Implementation and Evaluation of the Ottawa Ankle Rules in Pediatric Orthopedic Triage

by

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Abstract

Problem & Purpose: Overcrowding of emergency departments (EDs) is a national healthcare crisis, which include pediatric EDs (PEDs). During overcrowding, the length of stay (LOS) for patients with low acuity distal orthopedic complaints is longer than all other complaints combined at this site. This PED has no interventions to expedite care during high patient volume scenarios. This project implemented and evaluated the Ottawa Ankle Rules (OARs) in a PED. The OARs is a clinical decision tool to aid clinicians in determining if a patient requires radiography for ankle or foot injuries. Nurses implemented this tool in triage on patients to expedite diagnostic imaging prior to physician assessment to decrease LOS and door to diagnostic evaluation times.

Methods: Nurses implemented the OARs on all pediatric patients 5 years and older presenting to the PED with ankle or foot complaints. Data on median times for both total emergency department LOS and ankle or foot complaint patients as well as door to diagnostic evaluation were collected. The percentage of nurses compliant to the OARs and nurses' education completion percentage was also collected.

Results: There was 100% adherence of the nurses in implementing the intervention and 100% education completion by the sixth week of implementation. Median door to diagnostic evaluation time decreased to 29 minutes from 31 minutes pre- versus post-intervention. The total EDLOS did not change during the implementation of the intervention; however, when compared to the same months in the previous year, there was a 26.15-minute decrease in median total EDLOS. There was a 2-minute increase in EDLOS for ankle/foot patients.

Conclusions: Findings suggest implementing the OARs in PED triage can decrease EDLOS, and nurses are able to comply with the OARs in triage. Incorporation of the OARs into written PED

protocol was conducted for sustainability. Implications of these data suggested using the OARs in similar settings is feasible and may decrease EDLOS.

Introduction

Emergency departments (EDs) have been overused across the United States for decades leading to long wait times, which has contributed to ED overcrowding. Overcrowding occurs when the number of patients presenting to the ED outnumber available staff, space, and resources (Salway et al., 2017). ED overcrowding is a significant safety issue, Weissman et al. (2007) showed a 15% risk increase in medication errors when there was a 10% increase in ED crowding. There is a positive correlation between ED overcrowding and increasing ED length of stay (EDLOS); McCarthy et al., 2009). Using treatment guidelines and protocols in the ED has been shown to decrease during times of overcrowding (Gaieski et al., 2017). In addition, specific ED complaints are significantly affected as Wickman et al. (2017) found extremity pain or swelling experienced a 145% increase in EDLOS during overcrowding.

Maryland has had a significant problem with EDLOS as its median EDLOS has been over 190 minutes for the past 5 years compared to the national average of 141 minutes (Maryland Institute for Emergency Medical Services Systems [MIEMSS], 2017). This practice site experiences increased EDLOS and crowding. During certain overcrowding times, median EDLOS was 207 mins, and specifically the EDLOS for distal extremity complaints was 216.8 minutes, which was longer than all other complaints combined. Sorensen et al. (2012) found use of the Ottawa Ankle Rules (OARs) by the triage nurses can decrease EDLOS. According to Du et al. (2018), over 40 million school aged children and adolescents participate in organized sports every year, and rapid changes in bone development during this age group increases the likelihood of injury for these individuals. Ankle and foot injuries are one of the most common

injuries in children who play sports, and 5% of all fractures in this population involve the ankle (Du et al., 2018). The purpose of this DNP project is to implement and evaluate the OARs for patients with ankle or foot complaints in a pediatric ED triage. The anticipated outcome of this practice change is to see a practice change in processes where ED nurses can competently and appropriately triage patients using the OARs in pediatric orthopedic triage with nurse-led implementation of the OARs in triage as well as seeing a decrease in total EDLOS.

Literature Review

The level of evidence of studies were appraised using Melnyk (2011) hierarchy of evidence and the quality of evidence was appraised using Newhouse (2006) rating scale for quality of evidence. The level of evidence in the review ranged from II to V among the seven studies used to justify practice change. There were two single site randomized control trials included as level II evidence (Ho et al., 2018; Lee et al., 2016). A quasi-experimental study and a before-after study were comprised of the two level III studies included the in the evidence review (Abri et al., 2020; Sorensen et al., 2012). The last three studies reviewed consisted of two systematic reviews and one integrative review, categorizing these three as level V evidence (Ho et al., 2016; Robinson et al., 2013; Rowe et al., 2011; see Table 1). There was one study with a quality grade of C, or low quality, due to having many cofounding variables that were not accounted for and high risk of bias (Ho et al., 2016). The remaining six studies were graded as quality B, or good quality (see Table 2).

All seven studies included in the review of evidence used the intervention of triage nurse-initiated radiography, implemented in the ED to look at the outcome of EDLOS (Abri et al., 2020; Ho et al., 2018; Ho et al., 2016; Lee et al., 2016; Robinson et al., 2013; Rowe et al., 2011; Sorensen et al., 2012). There were five studies that specifically implemented the OARs by ED

triage nurses to initiate radiography (Abri et al., 2020; Ho et al., 2018; Ho et al., 2016; Lee et al., 2016; Sorensen et al., 2012). The other two studies implemented multiple standardized protocols with the vast majority being triage nurse-initiated radiography; however, neither study mentioned the use of the OARs (Robinson et al., 2013; Rowe et al., 2011). The age of the population studied included patients from 1 year and older in three studies (Ho et al., 2018; Ho et al., 2016; Rowe et al., 2011). The age of population studied from the remaining studies included patients 18 years and above. All of the studies showed a significant decrease in the median EDLOS after implementing the OARs or nurse-initiated radiography in triage, except for Sorensen et al. (2012), who found an increase in overall EDLOS, but a significant decrease in EDLOS for ankle/foot injuries.

Theoretical Framework

Lewin's change theory is used to aid changing the behavior of individuals, groups, and organizations (Burnes, 2004). There are three steps of change: unfreezing, changing, and refreezing. Within these steps there is a balance of driving forces enabling movement to the next stage and restraining forces that inhibit this move. Unfreezing is the first step, in which an organization must acknowledge that its current state or status quo is not beneficial or detrimental, and sufficient evidence must be presented for change to occur (Hussain et al., 2018). Changing is the next step, where individuals or groups collectively determine and acknowledge a change needs to take place, and effective solutions are found or developed to make the change (Hussain et al., 2018). Once driving forces (i.e., individuals, feasible solutions, and timing) outweigh restraining forces, the agreed upon solution will be implemented, and change will occur (Burnes, 2004). Refreezing is the third stage, and it is where the change has now become the status quo. In

this stage efforts are needed to prevent the organization from reverting to the previous state (Hussain et al., 2018).

Lewin's change theory can be leveraged for change at the practice site. Presenting evidence to administrators and other stakeholders that the EDLOS is longer than the national average, and that patients with distal extremity complaints have longer EDLOS compared to all other complaints at this site, can be a driving for to unfreeze organizational processes. Educating and displaying evidence to management that the use of nurse-initiated OARs in triage has shown to decrease EDLOS can be the driving force for the specific solution during the changing phase. Finally, if the solution has made a positive impact in the organization, producing a decrease in EDLOS, the use of the OARs in triage could be written into organizational policy. This integration into policy will give a sense of permanency of the new status quo and refreeze organizational processes (see Appendix J).

Methods

A quality improvement (QI) project was conducted from August 30, 2020, to December 10, 2020 in the PED of a designated Level 2 adult trauma center in Montgomery County, Maryland. The PED is separate from the adult ED and is a 6-bed department capable of treating patients less than 18 years old and historically has a monthly census of 400-600 patients. However, during the implementation of this project the coronavirus disease 2019 (COVID-19) pandemic had a significant impact on patient volumes, as it showed to drastically decrease the number of patients presenting to the hospital overall. This PED is staffed by one board certified pediatrician, two registered nurses (RNs), and one PED technician every 12-hour shift.

The OARs is a validated clinical decision tool for adults and children to aid in determining if a patient with an ankle or foot injury requires radiography (Plint et al., 1999; Stiell

et al., 1994). The OAR criteria states an ankle x-ray is only needed if there is pain in malleolar zone and at least one of the following: bony tenderness in at the posterior edge or tip of either medial or lateral malleolus, or if the patient was unable to bear weight directly after injury and unable to take four steps in the PED. The indication for a foot x-ray is if there is pain in the midfoot zone and any one of the following: bony tenderness at either the navicular or base of the fifth metatarsal, or inability to bear weight directly after injury and unable to take four steps in the PED (Stiell et al., 1994). All patients 5 years and older presenting to the PED with isolated ankle or foot complaints were eligible to be screened with the OARs regardless of race, sex, or primary language. Patients who were less than 5 years old or who had multiple injuries were excluded from an OARs screening. RNs implemented the OARs in triage for all eligible patients and sent them for x-ray based on OARs criteria prior to physician assessment. Patients not sent to x-ray received standard of care and waited for physician assessment before a decision to x-ray was made.

Implementation was tracked using process measures, the RNs' compliance on implementing the OARs in triage—defined as the number of patients presenting to triage who were screened with the OARs out of the total number of patients presenting to triage who were eligible to be screened with the OARs. Another process measure used was the median time of door to diagnostic evaluation—defined as the difference between patients' arrival to the PED to the start of x-ray initiation for patients with ankle or foot injuries who had radiography ordered.

The structure measure used to track implementation progress was completion of RN education—defined as the number of pediatric RNs who completed education out of the total number of pediatric RNs working on the unit. The education of RNs consisted of printed diagrams of the OARs with that included step-by-by instructions on the criteria for whom should

receive x-rays. All pediatric RNs were also shown a physical demonstration. The completion of each pediatric RN was validated if they were able verbally stated the OAR criteria and demonstrated the accurate physical assessment of the ankle and foot per the OARs. RNs were validated by the project leader, pediatric medical director, or unit champions. The outcomes of this project were total median EDLOS—defined as the time in minutes from patient arrival to the PED to patient discharge from the PED, and EDLOS for patients with ankle or foot complaints in their chief complaint was also measured.

The implementation strategies used for the structure measure of RNs' education completion were identifying and preparing champions, and making training dynamic. The champions were useful in creating awareness of the intervention and aiding in the accountability of RNs to attend education training. The dynamic nature of education training, which included educational handouts and demonstrations, provided better understanding of the OARs for the RNs (see Appendices A & B). Based on low education completion rates among RNs during the pre-implementation phase, an adjustment in tactics was made for RNs' education completion. The tactic of power sharing was added, as this allowed other RNs already trained on the OARs to train others. The implementation strategies used for the process measures of RNs' compliance of implementing the OARs in triage and door to diagnostic times and the outcome measures of both total EDLOS and EDLOS for patients with ankle or foot complaints included: conducting meetings, completing audits with feedback, one-to-one discussions, reminding clinicians, and providing data reports. An adjustment was made after data showed door to diagnostic times were not meeting goals and RNs' compliance to the OARs was not meeting the goal of 100%. The tactics of reminding clinicians by adding additional OAR reminder signs near physician workspaces (see Appendix C) and having the pediatric medical director reminding all pediatric

providers of the ongoing project through email were used. No adjustments to strategies for outcome measures were taken as these were meeting goals.

Documentation of all patients screened in triage with the OARs was completed by RNs on the Triage Documentation Form (see Appendix D). Data on EDLOS for patients with ankle or foot complaints and door to diagnostic evaluation was collected on the Triage Audit Form (see Appendix E). Total EDLOS data was collected through chart review. The data on RNs' adherence to the OARs was collected on the Staff Compliance Form (see Appendix F) and data on RNs' education completion was collected on the Education Completion Form (see Appendix G). Descriptive statistics were the main method used to analyze and understand variation in data. Median minutes were used to analyze EDLOS and door to diagnostic evaluation times. Percentages were used to analyze RNs' compliance to OARs and education completion. All data were converted into run charts for visual representation of the statistics (see Figures 2, 3, 4, 5, & 6). To protect participants, a separate file linking the pseudo-identifiers for triage documentation and triage audit was collected on the Triage Audit and Documentation Form Pseudo-Identifier Link (see Appendix H) and staff compliance collected in (see Appendix I) was kept in an internal password-protected computer only accessible by the DNP project leader at the practice site. All forms were kept in separate lock boxes at the RN's station, and files and forms were destroyed at the completion of the project.

Results

During the 15-week implementation of the OARs by pediatric triage RNs a change in structure was made as 100% of PED RNs were educated and evaluated on the use of the OARs (see Figure 6). Two changes in processes were made. First, was the compliance rate of PED RNs' on the use of the OARs during triage, which was defined as the percentage of RNs who

screened patient in triage using the OARs who were appropriate to screen out of all the patients who presented to the PEDs who were appropriate to be screened by the OARs. The compliance rate of PED RNs' use of the OARs reached 100% during the sixth week of implementation after one-on-one reeducation on the OARs and physician email reminder strategies were used (see Figure 5). The second process change made was door to diagnostic evaluation time, which was defined as the median minutes from patient arrival to the initiation of x-ray for patients presenting with ankle or foot complaints. The median door to diagnostic evaluation time decreased from 31minutes pre-implementation to 29minutes post-implementation. Also, according to the rule of runs, run chart analysis showed too many runs indicating the intervention may have caused the change (Perla et al., 2011). Furthermore, there was a sustained decrease under the target goal of 36 minutes during the sixth week of implementation, after a physician email reminder strategy was implemented (see Figure 4).

The observed associations among interventions, outcomes, and contextual elements were apparent because it could be seen that the strategies and tactics used such as one-on-one interactions with RNs and physician reminders on the use of the OARs in triage time-correlated with process outcomes of staff compliance and a decrease in median door to diagnostic evaluation times (see Figure 4 & 5). Moreover, contextually, because the triage location was physically located far from the PED unit, implementing the OARs in triage it was observed that treatment of ankle or foot complaint patients were expedited. Hence, during implementation of the OARs it was found the intervention may have decreased the median EDLOS for ankle or foot complaint patients after an analysis of run chart showed too many runs (see Figure 3). The analysis of total EDLOS did not show any nonrandom effects of the intervention during implementation (see Figure 2) as the number of runs were within the critical values of assessing

a 5% risk of failing the run test for random patterns of data (Perla et al., 2011). However, when the implementation dates September–December 2020 were compared to the same months in the previous year, there was a 26.15 minute decrease in median total EDLOS (see Figure 1).

There were some unintended consequences in the form of unexpected benefits such as PED RNs reporting an increase in work satisfaction and sense of autonomy. Patients and their parents also verbally reported an increase in satisfaction with the timeliness of their care. These benefits were collected as data because they were not incorporated into the data collection plan of this project. One unexpected problem that arose was the decrease in nursing staff available to implement the intervention that resulted from the ongoing COVID-19 pandemic, which decreased patient volume and hospital funds.

Discussion

The implementation of the OARs and initiation of radiography by triage RNs decreased total EDLOS by 26.15minutes when compared to the same implementation months of the previous year. The decrease in total EDLOS was consistent with studies by Abri et al. (2020), Ho et al. (2018), Lee et al. (2016), and Robinson (2013) who found a significant decrease in EDLOS with nurse-led radiography using the OARs criteria in triage. However, during the implementation phase there was no change in the total EDLOS, but did seem to decrease EDLOS for ankle or foot complaint patients according to run charts (see Figure 3). This was consistent with Sorenson et al. (2012) who found a 45-minute decrease pre- versus post-intervention of the OARs by triage RNs. The implementation of the OARs and initiation of radiography by RNs during this project also showed 100% compliance of the OARs by triage RNs, which was consistent with Lee et al. (2016) who found all patients meeting OAR criteria were screened and without missing any fractures. The door to initiation of x-ray during implementation of the

OARs by triage RNs found a median decreased from 31minutes pre-intervention to 29minutes post-intervention. There were no studies in the literature review that examined OARs use by triage RNs on door to initiation of x-ray. However, Ho et al. (2018) and Abri et al. (2020) found triage nurse-initiated radiography based on OAR criteria significantly decreased the number of x-rays ordered for ankle or foot patients, which decreased EDLOS.

The reason the total EDLOS during implementation did not change may have been due to this project being conducted during the global COVID-19 pandemic. This resulted in a significant decrease in patient volume. The application of the OARs by triage RNs was to expedite care during extended waiting time of patients during periods of overcrowding by receiving radiography while waiting to be seen by a provider. During the implementation period of the OARs in triage, there was limited overcrowding if any at all. Therefore, providers may have seen patients more quickly than during pre-pandemic times, which would possibly negate the full benefit of the OARs.

This project had limitations that needed to be considered. There was a limitation to the generalizability of the findings as this project was conducted at a single site PED with small 6-bed unit, which may not represent other stand-alone PEDs or larger mixed ED settings. The EDLOS meeting the national bench mark of less than 141 minutes could be credited to the significant decrease in patient volume due to the global COVID-19 pandemic. The comparison of the EDLOS during implementation and the same months of the previous year may not be a sound analysis of intervention effect. To limit this bias, a run chart for EDLOS during implementation was performed to present a complete picture with context. Finally, sample size was small so statistical calculations were limited to descriptive statistics and statistical narratives.

Conclusion

The implementation of the OARs and nurse-initiated radiography protocol by triage RNs showed a decrease in EDLOS for patients with ankle or foot complaint and total EDLOS when compared to similar seasons. Furthermore, all RNs completed OARs education and 100% of RNs were compliant with the OARs protocol after the sixth week of implementation. By decreasing the time patients with ankle or foot complaints wait to receive diagnostic imagining, their time in the ED was reduced. This leads to a decrease in EDLOS, which provides more efficient and quality care for patients overall and helps ameliorate throughput during times of overcrowding. This project created a practice change that included the use of the OARs with nurse-initiated radiography in triage, and it was decided to be used as a standard protocol at this practice site. Sustainability of this practice change was strengthened by incorporating the OARs protocol in triage by instituting it as a written PED protocol. Furthermore, two RN champions will conduct monthly ongoing audits on the compliance of staff RNs on this protocol. This protocol has shown to decrease EDLOS and could potentially be used in other similar PED settings. Moreover, there is a plan to use this protocol for the hospital's MORSE team, a team of RNs responding to patient falls will be implemented.

The use of a nurse-led standard protocol such as the OARs at this practice site, can reduce EDLOS and decrease time to diagnostic testing. Efficiency is a paramount concern in EDs that can affect quality, safety, and patient satisfaction. Future quality improvement projects should be conducted evaluating the use of other evidence-based interventions of common pediatric complaints that may benefit from expediting processes of care using a standardized protocol.

References

Abri, F. H. A., Muliira, J. K., & Awaisi, H. A. (2020). Effect of triage nurse-led application of the Ottawa Ankle Rules on number of radiographic tests and length of stay in selected emergency departments in Oman. *Japan Journal of Nursing Science*, *17*(1), e12270. https://doi.org/10.1111/jjns.12270

Burnes, B. (2004). Kurt Lewin and the planned approach to change: A re-appraisal. *Journal of Management Studies*, *41*(6), 977–1002. https://doi-org.proxy-hs.researchport.umd.edu/10.1111/j.1467-6486.2004.00463.x

Du, P., Chen, K., Patterson, D., & Ranade, S. (2018). The pediatric ankle and foot: A review of common injuries in the pediatric athlete and their treatments. *Annals of Joint*, *3*(4), 1–11. http://aoj.amegroups.com/article/view/4278

Gaieski, D. F., Agarwal, A. K., Mikkelsen, M. E., Drumheller, B., Cham Sante, S., Shofer, F. S., Goyal, M., & Pines, J. M. (2017). The impact of ED crowding on early interventions and mortality in patients with severe sepsis. *The American Journal of Emergency Medicine*, *35*(7), 953–960. https://doi.org/10.1016/j.ajem.2017.01.061

Gangong, L. H. (1987). Integrative reviews of nursing research. *Research in Nursing & Health*, *10*(1). 1–11. https://doi.org/10.1002/nur.4770100103

Ho, J. K., Chau, J. P., Chan, J. T., & Yau, C. H. (2018). Nurse-initiated radiographic-test protocol for ankle injuries: A randomized controlled trial. *International Emergency Nursing*, *41*(2018), 1–6. https://doi.org/10.1016/h.ienj.2018.04.001

Ho, J. K.-M., Chau, J. P.-C., & Cheung, N. M.-C. (2016). Effectiveness of emergency nurses' use of the Ottawa Ankle Rules to initiate radiographic tests on improving healthcare outcomes for patients with ankle injuries: A systematic review. *International Journal of Nursing Studies*, *63*, 37–47. https://doi.org/10.1016/j.ijnurstu.2016.08.016

Hussain, S. T., Lei, S., Akram, T., Haider, M. J., Hussain, S. H., & Ali, M. (2018). Kurt Lewin's change model: A critical review of the role of leadership and employee involvement in organizational change. *Journal of Innovation & Knowledge*, *3*(2018), 123–127. https://doi.org/10.1016/j.jik.2016.07.002

Lee, W. W., Filiatrault, L., Abu-Laban, R. B., Rashidi, A., Yau, L., & Liu, N. (2016). Effect of triage nurse initiated radiography using the Ottawa Ankle Rules on emergency department length of stay at a tertiary centre. *Canadian Journal of Emergency Medicine*, *18*(2), 90–97. https://doi.org/10.1017/cem.2015.67

Lewin, K. (1947). Frontiers in group dynamics: Concept, method and reality in social science; Social equilibria and social change. *Human Relations*, *1*(1), 5–41. https://doi.org/10.1177/001872674700100103

Perla, R. J., Provost, L. P., & Murray, S. K. (2011). The run chart: A simple analytical tool for learning from variation in healthcare processes. *BMJ Quality & Safety*, *20*(1), 46–51. https://doi.org/10.1136/bmjqs.2009.037895

Plint, A. C., Bulloch, B., Osmond, M. H., Stiell, I., Dunlap, H., Reed, M., Tenenbein, M., & Klassen, T. P. (1999). Validation of the Ottawa Ankle Rules in children with ankle injuries. *Academic Emergency Medicine: Official Journal of the Society for Academic Emergency Medicine*, *6*(10), 1005–1009. https://doi.org/10.1111/j.1553-2712.1999.tb01183.x

Maryland Institute for Emergency Medical Services Systems. (2017). *Maryland Institute for Emergency Medical Services Systems report*: *Joint chairmen's report on emergency department overcrowding*. https://www.miemss.org/home/Portals/0/Docs/LegislativeReports/MIEMSS-HospitalED-Overcrowding-Report_12-2017-FINA.pdf?ver=2018-01-11-145527-537

McCarthy, M. L., Zeger, S. L., Ding, R., Levin, S. R., Desmond, J. S., Lee, J., & Aronsky, D. (2009). Crowding delays treatment and lengthens emergency department length of stay, even among high-acuity patients. *Annals of Emergency Medicine*, *54*(4), 492–503.E4. https://doi.org/10.1016/j.annemergmed.2009.03.006

Melnyk, B. M. (2011). *Evidence-based practice in nursing & healthcare: A guide to best practice* (2nd ed.). Wolters Kluwer/Lippincott Williams & Wilkins.

Newhouse, R. (2006). Examining the source for evidence based nursing practice. *The Journal of Nursing Administration*, *36*(7/8), 337–340. https://journals.lww.com/jonajournal/Citation/2006/07000/Examining_the_Support_for_Evidence_based_Nursing.1.aspx

Robinson, D. J., & Moore. K. (2013). An integrative review: Triage protocols and the effect on ED length of stay. *Journal of Emergency Nursing*, *39*(4), 399–408. http://dx.doi.org/10.1016/j.jen.2011.12.016

Rowe, B. H., Villa-Roel, C., Guo, X., Bullard, M. J., Ospina, M., Vandermeer, B., Innes, G., Schull, M. J., & Holroyd, B. R. (2011). The role of triage nurse ordering on mitigating overcrowding in emergency departments: A systematic review. *Academic Emergency Medicine: Official Journal of the Society for Academic Emergency Medicine*, *18*(12), 1349–1357. https://doi.org/10.1111/j.1553-2712.2011.01081.x

Salway, R. J., Valenzuela, R., Shoenberger, J. M., Mallon, W. K., & Viccellio, A. (2017). Emergency department (ED) overcrowding: Evidence-base answers to frequently asked questions. *Revista Médica Clínica Las Condes, 28*(2), 213–219. https://doi.org/10.1016/j.rmclc.2017.04.008

Sorensen, E. L., Keeling, A., Snyder, A., & Syverud, S. (2012). Decreasing ED length of stay with the use of the Ottawa Ankle Rules among nurses. *Journal of Emergency Nursing, 38*(4), 350–352. https://doi.org/10.1016/j.jen.2011.02.014

Stiell, I. G., McKnight, R. D., Greenberg, G. H., McDowell, I., Nair, R. C., Wells, G. A., Johns, C., & Worthington, J. R. (1994). Implementation of the Ottawa Ankle Rules. *Journal of the American Medical Association, 271*(11), 827–832. https://jamanetwork-com.proxy-hs.researchport.umd.edu/journals/jama/fullarticle/367534

Weissman, J. S., Rothschild, J. M., Bendavid, E., Sprivulis, P., Cook, E. F., Evans, R. S., Kaganova, Y., Bender, M., David-Kasdan, J., Haug, P., Lloyd, J., Selbovitz, L. G., Murff, H. J., & Bates, D. W. (2007). Hospital workloads and adverse events. *Medical Care, 45*(5), 448–455. https://doi.org/10.1097/01.mlr.0000257231.86368.09

Wickman, L., Svensson, P., & Djärv, T. (2017). Effect of crowding on length of stay for common chief complaints in the emergency department: A STROBE cohort study. *Medicine, 96*(44), 1–5. https://doi.org/10.1097/MD.0000000000008457

Table 1

Evidence Review Table

Citation: Ho, J. K., Chau, J. P., Chan, J. T., & Yau, C. H. (2018). Nurse-initiated radiographic-test protocol for ankle injuries: A randomized controlled trial. *International Emergency Nursing, 41*(2018), 1–6. https://doi.org/10.1016/h.ienj.2018.04.001					Level II
Purpose/ hypothesis	Design	Sample	Intervention	Outcomes	Results
"This randomized control trial was performed to evaluate whether the implementation of a nurse-initiated radiographic-test protocol compared with the conduct of the usual practice could reduce unnecessary ankle and foot radiographic-test requests and shorten the patients' LOS in an ED by reducing their waiting time for physician reassessment" (Ho et al., 2018, p. 2).	A single-center unblinded randomized controlled trial.	**Sampling technique**: Convenience **Setting**: A single ED of an acute general hospital in Hong Kong. **Eligible:** Patients aged 1year old and above, suffering from blunt ankle injuries for not more than 10 days, could bear weight prior to their ankle injuries, and understood and spoke English or Cantonese. **Excluded:** Patients with visible ankle deformities or isolated skin injuries, returned for reassessment of previously examined ankle injuries, referred by other healthcare providers with ankle or foot radiographs, were pregnant, or lacked mental capacity. **Accepted:** 112 patients aged 1 year and above suffering from blunt ankle injuries were randomly placed into intervention and control group by triage nurses using a block size of four. The sequence was generated by an investigator using Microsoft Excel and concealed in sequentially numbered opaque envelopes. **Control:** 56 patients aged 1 year old and above; none were lost to follow-up or discontinued treatment.	**Control**: Usual practice of the ED; First, no radiographic test was initiated by the triage nurses. Second, the participants waited for physician consultation outside of the treatment area. Third, physicians assessed the participants and initiated radiographic tests based on their expertise if necessary. **Intervention:** Radiographic tests were initiated by the triage nurses based on the OARs. The OARs ankle radiograph series is only necessary if pain is detected in the malleolar zone and if any of the following findings are present: (a) inability to bear weight for four steps both immediately and in the ED, or (b) bone tenderness at the posterior edge or tip of	**DV:** Primary outcome was the proportion of radiographic-test requests that were nurse-initiated compared to physician requested. The secondary outcomes were patients' length of stay and proportion of fractures detected in the ED. **Measurement tool (reliability), time, procedure:** The primary outcome was measured by counting the number of radiographic test requested for all participants. Patients' length of stay was measured by the number of minutes based on the duration from registration time to discharge time, as recorded in the computer system of the	**Statistical Procedures(s):** Chi-square tests were used to compare the proportions of radiographic-test requests and fractures detected between intervention/control groups. Independent sample *t*-tests were used to compare patients' length of stay. **Results:** Proportion of radiographic-test requests nurse-initiated compared to physician initiated: Overall risk difference 66% compared to 94.6% (28%; 95% CI [14.2% to 42.1%], $p < 0.001$), Ankle risk difference 55.4% compared to 78.6% (23.2%; 95% CI [5.8% to 38.8%], $p = 0.009$), foot risk difference 51.8% compared to 80.4%

		Intervention: 56 patients aged 1 year old and above; none were lost to follow-up or discontinued treatment. **Power analysis:** 112 participants met an 80% Beta, .05 Alpha- power analysis minimizing Type II error. **Group homogeneity:** There was no statistical difference in the mean age, sex, triage category, and patient disposal between the Intervention/Control groups based on Table 1 for demographics of participants.	either malleolus. Also, a foot radiograph series is only necessary if pain is detected in the midfoot zone and if any of the following are present: (a) inability to bear weight both immediately and in the ED, or (b) bone tenderness at the navicular or base of the fifth metatarsal. Followed by waiting for physician consultation outside of the treatment area, and then physician assessment and subsequent request for radiographic test based on their expertise if necessary. **Intervention fidelity:** Three 1-hour training sessions were conducted by the PI who is an academic experienced in emergency care to teach emergency nurses the background and methods of the OAR implementation through case scenarios. Meta-analysis has shown a polled sensitivity of OARs to be 99%. Fidelity of the OAR implementation of the	ED. Proportion of fractures was measured by counting the number of fractures detected from all radiographic-test requests. No instrument or tool was used for outcome measure.	(28.6%; 95% CI [11.1% to 43.8%], $p = 0.001$). **Patients' length of stay:** There was a significant decrease in the intervention group compared to control for patients' length of stay in the ED, 74.4 ± 26.7 min down to 87.3 ± 24.0 mins (*MD* = -13.0 min; 95% CI [-22.5 to -3.5 min]; $p = 0.008$). **Proportion of fractures detected:** The intervention group had a higher proportion of fractures detected compared to the control. Ankle fracture proportion 35.1% compared to 22.6% (risk difference 12.5%; 95% CI [*31.0% to 6.0%]; $p = 0.193$), Malleolar fracture proportion 29% compared to 22.7% (risk difference -6.3%; 95% CI [-26.5% to 12.0%]; $p = 0.536$), Midfoot fracture proportion 20.7% compared to 11.1% (risk difference -9.6%; 95% CI [-28.4% to 6.9%]; $p = 0.258$).

			OARs was assessed by the PI through a return demonstration by the ED nurses.		
Citation: Lee, W. W., Filiatrault, L., Abu-Laban, R. B., Rashidi, A., Yau, L., & Liu, N. (2016). Effect of triage nurse initiated radiography using the Ottawa Ankle Rules on emergency department length of stay at a tertiary centre. *Canadian Journal of Emergency Medicine*, *18*(2), 90–97. https://doi.org/10.1017/cem.2015.67					Level II
Purpose/ hypothesis	Design	Sample	Intervention	Outcomes	Results
"To determine the effect of triage nurse initiated radiographs using the Ottawa Ankle Rules (OAR) on emergency department (ED) throughput. We hypothesized OAR use would reduce median ED length of stay (LOS) by 25 minutes or more" (Lee et al., 2016, p. 90).	Prospective randomized controlled trial.	**Sampling technique:** Convenience. **Setting**: A single ED in Vancouver General Hospital. **Eligible participants**: Patients aged 19 years or older presenting to the ED with isolated blunt ankle trauma. **Excluded:** Patients with isolated skin injury, polytrauma, obvious fracture or deformity, neurovascular deficit, altered mental status, intoxication, uncooperative, x-ray performed prior to their ED visit, pregnancy, prior ED visit for the same injury, or injury that occurred more than 10 days previously. **Accepted:** 146 patients with ankle injuries were enrolled into the study. Patients were randomly assigned to either the intervention or control group with a 1:1 allocation ration using a computerized random number generator. Randomization was performed using sealed envelopes. **Control**: 75 patients with blunt ankle injuries. **Intervention**: 71 patients with blunt ankle injuries. **Power analysis**: 71 patients needed in each group to have 80% power to	**Control protocol**: Patients received standard assessment by triage nurses without using the OAR or nurse initiated radiographs. Followed by standard assessment by the provider after triage. **Intervention protocol**: Nurse initiated radiography in triage using the OAR followed standard assessment by the provider after triage. **Treatment fidelity**: ED triage nurses were specifically trained by a single student research volunteer on the use of the OAR and study enrollment criteria through one-on-one interactive computer training session. ED triage nurse assessments were recorded on a data collection form.	**Dependent variable**: Total median length of stay in the ED, defined as the difference between time of arrival in the ED prior to triage, and the time of the time of ED discharge, the time provider authorized discharge, or time of orthopedic consultation request. **Measure**: ED length of stay was measured in minutes using descriptive statistics, including, mean, median, standard deviation, and interquartile ranges.	**Statistical procedure**: The difference between the medians of the intervention and control groups were analyzed using the Mann-Whitney *U* test. **Results**: The median/mean ED length of stay in the control and intervention groups was 128/143 mins (range 31-364 mins) and 108/115 mins (range 37-293 mins) respectively. This showed a median difference of 20 mins ($p = 0.003$).

		detect an improvement of 25 minutes in ED length of stay, .05 Alpha-Power analysis met, minimizing risk of Type II error. **Group homogeneity**: Intervention/Control was similar based on non-significant *p*-values on Table 1 for patients' baseline characteristics.			
Citation: Rowe, B. H., Villa-Roel, C., Guo, X., Bullard, M. J., Ospina, M., Vandermeer, B., Innes, G., Schull, M. J., & Holroyd, B. R. (2011). The role of triage nurse ordering on mitigating overcrowding in emergency departments: A systematic review. *Academic Emergency Medicine: Official Journal of the Society for Academic Emergency Medicine*, *18*(12), 1349–1357. https://doi.org/10.1111/j.1553-2712.2011.01081.x					Level V
Purpose/ hypothesis	Design	Sample	Intervention	Outcomes	Results
"The purpose of this study was to examine the available evidence for TNO, document contextual issues associated with this intervention, and determine its effectiveness" (Rowe et al., 2011, p. 1350).	Systematic review (SR) conducted by a panel of authors specialized in research for the study population and setting.	**Setting:** ED **Search strategy**: A priori protocol for the systematic review was used to define search strategy, set the study selection criteria, outline quality assessment, data extraction procedures, and plan the analysis of the study results. Two search strategies were used in this review: (a) Sensitive search- a comprehensive literature search was conducted in MEDLINE, EMBASE, EBM, Reviews – Cochrane Central Register of Controlled Trials, Health STAR, Science Citation Index Expanded, Dissertation Abstracts, and ABI/INFORM Global. There was a wide variety of key words used because of the lack of standardized medical indexing for ED overcrowding, see Data Supplement S1 for listing, available in the online version under supporting	**Control**: Controls were similar between all studies included in the SR, which mainly included ED physician initiated x-ray or diagnostic testing. **Intervention**: Interventions in the studies in the SR were almost exclusively triage nurse initiated x-rays for limb injuries with three studies adding additional interventions such as blood, urine, and ECG tests. One study's intervention was triage nurse requested investigations for chest pain, shortness of breath, abdominal pain,	**Dependent variable**: Most of the studies (11 out of 14) the researchers selected studies with the primary outcome of ED length of stay when comparing TNO to emergency provider and emergency nurse practitioner x-ray ordering. Three studies also reported outcome data on physicians' initial assessment (PIA) time, and two studies reported data on proportion of radiographs ordered by triage nurses compared to emergency physicians.	**Level of measurement**: Researchers used descriptive statistics to summarize characteristics of included studies. **Outcome data retrieval**: Researchers conducted analyses divided by study design (RCT vs. other design) and subgroup analysis by injury/suspected fracture status. Data was pooled from articles with similar designs. **Analysis**: 11 of 14 articles reported outcomes on ED length of stay. One RCT found a significant decrease in

		information. (b) Specific search-databases: MEDLINE, EMBASE, SCOPUS, and CINAHL were search using focused key terms such as "nurse/triage nurse" AND "test ordering," "radiography," "x-rays," and "testing requesting in the ED." Hand searches of abstracts and manual ancestry searches were conducted as well as contacting primary authors and experts in the field to identify additional or ongoing studies. Two of four independent reviewers reviewed articles that initially did not meet eligibility criteria and discrepancies were resolved by consensus. Two of four independent reviewers assessed the quality of the included articles using a standard quality-rating tool developed by the Effective Public Health Practice Project (EPHPP). The rating tool was based on criteria of selection bias, study design, confounders, blinding data collection methods, and withdrawals/dropouts. Articles overall were rated as strong, moderate, or weak. A kappa statistic was measured to calculate level of agreement between reviewers, and any discrepancies were resolved by consensus. Finally, information on study conclusions were collected, two independent reviewers conducted data extraction. **Eligible studies**: Primary research that assessed effects of a TNO (not nurse practitioners or floor nurses) to mitigate overcrowding in adult or mixed child and adult EDs. Study	or genitourinary complaints. **Protocol**: Not applicable to SR.	**Measure**: Numerical count in minutes of patient arrival to discharge from ED, patient arrival to physician patient initial assessment, and numerical count in frequency of number of radiographs ordered.	ED length of stay when using TNO compared to providers' initiated x-rays (*MD* = -37.2 mins; 95% CI [-44.1 to -30.3 mins]); this was consistent with pooled data from three non-RCTs (*MD* = -51mins; 95% CI [-56.3 to -45.5 mins]). For injured/suspected fracture subgroup analysis three RCTs found that TNO interventions made a significant decrease in ED length of stay (pooled *MD* = -19.7 mins; 95% CI [-37.5 to -1.9 mins]). In five non-RCTs there was a statistically significant decrease in ED length of stay (pooled *MD* = -18.2 min; 95% CI [-23.2 to -13.2 mins]). For PIA time two RCTs showed a nonsignificant reduction when comparing TNO interventions to provider x-ray ordering (pooled *MD* = -3.00 min; 95% CI [-6.99 to 0.99 mins]).

		designs eligible: parallel or clustered RCTs, controlled clinical trials (CCTs), prospective or retrospective analytical cohort studies, interrupted time series, case-control studies (C-C), and before-after (B-A) designs. Studies were required to have numeric data reported on one of the following: ED length of stay (time in mins from patient ED arrival to departure), physician initial assessment, and proportion of radiographs ordered by nurses. **Excluded**: (a) non-primary research (b) studies conducted solely in pediatric EDs, (c) multiple publications, (d) studies comparing two levels of the same intervention. **Included**: Three randomized control trials, one clinical controlled trial, two retrospective cohort studies, three prospective cohort studies, two case controlled studies, and three before-after studies with 24,146 participants total; all studies were conducted in the ED, all studies focused on focused on triage nurse initiated x-rays as main component of intervention except for one retrospective nested case controlled study. **Power analysis**: Not applicable to SR.			For proportion of radiographs ordered pooled data from two RCTs showed that the risk of ordering radiographs were the same comparing TNO with provider ordering (R^2 = 0.98; 95% CI [0.83 to 1.15]) as well as the risk of obtaining a positive result (R^2 = 1.03; 95% CI [0.85 to 1.23]). **Conclusions:** TNO interventions appears to be an effective intervention to decrease ED length of stay with a 37-min mean reduction in ED length of stay in one RCT and 51-min mean reduction in non-RCTs when compared to standard provider ordering. Furthermore, when especially applied to suspected fracture cases there was a 20 min and 18 min reduction in ED length of stay in three RCTs and five non-RCTs respectively. No significant decrease in PIA was found. **SR bias risk**: The variable methodologies presented create a risk for bias, however, with

					the comprehensive search strategy with independent reviews and standardized eligibility criteria, and follow-up with original researchers to add missing data, decrease risk of bias, bias is low.
Citation: Ho, J. K.-M., Chau, J. P.-C., & Cheung, N. M.-C. (2016). Effectiveness of emergency nurses' use of the Ottawa Ankle Rules to initiate radiographic tests on improving healthcare outcomes for patients with ankle injuries: A systematic review. *International Journal of Nursing Studies*, *63*, 37–47. https://doi.org/10.1016/j.ijnurstu.2016.08.016					Level V
Purpose/ hypothesis	Design	Sample	Intervention	Outcomes	Results
"The aim of the systematic review was to synthesize the most accurate information available on the extent to which emergency nurses' use of the OARs to initiate radiographic tests improves healthcare outcomes for patients with ankle injuries" (Ho et al., 2016, p. 38).	SR with meta-analysis.	**Setting**: Study settings included ED and one urgent care. **Search strategy**: A three step search strategy was conducted. The first step was a limited search of databases to identify key words in titles and abstracts and index terms for relevant published and unpublished studies in both English and Chinese. The following key words were "ankle;" "ligament;" "sprain;" "fracture;" "trauma;" "decision rule;" "guideline;" "protocol;" "Ottawa;" and "nurse." The second step included key words and index terms to conduct an extensive search of all relevant databases which included Ovid MEDLINE, EMBASE, ProQuest Health and Medical Complete, EBM Reviews, SPORTDiscus, CINAHL Plus, the British Nursing Index, Scopus, Health Sciences: A SAGE Full-Text Collection, BioMed	**Control**: Controls varied between conventional practice (providers not using the OARs after triage), nurses and non-medical staff not using the OARs, or no control. **Intervention**: All studies had the intervention of using the OARs in triage to determine the initiation of radiographs. **Protocol**: Not applicable to SR.	**Dependent variables**: The researchers selected articles with the primary outcome of proportions of radiographic-test, ankle fractures detected, and ankle fractures overlooked. The secondary outcome of interest were patients' length of stay. **Measure**: Frequency count of radiograph-test request, ankle fractures, and overlooked fractures. Count in mins from patient arrival to patient discharge from ED.	**Level of measurement**: All nine studies were subjected to narrative analysis. Five studies were pooled for meta-analysis using Review Manger 5.2 using a fixed-effects model for the absence of clinical heterogeneity ($I^2 < 25$). Four studies were excluded from meta-analysis because of clinical heterogeneity in settings, populations, interventions, or outcome measures. Odds ratio (OR) were calculated for dichotomous data and *MD* for continuous data. **Outcome data retrieval**: Researchers

		Central and Scirus. The databases used to obtain studies in Chinese were the Chinese Biomedical Literature Database, China Journal Net, WanFang Data, the National Central Library Periodical Literature System, HyRead, Taiwan Electronic Periodical Service and the Hong Kong Index to Chinese Periodicals. Unpublished and grey literature were also searched. The final step in the search strategy included a manual search from non-database sources and bibliography/reference searches. Two independent reviewers examined all articles and abstracts for eligibility and full text review was conducted on articles that met inclusion criteria. An eligibility form was used for assessment. Disagreements were resolved through discussion. Inclusion and exclusion criteria were stated in the SR. **Eligible studies**: Randomized control trials, quasi-experimental studies, prospective or retrospective cohort studies, and case controlled studies involving patients aged greater than 1year old who visited the ED or urgent care for blunt ankle injuries. Nurses implementing original or refined OARs compared to conventional treatment. **Excluded**: (a) irrelevant types of participants, interventions, outcome measures, and studies (b) duplicate studies.			used the data extraction form for experimental or observational studies from the Joanna Briggs Institute Meta-Analysis of Statistics Assessment and Review Instrument. Pooled data was only possible for four studies. **Analysis**: For radiographic test request, pooled data from three studies showed that the proportion of tests requested by ED nurses based on the OARs was significantly smaller than physician requested radiographs not using OARs (OR = 0.36, 95% CI [0.22-0.59], $p < 0.0001$). In studies subjected to narrative analysis, one quasi-experimental study found a significant decrease in nurses' request of x-rays using OAR compared to nurses not using OAR (56.4% to 70.8%); $X^2 = 4.589$, $df = 1$, $p < 0.005$. No statistical difference was found in a prospective cohort study comparing nurse practitioner x-ray

		Included: One randomized control trial, three quasi-experimental studies, two prospective cohort studies, and two case-control studies were conducted in the ED with one randomized control trial performed in an urgent care. Total of 4,475 participants all investigating the use of refined OARs. Six studies investigating nurses' use of OARs and requests for radiographic tests, and three studies investigated effects of patients' length of stay and nurses' use of OAR on radiographic test initiation in triage. One study looked at ED nurses' use of OAR to initiate x-rays in triage and patient satisfaction. Lastly, one study conducted in an urgent care looked at nurses' use of OAR in triage and length of stay, waiting times, patient satisfaction, and reduced request for radiographic tests. **PRISMA**: The preferred Reporting Items for Systematic Reviews and Meta-Analyses checklist was used to identify essential components of the review- detailed decision criteria was used for including or omitting studies from the SR. **Power analysis**: Not applicable to SR.			requests (78.4%) and medical doctors (88.6%) using the OARs (p = 0.081). One RCT conducted in an urgent care found no statistical difference between proportions of x-ray request of nurses using OARs compared to physicians not using OARs (88.7% vs. 88.5%; 95% CI [-5.0% to 15.0%], p = 0.359). For ankle fractures detected three studies were pooled for meta-analysis and found no statistical difference in proportion of fractures detected between ED nurses using OARs compared to ED nurses not using them (OR = 0.93, 95% CI [0.75-1.14], p = 0.46). The remaining studies that were subjected to narrative analysis found no significant difference in proportion of fractures detected by ED nurses using the OARs compared to ED nurses not using them (11.3% vs. 14.8%). One study of nurse practitioners use of OARs compared to physicians found a

					decrease in fractures detected for nurse practitioners (17.6% vs. 22.8%). For ankle fractures overlooked three studies were pooled for meta-analysis and found no statistical difference between nurses' use of OARs to initiate x-rays compared to physicians who did not use OARs (OR = 1.73, 95% CI [0.54-5.59], p = 0.36). Narrative analysis for un-pooled data found that no ankle fracture were overlooked in nurses and nurse practitioners using OAR, but there was 1.6% of ankle fracture overlooked by physicians using OARs. For patients' length of stay two studies were pooled for meta-analysis and found that ED length of stay was significantly shorter for nurses who used OARs in triage to initiate x-rays compared to physicians who did not use them (*MD* = -34.51 mins; 95% CI [-54.19 to -14.83 mins]; p = 0.0006). In narrative

					analysis of un-pooled data an RCT found a significant decrease in ED length of stay for ED nurses using OARs in triage compared to physicians not using them (ED nurses median 108 mins compared to physician median 128 mins, p = 0.003). In another RCT conducted in an urgent care there was no significant difference in length of stay for nurses using OAR compared to physicians (73.0 mins vs. 79.7 mins; 95% CI [-20.9 -7.4 mins], p = 0.349). **Conclusions**: Implementation of OARs to initiate x-rays by nurses in triage has shown to decrease the odds of ordering an x-ray by up to 64% compared to physician x-ray requests not using OARs. There is no difference in the detection of ankle fractures for ED nurses using OARs in triage compared to physicians not using OARs, and physicians using OARs overlook ankle fractures 1.6% more

					than nurses and nurse practitioners using OARs 0%. Finally, ED nurses using OARs to initiate x-ray can decrease ED length of stay by 34.51 mins compared to physicians not using OARs. **SR bias risk**: Publication bias minimized by comprehensive search of databases, and two reviewers assessed methodology, quality, and validity of studies. However, meta-analysis was not conducted on all studies due to variability, and not searching for potential articles in languages other than English and Chinese increase bias. Bias risk is moderate.
Citation: Abri, F. H. A., Muliira, J. K., & Awaisi, H. A. (2020). Effect of triage nurse-led application of the Ottawa Ankle Rules on number of radiographic tests and length of stay in selected emergency departments in Oman. *Japan Journal of Nursing Science*, *17*(1), e12270. https://doi.org/10.1111/jjns.12270					Level III
Purpose/ hypothesis	Design	Sample	Intervention	Outcomes	Results
"The main aim of the study was to evaluate the effectiveness of ED triage nurse-led application of the OARs toward improving	Quasi-experimental design.	**Sampling technique**: Convenience. **Setting**: ED of two government funded hospitals in Oman. **Eligible participants**: 18 years and above, presenting to ED within 12 hours from injury, chief complaint of ankle pain, trauma, injury, or inability to bear weight due to ankle	**Control protocol**: Usual care provided by ED physician. General assessment by triage nurse that assigns acuity level. Patient then waits in waiting room to be seen by	**Dependent variable**: The number of radiographic tests used to investigate ankle injury before diagnosis. ED waiting time defined as the time in minutes from point of	**Statistical results**: Independent samples *t*-test- There was a statistically significant lower than average number of x-ray request in the intervention group (1.33 ± 0.47)

healthcare outcomes (waiting time, LOS and number of radiographic test) of patients with ankle injuries" (Abri et al., 2018, p. 3).		injury, and able to speak Arabic or English. **Excluded**: Patients having other isolated injury of the skin of the lower leg, prior ankle injury returning for assessment, referred by another healthcare provider or facility that had already taken radiographic images of ankle/foot, pregnancy, and was unable to provide informed consent due to mental incapacitation. **Accepted**: 96 patients with ankle injuries who were willing to participate in the study were enrolled. Participants were given the choice of being placed in the intervention or control group after explaining the study procedures. **Control**: 50 patients with ankle injuries. No patients lost in follow up. **Intervention**: 46 patients with ankle injuries. No patients lost in follow up. **Power analysis**: No power analysis reported. Alpha set at 0.05 (two-tailed). **Group homogeneity**: Intervention and control group similar in demographic characteristics. No significant *p* values on Table 1 of characteristics of the participants.	physician. When patient is taken to ED room physician completes assessment of patient and then decides based on experience, not on OARs to send patient for radiographic imaging. **Intervention protocol**: One ED triage nurse specifically trained for this study will triage participants using the OARs and initiate x-rays or not based on protocol. If decision not to initiate x-ray patient will continue with usual care. **Treatment fidelity**: One ED triage nurse attended a 1-week training course in trauma nursing, and was oriented to the use of OARs by a senior ED physician.	registration to time of consultation (patient seen by a physician to develop plan of care). ED length of stay defined as total amount of time in minutes from time of arrival to when patient was discharged or admitted as an inpatient. **Measure**: The dependent variables were recorded by the electronic patient medical record automatically after each step from arrival to the ED to discharge or inpatient admission.	compared to the control (1.88 ± 0.40) (t = 6.19; p < .001; 95% CI [0.37-0.72]). Mann-Whitney U test analysis- There was a statistically significant decrease in mean ED waiting time from 60.52 mins in the control down to 35.43 mins in the intervention group (U = 549; p < .001). There was also a statistically significant decrease in ED length of stay from 68.15 mins in the control down to 27.14 mins in the intervention group (U = 167.5; p < .001). Nurse-led triage implementation of the OARs reduced ED length of stay by 41.01 mins and wait time by 25.09 mins.
Citation: Robinson, D. J., & Moore. K. (2013). An integrative review: Triage protocols and the effect on ED length of stay. *Journal of Emergency Nursing*, *39*(4), 399–408. http://dx.doi.org/10.1016/j.jen.2011.12.016					Level V
Purpose/hypothesis	Design	Sample	Intervention	Outcomes	Results

"The purpose of this integrative review is to identify the effectiveness of using triage protocols to decrease ED length of stay" (Robinson & Moore, 2013, p. 398).	Integrative review by the use of the Ganong Criteria (Ganong, 1987)	**Setting:** ED. **Search strategy**: A systematic search was conducted of online databases from 1992-2010 using the databases Cumulative Index to Nursing and Allied Health Literature (CINAHL), Medline, the Cochrane Library, Mosby's Nursing Consult, and the National Guideline Clearinghouse. A hand search of studies from the *Journal of Emergency Nursing* from 2005-2010 was also conducted as well as contacting three authors from prior articles to inquire about more current work. The key words used in the search included "triage protocols," "emergency services," length of stay," advanced triage protocols," and "emergency nursing treatment protocols." **Eligible studies**: Studies that correlated nursing triage protocols with ED length of stay, examined adult population, and in the English language. **Excluded**: Studies addressing length of stay focused on the issue of overcrowding or that evaluated location of ancillary departments, delivery of laboratory specimens, or patient registration processes. **Included**: Eight studies were included: Four randomized control trials with 3,100 participants total; two prospective cohort studies with 1,513 participants total; one retrospective nested-cohort study with 15,188 total participants; one retrospective chart review with 1,047	**Control**: No use of triage protocol in the ED. **Intervention**: Interventions in the integrative review were predominantly implementing a triage protocol and the majority of studies involved requesting radiography for patients.	**Dependent variable**: Researchers selected the main outcome of Total ED length of stay (TLOS) and length of stay after the provider assessment (LOS-PPA). **Measure**: Numerical count in minutes from patient arrival to discharge from ED (TLOS); Numerical count in minutes from provider assessment to patient disposition decision (LOS-PPA).	**Level of measurement:** Researchers used solely descriptive statistics to summarize the characteristics of included studies. **Outcome data retrieval**: Researchers collected data from all studies and entered them on a data summary sheet for evaluation. **Analysis**: Length of stay was examined in all eight studies and measured as total ED length of stay or LOS-PPA. Five studies examined only orthopedic injuries. When protocols were initiated in triage, the mean time savings for TLOS was between 2.45-74 minutes. The mean TLOS time saved was between 14-40 minutes in studies that examined nurse initiated radiographs in triage compared to waiting for radiography after being assessed by a medical provider. The mean time saved for LOS-PPA for protocols initiated in

		total participants. All studies were conducted in the ED and 7 studies examined the use of triage protocols on length of stay. **Power analysis**: Not applicable.			triage was between 8.5-89 minutes. **Conclusions**: Time saved by the use of triage protocols had wide variation, but even the smallest amount of time can have benefit for ED throughput. Implementing nurse triage protocols can increase ED efficiency and decrease throughput times, which benefit ED length of stay. **Bias risk**: There was a comprehensive search strategy, however, studies not in English were excluded. Also, variable data reporting among studies increases bias risk.
Citation: Sorensen, E. L., Keeling, A., Snyder, A., & Syverud, S. (2012). Decreasing ED length of stay with the use of the Ottawa Ankle Rules among nurses. *Journal of Emergency Nursing, 38*(4), 350–352. https://doi.org/10.1016/j.jen.2011.02.014					III
Purpose/hypothesis	Design	Sample	Intervention	Outcomes	Results
"Implementation of a nurse-driven protocol to assess patients with non-life-threatening ankle and foot injuries with use of the OARs would result in a significant decrease in the total length	Prospective before and after study.	**Sampling technique**: Convenience from a single ED. **Setting**: ED in Virginia. **Eligible**: Patients 18 years and older with ankle or foot injuries. **Excluded**: Pediatric patients. **Accepted**: A total of 205 study participants from a single ED who had ankle or foot injuries were placed in the intervention group or the control group.	**Control**: Usual care with no nurse-driven protocol with the use of OARs. **Intervention**: Nurse-driven trial protocol to assess patients with non-life-threatening ankle and/or foot injuries with the use of the OARs.	**Dependent variable:** Primary outcome variable was the total ED length of stay. **Measure**: The number of minutes based on the time from patient triage to patient discharge from the ED or admission to hospital.	**Statistical procedure(s):** The Student *t* was used to analyze data and compare average ED length of stay before and after implementation of nurse-driven triage protocol with the use of the OARs.

of stay (LOS) in the emergency department" (Sorensen et al., 2012, p. 350).		**Control**: 105 patients with ankle or foot injuries were gathered from chart review prior to implementation of protocol from March 1, 2009 to April 30, 2009. **Intervention**: 100 patients with ankle or foot injuries from January 1, 2010 to February 14, 2010. **Power analysis**: None reported **Group homogeneity**: Intervention and control groups were all over the age of 18 years and all had ankle or foot injuries.	**Intervention fidelity**: Face to face personal instruction by the primary investigator on the use of the OARs and protocol.		**Results:** For the overall ED, the total ED length of stay in the control was 234 minutes and 242 minutes in the intervention group. For patients with ankle and foot injuries the control group showed a total ED length of stay of 189 minutes ± 1 *SD* while the intervention group showed 144 minutes ± 1 *SD*, $p <$ .03.

Note. Level of evidence appraised using Melnyk, B. M. (2011). *Evidence-based practice in nursing & healthcare: A guide to best practice* (2nd ed.). Wolters Kluwer/Lippincott Williams & Wilkins.

Table 2

Evidence Synthesis Table

Evidence based practice question (PICO): Does implementing the OARs in triage for patients with ankle or foot complaints decrease ED length of stay?			
Level of evidence	**# of studies**	**Summary of findings**	**Overall quality**
II	**2**	Both studies examined the use of a triage nurse protocol using the OARs for patients with ankle and foot injuries. Both studies found that ED nurses initiating x-rays on	B, Ho et al. (2018) conducted a randomized control trial in which adequate sample size was reached through power analysis. The randomized control design strengthened internal validity. The strict

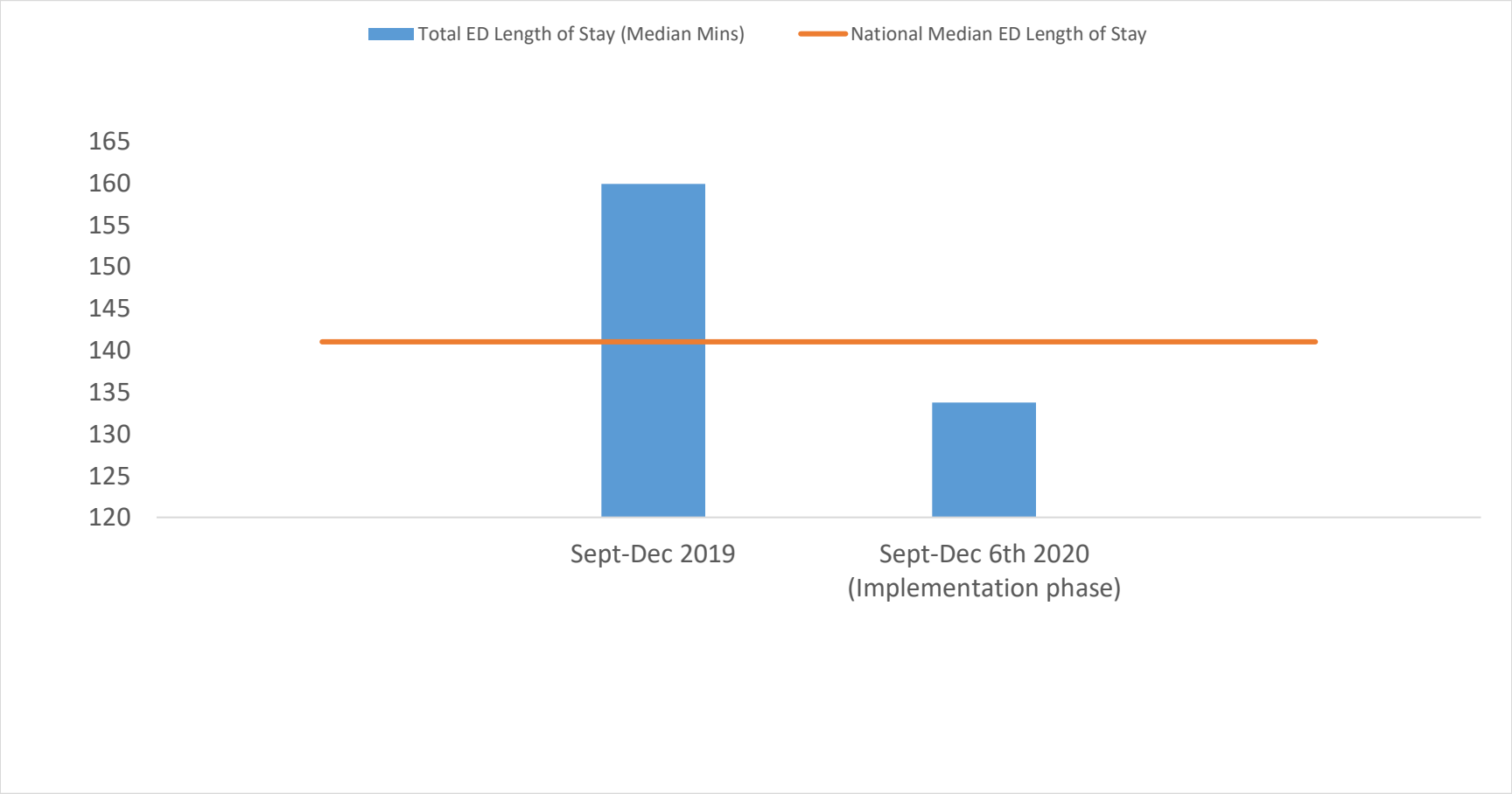
		blunt ankle injury patients in triage significantly decreased ED length of stay compared to usual standard of care. Both studies used the same standardized order protocol, the OARs to initiate x-rays on patients with blunt ankle injuries before physicians' initial assessment of the patient.	criteria for study eligibility lessened confounding variables. The recommendations were based on a fairly comprehensive literature review including references to scientific evidence and fairly definitive conclusions were made. B, Lee et al. (2016) conducted a prospective randomized control trial in which adequate sample size was reached through power analysis. The randomized control design strengthened internal validity. The strict criteria for study eligibility lessened confounding variables. The recommendations were based on a fairly comprehensive literature review including references to scientific evidence and fairly definitive conclusions were made.
III	**2**	One quasi-experimental and one before-after study examined the use of a nurse led protocol using the OARs in ED triage. The before-after study examined foot and ankle injuries while the quasi-experimental study only examined ankle injuries. One study found that ED nurses initiating x-rays in triage using a standardized order protocol, the OARs for patients with complaints of ankle injury, significantly decreased ED length of stay compared to usual standard of care. The other study found an increase in the overall ED length of stay but showed a significant decrease in length of stay for patients with ankle/foot injuries specifically.	B, Abri et al. (2019) conducted a quasi-experimental study. There was no power analysis to determine sufficient sample size. No randomization, but control was present, and results/recommendations were consistent based on a fairly comprehensive literature review based on scientific evidence, leading to fairly definitive conclusions. B, Sorensen et al. (2012) conducted a before-after study. There was no power analysis to determine sufficient sample size. No randomization, but control was present, and results/recommendations were consistent based on a fairly comprehensive literature review based on scientific evidence, leading to fairly definitive conclusions. Step were taken and data were examined to rule out confounding variables increasing validity.
V	**3**	Two systematic reviews and one integrative review examined the use of nurse triage protocols in the ED. All three reviews had outcome measures of ED length of stay. One systematic review solely examined the use of the OARs. The other systematic review and integrative review examined a variety or combination of nurse triage protocols; however, the vast majority of the triage protocols were triage nurse-initiated x-rays. All three reviews showed a significant decrease in ED length of stay when x-rays were initiated by the nurse in triage. This was consistent with three non-RCT studies that also found ED triage nurse x-ray ordering decreased ED length of stay. One study from one systematic review was conducted in an urgent care setting but did not find any	B, Rowe et al. (2011) included 11 studies in a systematic review evaluating nurse triage protocols and ED length of stay that included four controlled trials with the remaining studies being either before-after or retrospective studies. This review had a large sample size, strict and rigorous search strategy for study selection, criteria-based evaluation on overall scientific strengths, and consistent results with fairly definitive recommendation. C, Ho et al. (2016) included nine studies in their review of which two were RCTs and the remaining being either quasi-experimental, cohort, or case control studies. This review had a well-designed, reproducible, and rigorous search strategies. Criteria-based evaluation on overall scientific strengths were included in the review. However, there were insufficient number of well-defined studies. More than half of the studies were observational, and there were many confounding variables not accounted

		significant difference between triage nurse-initiated x-ray using OARs and provider not using OARs.	for in the included studies. The risk for bias was high. Reasonably consistent results were made by the authors, but no definitive conclusions can be made. B, Robinson et al. (2013) included eight studies in their review of which four were RCTs, three case control, and one descriptive study. There was a reasonably thorough and appropriate search strategy with reasonably consistent results from RCTs. Criteria-based evaluation on overall scientific strengths were included in the review. Authors were able to make fairly definitive conclusions.

Note. OAR= Ottawa Ankle Rules. Level of evidence appraised using Melnyk, B. M. (2011). *Evidence-based practice in nursing & healthcare: A guide to best practice* (2nd ed.). Wolters Kluwer/Lippincott Williams & Wilkins. Quality of evidence appraised using Newhouse, R. (2006). Examining the source for evidence based nursing practice. *The Journal of Nursing Administration, 36(7/8), 337–340.* *https://journals.lww.com/jonajournal/Citation/2006/07000/Examining_the_Support_for_Evidence_based_Nursing.1.aspx*

Figure 1

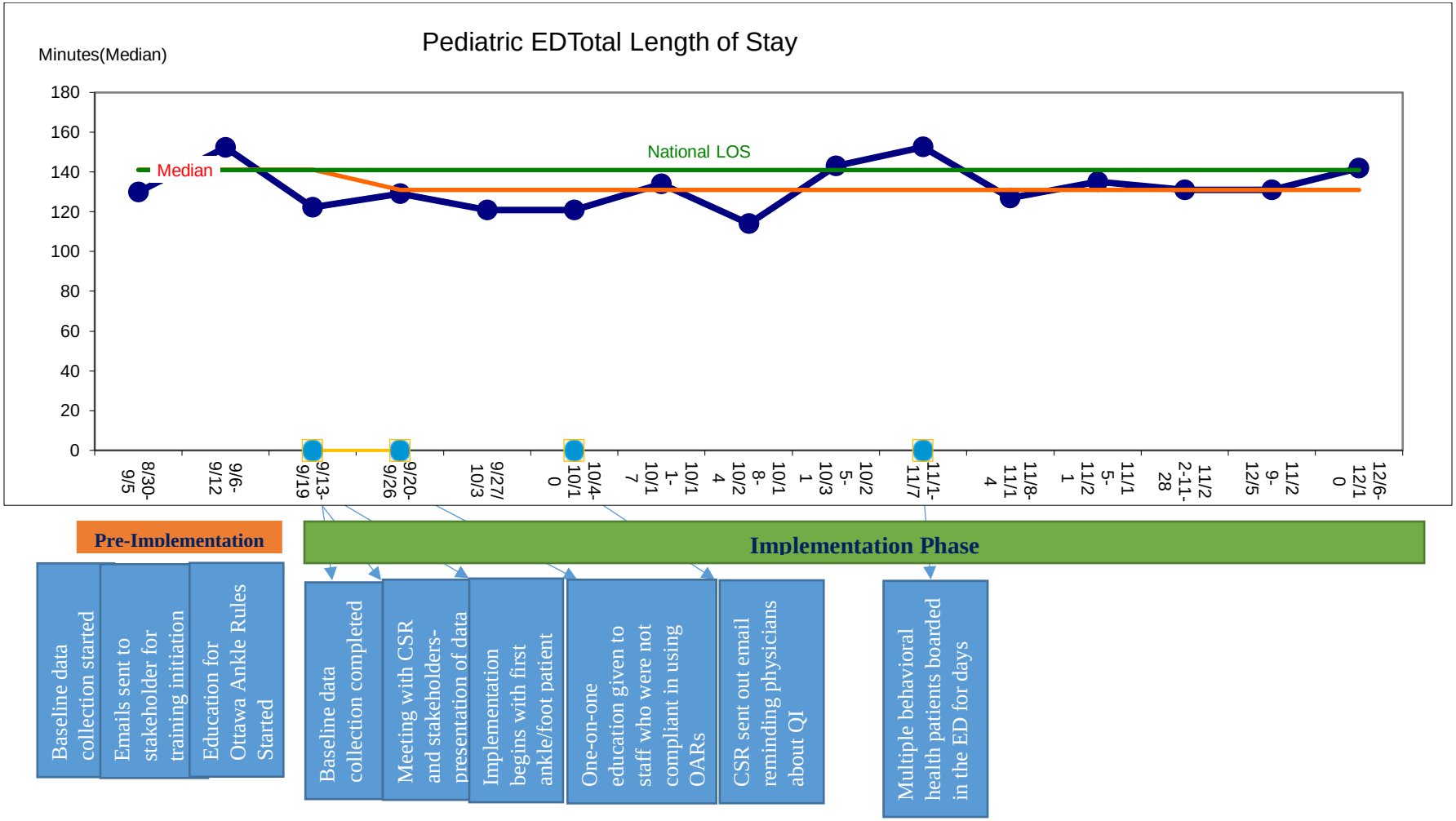
Change in Pediatric ED Total Length of Stay After Implementation of OARs by Triage RNs



Note. Total ED length of stay decreased below the orange line (the national median ED length of stay) from Fall of 2019 to Fall 2020

Figure 2

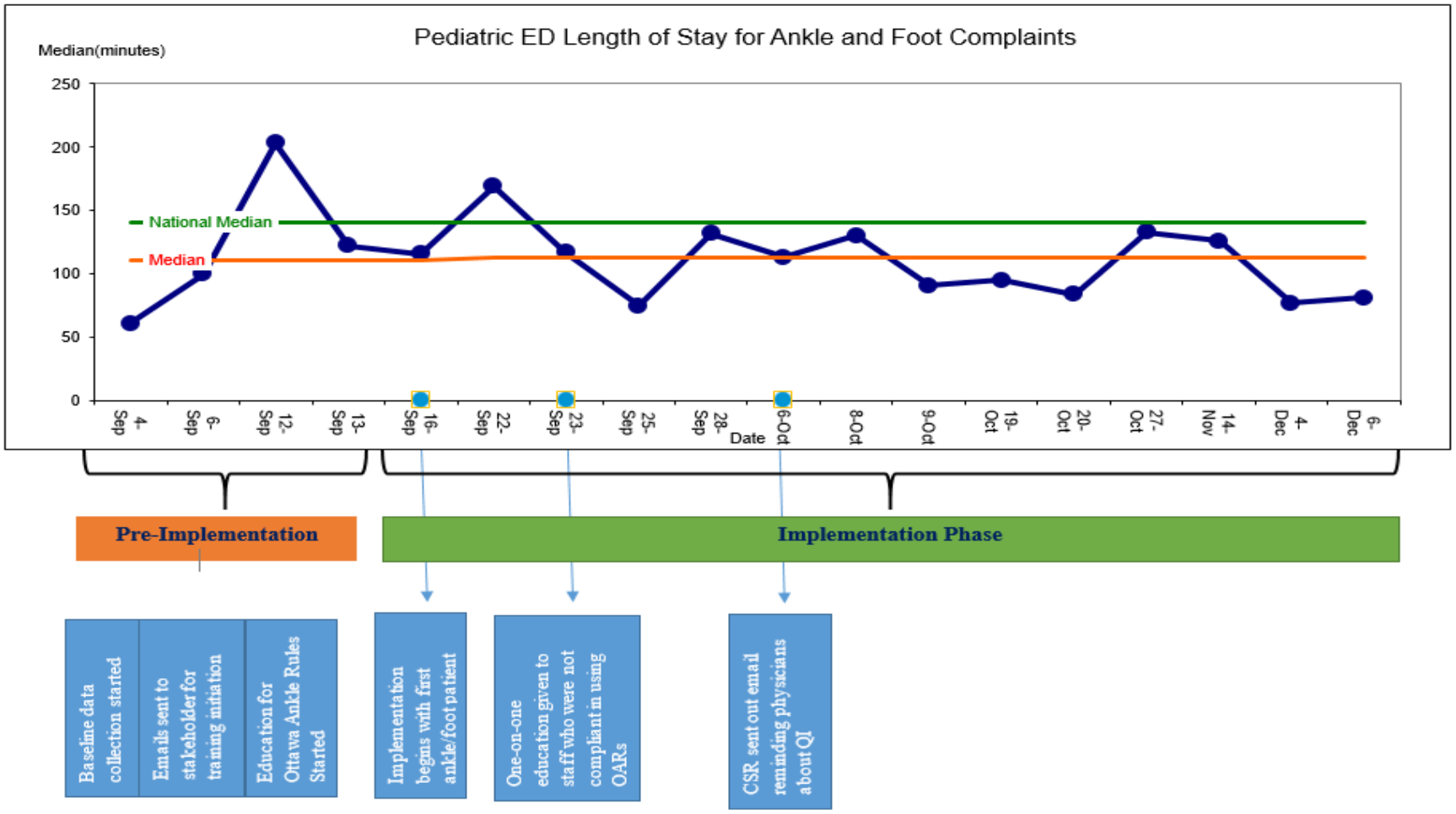
Total Median Length of Stay in the Pediatric ED



Note. Run chart depicted for total pediatric emergency department over 15 week period.

Figure 3

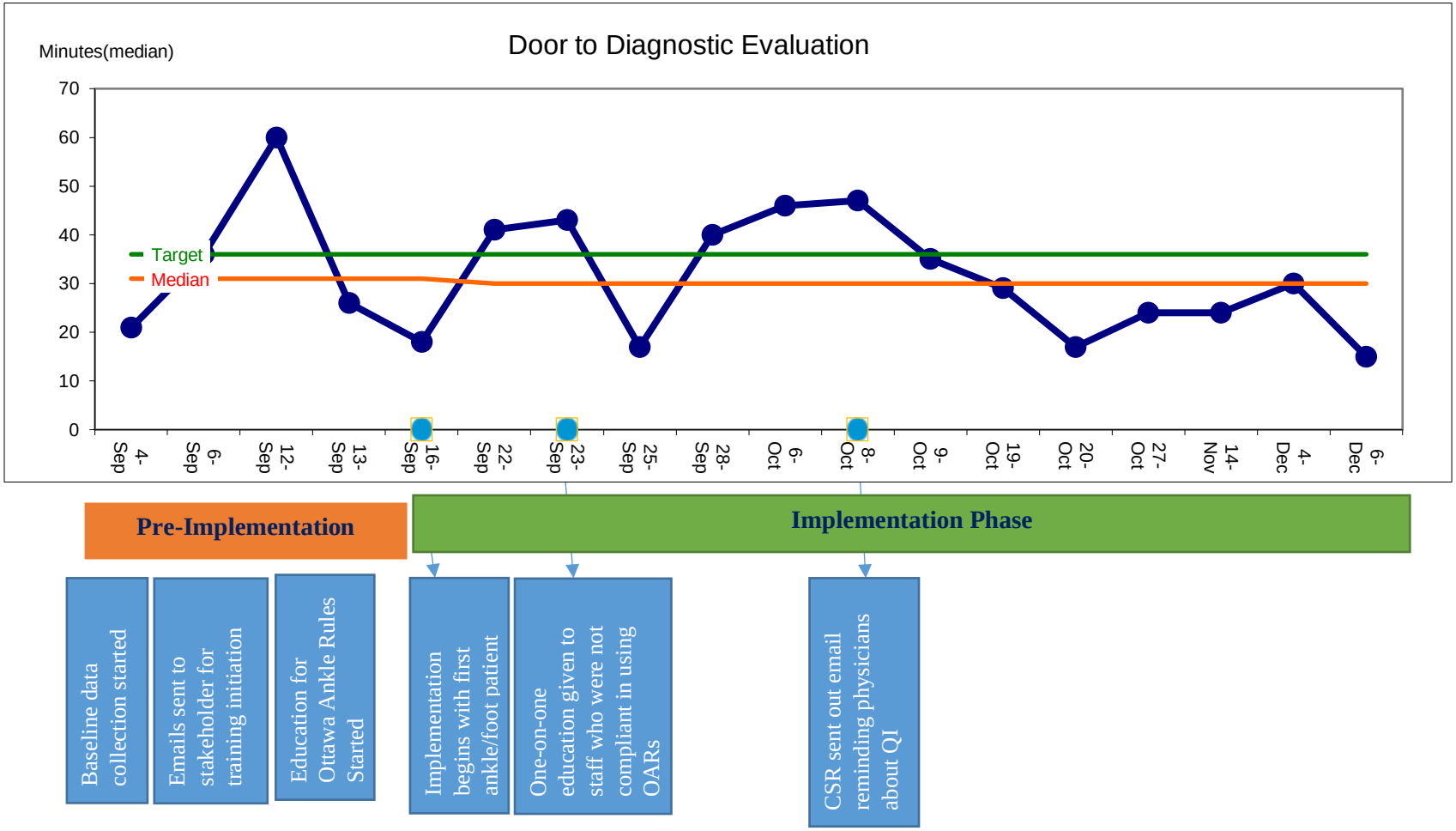
ED Length of Stay for Ankle and Foot



Note. Run chart depicted for emergency department length of stay for ankle and foot patients over a 15 week period

Figure 4

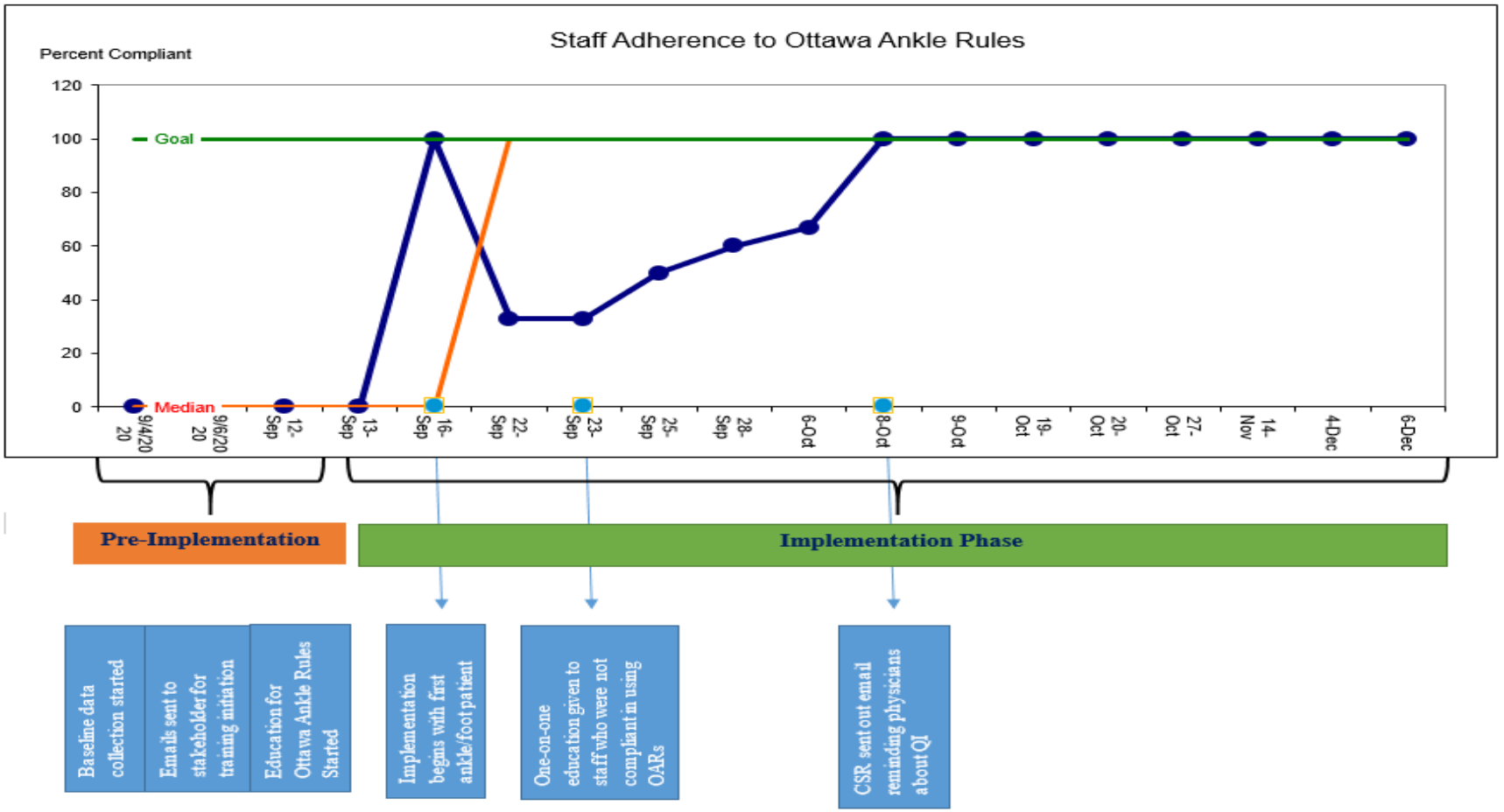
Door to X-ray Time



Note. Run chart of median time from door to x-ray initiation in pediatric emergency department over 15 week period

Figure 5

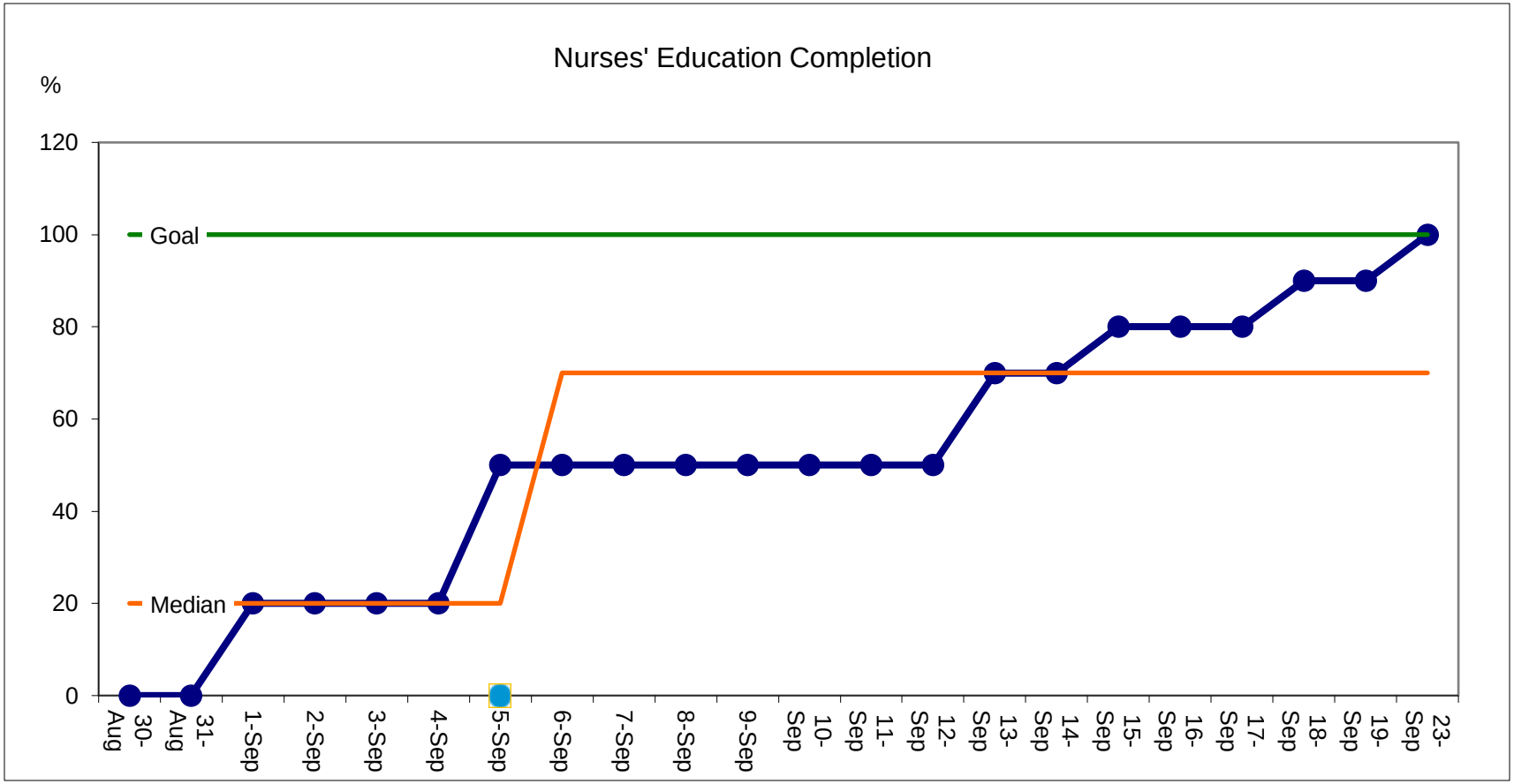
Staff Compliance to OARs



Note. Run chart of nurses' compliance on using the OARs in pediatric orthopedic triage over a 15 week period

Figure 6

Staff Education



Note. Run chart of nurses' completion of OARs education

Appendix A

Oar Training Tool

An ankle X-Ray series is only required if there is any pain in the malleolar zone and...

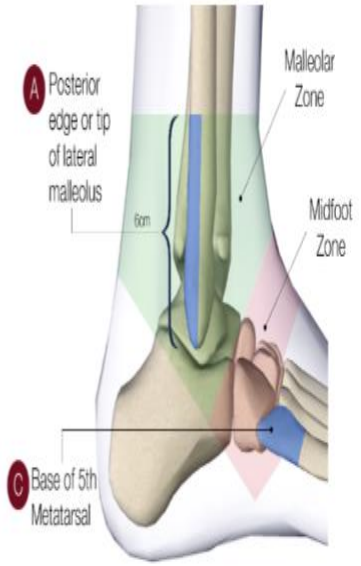
Bone tenderness at the posterior edge or tip of the lateral malleolus (A)

OR

Bone tenderness at the posterior edge or tip of the medial malleolus (B)

OR

An inability to bear weight both immediately and in the emergency department for four steps



Lateral View

A foot X-Ray series is only required if there is any pain the midfoot zone and...

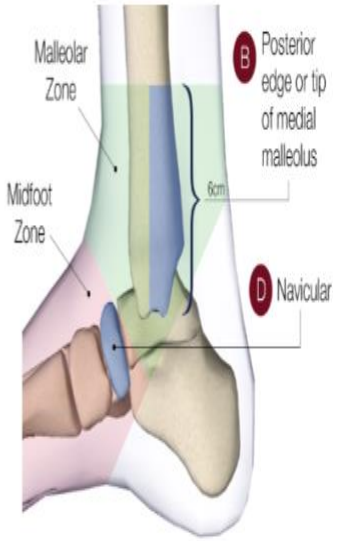
Bone tenderness at the base of the fifth metatarsal (C)

OR

Bone tenderness at the navicular (D)

OR

And inability to bear weight both immediately and in the emergency department for four steps



Medial View

Appendix B

Lesson Plan

Learning objectives	Content outline	Method of instruction	Time spent	Method of evaluation
• RN will be able to define terminology of ED overcrowding, patient throughput, and length of stay. • RN will be able to describe ED overcrowding, patient throughput, and length of stay problems specific to Suburban Hospital's pediatric ED. • RN will be able to describe how a standardized triage protocol could decrease length of stay.	1. Definitions 1.1. ED overcrowding described as when demand of services outnumbers resources available at any given time affecting the capabilities to provide safe and timely care. 1.2. Patient throughput described as the processes from patient arrival to departure from the ED. 1.3. Length of stay described as the time in minutes from patient arrival to departure from the ED. 2. Site specific problems 2.1. Overcrowding impedes patient throughput. 2.2. Patients wait in waiting room without any treatment- no standardized triage treatment. 2.3. Unit's average length of stay longer than national average and organizational standard- provide statistics. 3. Standardized triage treatment 3.1. Treatment while waiting to be seen by physician.	Lecture and discussion	10 mins	Question & Answer 1. What is the definition of ED overcrowding, patient throughput, and length of stay? 2. Describe unit specific problems with ED overcrowding, patient throughput, and length of stay? 3. How can a standardized triage treatment improve length of stay?

• RN will be able to identify specific anatomy points on ankle and foot per the Ottawa Ankle Rules. • RN will be able to describe the criteria for the Ottawa Ankle Rules to determine the need for diagnostic imaging. • RN will be able to apply and demonstrate the accurate use of the Ottawa Ankle Rules. • RN will demonstrate how to document on the Triage Protocol Documentation Form for patients with ankle and/or foot injuries.	1. Anatomy 1.1. Diagram of ankle and foot handout given to RNs. 1.2. Highlight anatomical sites specific to Ottawa Ankle Rules criteria. 1.2.1.1. Malleolar zone, midfoot zone, base of 5th metatarsal, lateral malleolus, medial malleolus, navicular. 2. Ottawa Ankle Rules criteria handout given to RNs. 2.1. An ankle x-ray series is only required if there is any pain in the malleolar zone and. . . bone tenderness at the posterior edge or tip of the lateral malleolus OR bone tenderness at the posterior edge or tip of the medial malleolus OR an inability to bear weight both immediately and in the emergency department for four steps. 2.2. A foot X-ray series is only required if there is any pain in the midfoot zone and . . . bone tenderness at the base of the fifth metatarsal OR bone tenderness at the navicular OR an inability to bear weight both immediately and in the emergency department for four steps. 3. Triage protocol documentation form 3.1. Population: Patients ≥ 5 years old with ankle and/or foot injuries. 3.2. Data elements collected. 3.2.1.1. Age, sex, mechanism of injury, time of protocol start, indication of x-ray ordering, x-ray start time, arrival time, discharge time, presence of fracture. 3.3. Maintenance of forms. 3.3.1.1. Completed forms will be placed in a locked cabinet at the nurse's station.	Lecture, demonstration, and role-play.	30 mins	Return demonstration and question and answer 1. Show me all the anatomic points relevant to the Ottawa Ankle Rules. 2. Describe the criteria for the Ottawa Ankle Rules to determine the need for diagnostic imaging. 3. In a given scenario, apply the Ottawa Ankle Rules and determine if diagnostic imaging is necessary. 4. Demonstrate the documentation and storage of Triage Protocol Documentation Form during given scenario.

Appendix C

OARs Reminders

FOR ANY PATIENT ≥ 5 YEARS OLD WITH ANKLE AND/OR FOOT COMPLAINT:

- **PLEASE TRIAGE AND DOCUMENT ON THE TRIAGE DOCUMENTATION FORM**

- **MAKE SURE CHIEF COMPLAINT IN ELECTRONIC HEALTH RECORD (EPIC) HAS THE WORD ANKLE AND/OR FOOT**

- **DOCUMENT IN EPIC AS USUAL**

- **IF RADIOGRAPHY INDICATED: PROCEED WITH ORDERING 3-VIEW X-RAY OF FOOT OR ANKLE ON AFFECTED EXTREMITY**

Appendix D

Triage Documentation Form

Use for Patients ≥ 5 years old with ankle and or foot complaints

Discharge Time:

Pseudo-Identifier (xx1,xx2,xx3,…)

Fracture Present?
Circle Y N

☐ An ankle X-Ray series is only required if there is any pain in the malleolar zone and...

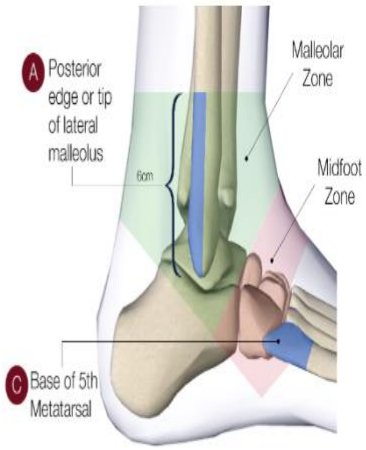
☐ Bone tenderness at the posterior edge or tip of the lateral malleolus (A)

OR

☐ Bone tenderness at the posterior edge or tip of the medial malleolus (B)

OR

☐ An inability to bear weight both immediately and in the emergency department for four steps



Lateral View

Time of Patient arrival to ED _____ Time OAR started _____
X-ray ordered by RN ☐ Time X-ray ordered _____

Fracture Present?
Circle Y N

☐ A foot X-Ray series is only required if there is any pain the midfoot zone and...

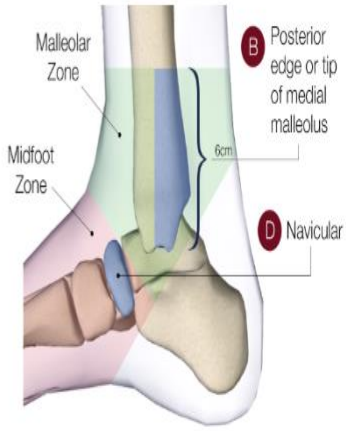
☐ Bone tenderness at the base of the fifth metatarsal (C)

OR

☐ Bone tenderness at the navicular (D)

OR

☐ And inability to bear weight both immediately and in the emergency department for four steps



Medial View

Time of Patient arrival to ED _____ Time OAR started_____
X-ray ordered by RN ☐ Time X-ray ordered _____

Appendix E

Triage Audit Form

Pseudo-identifier (xx1,xx2,xx3,...)	Date (day/month)	Length of stay in minutes (mean/median)	Fracture present (Y/N)	Door to diagnostic evaluation in minutes (median)	Number of patients with ankle and/or foot injuries meeting inclusion criteria triaged with OARs (N)	Total number of patients with ankle and/or foot injuries meeting inclusion criteria triaged with OARs (N)	% (number of patients triaged with OARs/total number of patients that should have been triaged with OARs) x 100

Appendix F

Staff Compliance Form

Date of patient assessment (day/month) Day shift (7A-7P)	Staff pseudo-identifier (xx1,xx2, …)	OARs implemented on patient. Yes = 1	Should have OARs been implemented on patient? No = 0
Date of patient assessment (day/month) Night shift (7P-7A)	Staff pseudo-identifier (xx1,xx2, …)	OARs implemented on patient. Yes = 1	Should have OARs been implemented on patient? No = 0

Appendix G

Education Completion Form

Pediatric RN name	Appropriate assessment & evaluation of OARs for **Ankle:** RN showed return demonstration of all criteria of OARs for patient with ankle pain and made decision to order radiography if indicated	Appropriate assessment & evaluation of OARs for **Foot:** RN showed return demonstration of all criteria of OARs for patient with foot pain and made decision to order radiography if indicated	Signature of pediatric RN	Signature of validator **(Dr. Foulkes, MD; Ben Kim, RN; Charlotte Savarino, RN; Kim Barthel, RN)**	Date

Appendix H

Triage Audit & Triage Documentation Form Pseudo-Identifier Link

Pseudo-Identifier (xx1, xx2, xx3, …)	Patient name
xx1	James QI
xx2	Joan Project

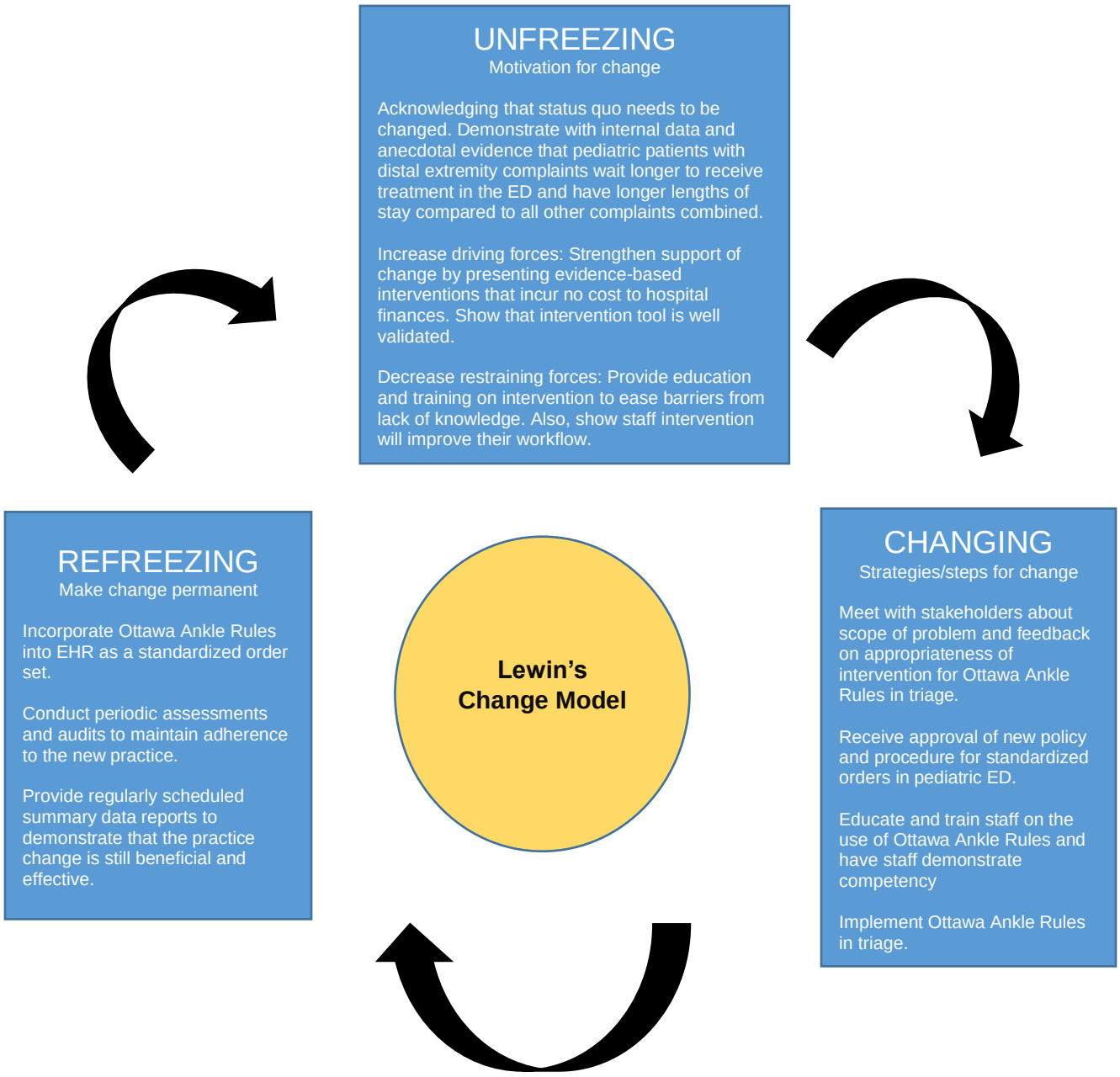
Appendix I

Staff Pseudo-Identifier Link

Pseudo-Identifier (xx1, xx2, xx3, …)	Name of pediatric RN
xx1	Jon Doe, RN
xx2	Jane Doe, RN

Appendix J

Mid-Range Theory



Note. Adapted from Lewin's Change Theory. Three stages of change. Swanson, D. J., & Creed, A. (2014). Sharpening the focus of force field analysis. Journal of Change Management, 14(1), 28-47. https://doi.org/10.1080/14697017.2013.7880