Online Journal of Rural Nursing and Health Care, 25 (2)
https://doi.org/10.14574/ojrnhc.v25i2.790

RESEARCH ARTICLE OPEN ACCESS

Using START to Reduce ED-2: A Quality Improvement Initiative

Jolyn Sackmann, DNP, CNP, FNP-BC [1 *]
Dannica Callies, DNP, CNP, FNP-C, CNE [2]

[1] Family nurse practitioner, jolyn.sackmann@outlook.com,
[2] Clinical Assistant Professor, South Dakota State University ; Family Nurse Practitioner, dannica.callies@sdstate.edu

*Correspondence: Jolyn Sackmann

Received: January 15, 2025 Accepted: May 15, 2025 Published: December 19, 2025

Abstract

Purpose: Long emergency department (ED) length of stay (LOS) is associated with increased mortality, delay in care, longer inpatient (IP) stays, readmission risk, poor patient satisfaction, and opportunity for error. Within the ED LOS is a quality indicator measuring the time a provider determines a patient will be admitted to the time the patient leaves the ED for an IP unit, called ED-2. Prolonged ED-2 indicates impaired ED output. Despite previous interventions, the ED-2 at a rural Midwest hospital was about 63.5 minutes; the goal set forth by the Centers for Medicare and Medicaid is 35 minutes or less.

Sample: All patients over the age of 18 years presenting to the ED over a 3-month period were eligible.

Method: A literature review identified admission prediction and proactive IP bed allocation as evidence-supported interventions to reduce ED-2. The Sydney Triage to Admission Risk Tool (START) was selected to aid nurses in predicting patient admissions at the time of triage. Staff were educated on START and proactive bed allocation. When a patient scored 17 or greater using START, ED staff contacted the IP bed manager to begin the bed assignment process. The ED-2

was compared 3 months pre-post implementation. Additionally, staff perceptions and experiences surrounding the change were evaluated.

Findings: A 1-minute reduction in ED-2 postintervention was observed, however, the difference was not statistically significant. Survey results indicated perceived value in the intervention, but there were notable barriers impacting its success.

Conclusions: The lack of postintervention ED-2 reduction, accuracy of START, and staff perceptions differed from the findings of previous studies, however, staff indicated a desire to continue the process change with modifications.

Keywords: Emergency department, Length of Stay, Rural, Admission prediction, Admit decision to departure time, Sydney Triage to Admission Risk Tool

Using START to Reduce ED-2: A Quality Improvement Initiative

Emergency departments (ED) experience a phenomenon known as overcrowding when the demand for services exceeds the capacity of available resources (Savioli et al., 2022). While an ED is full of patients awaiting provider evaluation, diagnostic results, treatment, transfer, or hospitalization, additional patients arriving seeking care cannot receive such care until the current patients are discharged to their appropriate disposition. The backlogging of patients worsens the situation, as resources become further stretched.

Three phases comprise the flow of the ED patient experience: input, throughput, and output (Savioli et al., 2022). Input factors include the intake of patients as they arrive and their acuity. Emergency departments have no control over when patients will arrive or how ill they are when they present; therefore, interventions for process improvement are aimed at throughput and output. Emergency department bed availability, turnaround time for services such as laboratory, radiology, and other diagnostics, staffing, and boarding affect throughput. Output is the flow of patients out of the ED and where they are discharged to- either home, to another facility, to the operating room, or to an inpatient unit. When a patient is destined for an inpatient unit, their timely movement from the ED to the inpatient bed depends upon inpatient bed availability, inpatient unit staffing, hospital occupancy, efficiency of transferring care and discharging patients, and the level of care the patient requires. The time it takes a patient to navigate input, throughput, and output comprises the emergency department length of stay (ED LOS). The ED LOS is important because not only is it a measure monitored by the Centers for Medicare and Medicaid Services (CMS), but as a patient's ED LOS increases, their risk of experiencing adverse events also increases (CMS, n.d.). Such adverse events include decreased accessibility to healthcare, poor quality of care, and elevated risk of lengthened inpatient stays, readmission, and opportunity for error. Inpatient mortality, 30-day mortality, and chances of a lengthened hospital stay also drastically increase, and each has been found to directly correlate with longer ED LOS (Jones et al., 2022; Kim & Lee, 2022).

Within the ED LOS lies a quality indicator outlined by CMS, the median admit decision time to ED departure time for admitted patients, termed ED-2 (CMS, 2023). This measure starts with the time the ED provider documents acceptance from an admitting physician, places an order for inpatient admission or documents an inpatient bed request, and ends with the time the patient exits the ED in route to the inpatient unit (CMS, 2023). Longer ED-2 times add to the overall ED LOS and signify ED boarding and dysfunction of ED patient outflow (CMS, 2023). Savioli et al. (2022) note impaired ED outflow of admitted patients is not a problem localized to the ED but indicates system-wide process inefficiency.

Purpose

The project site of this quality improvement initiative had been plagued with longer than desired ED-2 times despite multiple interventions. The average ED-2 between May 2023, when the director began recording this measure, and December 2023 was 63.5 minutes, but the goal determined by CMS is 35 minutes or less (M. Everson, personal communication, February 1, 2024). Previous attempts to improve outflow from the ED to the inpatient units included creating a resource nurse position to coordinate bed management, adopting the use of Voalte, a system-wide communication platform, and attempting bedside report (M. Everson, personal communication, February 1, 2024). Despite these interventions, the ED-2 remained above goal.

Available Knowledge

To identify evidence-based ED LOS reduction strategies, a population, intervention, comparison, outcome, and time (PICOT) question was developed: In patients being evaluated in the emergency department (P), how does early identification of potential admission using the Sydney Triage to Admission Risk Tool (START) (I) compared with no early admission prediction (C) affect the median admit decision time to time of departure (O) over the course of 3 months (T)? After applying inclusion and exclusion criteria and evaluating article quality using the Johns Hopkins Nursing Evidence-Based Practice model, this question generated 20 high quality articles (Dang et al., 2022). Evidence-supported interventions to decrease ED LOS were aimed at output solutions to decrease crowding and included early IP bed allocation by predicting patients that would potentially require admission. Moreover, tools to predict admission were shown to be valuable aids and many demonstrated reasonable accuracy.

Identifying potential admissions near the time of patient presentation to the ED resulted in significant decreases in ED LOS (Morley et al., 2018; Shamsi & Mahmoudi, 2015; Yazdanyar et al., 2022). Admission prediction tools aided in identifying potential admits with accuracy ranging between 81% and 83% (Noel et al., 2019; Parker et al., 2019; Zahid et al., 2023). Three studies compared the predictive capabilities of admission risk tools against nursing judgement. The results were varied but indicated nursing judgement combined with admission tools demonstrated better accuracy than either alone (Alexander et al., 2016; Cameron et al., 2017; Salvato et al., 2020). START was the only validated admission risk tool. An additional benefit of this tool is its use of data easily obtained during the ED triage process to generate a score, whereas most other tools use

computer generated algorithms to predict admission which require integration with the electronic health record.

Besides admission prediction and early bed requesting, some articles offered general considerations that demonstrated relevance in successful ED LOS process changes. Maninchedda et al. (2023) advised every ED is unique, and interventions must be individualized. Another factor in successful performance improvement projects in the ED was hospital-wide support, communication, and interdepartmental respect (Chang et al., 2018).

Despite the evidence discovered within the literature review, a variety of gaps became apparent. No articles were found that observed ED LOS interventions in rural settings. Also, several of the articles originated from countries outside of the United States, therefore, variability in geographic region and differences in healthcare delivery needed to be weighed when considering the translatability of evidence. A final gap noted was although articles described the creation and effectiveness of admission risk tools with the goal of improving ED outflow, few analyzed or provided objective data as to whether or not admission prediction tools truly achieved improved outflow.

Rationale

Havelock's theory of planned change (White et al., 2021), the Iowa model (Melnyk & Fineout-Overholt, 2019), and Haines and Jones's translation model (White et al., 2021) guided the quality improvement initiative.

Specific Aims

The goal of this initiative was to develop, implement, and evaluate the outcomes of an evidence-based intervention with a reduction in ED-2 as the desired outcome. The literature review supports early bed allocation and the use of predictive admission tools to identify potential admissions and reduce ED-2.

Methods

Context

This initiative took place in the rural Midwest at a private, 81-bed hospital with a 12-bed ED. In fiscal year 2023, the ED saw 13,193 patients, 12.6% of whom were admitted, and 1.8% were transferred to another facility (M. Everson, personal communication, February 19, 2024). For this project, rural was defined as any setting not contained within an urban area of 50,000 people or more (Health Resources & Services Administration, n.d.). Rural hospitals face unique challenges in quality improvement due to such factors as limited information technology capabilities, lack of resources for performance improvement, and fewer staff, especially those specializing in process improvement (Rural Health Information Hub, 2024). Each of these challenges played significant roles in intervention selection and implementation of this project.

Patients enter the ED either privately by presenting to the registration desk or by ambulance. Patients arriving by ambulance are taken directly to an exam room. When arriving

privately, a nurse triages the patient, determining if the patient is stable enough to wait in the waiting room or if they need immediate evaluation. Once a patient is roomed, they are assessed by a nurse and either a physician or advanced practice provider. Necessary diagnostics are done if needed, and the patient remains in the ED awaiting results and a final diagnosis.

When patients are admitted, the process begins with the ED provider calling the admitting provider- either a hospitalist or other specialty provider. The admitting provider determines if the patient will benefit from admission or if an alternative plan of care is needed. Once the admitting provider accepts care of the patient, the ED provider places the admission order. Then, a nurse or patient care technician notifies the house supervisor via phone call or text message. The house supervisor relays a room and nurse assignment back to ED staff, and the ED nurse caring for the patient calls report to the assigned inpatient nurse. Once nurse to nurse report is complete, the patient is transported to the inpatient unit either by a nurse, patient care technician, or other qualified staff.

Sample

During the project period, all patients aged 18 years and older presenting to the ED by any method over a 3-month timeframe were included. Patients under the age of 18 were not included, because START was primarily studied in patients over 16 years. Also, the admission process at the project site differs for patients under age 18. Direct admits are not included in the CMS ED-2 measure and therefore were not included in the sample (CMS, 2023). Patients transferred from the ED to the operating room (OR) were excluded because factors affecting movement of patients from the ED to the OR fall outside of the scope of this project.

Interventions

Sydney Triage to Admission Risk Tool

Dinh et al. (2016) developed an admission prediction tool through an analysis of 23 hospitals and 1,721,294 patients in New South Wales, Australia. Patients were assigned a score using the tool, and the higher the score, the greater the likelihood of admission (Dinh et al., 2016). To calculate the score, points were added or subtracted based on patient age, arrival by ambulance, triage level, admission within the last 30 days, time of day the patient arrived, and which body system their chief complaint related to. Patients scoring 17 or greater were likely to be admitted (Ebker-White et al., 2019).

This tool was selected for the intervention due to its ease of use, cost effectiveness, and validation. Of the numerous admission prediction tools developed, most use data that require programs capable of machine learning to calculate complex algorithms. Not only do these programs require an electronic health record (EHR) that interfaces with the machine learning program, but purchase of the program presents an added cost. START uses information obtained during triage without accessing the EHR, takes seconds to complete, and was the only prediction

tool found to have undergone validation. Permission to use the tool was granted under the Creative Commons Attribution 4.0 International License.

Study of the Interventions

Staff Education

The staff most affected by the proposed process change were the ED nurses, IP bed managers, and the ED and IP unit directors. An educational PowerPoint was presented to the ED nurses and IP bed managers during one of their respective monthly meetings. A recorded version of the presentation was distributed by email to employees unable to attend their respective meeting. From the day live education was provided, 1 week was allotted for staff to view the recorded presentation.

Early Bed Allocation Based on START

At or near the time of triage, a START score was to be calculated for every patient meeting inclusion criteria that presented to the ED. A score of 17 or greater triggered the IP bed assignment cascade. Emergency department staff contacted the IP bed coordinator notifying them of a patient score indicating high likelihood of admission. In turn, the IP bed coordinator provided a room and nurse assignment. Once the ED provider gave the official order to admit, ED staff notified the bed manager and IP nurse confirming the admission. Once nursing report was given, the patient was transported to the IP unit.

Circumstances outside of accurate admission prediction required consideration. Because the admission tool carried an accuracy of roughly 80%, about 2 in 10 early bed assignments would be discharged. Additionally, there was potential that patients predicted to be admitted would instead require transfer to another facility offering a higher level of care. In either case, although the IP unit prepared for an admission and the plan changed, that plan could remain in place for the next admission. Another challenge was predicting which unit would be most appropriate for a patient. With three IP units, ED nurses and house supervisors used clinical judgement to predict the most appropriate unit. If the disposition unit was unclear, a bed in each unit could be allocated. A final scenario to evaluate was when an on-call IP nurse needed to be called in to take an admission. When on-call, nurses stay home until the house supervisor contacts them if they are needed. It was not financially responsible or productive to have the on-call nurse come in based on a prediction. Waiting to call in a nurse until an admission order was the accepted process and was not changed with project implementation.

Staff Perceptions

Staff perceptions related to the process change played a pivotal role in the sustainability of this project. At the conclusion of the implementation period, an electronic survey was administered via email to the ED nurses and IP bed managers. The survey assessed ease of use, staff attitudes towards the process change, perceived impact on patient care and interdepartmental relationships,

and desire to continue the new process. These questions were rated on a Likert scale. In addition, open-ended questions provided an opportunity to express obstacles or recommend modification to the process.

Measures

Intervention data was collected for 3 months. Emergency department nurses were instructed to complete a paper copy of START for each patient meeting inclusion criteria that presented to the ED during the project period. In addition, nurses indicated on the form if the patient was admitted, discharged, transferred, or went to the OR. A receptacle was placed in the ED for collection of the completed forms. There was no identifying patient data on the forms, therefore patient privacy was maintained. Paper forms with the START score and patient disposition provided an opportunity to analyze the tool's accuracy. Obtaining the completed forms also allowed for assessment of compliance.

Analysis

Analysis involved evaluating the impact of START and early bed allocation on ED-2, the accuracy of START, and staff perceptions pertaining to the process change. A statistician was consulted for the analysis. The impact of START and early bed allocation on ED-2 was evaluated by comparing the mean ED-2 of the 3 months pre-intervention to the 3 months post-intervention. Normal distribution could not be confirmed because the ED-2 times of individual patients were not available to plot. The nonparametric Mann-Whitney U test was selected to analyze the difference in means between 2 independent groups. To calculate the accuracy of START, the information from each scorecard was logged to determine the positive predictive value (PPV), negative predictive value (NPV), specificity, sensitivity, and accuracy. Finally, staff perceptions regarding the intervention were analyzed from the post-intervention survey.

Ethical Considerations

The University Institutional Review Board (IRB) determined this project does not constitute human subjects research. No participant information or protected patient health information were collected.

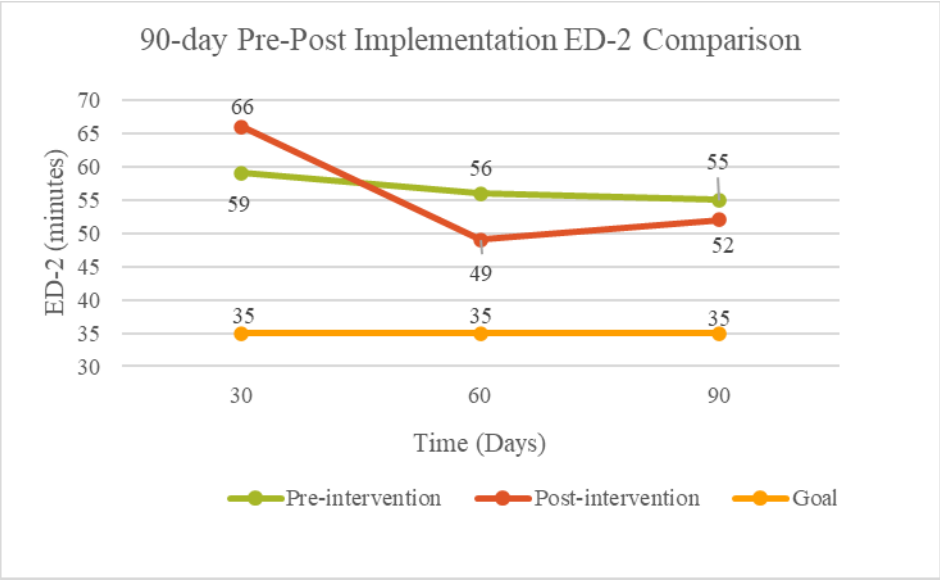
Findings

ED-2

The mean ED-2 preintervention was 56.7 minutes, and the mean ED-2 postintervention was 55.7 minutes indicating a change of 1 minute ($p = .700$). Despite the 1-minute improvement, the ED-2 goal of 35 minutes remained unmet (see Figure 1).

Figure 1

Pre-Post ED-2 Comparison



START Accuracy

Staff completed START scores for 1,055 patients. The total number of patients during the implementation period was 3,427. Accounting for 15% of ED visits being pediatrics, about 2,913 of the total visits were eligible for a START score. Scorecards that were incomplete accounted for some of the missing data, as these were excluded. The compliance rate for completed START scorecards was about 36%.

Addressing the accuracy of START, scores of 17 or greater that resulted in admission were true positives, scores of 17 or greater that did not result in admission were false positives, scores of 16 and less that were discharged were true negatives, and scores of 16 or greater that were admitted were false negatives. Patients scoring 17 or greater and predicted to be admitted totaled 449. Of those, 207 were actually admitted. Based on these findings, START demonstrated a positive predictive value (PPV) of 40%, negative predictive value (NPV) of 95%, accuracy of 71%, specificity of 68%, and sensitivity of 85%.

Staff Perceptions

Of 31 staff surveyed, 10 responses were collected. Common themes extracted from qualitative responses included challenges with ED and IP staff continuing the preintervention process of waiting to request or provide a bed assignment until an admission order was in place, calculating a START score and requesting a bed felt like a chore, START was forgotten during high volume periods, anticipating which unit a patient may be admitted to was challenging, and the accuracy of START was questioned. Two responses addressed integrating START into the EHR for automatic calculation, and two responses identified additional education for bed managers and IP staff may have improved the process. The final survey question prompted

comments for observations not addressed with the previous questions, to which two respondents provided answers. One staff member found the intervention interesting, but noted many patients scored over 17 but were discharged. Both responses reflected a sentiment that bed manager and IP staff adherence to the process was a barrier.

Discussion

Summary

This quality improvement initiative stemmed from an identified problem of an above goal ED-2 at the project site despite previous interventions. The ED-2 is an indicator of the efficiency of a hospital system to transfer admitted patients from the ED to the appropriate IP unit. Lengthy ED-2 times are associated with longer overall ED LOS and an increased risk of poor quality of care, lengthened inpatient stays, readmission, opportunity for error, and worsened mortality (CMS, n.d.; Jones et al., 2022; Kim & Lee, 2022).

Changing from reactive to proactive bed allocation, the ED-2 reduction of 30% to 48% observed by Lee et al. (2021) and Huang et al. (2018) was not observed within the project setting and sample. Regarding accuracy, some measures of START from the project sample were similar to those of Ebker-White et al. (2018), while some were stronger or weaker. The accuracy and specificity of this project and that of Ebker-White et al. (2018) were similar, 71% and 70.2% and 68% and 65%, respectively. The sensitivity of the project START was 85%, compared to that of 78.5% by Ebker-White et al. (2018), and the NPV was higher for the project data, 95% compared to 84.2%. However, the PPV of START for the project sample was markedly lower than Ebker-White et al. (2018) at 40% compared to 56.5%.

Assessing staff perceptions after using an admission prediction tool, Jessup et al. (2016) reported participants perceived improvement in the admission process and ED and IP staff teamwork. Participants also valued and desired continuation of the predictive tool (Jessup et al., 2016). In contrast, staff responses from this initiative indicated neither the admission process nor the relationship between the ED and house supervisors improved. Desire to continue using the prediction tool was mixed, but most staff that completed the survey value continuation of admission prediction and early bed requesting.

The strengths of this project were its design, the intervention being low cost and individualized to the site, and its contribution to rural healthcare. The design was based on a rigorous literature search that supported the likelihood of the intervention having the desired outcome. In addition, the intervention was tailored to the unique needs and processes of the participating healthcare system. Although the desired reduction of ED-2 was not achieved, the results of this initiative add to the scarce body of literature pertaining to rural healthcare, particularly managing ED crowding in rural settings. No financial losses were incurred, patients were not negatively impacted, and the results provide valuable considerations for future interventions to reduce ED-2.

Limitations

The primary limitation was resistance from both ED staff and bed managers. The number of START scorecards collected reflected about 36% of the total ED visits during the project period. Survey comments echoed this underrepresentation, stating staff forgot to calculate scores, especially during busy times, or the intervention was disliked because it felt like another task added to their workload. Staff also reported the low PPV affected the scorecard completion rate, verbalizing frustration with frequently requesting a bed for patients that were instead discharged. Staff buy-in was not only an issue in the ED, but also on the part of bed managers. Emergency department nurses voiced frustrations that when the process was followed and they requested a bed assignment based on START, some bed managers continued to follow the pre-intervention process. Suboptimal process adherence brings into question the reliability of the pre-post ED-2 analysis. Ensuring affected staff received initial process change education also proved difficult. During the first few weeks of implementation, some staff remained unaware of the process change. One survey comment stated an initial training would have been beneficial, even though training was provided in live and recorded formats.

Interpretation

Admission prediction using START and proactive bed allocation did not result in a significant reduction in ED-2. However, the validity of these results is questionable due to marginal process adherence. The survey revealed that value was seen in admission prediction and early bed allocation, but comments indicated modifications may be necessary. Suggestions included additional education, reinforcement, and unification between the ED and bed managers. Although the accuracy of START was similar to the results of another study, overprediction of admissions and frequently requesting a bed for patients that were eventually discharged impacted staff's confidence in the tool.

Conclusion

Much of the value of this initiative lies in its barriers and limitations. The obstacles experienced underpin the importance of communication, gaining staff support, managing resistance, and the importance of possessing a foundation in evidence translation, evidence-based practice models, and change theory. The theories and models that guided this project account for interpretation of the results followed by reassessment and adaptation of the previous steps when the desired effect was not achieved.

Staff finding value in admission prediction and early bed allocation sheds light on the future of this process change. Although use of the START tool has been discontinued, the ED director anticipates continuation of the process with modification. A tool with a better PPV that interfaces with the EHR and calculates automatically could be a better alternative to START. Also of interest would be the accuracy of admission prediction based on nursing judgement in conjunction with the use of a tool, as Cameron et al. (2017) suggest. Ultimately, adjusting the

intervention and additional data collection are needed to determine if admission prediction and early bed allocation result in ED-2 reduction.

Conflict of Interest
The authors declared no conflict of interest, financial or otherwise.

Acknowledgements
None declared.

Funding
None declared.

References

Alexander, D., Abbott, L., Zhou, Q., & Staff, I. (2016). Can triage nurses accurately predict patient dispositions in the emergency department? *Journal of Emergency Nursing, 42*(6), 513-518. https://doi.org/10.1016/j.jen.2016.05.008

Cameron, A., Ireland, A. J., McKay, G. A., Stark, A., Lowe, D. J. (2017). Predicting admission at triage: Are nurses better than a simple objective score? *Emergency Medicine Journal, 34*(1), 2-7. https://doi.org/10.1136/emermed-2014-204455

Centers for Medicare & Medicaid Services. (n.d.). *Timely and effective care*. U.S. Centers for Medicare & Medicaid Services. https://data.cms.gov/provider-data/topics/hospitals/timely-effective-care#emergency-department-care

Centers for Medicare & Medicaid Services. (2023). *Median admit decision time to ED departure time for admitted patients*. ECQI Resource Center. https://ecqi.healthit.gov/ecqm/eh/2023/cms0111v11

Chang, A. M., Cohen, D. J., Lin, A., Augustine, J., Handel, D. A., Howell, E., Kim, H., Pines, J. M., Schuur, J. D., McConnell, K. J., & Sun, B. C. (2018). Hospital strategies for reducing emergency department crowding: A mixed-methods study. *Annals of Emergency Medicine*, *71*(4), 497-505.e4. https://doi.org/10.1016/j.annemergmed.2017.07.022

Dang, D., Dearholt, S., Bissett, K., Ascenzi, J., & Whalen, M. (2022). *Johns Hopkins evidence-based practice for nurses and healthcare professionals: Model and guidelines* (4th ed.) Sigma Theta Tau International. https://search.worldcat.org/title/1261367148

Dinh, M. M., Russell, S. B., Bein, K. J., Rogers, K., Muscatello, D., Paoloni, R., Hayman, J., Chalkley, D. R., & Ivers, R. (2016). The Sydney Triage to Admission Risk Tool (START)

to predict emergency department disposition: A derivation and internal validation study using retrospective state-wide data from New South Wales, Australia. *BMC Emergency Medicine, 16*(46). https://doi.org/10.1186/s12873-016-0111-4

Ebker-White, A. A., Bein, K. J., & Berendsen Russell, S., & Dinh, M. M. (2018). The Sydney Triage to Admission Risk Tool (START): A prospective validation study. *Emergency Medicine Australasia, 30*(4), 511-516. https://doi.org/10.1111/1742-6723.12940

Ebker-White, A. A., Bein, K. J., Russell, S. B., & Dinh, M. M. (2019). The Sydney Triage to Admission Risk Tool (START) to improve patient flow in an emergency department: A model of care implementation pilot study. *BMC Emergency Medicine, 19*(1), 79. https://doi.org/10.1186/s12873-019-0290-x

Health Resources & Services Administration. (n.d.). *Defining rural population*. Accessed September 19, 2024, from https://www.hrsa.gov/rural-health/about-us/what-is-rural

Huang, D., Bastani, A., Anderson, W., Crabtree, J., Kleiman, S., & Jones, S. (2018). Communication and bed reservation: Decreasing the length of stay for emergency department trauma patients. *The American Journal of Emergency Medicine*, *36*(10), 1874–1879. https://doi.org/10.1016/j.ajem.2018.08.021

Jessup, M., Crilly, J., Boyle, J., Wallis, M., Lind, J., Green, D., & Fitzgerald, G. (2016). Users' experiences of an emergency department patient admission predictive tool: A qualitative evaluation. *Health Informatics Journal, 22*(3), 618-632. https://doi.org/10.1177/1460458215577993

Jones, S., Moulton, C., Swift, S., Molyneux, P., Black, S., Mason, N, Oakley, R., & Mann, C. (2022). Association between delays to patient admission from the emergency department and all-cause 30-day mortality. *Emergency Medicine Journal, 39*, 168-173. https://doi.org/10.1136/emermed-2021-211572

Kim, Y. E., & Lee, H. Y. (2022). The effects of an emergency department length-of-stay management system on severely ill patients' treatment outcomes. *BMC Emergency Medicine, 22*(204). https://doi.org/10.1186/s12873-022-00760-z

Lee, S.-Y., Chinnam, R. B., Dalkiran, E., Krupp, S., & Nauss, M. (2021). Proactive coordination of inpatient bed management to reduce emergency department patient boarding. *International Journal of Production Economics, 231.* Article 107842 https://doi.org/10.1016/j.ijpe.2020.107842

Maninchedda, M., Proia, A. S., Bianco, L., Aromatario, M., Orsi, G. B., & Napoli, C. (2023). Main features of control strategies to reduce overcrowding in emergency departments: A systematic review of the literature. *Risk Management and Healthcare Policy, 16,* 255-266. https://doi.org/10.2147/RMHP.S399045

Melnyk, B. M. & Fineout-Overholt, E. (2019). *Evidence-based practice in nursing and healthcare* (4th ed.). Wolters Kluwer.

Morley, C., Unwin, M., Peterson, G. M., Stankovich, J., & Kinsman, L. (2018). Emergency department crowding: A systematic review of causes, consequences and solutions. *PloS One, 13*(8), Article e0203316. https://doi.org/10.1371/journal.pone.0203316

Noel, G., Bonte, N., Persico, N., Bar, C., Luigi, S., Roch, A., Michelet, P., Gentile, S., & Viudesa, G. (2019). Real-time estimation of inpatient beds required in emergency departments. *European Journal of Emergency Medicine*, *26*(6), 440–445. https://doi.org/10.1097/MEJ.0000000000000600

Parker, C. A., Liu, N., Wu, S. X., Shen, Y., Lam, S. S. W., & Ong, M. E. H. (2019). Predicting hospital admission at the emergency department triage: A novel prediction model. *The American Journal of Emergency Medicine*, *37*(8), 1498–1504. https://doi.org/10.1016/j.ajem.2018.10.060

Rural Health Information Hub. (2024). *Rural healthcare quality*. Health Resources and Services Administration of the U.S. Department of Health and Human Services. https://www.ruralhealthinfo.org/topics/health-care-quality

Salvato, M., Solbiati, M., Bosco, P., Casazza, G., Binda, F., Iotti, M., Calegari, J., Laquintana, D., & Costantino, G. (2020). Prospective comparison of AMB, GAP and START scores and triage nurse clinical judgement for predicting admission from an ED: A single-centre prospective study. *Emergency Medicine Journal, 39*(12), 897-902. https://doi.org/10.1136/emermed-2020-210814

Savioli, G., Ceresa, I. F., Gri, N., Piccini, G. B., Longhitano, Y., Zanza, C., Piccioni, A., Esposito, C., Ricevuti, G., & Bressan, M. A. (2022). Emergency department overcrowding: Understanding the factors to find corresponding solutions. *Journal of Personalized Medicine, 12*(2), 279. https://doi.org/10.3390/jpm12020279

Shamsi, V. & Mahmoudi, H. (2015). The survey of ways of reducing patients' length of stay in the emergency department: A systematic review. *International Journal of Medical Reviews, 2*(2), 282-286. https://www.ijmedrev.com/article_68650_2f2046a217ff75cc08f4e7cf35257a8b.pdf

White, K. M., Dudley-Brown, S., & Terhaar, M. F. (Eds). (2021). *Translation of evidence into nursing and healthcare* (3rd Ed.). Springer Publishing Company, LLC.

Yazdanyar, A., Greenberg, M. R., [Megan], Chen, Z., Li, S., Greenberg, M. R. [Marna], Buonanno, A. P., Burmeister, D. B., & Jarjous, S. (2022). A customized early warning score enhanced emergency department patient flow process and clinical outcomes in a COVID-19 pandemic. *Journal of the American College of Emergency Physicians Open*, *3*(4). https://doi.org/10.1002/emp2.12783

Zahid, M., Khan, A. A., Ata, F., Yousaf, Z., Naushad, V. A., Purayil, N. K., Chandra, P., Singh, R., Kartha, A. B., Elzouki, A. Y. A., Al Mohanadi, D. H., & Al-Mohammed, A. A. (2023). Medical Admission Prediction Score (MAPS); A simple tool to predict medical admissions in the emergency department. *PloS One*, *18*(11), Article e0293140. https://doi.org/10.1371/journal.pone.0293140