

## ORIGINAL RESEARCH CONTRIBUTION

# Frequency of Pregnancy Testing Among Adolescent Emergency Department Visits

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## Abstract

**Objectives:** The objective was to estimate the frequency of pregnancy testing among adolescent emergency department (ED) patients and to determine factors associated with testing.

**Methods:** This was a retrospective cross-sectional study using the National Hospital Ambulatory Medical Care Survey (NHAMCS) from 2005 through 2009 of ED visits by females ages 14 to 21 years. The frequency of pregnancy testing among all visits was estimated for potential reproductive health complaints and for those associated with exposure to potentially teratogenic radiation. Multivariable logistic regression modeling was performed to calculate adjusted probabilities and odds ratios (ORs) with 95% confidence intervals (CIs) to evaluate factors associated with pregnancy testing by patient characteristics.

**Results:** The authors identified 11,531 visits, representing an estimated 41.0 million female adolescent ED visits. Of these, 20.9% (95% CI = 19.3% to 22.5%) included pregnancy testing. Among visits for potential reproductive health complaints and those associated with exposure to potentially teratogenic radiation, 44.5% (95% CI = 41.3% to 47.8%) and 36.7% (95% CI = 32.5% to 40.9%), respectively, included pregnancy testing. Among the entire study population, we found statistically significant differences in pregnancy testing by age, race or ethnicity, hospital admission, and geographic region ( $p < 0.001$  for all).

**Conclusions:** A minority of female adolescent ED visits included pregnancy testing, even if patients presented with potential reproductive health complaints or received exposure to ionizing radiation. Small but statistically significant differences in pregnancy testing rates were noted based on age, race or ethnicity, ED disposition, and geographic region. Future studies should focus on designing quality improvement interventions to increase pregnancy testing in adolescent ED patients, especially among those in whom pregnancy complications or the risk of potentially teratogenic radiation exposure is higher.

ACADEMIC EMERGENCY MEDICINE 2013; 20:816–821 © 2013 by the Society for Academic Emergency Medicine

Almost one million teenagers in the United States become pregnant annually,<sup>1</sup> of which more than 80% of pregnancies are unintended.<sup>2</sup> The United States continues to have one of the highest adolescent pregnancy rates of all industrialized countries,<sup>3</sup> with underserved youth and those with poor access to health care disproportionately represented.<sup>2,4,5</sup> Young

females have high rates of emergency department (ED) use, comprising 15% of all annual ED visits,<sup>6</sup> and high rates of unintended pregnancy have been found among women using EDs.<sup>5</sup>

The diagnosis or exclusion of pregnancy and its complications is critical during ED evaluation of many females of child-bearing age, but particularly among

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Received January 17, 2013; revision received February 19, 2013; accepted February 20, 2013.

Presented at the Pediatric Academic Societies Annual Meeting, Boston, MA, April 28–May 1, 2012; Society for Academic Emergency Medicine Annual Meeting, Chicago, IL, May 2012; and the American Academy of Pediatrics National Conference & Exhibition, New Orleans, LA, October 2012.

This work was supported by NIH grant K23 HD070910-01 (MKG), Department of Pediatrics, Children's Hospital of Philadelphia (MKG). The funders had no role in the study design; collection, analysis, or interpretation of data; writing of the report; or the decision to submit the paper for publication. The authors have no other disclosures or conflicts of interest to report.

Supervising Editor: Marc H. Gorelick, MD, MSCE.

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adolescent patients.<sup>7</sup> Adolescents often present late in their first trimester for pregnancy diagnosis,<sup>8</sup> and earlier pregnancy detection may help reduce some of the adverse sequelae associated with adolescent pregnancies, such as preeclampsia, prematurity, and fetal and maternal death.<sup>9</sup> Furthermore, because some diagnostic imaging and therapies provided in the ED are teratogenic to a developing fetus, it is crucial to consider pregnancy.

Given the importance of detecting pregnancies during the ED evaluations of adolescent females, it is necessary to understand current pregnancy testing patterns. Although single-center studies have found that the diagnosis of pregnancy in adolescents is often missed on initial ED evaluation,<sup>7,10</sup> national figures have yet to be estimated. Therefore, we sought to measure the frequency of pregnancy testing among a nationally representative sample of adolescent female ED visits and to determine factors associated with pregnancy testing.

## METHODS

### Study Design

We conducted a retrospective cross-sectional analysis of the National Hospital Ambulatory Medical Care Survey (NHAMCS) from 2005 through 2009. This study was determined to be exempt from formal review by our hospital's institutional review board because of the use of deidentified, publicly available data.

### Study Setting and Population

The NHAMCS, a multistage national probability sample survey of hospital EDs (excluding federal, military, and Veterans Affairs hospitals) conducted by the Centers for Disease Control and Prevention, National Center for Health Statistics, is conducted during a randomly assigned 4-week data period annually. This design involves selection of geographic primary sampling units, hospitals within primary sampling units, EDs within hospitals, and patient visits within EDs, with the patient visit being the basic sampling unit. Each patient visit represents a larger number of visits. A weight is assigned to each observation and allows for the generation of nationally representative estimates.<sup>11</sup>

The eligible study population included all ED visits by females between the ages of 14 and 21 years from 2005 through 2009. Subgroup analysis was also performed to evaluate the frequency of pregnancy testing among visits for potential reproductive health complaints as well as for visits with exposure to potentially teratogenic radiation. Potential reproductive health complaints were defined as visits with lower abdominal, pelvic, or genital pain; vaginal discharge or bleeding; or dysuria listed as one of the three reasons for visit collected by the NHAMCS for each patient visit. Furthermore, exposure to potentially teratogenic radiation was defined as patient visits associated with performance of computed tomography (CT). NHAMCS does not distinguish type of radiographs performed, and therefore we were unable to determine whether patient visits were also associated with radiographs of the abdomen or pelvis.

### Outcome Measures

Our primary outcome variable was performance of a pregnancy test. Covariates of interest included patient age, race and ethnicity, insurance status, disposition, geographic region, and care at a pediatric versus general ED. Patient age was categorized as 14 to 17 and 18 to 21 years. Race and ethnicity variables were collapsed into one racial/ethnic group variable. NHAMCS codes race as white, black/African American, Asian, Native Hawaiian/other Pacific Islander, American Indian/Alaska Native, and more than one race reported. Ethnicity is coded in NHAMCS as Hispanic and not Hispanic. We created a racial/ethnic group variable by combining the race and ethnicity variables into non-Hispanic white, non-Hispanic black/African American, Hispanic, and other. With regard to insurance status, we compared private versus nonprivate insurance. Non-private insurance was composed of the following categories: Medicare, Medicaid, self-pay, and no charge/charity. Geographic regions were defined as by the U.S. Census Bureau, including the Northeast, South, Midwest, and West. EDs were categorized as pediatric if >75% of ED patient volume was composed of patients younger than 21 years old.

### Data Analysis

We used descriptive statistics with appropriate survey weighting to calculate frequency of pregnancy testing. To identify factors that might be associated with pregnancy test performance, we first considered simple associations with these candidate factors and testing. Then we performed multivariate logistic regression to estimate associations with pregnancy test performance after adjusting for other factors. This exploratory investigation sought to adjust for confounding variables with *p*-values of <0.10 in any of the bivariate analyses and variables that were a priori felt to have a potential relationship with pregnancy testing were retained in our multivariate model. A goodness-of-fit test applicable to survey data, the F-adjusted mean residual test,<sup>12</sup> was used to provide an estimate of model performance. Estimates were derived from the multivariate model including adjusted odds ratios (AOR) with 95% confidence intervals (CIs) and standardized adjusted probabilities of receipt of pregnancy test. The survey sample suite of programs implemented in Stata 12.1 (StataCorp, College Station, TX; 2012) was used for regression analysis to account for the complex design of the NHAMCS survey. We estimated standardized probabilities of testing by means of predictive margins as implemented in the "margins" command in Stata.<sup>13</sup>

## RESULTS

During 2005 through 2009, a total of 11,531 records were identified, representing an estimated 41.0 million female adolescent ED visits. Of these, 20.9% (95% CI = 19.3% to 22.5%) or 8.6 million included pregnancy tests. Of the estimated 10.1 million ED visits for potential reproductive health complaints, only 44.5% (95% CI = 41.3% to 47.8%) were associated with pregnancy testing. Additionally, among the estimated 3.7 million patient visits with exposure to potentially teratogenic

radiation, only 36.7% (95% CI = 32.5% to 40.9%) included pregnancy testing. Table 1 provides the frequency of pregnancy testing by age, race, insurance status, geographic region, and ED disposition.

In bivariate analyses, we found associations with pregnancy testing by age category ( $p < 0.001$ ), racial/ethnic group ( $p = 0.003$ ), insurance status ( $p = 0.04$ ), geographic region ( $p < 0.001$ ), and ED type ( $p = 0.09$ ). In our subgroup analysis of visits for potential reproductive health complaints, analyses revealed statistically significant associations of pregnancy testing with racial/ethnic group ( $p = 0.03$ ), ED disposition ( $p < 0.001$ ), geographic region ( $p < 0.001$ ), and ED type ( $p = 0.04$ ). In our subgroup analysis of visits with exposure to potentially teratogenic radiation, pregnancy testing was associated with ED disposition ( $p = 0.04$ ) only.

Table 2 provides the standardized probabilities for pregnancy testing among all patient visits and the two subgroups, patient visits for potential reproductive health complaints, and patient visits associated with receipt of potentially teratogenic radiation. Table 3 provides the AOR for pregnancy testing by variable. Among all patient visits, we found that visits made by patients 14 to 17 years old (AOR = 0.79, 95% CI = 0.70 to 0.89) compared to 18- to 21-year-olds and non-Hispanic white patients (AOR = 0.85, 95% CI = 0.73 to 0.98) compared to non-Hispanic black/African American patients were less likely to undergo pregnancy testing. Furthermore, we also found geographic differences in that the Northeast (AOR = 0.53, 95% CI = 0.40 to 0.71) and Western states (AOR = 0.72, 95% CI = 0.56 to 0.92) were less likely to perform pregnancy testing when compared to the Midwest region. Insurance status, ED disposition, and ED type were not associated with pregnancy testing

in the multivariate model. Among patient visits for potential reproductive health complaints, visits made by Hispanic patients (AOR = 0.71, 95% CI = 0.52 to 0.98) compared to visits by Non-Hispanic black/African American patients and visits resulting in hospital admission (AOR = 0.35, 95% CI = 0.23 to 0.54) were less likely to be associated with pregnancy testing. With regard to regional differences, visits in the Northeast were less likely to be associated with pregnancy testing compared to those the Midwest (AOR = 0.56, 95% CI = 0.38 to 0.82). Among visits associated with exposure to potentially teratogenic radiation, the only factor associated with pregnancy testing was ED disposition, with visits resulting in hospital admission less likely to be associated with pregnancy testing than visits resulting in ED discharge (AOR = 0.52, 95% CI = 0.27 to 0.97).

## DISCUSSION

In this nationally representative cross-sectional analysis of ED visits by adolescent females, we found low rates of pregnancy testing overall, even among patients presenting with potential reproductive health complaints or among those with exposure to potentially teratogenic radiation. The diagnosis of pregnancy and its potential complications are of utmost importance in the ED evaluation of any woman of child-bearing age. Emergency physicians play an important role in the timely recognition and referral of pregnancy among teenagers, especially because EDs are disproportionately utilized by young women.<sup>14</sup> Furthermore, Todd and colleagues,<sup>5</sup> found that one-third of adolescent ED females are at risk for unintended pregnancy. As an ED visit might be an adolescent patient's only access to care, failure to

Table 1  
Characteristics of Adolescent Female ED Visits and Frequency of Pregnancy Testing

Demographic Characteristics	Actual No. in Unweighted Sample	Weighted* Proportion of Visits, %	Weighted Proportion with Pregnancy Testing, % (95% CI)
Total Visits	11,531	41.0 million	20.9 (19.3–22.5)
Age category, yr			
18–21	7,253	62.3	22.6 (20.8–24.4)
14–17	4,278	37.7	18.1 (16.2–20.1)
Race or ethnicity			
Non-Hispanic white	6,224	59.3	19.6 (17.7–21.5)
Non-Hispanic black/African American	3,151	23.9	23.2 (21.0–25.4)
Hispanic	1,833	14.7	20.9 (18.4–23.5)
Other	317	2.1	27.2 (16.8–37.7)
Insurance status			
Private	3,933	35.8	19.5 (17.5–21.6)
Nonprivate	7,598	64.2	21.7 (19.9–23.5)
Disposition			
Hospitalized	591	4.0	22.2 (17.7–26.9)
Discharged	10,940	96.0	20.9 (19.3–22.4)
Geographic region			
Northeast	2,858	17.9	14.9 (12.1–17.6)
Midwest	2,493	23.7	24.4 (21.0–27.8)
South	4,258	41.9	22.2 (19.4–24.9)
West	1,922	16.4	19.3 (16.4–22.3)
ED type			
General	11,117	96.8	21.1 (19.5–22.7)
Pediatric	414	3.2	15.6 (10.0–21.2)

\*National population proportion estimates may not equal unweighted proportions because of survey sampling methodology.

Table 2  
Standardized Probabilities of Pregnancy Testing

Variable	All Visits (20.9% Tested)	Potential Reproductive Health Visits (44.5% Tested)	Visits with Exposure to Potentially Teratogenic Radiation (36.7% Tested)
Age category, yr			
18–21	0.22 (0.21–0.24)	0.46 (0.41–0.51)	0.38 (0.33–0.43)
14–17	0.19 (0.17–0.20)	0.44 (0.40–0.47)	0.36 (0.30–0.42)
Race or ethnicity			
Non-Hispanic white	0.20 (0.18–0.22)	0.44 (0.40–0.49)	0.38 (0.32–0.43)
Non Hispanic black/African American	0.22 (0.20–0.24)	0.47 (0.43–0.52)	0.34 (0.26–0.43)
Hispanic	0.23 (0.20–0.25)	0.40 (0.34–0.46)	0.37 (0.27–0.48)
Insurance status			
Private	0.20 (0.18–0.22)	0.44 (0.40–0.49)	0.36 (0.30–0.42)
Nonprivate	0.21 (0.20–0.23)	0.45 (0.41–0.48)	0.38 (0.33–0.43)
ED disposition			
Admit	0.23 (0.18–0.27)	0.23 (0.15–0.31)	0.24 (0.13–0.35)
Discharge	0.21 (0.19–0.22)	0.46 (0.42–0.49)	0.38 (0.33–0.42)
Geographic region			
Northeast	0.15 (0.12–0.18)	0.36 (0.29–0.43)	0.35 (0.25–0.45)
Midwest	0.25 (0.21–0.28)	0.50 (0.44–0.56)	0.44 (0.37–0.52)
South	0.22 (0.19–0.25)	0.45 (0.40–0.51)	0.36 (0.29–0.42)
West	0.19 (0.16–0.22)	0.44 (0.37–0.51)	0.33 (0.22–0.44)
ED type			
General	0.21 (0.19–0.23)	0.45 (0.42–0.48)	0.38 (0.33–0.42)
Pediatric	0.15 (0.09–0.21)	0.26 (0.09–0.42)	0.19 (0.02–0.39)
Model goodness of fit: F-test = 0.379, p = 0.945.			

Table 3  
Adjusted ORs of Pregnancy Testing

Variable	All Visits (20.9% Tested)	Potential Reproductive Health Visits (44.5% Tested)	Visits with Exposure to Potentially Teratogenic Radiation (36.7% Tested)
Age category, yr			
18–21	Ref	Ref	Ref
14–17	0.79 (0.70–0.89)	1.1 (0.88–1.4)	0.93 (0.68–1.3)
Race or ethnicity			
Non-Hispanic black/African American	Ref	Ref	Ref
Non-Hispanic white	0.85 (0.73–0.98)	0.88 (0.68–1.1)	1.2 (0.71–1.9)
Hispanic	0.99 (0.84–1.2)	0.71 (0.52–0.98)	1.1 (0.64–2.1)
Insurance status			
Nonprivate	Ref	Ref	Ref
Private	0.94 (0.82–1.1)	0.98 (0.79–1.2)	0.94 (0.67–1.3)
ED disposition			
Discharge	Ref	Ref	Ref
Admission	1.1 (0.85–1.4)	0.35 (0.23–0.54)	0.52 (0.27–0.97)
Geographic region			
Midwest	Ref	Ref	Ref
Northeast	0.53 (0.40–0.71)	0.56 (0.38–0.82)	0.67 (0.39–1.1)
South	0.87 (0.68–1.1)	0.83 (0.59–1.1)	0.70 (0.46–1.1)
West	0.72 (0.56–0.92)	0.79 (0.53–1.2)	0.63 (0.35–1.1)
ED type			
General	Ref	Ref	Ref
Pediatric	0.66 (0.42–1.0)	0.42 (0.17–1.0)	0.37 (0.09–1.5)
Model goodness of fit: F-test = 0.379, p = 0.945.			

diagnose pregnancy could result in serious delay of receipt of obstetric services, thereby increasing the risk for preventable morbidity.

Complications of pregnancy must be considered in any woman of childbearing age with abdominal pain or vaginal bleeding, and as such, pregnancy testing for

patients presenting with these complaints is considered standard of care in management algorithms. Although pregnant adolescents can present to the ED with a variety of nonspecific complaints,<sup>15</sup> abdominal pain and vaginal bleeding are among the most common reasons for female adolescent ED visits.<sup>14</sup> In our study, we found

that even among patients who presented with potential reproductive health complaints, fewer than half were tested for pregnancy. This finding is concerning given previous studies demonstrating the high frequency (40%) of presentations with abdominal or genitourinary complaints among adolescents eventually diagnosed as pregnant, whose pregnancies were initially missed in the ED.<sup>7</sup> Givens and colleagues<sup>16</sup> found that among adolescents diagnosed with pregnancy in the ED, 80% presented with gastrointestinal or genitourinary complaints, but only 8% of the patients requested pregnancy testing or mentioned the possibility of pregnancy to the triage nurse. Furthermore, adolescents who are at risk of pregnancy might also be in denial about their risk; 10% of pregnant teenagers denied sexual activity. Additionally, Ramoska and colleagues<sup>17</sup> found that 11.5% of female ED patients who stated that there was no chance they could be pregnant were found to have positive pregnancy tests, and over 15% of patients who did not think they were pregnant were found to have positive pregnancy tests. Therefore, the treating provider should suspect pregnancy when female adolescent patients present with these complaints.

Excluding pregnancy is also essential before ordering radiologic examinations that can potentially introduce teratogenic radiation to a developing fetus. We found that among patient visits associated with exposure to potentially teratogenic radiation (e.g., those undergoing CT scan), less than 40% were evaluated for pregnancy. Furthermore, our finding might be overestimating the true frequency of pregnancy testing among patients exposed to potentially teratogenic radiation due to the differential nature of radiologic imaging coding in the data abstraction forms used by the NHAMCS.

We identified certain patient demographics associated with receipt of pregnancy testing. For example, we found that visits by younger adolescents were less likely to be associated with pregnancy testing. However, pregnancy risk must be considered even in younger patients, as almost 30% of ninth grade female students reported being sexually active.<sup>18</sup> Furthermore, we found racial differences in pregnancy testing rates, as visits made by white patients were less likely to be associated with pregnancy testing than visits by non-Hispanic black/African American or Hispanic patients. Although pregnancy rates are higher among black/African American and Hispanic adolescents compared to white adolescents, pregnancy rates among white adolescents are not negligible.<sup>1</sup> Therefore, performance of pregnancy testing should not be influenced by a patient's racial or ethnic background. Similarly, geographic differences were found in the performance of pregnancy testing, as the Northeast region was the least likely to perform pregnancy testing. The reason for such a geographic discrepancy in pregnancy testing rates is unclear and unrelated to teenage pregnancy rates, which are lowest in the Midwest and highest in the South.<sup>19</sup> Among ED visits for potential reproductive health complaints and exposure to potentially teratogenic radiation, patients who were hospitalized were less likely to undergo pregnancy testing. This may be because they had other identified causes for their symptoms, and consequently, ruling out pregnancy was not considered. However, the noted

differences in pregnancy testing by these mentioned factors in our study were small. Therefore, it appears that the decision to perform pregnancy tests may not be driven by patient demographics, disposition, or geographic location, as pregnancy testing rates were universally low. Future studies should focus on designing quality improvement interventions to increase pregnancy testing in adolescent ED patients, especially among those in whom pregnancy complications or the risk of potentially teratogenic radiation exposure is higher.

## LIMITATIONS

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Our study has several important limitations. First, pregnancy testing may have been undercoded in the overall survey. However, the data miscoding rate among NHAMCS surveys is less than 1%,<sup>11</sup> and beginning in 2005, data abstractors were specifically trained on pregnancy test data abstraction and given a list of acronyms, including "HCG." Furthermore, to validate our findings, we also estimated pregnancy testing rates using the Nationwide Emergency Department Sample (NEDS) of the Healthcare Cost and Utilization Project, a family of health care databases sponsored by the Agency for Healthcare Research and Quality,<sup>20</sup> and found similar rates of pregnancy testing (unpublished data, available on request). Although we found relatively low rates of pregnancy testing, what the optimal rate should be is difficult to determine. In some cases, patients and physicians may have already been aware of pregnancy or may have been referred from clinics where testing was already performed, and thus repeat or confirmatory testing may not have been necessary. For some patients with potential reproductive health complaints, an alternative diagnosis to pregnancy that accounts for symptoms may be or may become readily apparent. Furthermore, provider knowledge of sexual activity or contraceptive use is unknown. However, other studies have found positive pregnancy tests even among patients who denied sexual activity.<sup>16,17</sup> Moreover, given the nature by which radiographs were coded in NHAMCS, we were unable to determine which visits had exposure to abdominal or pelvic radiographs. Therefore, our results do not account for visits with such radiation exposure, and we may have overestimated pregnancy testing frequency among those exposed to potentially teratogenic radiation. Additionally, we cannot determine the timing of pregnancy testing among the patients who had radiologic examinations. As such, it is possible that patients were exposed to potentially teratogenic radiation prior to receipt of pregnancy testing, making our finding of a 37% frequency of pregnancy testing among this population an overestimate.

## CONCLUSIONS

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We found that a minority of adolescent females presenting to the ED had pregnancy testing, even when presenting with potential reproductive health complaints or when receiving potentially teratogenic radiologic examinations. Differences in pregnancy testing were noted based on age, race, geographic region, and ED disposition.

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