

## Effect of Triage-Based Use of the Ottawa Foot and Ankle Rules on the Number of Orders for Radiographic Imaging

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**Context:** Reducing unnecessary testing lessens the cost burden of medical care, but decreasing use depends on consistently following evidence-based clinical decision rules.

The Ottawa foot and ankle rules (OFARs) are validated, longstanding evidence-based guidelines to predict fractures. Frequently, radiography is automatically ordered for acute ankle injuries despite findings from OFARs suggesting no fracture.

**Objectives:** First, to determine whether implementation of protocol-driven use of the OFARs at triage would decrease the number of radiography orders and length of stay (LOS) in the emergency department. Second, to quantify the incidence of OFARs use at triage and to assess patient expectations of radiography use and patient satisfaction as rated by both patients and clinicians.

**Methods:** In this prospective, 2-stage sequential pilot study, patients with acute ankle and foot injuries were screened in the emergency department between January 2013 and October 2013. In the first stage, clinicians (physician assistants, residents, and attending physicians) performed their usual practice habits for radiography use in the control group. For the second stage, they were educated to appropriately apply the OFARs before ordering radiography. For patients who were suspected of having a fracture at triage, nursing staff ordered radiography. For patients who were not suspected of having a fracture at triage, a clinician reassessed them using the OFARs after their triage assessment. Radiography was then ordered at the discretion of the clinician. Results gathered after training in the OFARs comprised the intervention group. After discharge, patients were surveyed regarding their expectations and satisfaction, and clinicians were surveyed on their perceptions of patient satisfaction.

**Results:** A total of 131 patients were screened, 62 patients were enrolled in the study after consent was obtained, and 2 patients withdrew from the study prematurely, leaving 30 patients in each group. Fifty-eight of the 60 patients (97%) underwent radiography. Emergency department LOS decreased from 103 minutes to 96.5 minutes ( $P=.297$ ) after the OFARs were applied. There was also a decrease in LOS in patients with a fracture (137 minutes vs 103 minutes [ $P=.112$ ]). Radiography was expected to be ordered by 27 of 30 patients in the control group (90%) and 24 of 30 in the intervention group (80%) ( $P=.472$ ). Patients were equally satisfied among the groups (54 of 60 [90%]) (with no difference between groups), and 27 of 30 (90%) vs 30 of 30 (100%) clinicians in the control and intervention groups, respectively, perceived that patients were satisfied with their treatment.

**Conclusion:** There was no statistical evidence that application of the OFARs decreases the number of imaging orders or decreases LOS. This observation suggests that even when clinicians are being observed and instructed to use clinical decision rules, their evaluation bias tends toward recommendations for testing.

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Ankle injuries account for nearly 2 million visits to the emergency department (ED) in the United States and Canada each year.<sup>1</sup> Of these injuries, 15% involve clinically significant fractures of the ankle.<sup>2</sup> First described in 1992, the Ottawa foot and ankle rules (OFARs) were developed to assess the need for radiography in patients with an acute ankle or foot injury.<sup>3</sup>

Prospectively validated in 1993 by Stiell et al,<sup>3</sup> the Ottawa ankle rule requires localized bone tenderness of the posterior edge or tip of either malleolus or the inability to bear weight both immediately after the injury or in the ED (*Figure*). The Ottawa foot rule was also validated during the same study and requires bone tenderness at the base of the fifth metatarsal, bone tenderness at the navicular, and the inability to bear weight both immediately after the injury and in the ED.<sup>3</sup>

Both the ankle and foot clinical decision rules (CDRs) have shown a high sensitivity for diagnosing acute fracture after traumatic injury in both the adult (sensitivity, 100%) and pediatric (sensitivity, 98.2 % for children aged  $\geq 5$  years) populations.<sup>4,5</sup> After implementation of the OFARs, health care savings predictions varied between \$614,226 and \$3,145,910 per 100,000 patients in the United States, compared with \$730,145 per 100,000 patients in Canada.<sup>6</sup>

The lack of acceptance of this established tool at the clinical bedside has been reported and used as a case example of knowledge translation failure.<sup>7</sup> A survey-based study<sup>8</sup> suggested that 90% of US and Canadian emergency physician respondents were aware of the rules. However, 35% of US respondents reported using them in daily practice compared with more than 80% of their Canadian counterparts.<sup>8</sup> The mere publication of an abundance of confirmatory studies is insufficient to result in widespread implementation and changes in practice, even in the centers originally involved in developing and validating the Ottawa ankle rules.<sup>8-10</sup>

Moving the decision-making process from the physician to the nurse at bedside has been done in the ED setting, and studies have established that there is not only accurate understanding of CDRs among nurses,

but there is agreement between nursing orders of radiography and physician practice.<sup>11-13</sup> The OFARs have also been shown to be easily interpreted and applied by nursing staff after adequate training.<sup>13</sup>

Whether the nurse as a primary decision maker decreases radiography orders (thereby decreasing ED LOS) is still subject to debate. One study reported that imaging ordering by triage nurses decreased LOS in patients suspected of having a fracture.<sup>14</sup> Another study<sup>15</sup> at an urgent care center failed to show a significant decrease in LOS when ordering authority and OFARs were taken on by nursing staff and showed an increase in orders for radiographic imaging. Others have shown conflicting data on the effect of CDR implementation in ED triage on LOS.<sup>15-18</sup>

We set out to determine whether implementation of the protocol-driven OFARs at triage would decrease the number of radiography orders in the ED as well as LOS. Secondly, we hoped to determine patient expectations of radiographic imaging and patient satisfaction as rated by both patients and clinicians, defined here as triage nurses, other nursing staff, residents, physician assistants, nurse practitioners, and physicians.

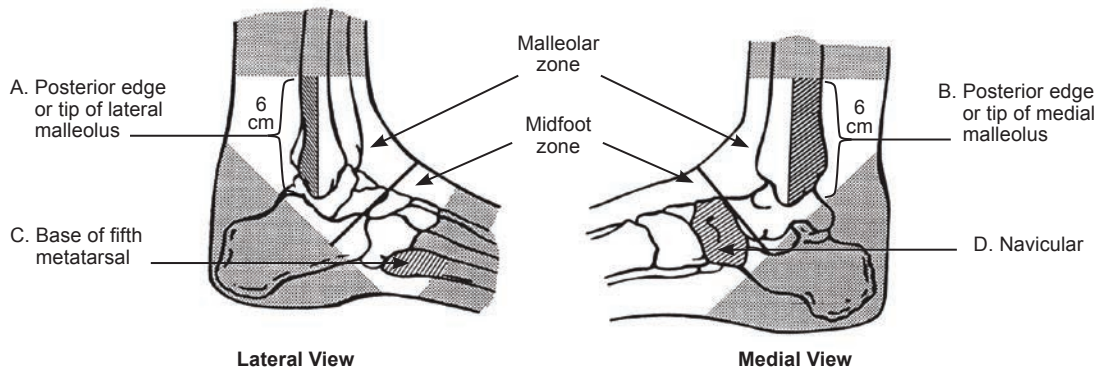
## Methods

### Setting

A prospective, 2-stage sequential designed pilot study was implemented after local institutional review board approval at Lehigh Valley Health Network (LVHN). From January 2013 to October 2013, patients who presented to 1 of 2 EDs within the LVHN with ankle or foot injuries were assessed for study enrollment. Study sites included a suburban tertiary care center with approximately 95,000 patients per year and an urban ED with approximately 33,500 patients per year.

### Population

Patients were included in the study if they were aged 16 years or older, spoke English or Spanish, and sustained an isolated traumatic ankle or foot injury with no other complaints or injuries present. A total of 131 patients



**Figure.**

Ottawa rules for assessing the need for radiography in patients with foot and ankle injuries. Reprinted from Stiell et al,<sup>3</sup> with permission from Elsevier.

with acute ankle or foot injuries were screened. Consent was obtained from patients younger than 18 years through an assenting process followed by parental consent. For those patients who spoke Spanish as their primary language, a separate Spanish consent form was developed that mirrored the English consent form, and an LVHN Spanish interpreter discussed the process with these patients. Exclusion criteria included the following: inability to give consent, current pregnancy, inpatient admission, presence of neurovascular compromise (pulselessness in the limb or overt signs of nerve damage), obvious ankle or foot deformity, open fracture, no isolated ankle or foot injury, or presence of gait abnormality of unknown origin (in pediatric patients).

### Procedures

The LVHN staff was not blinded to the study; they were told that the investigators were conducting a research study to assess the amount of radiographic tests being ordered.

Each eligible patient was identified at the primary triage nurse encounter and approached by a research

assistant, when available, after an emergency severity index number was assigned. After appropriate consent or assent, the LOS variable was initiated.

During the first stage of the study, clinicians (triage nurses, other nursing staff, and residents) and advanced practicing clinicians (physician assistants, nurse practitioners, and physicians) performed ankle and foot assessments as they would normally. Patients seen during the first stage were in the control group.

After the first stage was completed, and to prepare for the second stage, an educational session was conducted for clinical staff on the appropriate use of the OFARs through didactic and practical demonstration. The 30-minute educational session comprised a YouTube video depicting how to apply the OFARs (<http://www.youtube.com/watch?v=Bjktf4PCYgM>) followed by a 15-minute hands-on activity in which the clinicians demonstrated their knowledge. Clinicians were also educated on proper documentation of the OFARs in electronic medical records to ensure compliance with documentation. The OFARs' diagnostic criteria were also posted around the department.

In the second stage of the study, triage nurses examined the affected limb using the OFARs to determine whether patients needed radiographic imaging. For patients with suspected fracture at triage, nursing staff ordered radiography. After imaging, patients with suspected fracture were then brought back to the triage area until a treatment room became available. Those who were not suspected of having a fracture (no fracture suspected) at triage were assigned rooms in the treatment area. A clinician then assessed all patients. Those who were not suspected of having a fracture at triage received imaging at the discretion of the clinician. Those who were not suspected of having a fracture by both the triage nurse and the clinician received a written explanation about why radiography was not ordered in their discharge instructions. For those patients who underwent imaging, positive ankle or foot radiographs were defined as the presence of 1 or more fractures or dislocation as determined by a staff radiologist. Patients who received care after the educational session were in the intervention group.

A research assistant accompanied each patient throughout his or her stay in the ED and ensured that both clinicians and patients completed patient satisfaction surveys after discharge. The 3-question survey was not validated. The first 2 questions, structured in a yes/no format, were as follows: (1) “Were you expecting to receive an x-ray today?” And (2) “Do you plan on seeking a second opinion with any other health care providers (excluding any advice for follow-up given to you by your health care provider today)?” The last question, “Were you satisfied with your emergency department visit today?” used a 5-point Likert scale ranging from completely dissatisfied to completely satisfied. Two weeks after patient discharge, a research assistant followed up by telephone using a standardized questionnaire that measured whether the patient sought follow-up, whether he or she received additional imaging, and whether there were any missed fractures.

### Statistical Analysis

A power analysis was completed before patient recruitment began to ensure adequate enrollment. The sample size was determined based on the interest to quantify specific parameters that may be used in the powering of future research. An intention to treat (ITT) sample size of 60 patients was estimated based on type I and II error rates of 5% and 20%, respectively. Thus, this pilot study was statistically powered for 30 patients to be enrolled in each group. Primary outcomes were the number of radiography orders and the total LOS in minutes, defined as the length of time between informed consent until discharge from the ED. Secondary outcomes were to quantify the incidence of OFARs use at triage in all cases, and to assess overall patient and clinician satisfaction.

All computations were performed using SAS software version 9.2. Continuous demographic parameters, such as patient age at the time of enrollment, were summarized for the ITT population using descriptive statistics (N, mean, median, SD, minimum and maximum value, and 95% 2-sided CLs) and compared between groups using a 2-sample *t* test. Categorical demographic parameters, such as sex, were summarized as a proportion of the ITT population and compared using a 2-tailed Fisher exact test. Comorbid risk factors were summarized for the ITT population by implementation of the OFARs and according to the type of variable and were compared between groups. Kaplan-Meier estimates for time-to-event analyses were prepared based on the ITT population. Separate tables containing patient counts, percentages, and 95% binomial CLs were prepared on the basis of individual risk factors.

Patients who underwent radiography were analyzed using a 2-factor generalized linear model based on maximum likelihood, specifying the distribution as dichotomous. Analysis of the time to discharge was based on a time-to-event analysis using a Cox proportional hazards regression model. Patient and clinician expectations and satisfaction were recorded and analyzed as a multinomial end point using a 2-factor generalized linear model.

## Results

Sixty-two patients met the inclusion criteria and were enrolled. Two of these patients withdrew prematurely but were included in an ITT analysis. Thirty-seven female (61.7%) and 23 male (38.3%) patients were included in the study. The mean (SD) age was 36.5 (16.58) years (range, 16-85 years). Each study group had 30 patients. Of the 60 patients, 58 were sent for radiographic imaging (29 control, 29 intervention); there were no tests of significance conducted for this end point, given that more than 96% of the patients underwent imaging. Acute fracture was found in 9 patients (30%) in the control group and 7 patients (23%) in the intervention group.

At triage, 1 nurse (3%) in the control group and 2 (7%) in the intervention group documented using the OFARs ( $P=.29$ ). After triage, use of the OFARs was documented by 6 clinicians (for 6 patients) (20%) in the control group and 25 (for 25 patients) (83%) in the intervention group ( $P<.001$ ).

The mean difference in total LOS between the 2 groups was -6.5 minutes ( $P=.297$ ) in favor of the intervention group. In patients with a fracture, the median time in the ED for the control group was 137 minutes, and in the intervention group, 103 minutes ( $P=.112$ ). In patients without a fracture, the median time in the ED for the control and intervention groups was 96 minutes and 85 minutes, respectively ( $P=.751$ ).

Although there was an increase in overall clinician-perceived patient satisfaction in the control and intervention groups (27 of 30 [90%] vs 30 [100%], respectively;  $P=.237$ ), secondary analysis of patient satisfaction revealed that 54 of 60 patients overall (90%) were satisfied with their care in the ED. Notably, 27 patients (90%) in the control group and 24 (80%) in the intervention group expected radiography to be ordered ( $P=.472$ ).

Several people with fractures had follow-up imaging to assess fracture and most likely closed fracture reduction following splint placement. On the basis of our data, we cannot tell whether the radiograph was taken before or after cast placement or on another body part. We did not specifically ask this question during our survey. At the 2-week telephone follow-up, we

were unable to contact 2 patients (1 from the control and 1 from the intervention). The majority of patients (53%) did not seek follow-up care at 2 weeks. Of those who did follow up with another physician, 93% patients in the control group and 64% patients in the intervention group did not undergo imaging.

## Discussion

Despite the influence of knowing their care was being observed for a research study, clinicians ordered radiography for 58 of 60 patients. This behavior suggests that even when clinicians are being observed and instructed to use CDRs, they tend to order radiography. We were not able to assess one of our primary outcomes (LOS) because only 2 patients did not receive orders for imaging.

The clinicians in the current study may have held similar attitudes to US physicians in another study, who were found to have the least positive attitudes toward the use of CDRs compared with physicians in other countries.<sup>8</sup> Despite believing that CDRs are intended to cut health care costs and improve quality of care, many US physicians also believe that CDRs will not protect them from patient complaints, will challenge physicians' authority, and may increase the likelihood of litigation.<sup>8</sup> A missed fracture is one of the most common reasons for litigation in the United States.<sup>8,19</sup> As reported by Wilson et al,<sup>20</sup> physicians perceived that patients would not be satisfied with their care unless they received testing and that patient preferences tended to influence physician compliance with guidelines.

Another factor that may have influenced the number of radiography orders could be related to the failure of knowledge translation. The Canadian Institutes of Health Research<sup>21</sup> defines *knowledge translation* as follows:

[T]he exchange, synthesis and ethically sound application of knowledge—within a complex system of interactions among researchers and users—to accelerate the capture of the benefits of research for patients through improved health, more effective services and products and a strengthened health care system.

Despite the educational session for the clinicians in the intervention group, the translation of knowledge may not have occurred or may not have been retained among staff.

The current literature on the use of the OFARs after active knowledge dissemination indicates a lack of knowledge translation among physicians who did not fully demonstrate use or knowledge of the OFARs. Brehaut et al<sup>10</sup> performed a survey of 399 randomly selected Canadian physicians to determine whether they accurately, consistently, and exclusively used the OFARs. The overall response rate was 69.7% for the study, and 89.6% of those who responded stated that they used the OFARs always or most of the time.<sup>10</sup> However, only 30.9% were able to distinguish all components of the rules when questioned.<sup>10</sup>

Gravel et al<sup>22</sup> developed a mnemonic device to improve retention of all components of the OFARs. A single-blinded randomized control trial was undertaken during a pediatric emergency medicine rotation.<sup>22</sup> Students and residents in the intervention group were instructed on the 44-55-66-PM (inability to ambulate 4 steps immediately or in the ED, pain at the fifth metatarsal or the scaphoid, and pain 6 cm along the posterior edge of either malleolus) mnemonic device and answered a questionnaire at 3 weeks and 5 to 9 months after instruction.<sup>22</sup> After 3 weeks, knowledge of the components from the OFARs was similar, but at long-term follow-up, the intervention group showed an increased ability to remember components from both the mnemonic device and the OFARs.<sup>22</sup> In the current study, the educational intervention was not assessed, but moving forward with future studies, a pre- and posteducation test could be used to assess retention of knowledge.

Because nearly all of the patients in the intervention group underwent radiography, conclusive comments about patient satisfaction with radiography orders is difficult to ascertain. However, patients have been shown to be equally satisfied with care irrespective of radiography for acute ankle and foot injuries in previous studies.<sup>20,23</sup> Research has shown that effective communication can facilitate decision making, improve patient understanding, and increase patient satisfaction.<sup>20</sup>

As evidenced by the Choosing Wisely campaign (<http://www.choosingwisely.org/>), the medical profession continues to implement endeavors to greatly reduce the overuse of tests and, particularly, to avoid unnecessary tests. Based on the present pilot study, future studies may need to further assess how to best facilitate knowledge translation before these public campaigns can be successful. To ensure that the correct tests are ordered, facility administrators may have to encourage the necessary conversations between clinicians and patients to change patient expectations.

### Limitations

The OFARs were the first guidelines developed to be used by physicians as a screening tool to assess the need for radiography in patients with acute ankle or foot injuries. The current literature supports the use of the OFARs by nursing staff, but the OFARs have not been previously tested on triage nurses, to our knowledge.

The interpretation of the OFARs by our clinicians may have been biased, owing to knowledge and conceptions of patient care as established in their respective fields at this facility. Perceptions that patients wanted imaging might have influenced clinicians to loosely interpret the rules and order radiography. Therefore, the number of tests ordered would have been expected to increase and, secondarily, negatively affect LOS. Further, owing to incomplete documentation in the majority of the medical records, we were not able to determine how many patients the OFARs indicated should undergo radiography.

Along the same lines, we did not study knowledge translation, retention, and teaching methods. There was no directed follow-up to the education provided on the OFARs. The large number of radiography studies ordered may therefore have been the result of the triage nurse or clinician not correctly applying the OFARs. Also, the teaching method used in the study was not a vetted means of knowledge translation in the literature.

We studied patients in northeastern Pennsylvania; the results may not be generalizable to other communities. The number of patients surveyed was too small to

make profound interpretations. Additionally, sampling being limited to research assistant availability may have introduced bias.

### Further Research

The results of this pilot study have laid the groundwork for numerous future studies on the use of CDRs and the perceived constraints that physicians feel CDRs impose. First, the current study should be repeated with a larger number of patients to determine whether the trend of decreased LOS in those with fractures compared with those with sprains is statistically significant. This investigation could be accomplished through a multicenter design or by allowing a longer study period. Second, a systems-based approach could be studied to assess at which interval a decreased LOS would be statistically significant.

Although LOS is an important factor in emergency medicine, one must understand the reasons why a physician is reluctant to follow CDRs. This question was not directly assessed in the current study but should be followed up to determine whether there is a failure of knowledge translation or whether preconceived notions regarding CDRs play a role in physicians' practice habits. This assessment can be accomplished as 2 studies in which the researcher uses different teaching techniques and follows up with the learner at a set amount of time to assess retention of the components of the OFARs. Physicians' practice habits can be assessed through a survey study, and comparisons can be made with the literature to assess the role that CDRs play in everyday practice. Further, public campaigns to ensure that the correct tests are ordered may have to emphasize the necessary conversations between clinicians and patients that change patients' expectations.

### Conclusion

We found no statistical evidence that use of the OFARs results in a decrease in the number of radiography orders or a decrease in LOS. Although LOS was less in those with an acute fracture, the sample size was too

small to determine causality. Patient satisfaction does not appear to be related to the application of the OFARs at triage, and clinician-perceived patient satisfaction needs to be further investigated before definitive conclusions can be drawn.

### Author Contributions

All authors provided substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data; Drs Ashurst, Nappe, Digiambattista, Kambhampati, Alam, Kurt, Kane, and Greenberg drafted the article or revised it critically for important intellectual content; and all authors gave final approval of the version of the article to be published.

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