A Pragmatic Randomized Evaluation of a Nurse-Initiated Protocol to Improve Timeliness of Care in an Urban Emergency Department

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Study objective: Emergency department (ED) crowding is a common and complicated problem challenging EDs worldwide. Nurse-initiated protocols, diagnostics, or treatments implemented by nurses before patients are treated by a physician or nurse practitioner have been suggested as a potential strategy to improve patient flow.

Methods: This is a computer-randomized, pragmatic, controlled evaluation of 6 nurse-initiated protocols in a busy, crowded, inner-city ED. The primary outcomes included time to diagnostic test, time to treatment, time to consultation, or ED length of stay.

Results: Protocols decreased the median time to acetaminophen for patients presenting with pain or fever by 186 minutes (95% confidence interval [CI] 76 to 296 minutes) and the median time to troponin for patients presenting with suspected ischemic chest pain by 79 minutes (95% CI 21 to 179 minutes). Median ED length of stay was reduced by 224 minutes (95% CI −19 to 467 minutes) by implementing a suspected fractured hip protocol. A vaginal bleeding during pregnancy protocol reduced median ED length of stay by 232 minutes (95% CI 26 to 438 minutes).

Conclusion: Targeting specific patient groups with carefully written protocols can result in improved time to test or medication and, in some cases, reduce ED length of stay. A cooperative and collaborative interdisciplinary group is essential to success. [Ann Emerg Med. 2016;68:546-552.]

Please see page 547 for the Editor's Capsule Summary of this article.

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INTRODUCTION

Background

Emergency department (ED) crowding has required broad and creative strategies to ensure timely care provision.[1] A diverse range of approaches has been undertaken early in the patients' stay, such as diagnosis-specific nurse-initiated protocols that direct evidence-based care for sepsis,[2] corticosteroids for asthma,[3,4] sickle cell crisis,[5] chest radiograph in pneumonia,[6] and thrombolysis for myocardial infarction.[7] The purpose of these protocols is to make consecutive processes simultaneous and to improve departmental performance. Alternatively, protocols can target presenting complaints, such as chest pain[8] and abdominal pain,[9,10] and direct both diagnostics and treatments.

Two of the most common nurse-initiated protocols in the literature are the facilitation of radiographic examinations of orthopedic injuries[11-14] and analgesia provision.[9,15-20] The potential benefit of protocols is reductions in length of stay, especially after the patient is treated by a physician or nurse practitioner, because diagnostics are available during initial assessment, allowing disposition decisionmaking to occur.[10] One such study determined that the time saving in patient length of stay for 4 different presenting complaint protocols resulted in a 16% reduction in length of stay regardless of protocol deployed.[21] Deforest and Thompson[8] described combining nurse-initiated protocols with clinical scoring systems to create advanced nursing directives to have the best available evidence guide care. Unfortunately, the legality and acceptance of complaint-specific protocols are often unclear.[22]

Alternative "up-front" interventions include geographically anchoring nurse practitioners[23] or physicians[24] at triage to initiate care. The department being evaluated once had a triage physician, but the position's funding was discontinued before the evaluation. Triage

Editor's Capsule Summary

What is already known on this topic

Nurse-initiated management has potential to improve emergency department (ED) throughput for specific groups of patients.

What question this study addressed

This pragmatic randomized controlled trial assessed the effect of nurse-initiated management on ED length of stay and time to test or treatment for 5 common ED problems: fever or pain, suspected hip fracture, chest pain, vaginal bleeding in pregnancy, and abdominal pain.

What this study adds to our knowledge

Four of the targeted groups (n=23, 47, 19, and 46) showed improvement in median time to the outcome of interest. For suspected hip fracture, improvement seems likely but could not be clearly established because of small numbers (n=9).

How this is relevant to clinical practice

Use of well-designed nurse-initiated protocols may help improve ED throughput.

nurses in a 2012 study demonstrated a 76% sensitivity and 85% specificity when predicting patient admission,[25] implying potential untapped utility in streaming patients accordingly.

To our knowledge, this is the first study to combine the Revised Standards for Quality Improvement Reporting Excellence[26] with the Consolidated Standards of Reporting Trials[27] pragmatic trials extension to evaluate nurse-initiated protocols. To our knowledge, it is also the first evaluation of 5 diverse diagnostics-focused protocols implemented at any physical location in the ED (triage, hallway, and waiting with emergency medical services or in an ED patient care space while awaiting physician or nurse practitioner assessment).

MATERIALS AND METHODS

Setting

This evaluation took place in a busy and crowded inner-city, medium-sized, western Canadian ED with 55 beds, variable 25% to 40% emergency inpatient bed block, an annual census of 75,000, and a 10% left-without-treatment rate. The Royal Alexandra Hospital ED is publicly funded and administered by Alberta Health Services. The surrounding community of Edmonton is the provincial capital of Alberta, Canada's fifth-largest city, a governmental and cultural center with a metropolitan area population of 1.3 million. It has a major research university and is known as the Gateway to the North, a staging point for oil sands and mining projects.

Interventions

Our nurse-initiated protocols had been used for approximately 15 years without significant update or evaluation. These protocols were initially developed to provide more timely care, although they became used inconsistently. Before protocol evaluation, a multidisciplinary team, through collaboration and consensus building, reviewed and revised the protocol content. Six physicians and 44 registered nurses, 3 clinical nurse educators, and 3 unit managers were involved in revising 6 chief-complaint-focused protocols (see the Appendix E1 for protocols, available at http://www.annemergmed.com). The protocols were updated according to a review of evidence, culture, and compromise between clinician groups about any competing priorities such as nursing workload or physician practice styles.

Thirty (30/180) emergency nurses were provided 1 hour of training on the evaluation's inclusion and exclusion criteria, protocol procedure, and evaluation methods. Nurse training included review of the inclusion and exclusion criteria for each protocol, the enrollment procedure, evaluation document handling, and a number of case scenarios. These nurse "superusers," who enrolled patients and enacted the protocols, were selected through stratified sampling methods. Three groups of nurses were targeted for recruitment, one group with 3 to 5 years' experience (n=12), one group with 6 to 8 years' experience (n=10), and a third group with 10 or more years' experience (n=8). All nurses had a minimum of 3 years' experience and had progressed through our department to resuscitation or trauma training. Eighteen nurses were employed full time, 10 part-time, and 2 periodically.

Eligibility criteria, inclusion, and exclusion were specific to each protocol. The acetaminophen for pain and fever protocol was written for patients older than 3 months. The suspected fractured hip, suspected ischemic chest pain, lower abdominal pain, upper abdominal pain, and vaginal bleeding during pregnancy protocols were designed for adult patients aged 17 years or older. Patients could be enrolled by any of the trained nurses at any physical location in the ED before their being treated by a physician.

Over 42 days in the winter of 2014/2015, patients were enrolled by the 30 trained emergency nurses working their regular assignments and workloads. The protocol

application was not strictly standardized. The enrolling nurse could deviate from the protocol by seeking consultation with a physician, outside the protocol scope, at any time. No additional resources were added or removed from the ED to perform this evaluation.

Patients who met protocol inclusion criteria were enrolled and allocated to either intervention (receive the protocol) or control (usual care) groups. Computerized randomization (http://www.randomizer.org) instructions contained in consecutively numbered opaque envelopes directed allocation. If the patient was allocated to the control group but the nurse believed he or she required diagnostics or treatments to be initiated immediately, the nurse involved a physician for covering order or assessment. Nurses were empowered to involve a physician at any time according to patient acuity. Enrollment stopped after 42 days because of lack of resources. No sample size calculations were performed.

Outcome Measures

The primary objective of this evaluation was to determine whether our nurse-initiated protocols improved the timeliness of care according to a priori–defined outcome measures that were specific to each protocol. The primary outcomes were time to diagnostic test, time to treatment, and length of stay. The secondary outcome of this initiative, clinician satisfaction, was elicited by physician satisfaction questionnaires affixed to paper charts of enrolled patients. The protocol-trained nurses completed an anonymous online questionnaire before and after the evaluation. We hypothesized that protocols would result in more timely care provision and clinicians would be satisfied with them.

Primary Data Analysis

Statistical analysis occurred in a blinded fashion. The data were abstracted from the data set in a manner concealing patient allocation. Clinician blinding was not possible because of documentation and ethical standards. The Alberta Research Ethics Community Consensus Initiative's Ethics Screening Tool was used to screen this evaluation, which was scored as low risk and was performed according to Ethics Guidelines for Quality Improvement and Evaluation Projects.[28]

Median outcome times, along with interquartile ranges, were calculated. Confidence intervals (CIs) on the difference in medians were calculated between the intervention and control groups with the method proposed by Bonett and Price.[29] This evaluation followed intention-to-treat analysis.

RESULTS

One hundred forty-three patients were approached to determine eligibility (Figure). The protocol nurses sought verbal orders from emergency physicians for 9 patients of the 143 after allocation to the control group. The protocol nurses sought physician involvement to obtain acetaminophen orders for 3 patients, to initiate diagnostics and administer aspirin for 4 patients with suspected ischemic chest pain, and to initiated diagnostics for 1 patient with vaginal bleeding during pregnancy and 1 presenting with upper abdominal pain. One hundred forty-three patients were enrolled in the evaluation, 76 in the protocol and 67 in the control group.

All but 17 patients were enrolled from triage of our ED. Sixty-six female patients and 77 male patients were enrolled. The average age was 56 years and the median was 49 years. Canadian triage and acuity scores ranged from 2 to 5 and averaged 3.2 (median 3). Only 1 violation of protocol adherence (inclusion, exclusion criteria, and execution) was noted during the evaluation, in which a nurse added a venous blood gas test to the suspected ischemic chest pain serum investigations.

Nurse administration of acetaminophen reduced the median time to analgesia or antipyretic by 186 minutes (95% CI 76 to 296 minutes). The median time to acetaminophen for the intervention group (n=11) was 54 minutes (interquartile range 21 to 103 minutes), whereas that for the control group (n=12) was 240 minutes (interquartile range 135 to 182 minutes). No adverse outcomes were reported. Refer to the Table for a summary of results.

The suspected fractured hip protocol reduced the median time to radiograph by 257 minutes (95% CI 161 to 352 minutes). The median time to radiograph in the intervention group was 42 minutes versus 299 minutes in the control group. The difference in medians between the intervention and control groups for patient length of stay was 224 minutes. However, the 95% CI crossed zero, likely because of the small number of patients enrolled (95% CI –19 to 467 minutes). The median length of stay of a patient with suspected fractured hip in the intervention group (n=5) was 196 minutes (interquartile range 38 to 233 minutes) and 420 minutes in the control group (n=4) (interquartile range 357 to 518 minutes).

The suspected ischemic chest pain protocol resulted in a median time to laboratory-reported troponin level of 114 minutes (interquartile range 44 to 235 minutes) in the control group (n=29) compared with 35 minutes (interquartile range 21 to 46 minutes) for patients enrolled in the intervention group (n=18). The difference in the

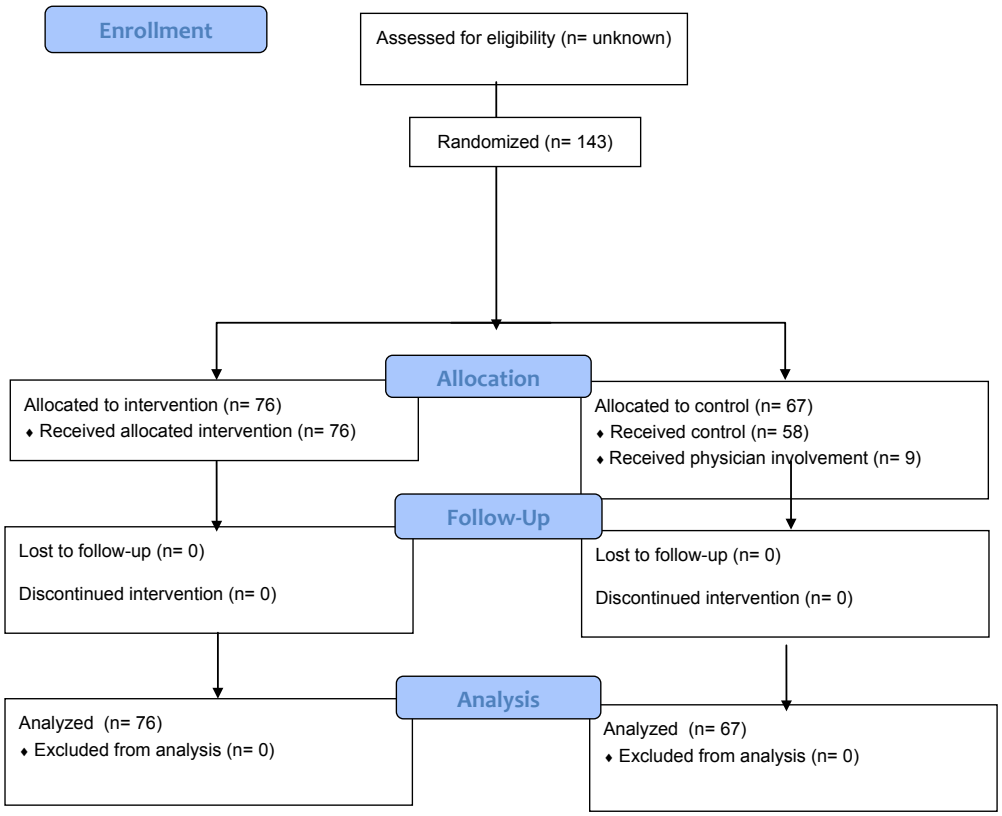

Figure. Pragmatic trial patient flow diagram.

medians was 79 minutes (95% CI 21 to 179 minutes). Nurse-initiated testing identified a non–ST-segment elevation myocardial infarction in our waiting room; however, the suspected ischemic chest pain protocol did not reduce the length of stay of enrolled patients.

The vaginal bleeding during pregnancy protocol, consisting of serum hemoglobin level, rhesus typing, and β-human chorionic gonadotropin testing alone, reduced median ED length of stay from 527 minutes in the control group (n=8) (interquartile range 351 to 625 minutes) to 295 minutes in the intervention group (n=11) (interquartile range 208 to 345 minutes). The difference in the median length of stay was 232 minutes (95% CI 26 to 438 minutes).

The median ED length of stay for patients enrolled in the lower abdominal pain protocol intervention group (n=9) was 320 minutes (interquartile range 236 to 483 minutes) and in the control group (n=9) was 501 minutes (interquartile range 424 to 523 minutes). The difference in the medians was 181 minutes (95% CI 1 to 361 minutes).

The difference in ED length of stay between the upper abdominal pain intervention (n=10) and control group (n=18) was 131 minutes (95% CI 16 to 278 minutes). The median ED length of stay for the intervention group was 347 minutes (interquartile range 208 to 420 minutes) versus 478 minutes (interquartile range 350 to 632 minutes) in the control group.

Table. Median outcome times: protocol versus control results.

Protocol Name	Outcome	Median Intervention Outcome Time, Minutes (Interquartile Range)	Median Control Outcome Time, Minutes (Interquartile Range)	Difference in Medians	95% CI of the Difference in Medians, Minutes
Acetaminophen for pain and fever (n=23)	Time to analgesia	54 (21 to 103)	240 (135 to 182)	186	76 to 296
Suspected fractured hip (n=9)	ED length of stay	196 (38 to 233)	420 (357 to 518)	224	–19 to 467
Suspected ischemic chest pain (n=47)	Time to troponin	35 (21 to 46)	114 (44 to 235)	79	21 to 179
Vaginal bleeding during pregnancy (n=19)	ED length of stay	295 (208 to 345)	527 (351 to 625)	232	26 to 438
Lower abdominal pain (n=18)	ED length of stay	320 (236 to 483)	501 (424 to 523)	181	1 to 361
Upper abdominal pain (n=28)	ED length of stay	347 (208 to 420)	478 (350 to 632)	131	16 to 278

Thirty-three physician satisfaction questionnaires were returned, representing a response rate of 59%. Of the 33 physician satisfaction responses, 29 (88%) were "satisfied or assisted," 4 (12%) were "neutral or unaffected," and zero were "dissatisfied or hindered" with the nurse-initiated protocol.

The enrolling nurses completed an anonymous online survey. Before updating of the protocols, 67% of respondents (20/30) reported being unclear what they were legally and professionally supported to initiate before a physician's seeing the patient. All the nurses surveyed reported that being able to initiate care and diagnostics by protocol increased their satisfaction and that they value doing so (100%). Eighty-seven percent of nurses (26/30) believed the tests were beneficial to patients. Ninety-seven percent of nurses (29/30) were "confident" the protocols represent the diagnostics the physicians send "most" or "all of the time."

LIMITATIONS

For our results to be generalizable to other settings, similar institutional support for nurse-initiated treatments and diagnostics is required, as well as similar departmental operating characteristics such as time to physician and time to consultation. Furthermore, several days of bed closures and understaffing may have affected the results. On the 11th day of the evaluation, 12 consecutively numbered envelopes disappeared. The evaluation continued with the next numbered envelopes.

College of registered nurses' approval of protocols or order sets continues to be a contentious issue for our jurisdiction. In the interest of protecting the public, the registered nurses' regulatory college discourages the use of medical directives, protocols, or standing orders and any registered nurse provision of medications or diagnostics before the patient is treated by a prescriber such as a physician or nurse practitioner. Furthermore, nurses shared their apprehension during training about what would happen if there was a bad outcome after their initiating care by protocol and nursing management and physician staff did not support their decisionmaking. Scope-of-practice issues, organizational approval, and support are often nebulous to the nurses deciding whether to enact protocols. Clarity is essential for protocol success.

The effect of the diagnostics measured in this evaluation is not representative of total patient evaluation or disposition decisionmaking. Nurse selection and enrollment of patients could have introduced bias into the evaluation. Furthermore, the effect of nurse-initiated protocols may be further confounded by protocol-receiving patients being advanced in the queue at triage. However, we believe when negative results are returned the patient is equally likely to be moved down in the triage queue. Finally, we anticipate that postevaluation monitoring for protocol adherence and quality assurance will be a significant challenge for our ED leadership team.

DISCUSSION

Given the long waits experienced in our ED before analgesia provision, the acetaminophen protocol represents a boon. Acetaminophen is a safe medication with limited adverse reactions or effects outside of toxicity. Although opioid medications would be more appropriate for treating acute pain in the ED, there was not institutional support for waiting room initiation of opioids.

Confirmation of hip fracture by radiograph allows early orthopedics consultation and expedited admission in our ED. Allowing triage nurses to initiate radiographs for patients with a shortened and externally rotated lower extremity facilitates confirmed fractures being referred to orthopedics earlier. The process in our ED is that after the radiograph, if positive for fracture, the protocol-initiating nurse informs a physician, who can consult the orthopedic service by telephone while enacting the orthopedic order set, including serum investigations, electrocardiograph (ECG), chest radiograph, and Foley catheter insertion. This facilitates earlier transfer to the inpatient unit once the patient is accepted by the consulting service.

Suspected ischemic chest pain was the protocol most valued by the trained emergency nurses. It was unpalatable to triage nurses to have patients with suspected ischemic chest pain in the waiting room without an ECG performed, acetylsalicylic acid administered, protocol blood work sent, and a saline solution lock in situ. ED length of stay, however, depends on too many consultation service and system variables to be affected by an almost 4 times reduction in time to first troponin level. The identification of a non–ST-segment elevation myocardial infarction in the waiting room was an anecdote often reported by triage nurses as rationale for the protocol. The report of a positive troponin-level result yielded a time to physician of 47 minutes on a day when average wait time was 4 hours and 11 minutes. In our evaluation, having been enrolled in the suspected ischemic chest pain protocol did not have a significant effect on length of stay. ECGs are routinely completed at triage without physician involvement, in accordance with the Canadian Heart and Stroke Foundation, which has been standard practice since 1999.[30] However, their influence is outside the scope of this evaluation because we were unwilling to randomize patients to not receive an ECG.

Presentation to our ED for abdominal pain during the evaluation period and receiving protocolized care did not result in a reduced length of stay. The triage complaint of abdominal pain appears to have been representative of too broad a differential diagnosis and require too many additional diagnostics and consultations to result in a statistically significant reduction in length of stay. Further refinement of patient population may result in a more effective protocol.

Overall, both physicians and emergency nurses experienced high levels of satisfaction related to protocol use. However, simply treating the patients in a timelier fashion and having care spaces available to treat them in may be more effective at achieving clinician satisfaction and reduced patient length of stay, but this is conjecture. The results of this evaluation are likely due to the long waits to consult with a physician in our faculty. Protocolizing medicine to be practiced by nurses is not an ideal solution but a stopgap measure. In settings with long waits, protocol-initiated care may improve timeliness, although efforts to relieve access block and back-end flow must not be neglected.

The use of protocols to initiate diagnostics can decrease length of stay in specific, carefully selected patient groups. Carefully targeting specific patient cohorts with diagnostics can result in some of the information required for patient disposition being made available when the physician or nurse practitioner treats them. According to our experience, a cooperative and collaborative interdisciplinary group is required to create protocols that are acceptable to all clinician groups and beneficial to patients.

In facilities in which long waits exist before patients are treated by physicians and nurse practitioners, creating protocols to guide diagnostics can result in decreased patient length of stay in certain patient cohorts. Sustainability and protocol adherence remain a challenge. Management and leadership team support is essential for maintaining quality review processes. Patients requiring multiple consultations and lengthy investigations and reassessments are less likely to benefit from nurse-initiated diagnostics, according to our findings. Simple presenting complaints in patients with few comorbidities appear to benefit most from nurse-initiated and protocol-directed diagnostics.

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IMAGES IN EMERGENCY MEDICINE

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DIAGNOSIS:

Spontaneous renal hematoma. Originally reported by Bonet in 1679 and later named Wunderlich syndrome, this is an uncommon entity with a classic presentation of Lenk's triad: acute flank pain, tenderness, and symptoms of internal bleeding such as hypovolemic shock.[1-3] Zhang et al[4] reviewed the English literature from 1975 to 1999 and found only 165 case reports. They reported that 61% (101 cases) were from neoplasm, with angiomyolipoma and renal cell carcinoma predominating (48 and 43 cases, respectively), followed by vascular disease (43) and polyarteritis nodosa (20).[4] CT and magnetic resonance imaging are 100% sensitive for the diagnosis and are the preferred diagnostic methods versus ultrasonography, which has a reported 56% sensitivity.[4] Treatment is not standardized, with some studies recommending radical nephrectomy if there is suspicion of subclinical renal cell carcinoma as a cause, whereas others suggest that outpatient serial CT examinations are appropriate until the hematoma is reabsorbed, with nephrectomy reserved for patients with nonfatty lesions other than hematomas, or persistent abnormalities.[5-7]

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