

Rapid evidence checks are based on a simplified review method and may not be entirely exhaustive, but aim to provide a balanced assessment of what is already known about a specific problem or issue. This brief has not been peer-reviewed and should not be a substitute for individual clinical judgement, nor is it an endorsed position of NSW Health.

## Organisation of emergency departments during COVID-19

### Evidence check question

What is the evidence to support surging the capacity of emergency departments (EDs) during the COVID-19 pandemic in terms of:

- a. infrastructure, including the use of hot zones, temporary hospitals, and repurposing of existing buildings
- b. staffing, including shorter shift patterns, rotations and pandemic rosters, pandemic rosters, using other specialties
- c. processes and patient flows, including flows out of ED, consolidating patients to a single hospital, rotating hospital intake, designating COVID-19 hospitals and patients' cohorts, and tipping points for implementation of such changes?

### Background

During discussions at the ED Community of Practice meeting on 22 August 2021, three areas outlined in the evidence questions above (infrastructure, staffing and process) were identified as key areas to collate existing evidence. There were also conversations around procurement of medi-hoods, high efficiency particulate air (HEPA) filters and air scrubbers.

The Critical Intelligence Unit in late 2020 undertook a scoping review to identify studies on pre-hospital models of care (including EDiTH and PACER), intra-ED processes, discharge and transfer. The review included triage and virtual models. A summary of the scoping review is provided in tables 1-3.

### Methods (Appendix 1)

PubMed and Google searches were undertaken on the 22 and 24 August 2021.

## Results

### Infrastructure: Hot and cold zones

Peer reviewed literature:

- Core characteristics of designated (hot and cold) zones include designated physical areas, certain personal protective equipment requirements, staffing models and screening areas to separate patients with known or confirmed COVID-19 from those without suspected COVID-19.
- In South Korea, an ED was [split into four zones](#), comprising the isolation care unit as the red and orange zones, emergency fever clinic, acute-care unit, and general zone. A unidirectional air-conditioning system was installed in this space and a dividing wall was installed between all the beds in the ED. People were screened on entry.<sup>1</sup>
- A dedicated area in the ED in the USA trialled two approaches: a dedicated hot area within the ED, and an [alternate care site outside the ED](#), but located in close proximity, to manage low-acuity patients presenting to the ED for concerns of COVID-19. A 52 square metre conference room space was used, and the Centers for Disease Control and Prevention guidance was used to model the floor plan. The mean ED length of stay was shorter for alternate care site patients.<sup>2</sup>
- In the Netherlands, a hospital [joined their ED and acute medical unit](#) to allow for designated high and low risk areas. Joining two existing units enabled an instant physical segregation of patients.<sup>3</sup>
- A paediatric hospital in Italy had [two designated zones with dedicated healthcare workers](#). A pre-triage area was created at the entrance of the ED.<sup>4</sup>
- An academic hospital in the USA had a dedicated [eight-room pod with a single entry](#). While staffing assignment remained in designated areas for four hour blocks, physicians regularly moved between the hot zone and rest of the ED.<sup>5</sup>
- Other examples of hot and cold zones have also been described in [Italy](#)<sup>6</sup> and the [USA](#)<sup>7</sup>, with the core features as outlined above. In these cases, constructing temporary walls can address some structural limitations. EDs with ample footprints can additionally designate a third 'flex' area that can be flipped between hot and cold, as the situation demands.
- In Philadelphia, [existing negative pressure rooms](#)<sup>8</sup> were designated for sicker respiratory patients more likely to require aerosol generating procedures. A tent was placed outside the ambulance and adjacent walk-in entrances of the ED.
- In Canada, [classrooms and offices](#)<sup>9</sup> were converted into extra examination rooms exclusively for patients with COVID-19. In New York the hospital converted an ambulance driveway with a high roof into a mini-field hospital with eight beds (including for chest x-rays). In Alberta, the expansion of a call-centre service to coordinate contact between long-term care homes and EDs was critical to keeping vulnerable patients out of the hospital.
- In San Francisco, there was rapid deployment of two [military-grade negative-pressure medical tents](#)<sup>10</sup>.

Grey literature:

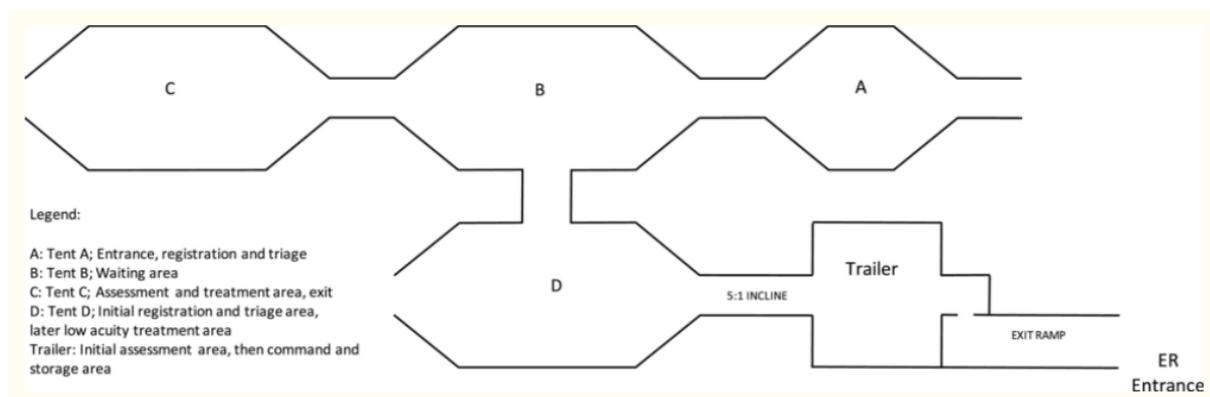
- Australasian College for Emergency Medicine [Clinical guidelines for the management of COVID-19 in Australasian emergency departments](#) (December 2020).
  - Patients meeting case definition criteria should be streamed into a dedicated high-risk treatment zone within the ED, with immediate isolation from other waiting patients.

- In the setting of significant rates of community transmission, it may be necessary to designate the entire ED as a high-risk zone. In effect, this would require staff to use droplet precautions personal protective equipment for every patient interaction. This strategy may decrease the risk that staff inadvertently become close contacts (resulting in furlough), and reduce complexity in the process.
- NSW Health Communities of Practice [Quick Reference Guide to ED assessment and management of COVID-19 in adults](#) last update 8 Sept 2020<sup>11</sup>.
- [6 Approaches to Managing Coronavirus Patient Surges in Emergency Departments](#) (Aug 2020)<sup>12</sup>: hot and cold zones, rapid testing, personal protective equipment, alternatives to mechanical ventilation, ED space constraints and telemedicine. Has a reference to perspective piece in *Annals of Emergency Medicine* [Surgeproofing the Hot Zone](#)<sup>13</sup>.
- Clinical Excellence Commission. [Emergency Department COVID-19 PPE Quick Reference Guide](#) (July 2021)<sup>14</sup>.
- Design perspective is considered in [The Hot Zone: Designing Hospital Units for Diseases as Infectious as COVID-19](#)

### Infrastructure: Temporary hospitals (e.g. tents and marquees)

Peer reviewed literature:

- In the USA, [two military-grade negative-pressure medical tents](#)<sup>10</sup> in the ED parking area were set up as accelerated care units as a model for EDs. The layout of the shelters, while modifiable and adaptable, was initially developed as follows.
  - 1: full triage, patient care occurs in chairs, rapid treat and release without nursing involvement after triage process and/or waiting area for evaluation by a provider; portable x-ray available inside.
  - 2: treatment cots or trolleys where a nurse is assigned to each patient, higher acuity patients, full ED treatments available.
- Also in the USA, [tents were used as outdoor treatment centres](#)<sup>15</sup> and these were placed under the control of the ED. The tents were for an arrival and treatment area for stable patients with respiratory symptoms. Image of set up below.



- Internationally, organisations have been [converting the outdoor spaces of their urgent care](#)<sup>16</sup> and medical office building to spaces to treat people outdoors. Facilities in the USA have used or have

plans to use their gardens and other outdoor spaces on their property, in tents or in the open air. Mount Sinai Health System in New York City treated patients in a 68-bed tent field hospital in Central Park.

- Recommendations for establishing [alternative care sites](#)<sup>17</sup>:
  - preparedness actions need to be continuous and flexible
  - staffing needs must be met
  - health equity must be a focus
  - site should be designed to function without compromising safe and effective care.

Grey Literature:

- The [Australian College for Emergency Medicine COVID-19 guidelines](#)<sup>11</sup> outline that it may be necessary for the ED to use temporary spaces for the care of patients. It is recommended that if an expansion of the ED footprint is required, EDs select an area that is in close proximity to the main department and can be rapidly fitted out to meet ED design standards (to the extent that is possible). Outpatient clinics and day treatment areas often represent a good option. In exceptional circumstances, the use of temporary structures (such as tents and marquees) may be required. These areas should be set up using the same design and infection control principles.
- In these news articles, emergency tents were erected in other countries [such as Indonesia](#)<sup>18</sup> and [in the UK](#)<sup>19</sup>, where the tents are used for triaging people who present to the ED.

### Infrastructure: Repurposing other buildings and designated COVID-19 hospitals

Note these studies are generally referring to repurposing buildings for hospitals rather than EDs specifically.

Peer reviewed literature:

- In China a [community hospital was transformed](#) to improve the emergency capacity of hospitals. Of 198 COVID-19 patients that went to this hospital, only 39 were transferred to the module hospitals, while 131 were discharged and 28 were still in the hospital at the end of the study period.<sup>20</sup>
- [Fangcang shelter hospitals](#)<sup>21</sup> and [mobile field hospitals](#)<sup>22</sup> were widely used in China and involved the [conversion of large-scale public venues](#)<sup>23</sup> into hospitals. They required sites with good ventilation, abundant space, and convenient patient transport. [Modelling data](#)<sup>24</sup> found without Fangcang hospitals, cases, deaths and days of the epidemic would have been much greater.
- In Minnesota a [long-term acute care hospital](#) was transformed into a COVID-19 hospital, as the usual work at the hospital didn't include emergency, obstetric, or operative services, fewer services had to be suspended. Engineers reconfigured the physical space and infrastructure to create 35 full-range intensive care beds. Additional modifications included wiring rooms for cardiac telemetry capabilities.<sup>25</sup>
- A children's hospital in China [implemented transition rooms](#) for children from regions outside of Shanghai to be under medical observation for at least three days.<sup>26</sup>
- In Spain an [exhibition centre was transformed](#)<sup>27</sup> into a hospital. It reflected that success depends on delimitation in admission criteria taking into account the proportion of patients who may require, during admission, assistance in the critical care area.
- A [concert hall in Italy](#)<sup>28</sup> meant there was a large area, it was covered and heated, the availability of a high-power electricity system, and the availability of parking. The target of the hospital was for

people with mild and moderate COVID-19 and the hospital was split into three zones with differing levels of personal protective equipment.

- A [field hospital in Italy](#)<sup>29</sup> had zones partition, dedicated in-hospital pathways for healthcare workers, strict infection prevention and control measures.
- In a [military field hospital in France](#)<sup>30</sup>, military staff were also used to help manage patients.
- The [NHS in the UK](#)<sup>31</sup> developed a framework to support field hospitals including political, environmental, social, technological, legal and economic aspects of development.
- In Bahrain, one floor of an [existing car parking structure](#)<sup>32</sup> was converted into a 130-bed field intensive care unit.
- [Designated COVID-19 hospitals](#) mainly included services for fever-clinics to screen patients, COVID-19 department for higher-levels of medical care, and makeshift wards for emergencies. One reported having a '[suspected ward](#)' where the key characteristics of this ward were isolate, triage, fast diagnosis and rapid referral.<sup>33, 34</sup>
- Different [organisation of care](#)<sup>35</sup> were also described, such as all hospitals manage COVID-19 positive cases, or one hospital is designated to manage, or four hospitals are designated to manage (in Australia, a country experiencing low prevalence of COVID-19).

#### Grey literature

- In scenarios of community transmission, the [World Health Organization](#)<sup>36</sup> recommend new hospitals or temporary structures can serve to augment COVID-19 patient care or essential health services, depending on national strategy.
- Purpose built or designated facilities established in [Singapore](#)<sup>37</sup> and [Japan](#)<sup>38</sup>.
- NSW Health has [surge capacity management](#)<sup>39</sup>, which includes detail on reinstating clinical spaces that are currently not in use for patient care. Items to consider include selecting a location, bed space, change rooms, utility area, entry to clinical zones, hand hygiene, waste bins, storage, room fabric, medical service, medical equipment, air conditioning, negative pressure environments and other engineering related considerations.

### Staffing: Shifts and teams

#### Peer review literature

- The [University Hospital of Brooklyn](#)<sup>40</sup> was designated a COVID-19 hospital in New York and residents were restructured into three teams.
  - Call team – routine floor work, support of medical services including proning patients and emergency resuscitations, covering transplant emergency service.
  - Surgical Emergency Advanced Line Service team – residents and a supervising attendant to assist with procedural solutions for all inpatients.
  - Remaining surgical residents were redeployed to the medical floors, ED and intensive care units.
- The Singapore General Hospital Department of Emergency Medicine [Outbreak Response Roster](#)<sup>41</sup> had five fixed teams of doctors working in rotation.
  - Members within teams remained constant and balanced in manpower and seniority.
  - 12 hour shifts with no overlapping or staggering.

- Handovers kept as brief as possible.
- Nurses also split into teams that worked same 12 hour shifts.
- The ED of the Royal Victorian Eye and Ear Hospital developed a [12-hour team pandemic roster](#)<sup>42</sup> with six teams of 13-16 members.
  - Staff were required to exclusively work within their team and in no other roles or hospitals.
  - 12 hour 'active' shifts for three days and six days of 'inactive' rest.
  - Equivalent team sizes and expertise.
  - Next active team placed on call.
- The [Stanford Hospital](#)<sup>43</sup> in the USA minimised the number of emergency physicians exposed to patients with COVID-19 by reducing resident staff, reassigning emergency medicine residents, increasing backup call capacity, flexing shifts to meet patient volume, using telemedicine and clustering patients to create lower risk areas in ED.
- A [modelling study](#)<sup>44</sup> of ED pandemic staffing compared the strengths and limitations of three ED clinician staffing models: two-team and three-team fixed cohort, and three-team unfixed cohort. The study showed time to staffing shortage with and without immunity.
- An [academic ED](#)<sup>8</sup> in the US created a respiratory ED team and a non-respiratory ED team to minimise staff exposures.
- An ED in Singapore piloted a military concept, [close air support](#)<sup>45</sup>, to support ED operations. A senior ED physician and two junior ED physicians on-site were teamed with two junior surgical residents off-site with teleconferencing access.
- In [China, an ED was reorganised](#)<sup>46</sup> to respond to a shortage of ED staff.
  - Additional residents were provided to the ED (made possible because elective surgery was curtailed).
  - Staff moved to a 12-hour shift system to maximise the number of staff available per shift.
  - Staff were divided into five teams.

#### Grey literature:

- The [Australian College for Emergency Medicine COVID-19 guidelines](#)<sup>11</sup> outline that evidence has shown the risk of COVID-19 infection is increased with longer shifts. To minimise fatigue and burnout among emergency physicians, it is recommended that 'safe working hours' are used, and that staff are rotated through shifts in areas of high stress (e.g. a high-risk zone) to areas of low stress.
- The Centers for Disease Control and Prevention in the USA advises not scheduling staff for more than 12 hours, if possible, to help avoid [workplace fatigue](#)<sup>11</sup>.

### Staffing: Using other specialties

#### Peer review literature

- In the [Singapore General Hospital Department of Emergency Medicine](#)<sup>41</sup>, manpower was supplemented by junior doctors from other departments.
- At the ED of the [Royal Victorian Eye and Ear Hospital](#)<sup>42</sup>, additional nurses, clerks and cleaners were deployed from surgical theatres, inpatient wards, and outpatient departments.

- [Advanced practice practitioners](#)<sup>42</sup> were trained to work in areas of the hospital impacted by COVID-19 at the Stanford Hospital in the USA.
- The [NYU Langone Medical Center](#)<sup>47</sup> in the USA deployed a ‘COVID army’ of providers from medicine, surgery, and other specialities to work on inpatient wards during the COVID-19 surge.
- At [Aarhus University Hospital in Denmark](#)<sup>48</sup>, orthopaedic surgeons were redeployed to minor and major injuries and trauma in the ED, while ED physicians were deployed to COVID-19 testing, triaging and clusters.
- [Paediatric emergency medicine](#)<sup>49</sup> providers were reallocated to telemedicine and expanded their clinical care to adult patients to meet ED needs at New York-Presbyterian Hospital – Weill Cornell Medical Center in the USA.
- [Cancellation of elective procedures](#)<sup>8</sup> and restrictions on ambulatory care visits free up subspecialty, non-ED providers.
- In [Switzerland, medical students](#)<sup>50</sup> were enlisted as volunteers to assist with COVID-19 testing.
- [Department of urology physicians](#)<sup>51</sup> staffed an ED-intensive care unit in the USA.
- A [large tertiary hospital in the UK](#)<sup>52</sup> sourced an additional 205 medical staff from anaesthesia, medical and surgical specialities to work directly in the intensive care unit.
- [Specialist surgeons were redeployed](#)<sup>53</sup> to treat COVID-19 patients in the ED of a general hospital in Milan, Italy.

#### Grey Literature

- The [Australian College for Emergency Medicine COVID-19 guidelines](#) recommend that hospitals redeploy non-ED staff (within their scope of practice) to assess acute, low risk COVID-19 patients outside the ED (e.g. in clinics, in the community or on wards) to decrease ED demand.
- The [World Health Organization](#) states in settings anticipating numerical shortages, sources of additional health workers should be identified, and existing health workers redeployed. People who may be redeployed include retirees, unemployed but qualified, medical residents, the private sector and national medical reserve corps. Health news articles report on [redeploying staff such as in Mount Sinai](#), where the [most obvious recruits](#) for redeployment are those with critical care backgrounds, such as anaesthesiologists and critical care intensivists. Second in line are general surgeons, orthopaedic surgeons, and internal medicine subspecialists like cardiologists and oncologists.

In NSW it was announced dozens of [private hospitals](#) will suspend non-urgent elective surgery so staff can help fight COVID-19.

### Process and patient flows: Cohorting

#### Peer reviewed literature

- The University College London Hospital ED, evaluated the [cohorting and isolation strategy for suspected COVID-19 cases during the pandemic](#) based on clinical features suggestive of COVID-19, age and comorbidities. Patients were allocated to triage categories defined by likelihood of COVID-19 and risk of a poor outcome: category A (low-likelihood; high-risk), B (high-likelihood; high-risk), C (high-likelihood; low-risk) and D (low-likelihood; low-risk). This determined the order of priority for isolation in single-occupancy rooms with category A the highest. Implementing this

cohorting tool has reduce the risk of hospital-acquired transmission of COVID-19 especially to individuals at the greatest of risk of severe disease.<sup>54</sup>

#### Grey literature

- The Australasian College of Emergency Medicine recommends [patient cohorting in the event of overwhelming patient demand](#). It may be necessary to cohort patients with suspected and/or confirmed COVID-19 in an open or shared area of the ED (within the 'high risk' zone).<sup>55</sup>
- The American College of Emergency Physicians recommends [cohorting patients with signs and symptoms of infection](#).<sup>56</sup>
  - Waiting rooms and common areas: to establish separate waiting rooms, or separate locations within same waiting area, to screen positive and screen negative patients.
  - Consider outdoor space and tents to screen positive patients.

Treatment resuscitation and trauma: create a separate resuscitation bay for patients with signs and symptoms or diagnosis of high-risk infectious diseases.

### Process and patient flows: Directing COVID-19 positive patients to designated COVID-19 centres

#### Peer reviewed literature

- St Lawrence Health used a [hub-and-spoke system](#) to route COVID-19 patients to its flagship hospital. It further assembled a small clinical team to manage admitted COVID-19 patients and to stay abreast of a quickly changing body of literature and standard of care. Twenty COVID-19 patients were identified. Sixteen patients (80%) met National Institutes of Health criteria for severe or critical disease. One patient died. No patients were transferred to other hospitals.<sup>57</sup>
- This paper determines how [inter-regional transfers](#) could alleviate bed shortages. For regions with bed shortfalls, transfers to the nearest region with unused beds were simulated using an algorithm that minimized total inter-region transfer distances across the USA. Inter-regional patient transfer has the potential to mitigate regional bed shortages during hospital volume surges.<sup>58</sup>
- [COVID-19 hospital designation: Effect on emergency department patient self-selection and volume](#). This study investigated the effect on ED patient self-selection and volume after Glenbrook Hospital was designated as the 'COVID hospital'. Designating a hospital as the pandemic hospital has reduced ED presentations by 30%, whereas the COVID-19 related presentations increased by 20%. Staffing, personal protective equipment distribution, provision of specialised care, and overall resource allocation can be prepped in advance to plan for the shift in ED volumes and pandemic-related visits.<sup>59</sup>

### Process and patient flows: Directing COVID-19 positive patients to designated COVID-19 centres

- A case study for Western Australia: [Should Australian states and territories have designated COVID-19 hospitals in low community transmission?](#) A rapid review of the literature was conducted of the advantages and disadvantages of having designated COVID-19 hospitals. The most practical option chosen was for all hospital facilities to remain prepared to care for COVID-19 patients where they present rather than having specified designated hospitals.<sup>35</sup>

Grey literature

A summary of the lessons learned, and key planning considerations prepared by USA Department of Health and Human Services (TRACIE) relevant to all [hospitals designating units for COVID-19 care](#). There has been an agreement among the facilities interviewed that designating one hospital within the health system or community was ideal for their circumstances and helped focus COVID-19 care and expertise, personal protective equipment, and processes and standardised care in one location.<sup>60</sup>

**Limitations**

Evidence on some of these topics, particularly around patient flows in the emergency department, is still emerging. International literature is included, and findings should be interpreted in the local context of disease prevalence.

**CIU scoping review**

The Critical Intelligence Unit in late 2020 undertook a scoping review to identify studies relating to pre-hospital models of care, intra-ED processes, discharge and transfer. This included triage and virtual models. Studies were not limited to COVID-19. Results are in tables 1-3.

**Table 1: Pre-hospital**

Interventions and strategies	Review articles (number of studies in review)	Details of intervention
Pre-hospital triage or assessment	Eastwood et al. 2015 <sup>61</sup> (n=7)	Secondary telephone triage conducted pre-ambulance arrival
Tele-emergency services	Ward et al. 2015 <sup>62</sup> (n=38)	Teleconsultation, telepresence, and tele-specialist services (delivered via methods such as real time audio and/or visual and image transfer)
Strengthening or expanding primary care	<ul style="list-style-type: none"> <li>Flores-Mateo et al. 2012 <sup>63</sup> (n=48)</li> <li>Morley et al. 2018 <sup>64</sup> (n=)</li> <li>Hong et al. 2020 <sup>65</sup> (n=20)</li> </ul>	<ul style="list-style-type: none"> <li>Increasing primary care accessibility and emergency department cost-sharing</li> <li>Extended hours of primary care</li> </ul> Improving accessibility to after-hours primary care
Bypassing or delaying ED care	<ul style="list-style-type: none"> <li>Kirkland et al. 2019 <sup>66</sup> (n=15)</li> <li>Li et al. 2019 <sup>67</sup> (n=3)</li> </ul>	<ul style="list-style-type: none"> <li>Interventions designed to either bypass the ED or direct patients</li> <li>Offload programs until ED admission</li> </ul>
Diversion to other hospitals	<ul style="list-style-type: none"> <li>Li et al. 2019 <sup>67</sup> (n=14)</li> </ul>	<ul style="list-style-type: none"> <li>Ambulance diversion. Patient allocation policy</li> </ul>



Interventions and strategies	Review articles (number of studies in review)	Details of intervention
	<ul style="list-style-type: none"> <li>• Delgado et al. 2013 <sup>68</sup> (n=2)</li> </ul>	(coordinated strategy between hospitals)
<p>Modelling or predicting patient flow</p> <p>Understanding patient factors for ED visits</p>	<ul style="list-style-type: none"> <li>• Dufour et al. 2019 <sup>69</sup> (n=8)</li> <li>• Mohiuddin et al. 2017 <sup>70</sup> (n=21)</li> <li>• Ortíz-Barrios et al. 2020 <sup>71</sup> (n=203)</li> <li>• Kreindler et al. 2016 <sup>72</sup> (n=35)</li> <li>• Liu et al. 2018 <sup>73</sup> (n=45)</li> <li>• Li et al. 2019 (n=18)</li> <li>• Dehghani et al. 2017 <sup>74</sup> (n=11)</li> <li>• Delgado et al. 2013 <sup>68</sup> (n=1)</li> </ul>	
Cancellation of elective admissions	Delgado et al. 2013 <sup>68</sup> (n=2)	

**Table 2: Intra-ED processes**

Interventions and strategies	Review articles (number of studies in review)	Summary of findings
Dedicated zones	<ul style="list-style-type: none"> <li>• Bullard et al. 2012 <sup>75</sup> (n=4)</li> <li>• Elder et al. 2015 <sup>76</sup> (n=21);</li> <li>• Chan et al. 2015 <sup>77</sup> (n=22);</li> <li>• Galipeau et al. 2015 <sup>78</sup> (n=5)</li> <li>• Delgado et al. 2013 <sup>68</sup> (n=2)</li> </ul>	<ul style="list-style-type: none"> <li>• Rapid assessment zone</li> <li>• Medical assessment units</li> <li>• Holding units</li> <li>• Short-stay units</li> </ul>
Increasing beds in ED	Li et al. 2019 <sup>67</sup> (n=2)	Increasing the number of beds
Workforce and staffing in the ED	<p><b>Nurse practitioners in ED</b></p> <ul style="list-style-type: none"> <li>• Chan et al. 2015 <sup>77</sup> (n=22);</li> <li>• Elder et al. 2015 <sup>76</sup> (n=21)</li> <li>• Beckerleg et al. 2020 <sup>79</sup> (n=1)</li> </ul> <p><b>Physiotherapists in ED</b></p>	

Interventions and strategies	Review articles (number of studies in review)	Summary of findings
	<ul style="list-style-type: none"> <li>• Ferreira et al. 2019 <sup>80</sup> (n=27);</li> </ul> <p><b>Co-location of primary care professionals</b></p> <ul style="list-style-type: none"> <li>• Chan et al. 2015 <sup>77</sup> (n=22);</li> <li>• Gonçalves-Bradley et al. 2018 <sup>81</sup> (n=4)</li> <li>• Khangura et al. 2012 <sup>82</sup> (n=3)</li> </ul> <p><b>Dedicated day-time surgeon for non-trauma patients in ED</b></p> <ul style="list-style-type: none"> <li>• Beckerleg et al. 2020 <sup>79</sup> (n=1)</li> </ul>	
<p>Triage by health care professionals</p>	<p><b>Physician triage</b></p> <ul style="list-style-type: none"> <li>• Abdulwahid et al. 2016 <sup>83</sup> (n=25)</li> <li>• Elder et al. 2015 <sup>76</sup> (n=21)</li> <li>• Rowe et al. 2011a <sup>84</sup> (n=28)</li> <li>• Benabbas et al. 2020 <sup>85</sup> (n=12)</li> </ul> <p><b>Triage team</b></p> <ul style="list-style-type: none"> <li>• Ming et al. 2016 <sup>86</sup> (n=58)</li> <li>• Oredsson et al. 2011 <sup>87</sup> (n=33)</li> <li>• Yarmohammadian et al. 2017 <sup>88</sup> (n=)</li> <li>• Harding et al. 2011 <sup>89</sup> (n=8)</li> </ul> <p><b>Non-physician provider (e.g. nurse practitioner, physician assistant) triage</b></p> <ul style="list-style-type: none"> <li>• Rowe et al. 2011b <sup>90</sup> (n=14)</li> <li>• Afnan et al. 2020 <sup>91</sup> (n=10)</li> <li>• Benabbas et al. 2020 <sup>85</sup> (n=12)</li> <li>• Harding et al. 2011 <sup>89</sup> (n=4)</li> </ul>	

Interventions and strategies	Review articles (number of studies in review)	Summary of findings
	<p><b>Training personnel in triage processes</b></p> <ul style="list-style-type: none"> <li>Harding et al. 2011 <sup>89</sup> (n=1)</li> </ul>	
<p>Triage scales and systems</p>	<p><b>Changing triage criteria</b></p> <ul style="list-style-type: none"> <li>Harding et al. 2011 <sup>89</sup> (n=4)</li> </ul> <p><b>Various ED scales</b></p> <ul style="list-style-type: none"> <li>Farrohknia et al. 2011 <sup>92</sup> (n=24)</li> </ul> <p><b>Manchester Triage System</b></p> <ul style="list-style-type: none"> <li>Azeredo et al. 2015 <sup>93</sup> (n=22)</li> <li>Parenti et al. 2014 <sup>94</sup> (n=12)</li> </ul>	<ul style="list-style-type: none"> <li>Canadian Emergency Department Triage and Acuity Scale (CTAS)</li> <li>Australian Triage Scale (ATS)</li> <li>Medical Emergency Triage and Treatment System (METTS)</li> <li>Emergency Severity Index (ESI)</li> <li>Soterion Rapid Triage Scale (SRTS)</li> </ul>
<p>Re-organisation of the workflows</p>	<ul style="list-style-type: none"> <li>Cabilan et al. 2017 <sup>95</sup> (n=5)</li> <li>Cassarino et al. 2019 <sup>96</sup> (n=6)</li> <li>Katz et al. 2012 <sup>97</sup> (n=23)</li> <li>Oredsson et al. 2011 (n=33)</li> <li>Beckerleg et al. 2020 <sup>79</sup> (n=4)</li> </ul>	<ul style="list-style-type: none"> <li>Nurse-initiated medications</li> <li>Early assessment and intervention by health and social care professional teams</li> <li>ED-based care coordination interventions</li> <li>Nurse-requested x-ray</li> <li>Restructuring the consultation process</li> <li>Education, audit and feedback of ED residents</li> <li>Implementation of institutional guideline of consultation to decision time</li> <li>Expansion of ED service coverage and added physician time</li> </ul>
<p>Streaming, fast-tracking patients</p>	<ul style="list-style-type: none"> <li>Jarvis 2016 <sup>98</sup> (n=)</li> <li>Oredsson et al. 2011 <sup>87</sup> (n=33)</li> <li>Yarmohammadian et al. 2017 <sup>88</sup> (n=30)</li> </ul>	<ul style="list-style-type: none"> <li>Rapid assessment</li> <li>Streaming</li> <li>Fast-tracking</li> </ul>

Interventions and strategies	Review articles (number of studies in review)	Summary of findings
	<ul style="list-style-type: none"> <li>• Li et al. 2019 <sup>67</sup> (n=1)</li> <li>• Beckerleg et al. 2020 <sup>79</sup> (n=2)</li> </ul>	<ul style="list-style-type: none"> <li>• Increase ED patient throughput</li> <li>• Standardisation of the admission process</li> </ul>
Technologies	<ul style="list-style-type: none"> <li>• Dobson et al. 2013 <sup>99</sup> (n=22)</li> <li>• Jarvis 2016 <sup>98</sup> (n=)</li> <li>• Oredsson et al. 2011 <sup>87</sup> (n=33)</li> <li>• Yarmohammadian et al. 2017 <sup>88</sup> (n=30)</li> <li>• Beckerleg et al. 2020 <sup>79</sup> (n=2)</li> <li>• Delgado et al. 2013 <sup>68</sup> (n=1)</li> </ul>	<ul style="list-style-type: none"> <li>• Electronic tracking technologies</li> <li>• Point-of-care testing</li> <li>• Text messaging reminder for delays in consultation process</li> </ul>

**Table 3: Discharge and/or transfer**

Interventions and strategies	Review articles (number of studies in review)	Details of intervention
ED to outpatient care transition interventions	<ul style="list-style-type: none"> <li>• Abraham et al. 2016 <sup>100</sup> (n=16)</li> </ul>	ED-based care transition interventions
Discharge strategies interventions	<ul style="list-style-type: none"> <li>• Chan et al. 2015 <sup>77</sup> (n=22)</li> <li>• Morley et al. 2018 <sup>64</sup> (n=)</li> </ul>	<ul style="list-style-type: none"> <li>• Early discharge</li> <li>• Initiatives to meet timed patient disposition targets</li> </ul>
Lean Thinking principle	<ul style="list-style-type: none"> <li>• Bucci et al. 2016 <sup>101</sup> (n=9)</li> <li>• Ortíz-Barrios et al. 2020 <sup>71</sup> (n=203)</li> <li>• Tlapa et al. 2020 <sup>102</sup> (n=40)</li> </ul>	<ul style="list-style-type: none"> <li>• Computer simulation of patient flow</li> <li>• Lean manufacturing</li> </ul>
Other	<ul style="list-style-type: none"> <li>• Chan et al. 2015 <sup>77</sup> (n=22)</li> <li>• Elder et al. 2015 <sup>76</sup> (n=21)</li> <li>• Morley et al. 2018 <sup>64</sup> (n=102)</li> <li>• Yarmohammadian et al. 2017 <sup>88</sup> (n=30)</li> </ul>	<ul style="list-style-type: none"> <li>• Political action - management and resource priority</li> <li>• Whole-of-system initiatives</li> <li>• Managing supply resources</li> <li>• Strategies toward ‘ideal ED patient journey models’</li> </ul>

## Appendix

### Search terms

#### Hot and cold zones

PubMed and Google searches were conducted on 22 August 2021 using the terms “emergency department” AND “COVID-19” AND (PPE OR triage OR zone OR model OR organis\* OR design\* OR segreg\* OR prepar\* OR adapt\* OR divid\*)

Studies were included from October 2020 to present (22 August 2021). Previous literature is summarised in the [CIU evidence check<sup>103</sup>](#) dated 4 November 2020. Insights from some earlier examples from this evidence check have been included in this results table.

#### Temporary hospitals or repurposing existing buildings

PubMed and google searches were conducted using terms (covid-19) AND (((("solution\*" OR model\*) AND "surge capacity") OR ("surge planning" OR "hub and spoke")) OR (hospital[Title] AND (field[Title] OR temporary[Title] OR mobile[Title] OR shelter[Title]))) conducted on 13 August 2021. covid-19 AND tent\*[ti] was also searched on 24 August.

Due to the [CIU evidence check<sup>104</sup>](#) published in April 2020, only studies in the peer reviewed literature from May 2020 onwards were included. This brief focused on the establishment or new facilities or repurposing existing facilities for the care of COVID-19 patients. Studies on surge capacity within a hospital (e.g. increasing intensive care unit beds by using corridor space) were not included.

#### Staffing

PubMed and Google searches were conducted on 23 August using the terms (workforce[Title/Abstract] OR roster\*[Title/Abstract] OR sprint\*[Title/Abstract] OR restructur\*[Title/Abstract] OR "staffing models" OR redeploy\*[Title/Abstract]) AND ("emergency medical services"[MeSH Terms] OR "emergency medical services"[All Fields] OR "emergency service"[Title/Abstract] OR "emergency medical services"[Title/Abstract] OR "emergency medicine"[Title/Abstract] OR "emergency department\*" [Title/Abstract] OR "emergency hospital"[Title/Abstract] OR "emergency hospitals"[Title/Abstract] OR "emergency medical service"[Title/Abstract] OR "emergency medicine"[Title/Abstract] OR "emergency service, hospital"[MeSH Terms] OR ED[Title/Abstract]) AND ("COVID-19"[Title/Abstract] OR "COVID-19"[MeSH Terms])

#### Process and patient flows

PubMed searches were conducted on 24 August 2021 using the terms “emergency department” AND “COVID-19” AND (patient flow OR cohort\* OR model OR designat\* OR trasfer\*). Google searches included: emergency department, flow out of ED, SPRINT, consolidating COVID-19 patients, cohorting, designating hospitals.

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