients that did not have a chance at life in the past (and so were not eligible for ICU and CCU care) may in the future have a chance and so increase admission rates of higher acuity patients.

The model of care is also most likely to extend to the private sector for early cardiology interventions such as PCI, angioplasty and treatment of unstable angina. If there is an increase in cardiothoracic surgical procedures in the private sector, post-operative ICU hours in the public sector are likely to reduce. This would be consistent with the flow of elective surgery from the public sector to the private sector and would free up beds in ICUs for acute admissions. In light of the recent shift toward publicly funded surgery in the private sector, there is no way of estimating how the private demand will be funded. This will necessitate greater critical care nursing skill acquisition in the private sector.

As demand increases for higher level nursing skills, critical care nursing roles may become reconfigured. While higher levels of skills will be required to manage advances in procedures and technology, nurses will require greater levels of support roles. There are some new health

occupational groupings emerging that may well provide this. Conversely, Registered Nurses are now able to expand the Registered Nurse scopes of practice to include undertaking more highly technical but less invasive skills in the units.

In 2008 the NCNZ discussed a range of issues relating to nurses working in roles which extend the Registered Nurse scope of practice. Already the NCNZ has redefined some specific procedurally based Registered Nurse scopes of practice and this is likely to extend into the critical care area of nursing practice<sup>vii</sup>, as nursing skills and roles expand to meet need.

The emergence of new occupational groups internationally such as anaesthetic technicians, physician assistants and critical care assistants<sup>3</sup> may affect the model of care for critical care nursing. These include:

- Registered Nurses working as critical care nurses may expand their scope of practice to include higher level skills and procedures. Although this will provide support for medical staff it is unlikely to relieve pressure on the bedside nurse
- Anaesthetic technicians may provide personnel to assume some of the tasks that up until now nurses have performed with regard to invasive ventilation
- Physician Assistants have been introduced to New Zealand in a pilot programme at one DHB. Although this will have an impact upon the medical intensivist workforce it may have little impact on the critical care nursing workforce.
- Re-introduction of Enrolled Nurses. Although Enrolled Nurses will have a greater presence within the nursing workforce, it is not anticipated that there will be a defined role for them in critical care units, commensurate with NCNZ scope of practice limitations for Enrolled Nurses.

These factors suggest critical care nurses may be able to refine their skills set to better meet the demand for increasingly complex procedures and technology. This may include using non-invasive technologies to perform procedures that have in the past been carried out by medical staff within the multi-disciplinary team. However, without planned occupational groups to support the role of critical care Registered Nurses, the gap between supply and demand can only grow.

## Supply

There are 1612 nurses who identified as critical care nurses in 2008, by selecting the ICU/CCU category in their Annual Practising Certificate survey. The supply of critical care nurses over the next 20 years is based upon current and historical numbers of nurses who work/have worked in critical

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<sup>vii</sup> Nursing Council of New Zealand (2009), Authorisation for first surgical assistant guidelines. Available at: [www.nursingcouncil.org.nz/Guidelines%20for%20FSA.pdf](http://www.nursingcouncil.org.nz/Guidelines%20for%20FSA.pdf)

care. Career changes, job patterns, inflow of nurses (entering) and outflows (exiting) the specific workforce group over time also contribute to the supply forecast. Inflows are based on education (availability and achievement), immigration and nurse return numbers to the service.

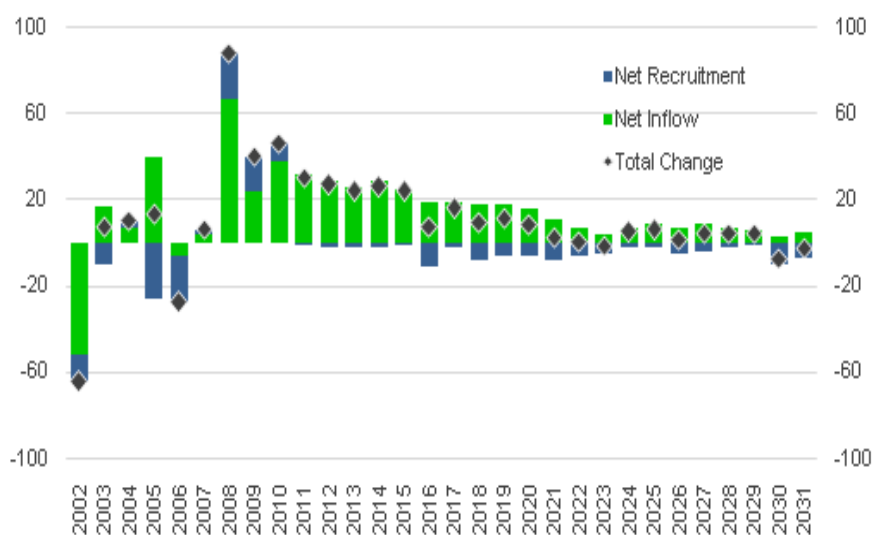
### **Entries to and exits from the workforce**

The critical care supply model starts with a constant baseline inflow of new nurses<sup>4</sup> based on historical averages – in this case 198 nurses per annum. In addition to new nurses, nurses returning to critical care are an important inflow. An estimated 87 nurses will return to critical care nursing in 2009 growing to 101 per annum by 2029. This is demonstrated in graph two as the net recruitment. The rate at which new nurses (graduates and immigrants) enter critical care nursing is lower than the overall nursing workforce in general. The rate at which returning nurses enter the critical care nursing workforce is substantially lower than the rate at which they enter the nursing workforce in general.

The number of nurses entering the critical care workforce from other areas of nursing is a significant component of the supply of critical care nurses. This is demonstrated in graph two as the net inflow.

This means that in 2008 most of the entries to the critical care nursing workforce came from other nursing areas of practice, not as new nurses. In 2016 the position is reversed. By 2029 changes from inflows into critical care nursing will be minimal. Conversely, many nurses leave critical care to work in other areas of nursing.

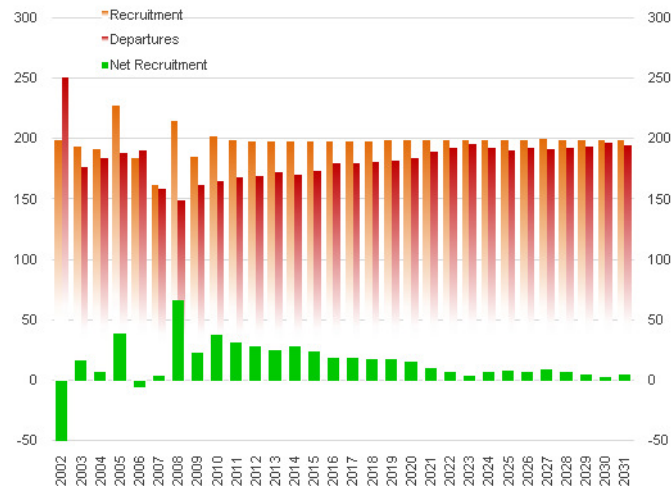
**Graph 6: Estimated critical care nursing inflows to 2031**



Entries to critical care nursing are balanced by exits. Exit rates are relatively static for the critical care workforce, at 10 percent in 2009 and 10.3 percent in 2029. In graph three the recruitments (nurses entering from education, return to nursing and immigration), are presented in relationship to the departures (leaving critical care and/or leaving nursing) giving a net recruitment pattern for the future. Whereas in 2002 nurses departed critical care nursing in greater numbers than were recruited into nursing the net recruitment was minus 50 nurses, in 2008 this had reversed. Between 2008 and 2029

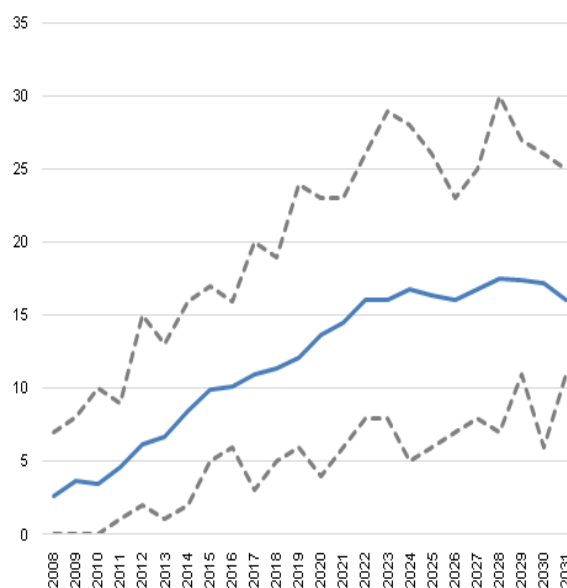
the departures will gradually increase in proportion to recruitments. Therefore, the net recruitments will be minimal. The rate of departure from critical care nursing from 2023 onward is estimated to be around 10 percent per annum.

**Graph 7: Net recruitment trends for critical care nurses, 2002 - 2029**



The critical care workforce is younger than the average age of nursing workforce in general. While the workforce will age over the next 20 years, the proportion of critical care nurses in the highest age groups (over 60) remains quite small. However, the rate of exit by nurses over 65 climbs to 0.9 percent by 2029 (graph four). For instance, in 2015 it is expected that 10 critical care nurses will leave. By 2028 that number will have peaked at about 17.

**Graph 8: Average numbers of nurses over 65 years exiting from the critical care nursing workforce.**



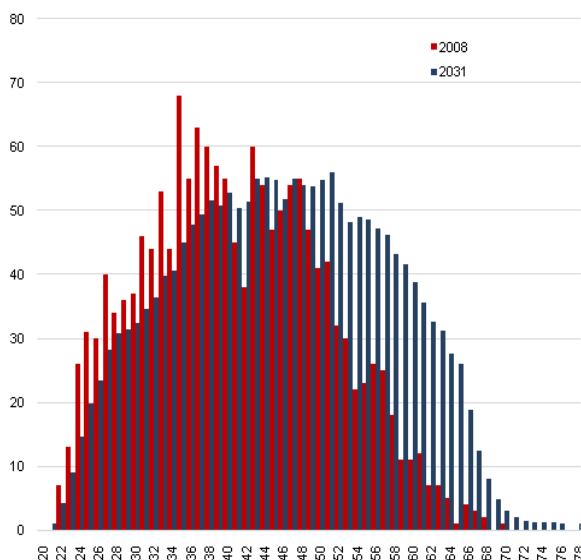
### Skill mix

Due to the high acuity nature of patients requiring critical care nursing, the skill mix in critical care units differs from other nursing services with lower acuity patients such as general wards. Nurse/patient ratios are higher, the requirement for post graduate qualifications is higher, the presence of ACCESS nurses (or clinical coordinators) is higher, the availability of a Clinical Nurse Educator (or equivalent) is higher, the need for support staff, (such as health care assistants, allied health professionals, and other support nurses) is higher and the need to supply a retrieval service impact upon future critical care nursing supply<sup>5</sup>. Extra staffing is required when support is not supplied as nurses need to substitute as they cannot leave their patients to attend to support work.

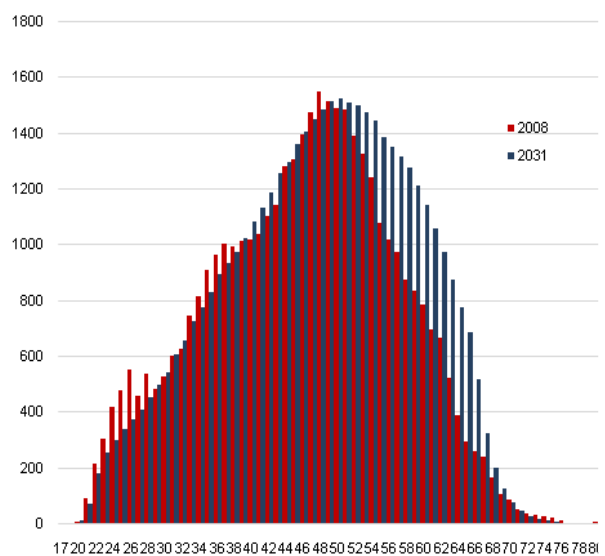
### Career changes

The age of nurses has a strong effect on their chances of leaving their positions. While age increases exit rates due to retirement, it decreases the chance of a nurse leaving his or her position for another. The older a critical care nurse is, the less likely they are to change to another area of practice. The average age of critical care nurses is 40, seven years younger than the overall average age of nurses and the workforce will remain younger than the overall nursing workforce. Nurses will continue to leave critical care nursing for other areas. Outflows from critical care nursing continue to grow over the forecast period, growing in line with the size of the workforce (graph seven and eight).

Graph 9: Critical Care Nurses Age Distribution



Graph 10: All Nurses Age Distribution



### Education

The undergraduate pre-registration programme for nurses in New Zealand provides graduate nurses with a comprehensive set of beginning practice skills. Very few if any beginning nurses have had

clinical exposure to the critical care environment. Therefore all New Zealand-educated nurses (and most overseas nurses) entering critical care nursing will require training.

When nurses enter the critical care nursing workforce orientation to the unit is provided as part of specific on the job training. It is accepted that the critical care orientation programme develops the novice to an advanced beginner critical care nurse. Clinical experience and ongoing education within any professional development and recognition programme (PDRP)<sup>6</sup> provide critical skills development to enable nurses to function competently within ICU/CCU/HDU units.

Post graduate critical care specific education is crucial to the provision of optimal patient care in critical care nursing environments throughout New Zealand. Minimum guidelines for intensive care nurse staffing in New Zealand requires 50 percent of nursing staff to be qualified as critical care nurses as a minimum skill mix<sup>viii</sup>. The nurse at the level of competent is not considered 'qualified' as a critical care nurse. A Registered Nurse is considered qualified as a critical care nurse when they have completed a specialty practice post registration/post graduate course that is specific to the sub-specialty and meets the New Zealand Standards for Critical Care Nursing Education, (2010)<sup>ix</sup>.

In order to maintain 50 percent of critical care nurses as qualified in the field as the minimum skill mix level (optimal is 75 percent), NZNO, 2005 suggests financial assistance and study leave as a necessity.

In-house on-the-job training may or may not be supported by formal education for critical care nurses. Historically nurses have had to pay for their own studies, secure external scholarships or have employer support in order to study. It is not possible to measure how many critical care nurses have undertaken post-graduate study in a post-operative related course funded by these means.

From 2006 post-graduate critical care nursing courses have been supported by Health Workforce New Zealand: Contracting Support (formerly the Clinical Training Agency) there were 334 Registered Nurse trainees, who completed a critical care and emergency nursing CTA funded post graduate course 2007/ 2008<sup>7</sup>. Of these 61 were from neonatal or emergency clinical areas (excluded in this project from the critical care nursing workforce).

The future supply of critical care nurses skilled for an increasingly complex intensive care environment will depend on access to and availability of ongoing post graduate related courses.

Nurses working within the critical care nursing workforce are more likely to have a Bachelor Degree as their highest qualification (38 percent) than the nursing workforce in general (29 per cent), according to the Nursing Council of New Zealand data collection. This may be because of the

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<sup>viii</sup> New Zealand Nurses' Organisation (2005) Minimum guidelines for Intensive Care Nurse Staffing in New Zealand (2005).

<sup>ix</sup> New Zealand Nurses' Organisation 4<sup>th</sup> Ed. (2010). New Zealand Standards in Critical Care Nursing Education. Available at: <http://www.nzno.org.nz/LinkClick.aspx?fileticket=QnQx0NAFuW8%3D&tabid=73>

younger age group that make up this workforce, or it could be because more existing hospital-based trained nurses have upgraded to bachelor degree status within the critical care nursing workforce than within the general workforce.

### *Critical care nursing education needs 2009-2029*

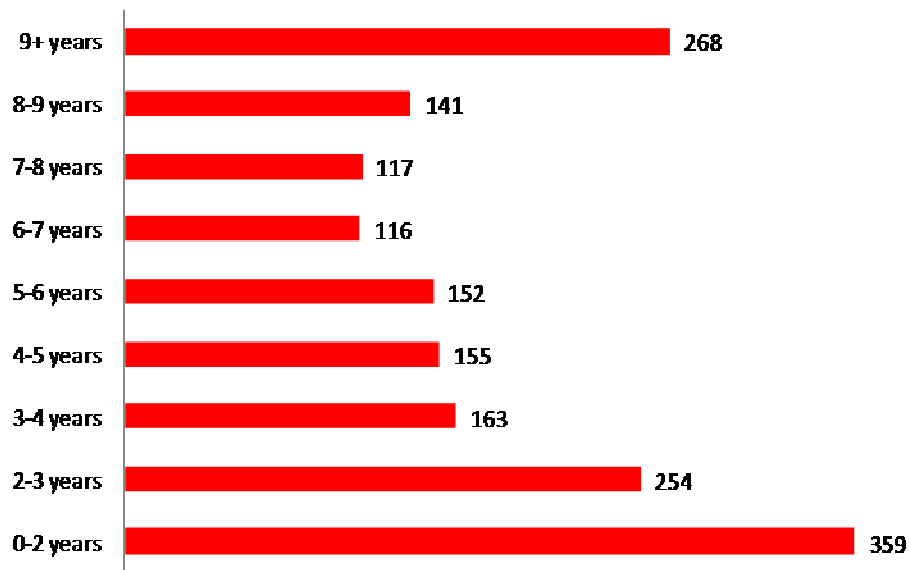
One of the objectives of workforce forecast modelling is to identify future training needs for each of the workforce sub-specialties that are undergoing predictive forecasting. For example, how many nurses will require post-graduate education to sustain nursing service provision in each nursing subspecialty in the future?

In most health workforces this can be predicted because people making career changes between sub-specialties do so for a lengthy period of their remaining career time. That is, the flow between sub-specialties is slow. For instance, when a doctor decides to enter a medicine sub-specialty, such as General Practice, he or she does the required training and is likely to remain in General Practice for a long time. Thereafter they are unlikely to exit that sub-specialty or enter another for a long period of time. Consequently one can predict how many trainees need to be trained for General Practice based on historical averages and predicted supply to meet predicted demand for General Practice services. The same can be applied to other health practice areas such as physiotherapy and pharmacy.

In nursing the picture is different. The median career length in the nursing workforce is 12 years, unlike other professional groups who may have a life span in the same profession. This means that half of all nurses in the current cohort<sup>8</sup> of nurses will spend more than 12 years in the nursing workforce. Regardless of specialty a nurse changes their job within nursing several times over a career. Half of all nurses now in nursing will stay in nursing for the next five to six years, and this is referred to as the half-life of nursing<sup>9</sup>.

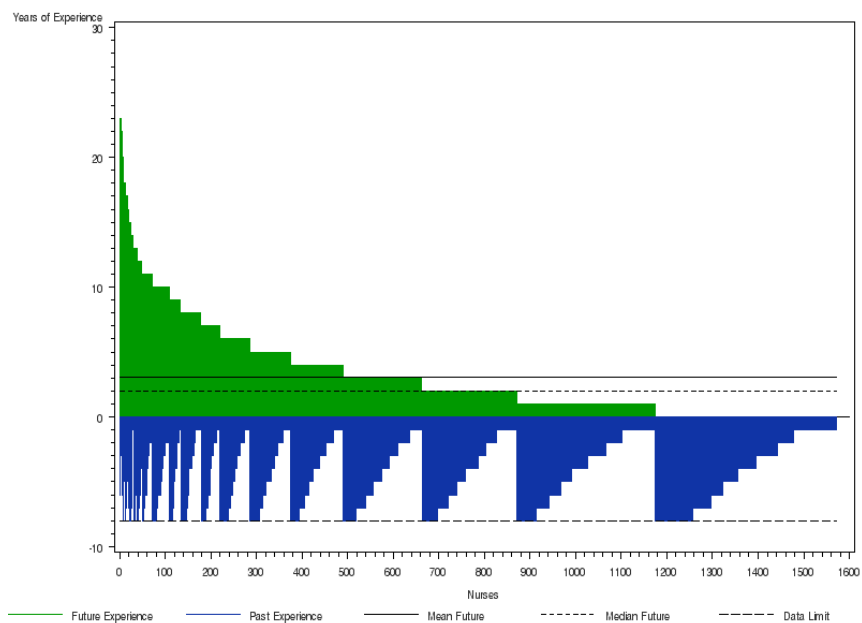
In the critical care nursing workforce 2009, about one-third of nurses have been in the subspecialty for more than seven years. Conversely the highest attrition rate occurs within the first three years of being in critical care nursing. While the more experienced nurses need to be engaging with clinically based post graduate study ensure ongoing skills upgrade for the future nurses in their first two-three years are the ones who need intensive specific skills development from orientation and Professional Development Recognition Programmes to become skilled in the area (graph 11), yet are the most likely to leave.

**Graph 11: Years of experience for critical care nurses (2009)**



Few nurses will remain in the workforce for 20 years (the tip of the green area in graph two), and fewer still of the nurses working in a particular area of nursing will stay in the same field (graph 2.)

**Graph 12: Career length of nurses**



If all the critical care nurses who have been in this specific workforce for less than 3 years (776), secured a post graduate certificate in the next two years, only 385-390 would still be in the critical care nursing workforce at the end of that time. Added to this would be the training needs of new entries to the workforce each year until 2029, which rises exponentially compared with supply

numbers. Also needing consideration is the rate of nurses leaving the specific workforce and the rising rate of demand for critical care nursing services.

Extrapolating from NCNZ APC data gives an estimate of an overall mean career length of more than 13 years, possibly as much as 16 years<sup>10</sup>. With only a limited set of historical data this estimate depends on assumptions about the rate at which nurses have historically left the workforce. Within nursing subspecialties, inflows and outflows are more rapid with nurses changing between subspecialties more frequently. As outlined in table two the gross year to year new entry inflow of nurses to critical care nursing is about 98 nurses. Some of these nurses will have had past experience in critical care nursing.

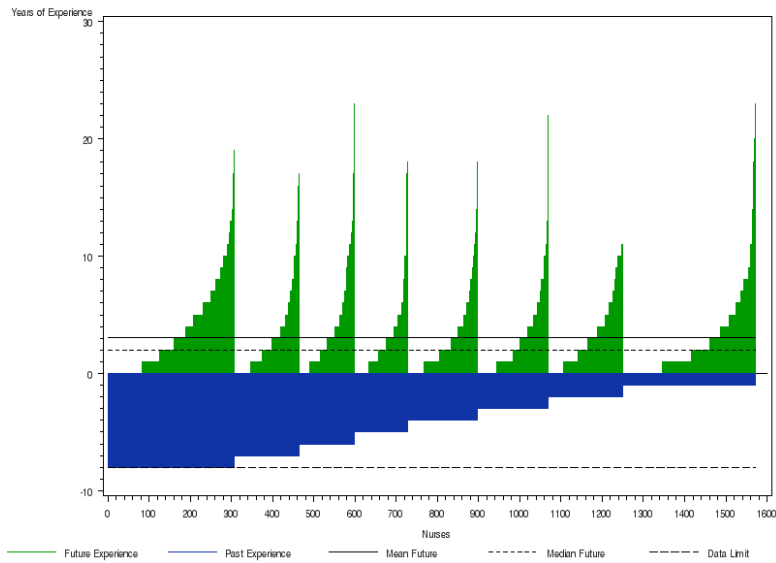
**Table 1: Inflows and outflows of critical care nurses (2009-2029)**

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2019	2023	2027	2031
Nurses		148	157	161	165	168	171	173	176	178	181	183	185	185
Exits	1478	4	2	2	8	8	4	8	4	7	9	9	5	3
New Entries	190	158	149	162	164	168	170	173	170	174	180	196	191	195
Returns	87	88	122	98	98	98	98	98	98	98	98	98	98	98
Inflow/	97	74	93	87	104	101	100	100	100	100	100	101	102	101
Outflow	-22	2	22	17	9	-1	-2	-2	-3	-1	-9	-5	-5	-7

The half-life within any subspecialty is shorter than within the general nursing workforce. For example, in critical care nursing the half life is two<sup>11</sup> years. This means that in two years time years time half the nurses in the current cohort of critical care nurses will have left. As training specific to critical care nursing begins on entry to the sub-specialty half of those who have had some specific training will have left. This does not take into account nurses who leave but later return to this workforce. If they are included, the rate at which they leave is even higher.

Conversely this also means that half of the current cohort of nurses will stay more than two years, although it is impossible to predict who will stay and who will leave. Some nurses are more likely to leave than others (for instance, nurses over 60, or nurses in their late 20s), but these differences only apply on average. In 20 years time the number of the current cohort of critical care nurses that will still be in the critical care nursing workforce is negligible (graph 16).

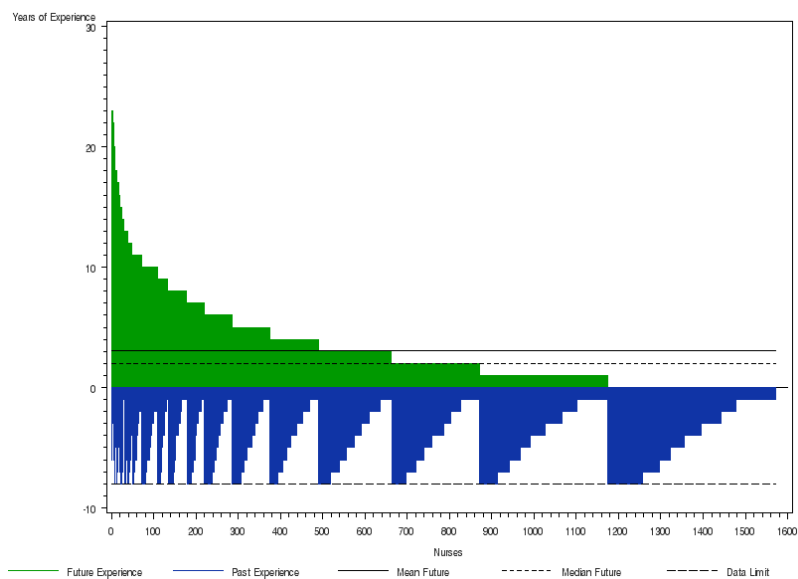
**Graph 13: Past experience of critical care nurses**



In the graph above, the past experience (in blue) of critical care nurses is emphasised. The vertical axis plots the years of past experience (shown as negative numbers). The horizontal axis charts the number of nurses with this much experience. As the numbers of the years of past experience increases the number (and proportion) of nurses with this much experience declines. The predicted future experience of each of these groups of nurses is shown for reference. Past experience is not thought to be a very good predictor of future experience or length of service.

In graph 17, below, the (predicted) future experience of critical care nurses, shown in green, is emphasised. As can be seen the number and proportion of nurses (horizontal axis) declines as years of experience (vertical axis) increases. Past experience of each group is shown in blue.

**Graph 14: Implications for critical care nursing in the future**



This implies that the number of nurses to be trained will be a lot higher than any increase in demand. For every extra nurse required in critical care nursing in two years time, approximately two need to be trained now.

Post graduate critical care specific education is crucial to the provision of optimal patient care in critical care nursing environments throughout New Zealand. Minimum guidelines for intensive care nurse staffing in New Zealand requires 50 percent of nursing staff to be qualified as critical care nurses as a minimum skill mix<sup>x</sup>. A nurse identified as 'competent' is not considered qualified as a critical care nurse. A Registered Nurse is considered qualified as a critical care nurse when they have completed a post registration/post graduate course specific to the sub-specialty and meets the New Zealand Standards for Critical Care Nursing Education, (2010)<sup>xi</sup>.

In order to maintain 50 percent of critical care nurses as qualified in the field as the minimum skill mix level (optimal is 75 percent), Critical Care Nurses Section, NZNO, 2005 suggests the need for financial assistance and study leave.

When recruited to the critical care nursing workforce for the first time, nurses need to undergo orientation and professional development programmes within their first two years of practice. Coupled with the clinical experience that comes from functioning within an intensive care environment, in-house training enables a degree of usefulness as a level II nurse. However, as technological procedures become more complex, level III and beyond nurses will require critical care post-graduate education to sustain skills currency in a changing work environment.

Considerable barriers exist to the provision and uptake of education for critical care nurses. These include:

- Level of inflow to critical care by nurses new to the area. Although these nurses are provided with orientation and PDRP programmes, there is a level of supervision required in practice on entry. This requires existing critical care nurses to be in a supervisory role. The more entries to the sub-specialty the greater the need for supervision. The more existing critical care nurses supervise new nurses, the less likely they are to fit study into their busy lives.
- Emphasis upon formal post graduate study when nurses new to the area need high level specific skills from experience and in-house study. As nurses have no prior exposure, considerable up-skilling is needed in the first two years.
- Expense. Nurses are less likely to do postgraduate study if they are not funded. Although funding may come from several sources, including Health Workforce New Zealand, employers, and scholarships, some nurses are left with little option but to pay for their own

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<sup>x</sup> New Zealand Nurses' Organisation (2005) Minimum guidelines for Intensive Care Nurse Staffing in New Zealand (2005).

<sup>xi</sup> New Zealand Nurses' Organisation 4<sup>th</sup> Ed. (2010). New Zealand Standards in Critical Care Nursing Education. Available at: <http://www.nzno.org.nz/LinkClick.aspx?fileticket=QnQx0NAFuW8%3D&tabid=73>

study. A question arises about whether subsequent increases in remuneration will be enough to outweigh the personal outlay.

- Backfill. The supply of nurses is insufficient to provide backfill for nurses to have leave to undertake postgraduate study
- Time release. Although tertiary education fees may be funded, nurses may not receive time compensation to complete the study.
- High proportion of part-time nurses. Half the nursing workforce in general works part time. Are part time nurses as likely to undertake postgraduate study as full time nurses?
- Distance to postgraduate courses that are offered in main urban areas, with compulsory on-campus attendance an issue.
- Existing heavy workloads that often include large on-call times over and above usual work hours for acute services may preclude choice to study.
- Capacity for tertiary educational facilities to provide courses. Most tertiary educators require a minimum number of nurses to establish a financially viable cohort for specific, sustainable education.
- Because critical care nurses work shifts, class times do not always match availability.

A major issue is the overall supply of new nurses to the workforce. In 2009, nurses entering from overseas outnumbered new graduates emerging from nursing schools in New Zealand<sup>xii</sup>. Operating in an environment of capped numbers for undergraduate study and rising demand for nursing services suggests that the gap between supply and demand will continue to widen as the population, including nurses, ages.

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<sup>xii</sup> Ministry of Health (2009), Current status of the national regulated nursing workforce. Available at [http://www.moh.govt.nz/moh.nsf/pagesmh/6795/\\$File/current-state-nursing.pdf](http://www.moh.govt.nz/moh.nsf/pagesmh/6795/$File/current-state-nursing.pdf)

## Cardio-thoracic demand

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*Future supply of cardio-thoracic nurses is contingent upon the demand for cardiothoracic surgery and Intensive Care (ICU)*

*Although the demand for cardio-thoracic surgery is estimated to grow by 50 percent by 2029, it is likely that the surgical procedures will become progressively less invasive over the same time period.*

*The demand for ICU hours for cardiothoracic patients grows by 49 percent over the same period.*

Although the Cardiac Surgery Service Development Working Group Report (2008) focuses upon improvement to provide for increasingly more timely cardiac intervention rates (reduced waiting and improved access), it does not provide for expected population based demand increases.

The demand for cardiac surgery has gradually increased as a result of increasing effectiveness, decreased mortality and increased patient benefit in patients of all age groups. In particular, improved surgical outcomes for the over 70s and onto those 80+ have seen a greater demand for cardiothoracic surgery than in the past (Ministry of Health, 2008).

The complexity and further technological development of cardiac surgery in order to achieve these outcomes has also increased. As the Cardiac Surgery Service Development Working Group Report (2008) points out “*the demands of cardiac surgery have exceeded the human and funding resources available in New Zealand*”<sup>xiii</sup> (p. 10)

Demand for coronary care nursing services has implications for intensive care service demand as the cardiac events needing coronary care admission are often the beginning of (or part of) a cardiac patient’s journey that may or may not lead to cardio-thoracic surgery requiring intensive care delivery.

Cardio-thoracic surgeries from coronary events include coronary artery bypass graft (CABG), heart valve surgery and a combination of CABG and heart valve surgery. CABG accounted for 9.3 percent of all admissions to ICUs in New Zealand in (2008). This is the largest diagnostic group of all ICU admissions. The third largest group were for heart valve surgery (four percent). Most patients in these two diagnostic groups will have had one or more coronary care admissions<sup>xiv</sup>. There is evidence that early cardiac intervention leads to a reduction in cardio-thoracic surgical demand. This means that

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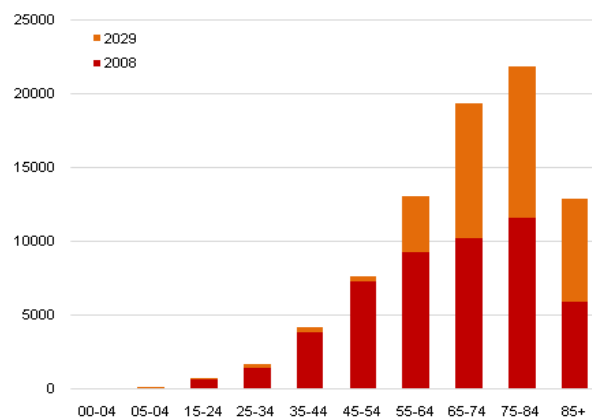
<sup>xiii</sup> Ministry of Health (2008) Cardiac surgery services in New Zealand. Cardiac Surgery Service Development Working Group Report. Available at: <http://www.moh.govt.nz/moh.nsf/0/6A0AF72DABC7C2C4CC2574DA00148D1E>

<sup>xiv</sup> Australian and New Zealand Intensive Care Society (2008). Centre for outcomes and resource evaluation - 2008 Annual Report. Available at: <http://www.anzics.com.au/core>

higher numbers of (and more successful) cardiac intervention at CCU level will reduce the cardio-thoracic nursing need at ICU level<sup>12</sup>.

The growth in demand for coronary care nursing service by 2029, based upon historical coronary events and population growth, is estimated to increase by 37.6 percent in the 55-64 year age band and 92 percent in the 65-74 age group. The greatest growth is estimated to occur in the 74-85 year age band at 103 percent, reducing to a 70 percent increase for the 85 + age group (graph 4).

**Graph 15: Growth in coronary care demand (2009-2029)**

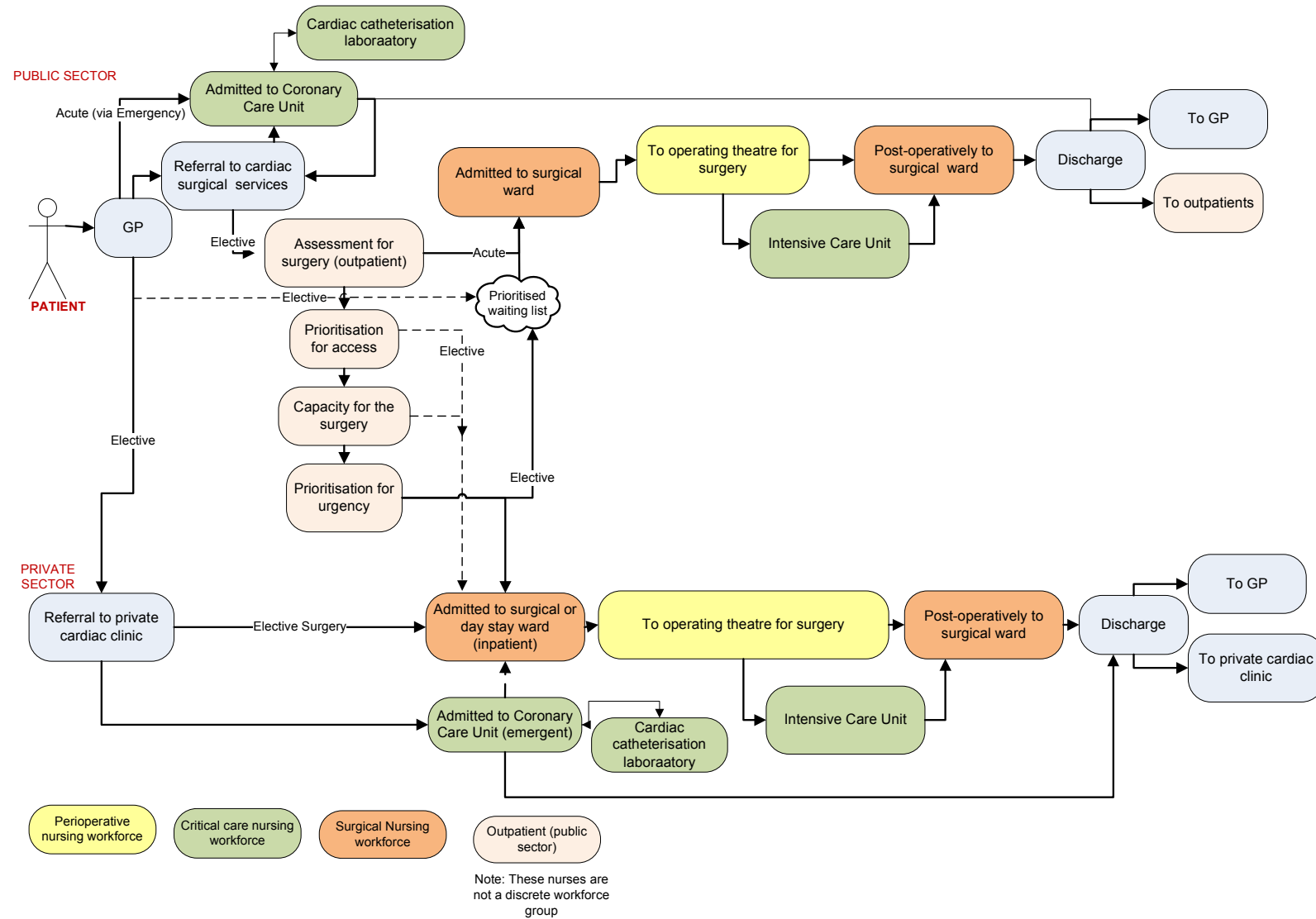


The demand for cardio-thoracic surgery (based upon coronary events) that will require ICU admission is also estimated to increase. Three quarters of cardio-thoracic patients are over 52 years. The median age of a public hospital inpatient that needs cardiothoracic surgery is 64. This is somewhat higher than the median age of patients undergoing surgery in general and a lot higher than the median age of the general population.

Figure two presents the cardiac patient journey. In particular this shows the relationship between coronary care and surgical services requiring ICU hours as a result of on-referral for cardio-thoracic surgery. In particular, this shows how patients admitted to a publicly funded CCU may have subsequent surgery in a private surgical hospital.

Patients admitted to a CCU require diagnostic procedures, in particular, angiography to determine cardiac intervention procedure need. Although angioplasty may be done simultaneously with angiography, this is not always the case. Often there is a waiting time for angiography and then between diagnosis and cardiac intervention performed in the cardiac catheterisation laboratory. The result of this is increased length of stay in CCUs. Anecdotally this time can be about two weeks.

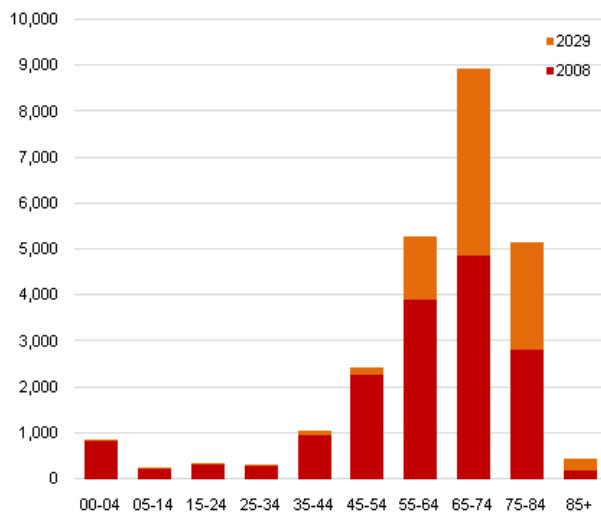
Figure 2: Cardiac patient journey



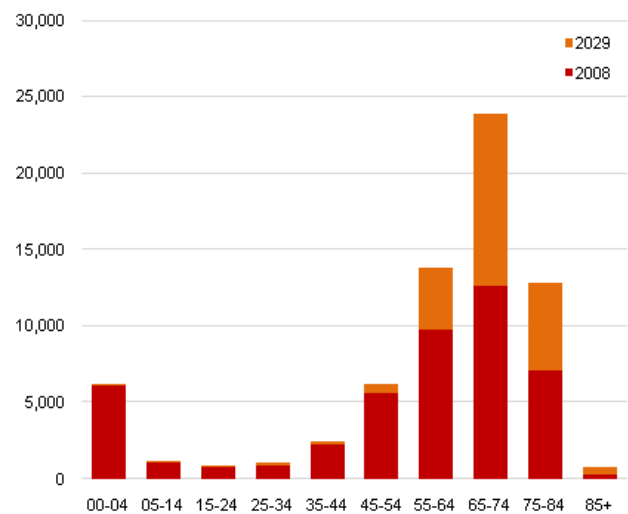
The growth in demand for cardio-thoracic surgery requiring intensive care services by patient events is similar to growth in ICU hours by age group demand (graphs 16 and 17).

Two differences stand out. The demand for those over 85 years is lower per event than other age groups whereas the demand for ICU hours as a result of cardio-thoracic surgery by the under five age group is high. This will remain relatively constant over time.

**Graph 16: Growth in cardiothoracic patient demand (weighted patient events)**

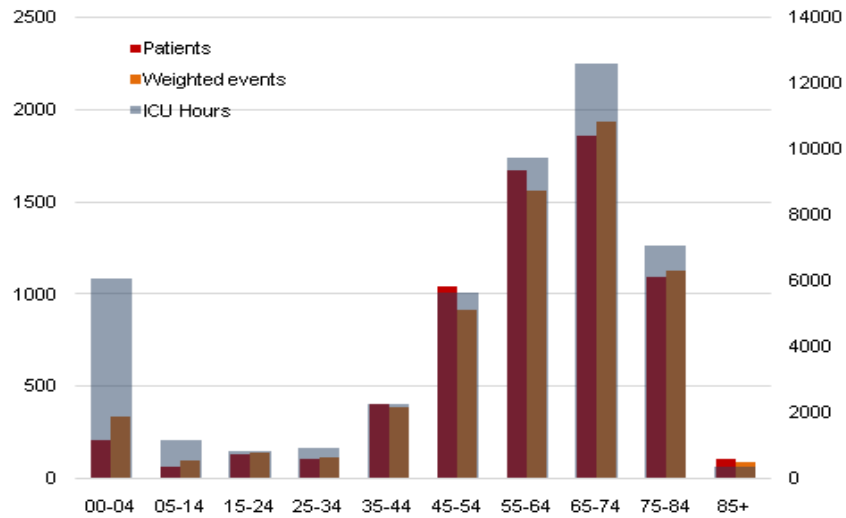


**Graph 17: Growth in cardiothoracic ICU Hours**



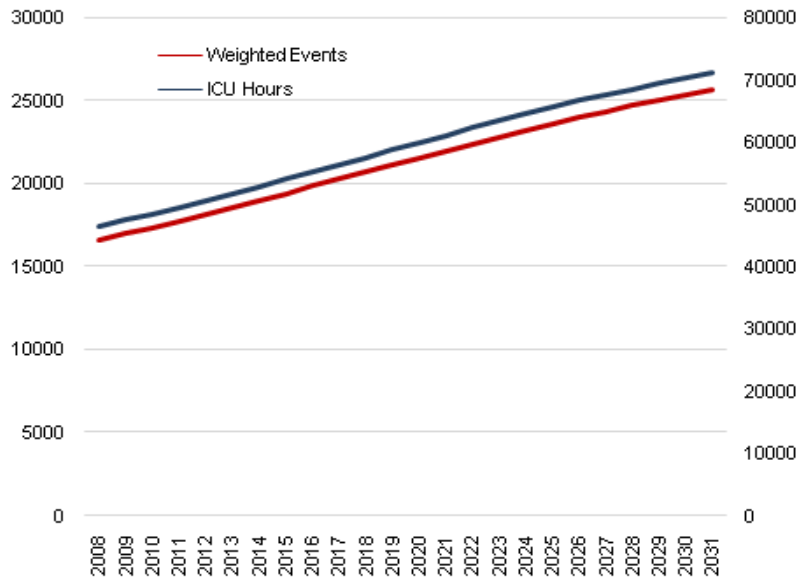
In graph 18 patients who are in ICU as a result of cardiothoracic surgical events are shown as they related to ICU hours according to age groups. This shows that the under five year old patients require many more ICU hours than any other cardio-thoracic event group. That is, the need for ICU hours by this group of cardio-thoracic patients (although fewer in number) require more ICU hours than the other groups combined. These children do not compete for beds within general ICU units. Dedicated paediatric intensive care units with a discrete paediatric critical care nursing workforce are available at tertiary hospital level.

**Graph 18: Cardiothoracic patient events and ICU hours (2008).**



Demand for cardiothoracic surgery grows by 50 percent by 2029, while demand for ICU hours for cardiothoracic patients grows by 49 percent (graph 19).

**Graph 19: Demand for cardiothoracic surgery and ICU hours 2008 - 2029**

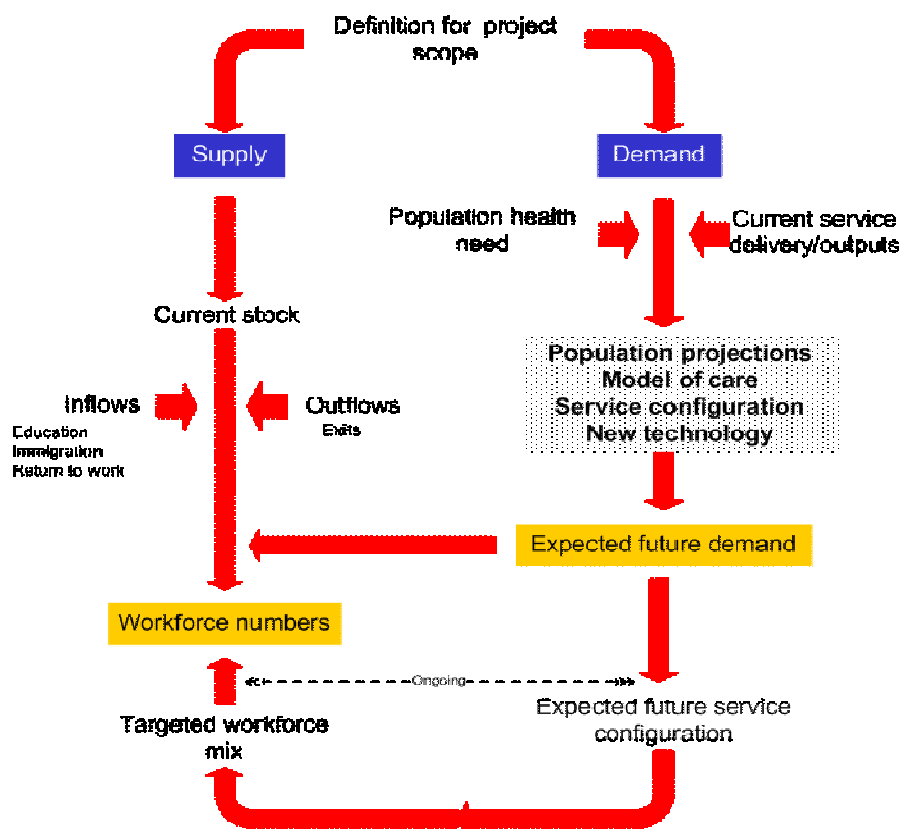


However, CABG and heart valve surgery are becoming less invasive procedures due to technological developments (such as keyhole surgery). One day cardio-thoracic surgery for these events may be a thing of the past. This would reduce ICU hours for cardio-thoracic surgical patients but increase CCU hours for less invasive procedures such as PCI.

## Methodology

The critical care nursing forecasted model has been developed from the HWIP Forecasting framework (figure 2). The HWIP- Forecasting framework is a type of supply - demand framework and is based on a number of assumptions from the compilation of scenarios about likely circumstances. The model predicts 20 years into the future consistent with the Ministry of Health population prediction data.

**Figure 3: HWIP Forecasting Framework (simplified)**



Using the HWIP-Forecasting Framework, the first step in forecasting model development is to define and decide on the scope the workforce group for analysis. Thereafter in basic terms the model has two main components – supply and demand.

### Supply methodology

Supply of nurses is the headcount plus net inflow (inflow less outflow) calculated iteratively. More than one inflow scenario is calculated based on past inflows and alternately on graduation and immigration.

Inflows are allocated to workforce areas (employer and occupation) in proportion to past data, while outflow is a proportion of the existing workforce, based on known numbers of exits in previous years, and taking into account age, gender, ethnicity and occupation. The proportion of nurses that will return to the workforce is estimated from past data, and this estimate is added to the inflow.

The four entry and exit models are based on binary logistic (regression) models (for a further discussion about logistic regression models refer to the supplementary document about technical methodology). The interflow models are a mix of logistic regression and simple averages. As with other workforce areas the inflow of critical care nurses will be exogenous. The supply is taken from a separate forecast of the total number of new nurses and the model is used to apportion nurses to various work areas (refer to the supplementary document for the technical report of this analysis). The exit model takes into account exits, re-entries and transitions between work areas and is an endogenous model – dependent on the current nursing workforce.

For any constant inflow of nurses, a long-run equilibrium number of nurses can be predicted and compared with a demand model. Long-term growth rates for inflow models that feature constantly increasing inflows (for example models based on a proportion of the population) can also be predicted.

## **Demand methodology**

Demand indicators for analysis include:

- Population growth projections further determined by age, gender, and ethnicity
- Historical, current and future changes to the way surgical services are configured
- Anticipated changes to the way critical care nursing is offered as models for critical care nursing care delivery
- The impact of current and emerging technologies

Analysis of these supply and demand factors, including trend analyses, leads to estimates of predicted workforce numbers and patterns.

Future demand considerations applied to current demand and production models lead to predicted future workforce needs. When compared with a workforce supply baseline, estimates of future shortfalls or over-supply can be obtained and training and recruitment plans made accordingly.

Factors related to patients requiring critical care nursing services in the public sector are extracted from national minimum data set (NMDS) data, using a set of Diagnostic Related Grouping (DRG) codes that have been determined to involve critical care nurses.

Demand measures concerning patients who require critical care nursing services from private surgical hospitals are extracted from Private Surgical Hospital Association statistics concerning annual total surgical procedures completed.

Each population group within this NMDS population has a growth rate applied which is taken from sub-national population forecasts, allowing forecast of demand for critical care nursing services.

## Demand Scenarios

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### 1. Outsourcing elective surgical events and implications for the critical care nursing workforces

#### *Assumptions:*

- critical care units (ICU and CCU) are becoming a reality in the private sector, which will enable greater numbers of cardio-thoracic, neurosurgical and cardiology intervention procedures to be performed in the private sector
- subsequently there will be a flow of critical care nurses from the public sector to the private sector
- cardiology intervention procedures increased by 15 percent in the private sector in 2008
- critical care skill acquisition has historically been undertaken by experience and education in the public sector
- private hospitals may now contract with DHB for publically funded elective surgeries
- the overall demand for critical care nurses is expected to double over the forecast period

#### *Managing the demand*

Demand for elective surgery is growing rapidly in New Zealand as the populating ages and life spans increase. It accounts for the use of two thirds of public sector surgical resources<sup>xiii</sup>. Based on demographic growth alone, and without considering the impact of improving intervention rates or other changes in practice, public sector elective surgery is forecast to grow by 38 percent by 2030<sup>xiv</sup>.

Maintaining public sector surgical services, including nursing services, at their current level could be done by concentrating on meeting the increasing demand for acute surgery (which will grow by 36 percent in the same period). As demand for acute surgery grows, overall demand on resources could be managed by outsourcing an increasingly large proportion of elective procedures. Under this scenario the size of the public sector perioperative and critical care nursing workforces would remain static, while the private sector would grow.

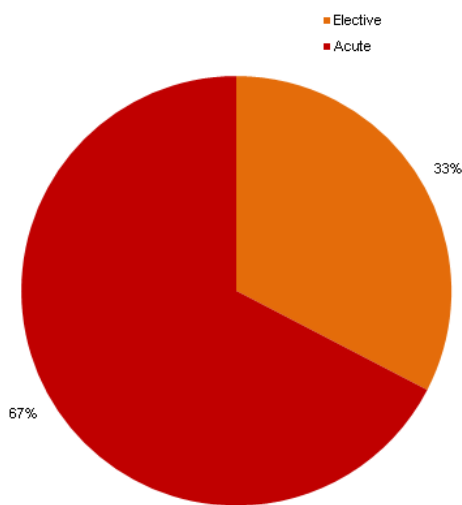
To hold the volume of surgery constant, elective surgery in the public sector would have to decrease by nearly 18 percent (from two thirds of all procedures now, to 56 percent of procedures by 2030, while private sector surgical services would nearly double in the same period to meet the increased demand.

#### *Implications for Critical Care*

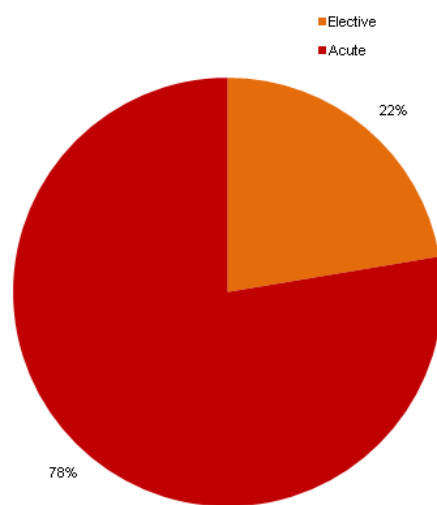
Acute surgical patients stay on average 5.5 times as long in intensive care as elective patients<sup>xv</sup> (2.9 hours, compared to an average of just half an hour for elective patients). Because of this large discrepancy in demand for intensive care services, outsourcing elective surgery to the private sector will have a smaller impact on public sector intensive care nursing.

Reducing the demand for elective surgery, as outlined above, has a smaller effect on intensive care nursing than on perioperative nursing. Elective surgery patients account for one third of hours spent in intensive care. Reducing elective surgery would reduce this share to 22 percent. The reduction in nurses needed for elective surgery patients would, however, be more than offset by the increase in demand from acute patients. The public sector critical care<sup>xvi</sup> nursing workforce would still need to grow 20 percent to meet demand by 2030.

**Graph 20: Estimated Public Sector Acute and Elective Mix - 2010**



**Graph 21: Hypothetical Public Sector Acute and Elective Mix - 2030**



The impact on the private sector is much more dramatic. Currently the private sector employs far fewer critical care nurses than the public sector – about six percent of the total critical care workforce. To care for the needs of the inflow of elective surgery patients will take fewer intensive care nurses than perioperative nurses in absolute terms (fewer than 25 nurses each year), but the rate of growth is much higher. The private sector intensive care workforce would need to grow more than four fold (a net gain of more than 380 nurses) to meet the extra demand<sup>xvii</sup>. The growth in the private sector workforce (320 nurses) would be similar to that of the public sector.

By 2030 the size of the private sector intensive care workforce would be around one quarter of the total critical care workforce. As with perioperative nursing, this has implications for training and recruitment for both the public and private sector. Increasing the number of private sector nurses by 380 nurses, while the demand from the public sector is also increasing, negates the possibility of simply recruiting from the existing pool of nurses. Turnover in the workforce means very few nurses recruited now will still be in the critical care workforce in 20 years time. Most of the critical care workforce needed in 2030, (more than 2260 nurses) will have been trained during the next 20 years.

## **2. Redundancy of cardio-thoracic procedures necessitating ICU post operative hours**

### ***Assumptions***

- Cardio-thoracic surgical patients uses ICU hours post-operatively
- The cardio-thoracic surgical procedures of CABG, heart valve and combinations are progressively becoming less invasive
- The emergence of cardiac interventions such as PCI should reduce need for CABG, heart valve and combination surgery
- In the future CABG and heart valve surgical procedures may not require cardio-thoracic surgery

The reduction of need for cardio thoracic surgery would reduce the ICU bed hours for these events. However it would not reduce demand for CABG and heart valve surgery as less invasive nature of the surgery would mean that the procedures would be carried out elsewhere, such as in a cardiac catheterisation laboratory. The domino effect of this would be an increase in demand for nurses in CCUs despite the demand reduction in ICUs. As CCU and ICU nurses are part of the same workforce, (critical care nursing), the need would be for more CCU nurses so that throughput can be increased. One increase may negate the other reduction.

## **3. Reconfiguration of the nursing workforce to meet increasing demand**

### ***Assumptions***

Expanded scopes of Registered Nurse practice and the review/redevelopment of an Enrolled Nurse pathway suggests that as the Registered Nurse scope of practice expands to include higher level critical care nursing skills, some of the support roles will be undertaken by Enrolled Nurses and other emerging occupational groupings such as critical care nurse assistants and anaesthetic technicians.

The Expert Advisory group considered this scenario and felt that the current scope of practice for Enrolled Nurses did not include a skill level or capacity for delegated orders to be sufficient for Enrolled Nurse participation in critical care units in the patient care encounter.

Emerging health occupational groups were directed more at medical care than critical care bedside nursing. Support personnel such as health assistants were already completing tasks such as supplies inventory, maintaining adequate linen and equipment levels but were not able to assist with bedside care due to the severity of patient conditions.

## Conclusion

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Critical care nurses consistently provide care for the most severely ill patients, whether within an ICU or CCU. To do so requires a high level of knowledge and skill in keeping with the highly technological environment in a society with increasing expectations of health intervention. Coupled with an aging population, greater morbidity of chronic disease and more people developing more than one pre-existing condition is expected to affect critical care service demand in the future. The demand for critical care nursing is estimated to double over the next 20 years while expected growth in the supply of critical care nurses will be gradual, with little change after 2018.

Although technological advancement may see the end of some cardio-thoracic procedures, this will shift the critical care nursing demand from ICU to CCU. Likewise, patients requiring critical care are likely to be older, sicker, and require more time in hospital.

Nurses entering this specialist nursing workforce for the first time do so with little if any prior exposure. Much of the first two to three years of nursing experience in critical care is aligned with high level skill acquisition appropriate to the area of practice. About 35 percent of the critical care nurse cohort (2009) has been in critical care nursing less than three years.

This sub-specialty group of nurses has a high need for education. On-the-job in-house training which may or may not be associated with orientation programmes is required to provide and sustain a safe and effective critical care nursing workforce. Much of this first up-skilling beyond the skill level of surgical, medical and primary care nursing is in the domain of the employer. More formal education by way of post graduate study is also required so that at least 50 percent of the workforce has a knowledge base that can be referred to as 'qualified' in the area. Given that post graduate certificate completion takes nurses two years, the study load for nurses entering critical care is high.

Given that the private sector of health care is now developing critical care units for elective post-operative and cardiac intervention procedures a greater proportion of the critical care nursing workforce than previously will be within the private sector. The nurses who enter critical care nursing in the private sector will require the same skill acquisition to provide safe and effective care as their public sector counterparts. There is likely to be a flow from public sector to private sector from within the workforce, which means that already trained critical care nurses from within the public sector nurses will leave and a gap for nurses entering critical care nursing for the first time will be created.

## Appendices

### Appendix I – The team

#### *Background of Health Workforce Information Programme (HWIP) - Forecasting*

This forecasting report is part of a suite of nursing sub-specialities projections. The overall project is a national initiative comprising a series of forecasting and workforce modelling exercises on the nursing workforce in New Zealand. The project has developed in response to the widespread need to understand nursing workforce demand, supply and training requirements. This project will help us understand our national nursing workforce picture now and into the future.

The objectives of the programme are:

- To provide a global view of the current status of the nursing workforce.
- To produce nursing workforce projections based on differing scenarios to inform workforce planning and training decisions.
- To improve the quality of nursing workforce information within the Ministry of Health and the health and disability sector.
- To provide a platform to improve the capability of the Ministry of Health and the health and disability sector to undertake nursing workforce planning and funding allocation.

The projections will underpin future planning, as accurate workforce information is fundamental to the effective management and planning of health and disability services. It is also essential to adequately plan for undergraduate, post-graduate and post-entry clinical training.

The programme is part of the Future Workforce Nursing strategy initiatives and has been commissioned by Health Workforce New Zealand (HWNZ). Initial work involved setting up a Stakeholder Reference Group that oversaw the development of the Current Status of the Regulated Nursing Workforce document. Each sub-specialty that is to be forecasted has an Expert Advisory Group (EAG), with a member who liaises between the stakeholders' reference group and the particular EAG.

#### *Future Workforce Nursing Strategy Group*

Jim Green	Lead CEO, Nursing and Midwifery WSG, Chief Executive Officer (CEO) Tairāwhiti District Health Board (DHB)
Chiquita Hansen	Director of Nursing, Primary Healthcare, MidCentral DHB
Glenda Alexander	Council of Trade Unions representative
Heather Casey	Director of Nursing, Mental Health, Otago DHB
Helen Pocknall	Director of Nursing and Midwifery, Wairarapa DHB
Jan Adams	Chief Operating Officer, Waikato DHB
Kevin McFadgen	Employment Relations Specialist, District Health Boards New Zealand (DHBNZ)
Liz Manning	Project Manager, Future Workforce, DHBNZ

Lynne Collier	Clinical Services Manager, Well Dunedin Primary Health Organisation (PHO)
Marilyn Rimmer	Manager, Future Workforce, DHBNZ
Christine Andrews	Acting Chief Nurse, Ministry of Health
Mary Gordon	Executive Director of Nursing and Midwifery, Canterbury DHB
Suzanne Rolls	Professional Nursing Advisor, New Zealand Nurses Organisation (NZNO)

### ***Stakeholder Reference Group***

Andrea McCance	Registrations Manager, Nursing Council of New Zealand
Andrew Potts	General Manager, Adult Health Services, Waitemata DHB
Anna Schofield	Nursing Leadership Manager, Te Pou
Daria Martin	Portfolio Manager, HWNZ (formerly Clinical Training Agency)
Heather Baker	Senior Lecturer, Nursing School of Nursing, University of Auckland
Jane O'Malley	Director of Nursing and Midwifery, West Coast DHB
Jocelyn Peach	Director of Nursing and Midwifery, Waitemata DHB
Karolyn Kerr	Project Manager, HWIP
Liz Manning	Project Manager, Future Workforce, DHBNZ
Maree Cassidy	Clinical Services Manager and Professional Nurse Advisor, Mercy Ascot Hospital
Maria Baker	Maori Workforce Champion Group
Mark Jones	Chief Nurse, Ministry of Health
Shona Wilson	Advisor, HWIP
Vicky Noble	Director of Nursing, Primary Health Care, Capital and Coast DHB

### ***Expert Advisory Group (EAG) – Critical Care***

Alison Pirret	Nurse Practitioner, Critical Care Complex, Middlemore Hospital
Anna Macgregor	Nurse Unit Manager, Cardiothoracic & Vascular ICU/HDU, Level 4, Auckland City Hospital
Annie Morley	Clinical Nurse Manager, Intensive and Coronary Care units, Rotorua Hospital, Lakes DHB. Chairperson of the Critical Care Nurses Section NZNO
Kate Te Pou	ICU/CCU, Waikato Hospital, Secretary – Critical Care Nurses Section, NZNO
Liz Manning	Project Manager – Workforce, DHBNZ
Nicola Gini	Nurse Manager, Paediatric Intensive Care Unit, Starship Children's Health, Auckland District Health Board
Steve Kirby	Steve Kirby. Clinical Charge Nurse, MercyAscot Hospitals

## Appendix II - Data Sources

### *Nursing Council Registration, Annual Practising Certificate and survey database*

A workforce questionnaire accompanies the Annual Practising Certificate (APC) application form sent by the Nursing Council of New Zealand (NCNZ) each year to nurses who are on the register of nurses and who need to update their APC to remain active. The APC workforce survey elicits individual data on a self reporting basis. This provides statistical information about the regulated nursing workforce. As the bulk of the nursing workforce information is within this NCNZ database, this was the major source for analysis. Mercury Project Limited, Wellington, has been recently commissioned by the NCNZ to redesign and implement a contemporary database management system for the nursing registration, annual survey, and APC processes. A copy of the NCNZ database of aggregated and anonymous data was supplied by Mercury Project Limited with permission from the NCNZ for analysis in this project. A contractual arrangement between HWIP and the NCNZ ensured security and anonymity of any data supplied to HWIP.

The NCNZ data collection is based on nurses' individual opinions with regard to their own working situation at the time of APC application using forced choice questions. The quality of the data relies upon the accuracy with which nurses report their situations and the nature of the survey form. In particular with regard to measurement of critical care nurses:

- the survey form does not supply term definitions to support categorisation of practice areas (e.g. the categories that are used to describe nurses' practice offer selections of terms for different areas of nursing practice, but do not define the meaning and scope of each term)

The NCNZ data is the primary data source for the supply estimates for nurses, the NCNZ data records data for over 40,000 individual nurses from 2001 through to the present. This dataset enables the calculation of the influence on entry and exit rates for variables such as age, gender, and ethnicity

## Appendix III - Data cleansing, integrity and business rules

Where there is more than one questionnaire record for a nurse for a year, only the record with the latest questionnaire data was kept. This removed 27 duplicate questionnaire records (over all years).

Where there was more than one set of records for a nurse's employment, the set of records with the latest (highest) unique identifier was kept. Seventy two records were removed in this way. Note: There are multiple records for each nurse, as a nurse may have more than one workplace.

To be included in the definition the nurse must work more than zero hours in their primary employment and this work must not be coded as midwifery (survey codes 31-36) or non-nursing employment, such as work in another health profession (survey codes 71-74). Removing nurses working zero hours or not working in nursing removes another 4633 nurses leaving 41,648 working in nursing (out of 46,281). Note: Nurses working in education, research and nurse management roles are included.

Of the 41,648 nurses working in nursing, 1032 are working overseas<sup>15</sup>. They are excluded from most of this analysis, leaving 40,616 nurses working in nursing in New Zealand.

To simplify analysis a small number of nurses with a missing gender have been recoded as female.

Estimates are made using the nurses' primary employment situation.

The analyses are supported by a supplementary technical report of the general nursing workforce. This will be available online at the conclusion of the forecast modelling project or by request from HWIP.

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<sup>15</sup> Health Workforce New Zealand (2009) Current status of the regulated nursing workforce. Available at: [http://www.moh.govt.nz/moh.nsf/pagesmh/6795/\\$File/current-state-nursing.pdf](http://www.moh.govt.nz/moh.nsf/pagesmh/6795/$File/current-state-nursing.pdf)

## NOTES

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<sup>1</sup> Although some private hospitals are now offering coronary care services numbers and information about the conditions that are treated within these units is lacking.

<sup>2</sup> Technological development in surgery is evolving quite rapidly, resulting in more complex procedures, which may result in higher risk, more invasive surgical procedures in the future. Conversely some surgical procedures are becoming less invasive as new techniques are developed, such as robotic surgery in urology and gynaecology.

<sup>3</sup> Critical care assistants as support assistants for Registered Nurses have been trialled in the United Kingdom

<sup>4</sup> 'New' nurses are nurses entering into critical care nursing for the first time – new graduates and nurses from other fields of nursing.

<sup>5</sup> The skills mix for critical care units is fully described in the Minimum Guidelines for Intensive Care Nurse Staffing in New Zealand, (NZNO, 2005).

<sup>6</sup> The Health Practitioners Competency Assurance Act 2003 requires the Nursing Council of New Zealand ('the Council') to ensure the ongoing competence of practitioners. The Council approves professional development and recognition programmes as recertification programmes under section 41 of the Act for the purpose of ensuring nurses are competent to practise. Continuing competence requirements for all nurses were introduced as part of the practising certificate renewal process in September 2004. The *Framework and standards for approval of professional recognition programmes* (2003) were developed to establish standards for programmes to meet the Council's requirements for competence-based practising certificates. The document was updated in March 2005 to reflect the continuing competence requirements introduced in September 2004. The Council acknowledges that many nurses demonstrate competence through professional development and recognition programmes developed by employers or professional organisations (NCNZ, 2009 p.2.)

<sup>7</sup> Throughout the first year of the post-graduate nursing programme, CTA gathered the clinical services area areas for each trainee. However, there was no classification system for the DHBs to select from. This was not a good process for later analysis. As a result a classification scheme was developed and has been used from 2008 going forward.

<sup>8</sup> The term 'current cohort' here is used to refer to all the nurses in the workforce this year. This cohort will always shrink (other nurses will enter the workforce, but they form part of future current cohorts). This differs from the concept of a generational cohort, which would all the nurses recruited in a particular year, or an age cohort (all the nurses of a particular age).

<sup>9</sup> The behavior of the workforce is similar enough for the terminology to be useful, but unlike other areas where the term half-life is used, the exits of nurses from the workforce are not random, nor do they occur at a constant rate, and the decline in the workforce does not exactly fit an exponential decay curve. Note also that the historical distribution is not the same as the future distribution. The median experience of the existing workforce tends to be slightly longer than the median future career length of the same workforce.

<sup>10</sup> The mean is higher than the median, with a relatively small number of very experienced nurses, and a large number of very short-term nurses skewing the distribution.

<sup>11</sup> NCNZ data is only available in discrete years, and our estimates can only be accurate to within 1 year

<sup>12</sup> Percutaneous coronary intervention (PCI), is a cardiac intervention that is a lesser invasive procedure and does not require ICU admission. PCI may prevent patients going on to CABG. However patients undergoing PCI must have ICU facilities available.

<sup>xiii</sup> Estimates of the "volume" of surgery are based on 2009 inpatient events from the national minimum dataset. A subset set patient events that are admitted under DRG codes that typically involve non-minor surgery are counted as "surgical" events. Rather than using a simple count of events (which would not take any account of the complexity of surgery), or using the full case weight (which includes possibly lengthy recovery in critical care and/or in a ward) the same day inlier weight (regardless of whether this weight is ever applied to an event) is used. This weight, which is technically only applicable to events lasting one day, is a compromise between ignoring complexity completely and using the full inlier event weight. Use of the same day weight rather than a count of patient events lowers the ratio of elective to acute: acute events are on average more complex and costly in the first day. The full case weight gives an even lower loading to elective events, implying (on average) a longer and more expensive recovery period, including extended time in ICU for acute events.

Better measures of the true volume and weight of surgery would take account of multiple procedures that might occur during a patient event. Ideally the weighting should be based on information on theatre time, staff time (particularly, in

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this case nursing time) and other costs. Such information is not readily available, and assembling it is beyond the scope of this work. Estimates of the volume and growth in volume of surgery should be seen as indicative, rather than exact measures of cost, resource use, etc.

<sup>xiv</sup> Demographic projections calculate growth in “estimation cells” that are defined by age group, gender and prioritized ethnicity, based on Statistics New Zealand population projections. Surgical events, grouped into the same cells based on patient details, are “projected” by these demographic growth estimates. Implicitly they use a constant “intervention rate” for surgery; they do not take into account other trends, with causes other than population growth, such as technology and public policy.

<sup>xv</sup> This is partly because many elective patients do not need intensive care at all.

<sup>xvi</sup> Nursing council data combines intensive and coronary care nurses into a critical care category and we are unable to separately estimate the size of the two workforces. The impact of outsourcing on the two areas would depend on exactly how the outsourcing proceeded. Obviously outsourcing orthopaedic surgery would have no impact on coronary care units.

<sup>xvii</sup> This assumes that the intensive care needs of patients treated in the private sector, even patients with serious complications, are met in the private sector. Anecdotal evidence suggests that many patients with serious complications after surgery are referred back to the public sector. If this practice continued the increase in the number of critical care nurses needed in the private sector would be lessened, at the expense of the public sector.