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The Use of a Triage-based Protocol for Oral Rehydration in a Pediatric Emergency Department

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Abstract

Background—Guidelines recommend oral rehydration therapy (ORT) and avoidance of laboratory tests and intravenous fluids (IVF) for mild to moderate dehydration in children with gastroenteritis; oral ondansetron has been shown to be an effective adjunct.

Objectives—To determine if a triage-based, nurse-initiated protocol for early provision of ondansetron and ORT could safely improve the care of pediatric emergency department (ED) patients with symptoms of gastroenteritis.

Methods—This study evaluated a protocol prompting triage nurses to assess dehydration in gastroenteritis patients and initiate ondansetron and ORT if indicated. Otherwise well patients aged 6 months to 5 years with symptoms of gastroenteritis were eligible. Prospective post-intervention data was compared to retrospective, pre-intervention controls.

Results—128 (81 post-intervention and 47 pre-intervention) patients were analyzed; average age was 2.1 years. Ondansetron use increased from 36% to 75% ($p<0.001$). Time to ondansetron decreased from 60 minutes to 30 minutes ($p=0.004$). Documented ORT increased from 51% to 100% ($p<0.001$). Blood testing decreased from 37% to 21% ($p=0.007$); IVF decreased from 23% to 9% ($p=0.03$). 52% of post-intervention patients were discharged with prescriptions for ondansetron. There were no significant changes in ED length of stay, admissions, or unscheduled return to care.

Conclusions—A triage-nurse initiated protocol for early use of oral ondansetron and oral rehydration therapy in children with evidence of gastroenteritis is associated with increased and

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earlier use of ondansetron and ORT and decreased use of IV fluids and blood testing without lengthening ED stays or increasing rates of admission or unscheduled return to care.

Keywords

Triage; ondansetron; gastroenteritis; dehydration; oral rehydration

INTRODUCTION

Diarrheal illness and dehydration are among the main causes of childhood fatality around the world. Even in the United States, gastroenteritis produces significant morbidity and mortality, resulting in over 300 pediatric deaths and 200,000 hospitalizations each year,[1] with total yearly medical costs exceeding two billion dollars.[2] Multiple guidelines recommend the use of oral rehydration therapy (ORT) for the treatment of mild to moderate dehydration.[1–3] Previous studies have shown reductions in hospital admission rates and emergency department length of stay as well as improved patient satisfaction with ORT in comparison with intravenous fluid (IVF) therapy.[4, 5] Guidelines also exist recommending that patients with mild to moderate dehydration should not generally receive laboratory tests. [1, 6] While many developing countries follow these guidelines, developed countries, including the United States, rely heavily upon the use of intravenous rehydration and frequently obtain laboratory studies for even mild cases of dehydration.[7–9]

In addition to guidelines and literature supporting the use of ORT over IVF, several randomized controlled trials have shown that the oral anti-emetic ondansetron decreases vomiting, decreases hospital admissions and improves success rates of ORT in children in the emergency room setting without significant side effects.[10, 11] There is growing consensus in the scientific literature that ondansetron is a safe and effective addition to the ED management of gastroenteritis, but its use varies widely. In one U.S. study, one-third of physicians stated they did not use anti-emetics routinely in vomiting children.[7] In a recent study in Canadian emergency departments, use of anti-emetics for children with gastroenteritis varied from 0–38% by hospital site.[12]

Studies have shown the utility of protocols to allow nurse-initiated care starting at the time of triage for a variety of conditions,[13–17] including favorable results from the early use of ORT, initiated after triage and before physician assessment.[18–20] A recent study found that 16% of emergency departments in Ontario, Canada, reported having directives in place allowing nurse-initiated administration of antiemetics,[21] but no currently published clinical studies specifically address the effects of ondansetron administration by nursing staff at the time of triage.

The purpose of this study was to assess the effects of implementation of a protocol allowing initiation of anti-emetic therapy and ORT for pediatric gastroenteritis patients at the time of ED triage, based on a formal assessment of dehydration by the triage nurse.

METHODS

Study Design and Setting

This study was a pre- and post-intervention analysis of the use of a clinical pathway to support the initiation of gastroenteritis assessment and management in triage. It was conducted in the ED of an urban, tertiary-care, pediatric teaching hospital with an annual pediatric emergency department census of approximately 11,000 children. The relevant institutional review board approved the study prior to protocol implementation and data collection.

Patient selection

Patients were eligible for inclusion if they were between six months and five years of age and presented to the emergency department with concern for gastroenteritis, specifically defined here as diarrhea with or without vomiting. Prospective enrollment of post-intervention patients began on the protocol implementation date of 11/8/2011 and continued through 4/30/2012.

Nurses were encouraged to enroll all eligible patients, but missed eligible cases were not analyzed. Patients were excluded if they had a relevant chronic disease (e.g. active oncologic process, cystic fibrosis, metabolic disease). Children with chronic diseases that were considered unlikely to have a significant impact on the treatment of gastroenteritis and dehydration, such as asthma or epilepsy, were not excluded. To avoid offering oral rehydration to potential surgical patients, those with vomiting without diarrhea or with severe abdominal pain were excluded.

Control patients were selected based on retrospective review of medical records from the 4 months prior to implementation for patients with chief complaints consistent with gastroenteritis. Patients were eligible for inclusion as controls if they reported a history of diarrhea with or without vomiting at the time of triage, indicating that they would have been candidates for treatment under the protocol had it been implemented. To match the approach used in the post-intervention period, patients who mentioned abdominal pain in their chief complaint were included unless there was evidence this pain was reported as severe at the time of triage. Chronically ill patients were excluded under the same criteria used for patients in the post-implementation group.

Intervention

The pathway (Figure 1) was developed by a team of ED nurses and physicians. It consisted of an algorithm outlining an approach to the patient with concern for dehydration due to gastroenteritis. Care began at triage with nurse assessment of the degree of dehydration using a standardized scale (Table 1), adapted from Bailey, et al.[22] The pathway was introduced to nurses and physicians in formal and informal meetings conducted by the investigators prior to the implementation date. If a patient was determined to have “some” dehydration according to the scale (score 1–4), formal oral rehydration therapy with measured amounts of solution to be given at scheduled time intervals was to begin immediately. World Health Organization oral rehydration solution (WHO ORS) packets

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were made available for this purpose, although alternative solutions (e.g., sports drinks, breast milk, commercially available infant rehydration solutions) could be substituted at clinician or family discretion. Children who were determined to have “no” dehydration according to the scale (score 0) were to be offered an unstructured oral challenge of water, milk, juice, an ice pop, or the rehydration solution. It was found that neither the WHO ORS nor the scheduled administration of small, intermittent volumes of oral fluid were well tolerated in mildly dehydrated patients, as they and their families preferred unstructured administration of more palatable fluids. Two months into the study period, the study materials were modified to recommend an unstructured oral challenge with the fluid of the child or family’s choice for all patients with dehydration score of 0 or 1, reserving structured oral rehydration for patients with scores of 2–4.

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If a child had recent or active vomiting according to the judgment of the triage nurse, an anti-emetic (ondansetron orally dissolving tablet or liquid) was administered prior to the initiation of oral rehydration or the oral challenge. This usage of ondansetron in children is off-label, but is well supported by the pediatric literature as noted above. To facilitate prompt physician assessment of children who were more ill, patients determined to have “moderate or severe” dehydration (score 5–8) were not eligible for the triage-based pathway; they were to be brought to the attention of a physician for immediate management. After care was initiated in triage, ED physicians assessed all children according to usual ED protocol. At that time, the physician assessed the success of the oral rehydration attempt and considered the child’s ability to initiate a regular diet.

Data Collection

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For patients treated under the triage protocol, the triage nurse and treating physician collected data on standardized case report forms. Data elements collected included the degree of dehydration at triage (Table 1), anti-emetic medication dosing and administration, documentation of the provision of oral rehydration when indicated, the use of IV fluid administration. Research assistants abstracted additional data on demographics and ED course, including the use of diagnostic studies (including blood testing, urine testing, and imaging studies), and ED disposition (discharge or hospital admission) from the electronic health record (EHR). Families were contacted one week after ED discharge to determine if the patient required unscheduled follow-up care for vomiting or diarrhea at an emergency department, urgent care, or clinic.

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Comparable data on control patients was collected retrospectively through research assistant review of standard documentation present in the EHR. This included review of nursing and physician documentation of fluids offered and consumed by patients during their ED stays. Dehydration score information was not available on control patients, as staff had not been trained on score calculation prior to the initiation of the intervention.

Data Analysis and Outcomes

The primary outcomes were the use ORT, use of anti-emetics and administration of IV fluids. Admission rate, unscheduled return visits for persistent symptoms, laboratory testing, and ED length of stay were measured as secondary outcomes. The differences between pre-

and post-protocol results were tested with a t-test with unequal variances for continuous outcomes, and Fisher's exact test for categorical outcomes. The difference between dehydration scores by the triage nurse and the physician was tested with a paired t-test. All data management and analysis was done in SAS v9.3.

Sample Size

Based on a review of our pre-implementation practice, we estimated that less than 10% of patients were offered oral rehydration but that 50% of children in our emergency department were no more than mildly dehydrated. We conservatively estimated that we would be able to increase our rate of ORT from 10% to 30%. In order to have 80% power to detect a 20% change in use of oral rehydration with a false-positive rate of 5% (i.e. alpha), we needed to enroll 100 children with dehydration (50 patients pre- and 50 patients post- implementation).

RESULTS

A total of 128 patients were enrolled into the study. Eighty-one children were enrolled between November 8, 2011, and April 30, 2012. Forty-seven pre-intervention control patients were identified by review of medical records of patients seen in the emergency department during the four months prior to implementation of the protocol.

Table 2 presents patient demographics and presenting complaint information. A high proportion of patients required language interpreters for their care, most commonly Somali (15% of all patients) or Spanish (4%). Although report of diarrhea to the nurse at the time of triage was a requirement for inclusion in the study, diarrhea was not listed as a *chief complaint* in all patients. There were significant differences in the proportion of patients pre- and post-intervention reporting abdominal pain and vomiting as chief complaints. The difference in abdominal pain is likely due to the post-intervention screening out of patients with significant abdominal pain from care under the study protocol; the difference in vomiting is likely due to the fact that the study protocol specifically prompted triage nurses to screen for and document vomiting.

Although pre-intervention control charts were reviewed for documentation of dehydration, it was found that triage nurses documented consideration of dehydration in only 9% of cases during the pre-intervention period; all of these were described as having no dehydration. Physicians included at least some documentation regarding dehydration in 85% of pre-intervention cases; 78% of these were described as having no dehydration. Table 3 presents the documented degree of dehydration in post-intervention patients. The mean dehydration score calculated by the triage nurse in post-intervention cases was 1.06 (SD 1.31). The mean dehydration score calculated by physicians at the time of their assessment was 0.99 (SD 1.23); P-value for this difference in a paired comparison was 0.65.

Although the study protocol called for an unstructured oral challenge for patients with dehydration scores of 0 (later amended to 0 or 1) and structured oral rehydration for scores of 1–4 (amended to 2–4), in practice, documentation of adherence to formal rehydration versus unstructured oral challenge was poor. Type of fluid given was documented in less than half of post-intervention cases; 27% received juice, 19% received Pedialyte, 17%

received Gatorade, 17% received an ice pop, and the remaining patients received other fluids.

Table 4 outlines the clinical findings and outcomes. Significant differences were found in a number of aspects of patient care before and after initiation of the triage-based protocol. The documentation of oral rehydration therapy was significantly different pre- and post-intervention ($p<0.001$). In addition, there were significant differences in ondansetron use ($p<0.001$), time to ondansetron ($p=0.004$), and IVF use ($p=0.03$). This difference was persistent when patients with documented vomiting were considered separately, as well, and thus was not attributable to the difference in the proportion of patients in the two groups with vomiting. There was no significant difference in the probability of obtaining any laboratory studies between the two groups, but there was a significant difference in the proportion of patients having blood tests. No significant differences were found in admission rate, ED length of stay, or rate of unscheduled return to care for symptoms of gastroenteritis.

At the time of discharge from the emergency department, 17% of pre-implementation patients and 52% of post-implementation patients were discharged with prescriptions for ondansetron ($p<0.001$).

DISCUSSION

We have demonstrated that a triage-nurse based protocol for early assessment of dehydration in children with gastroenteritis can significantly increase the early use of ondansetron and the initiation of oral rehydration therapy. The result is a significant decrease in the use of intravenous fluids and blood testing, without increase in the length of the ED visit, rate of admission to the hospital, or unscheduled return to medical care after discharge. These findings lend support to the safety and efficacy of nurse-initiated use of ondansetron and oral rehydration in children with symptoms of gastroenteritis. Previous studies have shown improvements in timing and delivery of pain medication with triage-based nursing protocols, [13, 14] supporting the idea that nurse-initiated delivery of medications at the time of triage can be a helpful adjunct to standard ED care. In addition, prior investigations have demonstrated successful early initiation of oral rehydration in the pediatric emergency department.[18–20] However, to our knowledge none have assessed the use of ondansetron at the time of triage to support oral rehydration. The efficacy of triage-nurse initiated provision of ondansetron in limiting the use of IV rehydration and blood testing in children with vomiting presumed to be due to gastroenteritis is a key finding of this study.

Previous assessments of agreement between triage nurse and physician interpretation of patient findings have shown mixed results, with agreement on orthopedic decision rules found to be fair, moderate, or good.[23–25] However, independent patient assessment by triage nurses is clearly an important part of ED practice. In the validation study for the dehydration scale from which ours is adapted, the triage nurse assessment of dehydration score was used as the primary assessment for the study.[22] In this investigation, we found that triage nurses and treating physicians showed similar calculation of dehydration scores, with a marked increase in nurses documenting the degree of dehydration. These findings

further support the feasibility of involving triage nurses in the assessment of degree of dehydration.

The initial protocol for this study was designed to mimic formal oral rehydration approaches described in the literature,[4] with frequent, small doses of rehydration solution for patients who had any clinical dehydration. However, we found this approach to be poorly tolerated in our patient population. In patients with mild dehydration, the WHO ORS was not considered palatable, and families preferred to offer unrestricted oral fluid. This low tolerance of formal rehydration is likely attributable to the effects of ondansetron, which decreased ongoing vomiting and obviated the use of small, timed quantities of oral fluid. Despite the use of a less formal approach to oral rehydration, the 2.5% rate of hospital admission in this study was lower than the 11% reported with the use of formal rehydration without antiemetics by Atherly-John, et al.[4] That study reported no patients requiring unscheduled return to care on 2–4 day follow-up, in contrast to our rates of 15% pre- and 19% post-intervention. However, the difference in admission rates and the fact that our follow-up calls were made at least one week after the ED visit render these results difficult to compare. The rates of unscheduled return to care in this study were comparable to those reported the initial study by Freedman, et al, assessing the use of oral ondansetron in children with gastroenteritis in the emergency department.[10]

The initial studies supporting the use of ondansetron in pediatric gastroenteritis patients describe the use of a single dose in the emergency department; they make no comment on its prescription at the time of discharge.[10, 11] An older investigation reported that 9% of children seen for acute gastroenteritis filled prescriptions for anti-emetics, but 92% of these were for promethazine.[26] In our sample, while the protocol did not specifically promote the prescription of ondansetron for home use in discharged patients, 52% of patients in the post-intervention period of this study were discharged with a prescription for ondansetron. Despite the clinical plausibility of ED discharge prescription of ondansetron as a safe and useful intervention for children with ongoing vomiting in the setting of gastroenteritis, we are not aware of literature specifically supporting or refuting this approach. Further study of the role of home use of ondansetron in gastroenteritis would be helpful to guide ongoing practice.

LIMITATIONS

This study was limited by the necessity of retrospective data-collection for the pre-intervention period, and by the inability to formulate exact comparisons between the routine EHR documentation available prior to the intervention and the prospectively collected post-intervention data. For example, the proportion of control patients with vomiting, as a potential indication for ondansetron use, was gathered based on report of vomiting as part of the chief complaint at triage. This almost certainly understated the number of control patients with vomiting, as triage nurses in the pre-intervention period were not prompted to seek this history. However, a larger denominator of pre-intervention patients with vomiting would tend to render the differences in ondansetron use after protocol implementation *more* striking rather than less. Likewise, the necessarily different approach to identifying patients pre- and post-intervention led to a discrepancy in the number of patients with abdominal

pain included among their chief complaints. This could potentially have introduced bias in either direction. However, the total number of patients affected by this difference was small: 5 pre- and 1 post-intervention.

In addition, the use of a contiguous time period for the control group may have had an unknown effect on the data given the seasonal variation in pediatric gastroenteritis, although we expect that the effect this would have on the treatment given to patients presenting with similar symptoms would be small.

Eligible patients were likely missed during the post-intervention period due to paper-based, rather than electronic, data collection. And as with all studies of this type, there is the possibility that nurse and physician behavior in the post-intervention period was influenced in unmeasured ways by the awareness that the study was underway. Last, the generalizability of these findings may be limited by the study's conduction in a single, urban, tertiary care hospital emergency department.

CONCLUSION

A nurse-initiated, triage-based protocol for early initiation of oral ondansetron and oral rehydration therapy in children with evidence of gastroenteritis is associated with increased and earlier use of ondansetron and ORT and decreased use of IV fluids and blood testing without lengthening ED stays or increasing rates of admission or unscheduled return to care.

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Abbreviations

ORT	Oral rehydration therapy
IVF	Intravenous fluid
EHR	Electronic health record
WHO ORS	World Health Organization Oral Rehydration Solution
SD	Standard deviation

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Figure 1. Protocol for assessment and early treatment of dehydration

Treatment according to this protocol was initiated by nurses at the time of triage

Table 1

Calculation Parameters for Dehydration Scale

Point value ^a	0	1	2
General appearance	Normal	Thirsty, restless, or lethargic, but irritable when touched	Drowsy, limp, cold, or sweaty, +/- comatose
Eyes	Normal	Slightly sunken	Very sunken
Mucous membranes (tongue)	Moist	Sticky	Dry
Tears	Tears	Decreased tears	Absent tears

^aPoint values are added up to obtain a final score. Zero indicates “no dehydration,” 1–4 indicates “some dehydration,” and 5–8 indicates “moderate to severe dehydration.”

Table 2

Study Patient Characteristics

	Pre (n=47)	Post (n=81)	P-value
Age (years) ^a	1.9 (1.2)	2.2 (1.3)	0.346
Male gender	30 (64%)	53 (65%)	0.850
Interpreter used	13 (29%)	15 (19%)	0.188
Chief complaint^b			
Diarrhea ^c	40 (85%)	68 (86%)	1.0
Vomiting	25 (53%)	60 (76%)	0.011
Fever	17 (36%)	20 (25%)	0.228
Abdominal pain	5 (11%)	1 (1%)	0.027
Other	6 (13%)	11 (14%)	1.0

^aMean (SD)^bPercentages add up to more than 100 as some patients had multiple chief complaints.^cMeasures inclusion of diarrhea among patient's reported *chief complaints*; report of diarrhea at the time of triage was a requirement for study inclusion.

Table 3

Frequency of dehydration scores among post-intervention patients

Score ^a	By RN at triage (n=80)	By MD at full evaluation (n=80)
0	38 (48%)	36 (45%)
1	19 (24%)	13 (16%)
2	9 (11%)	18 (23%)
3	9 (11%)	3 (4%)
4	4 (5%)	2 (3%)
5	1 (1%)	0 (0%)
6	0 (0%)	1 (1%)

^aThe dehydration score has a range of 0–8. No patients were given scores of 7 or 8.

Table 4

Clinical Outcomes

	Pre (n=47)	Post (n=81)	P-value	Missing
Vomiting reported at triage	25 (53%)	66 (81%)	0.001	0 (0%)
Ondansetron given	17 (36%)	61 (75%)	<0.001	0 (0%)
Ondansetron given in patients with vomiting	16 (64%)	57 (95%)	<0.001	--
ORT documented	24 (51%)	77 (100%)	<0.001	4 (3%)
Time to ondansetron (minutes) ^a	60 (36.8)	30 (19.6)	0.004	51 (40%)
Any studies done	17 (37%)	18 (22%)	0.098	1 (0.8%)
Blood studies	12 (26%)	6 (7%)	0.007	--
Urine studies	5 (11%)	6 (7%)	0.525	--
X-rays	2 (4%)	2 (3%)	0.620	--
Stool studies	5 (11%)	2 (3%)	0.098	--
Other tests	9 (20%)	8 (10%)	0.174	--
IVF given	11 (23%)	7 (9%)	0.034	1 (1%)
ED LOS (minutes) ^a	126 (64.0)	115 (55.6)	0.338	1 (1%)
Patient admitted	4 (9%)	2 (3%)	0.190	2 (2%)
Unscheduled return to ED or clinic for vomiting or diarrhea	7 (15%)	10 (19%)	0.605	32 (25%)

^aMean (SD)