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Improving the Diagnosis of Menstrual Dysfunction through Quality Improvement

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Abstract

Introduction: Prevalence of menstrual dysfunction (MD) in high school athletes ranges from 7% to 54%. Early recognition and intervention are crucial to prevent future consequences. The purpose of this Quality Improvement project was to optimize the institution's Epic Best Practice Advisory (BPA) screening tool and synthesize new patient questionnaires to diagnose MD in athletes greater than 12 years of age presenting to a pediatric sports medicine clinic. **Methods:** Using Quality Improvement methodology, we evaluated clinic flow, the Epic BPA tool, and actions by the physician following the appropriate triggering of the BPA. Diagnoses targeted were primary amenorrhea, oligomenorrhea, or irregular menstruation unspecified. Areas for intervention were global staff education, patient education, and provider alert fatigue. Our team implemented interventions using monthly Plan-Do-Study-Act cycles to address our key drivers. Proper implementation of questionnaire data and restructuring of the Epic BPA promoted identification and diagnosis of MD. The clinician discussed the diagnosis with the patient and family and provided an educational handout on MD. **Results:** The rate of appropriate diagnosis of MD in athletes greater than 12 years of age seen at a pediatric sports medicine clinic increased from a baseline of 2.1% to 30% over ten months. Identification of three key drivers ultimately drove the success and achievement of our aim. **Conclusions:** Using Quality Improvement methodology, we optimized the EPIC BPA and subsequently increased the rate of appropriate diagnosis of MD. Identification of the proper diagnosis improves our patient education. Ultimately, this project provided the framework for applicable discussion, interventions, and work-up for at-risk athletes. (*Pediatr Qual Saf* 2022;7:e505; doi: 10.1097/pq9.0000000000000505; Published online January 21, 2022.)

INTRODUCTION

Background Knowledge

Menstrual function exists on a spectrum ranging from eumenorrhea to amenorrhea. In young adult women, menstrual cycles recur at a median interval of 28 days with a variable SD of 7 days, and in young adolescents can range from 21 to 45 days.^{1,2} Menstrual function can serve as an additional vital sign in the assessment of normal

growth, development, and overall functioning.²

Deviations from eumenorrhea can occur due to a variety of medical conditions, comorbidities, in addition to extreme changes in dietary or exercise patterns. Menstrual dysfunction (MD) is a broad term for these deviations and specifically includes conditions such as primary amenorrhea, anovulatory cycles, oligomenorrhea, and secondary amenorrhea. The prevalence of MD varies based on a variety of intrinsic and extrinsic factors. The prevalence of secondary amenorrhea varies with specific sports, age of the athlete, the volume of training, and body weight/composition. In some studies, the prevalence is reported as high as 69% in a small group of professional ballet dancers and 65% in long-distance runners, compared with 2–5% in large general population studies. In addition, the reported prevalence of MD in high school athletes ranges from 7% to 54%.^{3–6}

Given its prevalence, associations, and long-term health consequences, screening for MD, especially in vulnerable populations such as athletes, is an essential component of healthcare. Screening and subsequent early detection of MD can prompt appropriate evaluation and intervention to prevent long-term consequences such as decreased bone mass, increased stress fracture risk, increased rate of musculoskeletal injuries with prolonged recovery time, endothelial dysfunction, and future fertility effects.^{1,7–9} A recent study looking at



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low bone mineral density in elite athletes showed that secondary amenorrhea for at least 1 year during teenage years was strongly associated with low bone mineral density (BMD) in the athletes' early 20s.

MD is one component of the Female Athlete Triad (Triad), in addition to decreased energy availability (with or without disordered eating,) and low BMD. Having one component of the Triad puts an athlete at an increased risk for other components of the Triad.⁷ The Female Athlete Triad coalition consensus statement recommends that athletes undergo annual screening with the Triad-specific self-report questionnaire, followed by a more in-depth evaluation if the athlete has or is at risk for any Triad component.⁷

There are several difficulties inherent to screening for MD that impact early detection and intervention. The use of hormonal contraception, limitations in self-reporting, subclinical symptoms, and lack of patient and clinician education regarding normal menstrual patterns and consequences of MD significantly limit a clinician's diagnostic capability. In addition, there exists a lack of knowledge in athletes regarding the relationship between bone health, athletics, and menstrual patterns, which further impact disclosure and awareness of symptoms.¹⁰ In a study investigating collegiate athletic trainers' knowledge of the Female Athlete Triad and relative energy deficiency in sports (RED-S), results indicated that while these front line care providers can recognize some features of both the Triad and RED-S, more comprehensive referral behaviors for MD and bone injury were more often seen in Division I institutions than Division II or III.¹¹ Experts also question the appropriate setting, frequency, and methods of screening. The annual preparticipation physical exam (PPE) is the most commonly recommended screening opportunity.⁷ The PPE may be completed at the athlete's annual well-visit, at an acute care clinic, or through mass team or school physicals. Although there is a current Preparticipation Physical Exam Monograph 5th edition, there is no systematic approach for implementation across the United States, and many PPE forms lack appropriate screening questions. At both a high school and collegiate level, studies have demonstrated that the standard PPE MD screening questions may not effectively screen for the Triad based on the recommendations from the Female Athlete Triad Coalition.^{6,12}

Local Significance

Pediatric sports medicine is an outpatient subspecialty service at Nationwide Children's Hospital with eight different clinic sites serving patients in Columbus, Ohio, and surrounding locations. In a prior study from our institution, the prevalence of menstrual dysfunction (MD) among injured athletes presenting to a pediatric primary care sports medicine clinic was 15.9% from October 2012 to May 2014.¹³ An Epic Best Practice Advisory (BPA) was designed in May 2013 to identify and prompt

further evaluation of new patients who met criteria for MD. Patients recorded their menstrual history on a paper pre-visit questionnaire, and the certified athletic trainer (ATC) or clinic assistant (CA) entered the data into the electronic medical system, EPIC. The data triggered the BPA if criteria for MD were met (See Table 1 for BPA Criteria). As a component of this QI initiative, a retrospective chart review analyzing these BPA triggers over 2 years determined the correct application of that information with appropriate ICD 10 diagnosis of MD, as a selected visit diagnosis occurred only 2.1% of the time for the appropriate patients.

Relevant Published Investigations

There are several published reports regarding the use of Clinical Decision Support (CDS) systems such as BPAs to improve healthcare processes, medical decision-making, guideline adherence, and medication dosing.¹⁴ Kucher et al described the use of CDS alerts to encourage deep-vein thrombosis (DVT) prophylaxis and successfully reduced the number of symptomatic and asymptomatic DVTs in hospitalized patients.¹⁵ Cecchini et al similarly used an Epic BPA at their institution and reported improvement in the rate of structured cancer staging as a direct consequence of electronic decision support.¹⁶ As with many automated processes, there still exists room for error and subsequent iatrogenic consequences. Studies report specifically on CDS-related treatment delays and the concept of "alert fatigue" leading to unintended overriding of potentially critical notifications.¹⁴ However, in a recent systematic review of the efficacy and unintended consequences of hard-stop alerts in electronic health record systems, Powers et al concluded that 79% showed improvement in health outcomes and 88% in process outcomes. Among the studies that reported good user experience, heavy user involvement and iterative design were cited.¹⁷

Within the Sports Medicine Department at our Children's Hospital, we have an appropriate CDS screening tool and unique opportunity to evaluate, diagnose, and appropriately intervene to prevent long-term consequences of MD in athletes. The aim of this Quality Improvement (QI) project was to optimize the institution's current Epic BPA screening tool and synthesize new patient questionnaire responses to diagnose MD in athletes greater than 12 years of age presenting to a pediatric sports medicine clinic. Our specific goal was to increase diagnoses from a baseline of 2.1% to 20% in 3 months and sustain for 12 months. The QI initiative focused on staff education, patients, and BPA redesign as key drivers to achieve our aim.

METHODS

Ethical Considerations

Institutional Review Board approval was not required because this was a QI project involving retrospective chart review and prospective Plan-Do-Study-Act

Table 1. MD BPA Criteria

MD BPA Triggers	BPA Message
Have you ever had a menstrual cycle?: No Patient is older than 15 years at the time of visit?: Yes Have you ever had a menstrual cycle?: Yes Age is >1 year from menarche age?: Yes Currently pregnant?: No Patient on hormonal contraceptives?: No Older than 35 days between cycles?: Yes <9 Menses in last 12 months: No Have you ever had a menstrual cycle?: Yes Age is >1 year from menarche age?: Yes Currently pregnant?: No Patient on hormonal contraceptives?: No Older than 35 days between cycles?: No <9 Menses in last 12 months: Yes Does Sport training affect your menstrual cycle?: No Have you ever had a menstrual cycle?: Yes Age is >1 year from menarche age?: Yes Currently pregnant?: No Patient on hormonal contraceptives?: No Older than 35 days between cycles?: No <9 Menses in last 12 months: No Does Sport training affect your menstrual cycle?: Yes	POSSIBLE MENSTRUAL DYSFUNCTION Based on the answers or missing information below, this patient has been flagged for menstrual dysfunction

(PDSA) cycles and did not qualify as research involving human subjects.

Setting

Our Hospital's Sports Medicine has 8 outpatient locations in Columbus, Ohio, and the surrounding area. The sports medicine department has nine attending physicians and a primary care sports medicine fellow. In addition, the certified athletic trainers (ATCs) serve as physician extenders, and CAs manage administrative tasks, patient rooming, patient scheduling, and contribute to patient education. In 2019, there were 17,533 patient visits at the Hospital's Sports Medicine clinics, with 7372 documented female patients over the age of 12 years.

Data Collection and Definitions

A baseline percentage of appropriate diagnosis of MD was established by retrospective chart review over 22 months for all clinic locations. We selected patient charts if the BPA was triggered, indicating a positive screen for MD, and assessed for the presence of an MD diagnosis for that encounter. We defined appropriate MD diagnosis according to criteria described in Table 2.

Interventions

Our multidisciplinary QI team included physicians, ATCs, and CAs, allowing for a holistic view of clinic flow and informed ways to improve the patient encounter to

achieve our aim. Using QI methodology, we evaluated the clinic workflow, Epic BPA tool, and actions by the physician following the appropriate firing of the MD BPA as areas to investigate for process improvement. The team constructed a process map of typical patient flow from intake to discharge during a new encounter (Fig. 1). This facilitated identification of potential process errors in our clinical flow. Specifically, we recognized that the physician could evaluate the patient before documentation of the screening questionnaire in Epic. This potentially resulted in a missed opportunity to diagnose and educate the patient if the BPA triggers after the physician completed the encounter with the patient. In addition, if electronic documentation is delayed, incomplete, or incorrect, the information serves as another missed opportunity.

The team also formulated a fishbone diagram documenting potential reasons for neglecting to record a MD diagnosis—for example, if the Epic BPA tool fired appropriately but the BPA dialogue box included extraneous patient data or complicated options. In discussions with physicians on our QI team, the BPA design was cumbersome and difficult to navigate. It was programmed to pull in laboratory data such as Vitamin D levels and chemistry panels that were often old or ordered during a time of acute illness. This, in combination with “alert fatigue” (a well-known phenomenon in the era of electronic medical records), often led to the physician overriding or ignoring the trigger and missing an opportunity to

Table 2. Definitions of MD and ICD 10 codes

Diagnosis	Definition	ICD 10 Codes
Primary Amenorrhea	Absence of menarche by age 15	N91.0, N91.1, N91.2
Oligomenorrhea	Age >1 year post menarche and older than 35 days between cycles, or <9 cycles in past 12 months	N91.3, N91.4, N91.5
Irregular Menstruation Unspecified	Training affects menstrual cycle	N91.6

Adapted with permission from World Health Organization (2004).

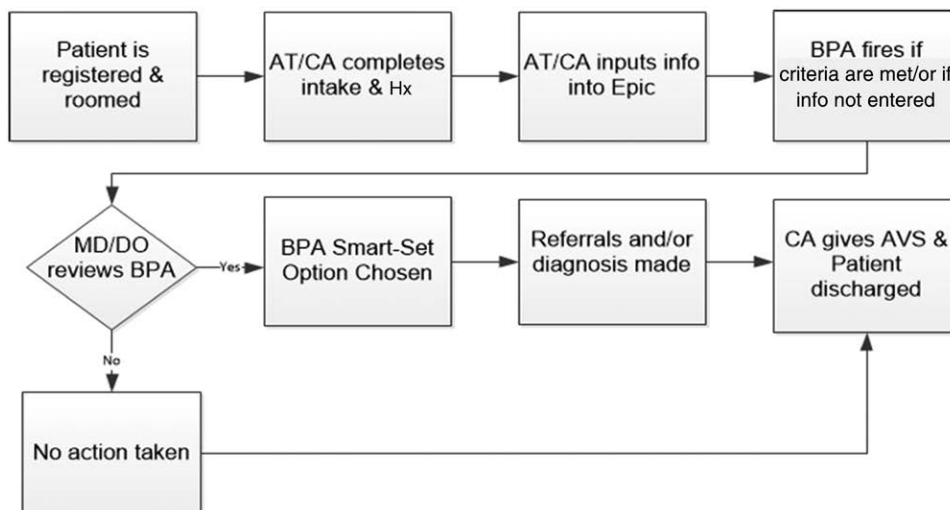


Fig. 1. Flow diagram for pediatric sports medicine process from patient registration to discharge.

educate, diagnose, and possibly intervene on a patient with MD. Ultimately, a key driver diagram demonstrated our team’s specific aim, drivers, and interventions (Fig. 2). The project’s unique drivers were staff education, patient education, and Epic BPA redesign.

The established baseline rate of appropriate diagnosis of MD by retrospective chart review of BPA triggers was 2.1% over 22 months. This was calculated by taking the number of athletes who screened positive and had an appropriate ICD 10 diagnosis associated with their visit over the total number of athletes who screened positive.

The interventions developed for each key driver were monthly Plan-Do-Study-Act cycles. The timing of the interventions described are noted in Figure 2. A presentation was prepared and delivered at a staff meeting highlighting menstrual function education, an in-depth look at the patient questionnaire, and emphasizing the importance of real-time electronic documentation in the patient chart to ensure timeliness of BPA trigger. In addition, an educational handout was created and electronically linked to patient care instructions in the After Visit Summary for each new patient MD diagnosis. This handout promoted patient

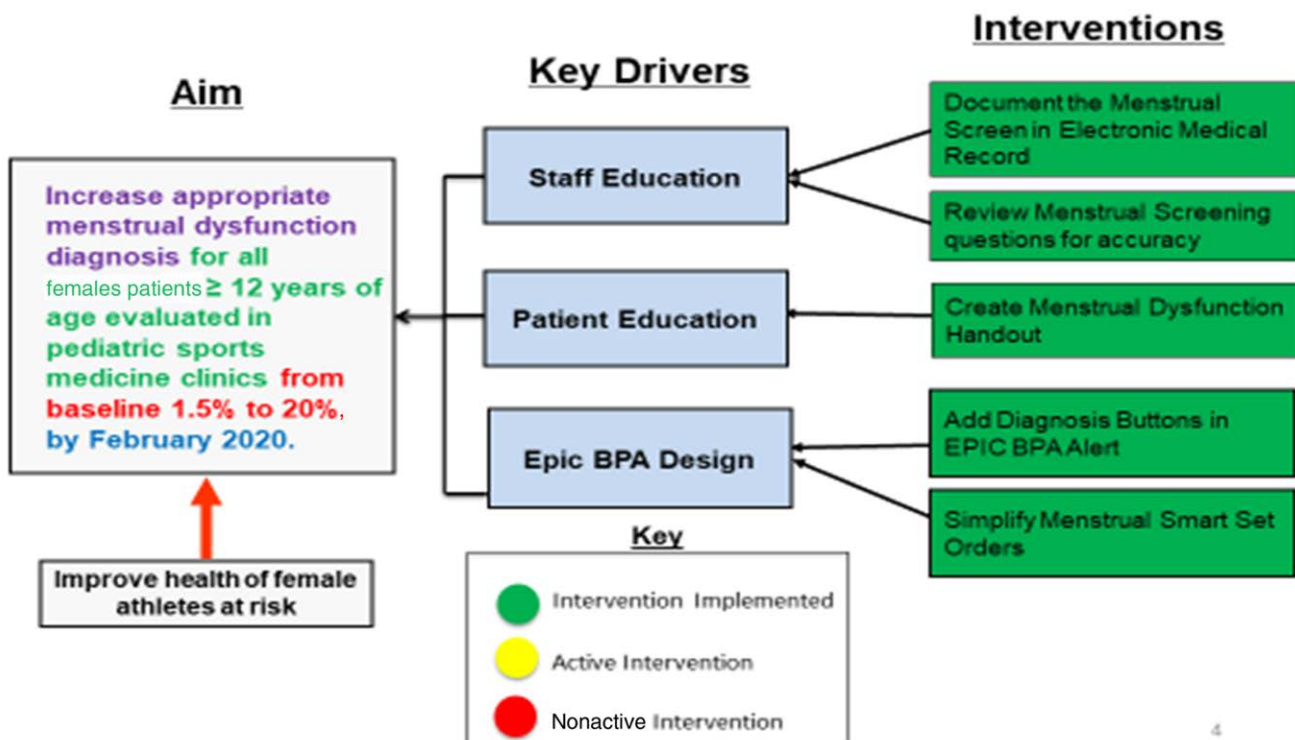


Fig. 2. Key driver diagram showing the three key drivers and various interventions to achieve the aim.

education, appropriate follow-up, and empowered athletes to understand the immediate and long-term consequences of MD. The simplified BPA included only the triggering information that suggested diagnostic criteria for MD, and a new streamlined Smart Set gave only the diagnosis suggested based on screening parameters (Table 1).

Data Analysis

Our primary outcome measure was the percentage of eligible patients with an ICD 10 diagnosis of MD entered when the criteria (Table 1) was met. The baseline percentage was 2.1%. Baseline data were entered into a control chart (p-chart), and centerline (mean) and control limits (± 3 SD, representing inherent variation) were calculated. Data were recorded on each subsequent month, and standard control chart rules were used to identify special versus common cause variation and if a centerline shift was warranted.

RESULTS

We achieved and surpassed our aim of reaching an appropriate MD diagnostic rate of 20% in January 2020 (Fig. 3). After our third intervention in December 2019, we continued to increase our diagnosis rate in the subsequent months with a solid centerline shift above our aim.

DISCUSSION

Increasing appropriate diagnosis of MD in athletes presenting to a pediatric sports medicine clinic proved to be an attainable goal with efforts directed toward staff education, patient education, and redesigning the Epic BPA. Overall, this QI project increased awareness of MD as a significant concern for athletes. We addressed this comprehensively through cultivating both educational initiatives and creating open dialogue to discuss the issue at the patient/family, staff, and physician level. QI data were reviewed monthly during department meetings to encourage awareness, participation, and to gather feedback.

Through our staff education, we empowered ATCs and CAs to use the patient intake process as an opportunity to investigate and educate in an efficient manner. As demonstrated in Figure 3, this resulted in an immediate increase in appropriate screening and diagnosis. Patients and family members were encouraged to ask questions about the intake form and screening questions as staff prioritized accuracy and completion of pertinent information. This initial interaction was essential in creating a dialogue about menstrual function and ensuring accurate information to electronically document and promptly alert the physician before visit with the patient.

The increased documentation of accurate information regarding menstrual function facilitated open and

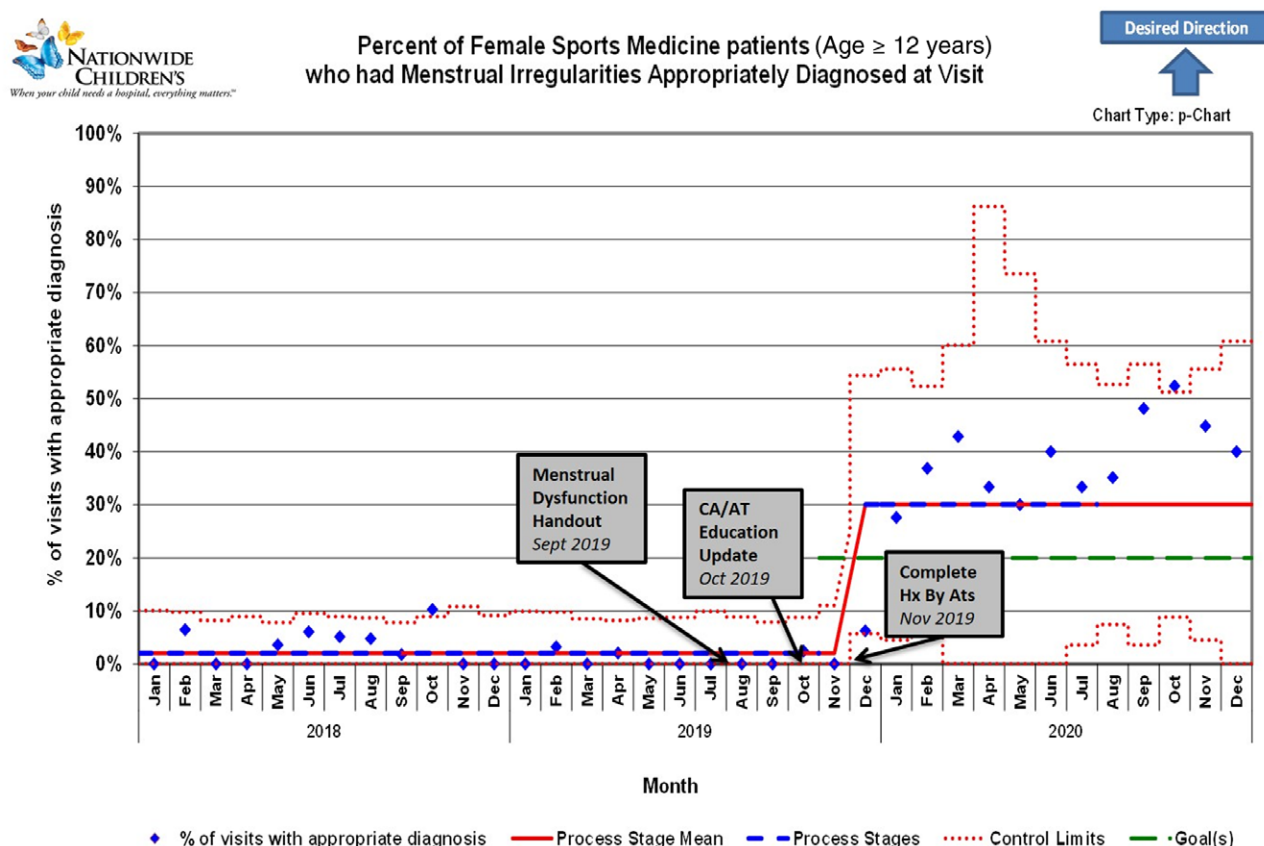


Fig. 3. Control chart (p-chart) demonstrating the percentage of patients with the appropriate MD diagnosis (y axis) over each month (x axis).

informative patient–physician discussions concerning the etiology, associated risk factors, and consequences of MD. Similar to any other vital sign, our physicians were encouraged to consider menstrual function as a component of objective data when evaluating their athletes because it can have multiple effects on a variety of musculoskeletal pathology. While often included in discussions surrounding stress injuries, MD was now a discussion to incorporate into all anticipatory guidance with new musculoskeletal injuries and concussions. The handout provided to all newly diagnosed patients re-enforced information shared by the physician and included important recommendations for prevention and follow-up care.

In addition to prompting immediate education and recommendations for prevention and possible interventions for the patient, documenting the appropriate diagnosis of MD alerts other medical providers of an important finding with profound health impacts. Any provider with access to the medical chart, such as primary care physicians, athletic trainers or other subspecialty physicians, will be able to identify the athlete’s diagnosis, evaluation, pertinent work-up and be better able to appreciate how MD may impact other concomitant medical conditions.

In reviewing the literature, the specific questionnaire and environment in which the screening for MD takes place are the targets to optimize so as to increase MD diagnosis in athletes. The current Preparticipation Physical Exam Monograph 5th edition includes four questions that are specific to screening for MD.¹⁸ The Female Athlete Triad Coalition recommends annual screening for Triad risk factors with a Triad-specific self-report questionnaire, which includes questions unique to MD.⁷ There is limited evidence regarding the efficacy of PPE forms in screening for triad risk factors, including MD.¹² Young et al specifically investigated the efficacy of the PPE in screening for MD by comparing it with another validated tool, the Healthy Wisconsin High School Female Athlete Survey. They found a high degree of inconsistency of participants’ answers between the standard PPE form and the Healthy Wisconsin High School Female Athlete Survey. This study challenges the validity and reliability of the standard PPE form and prompts further research into the quality of the questionnaire as a screening tool. The American Academy of Pediatrics and the American College of Obstetrics and Gynecology recommend the evaluation of menstrual cycles as part of the routine vital sign assessment in a preventative healthcare office visit to increase diagnosis of MD, educate patients and family, and encourage them to take responsibility for their own reproductive health.² There does not exist a standardized office protocol or specific study validating this recommendation or identifying other unique tools to increase the diagnosis of MD.

This study further shows that the appropriate use of CDS systems can improve the rate of MD diagnosis and supports the expanding literature recognizing the important role of CDS in improving processes. In their review article on CDS systems, Beeler et al identified certain

crucial features of a successful CDS intervention, including providing decision support automatically as part of clinician workflow, providing actionable recommendations, and justification of decision support via research evidence and local user involvement.¹⁴ Our re-designed Epic BPA has these unique features and, when appropriately used by the physician, improves the accurate diagnosis of MD.

As discussed in monthly Plan-Do-Study-Act review cycles, this QI project did not have a detrimental effect on overall clinic workflow, and likely improved the accuracy and efficiency of our new patient intake process. In reviewing feedback from other published CDS QI studies, our initiative did share similar negative feedback from users, including anticipation of extra time for physician documentation and education and dependence on timeliness of data entry to prompt firing of the BPA alert. As a retrospective chart review, this study was prone to observer bias if the charts were not analyzed correctly; however, this was minimized by using strict criteria and specific ICD diagnostic codes. We did not include “secondary amenorrhea” as a diagnostic code because we felt that further diagnostic work-up is needed to use that diagnosis, and this was not investigated in this study. We used greater than 35 days in between cycles as criteria for oligomenorrhea, per the Female Athlete Triad Consensus panel. As mentioned earlier, more recent publications, including those from the American Academy of Pediatrics and American College of Obstetrics and Gynecology, state that cycles occurring at intervals greater than 45 days meet criteria for oligomenorrhea. Therefore, our screening BPA tool is likely more sensitive than recent guidelines suggest. In addition, beginning in March 2020, our new patient visits were significantly impacted by the COVID-19 pandemic. The pandemic affected the number of new patient visits and our screening, documentation, and clinic workflow with our transition to Telehealth visits. However, we did continue to observe a positive trend in diagnosis despite unavoidable limitations from the pandemic.

The aim of this study was to increase the appropriate diagnosis of MD, through a unique CDS, in athletes presenting to a pediatric sports medicine clinic. We determined that appropriate diagnosis is a critical first step of a comprehensive evaluation of MD. In our discussions with patients and educational handouts we recommend follow-up with two of our attending physicians who have expertise in the care of the athlete or further evaluation with a primary care physician. In this study we did not collect data on subsequent actions, evaluation, or referrals placed after the diagnosis was made. This will be a crucial next step for future research to optimize care and positive outcomes for athletes.

CONCLUSIONS

Our goal was to increase the appropriate diagnosis of MD in athletes presenting to a pediatric sports medicine clinic. We increased our rate of diagnosis over 6 months.

Education and optimization of CDS systems were essential in achieving this goal. We intend to maintain this QI initiative and continue to improve our accurate diagnosis of MD to empower our athletes. Similar to the ultimate goal of CDS in healthcare, the future direction of this initiative is to affect patient outcomes. Appropriate identification and diagnosis of MD warrants subsequent evaluation and interventions.

DISCLOSURE

The authors have no financial interests to declare in relation to the content of this article. This study did not receive any grant.

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Preliminary data from this QI Initiative was published in the American College of Sports Medicine Supplement, Medicine & Science in Sports & Exercise. Our quality improvement measures did not assess MD in transgender athletes, given the complexity of hormonal treatment regimens and their effect on menstrual cycles beyond this study's scope.

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