



# Emergency Department Models of Care Review 2018

## **Emergency Department Models of Care Review, 2018**

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# Abstract

**Background:** Prolonged waiting times and high patient volumes are longstanding problems in EDs is repeatedly reported across Australia and globally. As a result, there has been significant amount of work to re-design care processes to improve waiting times, operation and flow and crowding. The purpose of this review is to describe the scope of research that is available assessing the relationship between ED crowding and patient outcomes.

**Methods:** A scoping review was conducted using as data sources: Embase, Medline (incl. PubMed), CINAHL (via EBSCO), and the Cochrane library (via Wiley) and relevant emergency medicine and nursing journals for studies published in the past two decades that pertained to ED crowding and the patient outcomes. An iterative process was used to define the search strategy for the review. The data extraction (and quality assessment) tool were developed a priori.

**Results :** The search identified 5518 articles. Ninety-eight (98) were included in the review: 1 audit, 28 before after interventional studies, 9 case control, 19 prospective cohort, 23 retrospective cohort, 1 quasi experimental, 1 quasi randomised 13 RCT and 1 non- RCT of performance improvement data. In addition 11 systematic reviews were included. Methodologic quality was moderate with weaknesses in the reporting of study design and methodology. Overall 18 various outcome measures were analysis in the papers. All papers measured ED LOS, followed by wait time.

Of titles identified from the academic literature 98 were relevant with one-third of the papers from Australia followed by USA (28.5%) and (16%). The majority of the analysed triage, nursing scope of practice and fast track. Very few documents were found to investigate care coordination and various discharge streaming models.

**Conclusions:** ED congestion is a major patient safety concern associated with poor patient outcomes. Interventions and policies are needed to address this significant problem. This review details the patient outcomes associated with various models identified to address ED congestion. Study results are relevant to medical professionals and ED administrators as well as those seeking care in the ED.

**Keywords:** access block, patient flow, ED congestion, models of care, ED LOS, DNW and ED re-presentation.

# Introduction

Emergency department (ED) crowding is a worldwide issue in all healthcare systems and is associated with the increased incidence of several adverse outcomes.<sup>1-6</sup> A systematic review identified 71 unique measures and classified them according to a commonly used conceptual model of ED output.<sup>7</sup> Although the etiologic of ED congestion is complicated, it can be divided into three aspects: the input, throughput and output of ED patients.

The input of patients (ED visits) has increased significantly over the past two decades and because modern EDs can diagnose and treat a much wider range of patients compared to 20 years ago, it is unlikely that the trend in patient visits will decline in the near future. The destination of patient disposition is mostly either home or stay at hospital. The process of ED admission is often difficult and patients need to wait and receive treatment in the ED. However, access block, excess block, output of patients is not an issue that can be easily tackled by the ED alone. In order to balance admissions and discharges, a larger scale of planning and coordination is needed. For example, health system administrations need to distribute available beds according to patient flows, different specialities, staffing changes and seasonal fluctuations.

Because patient input and output processes are often related to broader healthcare issues the throughput process is therefore left to be the main focus of researchers of ED congestion. An important indicator of the patient management process in the ED is length of stay (ED LOS). ED LOS has been identified as a cause as well as a result of ED congestion.

## Method

Following compilation of themes and topics considered relevant to the field, searching was carried out in with the focus on ED throughput defined as the internal processes that promote of effect patient movement.<sup>8</sup> This is an accepted stage for all scoping reviews as it seeks to establish optimal balance between sensitivity and specificity. This is important conceptually, to finalise the scope of the review and pragmatically, to ensure that the review is feasible within the available time and resources. A final search strategy was then developed to retrieve evidence relevant to the whole subject area. This final search aimed to identify slices of the evidence but was designed to be more focussed producing a higher yield of relevant papers and was therefore more time effective to review. The information specialist searched the electronic databases Embase, Medline (incl. PubMed), CINAHL (via EBSCO), the Cochrane library (via Wiley). Searches were conducted in August 2017 covering the period January 1997- August 2017.

Extracted titles and abstracts were screened by one reviewer on criteria noted in **Box 1**. Each title or abstract was reviewed and deemed relevant, no relevant or containing inadequate information for coding. To operational the brief peer-reviewed literature were included if they described the impact of the interventions on key performance indicators and outcomes, such as ED LOS, DNW and ED re-presentation rates. Studies that failed to discuss outcomes or the impact on ED flow and or hospital congestion were excluded from the review. Full text articles that met inclusion criteria were retrieved. Data extracted from the final articles included author, country, sampling, method/s and implications for practice.

### Box 1: Search strategy and literature selection process.

|                           |   |
|---------------------------|---|
| <b>Databases searched</b> | <ul style="list-style-type: none"><li>• Databases: Medline, CINAHL, Cochrane, Embase and Google Scholar searches.</li><li>• International and national emergency medicine journals between 2015-17.</li><li>• Reference list of selected papers.</li></ul>  |
| <b>Inclusion criteria</b> | <ul style="list-style-type: none"><li>• Full text articles published in English within date restrictions inclusive of 1997-2017.</li><li>• Qualitative, quantitative or mixed methods studies with focus on ED throughput defined as the internal processes that promote or effect patient movement through the ED.</li></ul>   |
| <b>Exclusion Criteria</b> | <ul style="list-style-type: none"><li>• Unpublished or ongoing research, conference abstracts, non-primary research (such as letters to the editor, editorials etc) case studies not evaluating interventions; research not in English, anonymous articles- or unclear authorship &amp; publication date were outside specified timeframes (1997-2017).</li><li>• Systematic reviews were not excluded from the review.</li></ul> |
| <b>Quality Assessment</b> | <ul style="list-style-type: none"><li>• Relevant details distilled and recorded.</li><li>• Papers were included if sufficiently well designed peer reviewed, from reputable sources or contributed to by experts in the field of emergency medicine, nursing, health policy or health system finance .</li></ul>  |
| <b>Synthesis</b>          | <ul style="list-style-type: none"><li>• Articles were systematically examined and categorised into major themes associated with models of care, and factors that appear to be driving changes within the ED.</li><li>• The distilled data were synthesised using narrative summaries and analysed thematically to identify and describe the main factors affecting models of delivering emergency healthcare.</li></ul>           |

## Results

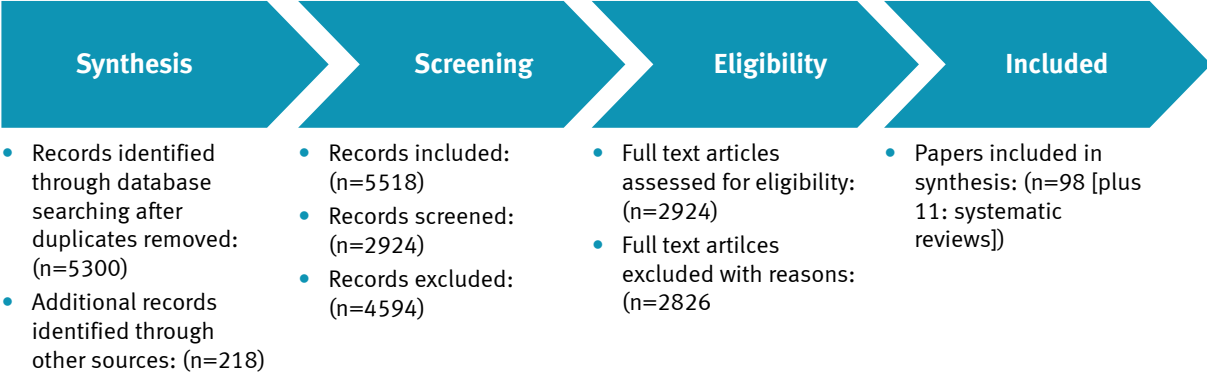
**Box 2** depicts article elimination process. The initial search retrieved 5518 articles and or abstracts. All duplicates were removed. The title of each article was then screened for relevance. Titles that were not relevant to the key focus areas around ED throughput were excluded from the study. The remaining abstracts and full articles were then screened for potential inclusion in the review, based on inclusion and exclusion criteria. A total of 98 were included. The characteristics and findings of these papers are summarised in **Appendix 4**. These comprised a variety of methodological designs ranging from before and after studies (n=28),<sup>9-34</sup> RCTs (n=13),<sup>35-46</sup> prospective cohort study/s (n=19)<sup>47-71</sup> and retrospective cohort study/s (n=22).<sup>72-87</sup> The majority of papers of the studies included in the review were conducted in Australia (n=36),<sup>10-17-19-21-22-26-35-37-38-44-47-50-54-56-61-63-63-68-73-75-79-80-81-83-88-89-90-92</sup> the USA (n=28),<sup>11-12-18-20-23-25-27-31-34-36-41-43-45-57-58-65-66-82-84-85-93-97</sup> UK (n=16)<sup>13-24-42-46-53-60-64-67-69-71-76-89-99-102</sup> and then Canada (n=8).<sup>14-16-39-59-77-86-87</sup> The remaining papers were categorised from other Europe (n=7),<sup>33-48-49-52-72-103-104</sup> Asia,<sup>70</sup> Africa<sup>51</sup> and New Zealand.<sup>9</sup> Most were single site studies (n=52).<sup>9-11-14-16-18-20-24-27-29-30-31-32-33-37-39-40-42-45-46-50-53-58-63-65-67-69-70-74-76-79-80-81-83-85-87-88-90-94-97-98-100-105</sup>

From the database search the most predominately evaluated model of care is Triage with 30 papers identified <sup>4 5 11 12 15 17 18 21 22 24 25 27-30 32 33 34 39 40 46 47 51 58 59 65 69 70 72 84 96 97 99 100-102</sup> followed by 23 papers categorised as Fast Track and Rapid Assessment studies. <sup>9 13 15 19 21 26 32 48, 49 52 54 61 62 73-75 81 85 90 103 105</sup> studies. The database search also identified <sup>16 17 21 38 50 53 56 60 63 67 76 79 80 83 88 89 91 92 94 98 104</sup> papers which could be categorised as Nursing Scope of Practice.

All papers (n=98) reported on EDLOS outcomes reported on included ED LOS. The majority of papers (n=87) also reported on wait time. <sup>9-19 21-23 25-30 32 34-44 46-49 51 52 54-59 61-71 73-77 79 80 82-87 89- 99 101-105</sup> followed turnaround time (n=41) <sup>9-12 16 24 26 29 31 35 39 41 43 44 47 49 54-56 60 61 63 64 66-68 71 75 76 79 80 83 85-87 91-93 102 104</sup> and left without being seen (LWBS)/ left without completing treatment (LWCT) (n=32). <sup>11 18 19 24 25 28-30 34 37 39 42 58 59 61 62 63 68 70 71 74 83-85 88 91 95 96 101 104 106</sup> The characteristics and findings of these papers are summarised in **Appendix 2, 4 & 5**.

Sample size varied from 107 <sup>36</sup> to 180,870 <sup>25</sup>. Twenty–seven (27) studies <sup>9 10 14 19 21 24 27 32 33 35 44 48 52 57 61 62 68 73 80 81 84 85 93 95 97 100</sup> were unclear as to the sample size.

**Box 2: Article elimination process**



## Discussion

This scoping review summarises the evidence on the effectiveness of a variety of models and interventions aimed to address congestion in the ED. As ED crowding worsens, it is important for departments to improve operations to promote patient throughput. This scoping review of the academic literature shows that few and often methodologically limited studies have been published concerning front end operational improvement strategies. Of those published only a handful noted the effects of these strategies on patient outcomes.

**Patient streaming** is a way of directing flow so that patients with minor injuries or illnesses can be seen in a separate area of the ED than patients with complex care requirements. The most common example of streaming minor presentations is fast track. Streaming has been reported to benefit all ED patients, not just those in fast track: with a number of studies in this review indicating were patients were seen by a doctor more quickly following implementation of streaming ED LOS was reduced as well as patients’ who did not wait for treatment following streaming.



**Triage** systems have traditionally been used to ensure that the most urgent patients receive timely service. The majority of the studies included in this review have been able to demonstrate that triage systems can also have a positive effect on patient flow, as measured by waiting time and ED LOS. However not all triage systems are the same, and the types of services provided at triage may influence these outcomes. Triage systems may be relatively simple seeking only to put patient in order or priority or allocate appropriate services. Other more complex systems enable simple treatment to take place at the time of triage, which could potentially remove a patient from the queue or increase efficiency of future treatment. The majority of papers that analysed **team triage** concluding that dedicating a senior doctor in triage reduced the wait time for patients to see a doctor, decreased LOS and lowered the proportion of left without being seen, leaving without completing treatment. However the impact of patient satisfaction was inconsistent across the studies identified. Triage systems may vary along the continuum until at some point the intervention become extensive enough that the process becomes assessment and treatment rather than triage.

Apart from triage, **Fast Track & Rapid Assessment** was the most studied intervention method supported by the strongest scientific evidence. By fast-tracking patients with less severe symptoms result in shorter wait times, ED LOS and fewer patients leaving without completing treatment or being seen. It has been reported that implementation of **computerised tracking systems and whiteboard systems** improves patient flow, shortens patient wait times, reduces left without being seen rates as well as improving patient and staff satisfaction as well as communication. Tracking systems (electronically) may be a useful addition to ED performance improvement initiatives not only to further streamline practices but also capture metrics and data to build on capacity and to continuously improve. Clearly, the use of these technologies together with other communication technologies in the ED setting and their effect on outcomes has yet to be fully explored.

In an attempt to address the growing ED population in the context of limited medical workforce, the adaption to the **scope of practice of nurses** in the ED is being presented as a staffing option. The results for the reviews included in this study suggest that the changing scope of the nurse, especially when dedicated to seeing minor treatment patients have improved wait time and ED LOS as well as improve patient satisfaction with little to no impact on quality of care. For the low acute patients in congested EDs as well as rural hospitals, the extension of the scope of practice for nurses may represent a viable and effective option allowing optimal use of limited physician resources and improving access to emergency care for the population.

In response to escalating workloads and waiting times and deteriorating patients, an attempt to shorten ED LOS, the scope of practice of nurses has expanded to allow **nurses to initiate investigations** and interventions including **blood tests, analgesia and x-rays**. The studies included in this review found that the majority of papers analysing nurse initiated analgesia, blood tests and x-rays found decrease to pain assessment, reduced length of stay and improved patient satisfaction.

**Medical Assessment Units** staffed by multi-disciplinary teams led by acute medical physicians have the potential to improve the quality and safety of care of a significant proportion of acutely ill patients presenting to hospital. Also, **Short Stay Units** have been co-located with many EDs to reduce LOS in the ED. These units accommodate patients requiring more time in the ED. The systematic reviews and the single study included in this scoping report show that short stay units and observation wards have the potential to benefit patients reduce LOS, improve efficiency of the ED.

## Limitations

There are a number of limitations of the studies included in this review making definitive recommendations from the literature difficult to make. Given the time constraints of this scoping review, the strengths of this review include the comprehensive search strategy, eligibility criteria and standardised data extraction. The principal weakness of the review is the variability in study design and methodologic quality of included articles. The included papers varied in the quality of descriptions of methodology (ie: principally most studies were single site), outcomes assessment and reporting of measure specifications may have resulted in misclassification of measures. However the three measures with the most evidence of a link to quality – ED LOS, waiting time and/ or turnaround time- are relatively straightforward measures. Slight differences in data collection or reporting between studies likely would have not altered the conclusion of the review. It is also acknowledged that the results of this review are limited to the measures studied and that there may have been a better choice of measures and or evidence hierarchy assessment than those that have been identified. Finally the number of included studies did not undergo any quality assessment

## Conclusions

Worldwide, ED congestion is a problem that is demanding hospital administrators and policy makers understand the complexity of front end hospital services and understand the impact of congestion has on a patient journey. The review indicates there is a plethora of literature available indicating the deleterious effects of ED congestion on patient outcomes. Improving access and flow is important with patient safety remaining of paramount importance.

The scoping report has evaluated key initiatives introduced to improve patient flow in EDs. Based on the papers reported, it seems that there is a significant body of models of care and strategies to manage ED congestion literature. The existing streaming, care processes and analysis of ED crowding is most frequently linked to quality of care measures such as the time of patients in the wait and their LOS in the ED.

The review identified that strategies are often limited in applicability from one institution to another. However there do appear to be some overarching alterations in behaviour and management that could serve to better assess, treat and flow patients through the ED. Useful strategies include improvements in triage (and registration), nurse initiated actions, fast track and point of care testing. The result of this review also highlight important gaps in knowledge with respect to the relative importance in knowledge with respect to the prioritisation of care processes and outcomes and the association between congestion and the quality of care in specific populations and settings. For example the majority of studies took place in large urban or suburban tertiary EDs. However the studies that included smaller EDs identified some differences in the link between crowding measures and quality between the ED settings. Also disparity in ED evaluation and treatment were identified based on factors including sex, ethnicity, and age. Finally the review highlights the need for the prioritisation of care process and outcomes to drive routine measurement to support quality improvement focused on crowding and quality of care.

The results of this review have important implications on future research on the measurement and alleviation of ED congestion. Further research, potentially incorporating a meta-analysis is needed to investigate the impact of various models of care designed for the admission and discharge



components of a patient journey from the ED. Innovations continue to emerge and each must be systematically and rigorously tested and evaluated.

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The authors of this report have been wholly responsible for all data collection, analysis and interpretation and writing up of their work.

## Contribution of Authors

Michele Romeo, Principal Project Officer, Healthcare Improvement Unit, Clinical Excellence Division

Undertook the proposal writing and design and ran the literature searches, undertook reference sifting and evidence syntheses for the review, data extraction into summary tables, contribution of writing the report, including the discussion and conclusions.

Dr Chris May, Healthcare Improvement Unit, Clinical Excellence Division.

Contributed to the plan and design of the proposal and contributed to the reports discussion and conclusions .

Data sharing statement

No new data have been created

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# Appendices

## Appendix 1: Abbreviations

| Abbreviation | Description   |
|--------------|---|
| A&E          | accident and emergency                                |
| ACS          | acute coronary syndromes                              |
| ADL          | activities of daily living                            |
| AHR          | after-hours referrals                                 |
| AMAU         | acute medical admissions unit                         |
| AMU          | assessment medical unit                               |
| AMU          | acute medical unit                                    |
| ATS          | Australasian triage scale                             |
| BA study     | before and after study                                |
| CCT          | clinical controlled trial                             |
| CGA          | comprehensive geriatric assessment                    |
| CI           | confidence interval                                   |
| CIN          | clinical initiatives nurse                            |
| CT           | computed tomography                                   |
| CTAS         | Canadian emergency department triage and acuity scale |
| DDR          | direct discharge rates                                |
| DFT          | discharge facilitation team                           |
| DNA          | did not arrive  |
| DNW          | did not wait  |
| DR           | doctor  |
| ECG          | electrocardiogram                                     |
| ED           | emergency department                                  |
| ED NPC       | emergency department nurse practitioner candidate     |
| EDTU         | emergency department treatment units                  |
| EHR          | electronic health record                              |
| EMS          | emergency medical service                             |
| EMW          | emergency medicine ward                               |
| EP           | emergency physician                                   |
| EPIX         | emergency physician-initiated x-ray                   |
| ES           | emergency services                                    |
| HITH         | hospital in the home                                  |
| Hr/s         | hour/s  |
| ICU          | intensive care unit                                   |
| KPI          | key performance indicators                            |
| LOE          | level of evidence                                     |
| LOS          | length of stay  |

| Abbreviation | Description                                |
|--------------|--|
| LWBS         | left without being seen                    |
| LWCA         | left without complete assessment           |
| MAPU         | medical assessment and planning units      |
| MATS         | minor accident treatment service           |
| MAU          | medical assessment unit                    |
| MIN          | minute                                     |
| MIU          | minor injury unit                          |
| MO           | medical officer                            |
| NHSD         | NHS direct                                 |
| NHSDW        | NHS direct wales                           |
| NI           | nurse initiated                            |
| NIPP         | nurse initiated pain protocol intervention |
| NP           | nurse practitioner                         |
| OC           | office care                                |
| OR           | odds ratio                                 |
| OT           | occupational therapist                     |
| OW           | observation ward                           |
| PACS         | patient acuity score                       |
| PAT          | physician assisted triage                  |
| PED          | paediatric emergency department            |
| PHIL         | paediatric health information line         |
| PIT          | physician at triage                        |
| PIT          | physician initiated                        |
| POCT         | point of care testing                      |
| POST         | patient off stretcher times                |
| RAP          | rapid assessment program                   |
| RCT          | randomised controlled trial                |
| REACT        | rapid entry and accelerated care at triage |
| RITZ         | rapid intervention and treatment zone      |
| RITZ         | rapid intervention and treatment zone      |
| RMA          | rapid medical assessment program           |
| RN           | registered nurse                           |
| RR           | readmission rates                          |
| RTT          | rapid triage and treatment                 |
| SAW          | surgical admission ward                    |
| SC           | self-care                                  |
| SHD          | Swedish healthcare direct                  |
| SSU          | short stay unit                            |
| SWAT         | senior work up assessment and treatment    |
| TAS          | telephone advice system                    |

| Abbreviation | Description                                |
|--------------|--|
| TENP         | transitional emergency nurse practitioners |
| TLP          | triage liaison physicians                  |
| TLP          | triage liaison physicians                  |
| TLP          | triage liaison physicians                  |
| TRIAD        | triage rapid initial assessment by doctor  |
| TTA          | time to analgesia                          |
| UAP          | unlicensed assistive personnel             |
| WR LOS       | waiting room length of stay                |
| WT           | wait time                                  |

## Appendix 2: Summary of main characteristics of included studies

| Characteristic           | Number of included Studies |
|--------------------------|----------------------------|
| <b>Country</b>           |                            |
| Australia                | 36                         |
| Asia                     | 1                          |
| Canada                   | 8                          |
| Denmark                  | 1                          |
| Italy                    | 1                          |
| New Zealand              | 1                          |
| South Africa             | 1                          |
| Sweden                   | 2                          |
| Switzerland              | 1                          |
| Turkey                   | 2                          |
| United Kingdom           | 16                         |
| United States of America | 28                         |
| <b>Study Design</b>      |                            |
| Audit                    | 1                          |
| BA Study                 | 28                         |
| Case Control             | 9                          |
| Non RCT                  | 1                          |
| Prospective              | 19                         |
| Quasi Experiential       | 1                          |
| Quasi Randomised         | 1                          |
| RCT                      | 13                         |
| Retrospective            | 23                         |
| Survey                   | 2                          |
| Plus: Systematic Reviews | 11                         |
| <b>Setting</b>           |                            |
| Care Coordination        | 3                          |

| Characteristic   | Number of included Studies |
|--|----------------------------|
| Fast Track (incl Rapid Assessment)                         | 23                         |
| Medical Assessment Unit                                    | 4                          |
| Non-traditional beds                                       | 1                          |
| Nursing Scope of Practice                                  | 21                         |
| Physician Assistants & ED Scribes                          | 4                          |
| Point of Care Testing                                      | 7                          |
| Short Stay Units   | 1                          |
| Streaming  | 4                          |
| Triage   | 30                         |
| <b>Variables Measured</b>                                  |                            |
| Did Not Wait   | 15                         |
| Disposition  | 20                         |
| ED Length Of Stay  | 98                         |
| Left Without Being Seen/ Left Without Completing Treatment | 32                         |
| NEAT   | 7                          |
| Quality: Patient Satisfaction                              | 27                         |
| Quality: Staff Satisfaction                                | 8                          |
| Rate: Discharge  | 12                         |
| Rate: Mortality  | 11                         |
| Rate: Re-Attendance  | 12                         |
| Time To: Pain Relief, X-Ray, Antibiotics                   | 18                         |
| Time To: Decision To Admit                                 | 25                         |
| Time To: Discharge   | 17                         |
| Time To: Dr / Be Seen                                      | 33                         |
| Total time: Treatment                                      | 20                         |
| Total time: Triage   | 30                         |
| Total time: Turnaround                                     | 41                         |
| Total time: Wait   | 87                         |



### Appendix 3: Summary of primary papers reviewed and also included within a systematic review paper

| Author                         | Abdulwahid (2016)<br>107 | Carter (2015)<br>108 | Crawford (2014)<br>109 | Daly (2003)<br>110 | Elder (2015)<br>111 | Harding (2011)<br>117 | Oredsson (2011)<br>112 | Rowe (2011)<br>113 | Scott (2009)<br>114 | Wiler (2011)<br>115 | Wiley (2015)<br>116 |
|--------------------------------|--------------------------|----------------------|------------------------|--------------------|---------------------|-----------------------|------------------------|--------------------|---------------------|---------------------|---------------------|
| Ardagh (2002) <sup>9</sup>     |                          |                      |                        |                    |                     |                       |                        |                    |                     | ✓                   |                     |
| Aronsky (2008) <sup>93</sup>   | ✓                        |                      |                        |                    |                     |                       |                        |                    |                     |                     |                     |
| Asha (2013) <sup>47</sup>      |                          |                      | ✓                      |                    |                     |                       |                        |                    |                     |                     |                     |
| Blank (2007) <sup>94</sup>     |                          |                      |                        |                    |                     |                       |                        |                    |                     | ✓                   |                     |
| Boger (2003) <sup>95</sup>     |                          |                      |                        |                    | ✓                   |                       |                        |                    |                     |                     |                     |
| Boyd (2005) <sup>50</sup>      |                          |                      |                        |                    |                     |                       |                        |                    |                     |                     |                     |
| Bruijns (2008) <sup>51</sup>   |                          |                      |                        |                    |                     |                       |                        |                    |                     |                     |                     |
| Bucheli (2004) <sup>52</sup>   | ✓                        |                      |                        |                    |                     |                       |                        |                    |                     |                     | ✓                   |
| Burnstrom (2012) <sup>72</sup> |                          | ✓                    |                        |                    | ✓                   |                       |                        |                    |                     |                     |                     |
| Byrne(2000) <sup>53</sup>      |                          |                      |                        |                    |                     |                       |                        |                    |                     | ✓                   |                     |
| Chan (2005) <sup>11</sup>      |                          | ✓                    |                        |                    |                     |                       |                        |                    |                     |                     |                     |
| Chang (1999) <sup>38</sup>     | ✓                        |                      |                        |                    | ✓                   |                       |                        |                    |                     |                     |                     |
| Cheng (2013) <sup>39</sup>     | ✓                        |                      |                        |                    |                     | ✓                     |                        | ✓                  |                     | ✓                   |                     |
| Choi (2006) <sup>12</sup>      |                          | ✓                    |                        |                    |                     |                       |                        |                    |                     |                     |                     |
| Considine (2006) <sup>89</sup> |                          | ✓                    |                        |                    | ✓                   |                       |                        |                    |                     |                     |                     |
| Considine (2006) <sup>88</sup> |                          |                      |                        |                    |                     |                       | ✓                      |                    |                     |                     |                     |
| Considine (2008) <sup>90</sup> |                          |                      | ✓                      |                    |                     |                       |                        |                    |                     |                     |                     |
| Considine (2012) <sup>75</sup> |                          |                      |                        |                    |                     |                       | ✓                      |                    |                     | ✓                   | ✓                   |
| Cooke (2002) <sup>13</sup>     |                          |                      |                        |                    | ✓                   |                       |                        |                    |                     |                     |                     |
| Cooper (2002) <sup>76</sup>    |                          |                      |                        |                    |                     |                       |                        |                    |                     | ✓                   | ✓                   |
| Darrah (2006) <sup>15</sup>    | ✓                        |                      |                        |                    |                     |                       |                        |                    |                     |                     |                     |
| Davis (2014) <sup>40</sup>     |                          |                      |                        |                    |                     |                       |                        |                    |                     |                     |                     |
| Dinh (2012) <sup>105</sup>     |                          |                      |                        |                    | ✓                   |                       |                        |                    |                     |                     | ✓                   |
| Ducharme (2009) <sup>77</sup>  |                          |                      |                        | ✓                  |                     |                       |                        |                    |                     |                     |                     |
| Farkouh (1998) <sup>41</sup>   |                          |                      |                        |                    |                     |                       |                        |                    |                     |                     |                     |
| Finn (2012) <sup>17</sup>      |                          | ✓                    |                        |                    |                     |                       |                        |                    |                     |                     |                     |
| Freij (1996) <sup>98</sup>     |                          |                      | ✓                      |                    |                     |                       |                        |                    |                     |                     |                     |
| Fry (2001) <sup>79</sup>       |                          |                      |                        |                    | ✓                   |                       |                        |                    |                     |                     |                     |
| Fry (2005) <sup>80</sup>       |                          |                      |                        |                    |                     |                       |                        |                    |                     |                     |                     |
| Fry (2011) <sup>54</sup>       |                          |                      |                        |                    |                     |                       |                        |                    |                     |                     | ✓                   |
| George (1992) <sup>99</sup>    |                          |                      |                        |                    |                     |                       |                        |                    |                     |                     |                     |
| Goodacre (2004) <sup>100</sup> |                          |                      |                        |                    |                     |                       |                        |                    |                     | ✓                   | ✓                   |

| Author                                   | Abdulwahid<br>(2016)<br>107 | Carter<br>(2015)<br>108 | Crawford<br>(2014)<br>109 | Daly<br>(2003)<br>110 | Elder<br>(2015)<br>111 | Harding<br>(2011)<br>117 | Oredsson<br>(2011)<br>112 | Rowe<br>(2011)<br>113 | Scott<br>(2009)<br>114 | Wiler<br>(2011)<br>115 | Wiley<br>(2015)<br>116 |
|--|-----------------------------|-------------------------|---------------------------|-----------------------|------------------------|--------------------------|---------------------------|-----------------------|------------------------|------------------------|------------------------|
| Gordon (2008) <sup>57</sup>              |                             |                         |                           | ✓                     |                        |                          |                           |                       |                        |                        |                        |
| Gouin (1997) <sup>118</sup>              | ✓                           |                         |                           |                       | ✓                      |                          |                           | ✓                     |                        |                        |                        |
| Han (2010) <sup>58</sup>                 |                             |                         |                           |                       |                        |                          |                           |                       |                        |                        |                        |
| Hendriksen<br>(2001) <sup>42</sup>       | ✓                           |                         |                           |                       |                        | ✓                        | ✓                         |                       |                        | ✓                      | ✓                      |
| Holyroyn (2007) <sup>59</sup>            |                             |                         |                           |                       |                        |                          |                           |                       |                        | ✓                      |                        |
| Ieraci (2008) <sup>81</sup>              | ✓                           |                         |                           |                       | ✓                      |                          |                           |                       |                        |                        |                        |
| Imperato (2012) <sup>18</sup>            |                             |                         |                           |                       |                        |                          |                           |                       |                        |                        |                        |
| Kelly (2005) <sup>91</sup>               |                             |                         |                           |                       |                        |                          | ✓                         |                       |                        |                        |                        |
| Kilic (1998) <sup>103</sup>              |                             |                         | ✓                         |                       |                        |                          |                           |                       |                        |                        |                        |
| Kocher (2012) <sup>92</sup>              |                             |                         |                           |                       |                        |                          | ✓                         |                       |                        |                        |                        |
| Kwa (2008) <sup>19</sup>                 |                             |                         |                           |                       |                        |                          | ✓                         |                       |                        |                        |                        |
| Lee-Lewandrowski<br>(2003) <sup>20</sup> |                             |                         |                           |                       |                        |                          |                           |                       |                        |                        |                        |
| Lindley- Jones<br>(2000) <sup>60</sup>   |                             |                         |                           |                       |                        |                          |                           |                       |                        |                        |                        |
| Lutze (2011) <sup>61</sup>               |                             | ✓                       |                           |                       |                        |                          |                           |                       |                        |                        | ✓                      |
| Malbrook<br>(1998) <sup>119</sup>        |                             |                         |                           |                       |                        |                          |                           |                       |                        |                        |                        |
| Mallett (1990) <sup>101</sup>            |                             |                         |                           |                       | ✓                      |                          |                           |                       |                        |                        |                        |
| Muntin (2011) <sup>104</sup>             |                             |                         |                           |                       |                        |                          | ✓                         |                       |                        |                        |                        |
| Murray (1999) <sup>45</sup>              |                             |                         |                           |                       |                        |                          | ✓                         |                       |                        |                        |                        |
| O'Brien (2006) <sup>62</sup>             |                             |                         | ✓                         |                       | ✓                      |                          | ✓                         |                       |                        |                        |                        |
| Parris (1997) <sup>63</sup>              |                             |                         |                           |                       |                        | ✓                        |                           |                       |                        | ✓                      |                        |
| Partovi (2001) <sup>97</sup>             | ✓                           |                         |                           |                       |                        |                          | ✓                         |                       |                        |                        |                        |
| Patel (2005) <sup>21</sup>               |                             |                         |                           |                       | ✓                      |                          |                           |                       |                        |                        |                        |
| Patel (2012) <sup>83</sup>               |                             |                         |                           |                       |                        |                          |                           |                       |                        |                        |                        |
| Paulson (2004) <sup>84</sup>             |                             |                         |                           |                       |                        | ✓                        | ✓                         | ✓                     |                        |                        |                        |
| Richardson<br>(2004) <sup>22</sup>       |                             |                         |                           |                       |                        |                          |                           |                       |                        |                        |                        |
| Rodi (2006) <sup>120</sup>               |                             | ✓                       |                           |                       | ✓                      |                          | ✓                         |                       |                        |                        | ✓                      |
| Rogers (2004) <sup>24</sup>              | ✓                           |                         |                           |                       |                        |                          |                           |                       |                        |                        |                        |
| Rogg (2013) <sup>25</sup>                |                             |                         |                           | ✓                     |                        |                          |                           |                       |                        |                        |                        |
| Rydman (1998) <sup>66</sup>              |                             | ✓                       |                           |                       | ✓                      |                          |                           |                       |                        |                        |                        |
| Sakr (2003) <sup>67</sup>                |                             |                         |                           |                       |                        |                          | ✓                         |                       |                        | ✓                      |                        |
| Sanchez (2006) <sup>85</sup>             |                             |                         | ✓                         |                       |                        |                          |                           |                       |                        |                        |                        |
| Sethuraman<br>(2011) <sup>26</sup>       | ✓                           |                         | ✓                         |                       | ✓                      |                          |                           |                       |                        |                        |                        |
| Shetty (2012) <sup>68</sup>              |                             |                         |                           |                       |                        |                          | ✓                         |                       |                        |                        |                        |
| Singer (2008) <sup>27</sup>              | ✓                           |                         |                           |                       |                        |                          |                           |                       |                        |                        |                        |

| Author                                | Abdulwahid<br>(2016)<br>107 | Carter<br>(2015)<br>108 | Crawford<br>(2014)<br>109 | Daly<br>(2003)<br>110 | Elder<br>(2015)<br>111 | Harding<br>(2011)<br>117 | Oredsson<br>(2011)<br>112 | Rowe<br>(2011)<br>113 | Scott<br>(2009)<br>114 | Wiler<br>(2011)<br>115 | Wiley<br>(2015)<br>116 |
|---------------------------------------|-----------------------------|-------------------------|---------------------------|-----------------------|------------------------|--------------------------|---------------------------|-----------------------|------------------------|------------------------|------------------------|
| <b>Soremekun (2012)<sup>29</sup></b>  | ✓                           |                         |                           |                       |                        |                          |                           |                       |                        |                        |                        |
| <b>Soremekun (2012)<sup>121</sup></b> | ✓                           |                         |                           |                       |                        |                          |                           |                       |                        |                        |                        |
| <b>Soremekun (2014)<sup>30</sup></b>  |                             |                         |                           |                       |                        | ✓                        | ✓                         | ✓                     |                        | ✓                      |                        |
| <b>Subash (2004)<sup>46</sup></b>     |                             | ✓                       |                           |                       |                        |                          |                           |                       |                        |                        |                        |
| <b>Tachakra (2001)<sup>102</sup></b>  |                             |                         |                           |                       | ✓                      | ✓                        |                           | ✓                     |                        |                        |                        |
| <b>Terris (2004)<sup>69</sup></b>     | ✓                           |                         |                           |                       | ✓                      | ✓                        | ✓                         | ✓                     |                        | ✓                      |                        |
| <b>Travers (2006)<sup>70</sup></b>    |                             |                         | ✓                         |                       |                        |                          |                           |                       |                        |                        |                        |
| <b>Tsai (2012)<sup>32</sup></b>       |                             |                         |                           |                       |                        |                          |                           |                       | ✓                      |                        |                        |
| <b>Wanklyn (1997)<sup>71</sup></b>    | ✓                           |                         |                           |                       |                        |                          |                           |                       |                        |                        |                        |
| <b>White (2012)<sup>34</sup></b>      |                             |                         |                           |                       |                        |                          |                           |                       |                        |                        |                        |
| <b>Wiler (2010)<sup>23</sup></b>      |                             |                         |                           |                       | ✓                      |                          |                           |                       |                        |                        | ✓                      |









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|---------------------------------------|--|---------------|--|--|---|------------------------------------|---------------------------------------|--------------------------|--|---|---|-----|--------------|-------------|-------------------|--|------|-----------------|---------------------|-----------------|--------------------------------|-----------------------------|--|----------------------------|--------------------|----------------------|----------------|-------------|------------------|-----------|
| Dinh <sup>105</sup>                   | Evaluating the quality of care delivered by an emergency department fast track unit with both nurse practitioners and doctors        | Fast Track    | Observational cohort study (n=320) over 1 year study period of outcome of patients to FT: single site.     | Report quality of care delivered by ED FT where both doctors and emergency nurses treated patients.  | Patients received high quality of care in this FT unit where both nurse practitioner and doctors treated patients. Emergency nurse practitioners were associated with higher patient satisfaction. FT unit such as these that manage all low complexity emergency patients delivery high quality care. Combining medical and nap experience may be the optimal model of care in Australian FT units.  |                                    |                                       |                          |  |   |   |     | ✓            | ✓           |                   |  |      |                 |                     |                 | ✓                              |                             | ✓                                      | ✓                          | ✓                  | ✓                    | ✓              | ✓           | ✓                | ✓         |
| Fry, 2011, Australia <sup>54</sup>    | A 12-month evaluation of the impact of Transitional Emergency Nurse Practitioners in one metropolitan Emergency Department.          | Fast Track    | Prospective observational study over 12 month study period of patients managed TENP (n=5249): single site. | The aim of this study were to: describe patient demographics and conditions managed within the TENP model; examine the efficiency and safety of TENP management; and evaluate the impact of the TENP role on the delivery of emergency services. | The study provides evidence that TENPs can enhance emergency service delivery outcomes and provide comparable, safe, timely, efficient patient care and management. Greater capacity building of this workforce is needed to meet future service demands.   |                                    |                                       |                          |  |   |   |     |              | ✓           | ✓                 |  |      |                 |                     |                 |                                |                             |  |                            | ✓                  |                      |                | ✓           | ✓                | ✓         |
| Ieraci, 2008, Australia <sup>61</sup> | Streaming by case complexity: evaluation of a model for emergency department Fast Track.   | Fast Track    | Retrospective before after interventional study comparing implementation of a FT: single site.             | To evaluate a patient flow streaming system within a teaching hospital's ED, using functional principles to separate patients into two streams on the basis of complexity rather than acuity, severity or disposition.                           | Key features in the success of the system included use of dedicated senior staff for FT patients, and quarantining of clinical resources. The ED aiming to improve their WTs and throughput should consider using complexity as a key criterion for triaging patients into separate streams. A low-complexity patient stream in the ED provides an ideal focus for advanced nursing practice.   |                                    |                                       |                          |  |   |   |     |              | ✓           |                   |  |      | ✓               | ✓                   |                 |                                |                             |  |                            |                    |                      |                |             |                  |           |
| Kilic, 1998, Turkey <sup>103</sup>    | Prospective, double-blind, comparative fast-tracking trial in an academic emergency department during a period of limited resources. | Fast Track    | Quasi randomised study (n=273): FT was used every other day during the daytime for a month.                | Determine the effectiveness of FT in an ED.  | The study was relatively small with 143 patients in the study group and 126 patients in the control group. WT was significantly reduced with FT.  |                                    |                                       |                          |  |   |   |     | ✓            | ✓           |                   |  |      |                 |                     |                 |                                |                             |  |                            |                    |                      |                |             |                  | ✓         |
| Kwa, 2008, Australia <sup>19</sup>    | Fast track: has it changed patient care in the emergency department?   | Fast Track    | BA study of all patients dyeing a 6 month period to evaluate the impact of a FT area.                      | To determine whether the introduction of a designated fast-track area altered the time to care and patient flow in an Australian mixed adult and paediatric ED.  | During its operational hours, FT managed 14.9% of all patients presenting to the ED. There was a significant increase in the proportion of all ATS 4 patients seen within their target times (77.8% to 79.9%, p < 0.001). There was a trend towards improved performance in ATS categories 2, 3 and 5. Median patient WTs were significantly decreased in ATS 4 (24 to 22 min, p < 0.001) and ATS 5 (27 to 25 min, p < 0.05), but increased in ATS 2 (3 to 4 min, p < 0.05). No deterioration in performance or WT for ATS 1 was shown. There was a decreasing trend in |                                    |                                       |                          |  |   |   | ✓   |              | ✓           | ✓                 |  |      |                 | ✓                   |                 |                                |                             | ✓                                      | ✓                          |                    |                      |                |             | ✓                |           |

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|---|---|------------------|--|---|---|------------------------------------|---------------------------------------|--------------------------|--|---|---|-----|--------------|-------------|-------------------|--|------|-----------------|---------------------|-----------------|--------------------------------|-----------------------------|--|----------------------------|--------------------|----------------------|----------------|-------------|------------------|-----------|
|   |   |                  |  |   | the proportion of patients who DNW to be assessed by a doctor in ATS categories 4 and 5. These improvements occurred despite a 12% increase in patient attendances and no change in medical staffing levels.  |                                    |                                       |                          |  |   |   |     |              |             |                   |  |      |                 |                     |                 |                                |                             |  |                            |                    |                      |                |             |                  |           |
| Lutze,2011, Australia <sup>61</sup>       | A review of the transitional emergency nurse practitioner.  | Fast Track       | Prospective cohort study of two hospital sites over 2 consecutive years for a three month period.  | Explore the TENP model as it applied to practice working across two urban ED to identify the demographic characteristics of the TENP managed patients and if TENP patients were appropriately, safely and timely managed. | NPs have demonstrated significant impact on patient outcomes and timely service. Transitional NP roles have been shown to be safe and appropriate in tertiary referral hospitals throughout.  |                                    |                                       |                          |  |   |   |     | ✓            |             | ✓                 | ✓  |      |                 | ✓                   |                 | ✓                              |                             |  |                            |                    |                      |                | ✓           | ✓                | ✓         |
| O'Brien, 2006, Australia <sup>62</sup>    | Impact of streaming 'fast track' emergency department patients.                                   | Fast Track       | Prospective study over 12 week period of patients identified at triage who were assessed to be likely discharged (ATS category 3,4 5) were treated in a separate FT area by ED medical and nursing staff rostered to work exclusively in the area. | Assessment of the impact on patient flows of a FT system implemented in the ED at hospital which dealt with relatively few low acuity patients.   | Streaming FT patients in the emergency department of an Australian tertiary adult teaching hospital can reduce WTs and LOS for discharged patients without increasing WTs for admitted patients, even in an ED with few low acuity patients. The FT area managed 21.6% of all patients presenting during its hours of operation. There was a 20.3% (-18 min; 95%CI -26min to -10 min) relative reduction in the average WT and an 18.0% (-41 min; 95%CI -52min to -30 min) relative reduction in the average LOS for all discharged patients compared with the same period the previous year. Compared with the 12-week period before the FT trial, there was a 3.4% (-2.1 min; 95%CI -8 min to 4min) relative reduction in the average WT and a 9.7% (-20 min; 95%CI -31 min to -9 min) relative reduction in the average LOS for all discharged patients. There was no increase in the average WT for admitted patients. This was despite major increases in throughput and access block in the study period. |                                    |                                       |                          |  |   |   | ✓   | ✓            |             | ✓                 | ✓  |      |                 |                     |                 |                                |                             |  |                            |                    |                      |                |             |                  | ✓         |
| Sanchez, 2006, 1549 <sup>85</sup>         | Effects of a fast-track area on emergency department performance.                                 | Fast Track       | Retrospective cohort study over 12 month period before and after FT was implemented: single site.  | To determine if a FT area improved ED performance.  | The opening of a FTA improved ED effectiveness, measured by decreased WT and LOS, without deterioration in the quality of care provided, measured by rates of mortality and revisits.   |                                    |                                       |                          |  |   |   |     |              |             | ✓                 | ✓  |      |                 | ✓                   | ✓               |                                |                             |  |                            | ✓                  |                      | ✓              | ✓           | ✓                |           |
| Sethuraman, 2011, Australia <sup>66</sup> | Effect of a rapid assessment program on total length of stay in a pediatric emergency department. | Rapid assessment | Before study to evaluate the impact of the RAP initiative on the overall LOS in the ED. Data acquired (n=2000)   | To measure the impact of the RAP initiative in a PED on WTs and ED LOS.   | Data from 990 visits (in 2004) and 1010 visits (in 2005) indicated similar age, sex, seasonal distribution, and weekday distribution. The total median LOS decreased by 37 minutes with RAP (103  |                                    |                                       |                          |  |   |   |     | ✓            | ✓           |                   |  |      |                 |                     | ✓               | ✓                              |                             |  |                            |                    | ✓                    | ✓              | ✓           | ✓                |           |

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|                                       |  |                        | through a retrospective review of both medical charts and an electronic database: single site.                                      |  | [interquartile range [IQR, 57Y187] minutes in 2005 vs 140 [IQR, 78Y234] minutes in 2004, p=0.001) but only among lower triage categories. Median door-to-physician time decreased by 20 minutes with RAP (15 [IQR, 7Y29] minutes in 2005 vs 35 [IQR, 18Y72] minutes in 2004, p=0.001) among lower triage categories. The LOS was reduced both in admitted and discharged patients with no difference in the boarding times or admission frequencies.   |                                    |                                       |                          |  |   |   |     |              |             |                   |  |      |                 |                     |                 |                                |                             |  |                            |                    |                      |                |             |                  |           |  |
| Shetty, 2011, Australia <sup>68</sup> | Senior Streaming Assessment Further Evaluation after Triage zone: a novel model of care encompassing various emergency department throughput measures. | Senior-led team triage | BA study evaluating the impact of a new model of care - SAFE-T- some concept on ED performance indicators and statistical outcomes. | Assessment of the implementation of intra-departmental strategies to streamline patient flows and employ innovative strategies to achieve best outcomes. Implementation of evidence-proven ED throughput measures may serve to that end.                                   | In total, 11 408 and 11 845 patients were included in the study periods pre- and post-intervention, respectively. Time to physician KPI improved from 72.5% to 84.1%. Did-not- wait rates dropped from 10.7% to 9.6% (p=0.02) and off-stretcher times for ambulances KPI improved from 74.5% to 79.5% (p < 0.001). ED LOS dropped most significantly for Australasian Triage Scale categories 3 and 4 (14.3% and 11.8%, p-values <0.001). These results were achieved despite worsened AB and hospital bed-occupancy rates during the intervention period (+3.9% and +6.7%). |                                    |                                       |                          |  |   |   |     | ✓            | ✓           | ✓                 |  |      |                 | ✓                   | ✓               | ✓                              |                             |  | ✓                          | ✓                  | ✓                    | ✓              | ✓           | ✓                | ✓         |  |
| Tsai, 2012, Australia <sup>32</sup>   | Rapid medical assessment: improving pediatric emergency department time to provider, length of stay, and left without being seen rates.                | Rapid assessment       | BA study investigating the implementation of a RMA: single site.  | Investigation of the impact of a RMA on patient flow and left without being seen rates in a paediatric ED. RMA is designed to evaluate and discharge uncomplicated patients quickly or initiate diagnostic workup and treatment before the patient is placed in an ED bed. | RMA is an effective way to improve patient flow and reduce the LWBS rate. A decrease in the LWBS rate allows the ED to provide healthcare to these potentially high-risk patients.   |                                    |                                       |                          |  |   |   |     | ✓            | ✓           |                   |  |      |                 |                     |                 |                                |                             |  |                            | ✓                  |                      |                |             |                  | ✓         |  |
| Bouman, 2017, Italy <sup>49</sup>     | Effects of an Integrated 'Fast Track' Rehabilitation Service for Multi-Trauma Patients: A Non-Randomised Clinical Trial in the Netherlands.            | Fast Track             | Prospective, multi-centre, non-randomised controlled study over 3 years study period (n=132).                                       | The effects on health related outcomes of a newly-developed rehabilitation program, called 'supported FT multi-trauma rehabilitation service' (FT), were evaluated in comparison with conventional trauma rehabilitation service (Care as Usual).                          | Both FT and Care as Usual rehabilitation programs were effective in that multi- trauma patients improved their functional status and quality of life. A faster (maximum) recovery in functional status was observed for FT at 6 months compared to 9 months for Care as Usual. At twelve months follow-up no differential effects between treatment conditions were found.   |                                    |                                       |                          |  |   |   |     |              | ✓           |                   |  |      |                 |                     |                 |                                | ✓                           |  | ✓                          | ✓                  | ✓                    | ✓              | ✓           | ✓                |           |  |











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|---------------------------------------|---|-------------------------|--|--|---|------------------------------------|---------------------------------------|--------------------------|--|---|---|-----|--------------|-------------|-------------------|--|------|-----------------|---------------------|-----------------|--------------------------------|-----------------------------|--|----------------------------|--------------------|----------------------|----------------|-------------|------------------|-----------|--|
|                                       |   |                         | review (n =55) measuring CIN documentation, patient demographics, triage code, diagnosis, LOS, disposition of DNW patients: single site.   |  | respondents reported there is a need for a dedicated orientation programme to the CIN role; 62% of nurses believed the CIN role provided greater opportunity for clinical and professional advancement; 88% reported the need for additional clinical guidelines to assist in understanding the role function and independence; 42% believed the role of the CIN should be extended.  |                                    |                                       |                          |  |   |   |     |              |             |                   |  |      |                 |                     |                 |                                |                             |  |                            |                    |                      |                |             |                  |           |  |
| Fry, 2002, Australia <sup>55</sup>    | Nurse-initiated intravenous morphine in the emergency department: efficacy, rate of adverse events and impact on time to analgesia. | NI analgesia            | Observational -prospective convenience sample (n=349) of patients presenting with acute severe pain.   | To measure the analgesia efficacy and frequency of adverse events following nurse initiated IV morphine in acute pain. | Experienced emergency nurses can initiate effective intravenous narcotic analgesia for patients in acute pain awaiting medical assessment, with minimal change in physiological parameters. This process can improve the time to analgesia for patients in acute pain. Median TTA of nurse initiated morphine was 18 min. PS initial median was 8.5 cm with a reduction to 4.0 cm at one hour. RR, oxygen saturation, HR and BP all showed small but statistically significant reductions over 60 min. 15 predefined adverse events but no interventions were required. |                                    |                                       |                          |  |   |   |     |              |             | ✓                 |  |      |                 |                     | ✓               |                                |                             | ✓                                      |                            |                    |                      |                |             | ✓                | ✓         |  |
| Fry, 2004, Australia <sup>56</sup>    | A prospective study of nurse-initiated Panadine Forte: expanding pain management in the ED.   | NI analgesia            | Observational-prospective exploratory study (n=202) of patients presenting with mild to moderate pain (hemodynamically stable).  | To evaluate the introduction of triage nurse initiated schedule 4 drug.  | Improving pain management can have a positive impact on patients in moderate pain who experience extended WTs prior to medical assessment. The average pre PS was 68 mm and the median was 70 mm. The average post PS was 37 mm and the median was 35 mm. The average post PS reduced by 31 mm demonstrating a clinically significant change. Average TTA was 23 min with a median time of 6 min.   |                                    |                                       |                          |  |   |   |     |              |             | ✓                 |  |      |                 |                     | ✓               |                                |                             | ✓                                      |                            |                    |                      |                | ✓           | ✓                |           |  |
| Kelly, 2005, Australia <sup>91</sup>  | Nurse initiated, titrated intravenous opioid analgesia reduces time to analgesia for selected painful conditions.                   | NI analgesia            | Explicit medical record review of patients (n=167) measuring nurse initiated time to analgesia compared to non-nurse initiated group measuring demographics, condition, ATS, time of arrival, whether analgesia was nurse initiated or not, and TTA. | Audit all adult patients with an ED discharge diagnosis of renal of biliary colic.                                     | A nurse-initiated opioid analgesia protocol reduces delays to opioid analgesia for patients with renal and biliary colic. Groups well matched for gender, age, ATS and time of arrival. Median TTA was 31 min in the nurse initiated group and 57 min in the non-nurse initiated group (95% CI 16–36 min, p < 0.0010).  |                                    |                                       |                          |  |   |   | ✓   | ✓            | ✓           | ✓                 |  |      | ✓               | ✓                   |                 | ✓                              |                             |  | ✓                          | ✓                  | ✓                    | ✓              | ✓           | ✓                |           |  |
| Kocher, 2011, Australia <sup>92</sup> | Interventions to safeguard system effectiveness during periods of emergency department crowding.                                    | NI testing - blood test | Cohort study (n=105473) of ED visits assessing ED Los and frequency of testing (blood testing, urinalysis,   | Review of the effects of testing and treatment on ED LOS.  | Patients requiring blood tests were found to stay longer (72min) than patients who did not require blood tests. Testing and less substantial treatment were associated with prolonged LOS in the  |                                    |                                       |                          |  |   |   |     |              |             | ✓                 |  |      | ✓               | ✓                   |                 | ✓                              |                             | ✓                                      | ✓                          | ✓                  | ✓                    | ✓              | ✓           | ✓                |           |  |







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|-------------------------------------|--|--------------------------------|---|--|--|------------------------------------|---------------------------------------|--------------------------|--|---|---|-----|--------------|-------------|-------------------|--|------|-----------------|---------------------|-----------------|--------------------------------|-----------------------------|--|----------------------------|--------------------|----------------------|----------------|-------------|------------------|-----------|--|
|                                     |  |                                | community treatment and appropriate referral made to other agencies: single site  |  |  |                                    |                                       |                          |  |   |   |     |              |             |                   |  |      |                 |                     |                 |                                |                             |  |                            |                    |                      |                |             |                  |           |  |
| Rodi, 2006, USA <sup>120</sup>      | Evaluation of a fast track unit: alignment of resources and demand results in improved satisfaction and decreased length of stay for emergency department patients.  | Physician Assistant            | Before and after survey (n=146) of implementation of a FT unit staffed by a physician assistant.  | Determine if implementation of a separate stream of care focused on low acuity patients in our academic ED.  | This study demonstrates that a FT unit staffed by PAs can be successfully initiated in an academic ED with significantly improved patient satisfaction and decreased LOS. This study supports an emphasis on improving turnaround time as a primary driver of satisfaction, and demonstrates that a simple intervention characterized by focusing existing resources on the needs of a specific population can significantly improve healthcare delivery. Thoughtful alignment of resources with the needs of specific patient populations should similarly streamline care in other clinical settings.                                      |                                    |                                       |                          |  |   |   |     |              | ✓           | ✓                 |  |      |                 |                     | ✓               |                                |                             |  |                            |                    | ✓                    | ✓              | ✓           | ✓                |           |  |
| Theunissen, 2012, USA <sup>31</sup> | Fast Track by physician assistants shortens waiting and turnaround times of trauma patients in an emergency department.  | Physician Assistants in the ED | BA study (n=1289) of introduction of physician assistant in FT for patients with simple noncomplex health issues in a Dutch ED without the introduction of additional staff over 6 month study period: single site. | Determine whether the introduction of a separate patient flow comprising patients with simple, non-complex health issues [FT (FT)] in a Dutch emergency department setting (ED), without the introduction of additional staff, and treated by a physician assistant, would have favourable effects on waiting and turnaround times without deleterious effects for patients with a higher urgency. | The introduction of FT performed by a physician assistant resulted in a significant drop in WT and LOS in a Dutch ED setting. This reduction was realised without the allocation of additional staff and even reduced waiting and turnaround times for the patient with a high urgency.  | ✓                                  | ✗                                     | ✓                        | ✗  | ✓   | ✓   |     |              | ✓           | ✓                 |  |      |                 |                     |                 |                                |                             | ✓                                      | ✓                          | ✓                  |                      | ✓              | ✓           | ✓                |           |  |
| <b>Point of Care Testing</b>        |  |                                |   |  |  |                                    |                                       |                          |  |   |   |     |              |             |                   |  |      |                 |                     |                 |                                |                             |  |                            |                    |                      |                |             |                  |           |  |
| Asha, 2014, Australia <sup>35</sup> | Impact from point-of-care devices on emergency department patient processing times compared with central laboratory testing of blood samples: a randomised controlled trial and cost-effectiveness analysis. | Point of Care Testing          | RCT of patients presenting with condition considered to only require blood tests available by POC compared to patients treated in usual manner.   | To determine if time to disposition decisions for emergency department (ED) patients can be reduced when blood tests are processed using POC devices and to conduct a cost-effectiveness analysis of POC compared with laboratory testing.   | Small improvements in disposition decision time were achieved with POC testing for a moderate increase in cost. Greatest benefit may be achieved when POC is targeted to senior medical staff. The mean times to a disposition decision for POC versus controls were 3.24 and 3.50 h respectively, a difference of 7.6% (95% CI 0.4% to 14.3%, p=0.04), and 4.32 and 4.52 h respectively for ED LOS, a difference of 4.4% (95% C 2.7% to 11.0%, p=0.21). Improved processing time was greatest for participants enrolled by senior staff with a reduction in time to disposition decision of 19.1% (95% CI 7.3% to 29.4%, p<0.01) and ED LOS |                                    |                                       |                          |  |   |   |     |              | ✓           |                   |  |      |                 |                     |                 |                                |                             | ✓                                      |                            |                    | ✓                    | ✓              | ✓           | ✓                |           |  |

| Author                                    | Title of Paper  | Model of Care         | Study Design  | Purpose  | Findings   | Eligibility criteria was specified | Subjects randomly allocated to groups | Allocation was concealed | The groups were similar at baseline regarding the most important prognostic indicators | Measures of at least one key outcome were obtained from more than 85% of the subjects initially allocated to groups | The study provides both point measures and measures of variability for at least one key outcome | ATS | Did Not Wait | Disposition | ED Length of Stay | Left Without: Being Seen or completing treatment | NEAT | Rate: Discharge | Rate: Re-attendance | Rate: Mortality | Quality: Patients satisfaction | Quality: Staff Satisfaction | Time to: analgesia, x-ray, antibiotics | Time to: Decision to admit | Time to: Discharge | Time to: Dr/ Be seen | Treatment Time | Triage time | Turn around time | Wait time |  |
|---|---|-----------------------|---|--|--|------------------------------------|---------------------------------------|--------------------------|--|---|---|-----|--------------|-------------|-------------------|--|------|-----------------|---------------------|-----------------|--------------------------------|-----------------------------|--|----------------------------|--------------------|----------------------|----------------|-------------|------------------|-----------|--|
|   |   |                       |   |  | of 15.6% (95% CI 4.9% to 25.2%, p=0.01).   |                                    |                                       |                          |  |   |   |     |              |             |                   |  |      |                 |                     |                 |                                |                             |  |                            |                    |                      |                |             |                  |           |  |
| Kendall, 1998, USA <sup>43</sup>          | Point of care testing: randomised controlled trial of clinical outcome.   | Point of Care Testing | RCT: blood samples (n=1728) from the ED were randomly allocated to point of care testing or testing by the hospital's central laboratory over 1 year study period: single site. | Determine the proportion of patients for whom point of care testing brought about a change in treatment in which timing was considered to be critical to clinical outcome. | Point of care testing reduced the time taken to make decisions on patient management that were dependent on the results of blood tests. It also brought about faster changes in treatment for which timing was considered to be critical in about 7% of patients. These changes did not affect clinical outcome or the amount of time patients spent in the department.  |                                    |                                       |                          |  |   |   |     |              |             | ✓                 |  |      |                 |                     |                 |                                | ✓                           |  |                            | ✓                  |                      | ✓              | ✓           | ✓                |           |  |
| Lee-Lewandrowski, 2003, USA <sup>20</sup> | Implementation of a point-of-care satellite laboratory in the emergency department of an academic medical centre: impact on test turnaround time and patient emergency department length of stay. | Point of Care Testing | BA study (n=396) comparing implementation of PCT: single site.  | Investigate the impact of PCT satellite laboratory in the ED of a hospital.  | After initiating a PCT program in the ED, we were able to show a significantly decreased turnaround time for selected tests and an overall decreased ED LOS for the patients who received testing.   |                                    |                                       |                          |  |   |   |     |              |             | ✓                 |  |      |                 |                     |                 |                                |                             |  |                            |                    |                      |                |             |                  |           |  |
| Loten, 2010, Australia <sup>44</sup>      | Point of care troponin decreases time in the emergency department for patients with possible acute coronary syndrome: a randomised controlled trial.  | Point of Care Testing | RCT over 12 week study period at two EDS presenting with ACS: multi-site.   | To determine whether POC troponin testing would decrease patient LOS in the ED for patients arriving with possible ACS.  | POC testing for troponin in the ED tended to reduce the LOS for possible ACS patients. The degree of this benefit is likely to be markedly dependent on its acceptance and uptake by attending personnel, and on the ED setting in which it is used.   |                                    |                                       |                          |  |   |   |     |              |             | ✓                 |  |      |                 |                     |                 |                                | ✓                           |  |                            |                    |                      | ✓              | ✓           | ✓                |           |  |
| Murray, 1999, USA <sup>45</sup>           | Effect of point of care testing on length of stay in an adult emergency department.   | Point of Care Testing | RCT compared PCT with central laboratory testing (n=1191) in a hospital ED to assess the difference in patients' LOS: single site.  | Evaluation of the effect of PCT on LOS, the median time in ED for PCT patients.  | No decrease in LOS was found during the experimental period, leading the investigators to doubt that PCT by itself can be expected to have an impact on LOS in an ED.  |                                    |                                       |                          |  |   |   |     |              | ✓           | ✓                 |  |      |                 |                     |                 |                                |                             |  |                            |                    |                      |                |             |                  |           |  |
| Rooney, 2014, UK <sup>64</sup>            | Point-of-care testing in the overcrowded emergency department—can it make a difference?   | Point of Care Testing | Prospective cohort (n=33367) over 4 year study period: single site.   | Determine the impact of the reorganisation of medical services to a 59 bed AMU with a dedicated consultant of the day for 24 h take. AMU maximum LOS: 5 days.              | Patients did not spend less time in the accident and emergency department even when test results were available more quickly and patient management decisions were made more quickly. This suggests that the availability of test results is not the factor which slows down the arrangement of further care. Improvements in process, such as a reduction in the time doctors wait for test results and the ability to make clinical decisions more quickly, do not seem to improve clinical outcome in this sample of patients .All cause hospital mortality in acute medical patients |                                    |                                       |                          |  |   |   |     |              | ✓           | ✓                 |  |      | ✓               | ✓                   |                 |                                |                             |  |                            |                    |                      |                | ✓           | ✓                |           |  |











| Author                              | Title of Paper   | Model of Care                | Study Design   | Purpose   | Findings  | Eligibility criteria was specified | Subjects randomly allocated to groups | Allocation was concealed | The groups were similar at baseline regarding the most important Prognostic indicators | Measures of at least one key outcome were obtained from more than 85% of the subjects initially allocated to groups | The study provides both point measures and measures of variability for at least one key outcome | ATS | Did Not Wait | Disposition | ED Length of Stay | Left Without: Being Seen or completing treatment | NEAT | Rate: Discharge | Rate: Re-attendance | Rate: Mortality | Quality: Patients satisfaction | Quality: Staff Satisfaction | Time to: analgesia, x-ray, antibiotics | Time to: Decision to admit | Time to: Discharge | Time to: Dr/ Be seen | Treatment Time | Triage time | Turn around time | Wait time |
|-------------------------------------|--|------------------------------|--|---|---|------------------------------------|---------------------------------------|--------------------------|--|---|---|-----|--------------|-------------|-------------------|--|------|-----------------|---------------------|-----------------|--------------------------------|-----------------------------|--|----------------------------|--------------------|----------------------|----------------|-------------|------------------|-----------|
|                                     |  |                              | study period.  |   | WT increased with nurse triage in all four triage categories. Successful in identifying urgent cases and reducing WTs and reducing DNA rate.  |                                    |                                       |                          |  |   |   |     |              |             |                   |  |      |                 |                     |                 |                                |                             |  |                            |                    |                      |                |             |                  |           |
| Goodacre, 2004, UK <sup>100</sup>   | Can additional experienced staff reduce emergency medical admissions?  | Physician assisted triage    | Audit of cases referred to A and E physician and cluster randomised comparison of service delivery with and without the A & E physician over 6 month study period: single site.  | Determination of the workload of the A & E physician and the number of potential admissions diverted to discharge home and/ or to outpatient follow up. | Despite receiving many referrals and discharging a substantial proportion of patients home, the physician did not significantly change emergency medical admissions and may have increased admission to other specialities.   |                                    |                                       |                          |  |   |   |     |              |             |                   |  |      |                 |                     |                 |                                |                             |  |                            |                    |                      |                |             |                  |           |
| Han, 2010, USA <sup>58</sup>        | The effect of physician triage on emergency department length of stay.   | Single SDT                   | Prospective interventional study (n=17265) measuring ED LOS, daily ED occupancy levels, WR LOS, boarding time, admitted and not admitted patients, number of patient in the WR per hour, number of LWBS patients of ~ 5 month study period: single site. | To evaluate the impact of a PIT SINGLE SDT - board certified emergency physician.   | A PIT can help improve patient flow. PIT reduced the overall ED LOS in discharged patients (from 246 min to 232 min, p < 0.001) with no effect on LOS of admitted patients. PIT also decreased ambulance diversion (from median diversion episode 431 min to 256 min, P=0.025), and the number of LWBS patients (from 4.5% to 2.5%, p < 0.001).   | ✓                                  | ✗                                     | ✓                        | ✗  | ✗   | ✓   | ✓   |              | ✓           | ✓                 |  |      |                 |                     |                 |                                |                             | ✓                                      |                            |                    |                      |                |             |                  | ✓         |
| Holroyd, 2007, Canada <sup>59</sup> | Impact of a triage liaison physician on emergency department overcrowding and throughput: a randomised controlled trial. | Senior doctor & nurse triage | Prospective RCT study (n=5718) measuring patient LOS, proportion of patients LWCA, staff satisfaction and episodes of ambulance diversion over 6 week study period.  | To evaluate the implementation of TLP shots at an academic tertiary care adult ED using comprehensive outcome reporting.                                | A TLP improved important outcomes in an overcrowded ED and could improve delivery of emergency medical care in tertiary EDs that are similar. The study found significant reduction in LOS with combined senior doctor and nurse triage. The study found LOS decrease 36 min (p=0.001); LWBS decrease 20% (6.6 to 5.4%); 90% nurses and physicians report improved patient care; 80% nurses and >70% physicians satisfied with process improvement. |                                    |                                       |                          |  |   |   |     |              | ✓           | ✓                 |  |      |                 |                     | ✓               | ✓                              |                             |  |                            |                    |                      |                |             |                  | ✓         |
| Imperato, 2012, USA <sup>18</sup>   | Physician in triage improves emergency department patient throughput.  | Senior led-team triage       | BA study (n=18109) measuring patient registration times, mode of arrival, time seen by physician, disposition category and disposition time, total time on ambulance diversion 6 month study period; single site.  | To evaluate the impact of a PIT on ED flow.   | Study found a significant reduction in LOS with combined senior doctor and nurse triage. PIT can help improve flow, but ED crowding remains a problem. PIT decreased ED LOS (median LOS for admitted patients was reduced by 24 min, p=0.005) as well as a decrease in ambulance diversions (number of days from 24 days to 9 days). Patient satisfaction, impact on radiology or pathology studies was not evaluated.                              |                                    |                                       |                          |  |   |   |     | ✓            | ✓           | ✓                 |  |      |                 |                     |                 |                                | ✓                           | ✓                                      |                            |                    |                      |                |             |                  | ✓         |



| Author                                    | Title of Paper  | Model of Care                | Study Design   | Purpose   | Findings  | Eligibility criteria was specified | Subjects randomly allocated to groups | Allocation was concealed | The groups were similar at baseline regarding the most important prognostic indicators | Measures of at least one key outcome were obtained from more than 85% of the subjects initially allocated to groups | The study provides both point measures and measures of variability for at least one key outcome | ATS | Did Not Wait | Disposition | ED Length of Stay | Left Without: Being Seen or completing treatment | NEAT | Rate: Discharge | Rate: Re-attendance | Rate: Mortality | Quality: Patients satisfaction | Quality: Staff Satisfaction | Time to: analgesia, x-ray, antibiotics | Time to: Decision to admit | Time to: Discharge | Time to: Dr/ Be seen | Treatment Time | Triage time | Turn around time | Wait time |  |
|---|---|------------------------------|--|---|---|------------------------------------|---------------------------------------|--------------------------|--|---|---|-----|--------------|-------------|-------------------|--|------|-----------------|---------------------|-----------------|--------------------------------|-----------------------------|--|----------------------------|--------------------|----------------------|----------------|-------------|------------------|-----------|--|
|   |   |                              |  |   | being seen rate was 2.3% compared to 1.6% after team assignment system (absolute difference 0.8%; 95% CI 0.4% to 1.1%). Patient satisfaction reported as very good or excellent showed improvement in satisfaction with the physician (absolute increase 3.1%; 95% CI 1.0% to 5.3%), staff courtesy (absolute increase 4.5%; 95% CI 2.3% to 6.7%), and coordination of care (absolute increase 3.6%; 95% CI 0.8% to 6.4%).  |                                    |                                       |                          |  |   |   |     |              |             |                   |  |      |                 |                     |                 |                                |                             |  |                            |                    |                      |                |             |                  |           |  |
| Paulson, 2004, USA <sup>84</sup>          | A comparison of wait times and patients leaving without being seen when licensed nurses versus unlicensed assistive personnel perform triage. | Nurse performing triage      | Comparative retrospective cohort study over 6 month study period covering pre- and post-intervention.  | To compare WTs when nurses perform triage compared with unlicensed personnel.   | No difference in triage time. WT reduced by 73 min (127 v. 54 in) when nurse performed triage LWBS rate fell 85%. Results of this study show a triage system using nurses provided more services during triage and were associated with less WT after triage and a decreased likelihood of patients LWBS compared with the triage system using UAP.   |                                    |                                       |                          |  |   |   |     |              |             | ✓                 | ✓  |      |                 |                     |                 |                                |                             |  |                            |                    |                      |                |             |                  | ✓         |  |
| Richardson, 2004, Australia <sup>22</sup> | Multidisciplinary assessment at triage: a new way forward.  | Senior doctor & nurse triage | BA study of senior EP (multidisciplinary team MDT comprising of a senior registrar /consultant and triage nurse) at triage (n=4148) over 6 month study period.                   | To evaluate a dual doctor and nurse triage system at a tertiary referral hospital.  | Study found that multidisciplinary triage performs a useful function in our department enabling us to reduce WTs. The process is widely accepted amongst the staff and it ensures a senior doctor assesses most patients. It reduces the number of patients leaving prior to being seen by a doctor and it provides one way of getting around access block and physically small department.   |                                    |                                       |                          |  |   |   |     |              | ✓           | ✓                 |  |      |                 |                     |                 |                                |                             | ✓                                      |                            |                    |                      |                |             |                  | ✓         |  |
| Rogers, 2004, UK <sup>24</sup>            | Evaluation of a 'see and treat' pilot study introduced to an emergency department.  | See and Treat                | BA study from questionnaire and hospital database review measuring time to be seen, time to be discharged ED LOS: single site. No record of sample size for 6 week study period. | To evaluate the effectiveness of a See and Treat model of care on WTs for minor injury and illness presentations to the ED. | 'See and treat' models of care have the potential to improve patient flow and decrease WTs if staffed appropriately. A reduction in overall ED LOS of 22 min (1h 39 min compared with 1h 17 min), average WT to see a Dr or NP reduced by 26 min. The percentage of patients assessed within 15 min of presenting increased from 82% to 98%. Average WT to see practitioner decreased from 56-30 mins; average LOS decreased from 99min to 77 min, WT for all patients in the department decreased. |                                    |                                       |                          |  |   |   |     |              | ✓           | ✓                 | ✓  |      |                 | ✓                   |                 |                                | ✓                           |  | ✓                          |                    |                      |                |             | ✓                |           |  |
| Rogg, 2013, USA <sup>25</sup>             | A long-term analysis of physician triage screening in the emergency department.   | Senior led-team triage       | BA study (n=180870) measuring LOS for ED patients, percentage of patients who LWCA, proportion of patients treated and dispositioned   | Evaluate the impact of the Supplemented Triage and Rapid Treatment of senior physicians and nurses (START).                 | Significant reduction in LOS with combined senior doctor and nurse triage. Physician led triage appears to provide sustainable improvements in ED performance metrics including ED percentage of patients who LWCA, door-to-room time, and percentage of patients treated without using a   |                                    |                                       |                          |  |   |   |     | ✓            | ✓           | ✓                 |  |      |                 | ✓                   |                 |                                |                             |  |                            |                    | ✓                    | ✓              |             | ✓                |           |  |









## Appendix 5: Data extraction of studies reporting on a models of care to address ED congestion and manage patient flow.

| Author                                   | Title of Paper   | Model of Care                                     | Objective   | Outcome   |
|--|--|---|---|---|
| Abdulwah, 2014, UK <sup>107</sup>        | The impact of senior doctor assessment at triage on emergency department performance measures: systematic review and meta-analysis of comparative studies. | <b>Team Triage</b>                                | Review of the literature to determine if placing a senior doctor at triage versus standard single nurse in a hospital emergency department (ED) improves ED performance by reviewing evidence from comparative design studies using several quality indicators. | Of 4506 articles identified, 25 relevant studies were retrieved; 12 were of the weak pre-post study design, 9 were of moderate quality and 4 were of strong quality. The majority of the studies revealed improvements in ED performance measures favouring SDT. Pooled results from two Canadian RCTs showed a significant reduction in LOS of medium acuity patients (weighted means difference (WMD) -26.26 min, 95% CI -38.50 to -14.01). Another two RCTs revealed a significant reduction in WT (WMD -26.17 min, 95% CI -31.68 to -20.65). LWBS was reduced in two Canadian RCTs (risk ratio (RR)=0.79, 95% CI 0.66 to 0.94). This was echoed by the majority of pre-post study designs. SDT did not change the occurrence of adverse events. No clear benefit of SDT in terms of patient satisfaction or cost effectiveness could be identified. |
| Carter, 2007, USA <sup>123</sup>         | A systematic review of the impact of nurse practitioners on cost, quality of care, satisfaction and wait times in the emergency department.                | <b>Nursing Scope of Practice &amp; Fast Track</b> | Review of literature that discussed NPs in the ED setting, looking specifically at 4 key outcome measures; wait times, patient satisfaction, quality of care and cost effectiveness.  | The medical community should further explore the use of NPs, particularly in fast track areas for high volume departments. In rural areas, NPs could supplement overextended physicians and allow health centres to remain open when they might otherwise have to close. These strategies could improve access to care and patient satisfaction for selected urban and rural populations as well as make the best use of limited medical resources.   |
| Crawford, 2014, Australia <sup>109</sup> | Initiatives to reduce overcrowding and access block in Australian emergency departments: a literature review. Collegian.                                   | <b>Streaming</b>                                  | Review of the current literature highlighting strategies adopted by different EDs to reduce delays and streamline patient flow, including: waiting room nurses; streaming; rapid assessment teams; short stay units and care coordination programs.             | Many of the initiatives analysed have proven successful at reducing the number of people re-presenting to the ED, addressing time delays and improving the management of existing resources and patient flow. More recent changes include increasing the scope of practice and workload for triage nurses. With NEAT (which requires that most patients presenting to the ED within 4 h) the traditional roles of nurses in the ED are changing and expanding to meet the needs of modern healthcare systems.   |
| Daly, 2003, Australia <sup>110</sup>     | Short-stay units and observation medicine: a systematic review.  | <b>Short Stay/ Observation Wards</b>              | Review of the literature of how short stay observation units affect the efficiency of healthcare delivery and the quality of services provided.   | Short Stay Observation Units have the potential to increase patient satisfaction, reduce length of stay, improve the efficiency of emergency departments and improve cost effectiveness. However, SOUs have commonly been implemented alongside new clinical protocols, and it is not possible to distinguish the relative benefits of each. As demand increases, providing effective and cost-efficient care will become increasingly important. SOUs may help organisations that are attempting to streamline patient care while maintaining their quality of service delivery.   |
| Elder, 2015, Australia <sup>111</sup>    | Systematic review of three key strategies designed to improve patient flow through the emergency department.   | <b>Nursing Scope of Practice</b>                  | Exploration of the literature regarding 3 key strategies (PAT, MAU, NPs) designed to promote patient throughput in the ED.  | Advanced practice nursing roles, physician assisted triage and medical assessment units are models of care that can positively impact ED throughput. They have been shown to decrease ED LOS and DNW rates. Confounding factors such as site specific staffing requirements, patient acuity and rest-of-hospital processes can also impact on patient throughput through the ED.  |
| Harding, 2011, Australia <sup>117</sup>  | Do triage systems in healthcare improve patient flow? A systematic review of the literature.   | <b>Triage systems</b>                             | Exploration of the literature to understand how triage systems may be used to ensure the most urgent patients get timely service, but do not effect patient flow.   | Triage systems can improve patient flow, and providing some options for management of simple cases at the point of triage is likely to be of benefit in achieving this outcome across a broad spectrum of health services. Moderate evidence exists from a range of health services that the ability to combine triage and initial treatment in less resource intensive cases can have a positive effect on patient flow. There is conflicting evidence that triage systems that only prioritise patients, without providing any treatment improve overall patient flow, although tailoring triage criteria more specifically to the patient population or using triage to prioritise treatable cases may be of benefit.  |

| Author                                | Title of Paper  | Model of Care   | Objective   | Outcome  |
|---------------------------------------|---|---|---|--|
| Oredsson, 2011, Sweden <sup>112</sup> | A systematic review of triage-related interventions to improve patient flow in emergency departments. | <b>Triage related interventions (Fast track/ point of care testing)</b> | Literature search to scientifically explore which interventions improve patient flow in ED.   | Introducing fast track for patients with less severe symptoms result in shorter waiting time, shorter LOS and fewer patients leaving without being seen. Team triage, with a doctor in the team, will probably result in shorter waiting time and shorter LOS and most likely in fewer patients leaving without being seen. There is only limited evidence that streaming of patients into different tracks, performing laboratory analysis in the ED or having nurses to request certain x rays result in shorter waiting time and LOS.   |
| Scott, 2011, UK                       | Effectiveness of acute medical units in hospitals: A systematic review.                               | <b>Medical Assessment Units</b>   | Review of articles reporting effect of the introduction of a acute medical unit on mortality, length of stay, discharge disposition, readmissions, resource use and patient and/ or staff satisfaction. | Limited observational data suggest acute medical units reduce in - patient mortality, LOS and ED access block without increasing readmission rates, and improve patient and staff satisfaction.  |
| Wiler, 2010, USA <sup>23</sup>        | Optimizing emergency department front-end operations.   | <b>Streaming</b>  | Critical review of academic literature to identify ways to improve operations and promote patient throughput.   | This critical review of the academic medical literature reveals that few and often methodologically limited studies have been published concerning front-end operational improvement strategies. Currently, there exists a knowledge gap about what the optimal ED front-end strategy is, with the need for more well-designed trials identified. Although an optimal approach to streamline front-end operations for all EDs has not yet been identified, the strategies presented here may be important components of change management initiatives for individualised EDs to improve front-end operations and throughput. |



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