MEDICAL UNIVERSITY OF SOUTH CAROLINA
VALUE INSTITUTE
Evidence-Based Practice Brief
Effects of Cohorting Patient on Throughput in the ED

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ASK THE QUESTION

Question: In the emergency department, does cohorting patients by acuity level increase patient throughput & improve patient outcomes?

SEARCH FOR EVIDENCE

Databases: PubMed, Scopus, Google Scholar

PubMed search strategy: ("Emergency Service, Hospital"[Mesh] OR emergency) AND ("Patient Acuity"[Mesh] OR acuity OR severity) AND (cohorting OR placement OR grouping OR designat* OR screening OR identif* OR queueing OR “split flow”)

Keywords: emergency, “patient acuity”, acuity, severity, cohorting, placement, grouping, designat*, screening, identif*, queuing

CRITICALLY ANALYZE THE EVIDENCE

There were 8 articles found addressing the use of cohorting patients (i.e., split flow) to optimize patient throughput in the emergency department (ED) setting.

Wiler et al. (2016) evaluated the implementation of a front-end split flow model, and found that overall LOS for all ED walk-ins (220 min pre vs 175 min post and 140 min 1yr) and patients discharged home (216 min pre vs. 170 min post and 140 min 1 yr) decreased and were maintained at 1 year. Three studies (Arya et al., 2013; Bish et al., 2016; Joseph et al., 2013) directly addressed the use of the Emergency Severity Index (ESI) triage scale to assist with split flow processing of patients in the ED. Arya et al. (2013) found a 5.9% decrease in LOS for all patients (95% CI -7.2 to -4.5; p<0.0001) despite an ED volume increase of 3.4% when patients were cohorted based on ESI triage scale score. The largest effects were seen in patients with headache/migraine, abdominal pain, skin infection, sprains and superficial injury. Bish et al. (2016) saw a reduction in median arrival-to-departure time and door-to-diagnostic time (42% and 58%, respectively) after introduction of a split flow model in the ED based on ESI triage scale score. Joseph et al. (2013) reported a significant decrease in average door-to-bed times (94.2 min pre vs...
52.1 min post; p=0.0003) following the implementation of a split flow model based on ESI triage scale score. Mirhaghi et al. (2015) completed a systematic review & meta-analysis of the reliability of the ESI triage scale, which was used to cohort patients in the majority of the studies noted above. Their meta-analysis of 19 studies from 6 countries found the ESI triage scale had an acceptable level of overall reliability, with an overall pooled coefficient of 0.791 (95% CI 0.752–0.825).

Similar ED throughput decreases were seen in studies that focused on physician or team-based triage with and without split flow in three studies (Holroyd, et al., 2007, Pierce et al., 2016, Sharma et al., 2013). Pierce et al. (2016) found that utilizing split flow plus a provider in triage resulted in a 16.4% improvement in discharge LOS (145.3 min vs 173.8 min, difference 28.5 min) and decreased door to bed (1.6 min vs 5 min) and door to provider (10.6 min vs 12.9 min) times. Split flow alone resulted in a 9% improvement in discharge LOS (157.5 min vs 173.8 min, difference 16.3 min) in this study. Holroyd, et al. (2007) reported a 36 min decrease (median: 4hr 21min vs 4hr 57min) in median LOS when a triage liaison physician was on duty to support & assist triage nurses, evaluate ambulance patients, answer incoming physician calls, evaluate & treat patients as needed. Sharma et al. (2013) showed that LOS was 1h 18 min shorter (95% CI 1h 11min – 1h 27min) for low-acuity patients when a discharge facilitator team (attending physician, PA, RN) with a focus on rapidly treating and releasing low acuity patients was available.

<table>
<thead>
<tr>
<th>PICO Question: In the emergency department, does cohorting patients by acuity level increase patient throughput &amp; improve patient outcomes?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Author/Date/Journal</strong></td>
</tr>
<tr>
<td>Mirhaghi et al., 2015, Sultan Qaboos University Medical Journal</td>
</tr>
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</table>

Study did not address focused clinical question
Search was not detailed or exhaustive
Quality of the studies was not appraised or studies were of low quality
Methods and/or results were inconsistent across studies

| Holroyd, et al., 2007, Academic Emergency Medicine | To evaluate the implementation of triage liaison physician (TLP) shifts at an academic tertiary care adult ED on | RCT | 5718 patients treated at an ED in Canada using 2 distinct strategies over 6 weeks
-Intervention: TLP | Median LOS was decreased when the TLP shifts occurred (median: 4hr 21min vs 4hr 57min; difference 36min).
TLP on shift was still a major | Study Limitations = None RCT & Quasi-Experimental Studies |

Insufficient sample size
Lack of randomization
Lack of binding
Stopped early for benefit

GRADE CRITERIA for rating a body of evidence (See Appendix A for more info)

Lower Quality Rating if:
- Studies inconsistent (When there are differences in the direction of the effect, populations, interventions or outcomes between studies)
- Studies are indirect (Your PICO question is quite different from the available evidence in regard to population, intervention, comparison, or outcome)
- Studies are imprecise (When studies include few patients and few events and thus have wide confidence intervals and the results are uncertain)
<table>
<thead>
<tr>
<th>Study</th>
<th>Objective</th>
<th>Study Design</th>
<th>Population</th>
<th>Results</th>
<th>Limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arya et al., 2013, Academic Emergency Medicine</td>
<td>To determine the effect of implementing a split Emergency Severity Index (ESI) 3 flow model on patient LOS for discharged patients in the ED</td>
<td>Retrospective chart review (quality improvement case –control)</td>
<td>40,868 patients seen in a single urban academic medical center ED</td>
<td>There was a 5.9% decrease in LOS for all patients (95% CI -7.2 to -4.5; p&lt;0.0001) despite an ED volume increase of 3.4%</td>
<td>None</td>
</tr>
</tbody>
</table>

Study Limitations:
- Non-Experimental/Observational Studies (case-control, cohort, cross sectional, longitudinal, descriptive, epidemiologic, case study/series, survey)
- Insufficient sample size
- Sample not representative of patients in the population as a whole
- Variables (confounders, exposures, predictors) were not described
- Outcome criteria not objective or were not applied in blind fashion
- Insufficient follow-up, if applicable
- For prognostic study, sample not defined at common point in course of disease/condition
- For diagnostic study, gold standard not applied to all patients
- For diagnostic study, no
| Bish et al., 2016, Journal of Emergency Nursing | To evaluate the use of a split flow through process in the ED in order to improve patient throughput | Retrospective data analysis (quality improvement) | Patients treated at an adult ED in NJ following implementation of a split flow process | Median arrival-to-departure time has been reduced by 42%, from (112 min vs 192 min) 
Door-to-diagnostic evaluation time has gone down by 58%, (30 min vs 72 min) 
Patient satisfaction scores regarding physicians, nurses, and the overall emergency department are now up in the 90s compared with the 60s to 80s before split flow 
Volume has increase 10% during same time period | Study Limitations = None | Non-Experimental/Observational Studies (case-control, cohort, cross sectional, longitudinal, descriptive, epidemiologic, case study/series, survey) |
| | | | | | | Insufficient sample size |
| | | | | | Sample not representative of patients in the population as a whole |
| | | | | | Variables (confounders, exposures, predictors) were not described |
| | | | | | Outcome criteria not objective or were not applied in blind fashion |
| | | | | | Insufficient follow-up, if applicable |
| | | | | | For prognostic study, sample not defined at common point in course of disease/condition |
| | | | | | For diagnostic study, gold standard not applied to all patients |
| | | | | | For diagnostic study, no independent, blind comparison between index test and gold standard |
| | | | | | Quality Improvement (pre-post, controlled pre-post, historical comparison, time series) |

- Use of a split flow through process in the ED
- ESI criteria to identify patient area as follows:
  - ESI 1/2 – main ED for conventional process
  - ESI 3 – joint evaluation treatment (JET) area
  - ESI 4/5 – rapid care unit
- Patient flow model See Appendix C

- For Patient flow model See Appendix B

| | PA, 2 nurses, 1 scribe, 1 medical tech | the following visits:
  - headache/migraine (%diff = –17.8; p < 0.0001)
  - abdominal pain (%diff = –12.9%; p < 0.0001)
  - skin infection (%diff = –9.0%, p = 0.022)
  - sprains (%diff = –10.8%; p < 0.0001)
  - superficial injury (%diff = –8.7%, p = 0.0004) | independent, blind comparison between index test and gold standard

Quality Improvement (pre-post, controlled pre-post, historical comparison, time series)

- Intervention not evidence-based
- Improvement method was not clearly identified or the need for improvement was not described
- Stakeholders, organizational culture, patients, or interventions were not clearly described or appropriate
- Interventions were not described in enough detail to be replicated by others
- Baseline and outcome data were not collected and reported appropriately or in the same manner
- Data collection tools were not validated to measure intended outcomes
- Any modifications made to the intervention were not based on pilot studies

- For diagnostic study, gold standard not applied to all patients
  - Quality Improvement (pre-post, controlled pre-post, historical comparison, time series)
| Joseph et al., 2013, Annals of Emergency Medicine | To investigate the efficiency of a Split-Flow model in the care of ED patients with different acuity levels | Retrospective data analysis | 162,901 patients presenting to an ED from 2009-2012  
3 Phases:  
-Phase 1: pre-Split Flow  
-Phase 2: transitional period  
-Phase 3: Split Flow initiated  
Emergency Severity Index (ESI) used as triage system | The average door to bed time was 94.2 min in Phase 1, 86.2 min in Phase 2, and 52.1 min in Phase 3 (p=0.0003)  
The results of an autoregressive integrated moving average model revealed that use of a Split-Flow model affects the average door to bed time significantly (z=2.19, p=0.029, 95% CI 4.49-82.39) | Study Limitations =  
- None  
- Non-Experimental/Observational Studies (case-control, cohort, cross sectional, longitudinal, descriptive, epidemiologic, case study/series, survey)  
- Insufficient sample size  
- Sample not representative of patients in the population as a whole  
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| Pierce et al., 2016, Journal of Emergency Nursing | To evaluate the effect of a split flow model of care delivery and a provider in triage (PIT) model on ED length of stay | Prospective observational (quality improvement, case-control) | 68,603 patients treated and discharged during 2014 in 2 EDs in Ohio  
Compared two EDs of similar size, | Split flow resulted in a 9% improvement in discharge LOS (157.5 min vs 173.8 min, difference 16.3 min)  
Split flow + PIT resulted in a 16.4% improvement in discharge LOS (145.3 min | Study Limitations =  
- None  
- Non-Experimental/Observational Studies (case-control, cohort, cross sectional, longitudinal, descriptive, epidemiologic, case study/series, survey)  
- Insufficient sample size |
To assess whether a discharge facilitator team (DFT) can reduce the length of stay for all patients presenting with low-acuity complaints

| Sharma et al., 2013, Journal of Urban Health | To assess whether a discharge facilitator team (DFT) can reduce the length of stay for all patients presenting with low-acuity complaints | Retrospective review (pre-post intervention) | 9245 adult patients treated at an urban, academic ED in NYC before and after implementation of a DFT model -Pre: n=4472 -Post: n=4773 -DFT: included attending physician, PA, RN and focused on rapidly treating | DFT average LOS was 1h 18 min shorter than other low-acuity patients seen outside DFT hours (95% CI 1h 11min – 1h 27min) | Study Limitations = None | Non-Experimental/Observational Studies (case-control, cohort, cross sectional, longitudinal, descriptive, epidemiologic, case study/series, survey) | Insufficient sample size | Sample not representative of patients in the population as a whole | Variables (confounders, exposures, predictors) were not described | Outcome criteria not objective or were not applied in blind fashion | Insufficient follow-up, if applicable | For diagnostic study, sample not defined at common point in course of disease/condition | For diagnostic study, gold standard not applied to all patients | For diagnostic study, no independent, blind comparison between index test and gold standard | Quality Improvement (pre-post, controlled pre-post, historical comparison, time series) | Intervention not evidence-based | Improvement method was not clearly identified or the need for improvement was not described | Stakeholders, organizational culture, patients, or interventions were not clearly described or appropriate | Interventions were not described in enough detail to be replicated by others | Baseline and outcome data were not collected and reported appropriately or in the same manner | Data collection tools were not validated to measure intended outcomes | Any modifications made to the intervention were not based on pilot studies |
| White et al., 2014, *The Western Journal of Emergency Medicine* | To utilize Lean-based systems to reorganize non-emergent patient flow in the ED through a “Fast Track” area to optimize resources | Prospective observational (pre-post) | All patients seen through an adult ED before and after optimization of a “Fast Track” area for non-emergent cases. Optimization included: re-organization of room use & patient flow to decrease time to MD exam & non-value added time. -Pre: n=11,185 -Post: n=11,168 Included “wash-out” period of 6 months between -Medium acuity patient area (START) served as a control area as it remained the same pre/post | **Median LOS among discharged patients was reduced by 15 minutes** (143 vs 158 min, 95% CI 12-19 min, p<0.0001) -# patients discharged in < 1hr increased by 2.8% (9.7% vs 6.9%, 95% CI 2.1-3.5%, p<0.0001) -Median exam room time decreased by 34 minutes (56 vs 90 min, 95% CI 31-38 min, p<0.0001) -Control area (START) had no change in LOS or proportion of patients discharged in <1hr and an increase in exam room time during the same time period | **Study Limitations** = None
- **Non-Experimental/Observational Studies** (case-control, cohort, cross sectional, longitudinal, descriptive, epidemiologic, case study/series, survey)
- Insufficient sample size
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- Data collection tools were not
Wiler et al., 2016, *Joint Commission Journal on Quality and Patient Safety*

| To evaluate the implementation of a front-end split flow model to improve patient throughput in the ED | Retrospective observational (pre-post) | 44,750 patients seen in an urban academic ED pre-post implementation  
- Pre: n=17,307  
- Post: n=27,443  
- 1 year audit  
- Included a 6 month "wash-out" period  
- Included physician intake model, 16-bed clinic decision unit, expanded POC testing, dedicated ED transport services | A reduction was seen in the following:  
- Overall LOS for all walk-ins (220 min pre vs 175 min post and 140 min 1 yr)  
- Discharged (216 min pre vs. 170 min post and 140 min 1 yr)  
- Inpatient admissions (249 min pre vs. 217 min post and 181 min 1 yr)  
- Door-to-physician time (54 min pre vs. 15 min post and 12 min 1 yr)  
- Left without being seen rates (5.5% pre vs. 0.5% post and 0.0% 1 yr)  

The average total relative value unit (RVU) per patient discharged from intake was 2.31  

No significant increases in reported safety events were identified (10 vs. 9 per 1,000 patient encounters) | Study Limitations =  
- None  

Non-Experimental/Observational Studies (case-control, cohort, cross sectional, longitudinal, descriptive, epidemiologic, case study/series, survey)  
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**REFERENCES**


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**Appendix A: GRADE criteria for rating a body of evidence on an intervention**

Developed by the GRADE Working Group

**Grades and interpretations:**

- **High:** Further research is very unlikely to change our confidence in the estimate of effect.
- **Moderate:** Further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate.
- **Low:** Further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate.
- **Very low:** Any estimate of effect is very uncertain.

**Type of evidence and starting level**

- Randomized trial—high
- Observational study—low
- Any other evidence—very low

**Criteria for increasing or decreasing level**

**Reductions**
- Study quality has serious (−1) or very serious (−2) problems
- Important inconsistency in evidence (−1)
- Directness is somewhat (−1) or seriously (−2) uncertain
- Sparse or imprecise data (−1)
- Reporting bias highly probable (−1)

**Increases**
- Evidence of association† strong (+1) or very strong (+2)
- Dose-response gradient evident (+1)
- All plausible confounders would reduce the effect (+1)

†Strong association defined as significant relative risk (factor of 2) based on consistent evidence from two or more studies with no plausible confounders. Very strong association defined as significant relative risk (factor of 5) based on direct evidence with no threats to validity.
Appendix B: Patient Flow Model (Arya et al., 2013)
Appendix C: Patient Flow Model (Bish et al., 2016)