Original Study

Improving the Evaluation and Management of Abnormal Uterine Bleeding in Female Adolescents Presenting for Emergency Care

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A B S T R A C T

Study Objective: We sought to improve emergency care for adolescents with abnormal uterine bleeding (AUB) by developing a clinical effectiveness guideline (CEG) and assessing its effect on quality of care.
Design, Setting, Participants, and Interventions: A stakeholder engagement group designed a CEG algorithm for emergency AUB management. Pediatric residents received CEG training and their knowledge and attitudes were assessed using pre- and post intervention surveys. International Classification of Diseases ninth and 10th revision codes identified electronic health record data for patients who presented to the pediatric emergency department for AUB 6 months before and after CEG implementation. A weighted, 20-point scoring system consisting of prioritized aspects of history, laboratory studies, and management was developed to quantify the quality of care provided.
Main Outcome Measures: Descriptive statistics, χ^2 test, Wilcoxon rank sum test, and a run chart were used for analysis.
Results: Pediatric residents reported higher confidence and knowledge scores post CEG implementation. Of the 91 patients identified, 62 met inclusion criteria. Median score was 14 $\pm$ 7 before CEG implementation and 15.5 $\pm$ 6 after. The Wilcoxon rank sum test showed a difference in AUB evaluation and management scores ($P = .09$) after implementation of the CEG. Run chart data showed no shifts or trends (overall median score, 14 points). Pre- and post implementation, points were deducted most frequently for not assessing personal/family clotting disorder history. The largest improvements in care were with appropriate medication dosing and disposition.
Conclusion: We designed a CEG and educational intervention for AUB management in a pediatric emergency department. These findings suggest our CEG might be an effective tool to improve emergency AUB care for adolescents and could increase trainees' confidence in managing this condition, although additional cycles are needed.
Key Words: Adolescents, Abnormal uterine bleeding, Clinical effectiveness guidelines

Introduction

Abnormal uterine bleeding (AUB) is a term that describes any menstrual bleeding that is abnormal in duration, timing, or quantity, and is a common concern among adolescent and young adult women. In fact, a recent study showed that nearly one-quarter (22%) of university-age young women met criteria for heavy menstrual bleeding when using a validated pictorial bleeding assessment chart.[1] Additionally, there have been multiple studies that showed that AUB is associated with lower quality of life scores and increased days of missed school, work, and social activities compared with women without heavy menstrual bleeding.[2–4] Evaluation and management of AUB is also very expensive.[5] A large matched-cohort study published in 2012 showed that patients with a diagnosis code of heavy menstrual bleeding had significantly higher resource use including increased hospitalizations, emergency department (ED) visits, and outpatient visits compared with their matched controls.[6]

Despite the high prevalence of AUB, the effect on quality of life, and the associated health care cost utilization for young women with AUB, care for these young women is fragmented and understudied.[7] There is a lack of management strategies for adolescents with AUB, and there is no current standard of practice in the evaluation and management of patients. We sought to improve quality and consistency of care for adolescent and young adult women who present to the ED with AUB. To accomplish this goal, we established 3 study aims: (1) create and implement an algorithm for ED management of AUB; (2) increase residents' knowledge of AUB management; and (3) assess the algorithm's effect on the quality of care in the ED for AUB patients.

The authors indicate no conflicts of interest.

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Materials and Methods

Aim 1: Developing a Clinical Effectiveness Guideline and AUB Scoring System

In April 2015, a multidisciplinary stakeholder engagement group was established consisting of physicians from the Divisions of Pediatric Hematology, Adolescent Medicine, General Pediatrics, Pediatric Emergency Medicine, and Adolescent Gynecology at the University of Pittsburgh Medical Center Children's Hospital of Pittsburgh. The stakeholder engagement group used information gathered from a literature search in addition to consensus opinion to develop a clinical effectiveness guideline (CEG) for management of AUB in the pediatric ED.[8,9] The CEG is in the form of an algorithm and establishes guidelines for medical management on the basis of the results of the medical history, physical exam, laboratory results, and identification of patients with rapid bleeding, as defined by more than 1 soaked pad or tampon per hour. It also provides recommendations for pharmacologic management, transfusion, disposition, and follow up. Because of the prevalence of bleeding disorders in women who present to the ED with AUB, specific instructions on which patients should be screened for an underlying bleeding disorder was included.[10]

After completion of the CEG draft by the stakeholder group, our Pediatric Emergency Medicine Department provided an overview of the AUB CEG to emergency physician attendings, fellows, and advanced practice providers during their monthly division meeting. They had opportunities to provide feedback and ask clarifying questions. Then, the stakeholder group adopted these recommendations and presented the modified algorithm to a multidisciplinary institutional quality improvement committee. This committee approved the final version of the CEG (see Supplemental Fig. 1), and it was subsequently available online for use. The Pediatric Emergency Medicine faculty were responsible for directing rotating trainees to the CEG.

In addition to the CEG, the stakeholder engagement group developed a weighted, 20-point scoring system to assess overall AUB management, shown in Table 1. The scoring system was designed to quantify the quality of AUB evaluation and management delivered during each clinical encounter, providing more weight to aspects of care that would change management if they had not been performed, such as obtaining a β human chorionic gonadotropin and complete blood count.

Table 1
Abnormal Uterine Bleeding Clinical Effectiveness Guideline Scoring System

Item	Score
History	
Sexual history	1
Bleeding history	1
Thrombosis history	1
Family history of bleeding disorders	1
Family history of thrombotic disorders	1
Laboratory tests	
Urine hCG	5
CBC	3
Coagulation profile	1
Management	
Appropriate use of OCP	1
Correct OCP dosing regimen	1
Appropriate disposition	2
Iron rx if Hb <12 g/dL	1
Antiemetic if OCP given TID	1
Total	

CBC, complete blood count; Hb, hemoglobin; hCG, human chorionic gonadotropin; OCP, oral contraceptive pill; rx, prescription; TID, 3 times per day.

Aim 2: Educational Intervention

Before CEG implementation, we conducted a 1-hour educational training for pediatric residents on evaluation and management of AUB in the ED during protected time for resident education. During this educational intervention, we introduced the residents to the CEG, discussed various scenarios for the application of the CEG, and highlighted key points regarding evaluation and management of AUB in the emergency setting. The session took place in May 2015, approximately 1 month before the CEG was officially available for use in the ED. All resident physicians rotating at our institution were invited to attend. The session objectives were: (1) improve resident knowledge on acute management of AUB; (2) increase resident confidence in evaluating and managing acute AUB; and (3) familiarize residents with the new CEG.

Resident knowledge regarding evaluation and management of AUB was assessed via a secure online anonymous survey before and after the session and the CEG implementation. The survey was developed by members of the research team and aligned with the session objectives because no validated survey tools existed at the time of the session. The survey consisted of 3 multiple choice questions about resident confidence in evaluating and managing AUB in the ED, and 7 questions with patient scenarios to assess knowledge in evaluating and managing AUB. The survey was sent to the resident e-mail listserv 1 week before the educational session. The follow-up survey was sent approximately 3 months later, when the CEG was available for use and residents had the opportunity to familiarize themselves with the guideline.

Aim 3: Evaluation of the CEG

We obtained a quality improvement waiver to conduct a retrospective chart review of electronic health record (EHR) data from all patients evaluated in the ED from January 1, 2015 to January 1, 2016. Using the International Classification of Diseases (ICD) 9th and 10th revision codes for vaginal bleeding, dysfunctional or functional vaginal bleeding, bleeding unrelated to menstrual cycles, and anovulatory bleeding, we selected patients who had been seen for AUB 6 months before and 6 months after implementation of the CEG. We excluded patients if they were prepubertal, their vaginal bleeding was secondary to traumatic injury, there was no evidence of vaginal bleeding recorded in the chart, or the visit took place in a location outside of the pediatric ED. There was no upper age limit because we wanted to truly capture the breadth of patients who are seen at a pediatric ED. We scored the clinical encounters using the rubric in Table 1 by extracting data from the EHR including laboratory

values, medications prescribed, discharge instructions, and ED provider documentation. To ensure accurate and consistent scoring from all members of the research team, we randomly selected 25% of the cases for validation by a different member of the research team. Three inconsistencies in scoring were found during this review, all of which would have changed the individual score by no more than 1 point. The research team discussed any discrepancies to reach a consensus in each case.

All scored clinical encounters were plotted chronologically on a run chart. Because the data were nonparametric, the Wilcoxon rank sum test was used to test median scores pre- and post CEG implementation. Descriptive statistics were used to summarize the resident survey results and to discuss the characteristics of the clinical encounters.

Results

Resident Survey Results

Residents from all levels of training participated in the educational intervention; however, because the study spanned 2 separate academic years, only individuals who were pediatric residents at our institution during the pre- and post session surveys were analyzed. The pre-session survey was completed by 32 of 55 of the eligible pediatric residents. Of the 32 respondents, 13 of 32 were post-graduate year (PGY)-1 and 19 of 32 were PGY2 at the time of initial survey. The post session survey was completed by 25 of 55 pediatric residents. Of the 25 respondents, 11 of 32 were PGY2, 11 of 32 were PGY3, and 3 of 32 were PGY4. Only 25% of residents who filled out the post session survey remembered taking the pre-session survey. The number of residents present at the educational session was not recorded.

Resident agreement with the following statement “I feel confident evaluating a pediatric patient with AUB who presents to the emergency department” increased from 28% before the intervention to 58% post intervention. Likewise, there was a similar increase in resident comfort in the management for patients with AUB and criteria for inpatient admission (Fig. 1). Residents had high levels of baseline knowledge on how to evaluate a patient who presents with AUB that was maintained after implementation. Residents’ knowledge on the medical management of AUB increased from 57% to 81% post CEG implementation (Fig. 2).

CEG Evaluation and Management

Ninety-one patient encounters for AUB were identified through ICD ninth and 10th revision codes, and 62 met criteria for inclusion in further analysis. Thirty-four patient encounters pre-CEG implementation and 28 patient encounters post CEG implementation were evaluated (Fig. 3). Data were abstracted through electronic medical record documentation by 4 independent researchers. To ensure quality control, a fifth individual reviewed approximately 25% of encounters from each of the reviewers to ensure consistency. The research team discussed any discrepancies to reach a consensus in each case.

The sample population was 52% white and had a mean age of 15.9 years (Table 2). Patients who presented to the pediatric ED for AUB ranged in age from 9 to 30 years. Approximately 37% were using some form of contraception at time of presentation, with approximately 10% using a form of long-acting, reversible contraception. Thirteen percent of the patients had bleeding related to a current or recent pregnancy. Sixteen patients had von Willebrand testing performed, and 5 of 16 women had abnormalities in their testing. The average initial presenting hemoglobin was within normal range at 12.2 (range, 5.3-14.5).

AUB evaluation and management scores ranged from 2 to 18 points. Before CEG implementation, the median score and

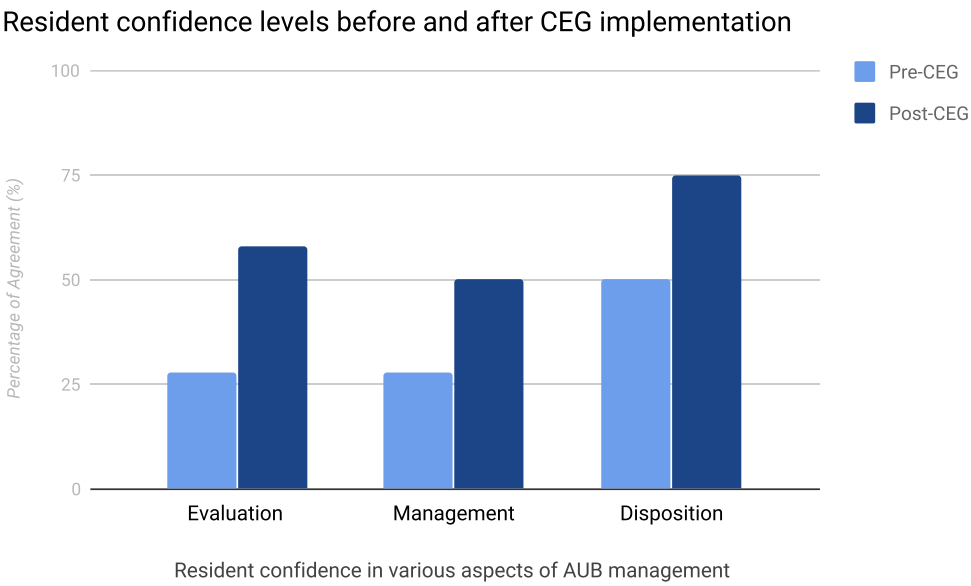

Fig. 1. Resident confidence assessment on in the evaluation, management, and determining disposition of patients with abnormal uterine bleeding (AUB) who present to the pediatric emergency department pre- and post clinical effectiveness guideline (CEG) implementation.

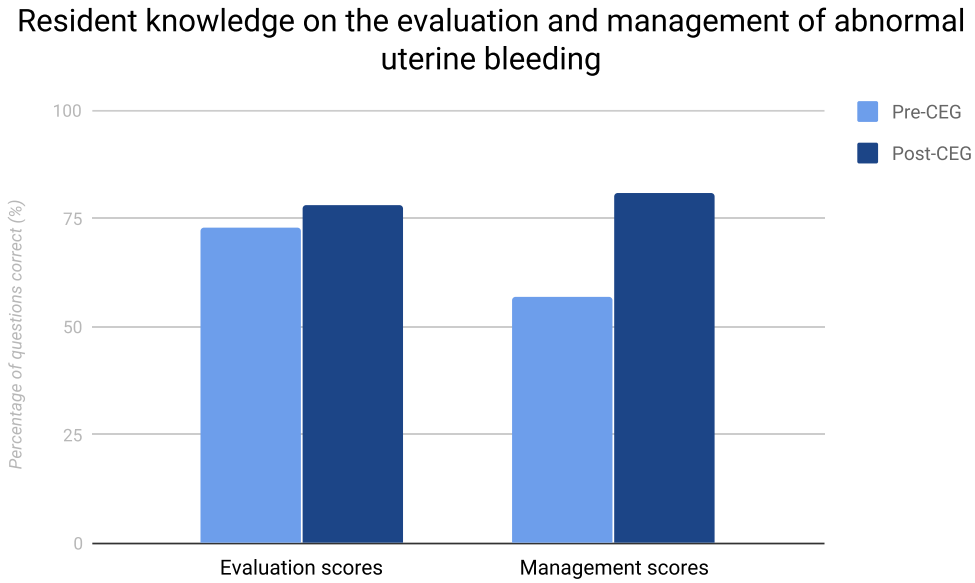

Fig. 2. Resident knowledge assessment regarding the evaluation and management of patients with abnormal uterine bleeding who present to the pediatric emergency department pre- and post clinical effectiveness guideline (CEG) implementation.

interquartile range was 14 ± 7. After CEG implementation, the median score and interquartile range was 15.5 ± 6. The Wilcoxon rank sum test showed a trend toward an improvement in AUB evaluation and management scores ($P = .09$) after implementation of the CEG. ED encounters documenting each area of the CEG increased in most areas after CEG implementation (Fig. 4). Pre- and post implementation, points were deducted most often for not assessing personal/family history of clotting disorders, with only 3% of preimplementation and 4% of postimplementation charts documenting a clotting history. Assessment for rapid bleeding was the most consistently documented item, with 89% of charts pre- and post implementation having comments on rapid bleeding. The largest increases were with appropriate oral contraceptive pill (OCP) dosing and appropriate iron dosing as per the CEG (see Supplemental Fig. 1 with dosing details) with an increase from 54% pre and 78% post CEG implementation, for both parameters. Additional improvements were made from pre- to post implementation in management scores including appropriate OCP use and correct disposition on the basis of hemoglobin.

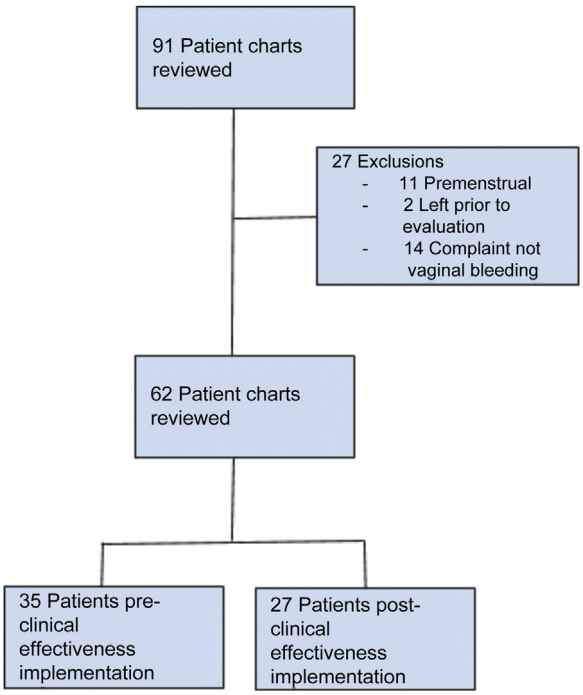

Fig. 3. Flow diagram showing the data extraction resulting in 62 clinical encounters reviewed.

Run Chart

Run chart data were analyzed in accordance with the standard probability based rules outlined by Perla et al.[11] As shown in Figure 5, analysis of run chart data shows no shifts or trends and a median score of 14 points. A total of 24 runs were identified, which is within the expected range because 54 nonmedian data points were plotted. Eight runs were identified before institution of the CEG, and 16 occurred after institution.

Discussion

We used an institutional stakeholder engagement group to create and implement a CEG for the evaluation and management of AUB in a pediatric ED. This study highlighted that several important facets of care for adolescent and young adult women who present to the ED with AUB could be improved with implementation of a CEG and educational session.

First, resident confidence regarding the evaluation and management of AUB in the pediatric ED improved after the educational intervention and CEG implementation. Residents had high levels of baseline knowledge on how to evaluate a patient who presents with AUB that was maintained post implementation. However, resident knowledge

Table 2
Patient Demographic Characteristics

Characteristic	%	n
Mean age	15.9	62
Race		
White	52%	32
Black	42%	26
Asian	2%	1
Not reported	5%	3
Contraception use		
None	61%	38
IUD	3%	2
Nexplanon	7%	4
Depo-Provera	7%	4
OCP	21%	13
Unknown	2%	1
Mean Hb	12.2	
Bleeding related to pregnancy	13%	8
Bleeding related to bleeding disorder	8%	5

IUD, intrauterine device; OCP, oral contraceptive pills; Hb, hemoglobin.

regarding the medical management of patients who present with heavy bleeding was much higher after the medical intervention (57% pre- to 81% post educational intervention). It is not possible to say the degree to which the knowledge and confidence gained was because of the educational intervention, as opposed to simply having a CEG as an available resource. However, it is likely that the CEG contributed to the improvement of these scores, because most residents surveyed did not recall attending the educational intervention.

We also were able to describe the demographic characteristics of patients who present to a large pediatric tertiary care ED with AUB. Surprisingly, 13% of patients who presented with AUB had a recent or current pregnancy. This highlights the importance of obtaining pregnancy test for all patients of reproductive age who present with AUB. We also found that 5 patients of the 62 patients (8%) included in our analysis had AUB related to a bleeding disorder. The true incidence of bleeding disorders in this population is unknown because only 16 of 62 patients who presented to the ED underwent testing for a bleeding disorder. Further research regarding screening practices for bleeding disorders in pediatric patients who present with AUB to a pediatric ED is needed, but is beyond the scope of this study.

With respect to pre- and post CEG implementation scores, items addressing the evaluation of a patient who presents to the ED with AUB had similar scores pre- and post implementation. For example, sexual history-taking, bleeding history, and assessment of rapid bleeding were documented in most cases before and after CEG implementation. Additionally, clotting history was obtained in a small proportion of cases pre- and post implementation, likely because a point was received only if explicit documentation of a lack of personal clotting history was noted. In contrast to AUB evaluation items, scoring items addressing the management and disposition of a patient who presents to the ED with AUB did show a difference after implementation of the CEG. Specifically, there was a higher proportion with appropriate OCP and iron administration and dosing post implementation of the CEG. These likely contributed to the overall trend toward improved quality of care as indicated by the run chart and Wilcoxon rank sum analysis, although this did not meet a level of significance at $P = .05$.

There is currently a lack of data to direct the care of adolescent women who present to the ED with AUB. In an era of calls for decreased resource utilization, consensus guidelines about management and when to admit a patient are important tools that can be used to improve patient care. Further, evidence-based data for adolescent and young women with AUB is important, because the physician cannot simply extrapolate adult data for their workup and management. Unlike adult women who typically have structural or anatomic reasons for abnormal bleeding

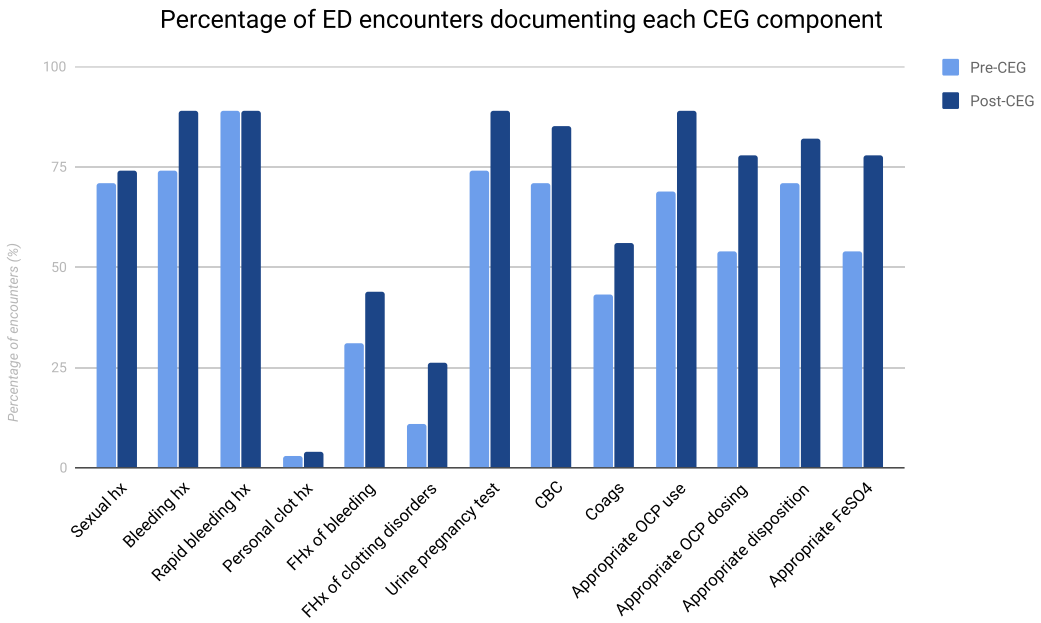

Fig. 4. Percentage of emergency department (ED) encounters documenting each clinical effectiveness guideline (CEG) component pre- and post implementation. CBC, complete blood count; coags, coagulation studies; FeSO4, ferrous sulfate; FHx, family history; hx, history; OCP, oral contraceptive pill.

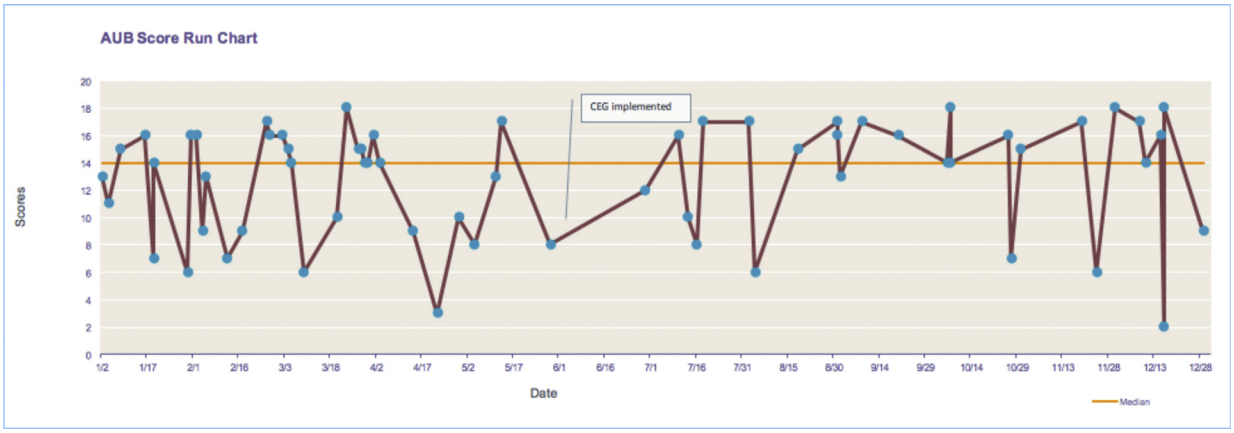

Fig. 5. Run chart showing change in abnormal uterine bleeding (AUB) evaluation and management before and after implementation of the clinical effectiveness guideline (CEG) showing no shifts or trends and a median score of 14 points.

(polyps, adenomyosis, uterine fibroids), which require uterine imaging for diagnosis and possible surgical interventions for treatment, the causes of AUB in adolescents and young adults are different. Adolescents more frequently have nonstructural causes for AUB including ovulatory dysfunction (anovulatory cycles), polycystic ovary syndrome, or coagulopathy, and they require a very different workup and management than structural causes of AUB. If adult guidelines[12] were used to assess and manage adolescents who presenting with AUB, there might be testing such as frequent transvaginal ultrasound and pelvic exams, which can be time-intensive, expensive, potentially emotionally traumatizing, and often unnecessary for many adolescents who present for care.

There are several limitations to this study. First, limited evidence was available for the design of the CEG, so the design was largely on the basis of review articles and consensus expert opinion. In 2017, Haamid et al published a comprehensive review on managing heavy menstrual bleeding in adolescents,[13] which was not available at the time of the CEG conception. This article does not include an algorithm to follow; however, it does provide additional detail regarding focused history-taking and physical examination components for young women with AUB. Another limitation is that the resident survey had a less than 50% overall response rate, which might introduce response bias. The surveys were completed anonymously, so we were not able to use paired data. Additionally, we did not record the identities of the residents who attended the initial 1-hour training session and did not specifically ask those residents who filled out the post survey if they also attended the educational intervention, so it is difficult to know whether the differences in scores are from the educational intervention or just the availability and utility of the CEG. It is possible that this skewed the results to show less of an effect of the educational intervention. There was also a possibility that encounters were missed because of incorrect or incomplete coding of ICD codes; however, we included all possible codes for vaginal bleeding in attempt to ensure data of all patients who presented with AUB were captured. Several portions of the CEG scores were abstracted through free text portions of ED documentation, so there is a possibility that the provider asked additional family or personal history questions that were not included in the documentation. In addition, we commented that 37% of young women who presented for AUB were using contraception at the time of presentation; however, the data were not available on whether these young women were using this for dysmenorrhea, birth control, or previous heavy menstrual bleeding. No data were available regarding how frequently the CEG was used, nor for which clinical encounters it was used, thus limiting our ability to determine causation.

Future directions include additional resident education sessions about AUB and reintroduction of the CEG to the current pediatric ED trainees. This would provide opportunities for additional data collection and targets for improvement. Another area in which we plan to focus improvement efforts is on obtaining and documenting a clotting history. Because it is a contraindication for patients with a history of a blood clot or migraine with aura to receive estrogen-containing contraceptives,[14] we believe that it is important to ask and document this information before prescribing them. Therefore, the use of a pretemplated EHR will be implemented to encourage more consistent and robust documentation. Additionally, we will develop an automatic message that will alert providers when any medications containing estrogen are ordered through the EHR to ask the ordering clinician if the patient has a personal history of clots or migraine with aura. Finally, although we are pleased with the differences in AUB management scores pre- and post CEG implementation, this was just a single cycle, and in the future we will need to include additional cycles of data collection to better clarify and define areas for improvement.

Conclusions

We designed and implemented an educational intervention and CEG for management of AUB in a large academic pediatric ED. Resident knowledge and confidence in management of AUB were higher post implementation of the CEG. After CEG implementation there was a trend toward higher AUB management scores, suggesting CEGs might be an effective tool to improve the care provided to adolescents who present to the ED with AUB. Future

directions include various ways to improve inquiry and documentation of clotting disorders before starting estrogen-containing medications.

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Supplementary Data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.jpag.2018.11.002.

References

1. Gursel T, Biri A, Kaya Z, et al: The frequency of menorrhagia and bleeding disorders in university students. Pediatr Hematol Oncol 2014; 31:467
2. Rae C, Furlong W, Horsman J, et al: Bleeding disorders, menorrhagia and iron deficiency: impacts on health-related quality of life. Haemophilia 2013; 19:385
3. Nur Azurah AG, Sanci L, Moore E, et al: The quality of life of adolescents with menstrual problems. J Pediatr Adolesc Gynecol 2013; 26:102
4. Anastasakis E, Kingman CE, Lee CA, et al: Menstrual problems in university students: an electronic mail survey. Vivo 2008; 22:617
5. Jensen JT, Lefebvre P, Laliberte F, et al: Cost burden and treatment patterns associated with management of heavy menstrual bleeding. J Womens Health (Larchmt) 2012; 21:539
6. Pawar A, Krishnan R, Davis K, et al: Perceptions about quality of life in a school-based population of adolescents with menorrhagia: implications for adolescents with bleeding disorders. Haemophilia 2008; 14:579
7. Huguelet PS, Buyers EM, Lange-Liss JH, et al: Treatment of acute abnormal uterine bleeding in adolescents: what are providers doing in various specialties? J Pediatr Adolesc Gynecol 2016; 29:286
8. Bennett AR, Gray SH: What to do when she's bleeding through: the recognition, evaluation, and management of abnormal uterine bleeding in adolescents. Curr Opin Pediatr 2014; 26:413
9. Committee on Practice Bulletins—Gynecology: Practice bulletin no. 128: diagnosis of abnormal uterine bleeding in reproductive-aged women. Obstet Gynecol 2012; 120:197
10. Ragni MV, Bontempo FA, Hassett AC: Von Willebrand disease and bleeding in women. Haemophilia 1999; 5:313
11. Perla RJ, Provost LP, Murray SK: The run chart: a simple analytical tool for learning from variation in healthcare processes. BMJ Qual Saf 2011; 20:46
12. American College of Obstetricians and Gynecologists: ACOG committee opinion no. 557: management of acute abnormal uterine bleeding in nonpregnant reproductive-aged women. Obstet Gynecol 2013; 121:891
13. Haamid F, Sass AE, Dietrich JE: Heavy menstrual bleeding in adolescents. J Pediatr Adolesc Gynecol 2017; 30:335
14. Curtis KM, Tepper NK, Jatlaoui TC, et al: U.S. medical eligibility criteria for contraceptive use, 2016. MMWR Recomm Rep 2016; 65:1