

A systematic review to identify the challenges to achieving effective patient flow in public hospitals

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Abstract

This systematic review aims to uncover the challenges related to patient flow from a whole public hospital perspective and identify strategies to overcome these challenges. A search in Medline, Emcare and PubMed was conducted and 24 articles published in English, from 2015 to 2020, were selected in relation to patient flow challenges and strategies. Analysis of the articles was completed using a thematic approach to identify common themes in relation to the area of focus. Strategies from the literature were then aligned with the challenges to inform areas of potential improvement in relation to patient flow. The themes generated included Teamwork, Collaboration and Communication; Public Hospitals as complex systems; Timely discharge; Policy, Process and Decision-making; and Resources-capacity and demand. The key finding is that a whole system approach is required to improve patient flow in public hospitals. When effective patient flow is achieved, demand and capacity are matched, increasing patient access to the health service and enabling the resources required to provide high quality patient care. The findings will create a better understanding of improving patient flow in public hospitals.

KEYWORDS

emergency department, patient flow, policy, public hospital, teamwork

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Highlights

- The key finding of this study is that a whole system approach is required to improve patient flow in public hospitals.
- The collaboration of the multidisciplinary team is essential for the successful implementation of strategies and improvement in patient flow.
- Increasing patient access to the health service and enabling the resources required to provide high quality patient care.

1 | INTRODUCTION

Effective patient flow in public hospitals is essential to ensure all patients have the right access, to the right care, at the right time and in the right place with minimal waiting times.¹ Effective patient flow may guarantee hospital capacity and resources availability to cope with both predicted demands and unexpected emergencies and enables the provision of quality and safe patient care.¹ Effective patient flow enables the movement of patients through this system seamlessly, without disruption or negative outcomes. This however is not the case in many public hospitals, with many patients experience delays in access to services, services not provided, and long waits with suboptimal care delivered.

Patient flow is defined as the movement of patients through the health care system. It involves the medical care, physical resources, and internal systems needed to get patients from the point of admission to the point of discharge while maintaining high quality care, and both patient and staff satisfaction.² Patient flow management is a system wide process and is an essential component for the efficient functioning of public hospitals to deliver high quality, cost effective services and meet the demands of the community around the world.³⁻⁵

The healthcare system through the world especially in Western countries, is under increasing pressure to meet the growing demand for healthcare. This is due to an increase in the population who are ageing and are more likely to need healthcare services, and technological advances in the healthcare setting.^{6,7} Public hospitals are faced with the challenge of delivering quality patient care that meets the needs of the community. This involves a complex and varied network of services and professionals working simultaneously to achieve the desired patient journey through the system.⁸

Ineffective patient flow is evident in critical care units with access block to admit patients due to the inability to move current patients to other areas in a timely manner.⁹ Currently public hospitals are not meeting key Performance Indicators (KPIs) in relation to Emergency Treatment Performance (which was formerly known as National Emergency Target (NEAT)) in the emergency departments resulting in a backlog of patients and overcrowding.¹⁰ Patients are often placed in outlining areas different to the required treating speciality, increasing the risk of suboptimal outcomes.¹¹ Strain due to ineffective patient flow can also result in the cancellation of elective procedures in the operating theatres and lengthen wait-times for patients to access services. Public hospitals attempt to meet the increased demands caused by ineffective patient flow by opening more 'surge' beds. This puts further strain on the system, with increased workloads for staff and the increased use of resources, adding to further costs and budget deficits.³

Patients access public hospitals through multiple entry points. Whilst some demand is scheduled or planned, the emergency component of the health care system results in an element of variability that must be resourced to meet the needs of the population and cope with the unpredictable demand.⁸ Failure of hospitals to cope with this demand results in overcrowding which can be described in terms of an imbalance between the demand and capacity to provide care.¹² In this respect public hospitals across the globe are faced with the challenge to create effective patient flow on a daily basis to avoid the negative impacts and adverse outcomes of overcrowding.

Ineffective patient flow results in overcrowding and a mismatching of demand and capacity within the public hospital system.¹³ Elder et al.¹⁴ state that the factors that impact patient flow are well recognised within the emergency department. Recent research has been focused on patient flow within the emergency department,⁶ however effective patient flow within the emergency department is dependent of capacity in the whole hospital, and patient flow remains an issue in public hospitals.¹⁵

The decision to focus this systematic review on patient flow is to seek information to drive improvements and lasting change in this area. Daily ineffective patient flow is compromising public hospitals performance, effecting the quality of care delivered to patients and creating a negative culture within teams.¹⁶ There is also significant pressure from a political level to improve performance to deliver efficient and cost effective quality healthcare to meet the needs of the population. Improvements would therefore improve the work environment and culture in public hospitals, creating better patient satisfaction and enabling focus on further innovations.¹¹

Current research in this area is mainly focused on individual units or the emergency department. There is only one other literature review focussing on patient flow from a whole hospital or system level perspective conducted by Winasti et. al.¹⁷ which reviewed studies up until 2015. Therefore, this systematic review aims to build on the information generated from this previous study and inform the field with further current information in relation to the challenges of patient flow and strategies to improve in public hospitals. More particularly, this systematic review aims to answer the following two questions; (1) what are the common issues that affect patient flow in public hospitals? (2) What tools and strategies have been implemented to improve patient flow in Public hospitals? It will use a thematic approach to analyse the literature and answer the research question.

2 | METHODS

2.1 | Search strategy

This systematic review was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) protocol.¹⁸ A search of existing literature was conducted using Medline, Emcare and PubMed. These databases were chosen because they are comprehensive and would capture the data required for the area of focus. A trial of the identical search was conducted in other databases to ensure all literature was captured however, this resulted in duplication of results and results not relevant to the research question. It was decided to focus on peer reviewed published primary research literature for the review. Grey literature which include reports, working papers, theses, and conference proceedings was not searched for as part of the search strategy. The search strategy, including selection of databases and key concepts, was conducted by the student author (first author) in consultation with the research supervisor (second author) and a senior health librarian of the University of New England.

The key concepts used in the search strategy included, 'patient flow', 'emergency' and 'hospitalisation'. The concepts were searched in titles, abstracts and as keywords. The concepts were searched alone and then combined with each other to capture all potential literature for review. Filters were applied to limit results to English only and a date range of 2015–2020 to return contemporary evidence of patient flow in the health service.³

2.2 | Study selection

Two authors independently reviewed the literature search procedures to determine the appropriate selection of the related studies and disagreements were resolved through discussion. The article titles and abstracts were screened based on their relevance to the research question and duplicated articles were removed. Chosen articles were then selected based on the following eligibility criteria.

2.2.1 | Inclusion criteria

- Peer Reviewed published primary literature.
- Full-text published in English.
- Date range 2015–2020 inclusive.
- Clear methodology.
- Focuses on the whole hospital patient flow and effects patient flow movement.
- Addresses patient flow management in a public hospital setting.
- Addresses disruptions to patient flow in a public hospital setting.

2.2.2 | Exclusion criteria

- Research uses secondary data.
- Research in other languages.
- Unpublished research, conference abstracts and case studies not evaluating interventions.
- Articles with no clear author.
- Publication date outside the specific time frame.
- Studies that focus on patient flow within a single unit.
- Studies that focuses on medical interventions only.

To answer the research question studies were included that focussed on patient flow through the whole hospital. If an intervention was focussed in one department the article would only be included if a flow on effect to other departments was considered and identified in the study. Full-text articles that met the inclusion criteria were retrieved for further analysis.

2.3 | Quality assessment

The full-text articles were then assessed for quality. A 16-item quality assessment tool (QATSDD) developed and evaluated by Sirreyeh et al.¹⁹ was chosen to appraise the articles. This tool shows good reliability and validity for use in the quality assessment of a diversity of studies. The articles retrieved for the literature review consisted of multiple methodologies, so one tool was sourced to aide in the quality assessment process. Following the quality assessment, all studies were included in the literature review, however their weight and relevance were taken into consideration based on their quality. The quality assessment of the articles produced scores ranging from 7 to 37. The total score achievable was 42 for qualitative and quantitative studies and 48 for a mixed method approach. 12 articles scored greater than 20 with 2 scoring below or equal to 10. It was concluded that half the literature was of high quality and good data for this systematic review. Table 1 shows the results of the quality assessment on the articles. The quality assessment of the included studies was carried out independently by two authors. Any discrepancies about the quality of the articles were discussed subjectively to reach an agreement.

2.4 | Data extraction and analysis

The main data extracted included; study aim, study type, country the study is based, patient flow challenges, and patient flow strategies. A short critical analysis which corresponds with the results of the quality assessment is provided and displayed in the literature summary table along with the other information mentioned. Table 2 displays the summary table of the articles.

TABLE 1 The quality assessment results of selected studies.

| Author | Criteria: 1) Explicit theoretical framework; 2) statement of aims/objectives in main body of report; 3) Clear description of research setting; 4) Evidence of sample size considered in terms of analysis; 5) Representative sample of target group of reasonable size; 6) Description of procedure for data collection; 7) Rationale for choice of data collection tool; 8) Detailed recruitment data; 9) Statistical assessment of reliability and validity of measurement tool (Quantitative only); 10) Fit between stated research question and method of data collection (Quantitative only); 11) Fit between research question and format and content of data collection too for example, interview schedule (Qualitative only); 12) Fit between research question and method of analysis; 13) Good justification for analytical method selected; 14) Assessment of reliability (Qualitative only); 15) Evidence of user involvement in design; 16) Strengths and limitations critically discussed | | | | | | | | | | | | | | | | Total |
|--------------------------------|--|---|-----|---|---|---|---|-----|-----|-----|-----|----|----|-----|-----|----|-----------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | |
| Barnes et al., (2015) | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 3 | 1 | n/a | 2 | 2 | n/a | 0 | 2 | 31 |
| Bean et al., (2017) | 2 | 2 | 3 | 2 | 1 | 2 | 3 | 1 | 1 | 2 | n/a | 2 | 3 | n/a | 0 | 1 | 25 |
| Boiko et al., (2020) | 3 | 2 | 3 | 2 | 1 | 2 | 1 | 1 | n/a | n/a | 1 | 1 | 1 | 1 | 0 | 0 | 19 |
| Claret et al., (2016) | 2 | 2 | 2 | 3 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 2 | 22 |
| Cornes et al., (2018) | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 0 | 2 | 2 | 0 | 1 | 1 | 0 | 0 | 1 | 18 |
| Crilly et al., (2015) | 2 | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 2 | 2 | n/a | 2 | 2 | n/a | 0 | 3 | 31 |
| Destino et al., (2019) | 3 | 3 | 3 | 3 | 2 | 1 | 2 | 2 | 3 | 2 | n/a | 3 | 3 | n/a | 2 | 1 | 33 |
| Driscoll et al., (2015) | 1 | 1 | 2 | 2 | 1 | 1 | 2 | 1 | 0 | 1 | n/a | 1 | 0 | n/a | 0 | 0 | 13 |
| Khalifa (2017) | 1 | 2 | 1 | 2 | 1 | 1 | 0 | 0 | 1 | 1 | n/a | 1 | 0 | n/a | 0 | 0 | 11 |
| Khanna et al., (2015) | 2 | 2 | 2 | 3 | 2 | 1 | 1 | 0 | 1 | 2 | n/a | 2 | 1 | n/a | 0 | 2 | 22 |
| Kriendler (2017) | 3 | 2 | 3 | 3 | 2 | 3 | 2 | 3 | n/a | n/a | 2 | 1 | 2 | 2 | 2 | 3 | 33 |
| Kriendler (2017) | 3 | 2 | 3 | 3 | 2 | 3 | 2 | 3 | n/a | n/a | 3 | 3 | 3 | 2 | 2 | 3 | 37 |
| Kriegel et al., (2015) | 2 | 2 | 1 | 1 | 1 | 2 | 1 | 0 | 0 | 1 | n/a | 1 | 1 | n/a | 1 | 1 | 15 |
| Kriegel et al., (2016) | 1 | 1 | 2 | 2 | 1 | 1 | 0 | 0 | 0 | 1 | n/a | 1 | 1 | n/a | 0 | 0 | 10 |
| Lees-Deutsch & Robinson (2019) | 1 | 1 | 3 | 2 | 2 | 1 | 0 | 0 | 0 | 1 | n/a | 1 | 0 | n/a | 2 | 2 | 16 |
| Lovett et al., (2015) | 1 | 1 | 2 | 0 | 0 | 1 | 0 | 0 | n/a | n/a | 0 | 1 | 0 | 0 | 0 | 1 | 7 |
| Martinez et al., (2018) | 3 | 3 | 3 | 3 | 1 | 3 | 3 | 2 | 2 | 2 | n/a | 2 | 3 | n/a | 1 | 3 | 35 |
| McBeth et al., (2017) | 1 | 1 | 2 | 2 | 1 | 0 | 0 | 0 | 1 | 2 | n/a | 1 | 0 | n/a | 1 | 2 | 14 |
| Odom et al., (2018) | 1 | 2 | 2 | 2 | 1 | 0 | 0 | 0 | 1 | 2 | n/a | 1 | 0 | n/a | 1 | 2 | 15 |
| Patel et al., (2017) | 1 | 1 | 2 | 2 | 1 | 0 | 0 | 1 | 1 | 1 | n/a | 1 | 2 | n/a | 2 | 2 | 17 |
| Qin et al., (2017) | 2 | 2 | 2 | 1 | 1 | 2 | 0 | 0 | 2 | 2 | n/a | 1 | 1 | n/a | 0 | 1 | 17 |
| Shaikh et al., (2018) | 2 | 1 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | n/a | 2 | 2 | n/a | 1 | 2 | 24 |
| Tabriz et al., (2019) | 3 | 3 | 2 | 3 | 2 | 3 | 2 | 3 | n/a | n/a | 2 | 2 | 2 | 2 | 2 | 1 | 32 |
| Winasti et al., (2017) | 2 | 3 | n/a | 2 | 2 | 3 | 3 | n/a | n/a | n/a | n/a | 3 | 3 | n/a | n/a | 1 | 22 |

Note: The bold values are the overall total score for each article as score against the quality assessment tool.

TABLE 2 Summary table of selected studies.

| Author/ year/ country | Title of paper | Type of study | Study aim | Main findings/themes | | | Critical appraisal |
|-------------------------------------|---|------------------|---|--|---|---|--------------------|
| | | | | Barriers to patient flow | Strategies to effective patient flow | | |
| Barnes et al., (2015) America | Real-time prediction of inpatient length of stay for discharge prioritisation | Quantitative | To support automation of real-time demand capacity (RTDC) process by producing daily predictions of patient discharge times for a single medical unit | *Tasks not completed for discharge | *Discrete-event simulation *Optimisation *Lean six sigma approaches *Matching staff & resource demand *operational decision making *Data driven approach *Patient/staff scheduling processes *Bed management policies *Real-Time demand capacity (RTDC) *Reduction in care process variability | Clear methodology & frameworks used to develop a tool, to predict the most likely patients for discharge. Tool has identified potential operational advantages, however has not been applied to other settings of units. Patterns detected may not be generalisable to other hospitals and units. | |
| Bean et al., (2017) England | Network analysis of patient flow in two UK acute care hospitals identifies key sub-networks for A & E performance | Quantitative | To understand the network architecture of patient flow through a data- driven network analysis of two hospitals. | *Hospitals are complex network systems | *Data to inform patient flow networks and key areas to focus initiatives. *Big data to forecast within a health economy | This study modelled a hospital as a network to understand both the spatial and temporal nature of network activity to help determine where and how bottlenecks occur. Claims to be the first research using this approach. Good justification of methods and tools used to collect data. Results may be limited to local area where study was performed however it indicates the potential benefits of further big data research to inform patient flow. | |

TABLE 2 (Continued)

| Author/ year/ country | Title of paper | Type of study | Study aim | Main findings/themes | | |
|------------------------------------|---|------------------|--|---|--|---|
| | | | | Barriers to patient flow | Strategies to effective patient flow | Critical appraisal |
| Boiko et al., (2020) England | Interprofessional barriers in patient flow management: An interview study of the views of emergency department staff involved in patient admissions | Qualitative | To explore the potential role of 'knotworking' as a theoretical approach to understanding interprofessional working in managing patient flow. | *Performance driven coordination barriers-political pressure, increased stress *Limited capacity/ increased demand *Interprofessional barriers- dysfunctional teams, referral-related collaboration *Communication | *Teamwork coordination and collaboration | Semi-structured interviews used to establish an understanding of patient flow barriers. Findings aim to improve understanding of the role of the social aspects in patient flow management and inform key breakdown points of interprofessional working. Small sample group used and not much detail given around the questions asked during interview. Mentioned as the first type of study in this area. Question is whether similar results would be found in a different department with a different culture. |
| Claret et al., (2016) France | Consequences of overcrowding in the emergency room of a change in bed management policy on available in-patient beds | Mixed method | To evaluate the consequences of a change in patient prioritisation on available hospital beds. | *Lack of policy *Capacity *Prioritisation and planning | *Informed policy around prioritisation of beds *Flexible resources *Central bed booking | This study consisted of computerised bed management simulation using real hospital data to test scenarios of patient prioritisation. It claims the best scenario which exhibited the best efficiency was the one that gave priority to planned admissions and surgery as opposed to ED patients. It utilised a small sample over a short period of time and did not take into account specialities of each ward. It does highlight the need to investigate potential policy changes for bed management. |

(Continues)

TABLE 2 (Continued)

| Author/ year/ country | Title of paper | Type of study | Main findings/themes | | |
|--|---|------------------|--|---|---|
| | | | Study aim | Barriers to patient flow | Strategies to effective patient flow |
| Cornes et al., (2018) United Kingdom | Early availability of laboratory results increases same day ward discharge rates | Mixed method | To investigate the impact of early phlebotomy and early availability of lab results on patient discharge. | *Inappropriate bed occupancy *Delayed discharge *Late discharges | *Early access to test results. Study compared discharge rates, discharge time and sample turnaround time prior to and after the introduction of an early phlebotomy strategy. It mentions interviewing patients to analyse their perspectives however very limited information given and the survey is not provided in the study. It concludes that early availability of blood results prior to ward rounds increased discharges but did not affect discharge time. |
| Crilly et al., (2015) Australia | The Implementation and Evaluation of the patient Admission Prediction Tool: Assessing its impact on decision- making strategies and patient flow outcomes in 2 Australian hospitals | Quantitative | To evaluate the implementation of a Patient Admission Prediction Tool (PAPT) in terms of patient flow outcomes and decision-making strategies. | *Lack of decision-making *Lack of synchronisation of admissions and discharges *Poor bed management system communication | *Patient Admission Prediction Tool This study used a multisite prospective comparative design to evaluate the implementation of the PAPT on patient flow. The PAPT helped inform transparent hospital- wide decision- making strategies and changes. The limitations of this study are well discussed with clear recommendations for future research in this area. |
| Destino et al., (2019) America | Improving patient flow; analysis of an initiative to improve early discharge | Quantitative | To increase the percentage of early discharges and decrease bed wait times in the ED and postanesthesia care unit. | *Lack of bed capacity *Mismatch bed availability times *Poor identification of patients for early discharge | Following the implementation of interventions to improve communications and awareness of patients for early discharge the percentage of early discharges increased. This improve wait times in relation to bed availability. Easy to read study using clear methodology and building on previous research in the area. Limited discussion on limitations. |

TABLE 2 (Continued)

| Author/ year/ country | Title of paper | Type of study | Study aim | Main findings/themes | | | Critical appraisal |
|------------------------------------|---|------------------|--|--|---|---|--------------------|
| | | | | Barriers to patient flow | Strategies to effective patient flow | | |
| Driscoll et al., (2015) America | Breaking down the silos to decrease internal diversions and patient flow delays | Quantitative | To minimise placement diversions and patient flow delays through formal methods of communication and collaboration related to hospital capacity. | *Capacity *Lack of team collaboration & communication | *Lean/six sigma methodology *Forecasting tools *Huddles *Conditional discharge orders. *Ancillary services discharge prioritisation | Outlined a process using a project improvement methodology to evaluate initiatives developed from a lean/six sigma methodology to improve communication and collaboration to promote patient flow. Project limited to one hospital and with limited representation of results. | |
| Khalifa, (2017) Australia | Reducing length of stay by enhancing patients' discharge: A practical approach to improve hospital efficiency | Quantitative | To identify and manage reasons of delay in discharging patients. | *System inefficiency | *Multidisciplinary huddles *Rewards/appreciation for staff that meet targets *Optimising the discharge process - Dedicated slots diagnostic services - Improved communication - Eliminating pending exams - Identifying patients for next day discharge - Prioritising lab results - Coordination of medications - Case management | Performance improvement project to enhance patient flow by improving the patient discharge process. This reduces average length of stay and improves the hospital efficiency. Used root cause analysis with staff collecting data and inputting to a database for analysis. Accuracy of data open to variance. Limited discussion on methodology used, no justification. | |
| Khanna et al., (2015) Australia | Discharge timeliness and its impact on hospital crowding and emergency department flow performance | Quantitative | To identify optimal inpatient discharge time targets to help hospitals reduce crowding and improve patient flow. | *Late discharges *Poor discharge planning | *Early discharge | Retrospective observational study uses simulation to identify achievable and effective discharge timeliness targets. Provides evidence that earlier discharges in the day improves patient flow. A target of 80% of discharges by 11 AM improves flow, reduces occupancy and wait times. It does not extend into initiatives to achieve this target. | |

(Continues)

TABLE 2 (Continued)

| Author/ year/ country | Title of paper | Type of study | Study aim | Main findings/themes | | Critical appraisal |
|--------------------------------|---|------------------|--|---|---|--|
| | | | | Barriers to patient flow | Strategies to effective patient flow | |
| Kreindler, (2017) Canada | Six ways not to improve patient flow: a qualitative study | Qualitative | To identify common design flaws that limit the impact of flow initiatives. | *Complex systems *Intervention implementation failure | *Population-capacity-process *Framework to critically analyse interventions | Reports a qualitative study undertaken within the context of an embedded explanatory case study of the regions flow-improvement efforts. Evaluated reasons for the failure of initiatives and discussed a population-capacity- process triad as a useful frame for improving patient flow. Open to bias due to a single coder analysing data. Also did not include front-line staff for input into intervention flaws. Does provide some understanding of why patient flow remains a problem and creates ideas for future research. |
| Kreindler, (2017) Canada | The three paradoxes of patient flow: an explanatory case study | Qualitative | To determine what system-level flaws impede healthcare organisations from improving patient flow. | *Weak primary care infrastructure *System level flaws | *Systems approach/ understanding systems | Paper informed by complex adaptive systems (CAS) and sought to understand the causes of a regional health systems difficulty in improving patient flow. Analyse uncovered three paradoxes revealing a deeper understanding of system dysfunction. Information from managers in the region was gathered and involved a single organisation. This creates some limitation to the findings, but further research to replicate the study in another area could potentially strengthen the findings. |

TABLE 2 (Continued)

| Author/ year/ country | Title of paper | Type of study | Main findings/themes | | | Critical appraisal |
|---|--|----------------------|---|---|--|--|
| | | | Study aim | Barriers to patient flow | Strategies to effective patient flow | |
| Kriegel et al., (2015) Austria | Optimising patient flow in Austrian hospitals- Improvement of patient- centred care by coordinating hospital-wide patient trials | Quantitative | To identify, visualise and initiate the optimal patient flow and the different relevant stakeholders and influential factors in the complex system of the hospital. | *Complex system *External variability *Central admission point | *Case management *Discharge management *Performance measures *Central admission point | The analytic hierarchy process (AHP) framework was adapted to identify, organise and analyse the challenge of patient flow logistics in Austrian hospitals. Influential factors on patient flow were formulated which could be either positive or negative. There is a limited discussion on sample size and setting. Concludes that central admission, case management and patient discharge management were the most influential levers in optimising patient flow logistics. |
| Kriegel et al., (2016) Austria | Patient logistics management of patient flows in hospitals: A comparison of Bavarian and Austrian hospitals | Quantitative | To identify the different objectives, developments and improvements on patient flows in hospitals. | *Complex system | *Central patient receiving *Hospital case management *Discharge management *Communication | Data was collected using an online survey and results were quantified. Online questionnaire had a poor response rate with only 19% responding from one hospital and 28% from another. This resulted on a small size. No detail was given around the survey structure. Results were clearly presented and a comprehensive table representing levers, Objectives and measures of improved patient logics in hospitals is provided. |
| Lees-Deutsch & Robinson, (2019) United Kingdom | A systematic review of criteria-led patient discharge | Systematic review | To identify literature criteria-led discharge from 2007 to 2017. | *Delayed discharges | *Criteria-led discharges *Early discharges | Review focussed on literature for a 10 years period to capture most up-to-date information. Findings indicate improved quality of discharges and reduced length of stay. Study had two reviewers and clearly links to research question. |

(Continues)

TABLE 2 (Continued)

| Author/ year/ country | Title of paper | Type of study | Study aim | Main findings/themes | | Critical appraisal |
|---------------------------------------|---|------------------|---|--|--|---|
| | | | | Barriers to patient flow | Strategies to effective patient flow | |
| Lovett et al., (2015) America | A successful model for a comprehensive patient flow management centre at an academic health system | Quantitative | To outline severe patient flow problems and develop a comprehensive, centralised and systematic approach to improve performance measures related to patient flow. | *Mismatching of resources for demand *Lack of coordination | *Development of Patient flow Management centre (PFMC) *Meetings/huddles/operations meeting/bed meeting *IT support/patient flow software | A descriptive report of pre and post data analysis of the PFMC on [patient flow] problems faced by a large academic medical centre. Multiple small projects implemented to establish the desired change. Limited discussion and justification given for methodology used. Concluded that management of patient flow through the PFMC and supporting systems with information technology and data is critical to improving organisation, communication, coordination and accountability and to increase performance. |
| Martinez et al., (2018) America | An electronic dashboard to monitor patient flow at the Johns Hopkins Hospital: Communication of key performance indicators using the Donabedian Model | Qualitative | To describe the design and development of an electronic hospital capacity dashboard and analyse the usability of the system. | *Technology not utilised *Lack of training/understanding/access | *Electronic dashboard to monitor and inform patient flow. | Semi-structured interviews conducted to understand the barriers to utilising e-Dashboard. No explanation given around the content of the interviews and limited discussion of results. More of a report around the design of the e-Dashboard. Gives an example of a patient flow monitoring systems ad potential implications. |
| McBeth et al., (2017) America | Interprofessional Huddle: One children's Hospital's approach to improving patient flow | Quantitative | To improve patient flow by improving interprofessional and interdepartmental communication and collaboration. | *Poor communication *Poor collaboration | *Huddle | A quantitative, retrospective, descriptive design was used to examine the changes in patient flow before and after the implementation of the huddle. Easy to read, clear description of research method and justification of design/. Study demonstrated a significant decrease in patient boarding and improved communication/collaboration. Limitations of the study well discussed. |

TABLE 2 (Continued)

| Author/ year/ country | Title of paper | Type of study | Study aim | Main findings/themes | | Critical appraisal |
|------------------------------------|---|------------------|---|-----------------------------|---|---|
| | | | | Barriers to patient flow | Strategies to effective patient flow | |
| Odom et al., (2018) America | Patient progression: A Hospital-wide, multi-disciplinary, data-driven approach to moving patients safely, timely & efficiently | Quantitative | To initiate and implement a plan to resolve patient flow issues in order to provide safe, efficient and timely movement of patients from admission to discharge. | *Ineffective processes | *Align to strategic plan *Strong leadership *Dashboard- KPI monitoring *General medicine unit/ transition care unit | A multi-disciplinary, data-driven approach to improve hospital-wide patient progression. Discussion of an improvement project in a community hospital. Limited in the timeframe for data collection with minimal description of methodology used. |
| Patel et al., (2017) America | Using a systematic framework of interventions to improve early discharges | Quantitative | To achieve a discharge before noon (DBN) rate of greater than 20% from a baseline of 10.4%. | *Late discharges | *Early discharges - Multidisciplinary team rounds - Transportation & discharge logistics - Discharge workup/ identification the day prior - Audit and feedback - Performance management & data collection | Article is a description of interventions and sustainability plan on the medical service using a continuous process improvement model. Qualitative improvement project sustained results in improving discharge times to an average of 19.7%. Single site study with several interventions resource dependent requiring a dedicated team of providers. |

| | | | | | | |
|------------------------------------|---|--------------|---|--|---|---|
| Qin et al., (2017) Australia | Hospital occupancy and discharge strategies: A simulation-based study | Quantitative | To propose and test different discharge strategies to reduce occupancy rates in the hospital. | *Increased capacity *Discharge delays *Complex systems | *Early discharge planning of long stay patients *Policy to promote discharges any time/day of the week | A simulation approach using the Hospital Event Simulation Model: Arrival to discharge (HESMAD) to analyses a range of proposed discharge strategies. Results demonstrated possibilities to reduce the number of days when a hospital runs above its base bed capacity. Practical implications of the study would need to be further tested. |
|------------------------------------|---|--------------|---|--|---|---|

(Continues)

TABLE 2 (Continued)

| Author/ year/ country | Title of paper | Type of study | Study aim | Main findings/themes | | Critical appraisal |
|-------------------------------------|--|------------------|--|--------------------------------------|---|--|
| | | | | Barriers to patient flow | Strategies to effective patient flow | |
| Shaikh et al., (2018) America | Risks predicting prolonged hospital discharge boarding in a regional acute care hospital | Quantitative | To determine the risks predicting prolonged hospital discharge boarding and their direct and indirect effects on patient flow. | *Delayed discharges/ transfers | *Case management consultation | A retrospective single centre observational project indicated that reducing discharge boarding below 2 h would result in 16,376 saved bed hours and \$98,256 in unnecessary costs. Decreasing boarding time has a positive impact to overall hospital resources and finances. Authors acknowledge potential bias in terms of information accuracy, incomplete data and potential selection bias. |
| Tabriz et al., (2019) America | What is full capacity protocol, and how is it implemented successfully? | Qualitative | To identify the core components of full capacity protocol (FCP), explore the key barriers and facilitators associated with the FCP implementation, and provide practice recommendations on how to overcome those barriers. | *Lack of inpatient beds. | *Full capacity protocol | Qualitative study utilises in-depth semi- structured interviews to provide an understanding of the evolution of FCP, the key barriers and practical recommendations. FCP can improve patient flow when utilised in the right context, however implementation is challenging and requires a dedicated multidisciplinary team and good leadership. Noted that FCPs need to match the demands of specific health services and have supporting protocols for implementation that can differ depending on setting. |

TABLE 2 (Continued)

| Author/ year/ country | Title of paper | Type of study | Study aim | Main findings/themes | | |
|------------------------------|--|----------------------|--|--|--|--|
| | | | | Barriers to patient flow | Strategies to effective patient flow | Critical appraisal |
| Winasti et al., (2017) | Inpatient flow management: A Systematic review | Systematic review | To look at the information available in system- wide patient flow management studies and evaluate to demonstrate which interventions improve patient flow. | <ul style="list-style-type: none"> *Variability *Insufficient resources *Ineffective inter- unit interactions *Delays in discharge | <ul style="list-style-type: none"> *Flow coordinator *Transition units *Changes in admission and discharge planning *Optimal resource allocation | <p>A two stage search was performed to gather information to report inpatient flow management study characteristics, study content, and study design and quality.</p> <p>Clear search strategy and inclusion/exclusion criteria presented/.</p> <p>Study claims to be the first review in relation to this area.</p> |

2.5 | Search results

The initial search yielded a total of 596 articles. Following the removal of duplicates, 343 article titles and abstracts were screened for their relevance to answer the focus question. A total of 72 articles were then retrieved for full-text review after the application of the inclusion and exclusion criteria. The majority of the studies not included related to a focussed on a single unit. The most common area for patient flow studies to be conducted was the emergency department as opposed to wards or critical care areas within a public hospital. A total of 24 articles were selected against the selection criteria and included in the literature review. Figure 1 shows the flow diagram of the search strategy.

2.6 | Overview of articles

The 24 articles comprised of a variety of methodologies. These included quantitative methods ($n = 15$), qualitative methods ($n = 5$), mixed methods ($n = 2$), and systemic reviews ($n = 2$). The research was conducted in a range of countries including America ($n = 10$), United Kingdom ($n = 2$), England ($n = 2$), France ($n = 1$), Australia ($n = 4$), Canada ($n = 2$), Austria ($n = 2$) and Netherlands ($n = 1$). The majority of the studies were conducted within a single public hospital ($n = 16$), with a total of 8 studies using multiple hospitals to gather data. The unit specific studies were mainly conducted in the emergency department, however they linked to whole hospital strategies as per the selection criteria.

3 | RESULTS

This systematic review focussed on uncovering evidence related to two key categories; challenges to patient flow and strategies to improve patient flow. The selected articles were analysed and the findings from the articles were grouped together to form common themes within these two categories. A total of 5 themes were generated in relation to patient flow. These include; (1) Teamwork, Collaboration & Communication, (2) Public hospitals as complex systems, (3) Timely discharge, (4) Policy, Process and Decision-making, and (5) Resources- Capacity and demand. Strategies for improvement identified from the literature were then grouped into these same themes to identify ways to overcome the challenges.

3.1 | Themes

3.1.1 | Teamwork, collaboration and communication

Challenges

This theme was identified in 4 studies to be a challenge in achieving effective patient flow. McBeth et al.²⁰ identify effective communication and interdepartmental collaboration as key elements to address patient flow problems. This is supported by Driscoll et al.¹¹ in their discussion on the segregated nature of patient care units and the challenges posed by staff working in silos. A systematic review conducted by Winsasti et al.¹⁷ also identified inter-unit interactions in 20% of studies.

The lack of communication between teams and poor collaboration leads to a breakdown in interprofessional working. Interprofessional barriers are explored in a study by Boiko et al.⁶ They identify teamwork, coordination and collaboration as the processes that underpin their interprofessional analysis of flow management. Following the use

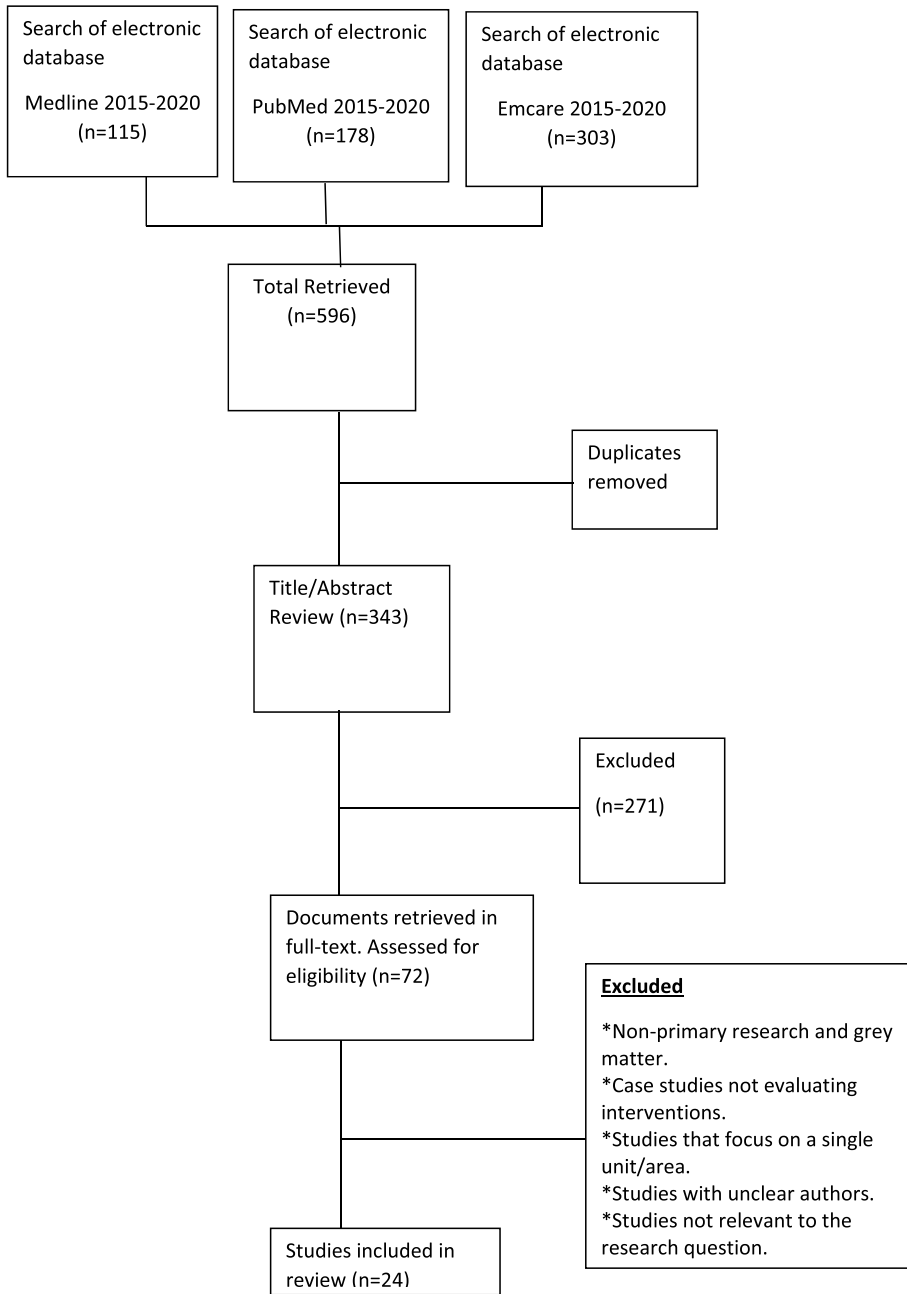


FIGURE 1 Flow diagram of search strategy results.

of 'knotworking' as a theoretical approach to understanding barriers in relation to patient flow, they report three main barriers; teamwork, performance driven coordination and referral-related barriers.

Strategies for improvement

Strategies to improve teamwork, collaboration and communication was a focus in 5 studies within the literature review. The main concept to improve patient flow within this theme was engagement of the multidisciplinary team.

Winasti et al.,¹⁷ Odom et al.²¹ and Driscoll et al.¹¹ all identify the engagement of the multidisciplinary team as key to improving communication and improving patient flow. Odom et al.²¹ further expanded this concept and discussed the importance of the multidisciplinary approach across multiple departments to have the best impact on effective patient flow.

The most common strategy to improve the collaboration of the multidisciplinary team was the formation of huddles and bed management meetings. McBeth et al.²⁰ demonstrated a significant decrease in hospital boarding times after the implementation of huddles with their pre and post study over a period of 3 months. The study by Driscoll et al.¹¹ also found that 'plan of the day huddles' based on real-time demand-capacity management methodology improved communication and patient flow across multiple units.

3.1.2 | Public hospitals as complex systems

Challenges

Public hospitals, described as a complex system causing challenges to effective patient flow was identified in 9 studies. Kriegel et al.^{22,23} discussed a complex system characterised by a high level of division of labour, high number of parties involved, and a wide range of specialised health professionals along a patient related performance and value creation process. This identified complex patient care structure is further identified in the study by Bean et al.¹⁶ who state that previous studies that focussed in linear flow process of a single patient pathway failed to capture the complex topology of a real-world hospital comprising of hundreds of patient journeys overlapping in time-space.

The public system is further challenged by variability that can occur on a day-to day basis. Winasti et al.¹⁷ and Qin et al.²⁴ discuss variability with patient flow causing further complexity. Interventions are confounded by variables such as workloads and resource allocation across the whole hospital due to the complexity of the hospital structure. Kriendler²⁵ further explored this concept concluding that a lack of a coherent system-level strategy caused challenges. Interventions to improve patient flow focussing on small segments within the system and patient journey reflect a decentralised system. Kriendler²⁶ documented three synthesis in their explanatory study; (1) Initiatives have improved parts of the system but missed the greatest system problems/constraints, (2) If sites and regional programs shared clear, specific goals, either could lead change, (3) The phenomenon of stateless patients reflects haphazard system design. A well-designed system features appropriate services to meet the needs of each patient population.

Strategies for improvement

Strategies around this theme were discussed in 5 articles. Both Kreindler²⁵ and Kriegel et al.²² published two studies each which built on similar areas of focus. To meet the complexity evident in the public health systems, it was found that most studies identified the need for a whole system approach. Kreindler²⁵ used an in-depth interview approach to uncover three paradoxes in relation to patient flow. It was concluded that initiatives must have a system approach involving a coherent strategy defined by patient population needs, analysing their entire trajectory of care, and developing consistent processes to better meet these needs. Kriegel et al.²² identified four levers to drive patient flow at a system level. These included; central patient receiving, hospital case management, discharge management, and communication. In order to understand where system level initiatives need to be targeted, Bean et al.¹⁶ used a data driven approach to analyses areas within the patient flow network and show where issues occur. They hypothesised that by understanding the systems areas that require change, initiatives will have a greater impact towards improvement of patient flow. This however was a pilot study and is yet to be further tested.

3.1.3 | Timely discharge

Challenges

The literature included in this systematic review contains 9 articles that discussed late discharges or poor discharge processes as a challenge to effective patient flow. Khanna et al.¹⁵ and Shaikh et al.²⁷ discuss the need for early

discharges at a ward level to minimise overcrowding and bottlenecks in the emergency department. Shaikh et al.²⁷ also define the issue of hospital discharge boarding which is the time from the discharge disposition order to the patient departure. The longer a patient waits to discharge reflects through the whole hospital and causes backlogs throughout the system.

These discharge delays are identified in the study by Destino et al.²⁸ who identify the discharge delays as being a significant problem when hospitals are at peak capacity. Winasti et al.¹⁷ and Qin et al.²⁴ also conclude that delays in inpatient discharge for non-medical or organisational reasons increase hospital occupancy. The mismatch of early admissions and late discharges have been shown to increase costs, decrease hospital efficiencies and inconvenience patients in a study by Cornes et al.²⁹ To help minimise this Barnes et al.¹³ identified the need to predict when patients were able to be discharged so that tasks could be prioritised. This poses a challenge when data is not available, relevant or used by staff who drive patient flow.

Strategies for improvement

Strategies to improve patient flow in relation to discharges within a public hospital were found in 7 studies, with all of the strategies incorporating elements of communication, teamwork and process improvement. Destino et al.²⁸ applied a multidisciplinary approach within their 'Plan-Do-Check-Act (PDCA) cycle to improve discharges. They used the concepts of early discharge identification, daily huddles, and early discharge recognition in a study over 10 months to improve discharges from 8.8% to 15.8%. Khalifa et al.³⁰ implemented eight interventions to improve discharges. These included; dedicated slots in diagnostic services for discharging patients, improved communication, eliminating pending exams, identifying discharges the day before, prioritising laboratory tests, coordinating discharge medication processes and utilising case management. In order to prioritise pathology results, Cornes et al.²⁹ focussed their study on increasing the availability of early results on hospital wards. They found that discharges did not occur earlier in the day, but discharges were increased. Patel et al.³¹ also evaluated interventions to improve early discharges. These included; education campaigns on the safety implications of reducing hospital boarding times, afternoon huddles and web-based dashboards to display real-time discharges by noon. A further strategy facilitate early discharge was investigated by Lees-Deutsch and Robinson⁵ with their study on criteria led discharge. This strategy requires a strong protocol and commitment of the treating medical teams to succeed, but has shown the potential to streamline the discharge process.

Two studies focused on the strategy to provide data to inform best practice around the optimal time for discharge to reduce occupancy rates. Khana et al.³² and Qin et al.²⁴ both used a simulation to identify optimal discharge time targets in order to improve performance. Both simulations identified the benefits of early discharges on patient flow performance targets.

3.1.4 | Policy, process and decision-making

Challenges

This theme incorporates the policies around processes that drive patient flow, the decision-making around these processes. A total of 5 articles identified challenges within this theme. Ineffective flow process and fragmented bed management processes when identified by Boiko et al.⁶ and Odom et al.²¹ These ineffective process lead to increased length of stays (LOS), increased mortality, increased adverse events, further impact hospital wide patient flow issues. The lack of clearly defined policy on prioritisation of admissions contributes to a disorder system.³³ This causes a lack of coordination between the ward, operating theatres and the emergency department resulting in delays and bottlenecks within the system. Barnes et al.¹³ discusses the need for a data driven approach to inform operational decisions which is confirmed by Crilly et al.³⁴ and their study into a Patient Admission Predication Tool (PAPT) to help drive patient flow through informed decisions.

Strategies for improvement

Strategies in relation to policy, process and decision-making are identified in 6 studies. These strategies are also strongly reliant on a multidisciplinary approach and communication. Odom et al.²¹ identified that to achieve effective patient flow a multidisciplinary-data driven approach must be incorporated into the strategic plan. This data driven approach increases effective decision-making around patient flow. Crilly et al.³⁴ discussed a Patient Admission Prediction Toll (PAPT) and workflow guidelines as necessary elements to improve decision-making around patient flow and improve performance. Evaluation of these strategies identified an ideal occupancy rate for hospitals as 85% and demonstrated the ability to increase admissions without increasing occupancy through the use of predicted data and structured flow processes.

Barnes et al.¹³ utilised a real-time demand capacity (RTDC) management analytical tool generated using machine algorithm learning. This predicted the patients most likely to discharge so that tasks could be prioritised early in the day. It was shown that the tool had some accuracy, however further testing is required. A key element for its success was also multidisciplinary huddles and communication. Strategies that respond to times of high demand were also identified. Lovett et al.⁸ identified the need for a central patient flow management centre with plans to respond to surge beds and escalation requirements. Tabriz et al.³⁵ looked at the implementation of a full capacity protocol (FCP). This protocol outlines the escalation plan when hospital exceeds its capacity. This requires a multidisciplinary approach and hospital specific guidelines for success. It is also dependent on collaboration, consensus about escalation criteria and available staffing and resources to respond to demand.

3.1.5 | Resources-capacity and demand

Challenges

This theme identified the challenge of having the resources to meet capacity and demand in public hospitals. This theme was evident in 9 studies, identifying that capacity and demand is a key concept to patient flow management. The concept of mismatching between capacity and demand is discussed in several studies. Destino et al.²⁸ discuss the mismatching of beds with the demand required early in the day and discharges occurring late, while Tabriz et al.³⁵ and Claret et al.³³ discusses how to need for services exceeds the availability of beds and the lack of hospital beds is a major difficulty in managing patient flow. Lovett et al.⁸ state that inefficiencies in flow reflect systematic mismatching of demand and supply for inpatient resources across the whole hospital. This then leads to the issue of resource silos resulting in the inability to meet peaks in demands.

The relationship between resource inputs and outputs is identified by Winasti et al.¹⁷ and Khalifa.³⁰ Both studies identify inefficiencies to ensure appropriate resource allocation and insufficient resources in designated units. Qin et al. concludes that lower hospital occupancy results in a greater capacity of hospitals to absorb surges in workloads.²⁴

Strategies for improvement

Multiple articles looked at the challenges in this space, however most strategies to improve against this theme have already been discussed. The main concept is having the data, resources available and processes in place that can inform decision-making and create capacity to meet demand. Martinez et al. identify how an electronic dashboard which monitors patient flow can provide information required to make timely decisions and implement process early to facilitate effective flow.³⁶

4 | DISCUSSION

This systematic review summarised evidence from studies to look at patient flow from a whole hospital perspective to answer the research question, 'Why the slow flow?' and identify the challenges to achieving effective patient flow and strategies for improvement. Evaluation of the studies uncovered multiple challenges within public hospitals that work collectively to slow and impede patient flow.^{8,13} In their literature review Winasti et al. discussed the fact that we still know little about solving patient flow issues, but there is a growing trend in studies on inpatient flow management.¹⁷ Potentially for this reason and the complex nature of the problem, is why patient flow is still an issue in public hospitals.

Evidence around the engagement of the multidisciplinary team to improve patient flow was well supported in the literature.⁶ It is clear that processes must be in place to drive effective communication and bring professionals together to work as a team towards effective patient flow. The multidisciplinary team must have strong leadership and all members must be aligned with clear and transparent goals. If professionals within the hospital are not committed or do not understand the need for effective patient flow, interventions are unlikely to succeed.^{5,9}

Within the complex nature of the public hospital system the literature supports the need for all professionals to understand and be governed by a clear strategic plan.⁴ This again involves a strong culture of teamwork and understanding of how each area of the hospital contributes to patient flow in the whole hospital system. The system must also be structured to meet the demands of the population. If demand in the community has outgrown the infrastructure or capacity of a health service, process or service provisions should be reviewed to meet the changing need.¹² Understanding how the system functions and having a flexible system that can meet increased demands and variability, results in high quality care and the ability to provide scheduled services without cancellation or deferral. This enables the service to meet their required performance throughput whilst maintaining a safe operating capacity.⁸

In order to generate capacity for patient admissions, it is evident from the literature that timely discharge and effective discharge processes are essential.¹⁴ Early discharges in a day were important to maintain patient flow and prevent bottlenecks in departments. Often there is a mismatch between admissions and discharges with early requirements of beds from the emergency departments and operating theatres, and late discharges from the inpatient wards. Again, all the strategies to drive and facilitate early discharge required a multidisciplinary approach and good communication.³⁷

Effective patient flow also requires site specific policies to inform clear processes. Public hospitals must meet the needs of the communities they service, therefore not all hospitals will be identical. Similarity exist, however one process may not work for all. These processes should also help drive timely and effective decision-making around patient flow and create an understanding in the interprofessional team of the actions required to meet the demands within the hospital on a daily bases.³⁸ Processes should be in place that inform and guide in times of required escalation to ensure that flow through the hospital continues and care is provided at a high standard.

In order to provide patient care at a high standard, public hospitals must have the resources and capacity to meet the demands. The use of data and predictive tools can help drive decision-making and planning to pre-empt times of increased demand and put strategies in place early to create capacity. The literature supports the use of this data to help guide and structure workflows, however further research is required in hospital settings as opposed to simulation studies.³⁸

4.1 | Limitations

The review only focussed on public hospital and articles identifying improvements in more than one unit or area. The incorporation of the ambulating setting or private system may have delivered further results into strategies to improve patient flow. A notable limitation for this review is that only full text articles published in English language

in peer reviewed journals were included. The restriction of the publications to 5 years and the inclusion criteria may have excluded some relevant literature identified for the review. In addition, restricting the search to the English language only may have reduced the generalisability of the findings for this review. Moreover, this review uses literature from different countries around the world which may have different health systems and challenges to manage the health sector. Therefore, caution should be taken when applying the findings of this review. However, the use of specific health databases, clearly identified search methods with the consultation of university health librarian, and use of specific search terms helped to minimise these limitations.

5 | CONCLUSIONS

The key finding of this study is that a whole system approach is required to improve patient flow in public hospitals. It was found in this systematic review that limited studies focussed on whole system strategies to improve patient flow. Strong evidence suggests that to achieve effective patient flow a whole system approach is required with a centralised point of command to manage patient flow.⁸ This requires engagement and collaboration of the multidisciplinary team to work towards common goals throughout the whole patient journey. There is however limited literature available to test this theory and measure the outcomes within the public hospital system. Most of the articles analysed focussed on single hospital settings with limited duplication of the studies in other public hospitals. The strategies implemented may not be applicable to other areas, however further research is required to test whether the same strategies would improve patient flow in other hospitals. Therefore, further research is required to test whole hospital strategies across multiple sites.

Understanding the challenges within public hospitals is required to align strategies and implement processes to create effective patient flow. These process are ideally informed by data to predict admissions, track discharges and enable early decision-making when peaks in demand occur. This allows for pre planning and early escalation to occur in order to meet increases in hospital demand. When effective patient flow is achieved, demand and capacity are matched, increasing patient access to the health service and enabling the resources required to provide high quality patient care.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

Data and materials related to this review have been used in the manuscript.

ETHICS STATEMENT

The ethical approval is not required as no human subject participants are involved.

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