How and what do women learn about contraception? A latent class analysis of reproductive-age women in Delaware and Maryland

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Abstract

Studies of contraceptive learning have focused on younger ages and single information sources. We applied latent class analysis to a population-representative survey of 2,213 women aged 18-44 in Delaware and Maryland in 2016/17 to analyze women's combining of sources for contraceptive information. We identified four "learning profiles" from their sources of information received in the past 3 months: 1) primarily healthcare providers; 2) traditional media such as television, radio, and print ads; 3) personal networks and the Internet; and 4) all sources. Of the two thirds of women who had received contraceptive information in the last 3 months, healthcare providers and traditional media were the most common sources of information, followed by personal networks and the Internet. Lower education and older age predicted less information receipt. Women who received information from the most sources were more likely to learn about multiple aspects of contraceptive access, cost, effectiveness, and usage.

1. Introduction

High prevalence of unintended pregnancies among teenaged and young women [1], coupled with links between contraceptive knowledge and unintended pregnancy [2], has prompted studies on the sources through which these women receive information about contraception [2,3,4]. Unintended pregnancies, however, are not exclusive to younger women. In 2011, over one-third (approximately 772,000) of pregnancies among U.S. women aged 30-44 were unintended [1]. A recent qualitative study of learning processes among older women found that older women frequently use friends and family as sources of information about contraception [5]. However, to our knowledge, no study has used a sample representative of women of all reproductive ages to analyze how women acquire information about contraception.

Studies have shown that younger women are likely to acquire information from multiple sources, including healthcare providers, friends and family, the media and the Internet [3,5,6,7]. Qualitative evidence suggests a relationship between sources of contraceptive information and the type and quality of information received. For example, doctors and nurses typically provide more accurate information about the effectiveness and correct use of contraceptives [5], but may reinforce misconceptions about specific methods such as IUDs to young, nulliparous women [8,9]. Women's acquisition of information from different sources may generate complementary or conflicting information. We presently know little, however, about what combinations of sources different women use to acquire or receive information about contraception, and about how the combination of sources on contraception affects what information is acquired.

Younger women's likelihood of using certain sources of contraceptive information varies by sociodemographic characteristics and sexual history, with more education associated with higher likelihood of learning about contraception from the Internet [3] and greater contraceptive knowledge [10,11]. In qualitative studies, racial/ethnic minorities have been found to rely more heavily on information from personal networks [12,13]. Earlier onset of sexual activity and experience of unintended pregnancy is associated with more learning about contraception from healthcare providers [3]. These studies have typically investigated information sources one by one. In the present study, we aim to understand instead which combinations of sources are more or less likely to be used, and to generalize our findings across socio-demographic groups. Applying the methods of latent class analysis to population-representative survey data from women aged 18-44 residing in Delaware and Maryland, we first identify "learning profiles" to describe the diverse combinations of sources women receive information about contraception from; second, assess which sociodemographic characteristics and sexual and reproductive histories predict belonging to each of these learning profiles; and third assess how these profiles predict the content of information learned.

2. Materials and Methods

2.1. Data and Sample

We conducted a survey, fielded from November 2016 through March 2017 by NORC at the University of Chicago, of a probability sample of 2,976 women aged 18-44 residing in Delaware and Maryland households. In this 2016/17 Statewide Survey of Reproductive Age women in Delaware and Maryland, approximately 1,800 women

responded through a web-based survey instrument, 1,000 on a paper-based, mail-in survey, and a small number through a CATI (telephone) instrument. Invitations to complete the survey via the web-based instrument were first mailed to randomly selected households in November 2016, and responses were collected through the multiple modes through March 2017. The survey used an address-based sampling frame built from the United States Postal Service computerized delivery sequence, enhanced with age-targeted lists. Census tracts with higher proportions of minority (non-White) households were oversampled. Sample weights were constructed to account for both initial probabilities of selection and differential non-response. The achieved AAPOR2 response rate was 12.7%, which although low, is in the range of that achieved by an earlier national survey of women aged 18 to 29 [3]. We use the study's sample weights throughout so that our estimates represent the household populations of women of reproductive age in Delaware and Maryland.

The survey includes extensive information on women's contraceptive choices and reproductive behavior. The full weighted sample of 2,976 women was first restricted to 2,882 women who responded to the question described below on sources of contraceptive information. Of these women, we excluded 378 (13.1%) respondents who were sterile or infertile, and 32 (1.1%) women who reported learning from at least one source, but did not respond to the question on learned content. We further excluded 259 (9.0%) women who had missing values in any of the model covariates. The final weighted analytical sample comprised 2,213 women.

2.2. Measures and Analyses

2.2.1. Contraceptive Information Sources

Women were asked, "In the past 3 months, have you received any information about birth control methods from any of the following places?" They were given a "Yes/No" response option for each of 10 categories: 1) a friend or family member; 2) Twitter, Facebook, or Snapchat; 3) other social media and Internet sources; 4) posters, signs, and billboards; 5) TV or radio; 6) ads in community spaces; 7) print ads; 8) nurse, doctor, or other healthcare provider; 9) social worker or community health worker; and 10) any other place. We created a tenth category for learning from school or the workplace, which was based on written responses to the "other place" option.

We used latent class analysis [14] (See Online Appendix for methodological details) to classify all respondents who reported receiving information about contraception in the last 3 months from at least one source into five categories ("learning profiles"): 1) primarily healthcare providers (HPs); 2) traditional media sources such as television and magazines, supplemented by HPs; 3) personal networks and the Internet, supplemented by HPs; and 4) a combination of all sources. We estimated a multinomial logistic regression model to assess the associations of sociodemographic and reproductive variables with each learning profile, relative to women who did not report learning about contraception from any source in the last 3 months.

2.2.2. Contraceptive Information Content

A second outcome of interest is the type of information learned. Respondents who checked "Yes" to having used at least one source of information about birth control in the last 3 months were asked, "What types of information have you learned from these

sources? (Please check all that apply)" Options were: where you can go to get birth control; how much different birth control methods cost; what types of birth control methods are the most effective at preventing pregnancy; and information about a particular birth control method, such as how it is placed or how it works. We estimated separate binomial logistic regression models for the probability of learning about each of these four topics to assess how sources of contraceptive information predict what is learned. In these logistic regressions, we used "primarily from a healthcare provider" as the reference category, contrasted with learning profiles including combinations of different sources.

3. Results

[TABLE 1 ABOUT HERE]

As shown in Table 1, 31.6% of women did not receive contraceptive information from any source in the last 3 months, 16.9% learned mainly from a nurse, doctor, or other healthcare provider (HP), 27.2% learned from traditional media complemented by HPs, 13.0% primarily from personal networks and Internet sources complemented by HPs, and 11.3% received contraceptive information from a combination of all sources. Figure 1 illustrates the diverse patterns of sources of information received (see also Appendix Table A1). This figure shows for each of the four learner profiles the proportion of women who obtained contraception information from each of 10 possible sources. Among women classified as learning from "traditional media complemented by HPs," over 70% learned from TV/radio and about 70% learned from print ads, and nearly 35% learned from HP. Their proportion learning from Internet sources was very low. Among women whose "learning profile" was "Personal networks, Internet, and HPs",

family/friends, social media, and other Internet sources of contraceptive information were all prevalent (40 to 80%), and about 40% of them learned from HPs. The "all sources" group stands out as having the highest or near-highest proportion learning in every one of the 10 sources, including about 75% learning from HPs in the last 3 months.

[FIGURE 1 ABOUT HERE]

Demographic characteristics varied substantially between non-learners and learners, and varied somewhat across learning profiles (see again Table 1). In particular, women aged over 30 were over-represented among both non-learners (65.9%) and those relying primarily on traditional media (54.9%), and women with no more than a high school education were overrepresented among non-learners and among women learning mainly from HPs.

3.1. Predictors of learning profiles

Table 2 shows relative risk ratios from a multinomial logistic regression that predicts belonging to different learning profiles. Women who did not receive information about contraception from any source in the last 3 months are the reference outcome category. Even after controlling for socioeconomic and reproductive characteristics, women aged 30-44 were much less likely to have learned about contraception in the last three months, from any combination of sources, than were women aged 18-24 (the reference group). Women 25-29 were also generally less likely to have acquired information about contraception in the last 3 months than were 18-24 year olds. Having attended college was associated with a greater likelihood of having acquired information about contraception in the last 3 months, compared to having no more than a high school education. The likelihood of having acquired information either from a combination of

traditional media and HPs was much higher for women who had attended college. Race/ethnicity was only a significant predictor for learning from personal networks and Internet sources, wherein Blacks were less likely to learn from these sources than Whites. Being foreign born was negatively associated with learning from "all sources", but otherwise no different from U.S.-born.

[TABLE 2 ABOUT HERE]

Sexual and reproductive history was related to learning profile membership. Women who were sexually active were more likely to learn from traditional media plus HPs, and having already had two or more children was negatively associated with learning from a combination of personal networks and Internet sources plus HPs. Being less than fully satisfied with current contraception was associated with a greater likelihood of learning from HPs or from personal networks and the Internet plus HPs.

3.2. Learning profiles and content

Table 3 shows odds ratios from logistic regressions using learning profiles to predict content learned. Results show that respondents who receive contraceptive information from a combination of all sources are more than twice as likely to learn about where to get contraceptives, how much they cost, their effectiveness, and how they work, compared to women who obtain information primarily from healthcare providers. Women who receive information mainly from traditional media plus HPs are less likely to learn about method cost and effectiveness, but more likely to learn about how a method works, compared to women who receive contraception information primarily from healthcare providers. The information acquired by those who learned mostly from

personal networks and Internet sources plus HPs was not significantly different from that learned by those who relied primarily on healthcare providers.

[TABLE 3 ABOUT HERE]

4. Discussion

Our study adopted a "learning profile" approach to describing women's experiences of receiving information about contraception from often multiple sources. This complements previous work that has analyzed information sources one by one [5,7,12]. Of the two thirds of Delaware and Maryland women in 2016 and 2017 who had received any contraceptive information in the last 3 months, "traditional media" (especially TV, radio, and print ads) and healthcare providers were the most frequent sources of information. Social media, other Internet, and personal networks (family, friends, sexual partners) were also somewhat often used. The continuing importance of traditional media is noteworthy. Our survey, however, preceded the rollout of an Internet-based media campaign in the state of Delaware [18].

We found that healthcare providers were an information source that was likely across all learning profiles, either as a primary or supplementary source of contraceptive information. What mostly differentiates women is the type and number of sources they receive information from, in addition to healthcare providers, and their likelihood of having recently received information from any source. Both socio-demographic characteristics and sexual, reproductive, and contraceptive histories influence the likelihood and sources of learning about contraception. One important contribution of our study is our having included women across the reproductive ages. We found that recent contraceptive information acquisition is more likely among younger women (age 18-24).

One reason for this may be that they are less knowledgeable and experienced with contraception, and therefore both seek information about contraception and recall exposure to such information. Another is they may receive more information as a result of targeting by contraceptive information providers. Older women may in this way be more isolated from opportunities to acquire information on new, potentially more effective, contraceptive methods such as LARCs.

An important socio-demographic group we found to have been less likely to have recently received contraceptive information, and from fewer sources when they did, was women with no more than a high school education. This is significant in the context of greater rates of unintended pregnancy among women with lower educational attainment [1], and suggests that socio-economic status is an important factor to consider in the design of programs to increase contraceptive knowledge and thereby to reduce disparities in unintended pregnancy. After controlling for education and other characteristics, we found few differences in contraceptive learning by race/ethnicity and nativity.

Different sources of contraceptive information have previously been associated with varying quality and quantity of information regarding the promotion, effectiveness, and use of contraceptive methods [15,16,17,19]. Unsurprisingly, we found that women who are more likely to acquire information from across all types of sources learn about more contraceptive topics, including access, cost, effectiveness, and method of use. We also found that women who learn from a more limited set of sources may learn less about contraception than do women who rely primarily on healthcare providers for their contraceptive information. In particular, we found that women who learn mainly from traditional media were less likely to learn about method cost and effectiveness.

Understanding which combination of sources provides more complete information, and what may be the gaps in information learned, may therefore be important for the design of interventions and programs.

Our study faces some limitations. Given the nature of cross-sectional data, for example, we cannot ascertain a causal link between reproductive and contraceptive outcomes and the likelihood of belonging to a given learning profile. Nor are we able to infer from these data how learning profiles evolve over time and if they are a result of differences in preferences for sources of information or of differences in access to sources of information. Third, our data do not distinguish which specific types of information are obtained from which sources, making causality between information sources and learned content difficult to establish. Nevertheless, our study shows that interventions need to be cognizant of the existence of different learning patterns among women, of variations in learning profiles between more and less educated and younger and older women, and of the relationship between the different combinations of information sources and the acquired knowledge on contraceptive access, effectiveness, and usage.

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Table 1. Socio-demographic Characteristics and Reproductive Behavior and Attitudes of Contraceptive Non-Learners and Four Latent Contraceptive Learning Profiles, Delaware and Maryland women ages 18-44 2016-2017 (N= 2, 213)

	Non-learners	Healthcare Providers (HP)	All Sources	Traditional Media, HP	Networks, internet, HP
N	756	403	223	561	270
Weighted proportion	31.6%	16.9%	11.3%	27.2%	13.0%
Age					
18-24	16.5%	29.9%	37.8%	26.8%	42.4%
25-29	17.5%	21.6%	22.9%	18.3%	18.6%
30-44	65.9%	48.5%	39.3%	54.9%	39.0%
Education					
High school or less	22.1%	17.0%	12.5%	6.3%	8.0%
Some college	34.5%	39.4%	44.6%	42.2%	48.4%
BA or more	43.4%	43.5%	42.9%	51.5%	43.5%
Race/ethnicity					
White	50.3%	46.3%	55.0%	52.3%	59.6%
Black	29.6%	34.5%	30.1%	27.9%	12.5%
Asian	8.8%	4.6%	4.7%	8.0%	6.8%
Other	4.7%	3.7%	4.0%	4.6%	12.9%
Hispanic/Latina	6.5%	10.9%	6.2%	7.2%	8.1%
Nativity					
Born outside the U.S.	21.1%	18.8%	8.7%	20.2%	14.0%
Sexual Activity					
Pregnant or trying	12.2%	8.2%	6.1%	6.0%	9.4%
Not sexually active	26.9%	20.2%	26.7%	25.0%	25.3%
Sexually active	60.9%	71.5%	67.2%	69.0%	65.3%
Parity					
No children	42.8%	46.3%	60.7%	51.3%	70.5%
One child	19.8%	19.3%	22.4%	16.7%	13.2%
Two or more children	37.4%	34.4%	16.9%	32.0%	16.2%
Contraceptive Satisfaction					
Not using or pregnant/trying	51.6%	39.8%	39.9%	42.1%	35.3%
Using and satisfied	45.9%	52.5%	53.4%	52.4%	50.4%
Using and not satisfied	2.6%	7.7%	6.8%	5.5%	14.3%

Source: Authors' calculations from the 2016/17 Statewide Survey of Reproductive Age women in Delaware and Maryland. All estimates are weighted.

Table 2. Relative Risk Ratios and Standard Errors from a Multinomial Logistic Regression Predicting Latent Learning Profiles, Delaware and Maryland women ages 18-44 2016-2017 (N=2,213)

	Healthcare Providers (HP)	All Sources	Traditional Media, HP	Networks, Internet, HP
Age (Ref: 18-24)				
25-29	0.48*	0.47*	0.46*	0.37**
	[0.17]	[0.17]	[0.16]	[0.14]
30-44	0.25***	0.23***	0.33***	0.27***
	[0.08]	[0.08]	[0.10]	[0.10]
Education (Ref: High School grad, or less)				
Some college	1.94*	2.48*	4.88***	3.63**
	[0.65]	[1.02]	[1.85]	[1.80]
BA or more	2.49**	3.07**	6.32***	3.74**
	[0.75]	[1.28]	[2.33]	[1.89]
Race (Ref: White)				
Black	1.55	1.22	1.15	0.45*
	[0.38]	[0.37]	[0.28]	[0.16]
Asian	0.66	0.87	0.9	0.81
	[0.28]	[0.51]	[0.34]	[0.36]
Other	0.76	0.7	0.94	1.91
	[0.48]	[0.44]	[0.46]	[1.18]
Hispanic/Latina	1.99	1.31	1.36	1.36
	[0.80]	[0.64]	[0.58]	[0.64]
Nativity (Ref: U.S born)				
Foreign born	0.88	0.42*	1.01	0.89
	[0.26]	[0.17]	[0.28]	[0.32]
Sexual Activity (Ref: Pregnant or trying)				
Not sexually active	0.81	1.45	1.45	0.78
	[0.35]	[0.71]	[0.50]	[0.41]
Sexually active	1.27	2.05	2.03*	1.1
	[0.51]	[0.94]	[0.67]	[0.61]
Parity (Ref: No children)				
One child	1.27	1.36	1.02	0.61
	[0.35]	[0.44]	[0.27]	[0.23]
Two or more children	1.41	0.61	1.08	0.45*
	[0.38]	[0.19]	[0.26]	[0.16]
Contraceptive Satisfaction (Ref: Not using contraception)				

Using and satisfied	1.30	1.15	1.04	1.27
	[0.32]	[0.32]	[0.23]	[0.44]
Using and not satisfied	3.36*	2.92	2.02	6.94***
	[1.66]	[1.70]	[0.93]	[3.78]

***p<.001, **p<.01, *p<.05, !p<.10

Source: Authors' analyses of the 2016/17 Statewide Survey of Reproductive Age women in Delaware and Maryland. All estimates are weighted.

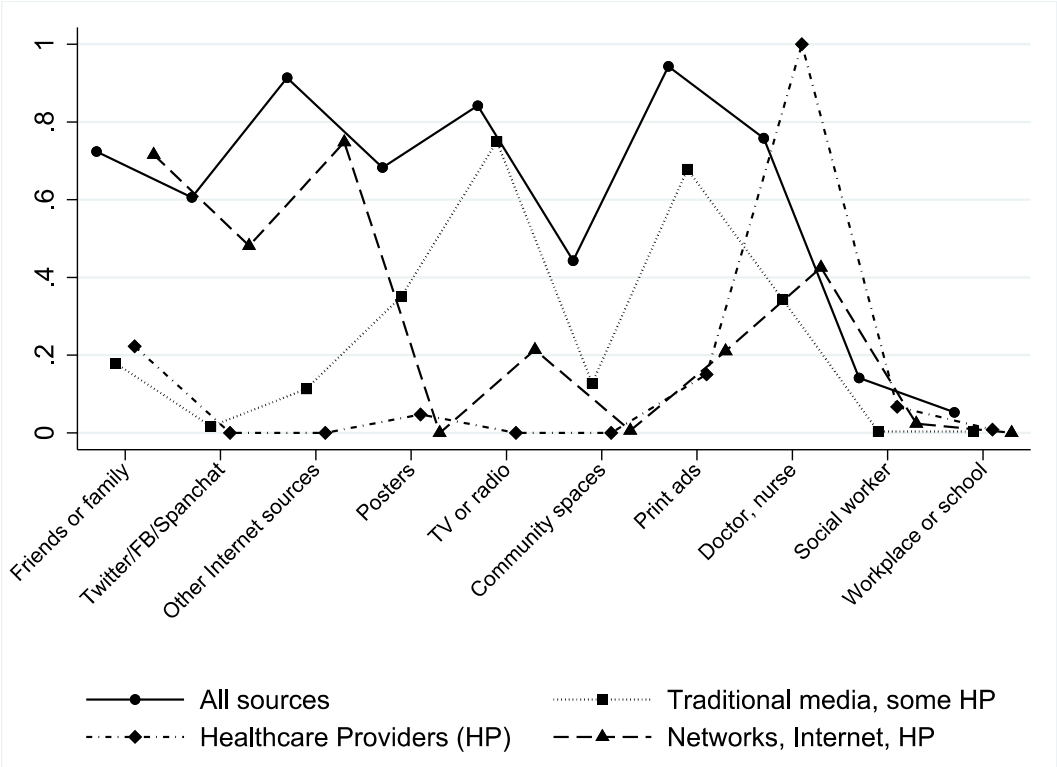
Table 3. Odds Ratios from Logistic Regressions Using Latent Learning Profiles to Predict Information Learned, among Women who Received Contraceptive Information in the Past 3 Months, Delaware and Maryland women ages 18-44, 2016-2017 (N=1,457)

(Ref: Healthcare Providers (HP))	Where to go	Cost	Method effectiveness	About how it works
All sources	2.31**	2.56**	2.31**	2.73***
	[0.64]	[0.85]	[0.64]	[0.76]
Traditional media, HP	0.92	0.46*	0.55**	1.61*
	[0.21]	[0.16]	[0.12]	[0.36]
Networks, internet, HP	0.93	1.21	1.27	1.60
	[0.25]	[0.41]	[0.33]	[0.44]

***p<.001, **p<.01, *p<.05, !p<.10

Source: Authors' analyses of the 2016/17 Statewide Survey of Reproductive Age women in Delaware and Maryland. All estimates are weighted.

Figure 1: Source category proportions for women belonging to each of four classes of contraceptive learners identified through latent class analysis, Delaware and Maryland women ages 18-44 2016-2017 (N= 1,596)



Source: authors calculations from the 2016/17 Statewide Survey of Reproductive Age women in Delaware and Maryland

Appendix: Description of our Latent Class Analysis

Latent class analysis (LCA) uses multiple observed variables to predict unobserved subgroups (or classes) that yield clusters of observations that are similar within each class, and distinct from other classes. This modeling approach uses maximum likelihood (ML) to model underlying probability distributions present in the dataset, and estimates the person-specific probabilities of belonging to each class. Unlike factor analysis, LCA estimates membership in discrete latent groups, which is useful for identifying distinct types of learning patterns (Vermunt and Magidson 2002).

In order to generate these classes, we first restricted the original dataset of 2,976 respondents to 2,882 women who responded either "yes" or "no" to at least one of nine source categories (including respondents who chose "other sources" and provided written responses to specify these sources, which were later coded) from the question, "In the past 3 months, have you received any information about birth control from any of the following places?" Survey respondents were permitted to select multiple responses. All source categories were then recoded into binary variables using STATA 15, coded 1 for respondents who had heard about birth control from a particular source, and 0 for respondents who indicated either that they had not heard about birth control from a source or had some other response (missing, don't know, prefer not to answer). Respondents were also allowed to select "Other source" and provide with a written specification. Such written responses were then coded into any of the first nine source categories, if applicable. During the process of classifying and recoding written responses, we identified an additional, distinct type of information source, which was not originally offered as a response option: the acquisition of information from the workplace

and/or school. We therefore created a tenth source category for acquiring information through formal education and/or the workplace, but this was a small, residual category (see Table A.1). Of these women, we excluded 378 (13.1%) respondents who were sterile or infertile, and 32 (1.1%) women who reported learning from at least one source, but did not respond to the question on learned content. Then, all respondents who reported learning from at least one source were pooled into a "learners" dataset. This dataset included all contraceptive information source categories, together with sample weights and respondent IDs. There were 1,596 women in this subsample.

We used this dataset to determine the optimal number of latent classes in MPlus 8, starting with a 2-class model, and evaluating models up to 6 classes, when the entropy indicator started to decrease, thus suggesting that the identified classes were no longer substantially different from each other. Based on the AIC and BIC, together with considerations of theoretical interpretation, we selected the 4 class model as the one that better described the underlying learning profiles in the data. All models used survey weights that adjusted the sample to be representative of women of reproductive age (18-44) in Maryland and Delaware.

For each class, we then analyzed the distribution of probabilities of using each of the information sources, and identified what defined the four learning profiles: whether they relied more heavily on a single source or a particular combination of sources. We defined each respondent's learning profile based on the person-specific posterior class categorizations estimated by MPlus. This was subsequently merged with the original dataset to be used as an outcome in multinomial logistic models predicting class

membership, and as a predictor in binary logistic regressions predicting type of information learned.

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Table A.1 Proportions of respondents who said "yes" to learning from a source, in both learners-only sample (used for LCA) and full sample.

Sources of information	Learners + non-learners (N = 2, 472)	Learners only (N= 1,596)
A friend, family member, or sexual partner	25.7%	37.9%
Twitter, Facebook, Instagram, or Snapchat	13.2%	19.4%
Other social media, online advertisements, Google, or other internet sources	22.5%	33.2%
Posters, signs, or billboards	17.5%	25.8%
TV or radio	31.8%	47.0%
Ads in the community such as bars, restaurants, or other local events	8.2%	12.1%
Print ads, such as in magazines, newspapers, and brochures	33.5%	49.5%
A nurse, doctor, or other healthcare provider	40.0%	59.0%
Social worker or community health worker	3.0%	4.5%
Workplace, formal education	0.8%	1.1%

Source: authors calculations from the 2016/17 NORC/UMD Statewide Survey of Reproductive Age women in Delaware and Maryland