Auckland Critical Care Strategy 2020-2030

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Prepared By:	EY	
Input Provided By:	John Beca, Director Starship Surgical, SCD PICU Gillian Bishop, SCD DCCM Andrew McKee, SCD CVICU Mariam Buksh, SCD NICU Nic Gini, NUM PICU Janine Rouse, NUM DCCM Ana Gluyas, NUM CVICU Amelia Condell, ANUM CVICU Dale Garton, NUM NICU Sam Titchener, GM Cardiac Barry Snow, Director Adult Medicine Arend Merrie, Director Adult Surgical Jenny McDougall, SCD Obstetrics Jason Waugh, SCD Maternal-Fetal Medicine	
Received By:	Jo Gibbs, Director Provider Services John Beca, SCD PICU Gillian Bishop, SCD DCCM Emma Maddren, GM Child Health Katie Quinney, Nurse Director Adult Surgical Vanessa Beavis, Director Perioperative Mark Edwards, Director Quality and Safety David Vial, Finance Manager Tim Denison, Director Performance Improvement	
Endorsed By:	Auckland DHB Executive Leadership Team	**Date:** 3rd December 2019
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Executive summary

1.1 Overview

Auckland District Health Board ('ADHB') provides care for its resident population and has a regional and national role providing tertiary and quaternary care at Auckland City Hospital ('ACH') and Starship Children's Hospital ('Starship').

As a member of the Northern Region, ADHB collaborated with Counties Manukau, Northland and Waitemata DHBs to develop the Northern Region Long Term Investment Plan (NRLTIP). The NRLTIP sets the direction for future investment in the Region to meet and manage demand for health services over the next twenty years. For ADHB, the NRLTIP signalled that ACH and Starship will continue to deepen their roles as specialist providers for patients with the most complex clinical needs - regionally and nationally.

Demand for services at ACH and Starship has been increasing and is projected to continue to grow over the next twenty years. Demand is being driven by population growth, population ageing, and changes in service delivery. Improving health outcomes from tertiary and quaternary care are also driving demand for specialist care.

Critical care services are enablers of a range of specialist services provided by ADHB. Critical care services include intensive and high dependency care for adults, children and neonates. When demand for critical care is greater than capacity, it leads to deferral of planned care and disrupts hospital flow. It also causes disruption at other hospitals, where patients awaiting transfer to ACH / Starship are required to wait longer. Enabling the right scope and mix of critical care services at ADHB is therefore crucial for meeting local, regional and national responsibilities.

The COVID-19 pandemic has reinforced the need to have a resilient critical care sector, able to manage significant surges in demand, without unduly compromising patient and workforce safety. It has also highlighted the need to better understand equity of access to complex care for vulnerable populations, and their experience of care.

In response to growing demand and changing service delivery patterns, ADHB has developed this Critical Care Strategy ('the Strategy') to support prioritisation of capacity and capability development over the next 10 years. Priorities were identified based on projected demand growth, possible efficiency improvements, and potential model of care changes (including workforce, diagnostic and treatment modalities, and care settings).

1.2 Development of the Critical Care Strategy

The Strategy has been developed to provide:

- a long-term strategic direction for critical care services provided by ADHB
- a work programme to enable delivery on the Strategy, with a focus on actions from 2020 to 2025.

Three paramount goals framed Strategy development:

- Enhancing patient, family and whānau-centred care in the context of critical care services to improve outcomes;
- Achieving the Quadruple Aim (population health and equity; patient experience; effective use of resources; staff learning and development) in the context of critical care services; and,
- Achieving ongoing clinical, operational and financial sustainability of critical care services, with consideration of the sustainability of interdependent services.

Strategy development has been clinically-led, data and evidence-driven, and informed by wider service and capacity planning within the Northern Region and nationally given ADHB's tertiary / quaternary provider role. It has considered drivers of demand, workforce requirements to sustainably meet patient needs, and likely evolution of models of critical care and use of technology.

1.3 Auckland DHB's critical care services

Auckland DHB has four critical care units at Auckland City Hospital and Starship Children's Hospital

Hospital inpatients require care across a spectrum of illness and acuity (level of nursing resource required). Critical care units provide care to those who are critically unwell, usually needing advanced monitoring and organ support, and who are also generally of high acuity.

Critical care units include Intensive Care and High Dependency Care. Intensive care is provided for patients who need intensive support for organ failure (commonly respiratory support and often other organ support), while high dependency is provided for those who need less organ support but still require invasive monitoring and high-acuity nursing care. Given the nature of care provided, admission criteria take in to account the burdens of treatment and likely outcomes.

Four critical care units provide critical care services at ADHB: the Department of Critical Care Medicine (DCCM; general adult ICU) and the Cardiothoracic and Vascular Intensive Care Unit (CVICU; adult cardiothoracic and vascular ICU) at ACH; the Paediatric Intensive Care Unit (PICU) and Neonatal Intensive Care Unit (NICU) at Starship. These services are provided for the populations of ADHB, the Northern Region and New Zealand. Table 1 summarises the roles and configurations of each unit at ADHB.

Table 1: Critical care units and their configuration in ADHB

Units	Directorate	Location at Auckland DHB	Co-located services	Physical beds	Resourced beds (2018)
CVICU	Cardiovascular	ACH Level 4	Level 4 operating rooms (ORs) and post-anaesthetic care unit (PACU), Cardiac and Vascular wards, Cath Lab and Cardiology wards on Level 3	26	16 ICU 6 HDU 22 Total
DCCM	Adult Medicine	ACH Level 8	Level 8 ORs and PACU, Neurology and Neurosurgery wards, General Surgery wards and Maternity delivery on neighbouring floors	24	11 ICU 6 HDU 17 Total
PICU	Child Health	Starship Level 2	Children's emergency department (ED), near to Starship ORs and PACU	22	16 ICU 6 HDU 22 Total
NICU	Child Health	ACH Level 9	Maternity delivery, postnatal wards, Level 8 ORs on floor below	46	40

Auckland DHB hospital services have experienced sustained increases in demand for care

Demand growth for ADHB's hospital services has been increasing over the past several years. This has placed significant pressure on most services at the DHB. For example, inpatient discharges from ACH and Starship grew by 5.5% over the past five years to 144,000 per annum. Reduction in average hospital length of stay has offset some of the impact on bed capacity needs. However, bed occupancy often exceeds best practice standards (e.g., 90% or less for adult inpatients).

Demand is expected to continue to grow, with severe shortfalls projected in inpatient acute beds over the next twenty years. Physical capacity shortages are also projected in operating and interventional rooms, diagnostic suites, cancer care and critical care. Projections undertaken as part of ADHB's Building For The Future (BFTF) programme suggest that at current activity levels, ADHB will require approximately 373 additional resourced beds and associated infrastructure and support by 2031/32. Assuming some efficiency gains (compared to current practice), 114 fewer beds will be required (i.e., 259[1] additional resourced beds required by 2031/32). Additional inpatient beds will need to be supported by a commensurate increase in operating and interventional rooms, imaging services and other support services.

Critical care capacity at Auckland City Hospital and Starship Children's Hospital is under pressure

Reflecting overall demand growth at ADHB, critical care capacity at ACH and Starship is under pressure, with extreme demand experienced over the first two months of 2019/20 in NICU and PICU. A combination of factors is driving demand for critical care services. These include demographic changes, national access priorities, regional service changes, changing clinical practices, and wider capacity pressures within each hospital and across the Region.

Over the past five years, demand growth has meant critical care units at ADHB have increasingly been operating at close to or full resourced capacity (on some days exceeding this capacity) (see Figure 1). Demand growth is not expected to ease, and will likely intensify over coming years as the roles of ACH and Starship in the Northern Region and national tertiary service configuration deepens.

Given that access to critical care units is often required at short notice, the opportunity cost of maintaining the status quo will rise rapidly - if nothing changes, the pressure on critical care units will continue to mount; forcing increasing deferral of planned care, disruption of hospital flow, and exacerbation of regional capacity constraints.

[1] The NRLTIP modelling indicated 337 beds based on current activity levels. The revised modelling undertaken by ADHB has confirmed the increase required is approximately 259 beds, assuming mid-level efficiency gains.

Figure 1: Frequency of beds occupied at 10am over time (from top left to bottom right: CVICU, DCCM, PICU, NICU[2])
Source: ADHB, EY analysis

Having adequate critical care capacity available for both unplanned and planned admissions, particularly post-operatively for children and adults and post-delivery for neonates, is important to ensure that all patients receive optimal care. For most critical care patients there are no alternative settings of care where their needs can be safely and effectively met.

When critical care capacity is constrained, services react in different ways, including the early or premature discharge of patients already in the service, delayed admission of presenting patients, or cancellation of elective patients who are planned to be admitted after routine surgery. These actions impose risks on patients, compromise care quality, and can affect patient outcomes inside and outside of the critical care unit. As capacity has become strained at ACH and Starship undertaking these actions has been necessary to manage demand and patient flow through critical care.

Demand pressure on critical care needs to be considered in the context of New Zealand's relatively low number of critical care beds per capita

Compared to other jurisdictions, New Zealand has a relatively low number of critical care beds per capita.[3] This is a historic trend, with the gap per 100,000 people in New Zealand and Australia widening from 2.7 beds in 2000 to 3.8 beds in 2018 (Ministry of Health, 2001; ANZICS 2018), which is equivalent to 190 ICU beds (note New Zealand has a total of ~250 dedicated critical care beds – meaning for parity to be reached with Australia, the critical care bed base would need to increase by ~75%).[4] The lower number of critical care beds per capita in New Zealand means that patients admitted to this care tend to be more severely

[2] Note that NICU's resourced bed capacity was greater in 2010 than in 2018.

[3] Prin, M. and Wunsch, H. 2012. *International comparisons of intensive care: informing outcomes and improving standards*.

[4] New Zealand also has a relatively low proportion of critical care beds as a percentage of total hospital beds. For comparison: New Zealand 1.96%, UK 2.18%, Australia 2.22%, Denmark 3.12%, Sweden 3.30%, Canada 5.40%, and the US 9.23% (Prin & Wunsch, 2012). Note country definitions of "critical care beds" and "hospital beds" do differ - so these figures should be considered illustrative only.

unwell and of higher acuity than in other jurisdictions[5] (ANZICS, 2017). It also means that sicker patients are cared for on general wards than other jurisdictions with risks for both patients and staff – if not appropriately managed.

The Northern Region has the lowest per capita rate of critical care beds in New Zealand (Figure 2). In the context of continuing population growth, per capita bed rates will fall, likely putting New Zealand further out of step with rates observed in other jurisdictions. With faster population growth in the Northern Region than the rest of New Zealand, it would also mean the Region's rate of beds per capita would decrease further relative to other Regions (if bed capacity remains the same).

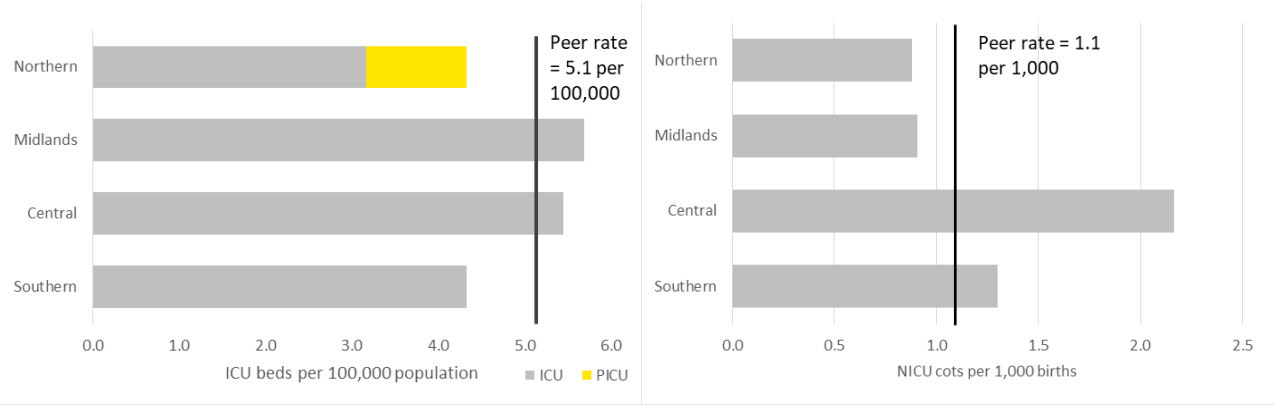

Figure 2: Adult and paediatric beds per capita, neonatal cots per birth, per DHB Region (2018)
Source: DHBs, SNZ

Most patients in Auckland DHB's critical care units are from other DHBs

ADHB's critical care units are crucial enablers of specialised care provided for the populations of the Northern Region and New Zealand (see Table 2), with the share of each unit's bed-days for non-residents being greater than 50%.

Table 2: Bed-days for ADHB ICUs by patient domicile (2018)
Source: ADHB, Unit-specific databases, EY analysis

	Bed-days				Share of Unit bed-days			
Patient domicile	CVICU	DCCM	PICU	NICU	CVICU	DCCM	PICU	NICU
Auckland DHB	1,261	1,477	783	6,248	22%	40%	14%	49%
Other Northern Region DHBs	3,258	1,715	1,562	5,146	57%	46%	29%	41%
Rest of New Zealand	1,165	536	3,082	1,231	20%	14%	57%	10%
Total	5,684	3,728	5,427	12,325				
Invasive ventilation (workload)	2,149	1,405	2,589		37.8%	37.7%	47.7%	

[5] For example, the ANZICS CORE APD activity report for 2017/18 states that the median APACHE III Score for adult admissions to critical care in New Zealand was 51 (38-68) compared to 47 (34-63) in Australia. Similarly, the ANZOD mean predicted risk of death was 9.4% in New Zealand compared to 7.7% in Australia.

The ethnic mix of patients cared for in critical care varies by unit. Across all critical care units, patients living in more deprived areas are more likely to be admitted

In CVICU/DCCM and to a lesser extent NICU, non-Māori / non-Pacific patients make up most cases. However, in PICU, Māori and Pacific children are overrepresented, while in NICU, Asian neonates appear to be overrepresented. In some cases, variation in admissions will reflect epidemiological reasons, in others they may indicate access barriers to critical care (or services earlier in a patient's care pathway).

Across all units a higher proportion of patients admitted to critical care are living in, or are born to mothers living in, highly deprived areas. Over the past few years the proportion of admissions from the most deprived areas has increased. This reflects higher burdens of disease (often occurring at younger ages) and risk of trauma.

When critical care capacity is constrained, admission thresholds need to increase. Clinical conditions, and prognosis of likely outcomes are the key factors used to guide access decisions. Given people from more disadvantaged groups are more likely to have pre-existing comorbidities, the triaging process results in them having less chance of being admitted to critical care – further perpetuating equity of access issues. This dynamic has been a key learning from COVID-19 pandemic preparations (see further below).

More patients with complex needs are driving an increasing average length of stay in some units

Patient average length of stay in CVICU has been increasing since 2009, from ~45 hours to ~52 hours in 2018 (Figure 3). The key driver of increasing length of stay has been patients staying five or more days. Patient cohorts driving this increase include high risk cardiac surgery, heart and lung transplants pre- and post-operatively, extracorporeal membrane oxygenation ('ECMO')[6] to support either transplantation, pre- or post-cardiac surgery, or for non-cardiac support, and left-ventricular assist devices ('LVADs').[7] In contrast, average length of stay in DCCM has remained similar over the same period.

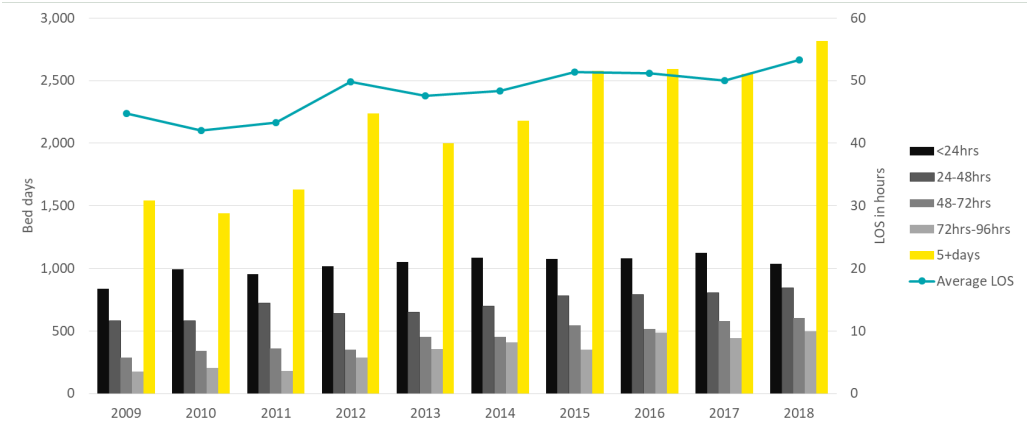

Figure 3: CVICU length of stay and bed days
Source: ADHB, EY analysis

PICU length of stay has substantially increased, up 44% between 2016 and 2017, while patient numbers decreased slightly (Figure 4). This was largely driven by long stay ventilated cardiac and ECMO patients.

[6] ECMO is a therapy that uses a portable modified heart-lung bypass machine to support patients whose hearts and/or lungs are failing. A national service model has been developed for this service.

[7] LVADs are mechanical pumps which are implanted for patients with end-stage heart failure.

Patients requiring long lengths of stay are expected to continue to increase their share of Unit bed-days over the next 5-10 years (based on the increasing trend in long term ventilation [51% increase since 2010] and ECMO [119% increase since 2010]), further increasing average length of stay and capacity pressure.

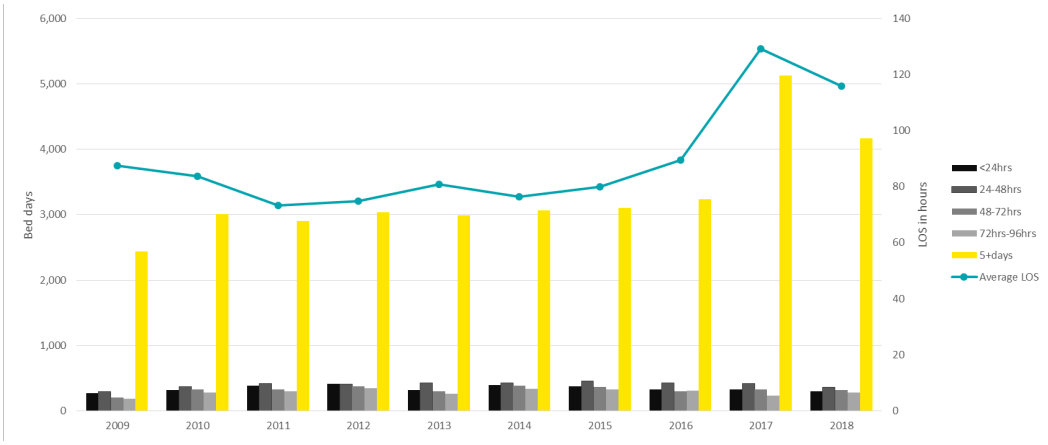

Figure 4: PICU length of stay and bed days
Source: ADHB, EY analysis

Average length of stay in NICU has fluctuated over the past decade, with an increasing trend from 2015 to a decade high in 2018 (Figure 5). In 2018, average length of stay was 332 hours, an increase of 36 hours since 2015. The increase appears to be driven by increased length of stay for extremely premature neonates and very complex high birthweight neonates (i.e., those requiring surgery). In 2018, fewer neonates were admitted for less than 96 hours compared to previous years, and fewer for greater than 60 days compared to the previous two years. Most bed days in 2018 were for neonates with a length of stay between 30 and 59 days.[8]

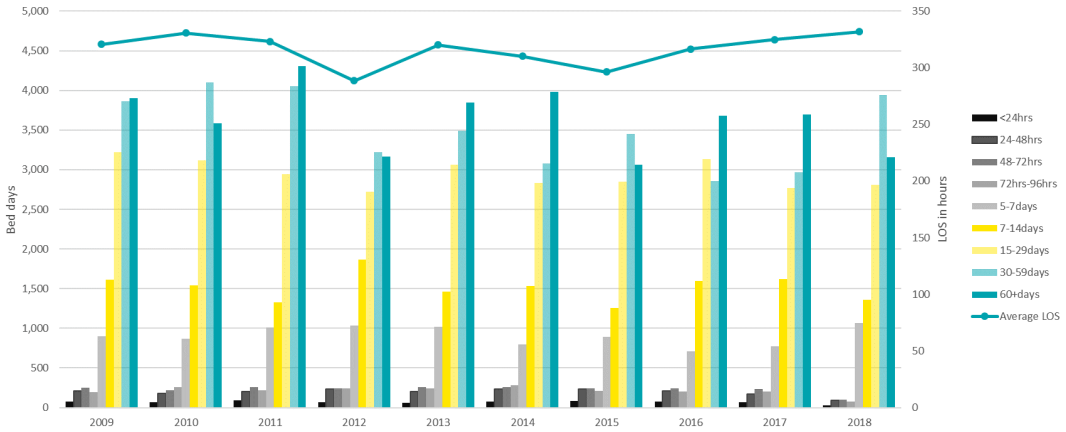

Figure 5: NICU length of stay and bed days
Source: ADHB, EY analysis

[8] Bed days are calculated at discharge date by year, therefore, for long stay neonates if they are discharged early in the New Year this may not be reflected in the year in which they accumulated most of their bed days

Demand for critical care at Auckland DHB is projected to increase because of demographic changes, complexity and increased length of stay changes and service configuration changes

As part of the development of this Strategy, a wide range of factors that influence demand for critical care were explored for their potential impact on future capacity needs. These included changes in intervention rates due to clinical practice, and regional and national service flows. It is difficult to accurately predict the impact of these factors, however, clinically informed assumptions provide a starting point to understand what the future might look like based on what is known now.

Opportunities for making best use of capacity while enhancing patient care were also considered. These opportunities include care pathways (e.g., extended post-anaesthesia care unit [PACU] models), changes in settings of care (e.g., transitional neonatal nursery) and improving patient flow through the hospital (e.g., reducing critical care 'exit-block'). Development of an Adult Regional Critical Care Network, and a National Critical Care Network, were identified as a key step to drive service, capacity and model of care planning in a structured way. For NICU, capacity constraints at other sites in the Region and nationally can exacerbate critical care capacity issues at Starship.

Table 3 summarises the projected net impact on potential future capacity requirements by unit based on data and assumptions used as part of Strategy modelling.

Table 3: Net projected capacity impacts by critical care unit[9]

Source: ADHB, EY analysis

Unit	Current demand	Demographic changes	Length of stay changes	Other factors (excluding risks)	**Total demand**	Offsetting factors	**Projected demand in 2032/33**
CVICU	23	8	7	7	**45**	-4	**41**
DCCM	20	7	0	6	**33**	-3	**30**
PICU[10]	24	1	10	3	**38**	0	**38**
NICU	44	2	9	12	**67**	-20	**47**

Photo Courtesy of NICU

Demand projections based on expected demographic and length of stay changes[11] suggest existing bed capacity for adult critical care will be exhausted within the next five years. The greatest demand pressure is on CVICU, with the Unit's physical bed capacity projected to be exceeded by 2021. Bed requirements based on demographic and length of stay demand projections compared with existing physical capacity are shown in Figure 6.[12] In summary, the projections suggest that:

- By 2033, CVICU will require an additional 12 physical beds and DCCM an additional 3 physical beds
- CVICU will exceed physical capacity by 2021, while DCCM has capacity until 2027.

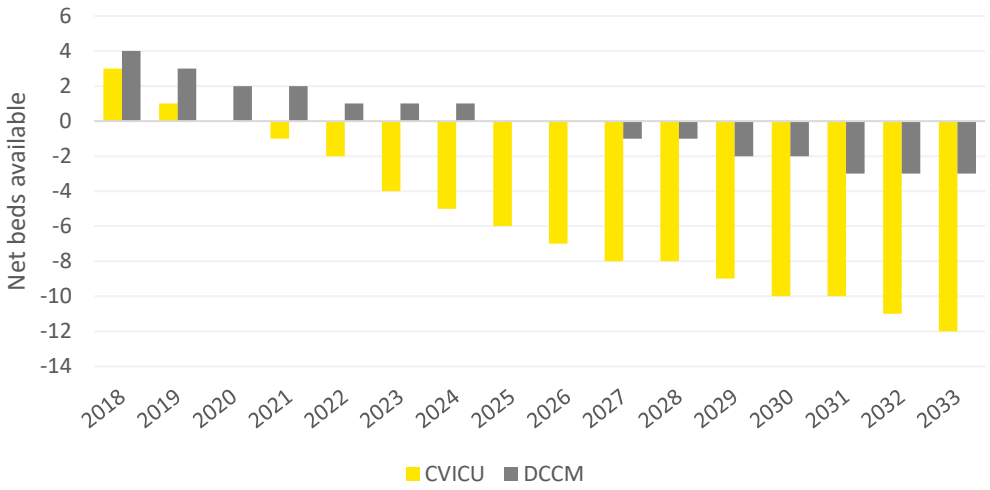

Figure 6: Net beds available by adult critical care unit between 2017/18 - 2032/33
Source: ADHB, EY analysis

Demographic and length of stay demand projections for paediatric critical care suggest that the Unit's existing bed capacity of 22 beds is already exhausted. Population growth will put demand pressure on PICU which will continue to exceed the Unit's physical bed capacity. Bed requirements based on the demographic and length of stay demand projections compared with existing physical capacity are shown in Figure 7. In summary, the projections suggest that:

- PICU required an additional 2 physical beds in 2018
- By 2025, PICU will require an additional 13 physical beds.

[11] Note these projections assume current per capita admission rates continue in the future.

[12] Due to the size of the adult units and space constraints within existing facilities, co-location of the adult units is not considered feasible. Therefore, capacity projections are shown separately.

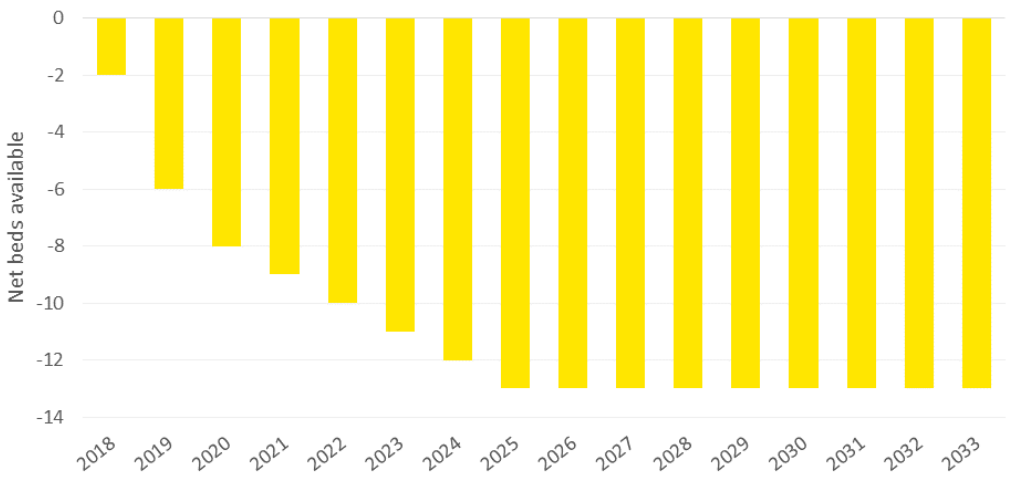

Figure 7: Net beds available in PICU between 2017/18 - 2032/33
Source: ADHB, EY analysis

Demographic and length of stay demand projections for neonatal critical care suggest existing cot capacity may be exhausted by 2020. Cot requirements based on the demographic and length of stay demand projections compared with existing physical capacity are shown in Figure 8. In summary, the projections suggest that by 2027, NICU will require an additional 11 physical cots. This may decrease to 9 by 2033 depending on other changes in service configuration.

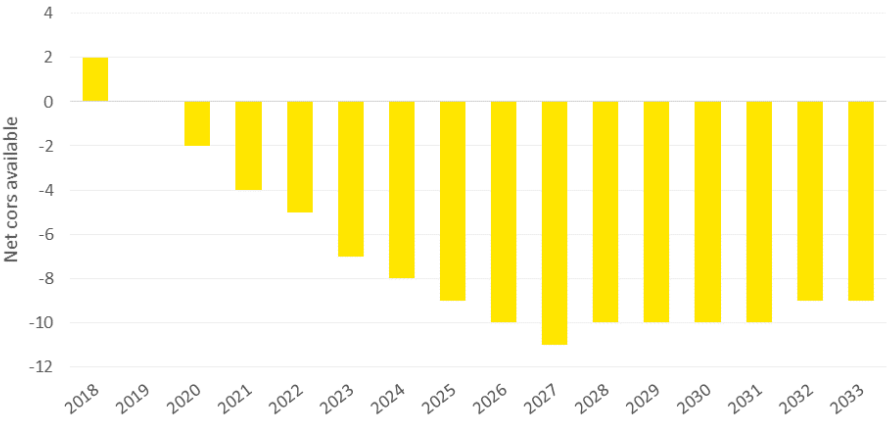

Figure 8: Net cots ('beds') available neonatal critical care unit between 2017/18 - 2032/33[13]
Source: ADHB, EY analysis

The COVID-19 pandemic has reinforced the need to have a resilient critical care sector, able to manage significant surges in demand, without unduly compromising patient and workforce safety

The novel coronavirus, COVID-19, has rapidly spread across the world. In a range of jurisdictions, COVID-19 has resulted in extreme strain on health services, and in some instances, service failures. Patients with COVID-19 can progress from asymptomatic or mild illness to hypoxemic respiratory failure or multisystem

[13] The decrease in bed projections beyond 2026/27 is due to Statistics New Zealand projecting a decline in births. Although changes in births do not necessarily drive demand for neonatal intensive care it is expected that this may decrease demand by 1-2 cots beyond 2026/27.

organ failure, necessitating intubation and intensive care management (Greenland et al, 2020).[14] International experience suggests around 5% of people who test positive for COVID-19 require intensive care management. The experience also suggests that most of these patients have significant underlying health co-morbidities.

New Zealand has been successful in managing the COVID-19 pandemic, with few patients hospitalised. While the COVID-19 pandemic is still escalating globally, it is hoped that New Zealand will be successful in preventing a wide-spread outbreak.

Nonetheless, the experience of preparing for the pandemic has highlighted the importance of managing the resilience of critical care through:

- A clear focus on:
    - vulnerable populations (e.g., Māori and Pacific Peoples), their equity of access, experience of care, and health outcomes
    - Understanding how triage practices during demand surges can exacerbate inequities, and having appropriate responses in place to minimise this risk
    - Assessing the level of surge demand at which the current resources would be overwhelmed
- Long-term capacity planning and investment pathways to ensure enough supply of critical care beds and workforce across the sector, and at each acute care site (with minimum thresholds of physical and resourced capacity by acute site, contextualised for local provision of services)
- Enough appropriate capacity to manage patients with infectious disease, particularly negative pressure rooms, both within critical care units and in other relevant areas of hospitals
- Strong regional and national relationships that support effective strategic and operational planning, and accountability
- Clear visibility of dedicated and flex bed and workforce capacity to manage surges in demand
- Scenario-based surge plans and escalation pathways within hospitals, and between hospitals (on regional and national bases as relevant)
- Benchmarking surge and escalation plans against international standards and increasing visibility around acceptable risk management plans (e.g., in Australia critical care was asked to scenario plan at 200% and 300% of current capacity)
- Making appropriate use of tele-ICU approaches, particularly for support of smaller units, and monitoring of higher acuity patients on general wards at tertiary centres

[14] Greenland et al (2020). *COVID-19 Infection: Implications for Perioperative and Critical Care Physicians*. Journal of Anesthesiology, 132(6):1346-1361.

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- Ensuring physical design of units supports efficiency of workflows, and ability to manage cohorts of patients appropriately
- Up to date information on key equipment and supplies used in the provision of critical care to enable forward planning and supply chain management.

A range of events can put pressure on critical care services locally, regionally and nationally, including natural disasters, infectious disease (such as COVID-19 and influenza), and unexpected tragedies such as terrorism-related events. The experience of preparing for COVID-19 has highlighted vulnerabilities in New Zealand's critical care sector, which need to be remediated through more effective ways of working regionally and nationally.

To deliver critical care requires a highly skilled workforce in an appropriate configuration

Providing care to severely unwell and high acuity patients in critical care units requires a large team of medical, nursing, allied health, and clinical support staff, specifically skilled in intensive care provision. Due to the severity and acuity of the patients cared for, staffing in critical care units is necessarily different from the rest of the hospital.

The College of Intensive Care Medicine of Australia and New Zealand (CICM) sets specific standards for staffing for adult and paediatric intensive care units, including minimum staffing requirements. For units consistently caring for more than 12-15 patients, a pod type arrangement should be operating. This is to improve unit logistics, allow cohorting of patients (usually by need or subspecialty), and to match medical resourcing with a safe number of patients for an individual doctor to care for. Pods are clinical sub-units within the overall critical care unit, consisting of between 8-15 beds. Pods can be incorporated in physical design but can also function virtually in traditionally designed units.[15]

The CICM standards state that there should always be a SMO rostered to a unit, and one per pod for larger units. This is in addition to a second appropriately trained medical practitioner, i.e., a total of at least one SMO and one Fellow/RMO per pod during the day.[16] There should also be an additional SMO for back-up within the unit and for other clinical activities. Other activities include (i) "outreach" – proactive involvement in deteriorating patient and transitional care patients throughout the hospital and (ii) retrieval services, including ECMO retrieval. There are also other ICU specific activities. Overnight the pods can be combined with one SMO on-call, along with one as backup. To resource these cover and clinical activities, the standards recommend at least four SMO FTE per pod.[17] An example of a pod arrangement is provided in Figure 9.

[15] For NICU, the Ministry of Health Specialist Neonatal Inpatient and Home Care Services Tier Level Two Service Specifications outline the service components for the different neonatal care levels.

[16] https://www.cicm.org.au/CICM_Media/CICMSite/CICM-Website/Resources/Professional%20Documents/IC-1-Minimum-Standards-for-Intensive-Care-Units_2.pdf

[17] For comparison, the UK Faculty of Intensive Care Medicine (FICM) Guidelines for the Provision of Intensive Care Services (GPICS) standards include that the daytime SMO to patient ratio must not normally exceed the range of 1:8 – 1:12, and that the RMO to patient ratio should not normally exceed 1:8, including overnight. Both RMOs and Advanced Critical Care Practitioners (generally nurses with additional training) may contribute to the RMO roster. The ratios are based on recent evidence on patient SMO ratios and patient outcomes. This evidence demonstrated a 'U-curve', where the optimum ratio was 7.5 patients per SMO in hours, with mortality increasing at lower and higher ratios (Gershengorn, et. al, 2017). The GPICS also suggests that a SMO roster with less than 8 people, due to the number of weekends and nights, is likely burdensome.

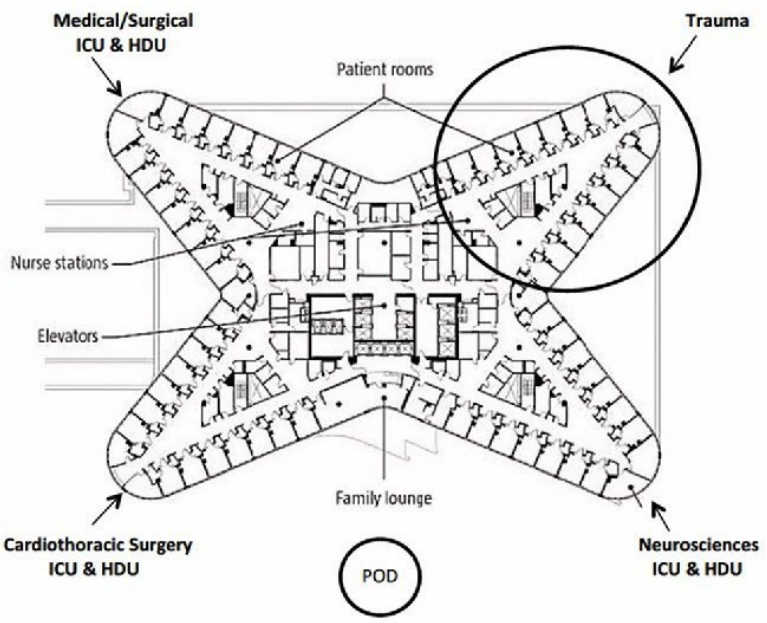


Figure 9: Conceptual diagram of pod model
Source: Abbenbroek, B., et al., 2017. Intensive care unit organisation and nurse outcomes: A cross-sectional study of traditional and "hot-floor" structures

The largest component of the workforce in critical care units are nursing staff. To work as a nurse in critical care requires specific skills, and new recruits have a significant period of education and supernumerary time. This is complemented with extra study in critical care nursing, with CICM expectations set for the proportion of nursing staff in a unit who have completed post-registration critical care nursing qualifications: at least 50%, and ideally, 75%.

Senior nursing staff in a critical care unit generally include a Nursing Unit Manager (NUM), and Clinical Charge Nurses (CCNs) / Charge Nurse Coordinators (CNCs) / Charge Nurses (CNs). For bed-side nursing, intensive care patients are generally cared for with a ratio of one nurse to one patient (1:1), and high dependency patients at a ratio of 1:2. There are some exceptions to this, such as nursing for patients receiving ECMO, which may require a ratio of up to 2:1, and special care baby unit neonates at a ratio of 1:3 or 1:4. In addition, there are allocated 'runners', who are not assigned to a patient but assist the bed-side nurses, cover breaks and move around the unit as activity requires.

The critical care nursing workforce also includes many other roles for the effective functioning of the unit. Nurse educators (NE) and research nurses support education and research in each unit, and units also have some other support roles, such as for equipment management. Nurse specialists (NS) provide care for the most complex patients (and their families) and typically carry out quality improvement activities. A clinical coach role, a relatively new position at ADHB, has also been developed to assist more junior staff as required and support the education requirements of the unit. Table 4 provides current critical care workforce resourcing, and resourced beds, by unit at ADHB.

Table 4: Critical care medical and nursing workforce by unit (FTE based on a 40 hour per week basis)

Source: ADHB

Role / type	CVICU	DCCM	PICU	NICU
Resourced ICU beds	16	11	16	40
Resourced HDU beds	6	6	6	
Total resourced beds	22	17	22	40
SMO (excl. AHOC)*	8.2	10.99 incl. AHOC	7.2	6.0
Fellow	1.0	1.0	1.0	2.0
RMO	10.0	10.0	12.0	11.0
Advanced Nurse Practitioner	-	-	-	9.0
SHO	2.0	-	-	1.0
Senior Nurse	NUM Shared w/41,42 1.0 ANUM 1.0 CN 3.0 CNC 5.4	NUM 1.0 CNC 1.0 CCN 6.0	NUM 1.0 CNC 0.5 CCN 7.0	NUM 1.0 CCN 6.0
Nurse Specialists (rounded) Note: research nurses are mainly externally funded	CNS 2.0 Technical NS 1.0 Research 3.5	Research 3.8	Research 2.6 Transport 0.5 Long term care 1.0 Technician NS 1.0	Family liaison 2.0 Lactation 0.8 Homecare 2.0
Nurse Educators	1.0	2.0	2.5	1.6
Registered Nurses (rounded)	112.5	86.6	119.5	91.0

*After hours on call (AHOC) is excluded from the FTE calculation. This excludes out-of-hours work and all call hours worked

Photo Courtesy of NICU

There are also a wide range of Allied Health and Clinical Support Services professionals who are crucial to delivery of high quality, multi-disciplinary care. Currently these teams tend to deliver care into the units, although some Allied Health and Clinical Support Services roles do exist within units, e.g., pharmacist in DCCM. Standards are limited for these workforces in critical care, with the main sources being CICM and the UK Faculty of Intensive Care Medicine (FICM) Guidelines for the Provision of Intensive Care Services (GPICS). This means that models of care vary across hospitals, and often between critical care units within hospitals.

As critical care capacity increases, Auckland DHB's units will need to continue to develop 'pod' arrangements to ensure appropriate workforce models. Bed capacity increases will also require additional workforce resourcing

Currently all critical care units have implemented aspects of the pod model, e.g., cohorting of patients within DCCM, however, no shared principles have been set across the units. As critical care capacity increases, each unit will need to continue to develop its pod arrangements, with medical and senior nursing workforce models aligned to the pod arrangement (Table 5). As part of Strategy development, a benchmark of 12 patients per pod was agreed, i.e., once demand reached a point of consistently more than 12 patients per pod then an additional pod should be opened. Currently the two adult units and PICU should be running a two-pod model. This benchmark also suggests that in the future CVICU and PICU will need to shift to a three-pod model. For NICU this benchmark applies to higher acuity neonates but is not appropriate for neonates of lower acuity. Therefore, the current three-pod model for NICU is expected to be sustainable into the future.

Alongside traditional medical roles, there is an opportunity to develop a Nurse Practitioner[18] role to support the RMO roster (for NICU, to continue to support the Advanced Neonatal Nurse Practitioner [ANP] role), and also provide career progression opportunities for nursing staff. The senior nursing structure and associated resourcing will also need further clarification as the pod-model is refined and implemented. Other opportunities include making more use of healthcare assistants and administration staff to support better use of nursing time, and taking a more planned and structured approach to the involvement of Allied Health and Clinical Support Services within and across units.

Table 5: Critical care projected SMO, CNC/CCN/CN, RN and NE workforce

Source: ADHB, EY analysis

	CVICU				DCCM				PICU				NICU			
Role \ Year	FY18	FY23	FY28	FY33	FY18	FY23	FY28	FY33	FY18	FY23	FY28	FY33	FY18	FY23	FY28	FY33
Pods	2		3		2				2	3			3			
SMO (excl. AHOC)	8.99		Review		12.23 (incl. AHOC)				8.99	Review			8.99			
CNC/CCN/CN	8.18		Review		8.18				8.18	Review			8.18			
RN[19]	119.9	152.8	171.7	190.5	92.65	106.1	115.1	124.1	119.9	162.3	171.7	171.7	92.65	109.2	114.7	112.9
NE	3.00	3.82	4.29	4.76	2.32	2.65	2.88	3.10	3.00	4.06	4.29	4.29	2.32	2.73	2.87	2.82

[18] For example Advanced Critical Care Practitioners are regulated practitioners (often nurse practitioners) and internationally are becoming more common, e.g., in the UK (118 registered, 100 in training at June 2019). It is expected that there will be a significant lag-time for development of such a role, however, in the meantime there are opportunities to explore Extended Scope of Practice roles for experienced nurses.

[19] As ICU and HDU bed-days were unable to be clearly separated in data, RN FTEs are based on the modelled RN FTE bed-side ratio and an assumed similar distribution of ICU / HDU resourced beds in the future. If the mix of ICU / HDU care changes over time then so will RN FTE resourcing needs.

There are a range of critical care workforce challenges, which need to be resolved for future sustainability

Tables 6 and 7 summarise key challenges to the sustainability of medical and nursing workforce in ADHB's critical care units, alongside possible responses. It will be important that as possible responses are working through, the implications for other hospital services are considered – in particular, the implications for nursing models and staffing in ward-based settings, and the need to ensure that increasing staffing in critical care units does not come at the expense of ward resourcing. For example, the continued roll-out of CCDM should consider the implications of the future roles of critical care units in ACH, and transitional care models (see p. 22).

Table 6: Medical challenges and responses

Challenge	Possible responses
SMO FTE allocation limits clinical availability, non-clinical time, and contingency for leave cover. It is unlikely to be sustainable	Develop appropriate medical staffing based on safety guidelines, pod configuration, with consideration of key responsibilities SMO/fellow staffing model developed to identify appropriate balance of SMO vs fellows to reduce burn out and fatigue, and support succession planning
SMO clinical workload, especially the burden associated with after hours call, can lead to burnout, reduced availability for call and early retirement	
As ECMO retrievals increase, additional SMO FTE will be required. An appropriate medical staffing model needs to be developed and implemented	
The use of medical time could be optimised – 'top-of-scope'	Identify opportunities for greater administrative and operations management support and ensure that clinical information systems streamline processes
Succession planning can be difficult	Identify opportunities to develop a regular intensivist fellow pipeline, potentially through sub-specialisation fellowships and rotation across critical care units Assess current RMO workloads particularly out of unit responsibilities, and revise rosters / resources to accommodate responsibilities Develop a Nurse Practitioner workforce to support the RMO roster (for NICU continue to support and develop ANPs)
In some cases, RMO out of unit work is substantial, and will likely increase as patient acuity increases	
RMOs are from a mix of training programs and the pool of intensivist RMOs is limited	
For NICU, it is difficult to sustainably meet Schedule 10, and the current SHO workload is significant	Review junior medical and NP staffing model for NICU to better balance cover over 24hrs and the supervision structure

Table 7: Nursing challenges and responses

Challenge	Possible responses
Current workforce resourcing does not meet guidelines, particularly regarding patient care ratios, education and post-registration qualification, and ability to take leave	Develop a nursing workforce that meets critical care standards based on calculated metrics and evaluate workforce roles and responsibilities with a focus on top of scope work
The use of nursing time could be optimised, as nursing time can currently be spent inappropriately on duties such as data entry, equipment management, rostering and cleaning	

Challenge	Possible responses
Linked to the prior challenges, staff retention is a key challenge, with more amenable factors including high workloads, ability to take leave, access to education, limited career opportunities, level of support and culture. More complex factors include high cost of living in Auckland, poor remuneration, attractiveness of jobs in provincial areas or in Australia (particularly directly after being trained in Auckland units) and parking difficulties	In order of priority: ► Increase the size of the senior nursing workforce for improved supervision, support and coordination of unit logistics ► Develop career pathways, including Extended Scope of Practice and Nurse Practitioner roles ► Expand opportunities for staff feedback, including via exit, stay and 'itchy feet' interviews and conversations ► Focus on creating an inclusive and supportive workplace culture and sense of team ► Strengthen approaches to staff resilience and wellbeing ► Explore opportunities to individualise career options
Maintaining skill mix is a challenge across all units, education days are often cancelled in response to demand pressure, and the proportion of nurses with a post-registration qualification in critical care is below recommended levels, and has been decreasing in recent years. A clinical coach role has emerged as a response to this challenge, however, it is resourced from bed-side nursing, with the impact that when demand is high, clinical coaching time decreases	Support the nursing workforce to reach and maintain the benchmark 75% of nursing staff with a post-registration qualification in critical care Formalise and ringfence the clinical coach role Prioritise education and training through ringfencing nurse learning and development time

Challenges in Allied Health and Clinical Support Services are organisation-wide, and at times are felt more acutely within the context of critical care

Tables 8 and 9 identify organisation-wide challenges to development and support of sustainable Allied Health and Clinical Support Service models of care and the workforce to deliver on these models. Possible responses to these challenges are identified, and are specific to ADHB's critical care units.

Table 8: Allied Health challenges and responses

Challenge	Possible responses
The development of allied health models of care and resourcing in critical care has largely been reactive	Take a planned and structured approach to allied health model of care design and resourcing, informed by benchmarked data Identify how allied health can work with critical care units to enable more efficient 'rounding' of unit pods
There is limited data and evidence collected on use and outcomes of allied health in critical care, impacting the ability for allied health to communicate their value	Improve data collection for service improvement and development
Best practice for allied health is changing	Support training for staff to ensure the service can meet the complexity of patient needs Consider the use of profession-specific assistants to support care delivery Consider establishing an evening shift
Changes in patient acuity are impacting on allied health service provision, with patient needs requiring more input for care planning and delivery	
Working in critical care requires a high level of skill	

Challenge	Possible responses
Staff wellbeing is compromised when there is little redundancy built into service resourcing	Ensure that staffing levels are appropriate for workload and allow contingency for leave
Allied health equipment is not efficiently managed	Develop a shared fleet management plan to allow more proactive maintenance of equipment

Table 9: Clinical Support challenges and responses

Challenge	Possible responses
Clinical support services may not be able to consistently provide optimal input within current resourcing	Identify workforce requirements to support desired model of care, and step changes in demand as capacity increases Identify how clinical support services can work with critical care units to enable more efficient 'rounding' of unit pods (e.g., clinical pharmacist rounds)
Some critical care unit layouts are not conducive to best practice infection control	Work with critical care units where applicable to establish strategies to reduce infection control risks
Future models of care / clinical best practice changes can have a significant impact on demand, as services may alter a pathway which significantly changes demand for clinical support	Work with services to ensure the voice of clinical support is included in any pathway developments
Access to advanced radiology requires patient movements in the hospital, and can disrupt patient flow	Consider developing in-unit access to advanced radiology
Point of care testing is becoming increasingly possible. To best make use of this, there is a need for regular staff training, equipment and consumables to be available, and appropriate space for the equipment and for running tests	A governance group has been recently established to consider point of care tests across the hospital. Ensure that critical care units, as a large consumer of laboratory tests, are involved in design and implementation of point of care testing
Equipment management is complex and costly; currently equipment is procured by services with the expectation it is supported and maintained through whole-of-life by clinical engineering	Identify opportunities to standardise equipment across the organisation, particularly for equipment across critical care units, to reduce the cost of maintenance Implement a fleet management process where appropriate Identify opportunities to reduce cyberattack risks, particularly for highly complex and bespoke pieces of equipment
Use of electronic systems to support clinical support services could be enhanced but need increased data integration and engineering	Identify opportunities to deploy best practice informatics solutions, particularly e-prescribing, to improve quality and reduce burden of patient handovers
There are challenges with workforce retention, recruitment and ageing for some support services	Identify retention and recruitment strategies

Increased collaboration between our two adult critical care units will provide benefits for patients, staff and the DHB

Models of critical care provision vary in very large hospitals. In some, there is a single large ICU with sub-specialties incorporated in pod design. In others, larger sub-specialty ICUs are physically separate. There are strengths and weaknesses with each approach. ADHB's two adult ICUs are physically separate with governance occurring within their respective directorates. This is partly due to historical factors, including that CVICU was originally located at Greenlane. When ACH was redesigned, the functional location of operating theatres, wards and ICUs were based on patient flows. Situating CVICU within the Cardiovascular Directorate, and physically near the cardiology and cardiothoracic wards and operating theatres, was considered to enable more efficient patient pathways. However, this has meant the two adult units have worked relatively independently, even where working together can provide benefits.

The potential benefits of collaboration and shared governance of the adult critical care units include improved patient safety and operational efficiency through common guidelines, procedures and staff training. Standardising patient related processes and protocols across the adult units should improve the ability for staff to work more easily and more efficiently across the two units if required. This is also true if equipment was standardised, with the bonus that procurement, consumables, and maintenance could be shared, leading to cost savings. For example, use of the same continuous dialysis machines in both units has provided benefits, including sharing of consumables and increased flexibility in staff working across the units.

The two units have made some progress on better working together, and have recently hosted their first joint training day. However, it is recognised that the separation of the units across clinical directorates presents a barrier to fully realise the benefits of collaboration. To strengthen collaboration, the DHB will establish a Critical Care Governance Group, which will bring together key leaders from the Units and relevant Directorates. The Board will be responsible for determining and executing a prioritised joint work programme of actions that support standardisation across the two units. There is also an opportunity for governance to include PICU and NICU where that is relevant.

Hospital inpatient services face challenges in managing patients of higher acuity

ACH and Starship inpatient services need to manage a wide spectrum of patient needs. In most instances the appropriate care pathway for patients at ACH and Starship is documented and clear including for patients who should be admitted to critical care. However, there is a group of patients where ambiguity exists about appropriate care pathways. These patients have greater acuity / care requirements than the 'average' inpatient, and require additional, and timely, medical and nursing input. A range of clinical issues can contribute to the higher needs of these patients, including uncertainty about the trajectory of their clinical progression.

The DHB recognises that better defining appropriate care pathways for this group of patients is critical for ensuring optimal patient care, both for patient and for others in their care setting, and for the workforce to be supported and resourced to provide the care required. If resourcing is not adequate, diverting care to a high acuity patient can make other patients on the ward more vulnerable. It can also impact on staff stress and cause dissatisfaction.

The patient group has been termed 'transitional care' patients, with 'transitional' indicating that the clinical needs for patients within the group are expected to be short, and only comprise part of their inpatient stay. It was agreed that a key principle of caring for these transitional care patients is that care should follow the

patient wherever possible - as opposed to moving the patient to a specific care setting (e.g., from the ward to HDU). A second principle was also agreed:

> "transitional care patients should be identified in a timely manner from Level 2 (ED and the Clinical Decision Unit) / PACU / on the ward and be evaluated by a senior clinician from the admitting / home team, in consultation with senior nursing staff. Input from the PAR team and /or critical care should also be sought if required. This is to confirm the patient is appropriate for transitional care, and to develop a clear management plan, including goals of care and actions to take if the patient deteriorates. This decision will consider patient and ward context factors, including resourcing and availability of after-hours staff. Patients will be revaluated to ensure that they continue to be appropriate for transitional care if their condition changes, or at least 12-hourly."

A range of models for transitional care were considered as part of the Strategy, including a package of care approach for individual patients so they can remain in a general ward setting, a designated area on a general ward for grouping together 'transitional' care patients, and changes to DCCM HDU admission criteria/bed capacity to enable a greater number of patients to be cared for in this setting. Given the spectrum of clinical needs within the 'transitional care' group, stakeholders considered a range of models will be required. However, there was consensus that:

- Designated ward-based areas will allow for most efficient resourcing of care, including skill-mix
- Further expansion of HDU capacity should be considered, with clearer, standardised admission criteria to support improved patient flow from Level 2 (ED and the Clinical Decision Unit) to HDUs
- Nursing resource and skill-mix requirements should be developed for transitional care patients as part of CCDM, and included in FTE establishments based on an agreed care model
- An appropriate medical model should be defined including input and availability of home teams and critical care (as required), and consideration of after-hours cover at nights and weekends
- That a Working Group should be convened to develop and drive a work programme for transitional care, with appropriate connection with current programmes of work, e.g., the existing General Medicine nursing and physician review. It may be appropriate to test the benefits and costs of several of these options to inform further development.

1.4 Strategic direction

To address the challenges confronting our critical care services, we have identified six strategic priorities. These priorities are evidence-based and data-informed. They are intended to ensure the ongoing delivery of high-quality critical care at ACH and Starship, to enable our services to be resilient, and to further build effective relationships between our critical care units, other parts of our hospitals, and services in other DHBs.

The six priorities are summarised in Table 10, with supporting headline actions provided in Section 1.4.1.

Table 10: Critical care strategic priorities

Priority	What delivering this priority will mean
We will grow critical care capacity to meet the needs of our patients, and to manage future high demand risks	We will develop new critical care bed capacity on a prioritised basis in-line with expected demand. Additional CVICU, PICU and NICU capacity will be delivered in the next five years. Additional DCCM capacity will be delivered in the next ten years
We will make best use of capacity	We will continue to optimise patient pathways. Key focus areas will be: ► delivering alternative care pathways for surgical patients that can be safely and effectively cared for in non-critical care settings ► developing a transitional neonatal nursey for lower acuity neonates, in-line with leading international practice ► addressing critical care 'exit-block' within our hospitals, and with domicile hospitals of non-residents
We will maintain and support a sustainable workforce that is resourced to provide best patient care and outcomes	We will progressively enable our critical care units to meet evidence-based staffing guidelines, and to develop their workforces in-line with expected demand and leading practice care models. We will strengthen the role of Allied Health and Clinical Support Services in delivery of critical care through taking a structured approach to model of care design and resourcing
We will ensure that teams across the hospital work collaboratively	We will develop a transitional care model for patients with higher acuity needs on general wards based on the principles and approach developed through this Strategy. This will ensure that patients receive care in the right setting, by the right team, and at the right time
We will leverage data and insight to drive best patient outcomes	We will enable our critical care services, and those who provide care for each unit's patients (e.g., Allied Health) to use data and information systems more effectively in tracking and monitoring patient flow and outcomes. This will support improved service and capacity planning, and resourcing of care
We will strengthen our relationships with other critical care stakeholders in the Region, and nationally	We will proactively work with our regional stakeholders to optimise critical care capacity and planning across the region. We will also work with our DHB partners across New Zealand, and with the Ministry, to advance a national critical care network. Key focus areas will be adult and paediatric patient pathways and flow, and surge and escalation planning

1.4.1 Strategic priorities and work programme headline actions

Priority 1: We will grow critical care capacity to meet the needs of our patients, and to manage future high demand risks		
Headline actions	**Timeframe**	**Relevant units**
i. Develop capacity based on demand projections, and feasible allowances for high demand risks	Present – 2033	All units
a. Continue to work with health architects on initial tranche of capacity expansion		PICU
ii. Work with BFTF project team as tranche business cases are developed to ensure bed capacity is appropriately sized. As part of this: a. rapidly assess the capacity "buffer" that should be factored into future planning to manage potential high demand risks, in the context of alternative models of care identified during COVID-19 preparedness planning b. identify capacity requirements for negative pressure rooms within adult and paediatric units	Present – 2023	All units
iii. Monitor changes in patient demand and their impact on the projected bed requirements	Annually	All units
iv. Explore the potential impact of improving equity of access to critical care for vulnerable populations, and quantify in terms of bed capacity required	2020	All units
v. Identify opportunities to develop more appropriate capacity which keep mother / baby dyads together	Present – 2028	NICU
a. Identify opportunities to increase rooming in / ability for whānau to stay	Present – 2028	NICU
b. Consider physical design of the unit with reference to best practice principles to identify opportunities to improve dyad care	Present – 2028	NICU

Priority 2: We will make best use of capacity		
Headline actions	**Timeframe**	**Relevant units**
i. Establish a Critical Care Governance Group to enhance collaboration across adult critical care and drive a shared work programme	Present – 2021	All units
ii. Work across adult critical care to determine the most appropriate pathway of patient cohorts	Ongoing	CVICU, DCCM
a. Determine if vascular and out-of-hospital cardiac arrest patients could be admitted to DCCM rather than CVICU as a short-term measure to ameliorate physical capacity pressure	Present – 2020	CVICU, DCCM

Priority 2: We will make best use of capacity		
Headline actions	**Timeframe**	**Relevant units**
iii. Develop a programme to address exit-block within ADHB as part of the Sustainability and Change Programme ALOS Value Stream in 2019/20	Present – 2020	CVICU, DCCM, PICU
a. Collaborate with other hospital services to identify initiatives to reduce exit-block	Present – 2020	CVICU, DCCM, PICU
iv. Collaborate with other hospital services to identify patients that could move straight to ward post operatively or have a reduced length of stay in critical care	Ongoing	CVICU, DCCM
a. Support vascular and thoracic pathway work underway to ameliorate demand pressure on CVICU	Present – 2020	CVICU, DCCM
b. Determine if well renal transplant patients could be sent straight to ward post operatively or have a reduced length of stay in critical care	Present – 2020	CVICU, DCCM
v. Identify opportunities to leverage extended PACU models where clinically appropriate to decrease need for HDU admissions	Present – 2023	CVICU, DCCM, PICU
vi. As part of the Sustainability and Change Improvement Value Stream Planned Care, identify opportunities to improve elective scheduling to optimise patient flow through critical care	Present – 2023	CVICU, DCCM, PICU
vii. Ensure proposed and implemented care models / patient pathways are culturally responsive to the needs of patients and their whānau	Ongoing	All units
viii. Identify model of care and resourcing opportunities for babies who require high acuity care to be safely cared for on postnatal wards to retain mother / baby dyads (i.e. babies remain with their mothers on the postnatal wards)	Present - 2023	NICU
ix. Collaborate with Women's Health to identify opportunities for Maternal-Fetal Medicine so that mothers are best supported to birth at ACH but return to their home domicile as early as clinically feasible	Present – 2023	NICU
x. Assess the physical design of units, with comparison to Australasian standards to identify opportunities to improve workflows and ability to manage cohorting of patients: a. In the short-term b. As new capacity is created as per the BFTF tranches	Present – 2023	All units

Priority 3: We will maintain and support a sustainable workforce that is resourced to provide best patient care and outcomes		
Headline actions	**Timeframe**	**Relevant units**
i. Right-size the critical care workforce		All units
a. Apply developed workforce metrics to current bed base / workload to right-size workforce to address immediately key pressure areas, and shift to full implementation of workforce sizing as recruitment and affordability allows	Present – 2021	All units
b. Formalise pod structure (virtual or physical) in-line with CICM standards	Present – 2021	All units
c. As part of sizing the SMO / fellow workforce, develop the model appropriately to balance SMOs vs fellows to reduce burn out and fatigue of the SMO workforce, and support succession planning / training of fellows	Present – 2021	All units
d. Develop appropriate senior nursing structure to support the unit to best complete quality, research and education activities	Present – 2023	All units
e. Identify opportunities for all staff to work at top of scope while overall efficiency is maintained	Ongoing	All units
f. Identify opportunities to work flexibly across units and call rosters	Present – 2020	CVICU, DCCM
g. Continue to identify opportunities for increased standardisation of processes, protocols and procedures	Ongoing	CVICU, DCCM
h. Identify optimal Allied Health models of care and progress towards them	Present – 2023	All units
i. Identify optimal Clinical Support models of care and progress towards them	Present – 2023	All units
ii. Support staff wellbeing		All units
a. Reduce the number of direct reports for senior nursing to best support supervision and support of junior staff	Present – 2023	All units
b. Bolster psychological support and opportunities for debrief through developing a critical care support role	Present – 2021	All units
c. Support workforce collaboration and culture in team days	Present – 2020	All units
d. Ensure exit interviews are conducted and information is anonymously returned to the unit so that retention risks can be mitigated	Present – 2020	All units
iii. Develop and maintain workforce skill-mix		All units
a. Develop a Nurse Practitioner role and the workforce to fill these roles	Present – 2025	CVICU, DCCM, PICU

Priority 3: We will maintain and support a sustainable workforce that is resourced to provide best patient care and outcomes		
Headline actions	**Timeframe**	**Relevant units**
b. Support the nursing workforce to reach and maintain the recommended proportion of nursing staff with a post-registration qualification in critical care (75%)	Present – 2025	All units
c. Ringfence learning and development time to help ensure staff are appropriately educated	Present – 2021	All units
d. Identify opportunities to increase the cultural competency of staff in relation to patient-mix within each unit	Ongoing	All units
e. Continue to identify opportunities for increased shared training and education days	Ongoing	CVICU, DCCM
iv. Continue to attract talent		All units
a. Develop a recruitment plan to meet capacity	Present – 2023	All units
b. Identify opportunities to develop a reliable intensivist fellow pipeline	Present – 2021	All units
c. Formalise exposure pathways for other employees in ADHB and the region to spend time in the critical care units	Present – 2023	All units
d. Identify opportunities to personalise roles to individuals based on life stage	Present – 2023	All units
e. Identify opportunities to keep in touch with employees who have left ADHB critical care services, particularly those on overseas experiences or maternity leave	Present – 2023	All units
f. Promote a workforce that is diverse and aligned with patient ethnic and cultural characteristics	Ongoing	All units

Priority 4: We will ensure that teams across the hospital work collaboratively		
Headline actions	**Timeframe**	**Relevant units**
i. Collaborate with the rest of the hospital to progress work on the role of transitional care, including where transitional care patients are best cared for and how models of care for these patients should be developed based on principles agreed to date	Present – 2023	CVICU, DCCM, PICU
ii. Work towards having clear goals of care for all patients in critical care including those outside of the units who are reviewed by critical care	Present – 2021	CVICU, DCCM, PICU
a. Work with the Goals of Care working group to identify how best to align critical care and transitional care services	Present – 2021	CVICU, DCCM, PICU

Priority 4: We will ensure that teams across the hospital work collaboratively		
Headline actions	**Timeframe**	**Relevant units**
iii. Identify the process required to make home teams aware of all their patients who are in critical care and their expected date of discharge (from the unit)	Present – 2021	DCCM
iv. Develop a neonatal transitional care arrangement in conjunction with Women's Health and Midwifery	Present – 2020	NICU
v. Build on work undertaken as part of COVID-19 readiness planning to ensure there are clear surge and escalation plans in place across care settings to manage high demand events in critical care – with these plans to be updated on a regular cycle, with use of scenario-based simulations involving critical care and wider relevant services to continue to improve relationships and models of care	Present – 2033	CVICU, DCCM, PICU

Priority 5: We will leverage data and insight to drive best patient outcomes		
Headline actions	**Timeframe**	**Relevant units**
i. Develop a data and information strategy, including consideration of technical requirements for the future Patient Administration System in critical care	Present – 2023	All units
ii. Identify opportunities to collaborate with the Integrated Operations Centre around patient flow and capacity management	Ongoing	All units
iii. Increase collection and use of patient experience data to enhance patient care and outcomes	Present – 2021	All units
iv. Monitor and embrace technology advancements, including for patient diagnostics, clinical decision support, and treatment	Ongoing	All units

Priority 6: We will strengthen our relationships with other critical care stakeholders in the Region, and nationally		
Headline actions	**Timeframe**	**Relevant units**
i. Work with Regional partners to develop a Regional Critical Care Network	Present – 2021	All units
a. Identify opportunities to make best use of capacity within the region	Present – 2023	All units
b. Develop a real-time capacity view across the region	Present – 2023	All units
c. Formalise a regional surge / disaster management plan, building on learnings from COVID-19 readiness planning	Present – 2023	All units
ii. Engage with the Ministry of Health and other DHBs to develop a National Critical Care Network	Present – 2023	All units

1.4.2 Delivering our strategic priorities for critical care

We recognise the Strategy is ambitious, and we have many other priorities to advance. We also recognise that the COVID-19 pandemic has significantly disrupted the delivery of our Provider Arm business plan in 2019/20. In taking the Strategy forward, key priorities for the first two years of Strategy execution are:

- Establishing a Critical Care Governance Group to drive delivery on the work programme of strategic priorities in 2020/21 and plan for delivery of priorities in future years, building in regional relationships as appropriate
- Delivering the planned expansion of PICU capacity
- Acting on opportunities to make best use of capacity:
    - Determining whether CVICU capacity should be physically expanded or can be managed through decanting of specific patient groups to DCCM, and if so, implementation plan and timeframe for decantation, with initial focus on:
        - Moving CVICU out-of-hospital cardiac arrests patients to DCCM
        - Moving CVICU vascular patients to DCCM
    - Acting on opportunities to make best use of capacity through changes in patient pathways for renal transplantation, vascular and thoracic patients
    - Developing and operationalising a neonatal transitional care service with input and collaboration between NICU, Women's Health and Midwifery
    - Addressing exit-block from critical care units:
        - within Auckland City Hospital and Starship as part of the 2019/20 Sustainability and Change Programme ALOS Value Stream. This should result in development of key patient flow principles to reduce exit-block. The impacts of this work should be evaluated and factored into capacity requirements in BFTF as appropriate. Initial focus will be on DCCM and its main discharge wards
        - with regional and national hospitals of domicile, with an initial focus on neonates ready for step-down from NICU to domicile DHB hospitals
- Addressing current staffing pressures, and developing a recruitment plan aligned with capacity projections:
    - Decision on standard occupancy is required to plan budgets and business cases. The NRLTIP standard was 75% and we support this because of the tertiary/quaternary role of our services, and inability to decant elsewhere
        - Resourced capacity should take account of current occupancy data and unmet need/planned expansion
    - Assessing current workforce roles and responsibilities and defining the appropriate workforce who should fulfil each role, e.g., data entry, cleaning, leave submission, and once agreed:
        - Refining staff resourcing metrics and quantifying the number of staff required by role
        - Revising staffing establishments, and recruiting as required to new establishments
    - Identifying, and then leveraging, funding mechanisms to support RNs to complete post-registration qualifications in critical care to meet Australasian standards
    - Identifying key milestones and timeframes for developing a Nurse Practitioner role and establishing mechanisms to assist in contextualising the role to ADHB considering if current or future staff could be supported to develop aspects of the role as part of learning and development, e.g., as part of a Masters' Programme
- Undertaking an exploration of equity of access, experience and outcomes for Māori and Pacific Peoples to understand whether changes in models of care are required, both within critical care, and more broadly along care pathways
- Assessing unit physical design using a suitably qualified health architect, with a focus on improving workflows in the short-term, and design options for future bed capacity development (as per BFTF)

- Establishing a transitional care working group to oversee development and delivery of a work programme focused on the care of high acuity medical and surgical patients. It is expected that this working group will initially build on reviews underway in General Medicine and reach a position on where and how transitional care patients will be cared for, including any implications for HDU capacity, particularly for DCCM
- Building on COVID-19 preparation planning, working with Northern Region DHBs to develop a Regional Critical Care Network, with a key focus on formalising surge and escalation / de-escalation planning and pathways – with the intention that this becomes part of a national programme of work lead by the Ministry of Health aligned with a national critical care network framework (and associated planning and performance framework for critical care).

Analytics addendum

This document serves as an addendum to the Critical Care Strategy. It updates some key pieces of analysis that were presented in the Strategy based on calendar year 2019 data.

Critical care capacity at Auckland City Hospital and Starship Children's Hospital remains under pressure, with notable growth in DCCM demand

CVICU – demand appears to have remained largely consistent between 2018 and 2019 (Figure 1). There is some indication that demand pressure is increasing as expected, with a higher number of days in the year with more than 20 beds occupied.

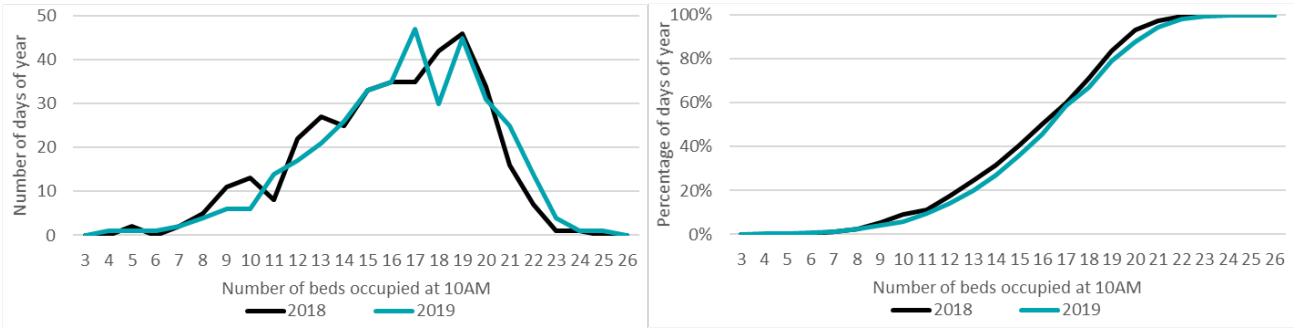


Figure 3: CVICU frequency of beds occupied at 10am over time
Source: ADHB, EY analysis

DCCM – demand appears to have increased by 1-2 beds (Figure 2). The pattern over the year is very similar, however, the 2019 trend has 'shifted' to the right.

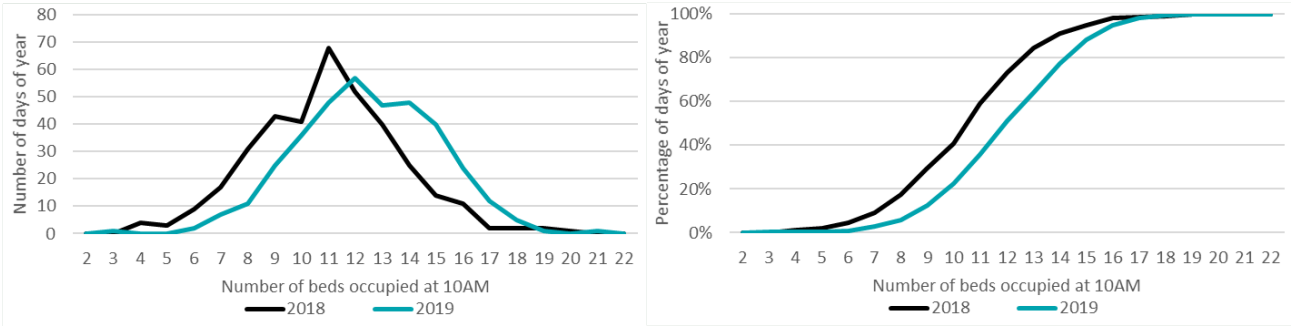


Figure 4: DCCM frequency of beds occupied at 10am over time
Source: ADHB, EY analysis

PICU – demand appears to have been slightly weaker in 2019 compared to 2018 (Figure 3). However, it is important to note that while total demand is lower, the number of days of 'extreme' demand remains largely the same – particularly for days with over 20 beds full.

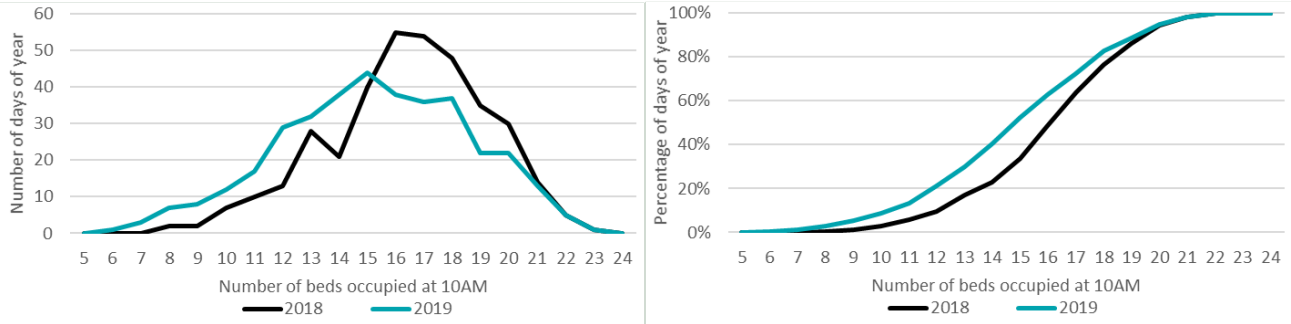


Figure 5: PICU frequency of beds occupied at 10am over time
Source: ADHB, EY analysis

NICU – similar to PICU, demand also appears to have been slightly weaker in 2019 compared to 2018 (Figure 3), though is more pronounced at a lower capacity (between 20-32 cots). Similarly, it is important to note that while total demand is lower, the number of days of 'extreme' demand remains largely the same – particularly for days with over 32 cots full.

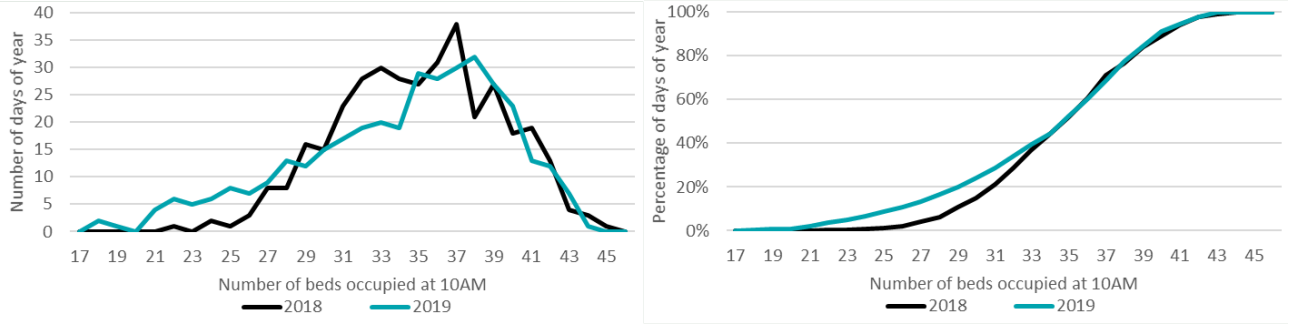


Figure 6: NICU frequency of cots occupied at 10am over time
Source: ADHB, EY analysis

Table 1 follows the methodology as per Table 9 of the Critical Care Strategy Appendix – that is, estimating the level of resourced beds based on the cumulative percentile with consideration of what the occupancy would have been at that resourced bed-base.

Table 1: Cumulative percentiles translated to beds and occupancy based on 2019
Source: ADHB, EY analysis

	CVICU		DCCM		PICU		NICU	
Cumulative percentile	Resourced beds	Occ %	Resourced beds	Occ %	Resourced beds	Occ %	Resourced cots	Occ %
85%	20	82%	15	83%	19	80%	40	85%
90%	21	78%	16	78%	20	76%	40	85%
95%	22	75%	17	73%	21	73%	42	81%
97.5%	22	75%	17	73%	21	73%	42	81%
99%	23	72%	18	69%	22	69%	43	79%

Length of stay patterns remained similar, however, fewer outliers were present for PICU and NICU in 2019[20]

Patient average length of stay in CVICU did not change notably between 2018 and 2019 (Figure 5).

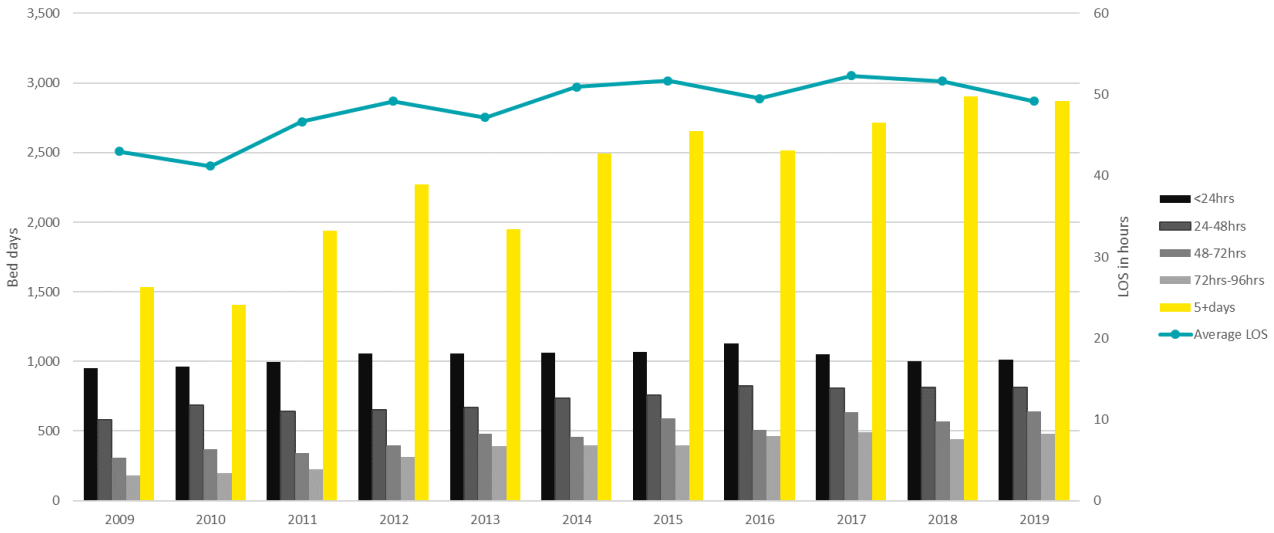


Figure 5: CVICU length of stay and bed-days
Source: ADHB, EY analysis

Patient average length of stay in DCCM increased between 2018 and 2019, with a significant increase in bed-days for patients staying five days or longer (Figure 6).

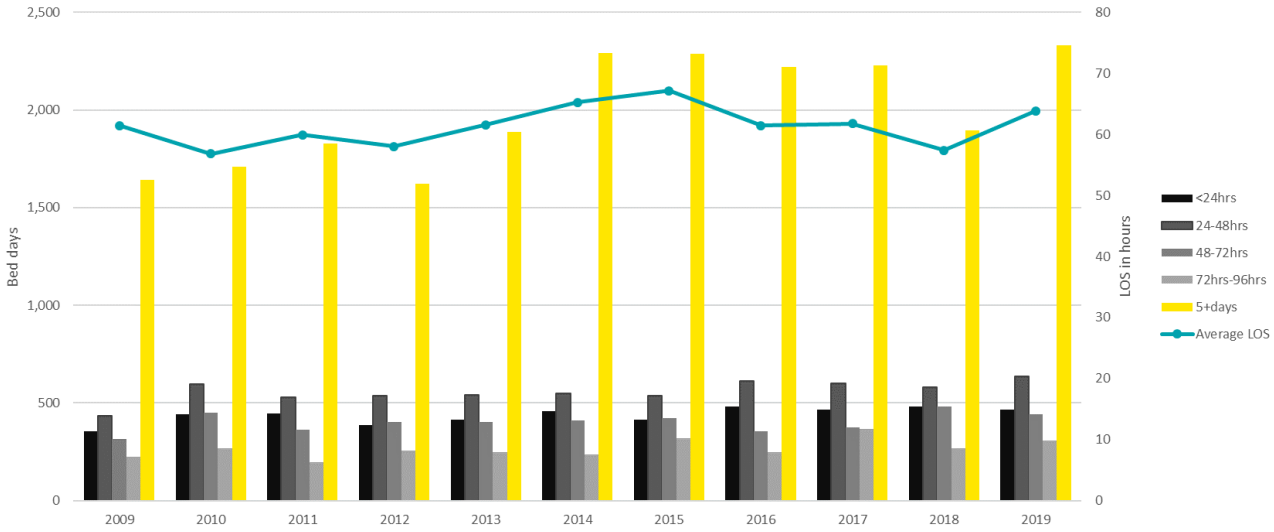


Figure 6: DCCM length of stay and bed-days
Source: ADHB, EY analysis

[20] Due to a small number of high length of stay cases with date of discharge missing, this length of stay analysis provides length of stay based on date of admission – this differs slightly from the figures in the Executive Summary which are based on length of stay at date of discharge.

PICU length of stay appears to decreased between 2018 and 2019 (Figure 7). It is important to note that the impact of long stay outliers is significant and makes up the majority of differences in demand over the last few years. For example, in 2017 there were five cases with a length of stay longer than 120 days, while in 2019, there was only one case.

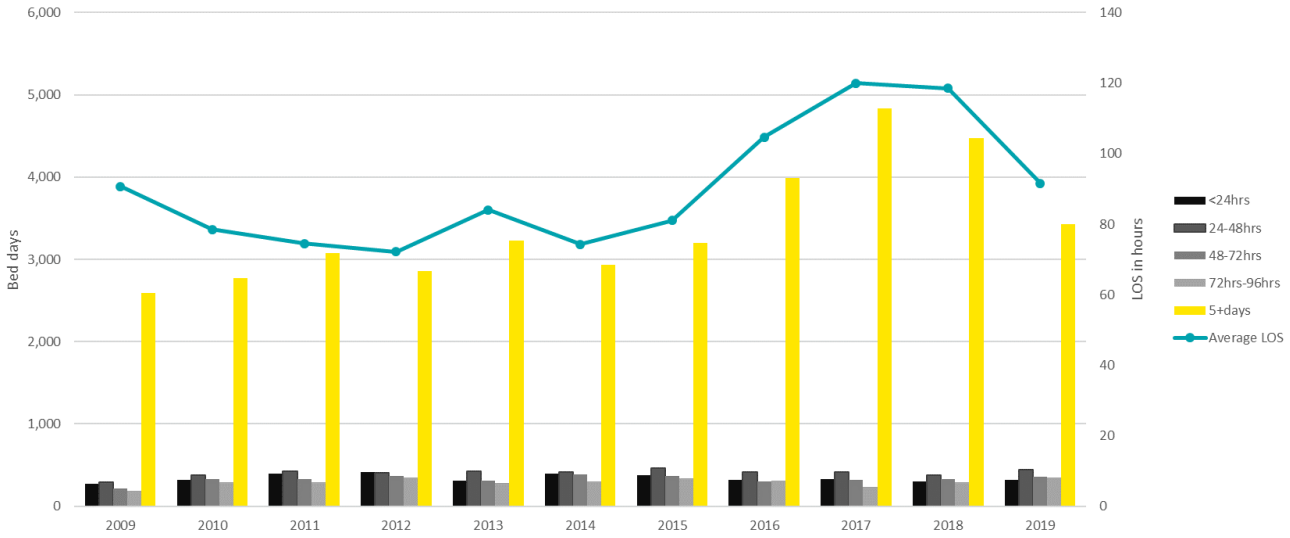


Figure 7: PICU length of stay and bed-days
Source: ADHB, EY analysis

NICU average length of stay has decreased between 2018 and 2019 (Figure 8). Apart from neonates staying longer than two months, longer stay categories had small declines in bed-days.

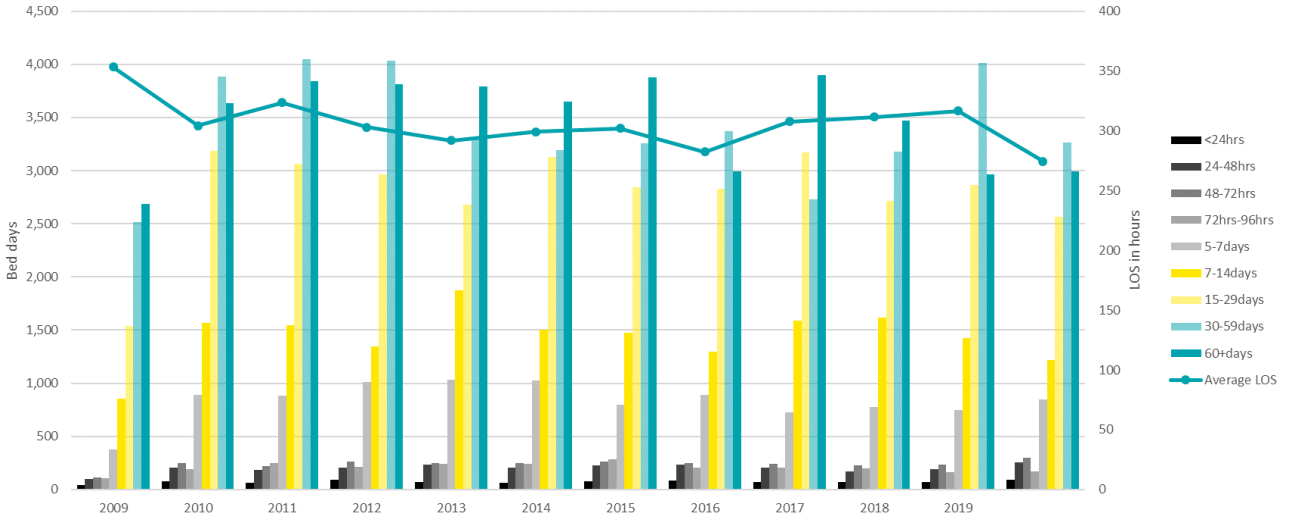
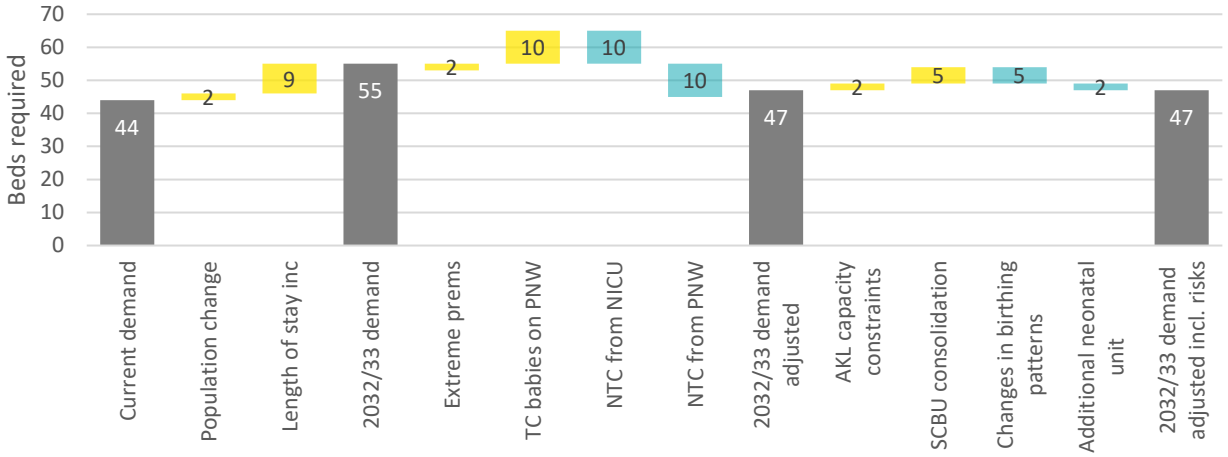


Figure 8: NICU / SCBU length of stay and bed-days
Source: ADHB, EY analysis

Modelling to inform NICU / SCBU and NTC

The following graph and table highlights the demand projection for NICU / SCBU and provides further information on key assumptions.



		2017/18	2022/23	2027/28	2032/33
Baseline projection	Age and flow specific projected beds at 10AM max	44	53	56	55
	Baseline demand increases	-	+9	+3	-1
Factors that could increase demand	MFM models of care	-	-	-	-
	Increases in extremely premature neonates	-	+1	+1	-
	Transitional care babies on PNW (based on no NTC)	-	+10	-	-
Factors that could offset demand	Neonatal transitional care (ADHB-only assuming all babies from NICU have priority)	-	-10	-	-
	Neonatal transitional care (transitional care babies on PNW)	-	-10	-	-
Total adjusted		44	44	48	47
Risks that could impact on demand	Metro-Auckland capacity constraints (Counties Manukau does not keep pace with demand)	-	+2	-	-
	Consolidation of SCBU configuration (Waitemata sends higher complexity neonates to Auckland)	-	+5	-	-
	Paediatric Surgery consolidation	-	-	-	-
	Changes in mothers' birthing decisions (Counties Manukau mothers choose Middlemore, excluding complex cases)	-	-4	-1	-
	Additional Neonatal Unit in Region (Waitemata develops a Level 3 unit and repatriation occurs)	-	-2	-	-
Total adjusted incl. risks		44	45	48	47

Neonatal transitional care was also sized based on two cohorts, those currently cared for on the PNW and NICU / SCBU graduates:

- Based on a PNW audit it was identified between 9-11 beds could be utilised by dyads currently being cared for on the PNW
- Based on administrative data, it was identified that between 10-11 beds could be utilised by dyads where the neonate is currently being cared for in NICU / SCBU and where the dyad is domiciled in Auckland DHB (if this was not the case then it would require 19-21 beds)

Overall this comes to 19-22 beds if the service was accessed by dyads who met the criteria from the PNW as well as NICU / SCBU graduates and their mothers if they were Auckland DHB domiciled.