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# **HIGH INCIDENCE OF SUBSEQUENT PREGNANCY IN TEENS TESTED FOR STDs IN THE EMERGENCY DEPARTMENT**

A Thesis Submitted to the  
Yale University School of Medicine  
in Partial Fulfillment of the Requirements for the  
Degree of Doctor of Medicine

by  
Alla Lescure Smith  
2012

HIGH INCIDENCE OF SUBSEQUENT PREGNANCY IN TEENS TESTED FOR STDs IN THE EMERGENCY DEPARTMENT. Alla L. Smith and Lei Chen. Section of Pediatric Emergency Medicine, Department of Pediatrics, Yale University, School of Medicine, New Haven, CT.

Teen pregnancy continues to be an important public health issue in the United States and elsewhere. Teens at risk for unplanned pregnancies often seek care in emergency departments (EDs). The ED therefore represents a potentially important arena for interventions to prevent subsequent unwanted pregnancies. Establishing the risk of subsequent pregnancy and the time interval from ED visit to conception (Time to Conception) is a necessary prelude to effective interventions. However, no data to date documents incidence of pregnancy or the average Time to Conception in this population. This study set out to measure the incidence of pregnancy and the Time to Conception in at-risk teenage women following an ED visit.

A review of medical records was conducted in an urban general and pediatric ED. Subjects were included if they were 13-19 years of age and were tested for Gonorrhea and Chlamydia in the ED from 2004-2006. Subjects were excluded if they were not patients in the Primary Clinics at the affiliated academic institution. Subsequent pregnancies were determined from the Primary Clinic charts. The duration of follow-up was 4 years.

Three hundred and ninety eight subjects were included in the study. The mean age at inclusion was 17.3 +/- 1.5 years. A majority, 279 of the 398 patients (70.1%) had a subsequent documented pregnancy (SP). For those patients who had a SP the mean Time to Conception was 15.8 months (481.5 days +/- 364 days.) 80 out of the total 398 patients (20.1%) tested positive for Chlamydia and 23 out of 398 (5.8%) tested positive for Gonorrhea at their ED visit. Patients who had a SP were significantly more likely to be an ethnic minority, were more likely to have tested positive for Gonorrhea and were more likely to have visited the adult ED.

In this population of at-risk teens the majority became pregnant within two years. Demographic distinctions between patients who had a SP and those who did not may assist clinicians in identifying high-risk patients. The test for Gonorrhea and Chlamydia is an excellent marker of future risk for SP in this ED population. Health care providers should consider offering a wide spectrum of reproductive health services to these high-risk patients. Future study is needed to establish attitudes of providers and subjects regarding prescription of contraception to teens during an ED visit.

## Acknowledgements

I would like to thank my advisor, Dr. Lei Chen, for his continuous support, advice and encouragement. I could not have asked for a better mentor.

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## INTRODUCTION

Teen pregnancy continues to be a significant social problem in this country and elsewhere. There are considerable adverse effects for both the teens and their children if these pregnancies are carried to delivery. Compared to socio-economic controls born to non-teen parents, in infancy these children have lower-birth weights, an increased risk of infant mortality and a higher risk of congenital anomalies (1, 2). In their first year they are more likely to be hospitalized and are less likely to be breastfed (1, 2). They also have academic difficulties: they have lower grade point averages, fail grades more frequently, and are less likely to graduate high school (1-5). They are more likely to enter foster care and are more likely to require intervention from the Department of Children and Families (2). They struggle with behavior difficulties, have higher levels of aggression, and demonstrate poor impulse control (4). They are also more likely to be unemployed, to be violent offenders and to be jailed (2-5). They are more likely to abuse drugs and to have mental health problems (5). Finally, and perhaps most importantly, they initiate sexual activity earlier and are more likely to become teen parents themselves, thereby perpetuating the cycle (2, 4).

While traditionally the children born to mothers in their twenties who had first given birth in their teens were not considered to have similar risks, this thinking has recently been challenged. It appears that these subsequent children actually have similar health and social problems as the children born to teen parents, including the increased risk of subsequent teen pregnancy (2). This finding significantly expands the pool of children who should be closely monitored by pediatricians.

Fortunately, the birth rate for teenagers has experienced a decline in the United States. In 2010, the birth rate for teenagers age 15-19 dropped 9% to 34.3 per 1000 teen women (7). This was the largest single year decline since 1946 and reflects a 44% decrease in teen births from the 1991 rate (7). The birth rate dropped for all age groups under 20 and also declined for all racial groups and for those of Hispanic origin (7). Disparities in the rates of teen pregnancy remain: those most at risk of teen pregnancy are older adolescents, racial/ethnic minorities, and those with a previous pregnancy (6).

Although the pregnancy rate for teenagers has also declined in recent years, it remains significantly higher than the birth rate. In the most recent data available from 2005, the pregnancy rate among sexually experience women age 15-19 was 152.8 per 1000 teens (6). Connecticut's teen pregnancy rate is below the national average: Connecticut is ranked 36<sup>th</sup> in the nation with a pregnancy rate of 57 per 1000 women age 15-19 (6). Thus, Connecticut is considered a low-risk state for teen pregnancy. However, Connecticut has one of the highest abortion rates in the country: in 2005, for ever 100 pregnancies that resulted in abortion or live birth, there were 53 abortions (6).

Given the discrepancy between the teen birth rate and the teen pregnancy rate, and the high percentage of pregnancies that end in abortion, it is clear that many of these teen pregnancies are unintended. Recent estimates have put the overall rate of unintended pregnancy for women of all ages living in Connecticut at 51% (8). The rate of unintended pregnancy for adolescents is even higher: it is estimated that 65-95% of all adolescent pregnancies are unintended (9-11).

For these reasons, there continues to be great interest in further reducing the number of unwanted teen births. Identifying at-risk populations to target for

interventions has been a central aim of the efforts to curb this rate. Several studies have identified the encounter with a patient presenting for a pregnancy test as a missed opportunity for pregnancy prevention counseling. In a large national study of women who had pregnancy tests administered in outpatient clinics approximately one third had a negative pregnancy test before having a positive one- demonstrating that these patients might benefit from pregnancy-prevention counseling (12). There have also been several longitudinal studies to document the risk of subsequent pregnancy in women who come to outpatient clinics for pregnancy tests. One study did a two year follow up of adolescents who presented to several inner city clinics for a pregnancy test: they discovered that 56% of their 302 patients became pregnant during the follow up period (13). Another study at this author's institution did an 18-month follow up on women presenting for a pregnancy test at a hospital-associated outpatient clinic and discovered that 36% became pregnant during this period (14). In this population the average interval between visit/pregnancy test and conception was 16.3 months (14).

Previous research aimed at identifying populations that are at-risk for teen pregnancy has focused on adolescents presenting to community, hospital and school-run clinics. Encounters with at-risk adolescents in the Emergency Department (ED) represent important and yet unstudied opportunities for intervention. Adolescents are very reliant on ED services: adolescents in general and older adolescents in particular are overrepresented in terms of the number of their ED visits relative to the size of their population (15). Explanations for this trend in adolescent ED use include the fact that adolescents are less likely to have health insurance than younger pediatric patients, and have been shown to underutilize primary care services (15).



The fact that adolescents increasingly rely on the ED for their healthcare is problematic for many reasons. Specifically, EDs can be challenging places for these teens to receive sexual-health counseling and services. By their very nature, EDs have traditionally administered acute care, and are often not set up to provide sexual-health counseling services, prescribe long-term medications such as oral contraceptives, or perform routine gynecological procedures such as diaphragm fittings or IUD placements. The extent of the patient history elicited is also variable: patients seen in primary care clinics are more likely to be asked about their sexual history and contraception use than patients seen in an ED (16). These factors help to explain why EDs have not been previously considered when searching for places to provide pregnancy-prevention care for adolescents. However, in light of the increased utilization of EDs by adolescents, this hesitancy to examine what services might be offered in the ED must be overcome and the pregnancy risk of the adolescent patients who visit the ED must be assessed.

In an effort to establish this pregnancy risk, a suitable marker for risky sexual behavior needs to be established. As outlined above, the historically studied marker that is associated with a high risk of subsequent pregnancy is a pregnancy test performed in a clinic. Unfortunately, there are other reasons why an adolescent might receive a pregnancy test in the ED, as it can be a prerequisite to imaging, anesthesia or medication administration. Therefore, a pregnancy test is not a good marker for identifying high-risk adolescents in the ED and an alternate proxy for high-risk sexual activity needs to be established in order to determine risk of subsequent pregnancy for patients in this unique setting.

The urine test for Gonorrhea (GC) and Chlamydia (C) has the potential to be such a proxy. A variety of tests for GC/C exist, and the use of many of the newer generation tests is increasing (17). The test used in this study is Nuclear Acid Amplification Test performed on a urine specimen. This test has a 94.7% sensitivity and a 98.9% sensitivity (18). Testing for GC/C has been increasing in the United States for several reasons including increased test accuracy, decreased invasiveness (many only require a urine specimen), a recognition of the high rates of infection, and awareness of the risks associated with untreated asymptomatic infection (largely Pelvic Inflammatory Disease and infertility sequelae) (19, 20).

A test for GC/C has the potential to be an excellent proxy for identifying patients engaged in high-risk sexual behavior in the ED for several reasons. First, the rate of GC/C in the US has been increasing, and the high risk of the disease among sexually active teens has motivated increased testing of this population (17). In 2010 there was a 5.1% increase in the number of Chlamydia infections nationally, and a 1.4% increase in the number of Gonorrhea infections (19, 20). The rate of both of these STDs is highest among 15-19 year olds: the national rate of Chlamydia infections in women age 15-19 is 3378.2/100,000 patients, and the rate of Gonorrhea infectious is 570.9/100,000 patients (19, 20). Another reason why the test for GC/C is an excellent proxy for identifying patients at high risk for subsequent pregnancy is that, as the disease is asymptomatic, testing is often based on history alone (21). Finally, the rates of GC/C testing in the ED are not significantly different from the clinic (16). Therefore, establishing the risk of subsequent pregnancy associated with a GC/C test will allow for future comparisons between the risks faced by ED versus clinic patients.

Assessing the percent of patients who test positive for Gonorrhea and Chlamydia is an important element of this study, as it will allow for comparisons of this patient population to national standards. In Connecticut, the positivity rate of a test for Chlamydia in women of all ages is 7.0% and the positivity rate of a test for Gonorrhea is 0.4% (19, 20). Several studies that have looked at positivity rates for a GC/C test for adolescents in urban areas have identified even higher positive GC or C rates- ranging from 16.2- 42% (22, 23).

While the CDC guidelines currently recommend pregnancy-prevention counseling for patients getting a pregnancy test, there is not a similar recommendation associated with the test for GC/C. The CDC's *Sexually Transmitted Diseases Treatment Guidelines 2010* recommend that physicians obtain a full history on patients being tested for STDs, including inquiring about contraception. However, they only recommend counseling on STD/HIV prevention, there is not a recommendation that these patients receive counseling on pregnancy prevention, or contraception options and availability. Furthermore, many patients do not receive the recommended STD/HIV prevention counseling: one study audiotaped visits for women in an urban ED age 18-35 being tested for an STD, and discovered that only 17% received CDC-recommended HIV/STD prevention information (24). If this study reveals that a test for GC/C carries a risk of subsequent pregnancy in this ED population, these patients would benefit from pregnancy-prevention counseling, and thus, current CDC recommendations would need to be reexamined.

## Specific Aims

The objectives of this study are as follows:

- 1) To establish the risk of subsequent pregnancy (SP) in a group of at-risk teenagers in a previously unstudied setting.
  - a. To determine the risk of SP, this study will establish the percent of teenagers who conceive within 4 years of being tested for GC/C in the ED, and the average time between that ED visit and the subsequent pregnancy.
- 2) To demonstrate the validity of using a test for GC/C as a novel proxy for high-risk behavior.
  - a. To demonstrate the validity of a test for GC/C, this study will link it to a rate of SP and compare the rate of SP in this population of patients tested for GC/C to the established rate of SP in the population of patients who receive pregnancy tests.
- 3) To compare the demographic characteristics of those patients who have an SP (SP group) to those patients who do not (NSP group) in order to assist physicians in identifying patients who are at risk of SP.

## Specific Hypothesis

- 1) We hypothesize that teenagers who are tested for GC/C in the ED are at high risk of imminent pregnancy. Given historical comparisons, we hypothesize that ~40% of the study population will be pregnant within 18 months of their ED visit.
- 2) We hypothesize that the test for urine GC/C carries a comparable risk of SP to the test for pregnancy.

- 3) Based on national demographic data on teens at high risk of SP, we hypothesize that the teens who have a SP in our population are likely to be an older teenagers, racial and ethnic minorities, have tested positive for GC or C, and have a higher rate of previous pregnancy.

## **MATERIAL/METHODS**

### **Statement of Student Involvement**

In accordance with the protocol conceived of and written by this student, which was approved by the IRB, a list of medical record numbers for teenage women who were seen in the adult and pediatric EDs between 2004 and 2006 and billed for a urine test for GC/C was provided by the RIMS office at Yale New Haven Hospital (YNHH).

All data collection, analysis and interpretation for this thesis was performed independently by this student.

### **Design**

This is a cohort study using retrospectively identified subjects. Data were collected using a medical record review.

### **Setting**

Participants were seen in YNHH's adult or pediatric ED. Primary care was provided by two hospital-based clinics, either the Adolescent Clinic or the Women's Center.

### **Sample**

Subjects in this study were seen in the Pediatric and Adult EDs at YNHH during the two-year period spanning from 5/4/04 – 5/4/06. Other inclusion criteria were, female gender, age between 13 and 19, having been seen in the hospital-based adolescent clinic or the women's center within two years of their emergency department (ED) visit, and having been billed for a urine test for Gonorrhea and Chlamydia during their ED visit.

The decision was made to only include patients who used the primary care system at YNHH in the two years before or after their ED visit because this study relied on self-reported pregnancy and it was essential to have a medical record that contained follow-up visit data for the patients in order to capture that information. Although YNHH is the major hospital in the area, it is possible that women might be terminating their pregnancies or delivering their children in other facilities, thus making inpatients records inadequate.

The decision was made to include patients seen in both the adult and pediatric EDs as it was the intent of this study to examine the phenomenon of teen pregnancy, irrespective of where the teen presented. Additionally, this allowed for a comparison between the two groups. Although the adult and pediatric EDs are physically separate facilities staffed by separate personnel, both systems bill to a central location, which allowed for patient entry into the study based on a billing code independent of which ED they were seen in.

Of the patients who met the inclusion criteria, those with pregnancies subsequent to their ED visit that were documented in their primary care notes, were placed into the subsequent pregnancy (SP) group. Those who did not have a subsequent documented pregnancy were placed in the non-subsequent pregnancy (NSP) group. If a subject was pregnant at the time of the ED visit, they were not excluded from the study- but being pregnant in the ED did not merit assignment to the SP group. Only subjects with pregnancies that were conceived after their ED visits were assigned to the SP group.

For those patients in the SP group who had multiple visits to the ED, only one visit per documented pregnancy was used. The visit chosen was the earliest of the ED

visits, thereby giving the longest interval between ED visit and conception (Time To Conception). Within the NSP group, only one visit per patient was recorded.

### Medical Records

A database was created including patient demographics (age, ethnicity), which ED was visited (adult v. pediatric), results of GC/C testing performed during ED visit, whether patients were pregnant during their ED visit, outcome of that pregnancy, date of conception of the first reported new pregnancy subsequent to the ED visit, and outcome of that subsequent pregnancy. The date of conception of the pregnancy subsequent to the ED visit was measured by subtracting 38 weeks from the estimated date of delivery used to calculate the gestational age for that pregnancy. Possible outcomes of pregnancy were 1) full-term (>37 weeks) vaginal birth, 2) full-term caesarean birth 3) pre-term (<37wks) vaginal and caesarean birth 4) elective abortion 5) miscarriage (spontaneous abortion +/- a Dilation and Curettage) and 6) ectopic pregnancy (+/- surgical intervention).

Not included in this study is the obstetric history of each patient. Data on obstetric history was collected from primary care records- but was available for only approximately 60% of the 398 patients. Even this available information was highly inconsistent- with an audit of 20 patients' medical record records turning up inconsistencies in documentation of obstetric history in 8. It was determined that, although the presence, absence or character of a patient's obstetric history has historically been a highly relevant piece of information in determining their subsequent likelihood for pregnancy, the data was too inconsistent and incomplete to yield meaningful conclusions.



As a proxy measurement for obstetric history this study documented whether each patient was pregnant at the time of the ED visit.

A “Time To Conception” measurement was extracted from the data, and represents the interval in days between the ED visit and the date of conception of the first reported pregnancy subsequent to the ED visit.

The duration of follow-up was four years from the date of the ED visit.

### **Analysis**

Two sample and one sample t-tests were used to determine significance for interval data.

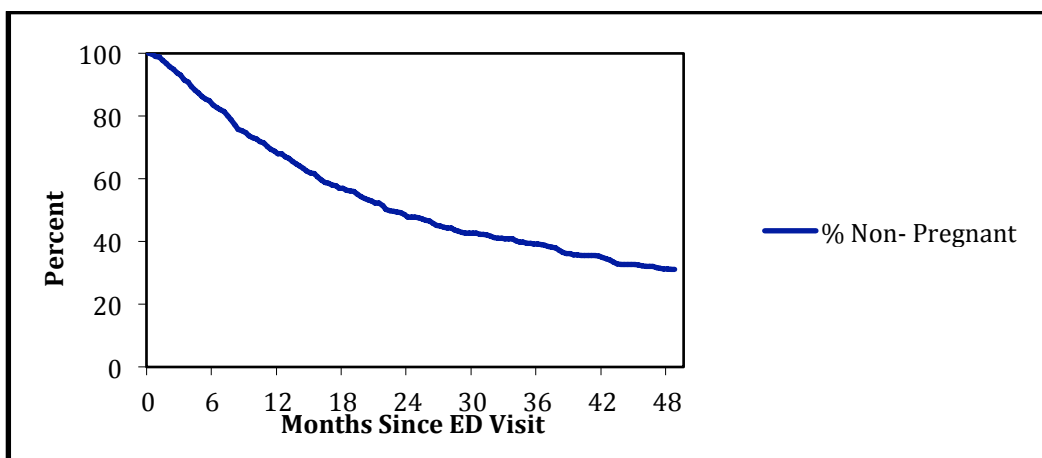
Chi-squared data was used to determine significance of nominal data proportions.

Significance was set at a p value of less than or equal to 0.05.

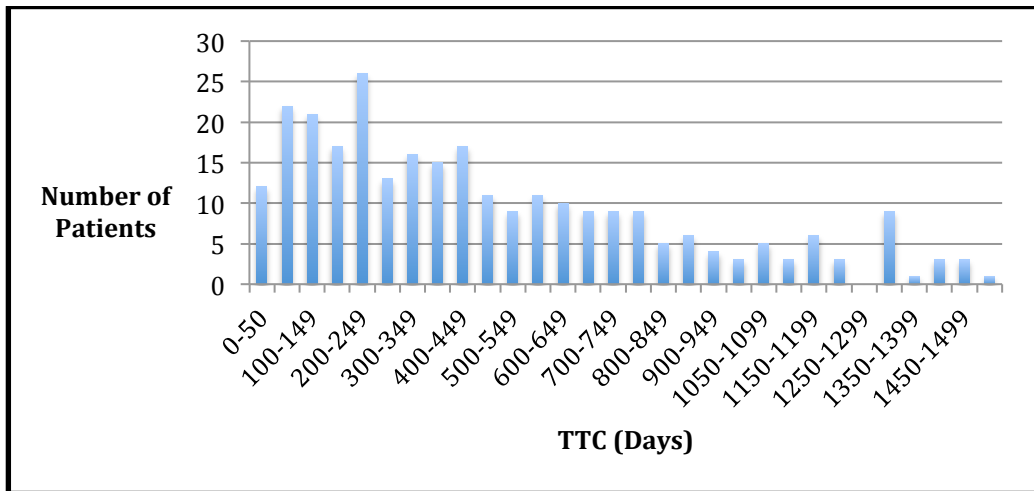
## RESULTS

### Assessment of SP Risk (Figure 1, Figure 2, Table 1):

Of the 398 patients who met the inclusion criteria, 70.1% (279 patients) had a subsequent pregnancy (SP) documented in their Primary Care Clinic (PCC) notes within four years of being seen in the ED. 29.9% (119 patients) did not have a documented subsequent pregnancy (NSP) within the follow-up period. Of those who had a subsequent pregnancy, the average Time to Conception (TTC) was 15.8 months (481.5 days +/- 364 days). The median TTC was 12.9 months (393 days). This discrepancy between median and mean reflects the fact that the TTC was skewed right, with more women conceiving earlier (Figure 1 and Figure 2). In the SP group, 47% conceived within one year and 64% conceived within 18 months. In the total study population, 32% conceived within one year, 45% conceived within 18 months and 54% conceived within two years.



**Figure 1. Pregnancy-Free Interval Following ED Visit.** The percent of patients who were not pregnant, charted over the course of the four year follow up.



**Figure 2. Breakdown of TTC in SP Group.** The distribution of TTC in patients in the SP Group.

**Demographics of Total Study Population\_(Table 1)**

The average age of the population was 17.3 years +/- 1.6 years. The population was skewed towards older teens, with 17-19 year olds making up approximately 70% of the total study population. Patients in this study self-identified their ethnicity. The options were Black, Hispanic, White and Other. In the total population: 58.0% were Black, 30.2% were Hispanic, 11.6% were White and 0.3% were Other. In the total population, slightly more people visited the Adult ED compared with the Pediatric ED: 57.2% of the population went to an adult ED compared to 42.8% that went to a Pediatric ED. 20.1% of the population tested positive for Chlamydia and 5.8% of the population tested positive for Gonorrhea. 30.4% of the population was pregnant at the time of their ED visit.

	Total n= 398	SP n= 279	NSP n= 119
<b>Average Age +/- STD</b>	17.3 +/- 1.6 years	17.4 +/- 1.5 years	17.0 years +/- 1.7 years
<b>Self-Identified Ethnic Breakdown</b>	58.0% Black 30.2% Hispanic 11.6% White 0.3% Other	59.9% Black 30.5% Hispanic 9.3% White 0.4% Other	53.8% Black 29.4% Hispanic 16.8% White
<b>ED Visited</b>	57.2% Adult ED 42.8% Pedi ED	59.9% Adult ED 40.1% Pedi ED	50.9% Adult ED 49.1% Pedi ED
<b>Tested + for Gonorrhea</b>	5.8%	7.2%	2.5%
<b>Tested + for Chlamydia</b>	20.1%	22.4%	15.1%
<b>Pregnant in ED</b>	30.4%	31.5%	27.6%

**Table 1. Demographics of Total Study Population, SP Group, and NSP Group**

**Factors Contributing to risk of SP (Table 1)**

**Age:** There was no statistically significant difference between the age of the SP and the NSP population (p= 0.98).

**Ethnicity:** The ethnic composition of the SP and NSP groups did significantly differ from each other (p= 0.02). The SP group had 6.1% more Black patients, 1.1% more Hispanic patients, and 7.5% fewer White patients compared to the NSP group. There was no statistically significant difference between the ethnic make-up of the SP group compared to the total population and there was also no significant difference between the ethnic make-up of the NSP group compared to the total population (p= 0.68 and p= 0.20, respectively).

**Adult ED v. Pediatric ED:** The proportions of the SP and NSP group that went to each ED did significantly differ from each other ( $p= 0.02$ ). The SP patients were more likely to go to the adult ED. In contrast, the proportions of the patients in the SP and the NSP population that visited the adult and pediatric EDs did not significantly differ from these proportions in the total population ( $p= 0.37$  and  $p= 0.09$ , respectively).

**Gonorrhea:** Where as 7.22% of the SP population tested positive for Gonorrhea, only 2.54% of the NSP population tested positive. There is a statistically significant difference between those two values ( $p= 0.05$ ). Patients who had a SP were more likely to have Gonorrhea.

**Chlamydia:** The difference between the rate of Chlamydia in the SP group and the rate of Chlamydia in the NSP group trended towards statistical significance ( $p= 0.06$ ).

**Pregnancy in the ED:** There was no significant difference in the proportion of the SP and the NSP groups that were pregnant at the time of their ED visit ( $p=0.28$ ). Patients who went on to have a SP were no more likely than those in the NSP group to be pregnant at the time of their ED visit.

<b>Demographic Characteristics of SP Group</b>	<b>Average TTC (Months) +/- STD</b>
<b>Overall TTC</b>	<b>15.8 +/- 12.0</b>
<b>Age</b>	<b>19.5 +/- 17.3</b>
<b>13 (n= 2)</b>	<b>19.7 +/- 9.7</b>
<b>14 (n= 7)</b>	<b>15.6 +/- 13.3</b>
<b>15 (n= 26)</b>	<b>19.0 +/- 13.2</b>
<b>16 (n= 43)</b>	<b>13.0 +/- 8.5</b>
<b>17 (n= 53)</b>	<b>14.6 +/- 11.4</b>
<b>18 (n= 69)</b>	<b>16.7 +/- 13.2</b>
<b>19 (n= 79)</b>	
<b>Race</b>	<b>15.9 +/- 11.9</b>
<b>Black (n= 167)</b>	<b>16.2 +/- 12.7</b>
<b>Hispanic (n= 85)</b>	<b>13.4 +/- 10.2</b>
<b>White (n= 26)</b>	
<b>GC/C Test Outcome</b>	<b>17.4 +/- 14.6</b>
<b>+ Gonorrhea (n= 20)</b>	<b>15.8 +/- 11.8</b>
<b>- Gonorrhea (n= 378)</b>	<b>15.9 +/- 12.5</b>
<b>+ Chlamydia (n= 62)</b>	<b>15.8 +/- 14.6</b>
<b>- Chlamydia (n= 259)</b>	
<b>ED Type</b>	<b>15.35 +/- 11.26</b>
<b>Pedi ED (n= 112)</b>	<b>16.13 +/- 12.45</b>
<b>Adult ED (n= 167)</b>	
<b>ED Pregnancy</b>	<b>18.11 +/- 12.76</b>
<b>Pregnant in ED (n= 88)</b>	<b>14.84 +/- 11.48</b>

Not Pregnant in ED (n= 191)	
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**Table 2. Demographic Characteristics of the SP Group**

**Breakdown of risk factors for a short TTC in SP Group (Table 3)**

The average TTC for patients in the SP group was 15.8 months (481.5 days +/- 364 days.) However, the median TTC was 12.9 months (393 days), reflecting a right-skewed distribution of TTC (Figure 1 and Figure 2). 47% conceived within one year and 64% conceived within 18 months.

TTC was tracked by age. There was no statistically significant difference between the TTC for any age group and the SP population's average TTC (13 year olds: p= 0.41, 14 year olds: p= 0.16, 15 year olds: p= 0.53, 16 year olds: p= 0.06, 17 year olds: p= 0.99, 18 year olds: p= 0.82, 19 year olds: p= 0.28). Although 16-year olds have a nearly statistically significantly lower TTC (p= 0.06).

TTC was also tracked by ethnic group. There was no statistically significant difference between the TTC of any one ethnic group and the average TTC for the total SP group.

TTC was also tracked by outcome of the test for Gonorrhea. There was no statistically significant difference between the TTC for these two populations (p= 0.73). There was also no statistically significant difference between the TTC of those who tested positive and negative for Gonorrhea compared to the overall TTC for the SP group (p= 0.31 for those who tested positive and p= 0.56 for those who tested negative).

TTC was also tracked by the outcome of the test for Chlamydia. There was no statistically significant difference between the TTC for these two populations (p= 0.54).

There was also no statistically significant difference between the TTC of those who tested positive and negative for Chlamydia compared to the overall TTC for the SP group ( $p= 0.46$  for those who tested positive and  $p= 0.52$  for those who tested negative).

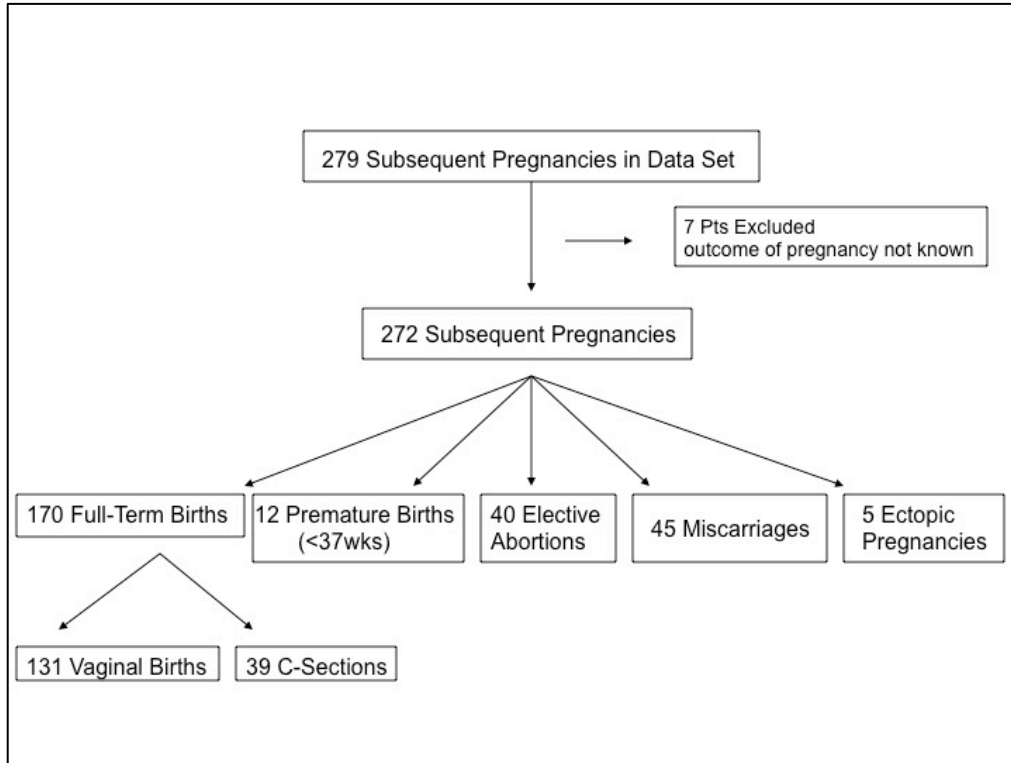
TTC was also tracked by the type of ED that the SP patients visited. There was no significant difference between the TTC of the patients who went to the adult ED versus the patients who went to the pediatric ED ( $p=0.30$ .) There was also no statistically significant difference between the TTC of these two groups when compared to the overall TTC for the SP group ( $p=0.67$  for those who went to the pediatric ED and  $p=0.37$  for those who went to the adult ED).

TTC was also tracked by whether the patients in the SP group were pregnant at the time of their ED visit. There was no significant difference between the TTC of the patients who were pregnant in the ED compared to the TTC of the patients who were not pregnant ( $p= 0.99$ ). There was also no statistically significant difference between the TTC of each of these populations and the TTC of the overall group ( $p= 0.48$  for those who were pregnant in the ED and  $p= 0.90$  for those who were not pregnant in the ED).

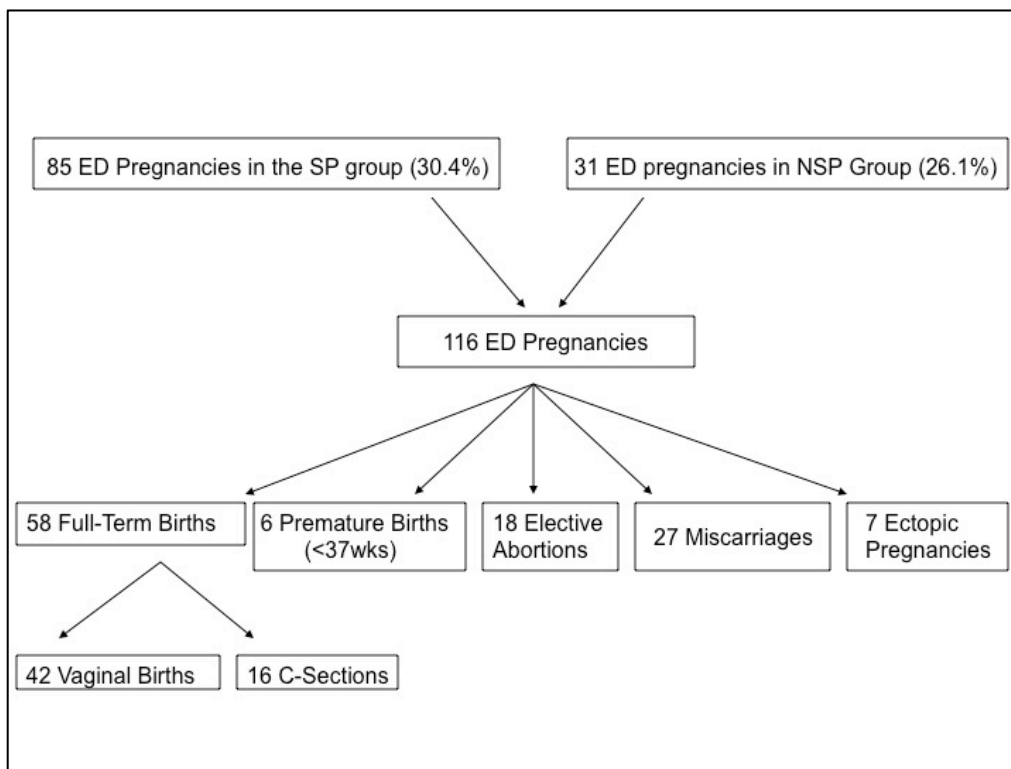
### **Outcome of Pregnancy of SPs versus ED Pregnancies** (Figures 3, 4, 5 and 6)

There were 279 SPs of which 272 had known outcomes. There were 170 full-term births (62.5% of total SPs), of which there were 131 vaginal births (48.1% of total SPs) and 39 C-sections (14.3%). Premature birth was defined as a birth before 37 weeks gestation: there were 12 premature births (4.4%). There were 40 elective abortions (14.7%). Miscarriage was defined as the spontaneous loss of pregnancy: there were 45 miscarriages (16.5%). And there were 5 ectopic pregnancies (1.8%).





**Figure 3. Outcome of Pregnancy in SP Group**

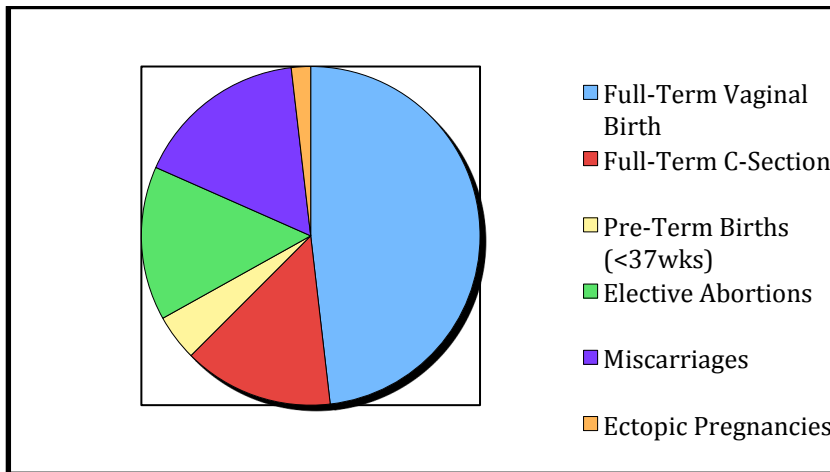


**Figure 4. Outcome of ED Pregnancies**

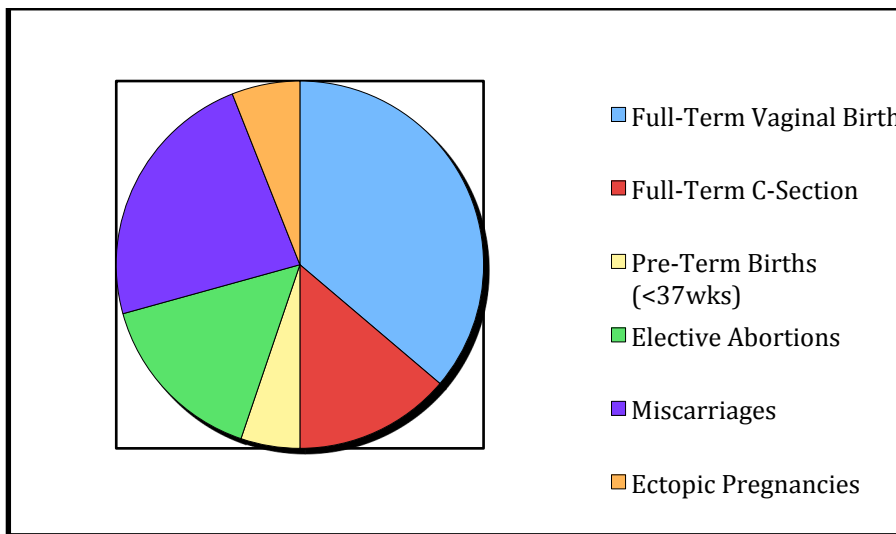
All of ED pregnancy outcomes were also recorded. As stated above, being pregnant at the time of ED visit did not merit inclusion in the SP group, a woman had to conceive following this ED pregnancy in order to be placed in the SP group.

Approximately 30% of the total study population was pregnant at the time of their presentation to the ED. There were 85 ED pregnancies in the SP group and 31 ED pregnancies in the NSP group for a total of 116 ED pregnancies. There were 58 full-term births (50% of total ED pregnancies), of which there were 42 vaginal births (36.2% of total ED pregnancies) and 16 C-sections (13.8%). Premature birth was defined as a birth before 37 weeks gestation: there were 6 premature births (5.2%). There were 18 elective abortions (15.5%). Miscarriage was defined as the spontaneous loss of pregnancy: there were 27 miscarriages (23.3%). And there were 7 ectopic pregnancies (6%).

The outcomes of the SP group pregnancies and the outcomes of the ED pregnancies are significantly different from each other ( $p= 0.003$ .) The SP group had 12.0% fewer full-term vaginal births, 0.5% more full-term c-sections, 0.79% fewer premature births, 0.8% fewer elective abortions, 11.8% fewer miscarriages and 4.2% fewer ectopic pregnancies. There was a significant difference between the number of full-term vaginal births, miscarriages and ectopic pregnancies ( $p=0.009$ ,  $p=0.02$ ,  $p=0.04$ ).



**Figure 5. Outcome of Pregnancies in patients in the SP Group**



**Figure 6. Outcome of ED Pregnancies**

### Patients with Multiple Visits

49 subjects in the SP group (17.6% of the group) and 20 subjects in the NSP group (16.8% of the group) had multiple visits to the Emergency Department. There were an additional 64 visits for the SP group. There were an additional 26 visits for the NSP group. As noted in the Methods section, in the SP group only the first ED visit per SP

was recorded - this generated the longest TTC. For the NSP group, only the first visit was recorded.

### **Timing of the Last PCC visit in NSP Group**

For patients in the NSP group- the date of their last visit to one of the primary care clinics (PCC) was recorded. As discussed in the methods section, one of the inclusion criteria for the study was a visit to the PCC within two years of the ED visit. Out of the 119 patients in the NSP group, 20 people (16.8%) had their last visit to the PCC before their ED visit. Of the remaining 99 patients in the NSP group, 49 (41.2% of the total NSP population) had their last PCC visit within 481 days of their ED visits, which was the average TTC in the SP group.

## DISCUSSION

### Establishing Risk of and Timing of SP in this ED Population

As adolescents increasingly utilize EDs, the primary aim of this study was to establish the risk of SP in this population of teenage women in order to better serve their healthcare needs. While previous research has demonstrated the high risk of SP for teens who come to outpatient clinics to receive a pregnancy test, this risk has not been documented in an ED population and it has not been documented in association with a test for GC/C. This study demonstrates that there is a real and acute risk of imminent pregnancy following an ED visit for teens tested for GC/C. 32.1% of the 398 teenagers in this study became pregnant within 1 year of their ED visit, 45% became pregnant within 18 months of the visit, and 70.1% of the teens became pregnant within four years of their visit.

### Assessing Predictive Validity of Test for GC/C

Another aim of this study was to assess if a test for urine GC/C is an accurate marker for high-risk sexual practices, and to establish whether it carries a similar risk of SP as a pregnancy test. There was a need to identify a novel proxy for teens who are at high risk of SP, because in an ED setting a test for pregnancy is not uniquely administered to these high risk patients, but can be a prerequisite to imaging or procedures. Previous research had indicated that, in similar populations, approximately 40% of patients who presented to outpatient clinics for a pregnancy test became pregnant within 18 months (14). We had hypothesized comparable results for patients getting a test for GC/C in the ED, and, indeed, 45% of the patients in this study became pregnant

within 18 months of their ED visit. This confirms that GC/C is a comparable marker for high-risk sexual practices, and carries with it a comparable rate of SP in this population.

One advantage of the test for GC/C is that, as a proxy for high-risk sexual behavior, comparing the rate of test positivity in the study population to national averages allows for a comparison of the risks experienced by this group and speaks to the applicability of this study's conclusions. The fact that the rates of Gonorrhea and Chlamydia in the population are comparable to national averages suggests that this is not a population of teens that has unusually high levels of risky sexual behavior (22, 23). Additionally, it suggests a broader applicability of the risk of SP associated with this test in an ED setting.

### **Identifying Patients at Highest Risk for Imminent SP**

The final aim of this study was to identify factors that conferred a higher risk of an imminent SP on a patient in an effort to assist clinicians in targeting services and pregnancy-prevention counseling to this group. It was our hypothesis that those patients at highest risk of SP would be older teens who were part of a racial/ethnic minority, who were more likely to have tested positive for GC/C and have had a previous pregnancy. In order to assess this hypothesis we split the analysis up in two ways. First, factors that made a patient more likely to have an SP were identified. Second, within the group of patients who did have an SP, factors that made a patient more likely to have a shorter TTC were identified.

## 1. Examining factors that make patient at high risk for an SP

When comparing the group of patients who went on to conceive following their ED visit (the SP group) to the group who did not (the NSP group) several interesting trends in the data are observed.

There was no significant difference between the average age of patients who had a SP and those who did not. This is slightly counterintuitive, as it might have been assumed that the older teens would be more at-risk than the younger. It is true that the entire population is skewed towards older teens. However, it appears that once a teen is suspected of risky sexual behavior (and therefore a urine GC/C is performed) their age is not a contributor to their risk of SP.

A significant difference was found in the ethnic compositions of the two groups. The SP group had slightly more Black and Hispanic patients and slightly fewer White patients. It is possible that this ethnic discrepancy is a proxy for socio-economic (SES) discrepancies described in the literature, although the absence of an SES discrepancy makes that impossible to discern. Furthermore, this significant ethnic discrepancy is consistent with ethnic difference independent of SES that is noted in the literature (6, 7).

Another significant finding was that patients who presented to the adult ED were significantly more at-risk of a SP. One possible explanation for this effect could be that pediatric patients who are known to be pregnant to pre-hospital providers are taken to the adult ED instead of the pediatric ED. However, it turns out that there was no statistically significant difference between the percent of people who were pregnant at the time of their ED visit in these two locations. Thus, it appears that there is a degree of self-selection of the higher risk patients to the adult ED for their care.

When examining the risk of SP by STD test outcome- another correlation was discovered: patients who tested positive for Gonorrhea were more likely to have a SP. The statistically significant difference between the proportion of the SP and NSP populations that tested positive for gonorrhea is intuitive, as the test for GC/C is a proxy for risky sexual behavior that could result in STD transmission or pregnancy. Thus, it makes sense that patients who had transmitted an STD (thus proving their participation in risky sexual behavior) were also more likely to go on to have a SP. A similar finding for the outcome of the test for Chlamydia was also described, however it just escaped statistical significance.

Analysis of the proportion of the SP versus the NSP patients who were pregnant in the ED revealed the surprising conclusion that being pregnant at the time of the ED visit did not increase the likelihood of a SP. This is unexpected because being pregnant at the time of ED was this study's proxy marker for obstetric history. And it is well documented that those teens who have already had a teen pregnancy are the group who is most at risk of subsequent pregnancies (1-3, 5). However, this effect was not seen in this study.

## **2. Examining Factors Contributing to Length of TTC**

When looking at age as a contributor to the length of time between ED visit and conception (TTC) among patients who had a SP, it was discovered that the TTC of no one age group was statistically different from the overall TTC for the SP group. The lack of contribution of age to the TTC is not wholly surprising when considering that, as stated above, age did not contribute to the likelihood of having an SP in the first place.



Just as age does not appear to be a major predictor of TTC, neither does ethnicity. No single self-identified ethnicity's TTC significantly differed from the average TTC for the SP group. As previously discussed, the ethnic composition of this SP group did significantly differ from the ethnic composition of the NSP group- however, it appears that while ethnicity might be predictive of whether the patient subsequently conceives, it has less utility in predicating the time at which this will happen.

While no individual ethnicity's TTC differed from the mean, they did differ from each other. Notably, White patients had a significantly shorter TTC than Hispanic patients. This fact is surprising, as there were significantly fewer White patients in the SP group- but those who are in the group have a significantly shorter TTC. Again, the degree to which race is a proxy for SES is unclear due to the lack of a SES marker.

While testing positive for an STD was a significant risk factor for having a SP, testing positive for an STD did not affect the TTC. Patients who tested positive for Gonorrhea or Chlamydia did not have a significantly shorter TTC compared to those with negative tests. Therefore, it appears that while testing positive for an STD influences the likelihood of becoming pregnant, it does not have an affect on how quickly pregnancy occurs following ED visit.

Similarly, while patients who had an SP were more likely to have visited the Adult ED, these same patients did not have a significantly shorter TTC. Indeed, the TTC for those patients that visited the Adult ED is actually longer than the TTC for patients who went to the Pediatric ED. It appears that while the group of patients who visits the Adult ED is at a higher risk of pregnancy, they do not have these pregnancies more

quickly than patients in the Pediatric ED. Thus, patients tested for GC/C in the pediatric ED should not be considered low-risk.

Finally, just as being pregnant in the ED at the time of their visit did not predispose patients to SP, patients who were pregnant in the ED also did not have statistically shorter TTCs, even when their TTC was corrected for a nine-month gestation of their ED pregnancy. This continues the surprising trend of the lack of significance of being pregnant in the ED. It is clear that being pregnant in the ED is not a predictor of future pregnancies or timing of those pregnancies

#### **Summary of Demographic Factors Contributing to a High Risk of Imminent SP**

In summary, our hypothesis that the teens who would be at highest risk of imminent SP would be older teens who were part of a racial/ethnic minority, who were more likely to have tested positive for GC/C and have had a previous pregnancy, met with variable success.

Our hypothesis that older teens would be more likely to have an imminent SP appears to be incorrect. While it seems that older teens were more likely to be thought to be engaging in high-risk sexual behavior and thus be tested for GC/C and included in the study, within this population being older did not make a patient more likely to have a SP. And, if she did have a SP, she was no more likely to have it sooner.

Our hypothesis that ethnic minorities would be more likely to have an imminent SP appears to be partially correct. While the group who had SPs did have more Black and Hispanic patients in it, Black and Hispanic patients were not more likely to have a shorter TTC. Thus, ethnic background appears only a partial contributor.

Our hypothesis that teens who tested positive for GC/C would be more likely to have an imminent SP also appears to be partially correct. Teens who tested positive for Gonorrhea were more likely to have a SP, and a similar trend was noted for those who tested positive for Chlamydia, but it just escaped statistical significance. However, testing positive for GC/C had no significant impact on the TTC. Thus, again, it appears that testing positive for GC/C is only a partial contributor to the risk for imminent SP.

Finally, our hypothesis that teens who had a previous pregnancy would be more likely to have an imminent SP yielded inconclusive results. As the obstetric histories on these patients were unreliable, we used pregnancy in the ED as a proxy measurement for obstetric history. Being pregnant in the ED did not make a patient more likely to have a SP, nor did it affect TTC. This is certainly compelling evidence against the contribution of previous pregnancy to imminent SP. However, it is possible that patients who were not pregnant in the ED could have been pregnant prior to that, thus, the contribution of previous pregnancy to risk of SP is inconclusive.

### **Is the rate of SP an Underestimation?**

It is important to note that while the rate of subsequent pregnancy for patients in this study is high, this is still likely an underestimation due to several factors.

First, the pregnancy rate is likely underestimated because of an under-reporting of elective abortions. In this study, only 14.7% of subsequent pregnancies resulted in elective abortions. Even among ED pregnancies, only 15.5% resulted in elective abortions. Both of these rates are statistically significantly below the national rate of teen pregnancy ending in elective abortion (27.3%) (6). The discrepancy is even more

striking when compared to state data: in Connecticut in 2005, for every 100 pregnancies that resulted in abortion or live birth, there were 53 abortions (6).

Every documented elective abortion in this study was performed at the local Planned Parenthood, located within 2 miles of the PCCs. A medical record system is not shared between the two institutions, meaning that the PCCs relied on patients to self-report these abortions. Therefore, the discrepancy between the national and state-wide abortion rate and the abortion rate in this study likely represents a failure of patients to report abortions that occurred subsequent to their ED visit to their primary care providers.

Adjusting the rate of elective abortion in this study to be in line with the state rate yields interesting results. If the reported abortion rate in Connecticut for teenagers is extended to this study- as there were 182 live births in the study population, we should expect that there would be ~96 abortions. There were 40 reported. This means that we expect that in this population, approximately 56 abortions were not reported.

Finally, another reason why the SP rate is likely an underestimation stems from a lack of available medical records. 20 patients (16.8% of the NSP group) did not have a PCC visit after their ED visit, thereby preventing any documentation of subsequent pregnancies. It is possible that this lack of follow up care reflects the fact that many of these women did not have SPs- as all had been seen in the two years prior to their ED visit and the presumption was that these women would return to the women's clinic with SPs. However, it is possible that patients moved away, or began receiving primary care elsewhere, thereby being lost to follow up.

Furthermore, of those 99 patients in the NSP group who did have a PCC appointment after their ED visit, 49 (41.2% of total NSP population) had their last

recorded PCC appointment within 481 days of being seen in the ED, which was the average TTC in the SP group. For 7 of these patients, their last trip to the PCC was within 10 days of their ED visit. Therefore, even within the subsection of the NSP group that did have subsequent PCC visits, there is a contingent for whom the visit might have been too soon after their ED visit to capture a SP.

## Limitations

### 1. Reliability of data

As this study relied on patients to self-report those pregnancies for which they received care elsewhere, the reliability of this information is impossible to confirm. Based on state data on abortion rates, it is likely that patients under-reported their elective abortions.

### 2. Generalizability of this inner city population

This is a very high-risk population. While rates of positivity to the test for GC/C are on par with past studies that have looked at urban populations of adolescents, they are higher than national and state averages. This makes it difficult to know whether non-urban adolescents tested for GC/C have a comparable rate of SP.

### 3. Variability in ordering the test for GC/C.

This study relies on a population of patients that have been pre-selected by physicians for a test for GC/C. Therefore, the generalizability of the risk for SP is dependent on physicians at other institutions having comparable ordering patterns. Furthermore, it is possible that a group of teens that were at risk for a SP were not captured in this study population.

### 4. Unknown attitudes towards / desire for SP

While there is data on the percent of teenage pregnancies that are intentional on a national level, this study did not assess patients' attitudes about or desire for their pregnancies. Further investigation into these perspectives is warranted.

## Implications

This study demonstrates that teenagers who are tested for GC/C during an ED visit are at very high risk for subsequent pregnancy. The numbers are compelling: 32% of the 398 patients conceived within 1 year of their ED visit, 54% conceived within 2 years and 70% of the patients conceived within four years. It is clear that the encounter between the ED provider and the patient being tested for GC/C represents a missed opportunity for pregnancy-prevention counseling.

This study has validated the use of a test for GC/C as a proxy for a pregnancy test in the ED setting. This is the first time that a test for GC/C has been linked to a rate of subsequent pregnancy. It appears that the rate of subsequent reported pregnancy among these patients is very similar to what has been described in the outpatient setting among patients who come to a clinic for a pregnancy test. Given the issues with using a pregnancy test as a proxy for high-risk sexual activity within an ED setting, our study demonstrates that a test for GC/C serves as an excellent substitute.

This study also establishes the ED as a novel point-of-contact for offering reproductive health services to adolescents. While outpatient clinics have traditionally been the arenas in which reproductive health services have been offered and studied, it is clear that as adolescents increasingly use EDs, some of these services may need to be offered within the urgent-care setting. Given the major implications that teen pregnancy

has on the health of both the teen and her children, it is not a topic that physicians can afford to avoid, even given the significant time constraints of the ED.

### Recommendations/Future Directions

Given the marked risk for SP in this population, and the knowledge that most teen pregnancies are unintended there is a need for an ED-based intervention to reduce the rate of these undesired pregnancies (9, 11). How best to make use of the ED-encounter must be the subject of further research. Basic questions must be answered before a study designed to establish whether an ED-based intervention could lower the rate of unwanted teen pregnancy in this population could be attempted. Specifically, studies need to be designed that assess these patients' attitudes about pregnancy and contraception, their partner's attitudes about these topics, these patients' interest in an ED-based intervention, and their contraceptive preferences. These sorts of studies will inform a decision about which reproductive health services are likely to benefit this population.

Many questions remain unanswered regarding the potential benefit of contraception prescription to this largely unstudied group of patients. Certainly it seems clear that offering some form of contraception to this population would be beneficial: but the type of contraception remains unclear. Do most of these teens want to use condoms? Do they actually use condoms? Would they consider an IUD? Can a partnership be formed with a local women's clinic to make IUDs available to them? Can they afford IUD placement? Do they want to take an oral contraceptive? In practice, are they actually going to take it every day?

Another set of questions revolves around the ED providers role in this process: should any contraception be prescribed in the ED? Who would provide the follow-up for

these patients? Who would counsel them about the risks of the medication? Is there a role for social workers in this process? What about for an OB-Gyn consult? Should the ED practitioner give information on how to prevent unwanted pregnancies to every teen who is tested for GC/C? How should the information be delivered and what should the content be? What do ED providers think about the idea of prescribing birth control in the ED? What are their hesitations?

Perhaps the largest limitation to be faced by future efforts to deliver reproductive health services to teens in this setting is the inherent nature of an ED: the ED is busy, designed as a place for short and targeted visits. It is not designed to be a place to have conversations with patients about issues that have been traditionally considered the realm of primary care. Furthermore, it is not set-up to provide follow up. Some of the practices that have been most effective in reducing the rate of unwanted teen pregnancies, such as repeated small group counseling sessions for at risk-teens are not easily adapted to the ED (25).

What is needed is a creative re-imagining of the role of the ED in these teens lives. Can partnerships be created that will allow for referrals of these teens to continuity care? Can social work be involved to alleviate some of the time stress on ED physicians? Can ED physicians prescribe an OCP and trust follow-up to happen in a local PCC? Can IUDs be placed in an ED?

Acknowledging these limitations and the need for further research to clarify some of the questions about this topic that remain: it is still worthwhile to consider what can be expediently done to decrease the rate of unwanted pregnancies in this population. Certainly some side-effect-free forms of contraception, such as condoms, should be made



available to these teens. Referrals can also be made to local free clinics for regular gynecological care. A pamphlet that outlines the different forms of contraception and the locations of nearby clinics where they are prescribed can also be made available. And perhaps the most important thing will be that the conversation happens at all: talking to these teens about pregnancy- their perspectives, attitudes, and their now known risk for SP may be the best thing that practitioners can do for their patients in the interim.

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