9. Improving patient flow: Data-driven operational management

A Timely Emergency Care Collaborative how-to guide for health services

OFFICIAL

VICTORIA State Government | Department of Health

Institute for Healthcare Improvement

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Authorised and published by the Victorian Government, 1 Treasury Place, Melbourne.

In this document, 'Aboriginal' refers to both Aboriginal and Torres Strait Islander people. 'Indigenous' or 'Koori/Koorie' is retained when part of the title of a report, program or quotation.
ISBN 978-1-76131-737-8 (online/PDF/Word)
Available at Emergency care <https://www.health.vic.gov.au/patient-care/emergency-care>

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Introduction

The Timely Emergency Care Collaborative (TECC) aimed to reduce delays for patients needing emergency care in Victoria through improving hospital-wide patient flow.

The project involved 14 teams from hospitals across Victoria, as well as a team from Ambulance Victoria. The Victorian Department of Health delivered the project in partnership with the Institute for Healthcare Improvement.

The project ran from December 2022 until the end of June 2024. Almost every team showed significant improvements in the timeliness of emergency care, as measured by emergency department (ED) lengths of stay.

The project set out with a change theory of how to improve hospital-wide patient flow. This change theory was developed by drawing on international evidence, local and international expert input and the ideas of the participating teams.

Through the results of testing and the insights from participating teams, the change ideas that were found to be most impactful (feasible to implement, demonstrated improvement) were identified as 'high-impact change ideas'. These ideas have been written up as a series of 'how-to guides'.

This guide is one of a series outlining each of these high-impact change ideas. All guides are available from Emergency care <https://www.health.vic.gov.au/patient-care/emergency-care> or by emailing the department <TEC2@health.vic.gov.au>. A summary of the overall change theory from the TECC can also be found on the Emergency care webpage <https://www.health.vic.gov.au/patient-care/emergency-care>.

The change theory and learnings from the TECC project continue to inform other departmental projects including the Timely Emergency Care (TEC) 2 Program.

Note: The content provided below is intended as guidance only. The concepts should be adapted to suit your specific local context and needs.

Problem this change idea addresses

Optimal patient flow is achieved when the right type of bed is available when needed. It takes significant planning and coordination to align capacity with demand for the following reasons:

- Most Victorian health services operate at close to 100% capacity. This requires health services to discharge patients to accommodate new admissions.
- Bed capacity must be created to meet daily demand – emergency admissions require inpatient capacity every day, which must be accommodated by discharges.
- ED demand is variable but predictable – the daily, weekly and seasonal variation in emergency demand can be accommodated by effective measurement, planning and system recalibration.

Emergency patient flow is a complex problem. Managing it well requires aligning capacity to variable demand for emergency health care. Admitted patient demand is most important for whole-of-hospital flow because these patients require capacity in the ED and hospital wards. Admitted patient demand is also a clinical priority, as admitted patients are generally more acutely unwell and need more intensive in-hospital services than non-admitted patients. Shortfalls in inpatient capacity result in new emergency admissions waiting for a bed to become available, increasing the length of stay in the ED and reducing the ED's capacity to assess and treat new arrivals. Delays in emergency care are associated with increased patient mortality, poor patient experience and decreased staff morale (Jones and van der Werf 2021; Liew and Kennedy 2003; Richardson 2006).

This how-to guide focuses on operational management approaches to optimise patient flow and align admitted patient demand with hospital inpatient bed capacity. These approaches improve the timeliness of care for both admitted and non-admitted patients.

Overview of the change idea

Effective hospital operational management balances the demand for and supply of healthcare resources. The clinical outcome and experience of emergency patients are time-dependent, driving health services to provide the right amount of care at the right time.

The first step to balancing healthcare supply and demand is to develop systems to effectively measure hospital capacity and emergency demand. Effective systems will:

- **monitor real-time data** to enable the early detection and correction of unpredictable daily problems that jeopardise patient flow
- **generate predictive data** to enable the future adjustment of resources to accommodate expected changes in service demand
- **highlight the actual and predicted imbalances between demand and supply** and identify the areas of pressure.

High-performing health services incorporate real-time and predictive data into their **Daily Operating Systems** (DOS) to help manage problems today and plan for tomorrow. A DOS is a series of organisational meetings with escalating authority that collate, review, troubleshoot and escalate capacity shortfalls. Straightforward or routine problems are solved at the ward level, while more complex problems are escalated to the executive leadership for early resolution.

Key measures

Emergency demand

Emergency demand can be measured by volume and categorised by disposition and clinical type as shown in **Table 9.1**.

Table 9.1: Data definitions for measurement of admission demand

Actual admission demand	
Volume	Number of ward admission bed requests per day
Bed acuity required	Ward level or higher acuity (e.g. ICU, HDU, CCU)
Patient type	Medical, surgical, paediatric, subspecialty
Predicted admission demand	
Volume	Number of ward admissions expected per day
Admission bed type	Number of each type of admission expected per day

Note: A day is defined as the 24-hour period from midnight to midnight.

Predicting admission demand

The daily volume of admissions can be predicted in many ways. In recent years, multiple complex models have emerged to achieve over 90% accuracy, which is likely to improve when applying artificial intelligence.

In the absence of a complex predictive tool, the most commonly used method is **6-week rolling averages**, which can be applied to:

- the total number of hospital admissions per day
- the number of admissions per day by unit or ward.

Using 6-week rolling averages helps to adjust the predicted demand over time by incorporating seasonally variable data and changes in baseline demand because the reference period moves forward every week.

To calculate 6-week rolling averages, use the approach provided below (note that this approach can be used at the division, unit or ward levels).

Predicted emergency admissions

1. Calculate the total number of emergency admissions (including unplanned direct admissions from outpatients or from the community) for each 'day of the week' over a 6-week period.
2. Divide each 'day of the week' total by 6 to create your 6-week rolling average for each weekday.
3. Every Monday, recalculate a new 6-week average for each weekday using the previous 6 weeks to create a new 'rolling' average for each weekday.

Hospital capacity

Hospital capacity can be measured by the number of beds available for emergency admissions and categorised by patient type (**Table 9.2**).

Table 9.2: Data definitions for measurement of hospital capacity

Actual hospital capacity	
Volume	
Currently available beds	The number of beds immediately available for admissions
Confirmed discharges	The number of beds that will become available for new admissions today (> 95% certainty)
Hourly distribution of actual discharges per day	The number of actual discharges per hour for each hour of the day (*y* axis) plotted against each hour of the day (*x* axis)
Bed types	
Higher acuity capacity	ICU, HDU, CCU or high-dependency subspecialties
Ward level capacity	By clinical patient type (medical, surgical, paediatric, subacute)
Predicted hospital capacity	
Volume	The number of discharges expected per day
Bed type	Medical, surgical, paediatric, subspecialty

Note: A day is defined as the 24-hour period from midnight to midnight.

Predicting hospital capacity

Discharges can also be predicted using **6-week rolling averages**, which can be determined by the whole hospital, a division, a unit or a ward.

To work out the 6-week rolling average use the approach below (note that this approach can be used at the division, unit or ward levels).

Predicted daily discharges

1. Calculate the total number of hospital discharges (including transfers and deaths) for each 'day of the week' over a 6-week period.
2. Divide each 'day of the week' total by 6 to create your 6-week rolling average for each weekday.
3. Every Monday, recalculate a new 6-week average for each weekday using the previous 6 weeks to create a new 'rolling' average for each weekday.

Some hospitals also report '**potential discharges**', which is the number of beds that may become available for new admissions (> 50% certainty of discharge). This measure becomes important when there is a significant difference between expected demand and capacity. In this circumstance, wards reporting high 'potential discharges' may be asked to identify opportunities to increase their actual discharge volume with extra effort or by exploring alternatives.

Non-emergency demand

Most Australian health services share beds for emergency and non-emergency cases, often on the same ward. Therefore, it is important to consider aspects of non-emergency demand, such as the following:

- **Planned demand:** Planned admissions will also create demand for hospital capacity, which must be considered when balancing capacity and demand. Surgical and procedural services should provide this data in advance and aim to reduce planned care at times and in places when increased emergency demand is expected.
- **Interhospital transfers:** The movement of patients into and out of health services will impact hospital demand and capacity and must also be considered. The urgency of transfers can vary according to clinical need and may be flexible to local service demands.
- **Direct admissions:** This includes demand for beds from outpatients and community services to prevent unnecessary ED presentations. These patients will also affect hospital demand and should be incorporated into the demand and capacity measurement strategy.
- **ICU bed capacity and demand:** This includes patients ready and waiting for admission to ward beds.
- **Internal health service repatriations:** Movement between hospitals under the one health service.
- **Repatriation of patients admitted to contingency beds:** Movement of patients from flex capacity, such as a day procedure unit or holding areas.

Daily operating system

High-performing health services use a **DOS** to predict, monitor and manage hospital capacity and emergency demand.

The DOS has **3 fundamental forums** that identify, address and escalate any mismatch between expected demand and capacity. These forums are:

- preparation for tomorrow's meeting
- bed meeting
- operational management meeting.

Each meeting should aim to complete within 15 minutes and focus on agreeing actions, recognising that:

- the information about demand and capacity should already be available and known
- actions that can be taken at the local level have already been taken
- members have arrived with proposed solutions to address a demand/capacity mismatch.

Depending on the organisational context, extra meetings may be needed to collect data or execute the response.

Bed meeting

Optimal start time: Early morning, around 8 am

Select a time early enough to impact morning discharges yet late enough for accurate data to be available.

Purpose

1. Enable decision-making, focus on creating enough capacity to meet demand.
2. Confirm demand and capacity data across the organisation to identify areas where daily demand will likely exceed hospital capacity. Avoid verbal reports on bed status – attendees should have access to this data and have reviewed it before the meeting.
3. Identify and share operational challenges across the organisation that will likely impact staff or patient safety, including patient flow.
4. Identify any potential shortfalls in capacity tomorrow using predicted discharges from inpatient wards and predicted demand from 6-week rolling averages.
5. Identify staffing issues that will impact bed capacity and patient flow. Exclude broader staffing concerns; these should be fed into and discussed in the Operational management meeting
6. Identify outputs that feed into the Preparation for tomorrow's meeting to maintain continuity and integration between these 2 meetings.

In many services, data collection and processing is automated, reducing the value of a scheduled bed meeting. This can be achieved via:

- a shared online spreadsheet, requiring all ward managers to enter their data into an automated spreadsheet that incorporates predicted demand and capacity to calculate expected variance for today and tomorrow
- EMR integration, where all actual and predicted data is gathered from unit-based patient tracking boards and displayed on a visual dashboard.

The 'bed meeting' component of DOS has been created for services lacking these systems, helping them enhance their understanding of daily capacity and demand. The components of this manual system can be integrated into an automated spreadsheet, which might render the bed meeting unnecessary.

Membership

- Chair: Hospital access coordinator or equivalent
- NUM/ANUM of the ED
- Nurse in charge of inpatient wards and high-dependency areas

Agenda

Item	Summary	Role	Suggested position
Welcome	Opening and formalities	Chair	Hospital access coordinator
ED reporting	Provides a summary statement considering the status of the ED incorporating the available workforce and local challenges **Reports** • Number of admissions in ED awaiting a ward bed • Number of patients waiting to be seen • Workforce status – fully staffed or reduced staffing with predicted operational impact • Local challenges impacting flow, patient and staff safety	ED nursing leadership	ED NUM or ED nurse in change

Item	Summary	Role	Suggested position
ED reporting (continued)	**Mitigation strategies** • Local plan and actions to address challenges • Escalation request for issues that cannot be managed by the NUM and need either higher authority or engagement with other NUMs in the hospital	ED nursing leadership	ED NUM or ED nurse in change
Ward reporting (repeat for all reporting wards, chair to acknowledge plans and note escalations for discussion at later meeting)	Provide a summary statement considering the status of their unit, incorporating bed capacity, available workforce and local challenges **Reports** • Bed status – open beds, available beds, confirmed discharges +/- potential discharges • Workforce status – fully staffed or reduced staffing with predicted operational impact • Local challenges impacting flow, patient and staff safety **Mitigation strategies** • Local plan and actions to address highlighted challenges • Escalation request for issues that cannot be managed by the NUM and need either higher authority or engagement by other NUMs in the hospital (for example, if a patient can go home this morning but needs a CT, can the CT scan be done as a priority?)	Inpatient nursing leadership	Ward NUM or ward nurse in charge
Summary and close	Highlight key challenges from the hospital report, including wards with significant problems Summarise and confirm responsibility for key actions emerging from ward reports Summarise issues for escalation with expectation for feedback to impacted areas	Chair	Hospital access coordinator

Operational management meeting

Optimal start time: Morning, 9:00 to 9:30 am

Purpose

1. Review expected hospital capacity against:
   a. current and expected emergency demand (avoid verbal reports on bed status – data should be displayed at the meeting)
   b. operational challenges across inpatient wards and supporting services
   c. the questions, 'Are we ready for today?' and 'Are we prepared for tomorrow?'
2. Develop a plan to address shortfalls in hospital capacity for hospital divisions reporting a deficit.
3. Manage escalations from the bed meeting and identify challenging issues that need to be escalated to hospital leadership.
4. Address emerging staff and patient safety concerns, addressing the question, 'Are we safe for today?'

Membership

Attendance should be restricted to roles with responsibility for flow, quality and safety and who have authority to make decisions:

- chief operating officer (or equivalent)
- general manager, director or manager of access and flow
- clinical and/or operational directors of each clinical division or deputy
- operational director of pathology and radiology or deputy
- medical and nursing workforce unit representation
- facilities management
- allied health
- pharmacy.

Agenda

Item	Summary	Role	Suggested position
Welcome	Opening and formalities	Chair	COO (or delegate)
	Role of the chair • Opens and closes the meeting • Coordinates reports delivered by operational leaders of each division • Summarises the health service status, flagging: – divisions with increased operational risk – agreed actions for these divisions to mitigate the identified risk, who is responsible for completing them and by when • Holds divisional leaders accountable for local risk management		

Item	Summary	Role	Suggested position
Divisional reports	Summarise the safety status of their division, considering: • the variance between demand and capacity • workforce constraints • other operational challenges by exception, including infrastructure, industrial or occupational safety issues • the actions being taken to mitigate any variance between capacity and demand • immediate actions to improve ED pressure (such as 2 patients moving from ED in the next hour) • risks – identify and clearly articulate • completed, ongoing and intended strategies to address identified risks • issues that require escalation to operational and executive leadership	Divisional leaders	Operations directors for each division
	Role of divisional leaders Ideally, the safety status of each division should be predefined and classified using a traffic light system or similar. Each division can then rapidly report their status and provide more details if they don't meet the requirements for 'green light' status. When divisions flag themselves as 'green', we should expect good patient flow through that division. Review of the day's performance against the previous day's performance is an opportunity for learning and improving the connection between status and divisional performance.		
Clinical workforce report	**Nursing, medical and allied health** • Summarise the staffing status of the organisation, including overall deficits, covered shifts and outstanding vacancies • Outline the plan to mitigate risks associated with staffing deficits, including redeployment and agency recruitment	Workforce managers	Medical, nursing, allied health workforce directors

Item	Summary	Role	Suggested position
Facilities report	• Provide an infrastructure status, including planned and unplanned infrastructure downtime • This should include non-clinical aspects of the health service: – patient service assistant workforce – utilities – electrical, water, medical gases – fire systems, including scheduled testing – cleaning services – pneumatic chute systems – patient transportation	Facilities director	Facilities director
Summation and close	**Chair to summarise** • Divisions with increased operational risk • Action list to mitigate identified risks – delegated, time-based, feedback • A summary of issues for escalation if executive huddle is required	Chair	Chief operating officer or delegate

Preparation for tomorrow's meeting

Optimal start time: Late afternoon, 3 to 4 pm

Select a time after the team, ward or unit-based afternoon discharge huddles have been completed and tomorrow's expected discharges have been identified to ensure divisions understand the predicted capacity for the tomorrow.

Purpose

The meeting should occur in 3 phases:

1. **Review the current situation:** Assess the current situation and create plans to address current variance and challenges.
2. **Plan for the overnight shift:** Accommodate and plan for predicted demand and capacity overnight. In some health services, an Evening huddle is also held to address these plans.
3. **Plan for tomorrow:** Review the predicted situation and create a strategy to prepare for future variances and challenges.

In times of severe access block, the outcome of this meeting may be escalated to the hospital executive on call to provide authority for changes in staffing, bed capacity or support services to manage overcrowding (refer to 'Escalation', below).

Membership

- Chair: Bed manager, hospital access coordinator or equivalent
- Nurse in charge of inpatient wards and units
- Nurse unit manager (NUM) or associate nurse unit manager (ANUM) of the ED
- Operational lead for pathology and radiology
- Facilities management
- If available, the daily operational executive on call for the evening for visibility and authority to make decisions about staffing and bed capacity changes (attendance may only be required during escalated conditions)

Agenda

Item	Summary	Role	Suggested position
Welcome	**Opening and formalities** • Follow-up and resolve actions from the bed meeting and feedback from the operational management meeting	Chair	Hospital access coordinator
ED reporting	Provides a summary statement considering the status of the ED, incorporating the available workforce and local challenges **Current demand profile** • Number of admissions in ED awaiting a ward bed • Number of patients waiting to be seen **Current and predicted situation for tomorrow** • Workforce status – fully staffed or reduced staffing with predicted operational impact • Local challenges impacting flow and patient and staff safety	ED nursing representative	ED nurse in charge, ED flow coordinator
Ward reporting	Provide a summary statement considering the status of their unit, incorporating bed capacity, available workforce and local challenges **Current demand profile** • Bed status – open beds, available beds, confirmed discharges +/- potential discharges	Ward nursing representative	Ward nurse in charge or flow coordinator

Item	Summary	Role	Suggested position
Ward reporting (continued)	**Current and predicted situation for tomorrow** • Workforce status – fully staffed or reduced staffing with predicted operational impact • Local challenges impacting flow and patient and staff safety	Ward nursing representative	Ward nurse in charge or flow coordinator
Plan for overnight	Determine current variance and highlight areas of significant shortfalls Develop strategies to create capacity for areas of need and/or provide support to reduce clinical risk	Discussion	
Plan for tomorrow	Determine probable variance for tomorrow Develop strategies to shift or increase capacity for tomorrow's predicted challenges	Discussion	
Summation and close	Create: • a summary of divisions with increased operational risk • an action list with delegations, timelines and feedback on progress • a summary of issues for executive escalation	Chair	Hospital access coordinator

Supplementary meetings

Executive escalation huddle

Purpose

Some health services have formalised a process to trigger an 'extraordinary huddle', which is scheduled during significant operational challenges. The need for this huddle should be determined by clear operational triggers (refer to 'Escalation', below), with the aim of identifying and troubleshooting complex or numerous challenges.

Membership

The huddle should be attended by executive and senior operational leaders with the authority to make decisions and direct actions to address significant organisational operating challenges:

- chief operating officer (chair)
- executive leadership team
- senior operational leadership team.

Key output

Strategy and delegated action list to ensure effective actions are implemented promptly.

Evening huddle

Purpose

Some health services hold an evening huddle to serve as a safety check-in, to assess the current state of ED flow and to plan for discharges required out of the ED and anticipated admissions overnight.

Membership

- After-hours hospital manager
- ED ANUM
- ED clinician in charge
- Medical officer in charge (senior medical officer based in the hospital overnight)

Key output

List of actions expected to create sufficient capacity to meet demand.

Escalation

Defining criteria for escalation

1. Define clear operational triggers.
    a. Establish quantifiable metrics to signal when intervention is needed, such as:
        i. number of ambulances waiting without an offload plan for more than *x* hours
        ii. forecasted end-of-day performance falling below a threshold (for example, negative *y*).
2. Automate response activation.
    a. Develop a library of predefined action cards that are:
        i. automatically triggered by specific metrics
        ii. standardised to ensure consistent and timely responses.
3. Ensure uniformity and preparedness.
    a. Train teams on action card protocols to ensure uniform execution.
    b. Regularly review and update triggers and action cards based on performance data and evolving needs.
4. Integrate with real-time monitoring systems.
    a. Link triggers to live dashboards or alert systems for immediate visibility.
    b. Enable automated escalation pathways when thresholds are breached.

How to improve your daily operating system

Every health service will have different opportunities to improve their DOS to achieve effective data-driven operational management. This section focuses on how to identify your opportunities for improvement. It then offers an approach to testing your changes using Plan-Do-Study-Act (PDSA) cycles to ensure changes made are working well and/or adapted and refined over time to achieve the objective.

Ideally, a focused effort to improve operational management in your hospital would be sponsored and championed by your chief operating officer. Executive leadership and active sponsorship signals to staff that this is a priority for the organisation.

Identifying opportunities for improvement

Ideally, a senior operational manager should lead the process to review the current approaches to operational management in your hospital. This process would include the following:

1. Review the data used to understand and manage capacity and demand and how this data is used and presented in DOS/operational meetings.
2. Document existing operational meetings that occur across the hospital, including their purpose, membership, duration, agenda and outputs.
3. Interview staff who take part in operational meetings and/or are accountable for actions to address capacity issues to learn how well they believe it is currently working, opportunities and potential ideas for improvement.
4. Observe operational meetings and assess how well these function using a set of criteria (**Table 9.3**).
5. Document any processes that trigger escalations; for example, what are the triggers, who activates the escalation and when, are the escalation actions defined, are they adhered to consistently?
6. Collate all the insights from data, observations, documentation and staff interviews to identify opportunities to strengthen daily operational management.

Table 9.3: Observable factors in effective operational meetings

Factor	Reasons
Structured and disciplined	All meetings of the tiered huddle system should be conducted with discipline, including a consistent chairperson who follows a standard agenda. The meeting should start and finish on time (unless completed early).
Action-oriented and accountable	Relaying of information is minimised. Meetings focus on clarifying issues, agreeing solutions and delegating accountable actions within specific timeframes for completion. Significant problems without solutions should be flagged for escalation.

Factor	Reasons
Essential high-valued membership	All meeting members should provide value to the meeting function. Actions may be further delegated by members to local staff after the meeting.
Defined escalation pathways	There are clear triggers and pathways. The tiered huddle system progresses in an escalating fashion to enable: • increasing authority for unresolvable identified problems • broadening visibility, to identify and address organisation-wide problems at the final tier.
Real-time data dashboards	Operational meetings are enabled by real-time demand and capacity information, helping to identify challenges and monitoring responses to actions taken.

Testing change ideas

Guidance for how to test changes is provided using the Model for Improvement framework <https://www.ihi.org/library/model-for-improvement>. This framework aims to use rapid cycle tests to quickly learn and adapt change ideas. As confidence in the idea increases, cycles can be longer and tested under different conditions.

The guidance below focuses on the first testing cycle, but plan extra test cycles should ahead of time so there is continuous testing and adaptation of the idea until it is ready for permanent implementation.

Refer to the IHI website for more information about PDSAs <https://www.ihi.org/how-improve-model-improvement-testing-changes>.

Sustaining new ways of working and continuously improving

Once changes have been tested and implemented, the following actions are recommended:

1. Establish a process for continuous improvement.
    a. Schedule regular (for example, quarterly) reviews to check that changes are being sustained and working as intended.
    b. Build in daily learning through debriefs to reflect on how your system worked when responding to unexpected or challenging events.
    c. Routinely capture quick feedback from members about opportunities to improve operational meetings.

2. Use data to proactively plan.
    a. Build in routine (for example, quarterly) processes to identify long-term trends and plan for future pressures on capacity.
    b. Develop predictive insights to prepare for known high-impact periods such as:
        i. school holidays
        ii. medical staff rotations
        iii. local sports events
        iv. estate or infrastructure changes affecting capacity.
    c. Integrate trend analysis and predictive insights into operational planning, including:
        i. building a calendar of anticipated pressure points and predicted threshold points
        ii. aligning resource planning with forecasted demand surges.

Key data components and calculations

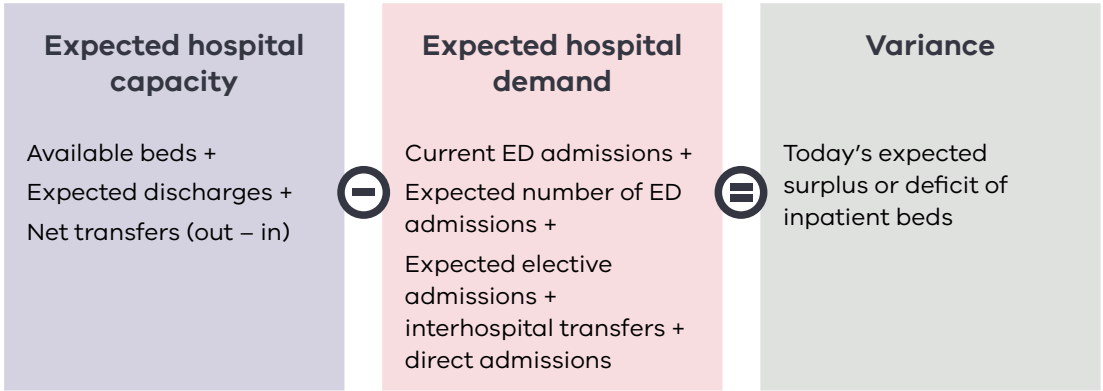
Today's situation

Data input

Hospital area	Inputs
Wards	Volume of currently available beds
	Volume already discharged today
	Expected volume of discharges
	Potential discharges
ED	Current ED admissions waiting for an inpatient bed
	Wait times – seen by ED, seen by inpatient teams, ambulances ramped and wait times
Operations	Expected volume of ED presentations (walk-in and ambulance)
	Expected volume of admissions (aggregate and by ward)
	Expected elective admissions
	Expected transfers into the service
	Expected transfers out of the service
All	Qualitative information about operational challenges across the organisation

Note: Potential discharges may increase your expected discharges by 20–30%.

Data output

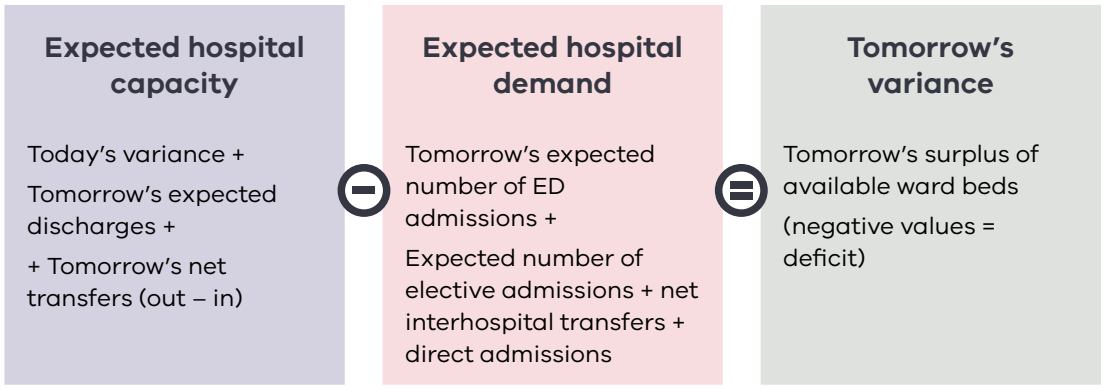


Tomorrow's situation

Data input

Hospital area	Inputs
Wards	Volume of expected discharges
ED	Nil
Operations	Expected volume of ED presentations (walk-in and ambulance)
	Predicted volume of ward admissions (aggregate and by ward)
	Expected volume of elective admissions
	Expected transfers into the service
	Expected transfers out of the service
All	Qualitative information about operational challenges across the organisation

Data output



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If you would like to access examples of DOS procedures and processes, including those used by the Royal Melbourne Hospital and Northern Health, email the TEC team <TEC2@health.vic.gov.au>.