EVIDENCE REVIEW

Intensive Care NSW

Intensive Care Unit Exit Block Project

Evidence Review

NSW GOVERNMENT

AGENCY FOR CLINICAL INNOVATION

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Glossary

After-hours discharge	Patient discharge from ICU that occurs after-hours, typically defined as between 6pm - 6am.
ICU exit block	Occurs when there is a delay between the patient being medically cleared for transfer out of the ICU and the time of the transfer.
Patient flow	A series of transitions in care as patients move through different parts of the hospital.

Abbreviations

AB	Access block
AHD	After-hours discharge
ANZICS	Australian New Zealand Intensive Care Society
APACHE	Acute Physiology and Chronic Health Evaluation
DRG	Diagnostic related groups
ED	Emergency department
IC	Intensive care
ICU	Intensive care unit
LOMT	Limitations of medical therapy
LOS	Length of stay
MeSH	Medical subject headings

Contents

Introduction

Aim

This review of evidence has been undertaken to identify key processes and strategies that improve patient flow through hospitals, with particular focus on reducing intensive care unit (ICU) exit block. The review was done to support the Reducing ICU Exit Block project and to address the following research questions.

Primary research question

- Do strategies to reduce exit block and after hours discharge (AHD) of patients from ICUs affect:
    - timely access to intensive care (IC) beds for critically ill patients
    - length of stay
    - adverse events
    - patient experience
    - mortality?

Secondary research questions

- What factors do clinicians and ICU managers believe contribute to exit block?
- What strategies do clinicians and ICU managers think will reduce exit block and AHD?

Method

The review was undertaken in several stages. First a search was undertaken using MeSH headings (see Appendix 1). Following this a review of relevant grey and associated literature was undertaken to ensure broad coverage. The NSW Ministry of Health also commissioned a literature review regarding patient flow that has been reviewed to inform this summary. Where relevant the original references have been reviewed. Papers included a mix of experimental, observational mixed method designs and discussion papers.

Emerging themes

Much of the experimental literature regarding exit block focuses on emergency department (ED) performance. More recently there has also been a focus on patient flow through the ICU (both access and exit block), although many studies examine factors associated with exit block rather than evaluating strategies to reduce this problem. There has also been an increasing focus on patient flow as a whole of hospital issue, requiring a systems view and multiple strategies focused on key issues affecting each hospital. The available literature has been considered together and key findings grouped into themes to inform the ICU Exit Block Project.

Document structure

This document provides a summary of the key articles relevant to ICU exit block, and the theory that patient flow requires a whole of hospital approach.

This document has been structured in the following sections to meet the needs of the project team and support communications about the project.

- An analysis of key issues and the literature reviewed.
- An overview of primary themes identified
- Detail of themes and subthemes with the relevant literature
- Brief summaries of the key articles reviewed has also been provided for additional information.

Summary of review

ICU exit block is one measure of patient flow through a hospital and occurs when there is a delay between the patient being medically cleared for transfer out of the ICU and the time of the transfer. Exit block is associated with after-hours transfer, where the patient is moved out of the ICU to a ward environment between 6pm - 6am (1).

Patient flow involves a series of transitions in care as patients move through different parts of the hospital (2). Smooth patient flow ensures patients 'have access to the right care, at the right time, and in the right place, with minimum waiting times' (3). Delayed transitions can 'threaten patient safety, hinder communication and worsen patient outcomes' (2)(p.534), and waste valuable hospital resources (4). Inefficient patient flow has also been associated with increased staff dissatisfaction and high work pressure (2).

There is evidence that ICU exit block, after-hours admission and discharge to IC are associated with poorer patient outcomes, reduced IC capacity and increased costs (5-7). The impact on patient outcomes includes increased risk of mortality (5, 8, 9). ICU exit block is associated with poor long-term outcomes, including longer time in the ICU. That may increase risk of acquired disability, associated with prolonged inactivity in an ICU, and increase overall hospital length of stay (10, 11).

After-hours discharges are associated with greater exit block from the ICU and are more likely to be premature, (5, 8, 12, 13) although the association with adverse patient outcomes is less clear. While most studies have reported higher mortality(8), a more recent study using robust modelling demonstrated no increase in mortality after adjusting for patient acuity, complexity of ongoing care needs and medical treatment limitation orders (14). Measuring the impact of AHD on patient outcomes is complex, but is likely to reduce the quality of the transfer of care and communication with both patients and their families when patients are discharged after hours (14-16).

There some evidence that some patients whose discharge from ICU is delayed report poor experience associated with lack of sleep, difficulty with mobility and visitor access due to the noisy busy environment of the ICU (17). Conversely, some published studies suggest patients are often anxious about leaving the security of the ICU to go to a general ward, with lower staff ratios and lower levels of technical skill to manage critically ill patients. Recommendations to improve patient experience during transitions in care include improved multimodal communication, addressing hospital and unit culture, standardising discharge tools, orientation to the ward and patient education (17). The impact on patient experience and outcome of both ICU exit block and AHD warrant further attention.

The effect on the costs and efficiency of IC are clearer. The problem is common: up to 45% of admissions and 48% of IC discharges occur between 6pm and 6am (6). In NSW in 2014 exit block contributed to a loss of approximately 80 000 IC hours at an estimated cost of over $15 million.(18) The results of internal analyses of unpublished data suggested the lost capacity costs attributed to ICU exit block in 2017 amounted to over $25 million worth of IC capacity. Inability to access IC beds can affect the timely transfer of ED patients, ED access and ED performance in emergency treatment performance targets (19). This also results in a delay in optimal IC management for critically ill patients outside of the ICU (5, 20). Access and exit block appear to be significant issues for the NSW ICUs that have worse (outlier) standardised mortality rate outcomes compared to peers (unpublished data, ACI). ICU and hospital exit block and sub-optimal patient flow can also lead to increased staff burden and stress (21).

Strategies to improve patient flow through the ICU will also improve patient outcomes for those critically ill patients waiting to be admitted into the ICU. When ICU access block occurs there is an increased risk of mortality when units choose to move patients to another hospital (inter-hospital transfer), or patients are kept waiting in ED longer than 8 hours. This can result in both premature and after-hours ICU discharges (5).

Patients who have been admitted to the ICU are likely to have ongoing complex needs and undergo several transitions through different parts of the hospital before going home. As such they should be considered for more comprehensive and proactive discharge planning support to better meet their complex needs and minimise time in the ICU and overall hospital stay (13, 22).

Optimal patient flow is associated with the provision of safe, high quality care, patient satisfaction, improved access and reduced costs (23). As such, improving the flow of patients through the acute care setting is a key focus of clinicians, hospital operators, consumers, regulators and governments (24). Intensive care units provide a critical function that supports the whole of the hospital and informs the level of patient acuity and surgical procedures that can be safely managed. Improving patient flow is also imperative to meet growing demand on constrained health resources and support the delivery of value based health care. Hospitals, including the ICU, would be able to manage more patients if efficiency improved.

Supporting smooth patient flow is complex and requires hospitals to match appropriate resources to meet demands and apply processes that support timely progression of patients through the system as their needs change. Quality improvement methods are appropriate to address problems with patient flow. These methods can handle the complex interactions of hospital systems to assess and drive change that accommodates local issues and structures (4). There is increasing evidence that strategies using a quality improvement approach can improve patient flow through ICUs and hospitals (25, 26). In the ICU, organisational changes, such as intensivist staffing and closed medical models, are reported as having grater association with reduction in ICU mortality in the past decade than changes in medications or treatments (27).

Health organisations contribute substantial funding into quality assurance initiatives, as these enable interventions to be tailored to address local contextual issues and the complexity of hospital structures. While there is an array of evidence using different settings, quality improvement methods and outcomes, careful planning is needed with strong executive support to achieve sustained improvements in patient flow.

There is an increasing recognition that patient flow requires a whole of hospital approach to achieve success (15). Focusing on individual units in isolation can lead to greater problems elsewhere in the system (28, 29). For example the introduction of the 4-hour rule in the ED has been associated with increased ICU exit block (28). Implementing protected beds for ED, theatre or ICU patients is not recommended, as while this can achieve gains at times, this strategy reduces overall hospital capacity when ward beds are left empty (29). Individual strategies need to be considered and evaluated for potential impacts on other patient flow performance indicators. Changing patient flow performance has other knock on effects too. For example if the average hospital length of stay (LOS) decreases this can pose extra demands on other services, including the need for more frequent cleaning, portering, allied health, tests, scans, etc. While most of the evidence regarding patient flow quality initiatives focuses on reduction in ED performance, this isn't surprising considering ED performance is a key indicator of hospital performance in Australia and elsewhere (4). More recently there are a growing number of studies evaluating transitions of care between departments including ED and ICU, and ICU and the wards (28, 30).

‘Effective patient flow requires systems that foster seamless continuity of care’ (13). This is true of the whole hospital as well as individual units within it. ‘Many factors impact on patient flow and reducing ICU discharge delays requires a collaborative, multifactorial approach which adapts to changing organisational policy on patient flow through ICU and the hospital, not just the discharge process in ICU’ (13). Supporting patient flow is a complex whole of hospital issue. Strategies to target the whole of the hospital journey will likely be required, such as front door policies to improve hospital admissions, demand and capacity management, improving the capacity of all services within the hospital and ensuring timely efficient discharges processes when patients are ready to leave the hospital (31). While some strategies will focus on unit specific issues, the improvement plan needs careful coordination to predict and manage any consequent impact on other departments, and to enable the most effective strategies to be identified (32).

A carefully planned program of initiatives is likely to achieve the best results, evaluating the success of each strategy carefully. Micro-processes are often amendable to quality improvement projects but may not have the same impact as other organisational approaches (4, 33). Not all strategies that have been tested are effective. Provision of general practitioner services in EDs has not impacted on hospital or ED patient flow performance. In the ICU, Williams (2010) reported a critical care outreach service was not associated with improvement in hospital LOS, readmission rate or hospital mortality. However it’s unclear how this was different to the ICU liaison nurse or medical emergency call team that do have evidence of patient flow benefits (34).

There are an increasing number of resources to support development of robust quality improvement methods and reporting to guide this complex work (15, 24, 29, 33, 35-37). Clinical redesign and lean thinking methodologies have been applied to solve patient flow for many years, although current evidence suggests they must be undertaken with strong executive and clinical leadership (38). Access and exit block are Australian Council on Healthcare Standards ICU clinical indicators, but collecting accurate information is difficult using current data systems. Ker (2018) advocated the need to harness hospital information systems to support patient flow, and this is consistent with the increasing literature on patient flow improvement theories and studies (39).

Strategies will also need to address more specific aspects of patient flow. The most common reason for ICU exit block in several studies is lack of ward bed availability. To address this, strategies to increase hospital capacity including on the wards need to be implemented (10, 13, 33, 37). There will be other benefits to improving capacity. Litvak (2010) noted that optimum efficiency (achieved after elimination of artificial causes of variability) is necessary before an accurate assessment of the bed numbers and staffing needed in any unit can be reliably determined (4). The identification and implementation of strategies to improve patient flow and reduce ICU exit block will inform more reliable future planning for ICU and hospital resource needs.

Patient flow is a complex problem and evidence suggests there are several key features of successful programs to improve patient follow performance.

Overview of primary themes

1. **Factors associated with ICU exit block** including patient and local unit factors.

2. **Quality improvement methods that are effective at improving patient flow.**

3. **Systems view of assessing and managing patient flow performance**, **setting priorities for improvement and measuring effectiveness.** Systems involve interconnection of people, processes and environments, and local changes can have unintended consequences in the system). This approach avoids assumptions and assesses the impact of competing priorities and demands.

4. **Strong leadership, hospital culture and teamwork** have been shown to be essential to support improved and sustained performance in patient flow in the facility and ICU.

5. **Real time accurate data on patient flow, capacity and demand** that can be accessed by a range of hospital staff and executive, and includes information technology systems and devices and the skills to use them.

6. **Proactive data driven approaches to predict and manage demand and capacity.** These can including advanced data analytics, predictive modelling, real time demand management and queuing processes for the facility and different subgroups of the hospital and patient cohort. This allows sites to ensure sufficient capacity to meet variation in demands specific to the site, unit and patient group.

7a. **Increase hospital and unit capacity.** Lack of bed availability is the most frequent reasons given for ICU exit block and increasing capacity should reduce waiting times in other parts of the hospital.

7b. **Improve capacity through improved more efficient discharge.** While this is related to the themes above there were many specific subthemes related to improving the efficiency of hospital and ICU discharge.

8. **Micro-processes to improve local patient flow factors** in the hospital and ICU, including admission and discharge criteria, also processes within the ICU for accessing testing and managing occupancy.

Description of sub-themes

Theme 1: Factors associated with ICU exit block

Sub themes	References
Greater patient acuity on ICU admission.	• Tiruvoipati, 2017 (10) • Santamaria, Duke, Pilcher, et al, 2014 (14) • Williams, Leslie, 2004 (40)
Complexity of patient condition and management in ICU.	• Santamaria, Duke, Pilcher, et al, 2014 (14)
Patient deterioration while waiting for transfer to the ward.	• Williams, Leslie, 2004 (40)
Principal admitting diagnosis (including sepsis and non-cardiac surgical patients) may have a bigger impact on patient flow rather than other patient groups. Some but not all studies have been able to report a significant association. Mechanically ventilated non-trauma patients also associated with slower patient flow through ICU.	• Williams, Leslie, 2004 (40) • Hung, Kung, Hung, et al, 2014 (41) • Tiruvoipati, 2017 (10) • Santamaria, Duke, Pilcher, et al, 2014 (14)
Discharge destination including patients transferred to trauma, orthopaedic, neurosurgery, surgical, medical, high dependency units.	• Williams, Leslie, 2004 (40) • Tiruvoipati, 2017 (10)
Day of discharge: weekend discharge, discharge on Monday or Sunday	• Williams, Leslie, 2004 (40) • Williams, Leslie, Brearley, et al, 2010(13)
Patients who have had a longer hospital stay LOS.	• Williams, Leslie, Brearley, et al, 2010 (13) • Tiruvoipati, 2017 (10)
No bed availability on ward (need to increase capacity).	• Williams, Leslie, Brearley, et al, 2010 (13) • Tiruvoipati, 2017 (10)
Introduction of and increasing compliance with ED 4-hour discharge rule (increased compliance).	• Van Heerden, Blott, Pinder, et al, 2013 (28)
Ward staff capacity to manage ICU patients: knowledge and skills of ward staff and number of staff needed to perform complex interventions.	• Van Sluisvel, Oerlermans, Westert, et al, 2017 (30)

Theme 2: Quality improvement methods that are effective at improving patient flow

Sub themes	References
Lean methodologies but only with strong executive leadership and staff engagement (otherwise not effective at achieving sustained change). Waiting times along journey and impact of these, allows options to be explored and potential impact of patient flow estimated.	• Bucci, de Belvis, Marventiano, et al, 2016 (38) • De Silva, 2013 (33) • Showell, Keen, Cummings, et al, 2012 (24)
Queuing theory and analyses.	• Bucci, de Belvis, Marventiano, et al, 2016 (38) • De Silva, 2013 (33) • Howell, 2011 (42) • Litvak, 2010 (4) • Showell, Keen, Cummings, et al, 2012 (24)
Simulation modelling.	• De Silva, 2013 (33) • Hsieh, Lee, Hsu, et al, 2016 (20) • Litvak, 2010 (4) • Luo, Cao, Gallagher, et al, 2013 (43) • Qin, 2017 (44)
Statistical process control.	• De Silva, 2013 (33)
Prediction modelling regarding expected demand and capacity.	• Bucci, de Belvis, Marventiano, et al, 2016 (38) • Litvak, 2010 (4) • Qin, 2017 (44) • Showell, Keen, Cummings, et al, 2012 (24)
Failure mode and effects analysis (process map and analyses on specific patients with interpretation of reasons for delays).	• De Silva, 2013 (33)
Time in motion studies (Note there are apps designed for healthcare available).	• De Silva, 2013 (33)

Sub themes	References
Audit and feedback processes regarding patient flow performance including what strategies are effective at improving patient flow.	• Bucci, de Belvis, Marventiano, et al, 2016 (38); • De Silva, 2013 (33); • Litvak, 2010 (4); • Showell, Keen, Cummings, et al, 2012 (24) • Van Sluisvel, Oerlermans, Westert, et al, 2017 (30);
Measure and report on compliance with admission and discharge criteria should be required.	• Bucci, de Belvis, Marventiano, et al, 2016 (38) • Litvak, 2010 (4); • Van Sluisvel, Oerlermans, Westert, et al, 2017 (30);
Staff aware of diagnostic information on patient flow and results of quality improvement initiatives.	• Bucci, de Belvis, Marventiano, et al, 2016 (38) • De Silva, 2013 (33);
Redesign discharge processes including to rehabilitation and mental health.	• Karakusevic, 2016 (29)
Critical path method – aim to reduce delays.	• Litvak, 2010 (4)
Variability methodology. This approach considers different causes of variability: • clinical variability • flow variability • care variability (operation duration, LOS, care provided) • artificial variability (which should be eliminated as much as possible) e.g. dysfunctional scheduling for elective surgery. Variability methodology proposes patient flow initiatives need to consider homogenous subgroups separately. • ED – separating fast track from high acuity patients • Elective versus emergency admissions • Short stay versus long stay admissions e.g. elderly or complex patients • Smooth admission of elective cases to balance demands in emergency admissions and plan resources required for smooth flow of each subgroup.	• Bucci, de Belvis, Marventiano, et al, 2016 (38) • Litvak, 2010 (4) • Showell, Keen, Cummings, et al, 2012 (24)

Theme 3: Systems view of assessing patient flow performance, priorities for improvement and measurement of effectiveness

Sub themes	References
Systems view of assessing and managing patient flow performance, setting priorities for improvement and measuring effectiveness.	• Karakusevic, 2016 (29) • Kreindler, 2016 (45) • Rutherford, Provost, Kotagal, et al, 2017 (37) • Showell, Keen, Cummings, et al, 2012 (24)
Whole of hospital patient flow strategies required to sustain reduction in ED access block.	• Forero, McCarthy, Hillman, 2011 (46) • Mason, Knowles, Boyle, 2017 (32) • Showell, Keen, Cummings, et al, 2012 (24)
Implementing system wide change to increase capacity is better than single initiatives.	• Kreindler, 2016 (45) • Mason, Knowles, Boyle, 2017 (32) • Showell, Keen, Cummings, et al, 2012 (24)

Theme 4: Strong leadership, hospital culture and team work

Sub themes	References
Strong leadership.	• De Silva, 2013 (33) • Bucci, de Belvis, Marventiano, et al, 2016 (38) • Litvak, 2010 (4) • McClelland, Bena, Albert, et al, 2017 (30) • Showell, Keen, Cummings, et al, 2012 (24) • Van Sluisvel, Oerlermans, Westert, et al, 2017 (30)
Hospital culture – to patient flow, change and innovation.	• de Grood, Parsons, Bagshaw, et al, 2018 (17) • De Silva, 2013 (33) • Litvak, 2010 (4) • McClelland, Bena, Albert, et al, 2017 (30) • Showell, Keen, Cummings, et al, 2012 (24) • Van Sluisvel, Oerlermans, Westert, et al, 2017 (30)
Strong staff engagement in supporting patient flow and quality initiatives.	• Kreindler, 2016 (24) • Litvak, 2010 (4) • McClelland, Bena, Albert, et al, 2017 (30) • Showell, Keen, Cummings, et al, 2012 • Van Sluisvel, Oerlermans, Westert, et al, 2017 (30)
Communication strategies: executive walk arounds to discuss patient flow, clear messaging from executive and staff engagement that patient flow is everyone's responsibility, importance of using data.	• Rutherford, Provost, Kotagal, et al, 2017 (37)
Team training and collaboration especially focused on across organisation and interdisciplinary collaboration and training.	• De Silva, 2013 (33) • Lin, Chaboyer & Wallis (15) • Van Sluisvel, Oerlermans, Westert, et al, 2017 (30)

Theme 5: Real time accurate data on patient flow, capacity and demand

Sub themes	References
Real time meaningful patient flow and service provision data to manage demand and capacity.	• De Silva, 2013 (33) • Litvak, 2010 (4) • McClelland, Bena, Albert, et al, 2017 (2) • Showell, Keen, Cummings, et al, 2012 (24)
Staff in hospital have access to real time patient flow data, including who are local contacts, updating medications at discharge.	• Litvak, 2010 (4) • Van Sluisvel, Oerlermans, Westert, et al, 2017 (30)
Technical solutions for hospital staff to manage and access real time patient flow data.	• Ker, 2018 (39) • Litvak, 2010 (4)
Matching workforce and rost7ring to demand and capacity predictions, e.g. explore new roles such as discharge planners, increase support staff at time of peak activity (high patient admission, transfer or discharge), match doctor rosters to patient arrivals.	• De Silva, 2013 (33)
Devices so staff can enter and use data in real time.	• De Silva, 2013 (33) • Van Sluisvel, Oerlermans, Westert, et al, 2017 (30)
Patient journey boards including knowledge of number of patients waiting for admission in ED, etc.	• De Silva, 2013 (33) • Showell, Keen, Cummings, et al, 2012 (24)
Better measurement and management of patient flow	• Howell, 2011 (42) • Karakusevic, 2016 (29) • Ker, 2018 (39) • McClelland, Bena, Albert, et al, 2017 (2)

Theme 6: Proactive data driven approaches to manage demand and capacity

Sub themes	References
Data driven hospital wide operational management system for patient flow; predictive modelling of demand and capacity, real time demand data and management.	• Litvak, 2010 (4) • Nates, 2016 (22) • Rutherford, Provost, Kotagal, et al, 2017 (37) • Showell, Keen, Cummings, et al, 2012 (24)
Implementing plans to address bottlenecks based on predicted capacity and demand.	• Bucci, de Belvis, Marventiano, et al, 2016 (38) • Karakusevic, 2016 (29) • Showell, Keen, Cummings, et al, 2012 (24)
Proactive review of patient flow data throughout the patient journey and across episodes of care to identify priorities for improvement, including for: • times of peak occupancy and peak flow times (high demand) • separate groups, such as separate elective, short stay, long stay, diagnostic related groups • reasons for patient flow delays including frailty, complex comorbidities, diagnostic related groups (DRG) with long LOS (e.g. >7 days).	• Bucci, de Belvis, Marventiano, et al, 2016 (38) • Howell, 2011 (20) • Hung, Kung, Hung, et al, 2014 (41) • Litvak, 2010 (4) • Nates, 2016 (22)
Operations management plans based on modelling, including scheduling surgery and support services (imaging, pathology, cleaning) and doctors for times of peak activities (e.g. rostering more cleaners at times of high discharge activity), with the aim of maintaining a fairly consistent predictable day to day census.	• Karakusevic, 2016 (29) • Kreindler, 2016 (45) • Litvak, 2010 (4)
Manage occupancy rates. Aim for less than 85%. Note high occupancy is associated with exit block.	• Forero, McCarthy, Hillman, 2011 (46) • Mason, Knowles, Boyle, 2017 (32)
Standard approach to bed management and unit patient flow huddles including standard definitions (transfer, discharge, etc.).	• De Silva, 2013 (33)

Theme 7a: Increase hospital and unit capacity

Sub themes	References
Increase hospital capacity.	• Forero, McCarthy, Hillman, 2011 (46) • Rutherford, Provost, Kotagal, et al, 2017 (37) • Tiruvoipati, 2017 (10)
Reduction in avoidable complications.	• Rutherford, Provost, Kotagal, et al, 2017 (37)
Reduction in low value care and unnecessary interventions, tests and procedures.	• Howell, 2011 (21) • Rutherford, Provost, Kotagal, et al, 2017 (37)
Elimination of steps and processes that don't improve patient flow, e.g. supplicated requests for beds (phone calls, emails, SMS, paper forms, data systems).	• Bucci, de Belvis, Marventiano, et al, 2016 (38) • De Silva, 2013 (33) • Howell, 2011 (20)
Integrated care models.	• Rutherford, Provost, Kotagal, et al, 2017 (37)
Improved communication and coordination with community based care services, particularly for complex patients (including mental health, frail older people).	• de Grood, Parsons, Bagshaw, et al, 2018 (17) • Rutherford, Provost, Kotagal et al, 2017 (37) • Showell, Keen, Cummings, et al, 2012 (24)
Improved handover, communication and coordination between ICU and general wards.	• de Grood, Parsons, Bagshaw, et al, 2018 (17) • Van Sluisvel, Oerlermans, Westert, et al, 2017 (30)
Advanced care planning and better use of palliative care. Provide hospital based palliative care. Initiate advanced care planning for complex or frequent patients.	• Rutherford, Provost, Kotagal, et al, 2017 (37)
Standardise hospital admission and discharge policies.	• de Grood, Parsons, Bagshaw, et al, 2018 (17) • De Silva, 2013 • Tobinm, Santamaria (8)
Compliance with hospital admission and discharge policies.	• Litvak, 2010 (4)

Theme 7b: Improve capacity through improved more efficient discharge

Sub themes	References
Early comprehensive assessment for discharge planning (not all studies show improved patient flow but all demonstrate improved patient experience). Could be clinical pathways specific e.g. hip or knee joint arthroplasty etc.	• de Grood, Parsons, Bagshaw, et al, 2018 (17) • De Silva, 2013 (33) • Rutherford, Provost, Kotagal, et al, 2017 (37) • Showell, Keen, Cummings, et al, 2012 (24)
Early community referrals.	• De Silva, 2013 (33) • Showell, Keen, Cummings, et al, 2012 (24)
Proactive approach from all staff, not just discharge planners.	• De Silva, 2013 (33) • Lin, Chaboyer, Wallis (15) • Showell, Keen, Cummings, et al, 2012 (24)
Completion of only necessary diagnostic tests.	• Rutherford, Provost, Kotagal, et al, 2017 (37)
Transfer of care plans.	• de Grood, Parsons, Bagshaw, et al, 2018 (17) • Rutherford, Provost, Kotagal, et al, 2017 (37) • Van Sluisvel, Oerlermans, Westert, et al, 2017 (30)
Communication of discharge plan, including rural patients (hospital), and for ICU discharge.	• de Grood, Parsons, Bagshaw, et al, 2018 (17) • De Silva, 2013 (33) • Lin, Chaboyer, Wallis (15) • Showell, Keen, Cummings, et al, 2012 (24) • Van Sluisvel, Oerlermans, Westert, et al, 2017 (30);
Improved coordination and communication between members of the multidisciplinary team.	• de Grood, Parsons, Bagshaw, et al, 2018 (17) • Rutherford, Provost, Kotagal, et al, 2017 (37) • Lin, Chaboyer, Wallis (15) • Showell, Keen, Cummings, et al, 2012 (24)

Sub themes	References
Social worker or case manager for complex patients (frail older people, complex comorbidities, social disadvantage, cognitive or behavioural impairments).	• Rutherford, Provost, Kotagal, et al, 2017 (37)
Risk screening.	• De Silva, 2013 (33) • Nates, 2016 (22)
Expedite discharge for short stay patients to increase hospital income.	• Karakusevic, 2016 (29)
ICU liaison nurse (reduced ICU and hospital mortality, reduced exit block, unclear association with readmission rates). Three time reduction in exit block.	• Chaboyer, 2006 (47) • Endacott, 2009 (48)
Improve admission practice during off-peak hours will reduce ED access block.	• Luo, Cao, Gallagher, et al, 2013 (43)
Checklists and criteria for ICU discharge.	• de Grood, Parsons, Bagshaw, et al, 2018 (17) • Van Sluisvel, Oerlermans, Westert, et al, 2017 (30)
ICU discharge summaries (particularly computer generated) including structured verbal handover.	• de Grood, Parsons, Bagshaw, et al, 2018 (17) • Lin, Chaboyer, Wallis (15) • Van Sluisvel, Oerlermans, Westert, et al, 2017 (30)

Theme 8: Micro-processes to improve local patient flow factors

Sub themes	References
Delays and management for access to laboratory tests, diagnostic imaging, procedures and preadmission clinic.	• Litvak, 2010 (4)
Every unit should have admission and discharge criteria. Admission criteria should consider patient characteristics, clinical service, care needs and unit capabilities. Discharge criteria should consider patient's care progress and needs.	• de Grood, Parsons, Bagshaw, et al, 2018 (17) • Lin, Chaboyer, Wallis (15) • Litvak, 2010 (4) • Nates, 2016 (22) • Van Sluisvel, Oerlermans, Westert, et al, 2017 (30)
Each department has a surge plan for high occupancy and approaching and managing over capacity.	• Litvak, 2010 (4)
Using systems more effectively to flag patients who are ready for discharge.	• Litvak, 2010 (4)
Redesigning processes to fast track progress, e.g. ward clerk calls cleaners directly when discharge known.	• Litvak, 2010 (4)
Streamlined process of communication and recording of medically cleared patients for ward.	• Showell, Keen, Cummings, et al, 2012 (24) • Williams, Leslie, 2004 (40)

Summary of articles

The following articles were reviewed and a summary of the findings is provided to inform the *ICU Exit Block Project* (listed in alphabetical order).

Bucci S, de Belvis A, Marventiano S, et al. Emergency department crowding and hospital bed shortage: Is Lean a smart answer? A systematic review. 2016. (38)

- Nine pre and post studies examining Lean methods in healthcare, management of patient flow was main intervention.
- All but one study demonstrated improved ED performance including ED volume, decreased ED LOS, number of patients left without being seen, reduced costs and increased patient satisfaction.
- Unable to draw clear conclusions as one study reported worse results for number of patients who left without being seen but demonstrated decrease in waiting time to first visit and patient volume increase.
- Chadua (2012) included Lean and queuing theory (mathematical model to determine the waiting times of the queue). Patients streamed into three categories using variability management and continuous flow cell creation to reduce bottlenecks.
- White (2014) reviewed multiple Lean methods including Six Sigma, queuing theory, demand and capacity management, theory of constraints, managing variation, forecasting and scenario analyses. Used leadership involvement, staff engagement, audits.
- The King (2006) study involved streaming according to acuity (homogenous groups, variability management) and saw reduction in ED LOS and number of admissions.
- Dickson (2008) used manager and staff education regarding patient flow, design through variability management (improved patient satisfaction, reduced cost, ED LOS decrease). Dickson separated sites with different levels of leadership support. No leadership support did not achieve gains in patient flow improvement.
- Strong systematic review examined quality of studies and demonstrated variety of clinical redesign and lean methodologies to improve patient flow performance. Recommended more high quality studies needed.

Chaboyer W, Thalib L, Foster M, et al. The Impact of an ICU Liaison Nurse on Discharge Delay in Patients after Prolonged ICU Stay. 2006. (47)

- Investigated impact of ICU liaison nurse on reducing ICU exit block using prospective block intervention study, using Australian New Zealand Intensive Care Society (ANZICS) data. Data matched for dates of admission with dates the block intervention (introduction of role of liaison nurse) provided.
- No patient characteristics significantly different between delayed and non-delayed.
- Delay more than two hours and more than four hours used.

- Risk-adjusted logistic regression to quantify risk of exit block associated with discharge liaison role adjusting for potential confounders (age, gender, weekend versus weekday, after hours discharge, ICU LOS, surgical or medical, emergency or elective.
- Those who received ICU liaison nurse care were three times less likely to experience discharge delay or exit block.
- Strong study.

De Silva D. Evidence Scan: Improving patient flow across organisations and pathways. 2013. (33)

- Quality improvement processes with evidence of improving patient flow include:
    - Lean methodologies but only with strong executive leadership and staff engagement
    - failure mode and effects analysis (process map and analyses on specific patients with interpretation of reasons for delays)
    - time in motion studies (apps designed for healthcare available)
    - audit and feedback processes for patient flow performance including what strategies are effective at improving patient flow.
- Discharge planning
    - Risk screening
    - Early community referrals
    - Communication of discharge plan – including rural patients
    - Could be clinical pathways specific e.g. hip or knee joint arthroplasty, etc.
- Hospital processes and policies
    - Standardise hospital admission and discharge policies
    - Standard approach to bed management and unit huddles including standard definitions (transfer, discharge etc.).
- Hospital culture around patient flow, change and innovation
    - Team training and collaboration especially focused on across organisation and interdisciplinary collaboration and training.
- Data and analyses
    - Devices so staff can enter and use data in real time
    - Patient journey boards
    - Staff aware of diagnostic information on patient flow and results of quality improvement initiatives
    - Real time data to manage demand and capacity

- Matching workforce and rostering to demand and capacity predictions e.g. explore new roles such as discharge planners, increase support staff at time of peak activity (high patient admission, transfer and discharge), match doctor rosters to patient arrivals
- Modelling regarding impact of changes in patient flow processes and performance
- Queuing analyses
- Statistical process control.

De Grood C, Parsons J, Bagshaw S, et al. Patient, family and provider experiences with transfers from intensive care unit to hospital ward: a multicentre qualitative study. 2018. (17)

- Recommendations to improve patient experience during transitions in care include improved multimodal communication, addressing hospital and unit culture, standardised discharge tools, orientation to the ward and patient education.
- 'Transitions of care between the ICU and hospital ward are challenging and high risk. Key stakeholders describe 3 overarching themes perceived as barriers or facilitators to high-quality patient transfers: resource availability, communication and institutional culture. Patients and providers have distinct (e.g. process-vs. experience-oriented) but largely overlapping perspectives. They suggest implementing standardized multimodal communication and procedures to manage common delays in patient transfer.'
- Excellent article about patient experience related to ICU exit block.

Duke GJ, Buist MD, Pilcher D, et al. Interventions to circumvent IC AB: a retrospective 2-year study across metro Melbourne. 2009. (5)

- Used ANZICS data from 11 ICUs.
- Interventions in response to ICU access block are often associated with increased risk of mortality including when units choose to move patient to another hospital (inter-hospital transfer), or patients are kept waiting in ED longer than 8 hours, and both premature and after hours ICU discharges.
- Study used de-identified data from several sources so did not link data.
- Sophisticated risk estimates for factors derived from literature using raw data.
- Risk of mortality increased with AHD and premature ICU discharge and inter-hospital transfer.
- Strong study.

Endacott R, Eliott S, Chaboyer W. An integrative review and meta-synthesis of the scope and impact of intensive care liaison and outreach services. 2009. (48)

- ICU liaison nurse found to reduce ICU and hospital mortality and discharge delay. Uclear effect on ICU readmission as may increase number due to early detection of patient deterioration, improved communication networks between critical care and ward settings and staff.
- Describes benefits of pragmatic trials of interventions in real life settings, where not everyone receives the same intervention; describes nursing role effectiveness model as framework for evaluating services.
- Systematic review completed and meta-analysis.

Forero R, McCarthy S, Hillman K. Access block and overcrowding: A literature review. 2011. (46)

- Whole of hospital patient flow strategies required to sustain reduction in ED access block. Need to increase capacity of beds at all levels of care.
- Access block defined as waiting in ED longer than four hours before transfer.
- Hospital occupancy over 85% contributes to ED exit block.

Gantner D, Farley K, Bailey M, et al. Mortality related to after-hours discharge from intensive care in Australia and New Zealand, 2005-2012. 2014. (9)

- After hours discharge is associated with increased risk of adverse patient outcomes including mortality and ICU readmission.
- ANZICS data 2005-2012 (N=710,535) demonstrated 15.4% AHD rate and increased risk of adverse event outcomes maintained over the eight years despite an overall decline in ICU mortality.

Howell MD. Managing ICU throughput and understanding ICU census. Current Opinion in Critical Care. 2011. (42)

- ICUs need additional tools to manage high ICU census, as building more beds is not always the solution.
- Higher ICU census should be accompanied by compensatory surges in nursing capacity.
- Queuing analyses (Little's Law) provides a practical approach for managing ICU census and throughput.
- This supports units to minimise steps that don't add value for the patient (e.g. waiting for a bed at ICU discharge) and maximising process steps that do add value (daily wake-ups, spontaneous breathing trials, early occupational therapy and physiotherapy). High value processes can reduce ICU LOS and help manage ICU census.

Hsieh C-C, Lee C-C, Hsu C, et al. Impact of delayed admission to intensive care units on patients with acute respiratory failure. 2016. (20)

- Impact of access block into ICU on outcomes for people with acute respiratory failure in Taiwan, Jan - Aug 2013, N=267.
- Patients with acute respiratory failure who were mechanically ventilated had increased risk of longer ICU stay and mortality if admission into ICU was delayed by more than one hour.

Hung SC, Kung CT, Hung CW et al. Determining delayed admission to intensive care unit for mechanically ventilated patients in the emergency department. 2014). (41)

- Non-traumatic adult patients on mechanical ventilation in ED, 2009-2010, N=1242.
- Delayed ICU admission affected mortality for patients on ventilator support over 21 days, prolonged hospital LOS (and associated increased costs).

Karakusevic K. Briefing: Evidence for better patient flow. 2016. (29)

- Better measurement and management of patient flow.
- Predicting capacity and demand and implementing plans to address bottlenecks.
- Review reasons for long LOS, exit block, delays in patient flow (frailty, complex comorbidities, DRG with long LOS [e.g. >7 days]).
- Redesign discharge processes including to rehabilitation and mental health.
- Real time patient flow data.
- Expedite discharge for short stay patients (to increase hospital income).
- Review patient flow data and separate elective, short stay and long stay.
- Look at peak occupancy and peak flow times and demands to manage workforce and identify priorities for improvement, e.g. plan cleaners needed.
- Protected beds not recommended as can reduce overall hospital capacity when left empty.

Ker J-I, Wang Y, Hajli N. Examining the impact of health information systems on healthcare service improvement: The case of reducing in patient-flow delays. 2018. (39)

- Harnessing hospital information systems to support patient flow.

Kreindler S. Six ways not to improve patient flow: a qualitative study. 2016. (45)

- Qualitative study involving interviews of 62 senior, middle and departmental hospital managers in Canada.
- Discusses factors associated with flawed initiatives that fail to improve patient flow:
  - focusing on too narrow a process or hospital segment
  - linking new processes to improve capacity
  - ability to respond to and address identified bottlenecks.
- Focused on need for coherent system level strategies to address patient flow effectively.
- Good quote supporting themes.

Lin F, Chaboyer W, Wallis M. A literature review of organisational, individual and teamwork factors contributing to the ICU discharge process. 2009 (15).

- Literature review exploring evidence regarding discharge guidelines, impact of premature discharge, impact of teamwork and team training to improve communication and safety of discharge.
- Highlights need to use intensive care resources more effectively.

Litvak E (Ed.). Managing Patient Flow in Hospitals: Strategies and Solutions (2nd ed.). 2010. (4)

- Evidence and case studies used to describe what and how strategies and solutions can be implemented in different types of site and service contexts to improve patient flow.
  - Systems thinking approach to assessment and management of patient flow.
- Data driven
  - Real time access to patient flow data for all people in hospital.
  - Technical solutions for managing and accessing real time patient flow data.
- Demand and capacity planning methods
  - Managing capacity and demand through patient journey and across episodes of care, including access to imaging, procedures, etc.
  - Reviewing demand and capacity for different DRGs, and by LOS and blockages in patient flow, e.g. access and exit block.
  - Queuing methods.
  - Simulation modelling.
  - Prediction modelling for expected demand and capacity.
  - Maintain day to day census, plan surgery schedules to support this.

- Operations management strategies
    - Scheduling surgery.
    - Scheduling support services and doctors for times of peak activities, e.g. rostering more cleaners at times of high discharge activity.
- Quality methods
    - Critical path method. Aim to reduce delays.
    - Lean methods. Looks at waiting times along journey and impact of these. Allows options to be explored and potential impact of patient flow estimated.
    - Audit and feedback.
    - Measuring compliance with admission and discharge policies.
    - Variability methodology. Considers different causes of variability:
        - clinical variability
        - flow variability
        - care variability (operation duration, LOS, care provided)
        - artificial variability (which should be eliminated as much as possible), e.g. dysfunctional scheduling for elective surgery.
- Variability methodology proposes patient flow initiatives
    - Consider homogenous subgroups separately including:
        - ED, separating fast track from high acuity patients
        - elective versus emergency admissions
        - short stay versus long stay admissions, e.g. elderly and complex patients.
    - Review outliers in each group.
    - Scheduling for day only admissions.
    - Smooth the flow of elective admissions to decrease the competition for elective and emergency admissions, increase hospital-wide throughput, achieve staff to patient ratios and support admissions to appropriate units.
    - Estimate resource (e.g. beds. staff) needs for flow of each subgroup to ensure right care at the right time and place for every patient.
- Hospital policies and procedures
    - Compliance with hospital admission and discharge policies.
- Strong leadership and culture
    - Culture of change and innovation.
    - Staff engagement.

- Micro-processes at unit or department level
    - Delays and management for access to laboratory tests, diagnostic imaging, procedures, preadmission clinic.
    - Every unit should have admission and discharge criteria.
        - Admission criteria should consider patient characteristics, clinical service, care needs and unit capabilities.
        - Discharge criteria should consider patient's care progress and needs.
    - Compliance with admission and discharge criteria should be monitored and adherence required
    - Each department has a surge plan for high occupancy and approaching and managing over capacity.
    - Using systems to flag patients who are ready for discharge.
    - Redesigning processes to fast track progress e.g. ward clerk calls cleaners directly when discharge known.

Luo W, Cao J, Gallagher M, et al. Estimating the intensity of ward admission and its effect on emergency department access block. 2013. (43)

- Sophisticated modelling techniques to examine impact of bed capacity on ED access block (poison process modelling, penalised regression spines, functional linear regression and principal component analyses).
- Improved admission practice during off-peak hours will reduce ED access block.

Mason S, Knowles E, Boyle A. Exit block in emergency departments: A rapid evidence review. 2016. (32)

- Bed occupancy associated with exit block.
- One third of patients experienced ED exit block. Often shorter for patients admitted to ICU or emergency surgery.
- Implementing system wide change to increase capacity is thought better than single initiatives.
- Features of exit block described.
- Limited and mixed evidence relating to increasing prevalence of exit block.
- Exit block may be more likely to occur in densely populated areas and less likely to occur in paediatric settings.
- Mixed evidence regarding compliance with four-hour standards and exit block.
- Boarding in the ED is a direct result of exit block.

- When hospital bed occupancy is high, so too is block. Evidence suggests that increasing inpatient beds reduces patient time in the ED, but increasing the number of ED beds does not reduce block.
- Experiencing block has been shown to lead to adverse patient outcomes among certain groups and may have a negative impact on mortality.
- Possible solutions to exit block
    - Increasing staff numbers both within the ED and the wider hospital
    - Facilitating the movement of patients promptly once a bed is available
    - Increasing inpatient bed capacity
    - Implementing a system wide change supported by the whole organisation, rather than a single initiative.

McClelland M, Bena J, Albert N, et al. Psychometric evaluation of the Hospital Culture of Transitions Survey. 2017. (2)

- Ineffective or inefficient transitions threaten patient safety, hinder communication and worsen patient outcomes.
- Validation of psychometric properties of scale designed to assess hospital culture related to patient flow during transitions in patient care.
- Factors associated with hospital culture regarding transitions include hospital leadership, use of data, other units' culture, staff's own unit culture, unit leadership, busy workload and priority of patient care.

Nates JL, Nunnally M, Kleinpell R, et al. ICU Admission, Discharge, and Triage Guidelines: A Framework to Enhance Clinical Operations, Development of Institutional Policies, and Further Research. 2016. (22)

- Updated Society of Critical Care Guidelines for ICU admission discharge and triage.
- Review for further details regarding strategies targeting these processes.

Qin S, Thompson C, Bogomolov T, et al. Hospital occupancy and discharge strategies: a simulation based study. 2017. (44)

- Simulation and modelling to identify effective strategies.
- Simulation results demonstrated that it is possible to reduce significantly the number of days when a hospital runs above its base bed capacity.

Rutherford PA, Provost LP, Kotagal U, et al. White paper Achieving Hospital-wide patient flow. The right care in the right place, at the right time. 2017. (37)

- Improve capacity in system implementing integrated care models.
    - Reduction in avoidable complications.
    - Reduction in low value care and unnecessary interventions, tests and procedures.
    - Elimination of steps and processes that don't improve patient flow, e.g. supplicated requests for beds (phone calls, emails, SMS, paper forms, data systems).
    - Improved communication and coordination with community based care services, particularly for complex patients, e.g. mental health, frail older people.
    - Advanced care planning and better use of palliative care. Provide hospital based palliative care. Initiate advanced care planning for complex and frequent patients.
- Improved early discharge
    - Early comprehensive assessment.
    - Proactive approach from all staff, not just discharge planners. Complete only necessary diagnostic tests.
    - Transfer of care plans.
    - Multidisciplinary team coordination.
    - Social worker or case management for complex patients, e.g. frail older people, complex comorbidities, social disadvantage, cognitive / behavioural impairments.
- Communication strategies
    - Executive walk arounds to discuss patient flow.
    - Clear messaging from executive and staff engagement that patient flow is everyone's responsibility.
- Importance of using data to manage capacity and demand.
- Data driven hospital wide operational management system for patient flow. Predictive modelling of demand and capacity. Real item demand data and management.
- Patient journey boards including knowledge of number of patients waiting for admission in ED, etc.

Santamaria J, Duke G, Pilcher D, et al. The timing of discharge from the intensive care unit and subsequent mortality. A prospective, multicenter study. 2015. (14)

- Unlike previous studies this study **did not demonstrate an increased risk of mortality associated with afterhours discharge**.
- 2009-10 data, more sophisticated modelling than previous studies, included fixed effects for site and inclusion of limitations of medical therapy orders and other acuity indicators. Once these factors included the time of discharge not significant predictor of mortality.

- Risk adjustment included limitations of medical therapy orders, Acute Physiology and Chronic Health Evaluation (APACHE) score, ongoing organ dysfunction diagnosis codes, interventions in ICU, exit block, prematurity of ICU discharges as measured by handover or ICU discharge summaries and other data collected for the purpose of the study.
- Limitations of medical therapy order (goals of therapy) was the strongest predictor of in hospital death.
- Intervention to reduce mortality after ICU should focus on the complexity of the patient at discharge over the time of ICU discharge.
- Strong paper.

Showell C EL, Keen E, Cummings E, et al. An Evidence based Review and Training Resource on Smooth Patient Flow. 2012. (24)

- NSW Ministry for Health commissioned this evidence review regarding patient flow from the University of Tasmania.
- 142 papers reviewed.
- Review described in context of *NSW Patient Flow Systems Framework (3)*.
- Key themes: communication, culture, capacity driven discharge, impact of visiting medical officer practices on patient flow.
- Highlights need for systems approach to patient flow, noting local initiatives may have unintended consequences in other parts of the hospital (need balance measures).
- Hospital culture identified as key issue affecting patient flow.
- Discusses key issues and strategies to improve patient flow at hospital and system level.
- Included strategic, operational and tactical interventions, evidence supporting these and detailed reference list.

Tiruvoipati R. Intensive care discharge delay is associated with increased hospital length of stay: A multicentre prospective observational study. 2017. (10)

- Five Victorian ICUs, mostly rural hospitals (N=955).
- Exit block 49.9% median duration delay 24 hours. Discharge delay considered six hours after medical cleared for discharge.
- Included delirium but not significant, although there were higher rates in those whose ICU discharge was delayed.
- Delayed discharge from ICU associated with need for isolation room, to avoid after hours discharge for those patients, awaiting transfer to nursing home, private hospital, psychiatric ward or inter-hospital transfer, or those with higher APACHE score at admission to ICU.

- ICU discharge delay associated with longer hospital LOS and high rate of after-hours discharge from ICU.
- Most common reason for delay was non availability of a ward bed (73.6%).

Tobin A, Santamaria J. After-hours discharges from intensive care are associated with increased mortality. 2006. (8)

- 1992-2002 from single ICU.
- Risk adjusted multiple regression models demonstrated hospital mortality associated with higher APACHE scores, admission from theatres or general ward and afternoon and evening ICU discharge.
- Patients more likely to be discharged in afternoon or night shift.

Van Heerden P, Blott J, Pinder M, et al. Intensive care unit occupancy after the introduction of the emergency department 4-hour discharge rule at a tertiary referral hospital in Western Australia. 2013. (28)

- The introduction of the 4-hour rule in emergency department has been shown to be associated with increased ICU exit block (not explained by changes in ICU occupancy), but not with increased medical emergency team calls to unstable ward patients.
- It was associated with small reduction in hospital mortality.

Van Sluisveld N, Oerlermans A, Westert G, et al. Barriers and facilitators to improve safety and efficiency of the ICU discharge process. 2017. (30)

- Evidence exists suboptimal clinical handover from ICU to the wards leads to unnecessary ICU readmissions and increased mortality.
- Mixed methods study: interviews, focus groups with patients, managers, ward and ICU staff, including physicians, plus survey (N=166 physicians from 64 hospitals).
- Improve ICU discharge by:
    - improving handover communication
    - formulating specific discharge criteria
    - stimulating a culture of feedback between different units
    - preventing overestimation of capacity of general wards.
- Sixty-six barriers and facilitators including the following.
    - Intervention related factors: 66% survey respondents thought planning ICU discharge at least 24 hours in advance not feasible, practice variation due to lack of ICU discharge criteria (but some thought this hard to achieve), lack of staff, ward physician unavailable when needed for discharge decisions.

- Professional factors: improve communication between ICU and the ward, identified negative attitude to checklists to support discharge and handover process (although most thought them useful); knowledge and skills of ward staff and number of staff needed to perform complex interventions, lack of IT skills regarding data systems; clinicians not involved with leadership on decisions; physicians lack of understanding re nurses discharge practices.
- Social factors: 25.9% thought an intensivist should remain involved with the patient until hospital discharge and needed better management support regarding improving ICU discharge process. Barriers identified included: lack of prioritisation by management, no culture of feedback, little or no consultation with general ward and the ICUs 'island' or 'ivory tower image' (cultural differences between wards).

Williams TA, Leslie G, Finn J, et al. Clinical effectiveness of critical care nursing outreach service in facilitating discharge from the intensive care unit. 2010. (34)

- Sample size N=1435 from three hospitals.
- No improvement in hospital LOS, readmission rate or hospital mortality.

Williams T, Leslie G. Delayed discharges from an adult intensive care unit. 2004. (40)

- Pre-post study examining discharge delay longer than eight hours; found incidence 27% over six months.
- Streamlined process of communication and recording of medically cleared for ward.
- Reasons for delay included: unavailable bed on ward (81%).
- Patient factors associated with exit block included: greater patient acuity on ICU admission, patient deterioration while waiting for transfer to the ward, principal admitting diagnosis, discharge destination and weekend discharge.

Williams TA, Leslie GD, Brearley L, et al. Discharge delay room for improvement? 2010. (13)

- Pre-post study reported 31% delayed ICU discharge.
- Manual data collection re times and dates to measure exit block.
- Main reasons for delay included: no bed availability, 9% due to medical concern; delay associated with longer hospital LOS.
- Good reference for other factors associated with exit block, e.g. delayed patient ICU admission, increased LOS, cancelled surgery, referrals refused.
- 'Many factors impact on patient flow and reducing ICU discharge delays requires a collaborative, multifactorial approach which adapts to changing organisational policy on patient flow through ICU and the hospital, not just the discharge process in ICU'.

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Appendix 1: Potential search terms identified from MeSH on Demand provided to Brian Tutt library

APACHE

Australia

Beds/supply & distribution*

Critical care

Critical care/standards*

Critical illness/mortality*

Critical illness/therapy

Critical illness/therapy

Emergency nursing/standards*

Emergency service, hospital*

Health services accessibility

Intensive care units

Intensive care units/economics

Intensive care units/organization & administration*

Intensive care units/statistics & numerical data*

Length of stay

Length of stay/economics*

Models, statistical

Patient admission/economics

Patient admission/statistics & numerical data*

Patient discharge*

Patient discharge/economics

Patient discharge/standards*

Poisson distribution

Principal component analysis

Time factors

Total quality management