The Additive Value of Pelvic Examinations to History in Predicting Sexually Transmitted Infections for Young Female Patients With Suspected Cervicitis or Pelvic Inflammatory Disease

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Study objective: We evaluate the additive value of pelvic examinations in predicting sexually transmitted infection for young female patients with suspected cervicitis or pelvic inflammatory disease in a pediatric emergency department (ED).

Methods: This was a prospective observational study of female patients aged 14 to 20 years who presented to an urban academic pediatric ED with a complaint of vaginal discharge or lower abdominal pain. Enrolled patients provided a urine sample for chlamydia, gonorrhea, and trichomonas testing, which served as the criterion standard for diagnosis. A practitioner (pediatric ED attending physician, emergency medicine or pediatric resident, pediatric ED fellow, or advanced practice provider) obtained a standardized history from the patient to assess for cervicitis or pelvic inflammatory disease according to the Centers for Disease Control and Prevention criteria. They then recorded the likelihood of cervicitis or pelvic inflammatory disease on a 100-mm visual analog scale. The same practitioner then performed a pelvic examination and again recorded the likelihood of cervicitis or pelvic inflammatory disease on a visual analog scale with this additional information. Using the results of the urine sexually transmitted infection tests, the practitioner calculated and compared the test characteristics of history alone and history with pelvic examination.

Results: Two hundred eighty-eight patients were enrolled, of whom 79 had positive urine test results for chlamydia, gonorrhea, or trichomonas, with a sexually transmitted infection rate of 27.4% (95% confidence interval [CI] 22.6% to 32.8%). The sensitivity of history alone in diagnosis of cervicitis or pelvic inflammatory disease was 54.4% (95% CI 42.8% to 65.5%), whereas the specificity was 59.8% (95% CI 52.8% to 66.4%). The sensitivity of history with pelvic examination in diagnosis of cervicitis or pelvic inflammatory disease was 48.1% (95% CI 36.8% to 59.5%), whereas the specificity was 60.7% (95% CI 53.8% to 67.3%). The information from the pelvic examination changed management in 71 cases; 34 of those cases correlated with the sexually transmitted infection test and 37 did not.

Conclusion: For young female patients with suspected cervicitis or pelvic inflammatory disease, the pelvic examination does not increase the sensitivity or specificity of diagnosis of chlamydia, gonorrhea, or trichomonas compared with taking a history alone. Because the test characteristics for the pelvic examination are not adequate, its routine performance should be reconsidered. [Ann Emerg Med. 2018;72:703-712.]

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0196-0644/$-see front matter

https://doi.org/10.1016/j.annemergmed.2018.05.004

INTRODUCTION

Background

In the United States, rates of sexually transmitted infections caused by *Chlamydia trachomatis* and *Neisseria gonorrhoeae* are highest among girls and women aged 15 to 24 years.[1,2] In 2016, there were more than 1.5 million chlamydia cases and more than 400,000 gonorrhea cases reported, reaching a record high level.[3,4] Americans aged 15 to 24 years account for nearly two thirds of chlamydia diagnoses and half of gonorrhea diagnoses.[1,2] *Trichomonas vaginalis* infection is one of the most common vaginal infections. Its prevalence in the United States is estimated to be 2.3 million (3.1%) among female individuals aged 14 to 49 years.[5] In girls and women, chlamydia and gonorrhea infections are often asymptomatic, but they are also the most common bacteria isolated in cases of cervicitis and pelvic inflammatory disease.[6,7] Trichomonas infections are most often associated with vaginitis, but this parasite can infect the cervix and uterus, causing upper reproductive organ infection as well.[5]

Editor's Capsule Summary

What is already known on this topic

A pelvic examination is typically performed in the setting of pelvic pain or vaginal discharge.

What question this study addressed

What does a pelvic examination add to clinical judgment when sexually transmitted infection is possible?

What this study adds to our knowledge

In this evaluation of 288 female patients aged 14 to 20 years with a high prevalence (27%) of sexually transmitted infection, physician predictive ratings of the probability of sexually transmitted infection did not improve after the pelvic examination.

How this is relevant to clinical practice

Pelvic examinations did not add to history in predicting which adolescent female patients would have positive antigen test results for sexually transmitted infection.

There is no historic finding, physical examination finding, or laboratory test that is specific or sensitive for cervicitis or pelvic inflammatory disease. The current Centers for Disease Control and Prevention (CDC) guidelines suggest using a combination of history and physical examination and to treat empirically according to clinical findings, relying heavily on the pelvic examination to make this diagnosis. The diagnostic criteria for cervicitis include visualization of an inflamed cervix or abnormal discharge in the vaginal canal or at the cervix through speculum examination. The diagnostic criteria for pelvic inflammatory disease include lower abdominal pain with no other obvious cause (such as appendicitis or ovarian torsion) and abnormal findings on bimanual examination (such as cervical motion tenderness, adnexal tenderness, or uterine tenderness).[6,7]

Recent guidelines from the American College of Gynecology, the American Academy of Pediatrics, and the CDC, along with the advent of urine nucleic acid amplification tests, have questioned the need for the pelvic examination in asymptomatic female patients.[8-11] Nucleic acid amplification tests are the most sensitive and specific ones for chlamydia and gonorrhea, are the recommended test of choice by the CDC, and are Food and Drug Administration approved for urine sample testing.[12,13] Most practitioners continue to perform the pelvic examination for symptomatic female patients and provide empiric treatment because urine nucleic acid amplification test results are not immediately available in the emergency department (ED).

Importance

To the best of our knowledge, this is the only study that prospectively assesses the utility of the pelvic examination in young female patients with suspected cervicitis or pelvic inflammatory disease in the emergency setting.

Goals of This Investigation

The objective of this study is to describe the test characteristics of the pelvic examination for predicting sexually transmitted infections that cause cervicitis or pelvic inflammatory disease in young female patients. If the pelvic examination taken as a "test" to rule in or rule out cervicitis or pelvic inflammatory disease does not have adequate test characteristics, then its routine use should be reevaluated.

MATERIALS AND METHODS

Study Design and Setting

This was a prospective observational study conducted in an urban academic pediatric ED that took place between October 2015 and October 2017. The site has a census of 30,000 patients per year. Patients provided written informed consent, and approval was obtained from the institutional review board.

Selection of Participants and Interventions

This was a convenience sample, with eligible patients approached for enrollment when study personnel were available. In general, study personnel were available every day, except from midnight to 7 AM. Female patients aged 14 to 20 years who presented to the pediatric ED with a complaint of vaginal discharge or lower abdominal pain, regardless of pregnancy status, were included in the study. Patients who met criteria but had unstable vital signs (pulse rate >110 beats/min or systolic blood pressure <90 mm Hg), needed critical care management, refused testing, never had had a pelvic examination, or were not English proficient were excluded from enrollment. Enrolled patients provided a urine sample for chlamydia, gonorrhea, and trichomonas testing. No specifications about urine collection methods were made and the samples were routinely collected in our triage section before study enrollment.[14] Testing for chlamydia and gonorrhea was conducted in the laboratory, and results were returned within 3 to 5 days, whereas trichomonas results were returned within 1 to 3 hours. A practitioner (pediatric ED attending physician, emergency medicine or pediatric resident, pediatric ED fellow, or advanced practice

provider) recorded a standardized history from the patient to assess for cervicitis or pelvic inflammatory disease according to CDC criteria. They then recorded the likelihood of cervicitis or pelvic inflammatory disease on a 100-mm visual analog scale (VAS; first VAS score). The history was taken without the parent in the room unless otherwise requested by the patient. The same practitioner then performed a pelvic examination and again recorded a likelihood of cervicitis or pelvic inflammatory disease on a VAS (second VAS score) with this additional information. The physical examination portion of the data form included external genital visual inspection, a speculum examination, and bimanual examination. Practitioners were advised that documentation of VAS scores of 50 mm or greater would indicate that they believed the patient should be treated for cervicitis or pelvic inflammatory disease. A full list of the study questions and pelvic exam assessments is shown in Figure E1 (available online at http://www.annemergmed.com). All practitioners and study participants were blinded to results of sexually transmitted infection testing at the primary visit.

Demographic data, including race, age, and telephone contact information, were collected. At the primary visit, patients were told they would receive a telephone call to inform them of the results of the sexually transmitted infection tests. Once results for the urine nucleic acid amplification test returned, all patients were called back at the number provided on the data form and informed of these results. At this time, patients were also asked about resolution of symptoms and advised to follow up in the pediatric ED if additional antibiotics were required or if symptoms persisted. Study personnel (S.F. and C.T.) looked up the results of the sexually transmitted infection tests, made the follow-up telephone calls, and recorded sexually transmitted infection results and which patients had been contacted.

At the beginning of the study, the site laboratory used the Abbott RealTime CT/NG assay (Abbott Molecular, Abbott Park, IL) to detect chlamydia and gonorrhea. During the study period, the CT/NG assay choice was switched to the APTIMA combo 2 assay (Gen-Probe, San Diego, CA) and was run at an outside central laboratory for the New Jersey Barnabas Health system. Both tests have a high sensitivity for detection of chlamydia and gonorrhea. The Abbott urine test sensitivity for chlamydia is 92.6%, and APTIMA's is 94.7%. The Abbott urine test sensitivity for gonorrhea is 93.8%, and APTIMA's is 91.3%.[12,13] Trichomonas testing was conducted in our laboratory by wet mount preparation. All samples were sent in a sterile tube with no added preservative. In our hospital, samples are stored at room temperature, and laboratory technicians are required to perform the wet mount analysis within 1 hour of receiving the urine. All laboratory technicians have been trained in microscopic analysis of urine samples. General reports of sensitivity range from 32% to 82%, depending on technician level of experience and inoculum size.[15]

Methods of Measurement and Outcome Measures

The demographic, historic, and clinical information for patients with negative and positive sexually transmitted infection testing results was recorded and compared with 95% confidence intervals (CIs). The VAS scores, before and after pelvic examination for patients with negative and positive sexually transmitted infection testing results, were recorded and compared in a hybrid parallel line chart. The number of cases in which the pelvic examination changed management was calculated. In accordance with discussion with local providers, we decided a management change was indicated if the VAS score crossed the 50-mm mark after the pelvic examination. Using the results of the urine sexually transmitted infection tests as the criterion standard for a true diagnosis of cervicitis or pelvic inflammatory disease, practitioners calculated and compared test characteristics of history alone and history with pelvic examination. A subgroup analysis of test characteristics based on clinician experience level was also performed.

Primary Data Analysis

Given a historic chlamydia or gonorrhea incidence of 30% in our patient population, a desired absolute CI of 0.05, and the average sensitivity of 94% for the Abbott and the APTIMA chlamydia urine testing, we calculated that we needed to enroll a sample size of 288 patients.[16] All data were entered in Excel (version 15.41; Microsoft, Redmond, WA), and the graphs were made in Excel. We used VassarStats.com to calculate descriptive statistics, including differences between proportions, Student's t test values, sensitivities, specificities, positive and negative predictive values, and likelihood ratios with 95% confidence limits. There were 18 cases in which trichomonas testing was not conducted, but we included these cases in the analysis because the most likely cause of cervicitis or pelvic inflammatory disease in our patient population was chlamydia or gonorrhea. During the follow-up period, these 18 patients were called and all stated their symptoms improved. Further chart review after the enrollment period indicated that 10 of those patients were subsequently tested in our hospital setting for trichomonas and one patient had a positive test result.

RESULTS

Characteristics of Study Subjects

Figure 1 shows all the patients who were eligible for enrollment. During the study period, 848 nucleic acid amplification tests were ordered for female patients aged 14 to 20 years who had a primary final diagnosis of cervicitis, pelvic inflammatory disease, vaginitis, urinary tract infection, dysfunctional uterine bleeding, or undifferentiated abdominal pain. Of these patients, 560 were not evaluated for enrollment because either study personnel were not available during their presentation or they were missed for enrollment. During the study period, 322 patients were enrolled in the study. Of those patients, 34 were excluded from the study after enrollment because the urine nucleic acid amplification test was not sent to the laboratory, not run by the laboratory, or deemed to be in the wrong container by the laboratory.

Of the remaining 288 patients who completed enrollment, 79 had positive urine sexually transmitted infection test results, with an overall prevalence of infection of 27.4% (22.6% chlamydia, 6% gonorrhea, 3.5% trichomonas, and 4.5% coinfection). One hundred twenty-three patients were treated for cervicitis, 35 were treated for pelvic inflammatory disease, and 93 were treated for vaginitis. Of the 166 patients who had second VAS scores less than 50 mm, 36 were treated with empiric antibiotics even though the clinician did not think it was warranted. Treatment in these cases was given at patient request. Follow-up telephone calls reached 68% of the patients in regard to test results and resolution or continuation of symptoms. All patients who had chlamydia-, gonorrhea-, or trichomonas-positive test results were treated appropriately during the initial visit or contacted and given appropriate care through a subsequent visit or pharmacy prescription.

Before the pelvic examination, 127 patients were thought to have cervicitis or pelvic inflammatory disease. After the pelvic examination, management changed in 71 cases; 34 of those cases correlated with the urine sexually transmitted infection test and 37 did not.

Table 1 describes the demographic and clinical information for patients with and without infection. The historical findings of vaginal discharge and pruritus were more common in the group with negative sexually transmitted infection results. There were no significant differences between the 2 groups in regard to any of the physical examination findings, including abnormal vaginal discharge, cervical motion tenderness, uterine tenderness, or adnexal tenderness. The mean VAS practitioner confidence scores were significantly higher in the group with positive sexually transmitted infection results, but this

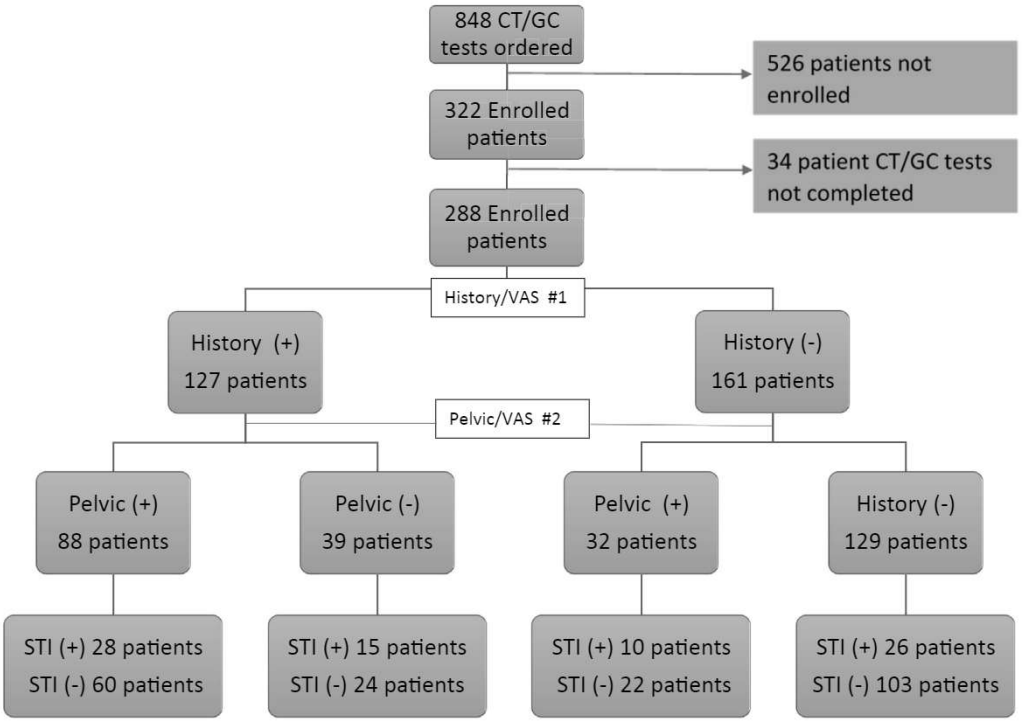

Figure 1. Study flow chart. *CT/GC*, Chlamydia/gonorrhea; *VAS*, visual analog scale; *STI*, sexually transmitted infection.

Table 1. Patient demographics and characteristics.

Characteristics	No. of Patients (%)		Difference (95% CI)
	STI Urine Positive (n=73)	STI Urine Negative (n=209)	
Patient demographics			
Age, mean, y	18.1	18.6	0.50 (−0.16 to 0.08)
Race			
White	1 (1.3)	1 (0.5)	0.01 (−0.02 to 0.06)
Black	77 (97.4)	194 (92.8)	0.05 (−0.02 to 0.09)
Hispanic	1 (1.3)	10 (4.7)	0.01 (−0.02 to 0.07)
Asian	0	0	0.00 (−0.05 to 0.02)
Other	0	4 (1.9)	0.02 (−0.03 to 0.05)
History characteristics			
Abnormal vaginal discharge*	46 (58.2)	150 (71.7)	0.14 (0.01 to 0.26)
Odor	27 (34.2)	78 (37.3)	0.03 (−0.10 to 0.14)
Pelvic pain	41 (51.9)	119 (56.9)	0.05 (−0.08 to 0.17)
Abdominal pain	48 (60.8)	113 (54.1)	0.07 (−0.06 to 0.19)
Vaginal pruritus*	16 (20.2)	73 (34.9)	0.14 (0.03 to 0.25)
Abnormal vaginal bleeding	18 (22.8)	50 (23.9)	0.01 (−0.10 to 0.11)
Previous STI	41 (51.9)	113 (54.1)	0.02 (−0.10 to 0.15)
Dysuria	24 (30.4)	58 (27.8)	0.02 (−0.08 to 0.15)
Genital lesions	6 (7.6)	25 (11.9)	0.04 (−0.04 to 0.11)
Condom use	20 (25.3)	49 (23.4)	0.02 (−0.08 to 0.13)
Positive POC UTI	35 (44.3)	85 (40.7)	0.03 (−0.09 to 0.16)
Mean first VAS score*	50	40.6	9.44 (2.04 to 16.84)
Physical/pelvic examination characteristics			
Abdominal tenderness	27 (34.2)	92 (44.0)	0.09 (−0.03 to 0.22)
Abnormal vaginal discharge	53 (67.1)	148 (70.8)	0.04 (−0.08 to 0.16)
Odor	22 (27.8)	53 (25.4)	0.02 (−0.08 to 0.15)
Pelvic pain	30 (37.9)	80 (38.3)	0.003 (−0.12 to 0.12)
Cervical motion tenderness	13 (16.5)	38 (18.2)	0.02 (−0.09 to 0.10)
Uterine tenderness	6 (7.6)	14 (6.7)	0.009 (−0.05 to 0.09)
Adnexal tenderness	11 (13.9)	28 (13.4)	0.005 (−0.07 to 0.10)
Genital lesions	4 (5.1)	24 (11.5)	0.06 (−0.02 to 0.12)
Mean second VAS score*	50.4	40.4	10.03 (1.42 to 18.91)

POC, Point of care; *UTI*, urinary tract infection.
*Significant values.

increase was present in both the first and second VAS scores.

Figure 2 is a hybrid parallel line graph that shows the practitioner pretest and posttest probability scores as paired data. The blue line indicates the first VAS score and the orange bar graphs indicate how the second VAS score was adjusted after the pelvic examination for each patient. The left side of the graph indicates the urine sexually transmitted infection negative cases, whereas the right side of the graph indicates the urine sexually transmitted infection positive cases. After performance of the pelvic examination, the second VAS values did not show a decreasing trend in the sexually transmitted infection negative cases or an increasing trend in the sexually transmitted infection positive cases.

Main Results

Table 2 demonstrates the test characteristics of history alone and history with pelvic examination. The sensitivity of history alone in diagnosis of cervicitis or pelvic inflammatory disease was 54.4% (95% CI 42.8% to 65.5%), whereas the specificity was 59.8% (95% CI 52.8% to 66.4%). The sensitivity of history with pelvic examination in diagnosis of cervicitis or pelvic

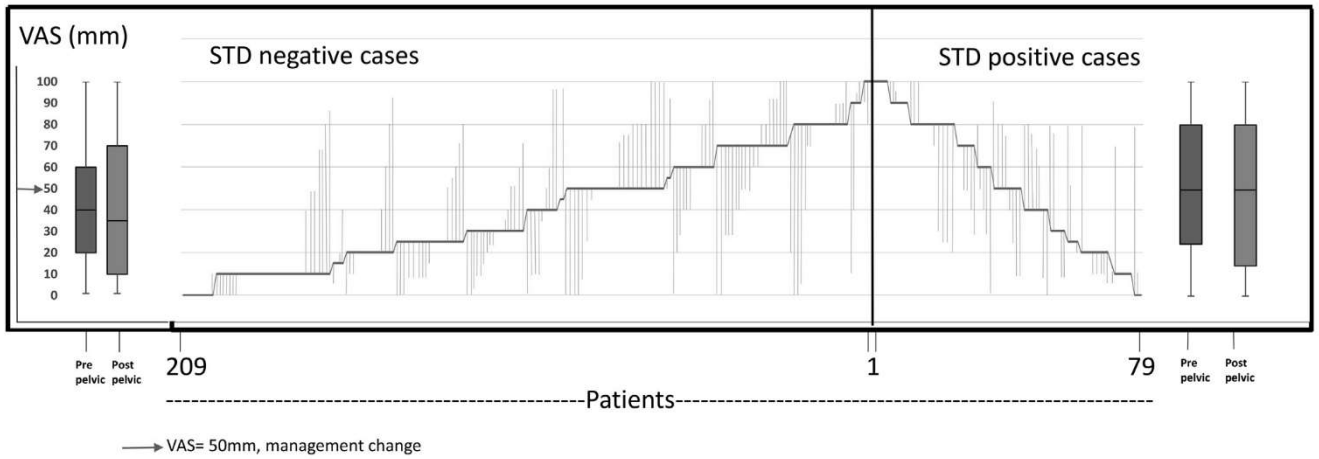

Figure 2. Data distribution for prepelvic VAS assessments (shown in blue) and postpelvic VAS assessments (shown as the open end of the orange line). *STD*, Sexually transmitted disease.

inflammatory disease was 48.1% (95% CI 36.8% to 59.5%), whereas the specificity was 60.7% (95% CI 53.8% to 67.3%). The positive and negative likelihood ratios for history alone were 1.35 (95% CI 1.04 to 1.75) and 0.76 (95% CI 0.59 to 0.98). The positive and negative likelihood ratios for the history with the pelvic examination were 1.23 (95% CI 0.92 to 1.63) and 0.85 (95% CI 0.68 to 1.06). Table 3 describes the test characteristics based on provider level of experience. Sensitivities and specificities did not change significantly as provider level of experienced increased.

LIMITATIONS

There are several limitations to this study. First, this was a single-center study in a population with a high prevalence of symptomatic infection and may not be generalizable to nonurban institutions with a different population.[17] Second, because study personnel were not always available for enrollment, the patients were not enrolled consecutively and represent a convenience sample.

Table 2. Test characteristics.

Test Characteristics	History Alone (95% CI)	History and Pelvic Examination (95% CI)
Sensitivity	54.4 (42.8- 65.5)	48.1 (36.8–59.5)
Specificity	59.8 (52.8–66.4)	60.7 (53.8–67.3)
PPV	33.8 (25.9–42.9)	31.7 (23.6–40.9)
NPV	77.6 (70.3–83.7)	75.6 (68.3–81.7)
LR+	1.35 (1.04–1.75)	1.23 (0.92–1.63)
LR–	0.76 (0.59–0.98)	0.85 (0.68–1.06)

PPv, Positive predictive value; *NPV*, negative predictive value; *LR+*, positive likelihood ratio; *LR–*, negative likelihood ratio.

A final limitation is that we might have missed cases of gonorrhea or trichomonas, or cases caused by other microorganisms. We used the urine nucleic acid amplification test as opposed to the cervical swab nucleic acid amplification test. The urine nucleic acid amplification test is more sensitive for chlamydia than clinician-collected swabs for both the Abbott and the APTIMA test, but it is less sensitive for gonorrhea. Although the clinician-collected swabs are only minimally more sensitive, there might have been missed gonorrhea cases. Also, we did not have trichomonas testing for 18 cases but decided to keep these patients in the analysis because the most common cause for cervicitis or pelvic inflammatory disease is chlamydia or gonorrhea. Trichomonas cases also might have been missed because the sensitivity of the wet mount preparation is highly variable and technician dependent. Finally, we used the genomic testing for chlamydia, gonorrhea, and trichomonas as a criterion standard for the diagnosis of cervicitis or pelvic inflammatory disease. Literature indicates that these are the most common causes for cervicitis and pelvic inflammatory disease, but they are not the only organisms that cause these sexually transmitted infection complications. The CDC guidelines mention that cervicitis and pelvic inflammatory disease can also be caused by mycoplasma vaginalis, genital herpes, and normal vaginal flora overgrowth.[3,4] With this in mind, some of the cases that were considered false positives might have actually been correctly identified for cervicitis or pelvic inflammatory disease caused by an organism that we did not consider as a criterion standard for diagnosis. The CDC guidelines indicate there is no easily available testing for mycoplasma vaginalis, and other causes besides chlamydia and gonorrhea should be considered only for cases that

Table 3. Test characteristics for providers, separated by level of experience.

	Sensitivity (95% CI)		Specificity (95% CI)	
Providers (n)	**History Alone**	**History and Pelvic Examination**	**History Alone**	**History and Pelvic Examination**
Pediatric ED attending physician (42)	50.0 (22.2–77.7)	50.0 (22.2–77.7)	53.3 (34.6–71.2)	40.0 (23.2–59.2)
Pediatric ED fellow (123)	58.8 (40.8–74.8)	47.1 (30.2–64.6)	65.2 (54.2–74.8)	66.3 (55.4–75.8)
Resident (87)	45.5 (25.1–67.3)	45.5 (25.1–67.3)	60.0 (47.1–71.7)	67.7 (54.8–78.5)
APP (36)	63.6 (31.6–87.6)	54.5 (24.6–81.9)	48.0 (28.3–68.2)	48.0 (28.3–68.2)

APP, Advanced practice provider.

recur or fail antibiotic treatment directed toward chlamydia and gonorrhea.[18]

DISCUSSION

Sexually transmitted infection rates for young female patients are reaching epidemic proportions, and the morbidity caused by chlamydia and gonorrhea infections is significant. Patients with these infections are more likely to become infertile, have ectopic pregnancies, have dysfunctional uterine bleeding, experience chronic pelvic pain, and develop HIV infection.[1,2] There is no definitive test for cervicitis or pelvic inflammatory disease, but the organisms most commonly identified in these disorders are chlamydia and gonorrhea, and the antibiotics commonly chosen for cervicitis and pelvic inflammatory disease specifically treat these organisms. The main result of our study demonstrates that for young female patients with suspected cervicitis or pelvic inflammatory disease, the pelvic examination does not change the sensitivity or specificity for diagnosis of chlamydia, gonorrhea, or trichomonas compared with taking a history alone.

Most recently, the use of the pelvic examination in asymptomatic women has been questioned by the American College of Gynecology, American Academy of Pediatrics, and CDC, and the literature demonstrates it may lack utility in symptomatic women was well. In 2001, Close et al[19] studied the value of the pelvic examination in the ED setting. The authors reported that interrater reliability of the physician pelvic examination is poor and that only 17% of physicians were in agreement about findings such as cervical motion tenderness.

In our study, the findings of cervical motion tenderness, adnexal tenderness, and uterine tenderness were not significantly different between the sexually transmitted infection–positive and –negative groups. Brown et al[20] evaluated the pelvic examination in adult ED patients with various presentations to determine whether the examination added new information or changed the clinical management. These authors found that in 94% of patients, the results of the pelvic examination were either predicable or did not change clinical management of a case. They concluded that the pelvic examination may safely be deferred in a subset of women with abdominal pain or vaginal bleeding. For the majority of cases (217) in our study, the pelvic examination did not change the clinician's decision to treat the patient with antibiotics, and in 106 cases the clinician VAS confidence score was the same before and after the pelvic examination. There were 71 cases in which the medical management was changed by the findings of the pelvic examination; 34 cases correlated with the sexually transmitted infection results and 37 cases did not. The information obtained by the pelvic examination did not consistently redirect the clinician to better identify sexually transmitted infection–positive or –negative cases.

Padilla et al[21] studied the test characteristics for the pelvic examination in the evaluation of adnexal masses and found the sensitivity and specificity did not improve as level of physician experience increased. Pelvic-related complaints are a common presenting symptom in our urban pediatric ED, and most of our study providers have some experience performing a pelvic examination. However, because we had a variety of providers participate in our study, including residents in training, we stratified our results according to level of experience. Although this component of the study was not powered, the pelvic examination when performed by health care workers with more years of practice was not more accurate. The test characteristics presented in Table 3 are consistently low among all providers, and the pelvic examination taken as a test does not significantly increase sensitivity or specificity for sexually transmitted infection detection at any provider level.

The hybrid parallel line plot in Figure 2 pairs clinician pretest and posttest probabilities of sexually transmitted infection for each patient in the study. If the pelvic examination had value in detecting sexually transmitted infections, we would expect the second VAS scores to decrease in the sexually transmitted infection–negative cases

and increase in the sexually transmitted infection–positive cases. Instead, clinicians were equally likely to alter the postexamination probability of their patients' having a sexually transmitted infection across a wide spectrum of pre-examination VAS scores with no discernable pattern. The first and second VAS score interquartile data distribution appears similar, and the mean VAS values from Table 1 were almost equivalent. Because urine nucleic acid amplification tests are not returned immediately in most hospital settings, clinicians must decide how to treat patients with incomplete test results. With the likelihood ratios we calculated, positive findings on a pelvic examination do not change the pretest probability of disease enough to treat a patient empirically with antibiotics. A number of competing interests come into play when a pretest probability that should warrant empiric antibiotics is chosen, including patient follow-up rate, antibiotic stewardship, previous visits with sexually transmitted infection testing, patient request for empiric treatment, and potential complications of untreated sexually transmitted infections. In our study, we suggested that a VAS score of 50 mm or greater should warrant treatment for cervicitis or pelvic inflammatory disease. CDC guidelines suggest that a lower threshold for empiric treatment in areas with high disease prevalence may provide an overall public health benefit.[6,7] Other studies confirm that provider judgement in this area lacks sensitivity or specificity and a completely different approach might be needed.[17,22] Possible strategies to improve medical care for these young women include point-of-care testing, better follow-up mechanisms, and the development of clinical decisionmaking rules for sexually transmitted infection treatment.

Ideally, laboratory testing should have a rapid turnaround time with high accuracy, obviating the need for empiric therapy in the absence of test results. Cepheid (Sunnyvale, California) CT/NG Xpert assay is a 1-hour urine point-of-care test for chlamydia and gonorrhea that has a high sensitivity.[23] In areas in which these organisms have a high prevalence, a suggested approach is hospital purchase of a point-of-care urine sexually transmitted infection test for adolescent girls with complaints of vaginal discharge or lower abdominal pain. Self-collected vaginal swabs or urine for trichomonas, candida, and bacterial vaginosis can also be sent then. Because the World Health Organization is now reporting widespread gonorrhea resistance to antibiotics in multiple countries, this approach would increase specificity of treatment and prevent the development of resistant bacteria.[24] Practitioners can then defer the pelvic examination, await results, and treat patients accordingly. For patients with complaints who do not have positive test results for any of the above-listed organisms, a pelvic examination can be considered.

Although this study demonstrates poor test characteristics for the pelvic examination for the diagnosis of cervicitis or pelvic inflammatory disease, there might be other information gained from performing a pelvic examination. Historically, the pelvic examination has been used to aid in the evaluation of adnexal masses, uterine masses, tubal ovarian abscess, labial abscess, appendicitis, ovarian cyst, and ovarian torsion. However, in our pediatric ED we have found that bedside or radiology-performed ultrasonography is a better modality of assessment for all of these entities. CDC guidelines use the pelvic examination to distinguish cervicitis from pelvic inflammatory disease, 2 distinct problems that require different medication courses. Our study suggests that the clinical features that determine pelvic inflammatory disease (cervical motion tenderness, adnexal tenderness, or uterine tenderness) are not present more in patients with sexually transmitted infection, and perhaps the guidelines need to be reconsidered. Another potential finding during the pelvic examination is genital lesions. In their large retrospective study of women in a sexually transmitted infection clinic, Singh et al[25] found that the odds of receiving a diagnosis of a clinically meaningful cervicovaginal lesion did not increase significantly after external inspection or speculum examination, but symptomatic women are more likely to have lesions that lead to diagnosis. In our study, the physical examination finding of abnormal genital lesions was not significantly higher in patients with positive results for sexually transmitted infection. A final reason to conduct a pelvic examination during a sexually transmitted infection evaluation is to exclude the presence of a vaginal foreign body, a risk factor for sexually transmitted infections. One patient in the study presented with a retained condom in her vagina, and she tested positive for trichomonas. If we had not conducted the pelvic examination, we would have been unaware of this foreign body because the patient herself did not know about it. For this case, the patient was made aware of the finding and, while the clinician went to get forceps for removal, the patient removed the condom by herself. Vaginal foreign body is a rare diagnosis; for our study, the rate was 0.35%, and in general complaints of abnormal vaginal discharge in our study age group are more likely due to infectious causes.[26]

The most important reason to reevaluate the need for a pelvic examination is that it lacks reliability and provides little additional information, but there are other reasons to reconsider the examination. The pelvic examination is physically uncomfortable and emotionally distressing for most women, and it is particularly anxiety provoking for

teenage girls. Studies show that adolescents are more likely to participate in sexually transmitted infection surveillance programs when samples obtained are self-collected.[27,28] Literature that advises against the pelvic examination for a screening tool in well women emphasizes that women are less likely to return for follow-up if they believe a pelvic examination will be conducted.[29] A recent ED-based study addressed the value of the pelvic examination in pregnant women with first-trimester vaginal bleeding and found that patient satisfaction was improved in the group that did not receive a pelvic examination, and these women felt less embarrassed during the physical examination. In the study, 6% of the patients refused enrollment because they did not want a pelvic examination performed, implying that some women believe a thorough evaluation can be made even if the pelvic examination is omitted. The study also prospectively assessed wait times for patients who had pelvic examinations compared with those who did not and found a trend toward shorter ED stays for the nonpelvic-examination group.[30] These patient-centered issues cannot be undervalued in ED management and must be taken into consideration when young female patients are evaluated, many of whom are minors possibly presenting without a parent or advocate.

In summary, for young female patients with suspected cervicitis or pelvic inflammatory disease, our results indicate that the pelvic examination does not improve the sensitivity or specificity in the diagnosis of chlamydia, gonorrhea, or trichomonas infection compared with taking a history alone. Because the test characteristics for the pelvic examination are not adequate, its routine use should be reconsidered. For populations with high prevalence of these infections, other forms of diagnosis, such as point-of-care testing, should be explored to prevent unnecessary antibiotic use and avoid missing patients who would benefit from treatment.

Supervising editor: Steven M. Green, MD

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Author contributions: SF, ABS, and CT conceived and designed the study. All authors enrolled patients and performed data analysis and statistics. SF, KP, and CT performed data collection and entry. CT drafted the initial article. ABS and CT contributed substantially to the article revision. CT takes responsibility for the paper as a whole.

All authors attest to meeting the four ICMJE.org authorship criteria: (1) Substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work; AND (2) Drafting the work or revising it critically for important intellectual content; AND (3) Final approval of the version to be published; AND (4) Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Funding and support: By *Annals* policy, all authors are required to disclose any and all commercial, financial, and other relationships in any way related to the subject of this article as per ICMJE conflict of interest guidelines (see www.icmje.org). The authors have stated that no such relationships exist. Dr. Farrukh used a fund for pediatric emergency fellows for travel. The fund was provided by Newark Beth Israel Medical Center.

Publication dates: Received for publication December 29, 2017. Revisions received April 12, 2018, and April 24, 2018. Accepted for publication May 2, 2018.

Presented at the Pediatric Academic Societies meeting, San Francisco, CA, May, 2017.

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History questions:

	Yes/positive	No/negative
Abnormal vaginal discharge		
Odor		
Pelvic pain		
Abdominal pain		
Vaginal pruritis		
Abnormal vaginal bleeding		
Previous STI		
Dysuria		
Genital lesions		
Condom use		
POC UTI results		
Cervicits/PID present		

VAS #1
0----------100

Pelvic exam:

	Yes/positive	No/negative
Abdominal tenderness		
Abnormal vaginal discharge		
Odor		
Pelvic pain		
Cervical motion tenderness		
Uterine tenderness		
Adnexal tenderness		
Genital lesions		
Cervicitis/PID present		

VAS #2
0----------100

POC, point of care, UTI, urinary tract infection

Figure E1. Study questions and pelvic exam assessments.