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Survey of obstetrician-gynecologists in the United States about toxoplasmosis: 2012 Update

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Abstract

Purpose—Toxoplasmosis, caused by the parasite *Toxoplasma gondii*, can have serious impacts on fetal development in the setting of acute maternal primary infection. The U.S. Centers for Disease Control and Prevention and the American College of Obstetricians and Gynecologists (ACOG) sought to determine current knowledge, practices, opinions and educational preferences regarding *T. gondii* infection in pregnancy among ACOG members practicing prenatal care.

Methods—A survey was sent to 1056 ACOG members chosen by stratified random sampling from membership lists, including 370 participants and 686 non-participants in the Collaborative Ambulatory Research Network (CARN). Mailings were sent up to 4 total times to nonresponders.

Results—Minimum response rates were 40.3% (CARN) and 19.7% (non-CARN); responses rates adjusted for imputed non-eligibility were 59.7% (CARN) and 22.6% (non-CARN). Among providers, 80.2% had diagnosed no acute maternal *T. gondii* infections in the past 5 years, 12.7% correctly identified the screening role of the Toxoplasma avidity test, 42.6% routinely performed serologic *T. gondii* screening for at least some asymptomatic pregnant women, and 62.1% of those who so did used appropriate approaches. Providers in the northeastern United States were 2.02 times more likely to routinely screen than those in the west (p=.025) and female providers were 1.48 times more likely than male providers (p=.047). The potential educational interventions considered useful by the most practitioners were updated ACOG guidelines on screening (81.4%) and management (71.7%) for acute *T. gondii* infection in pregnancy.

Conclusions—ACOG members would benefit from educational efforts targeted at risk factor counseling and screening approaches.

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Ethical Standards

This manuscript does not contain clinical studies or patient data.

Introduction

Acute *Toxoplasma gondii* infection in pregnant women can cause serious sequelae in their infants. If transplacental transmission causes fetal infection, neurologic and ocular birth defects can result. However, with early maternal diagnosis, treatment regimens are available that may decrease risk of transplacental transmission, or reduce clinical manifestations if transmission occurs. Due to the lack of well-controlled studies, though, the efficacy of these treatments and the utility of routine screening remain controversial. In the United States there are no universally accepted guidelines, and practice varies.

The US Centers for Disease Control and Prevention (CDC) and the American College of Obstetricians and Gynecologists (ACOG) conducted surveys of obstetrical providers in 1998 [1] and 2006 [2]. These identified educational needs later addressed in an ACOG practice bulletin [3]. In 2012, we circulated a third updated survey to the ACOG membership to follow changes in practitioner knowledge, practices and opinions. Here we report results.

Materials and Methods

A questionnaire was developed with reference to the prior surveys, and pilot-tested by ACOG. It addressed experience, knowledge and practices regarding screening, diagnosis and management of acute maternal and fetal toxoplasmosis; and opinions on legislative regulation of screening and continuing education needs. Demographic characteristics, practice type and patient population were also collected. Participants were selected from among ACOG members, including both non-participants and participants in ACOG's Collaborative Ambulatory Research Network (CARN), a cadre of practicing obstetrician-gynecologists who have agreed to participate in periodic ACOG surveys.

Stratified random sampling was used to sort ACOG and CARN members into groups of 100, balanced on age, gender and geography, minus losses due to invalid addresses or discontinued practice. Then groups were randomly selected to total a similar target respondent number to previous ACOG surveys. In 2012-2013, the questionnaire was mailed (including four mailings to nonresponders) to 1056 ACOG members (370 CARN members, 686 non-CARN). Analysis was performed using SAS Enterprise Guide version 9.3 (SAS Institute, Cary, NC). Respondent surveys were included if their CARN affiliation was known, they answered more than three survey questions, and they were currently practicing obstetrics including prenatal care. US Census regions [4] were used to delineate practice regions.

Responses were analyzed separately for CARN and non-CARN respondents. Denominators vary because not all respondents answered all questions. Results are for total proportion of respondents selecting a given answer; for questions for which multiple answers were accepted, totals may therefore exceed 100%. Answer proportions were compared between groups using the Fisher's exact test for categorical variables and a two-sample t-test for continuous variables. If not significantly different, groups were pooled to calculate total proportions giving each answer, for which 95% Clopper-Pearson confidence intervals (CIs) were calculated; otherwise, proportions were calculated for each group separately.

Univariate Poisson regression models were used to investigate the association between selected outcome variables -- ever performing serologic screening on pregnant women, correctly identifying letting a pet cat go outdoors and gardening as risk factors, and using an "acceptable"[a] seroscreening method -- and covariates including provider gender, years elapsed since completing residency, primary practice field, and geographic region. If more than one covariate was associated with a given outcome, multivariate Poisson regression using all covariates significant at alpha =.05 on univariate analysis (forward stepwise approach) was performed for that outcome. P-values are provided, allowing assessment of significance at either $p<.05$, or $p < .0125$ after adjusting for multiple comparisons.

The study was reviewed and exempted by ACOG and CDC human subjects committees.

Results

Response rate

The participant flowchart, including response rates, is in Figure 1. The minimum response rates were: 40.3% CARN, 19.7% non-CARN; if nonrespondents were ineligible in the same proportion as respondents, however, response rates were: 59.7% CARN, 22.6% non-CARN.

Respondent demographics

Respondents had been practicing for a mean of 21.0 years. Mean age was 52.7 years in 2012 (95% CI 51.6-53.1); mean years in practice were 21.0 (95% CI 19.8-22.0). Other characteristics are in Table 1. Only in gender were CARN and non-CARN respondents different ($p=0.04$; CARN percent male = 41.9, 95% CI 34.1-50.1; non-CARN, 50.8%, 95% CI 41.5-60.2).

Other significant differences between CARN and non-CARN respondents were uncommon and are noted below.

Provider Experience

Answers to questions about provider experience and the other topics that follow are shown in table 2, except where covered in the text. Where applicable, correct answers are marked in the table with the footnote: [a]. Providers had diagnosed few cases of acute maternal toxoplasmosis, with 80.2% diagnosing none, and only 5.4% over one, in the past five years.

Risk Factors and Counseling

Most respondents (73.8%) provided prenatal toxoplasmosis counseling at the first visit, including 30.0% when the patient asked questions and 25.5% when they considered the patient high-risk. Well-recognized risk factors included changing cat litter without gloves (95.1%), contact with sand from an uncovered sandbox (78.9%), and eating raw or undercooked meat (83.3%). Less-known factors included changing cat litter every few days compared to daily (54.1%), having a litter of kittens at home (21.2%), and gardening

[a]"Acceptable" screening methods included checking both IgG and IgM; checking IgG alone repeatedly (allowing ascertainment of seroconversion); or checking IgM if then confirmed with IgM and IgG.

without gloves or employment involving soil exposure (61.5%, 57.3%, respectively). feces). Among providers who considered an exposure a risk factor, prevalence of including it in counseling varied (39.1-97.3%).

Among those who identified gardening without gloves as a risk factor, CARN and non-CARN providers were significantly (p= .04) more likely to include it in counseling.

Overall, 6.4% of providers answered four or fewer risk factor questions correctly, 40.1% five to eight, 47.9% nine to twelve, and 5.6% more than 12. Among providers answering nine or more questions correctly, often-missed risk factors were eating raw or undercooked oysters, mussels or clams (35.8%); eating unwashed raw fruits or vegetables (55.0%); and drinking untreated water from a stream, lake or pond (55.0%).

Screening and Diagnosis

Forty-two point six percent of providers (95% CI 36.7%-48.6%) reported ever seroscreening for acute *T. gondii* infection in asymptomatic pregnant women. Of these, 55.6% reported deciding who to screen by asking about risk factors; 27.8% also required absence of a previous positive serology. Respondents who seroscreened generally did so once, either as early as possible (70.5%; 95% CI 64.9%-80.2%) or if indicated by signs/symptoms or exposure (16.0%; 95% CI 10.2%-23.5%).

Providers' mean estimate of the laboratory cost of their screening approach was $182.50. CARN providers estimated significantly (p=.02) higher costs ($224.17, 95% CI $163.17-$285.16 compared to $126.94, 95% CI $80.95- $172.94). Of providers who ever seroscreened asymptomatic pregnant women, 59.1% (95% CI 50.7%-67.5%) used *T. gondii* IgG and IgM (estimating a mean cost of $199.35); 24.2% (95% CI 17.2%-34.5%) IgG only (with or without "*T. gondii* titer", a term interpretable as referring to tests which do not discriminate between IgG and IgM); 2.3% (95% CI 0.5%-6.5%) IgM only (with or without "*T. gondii titer*"), 7.6% (95% CI 3.7%-13.5%) "*T. gondii* titer" only, 0.8% (95% CI 0.0%-4.2%) IgA, and 6.1% (2.7%-11.6%) did not know.

Among approaches to confirmation, most common were answers containing both IgG and IgM (20.8%), *T. gondii* titer only (8.0%), and 'don't know' (24.6%); 46.6% took other approaches. *Toxoplasma* avidity was included by 9.7%. Eleven point one percent of respondents would send confirmatory testing (vs 1.9% initial testing) to the Palo Alto Research Institute's Toxoplasma Serology Laboratory, a nonprofit institution offering expert testing.

Approach to Acute Maternal and Fetal *T. gondii* infection

Given a diagnosis of acute maternal *T. gondii* infection at 14 weeks or 23 weeks gestation, most providers (92.0% and 93.6% respectively) would consult a specialist. Fewer would begin antimicrobial therapy (14.4% and 8.6%) or perform amniocentesis (7.6% and 9.5%). For fetal toxoplasmosis, 84.4% would consult with an infectious disease specialist, 11% begin antimicrobial treatment, 10.3% perform immediate fetal ultrasound, and 0.8% recommend termination. In the case of acute maternal infection at 14 weeks, CARN respondents were significantly more likely (p=.01) to begin antimicrobial therapy.

Provider knowledge about toxoplasmosis testing options

Most respondents were not sure which screening test gives frequent false positives (62.1%; IgM is correct); or false negatives (70.9%; no widely used test is correct). Only 7.2% correctly stated that the effectiveness of spiramycin against maternal-fetal *T. gondii* transmission is unknown or controversial (51.3% did not know), and 12.7% that the *Toxoplasma* avidity test determines whether maternal *T. gondii* infection occurred in the last 3-4 months. CARN members were significantly more likely (p=.03) to answer this question correctly.

Provider opinions on standardized screening approaches

Eighty-nine percent of respondents were opposed (1 or 2 on a 5-point scale) to universal monthly toxoplasmosis screening in pregnancy, 72% to universal screening once per trimester, and 43% to universal screening once in each pregnancy (with 34% in favor). Eighty-one percent favored screening only for patients with risk factors or recent clinical signs or symptoms, consistent with reported practice (see above). (Those favoring risk-factor-based screening answered risk factor questions correctly in proportions similar to all respondents).

For the scenario of state-mandated universal monthly screening, often-cited benefits were improved patient knowledge about and avoidance of exposure to *T. gondii* risk factors (40.8%) and identification of toxoplasmosis infections without known risk factors (40.5%). Often-cited disadvantages were false-positive results leading to unnecessary workup and/or treatment with potential side effects (72.6%) or unnecessary anxiety (65.8%), and lack of evidence of cost-effectiveness (70.7%).

Provider sources of information

The most-cited sources of information on advances in OB/GYN infectious disease care used by respondents were ACOG publications (37.9% first choice; 82.8% among top 3 choices), followed by journals (24.1%; 53.1%) and UpToDate (14.6%; 43.4%); 53.4% also listed CME activities with any ranking. Sources favored by respondents (first, second or third choice) for ACOG to help physicians develop the skills to manage acute toxoplasmosis in pregnancy were updating ACOG guidelines on screening and management (81.4% and 71.7% respectively), feature articles in newsletters (30.1%), CME monographs (26.4%) and online CME (20.3%).

Comparison with prior years

Ninety point four percent of 1998 respondents had diagnosed no acute cases of toxoplasmosis in the past year, compared to 92.1% (95% CI 88.8%-95.3%) of 2012 respondents. Fifty-three point four percent of 2006 respondents compared to 73.8% (95% CI 68.1%-79.0%) of 2012 respondents reported providing risk factor counseling at the initial pregnancy visit. When counseling, similar proportions of respondents included handling cat litter in 2012 and 2006 (92.5% and 99.6%); 41.9% and 65.4% respectively (compared to 67.6% in 1998) included gardening. (In both cases the 2012 question added “without gloves”).

While only 8.8% of 2006 respondents had heard of the *Toxoplasma* avidity test, 50.8% of those who had, and who identified an answer for the time frame for infection it suggested, answered correctly (the past 3-4 months); in comparison, 12.7% of all 2012 respondents identified time frame correctly, where 61.5% chose “don't know”.

Associative Analysis

Providers in the Northeast were 2.02 times (95% CI 1.31-3.72; p = .025) more likely than those in the West to ever screen for acute maternal toxoplasmosis in asymptomatic pregnant women (59.1% vs. 29.3%). Female providers were 1.48 times (95% CI 1.00-2.17; p=.047) more likely to do so than male providers (63.1% vs. 42.6%). With both covariates included, region remained significant (1.98; 95% CI 1.30-3.67; p = .028); gender did not (1.45; 95% CI 0.98-2.15; p = .062). Other associations were not significant.

Discussion

Fetal toxoplasmosis is an uncommon but potentially serious complication of pregnancy. An estimated 89% of women of childbearing age are susceptible to acute *T. gondii* infection (not previously infected) [5], with roughly 400—4000 [6-9] newborns born with congenital *T. gondii* infection annually in the United States.

An increasing majority of obstetricians counsel pregnant women about risk factors for toxoplasmosis. While exposures from cat litter, sandboxes and raw meat were well-recognized, other risk factors for transmission via domestic cats, gardening, travel without food and water precautions, and soil exposure were less recognized. This is important given the importance of outdoor exposure of domestic cats [10], soil exposure [11] and travel [12] as risk factors for infection. Awareness of the *Toxoplasma* avidity test remains uncommon. Availability of comparison over time was limited by the substantial changes in the 2012 survey compared to prior years, but practitioner knowledge about toxoplasmosis does not appear to have increased substantially.

Changing cat litter daily can virtually eliminate its potential for *T. gondii* transmission, as oocysts require 1-5 days to become infectious [13,14]. *T. gondii* from infected feces can survive in soil for over a year [15] and contaminate hands, fruits or vegetables, or water. Pregnant women can minimize exposure risks by eating only washed produce and when gardening, wearing gloves and washing hands afterward, removing dirt under the nails.

Roughly half of providers sometimes seroscreened asymptomatic pregnant women, most commonly based on risk factors; the most-preferred approach among our respondents was seroscreening only for patients with risk factors or recent signs or symptoms. For diagnoses of acute maternal *T. gondii* infection or fetal toxoplasmosis, respondents favored specialist consultation.

No approach to toxoplasmosis screening or management is universally endorsed. One expert group in the United States, Montoya et al. [16], recommends screening all pregnant women for IgG and IgM early in the first trimester; 59.1% of respondents who screened used both tests. Depending on results, this group recommends following up initial positive results by

retesting (for example, when IgG-negative, IgM-positive) or sending samples to the Palo Alto Medical Foundation Toxoplasma Serology Laboratory (IgG and IgM both positive), where *Toxoplasma* avidity testing may be used. Eleven point one percent of our survey respondents would send confirmatory testing to this laboratory.

Montoya et al.'s approach takes into account properties of the screening tests: IgM has a high false-positive rate (reported specificities range between 49.2% [17] and 98.6% [18,19]). A true positive indicates infection within the past 12-18 months (in some cases *T. gondii* IgM can persist for up to two years [20].) A true positive IgG result indicates infection at some point in the past; of questions about test characteristics, this was the only one answered correctly by most respondents.

In contrast, another expert group, Gilbert and others [21] and the Society of Obstetricians and Gynecologists of Canada (SOGC) [22], recommend screening only in cases of high suspicion, such as suggestive maternal symptoms or high-risk exposures (consistent with the answers of 87.4% of respondents). Several countries have considered but not adopted universal screening [.23—27] Reasons include both costs and such possible harms [28] such as unnecessary treatment due to overdiagnosis and pregnancy terminations. Followup has also proven challenging: late initial testing and poor compliance with screening intervals has led to delayed therapy in France [29] and Austria [30].

The Healthcare Blue Book cites $30 for physician-ordered Toxoplasma IgG testing and $35 for Toxoplasma IgM as reimbursement levels typically accepted from insurers [31] - considerably lower than respondents' estimates. Awareness of the *Toxoplasma* avidity test remains low. Often this test can help distinguish whether infection occurred in the past 3-4 months [32-34], a useful feature for first-trimester diagnoses given the long persistence of IgM.

Most providers indicated they would seek expert help after diagnosing acute maternal *T. gondii* infection. This is a clearly reasonable approach. In such cases, they recommend fetal ultrasound as soon as possible and amniotic fluid PCR at 18 weeks gestation to determine fetal infection. If maternal infection was diagnosed before 18 weeks gestation, they recommend treatment begin with spiramycin until PCR and ultrasound results are available. Then, if either is positive, treatment switches to pyramethamine sulfadiazine and folinic acid (though others question its superiority to spiramycin for this or any indication); if negative, [22,35,36], spiramycin should be started or continued. If instead maternal infection is diagnosed after 18 weeks gestation, pyramethamine sulfadiazine and folinic acid are the default treatment until and unless PCR and ultrasound are negative, in which case either pyramethamine sulfadiazine with folinic acid or spiramycin can be continued untill delivery.

The efficacy of spiramycin, which most providers reported not knowing, is uncertain; comparisons with historical controls suggest benefit [37-39] while more recent nonrandomized studies [40] suggest it may decrease sequelae only [41,42]. Spiramycin is available in the United States from the FDA Division of Special Pathogen and Immunologic Drug Products under an Investigational New Drug license, at 301-827-2335.

The higher prevalence of seroscreening asymptomatic pregnant women among providers in the U.S Northeast is consistent with an increased prevalence of toxoplasmosis exposure in this region [43] (29.2%, vs. 22.5% nationally in 1988-1994).

Limitations of our study include the use of self-reported data and the low survey response rates, all potentially causing overestimation of practitioner knowledge. The many comparisons between CARN and non-CARN respondents may have caused discovery of spurious differences. The Clopper-Pearson method may not fully account for any intracluster correlation within the provider groups in which survey recipients were selected, but given the method used for composing these groups, intracluster correlation should be minimal, with any resulting underestimation of variance also countered by using sandwich estimators for variance.

Continuing education for providers on *T. gondii* prevention, diagnosis, and treatment is needed. Updated ACOG guidelines addressing these issues would be of particular benefit. However, additional evidence is needed on the magnitudes of expected benefits, harms and costs of routine screening, and comparative effectiveness of alternative antibiotic regimens against maternal-fetal transmission and sequellae.

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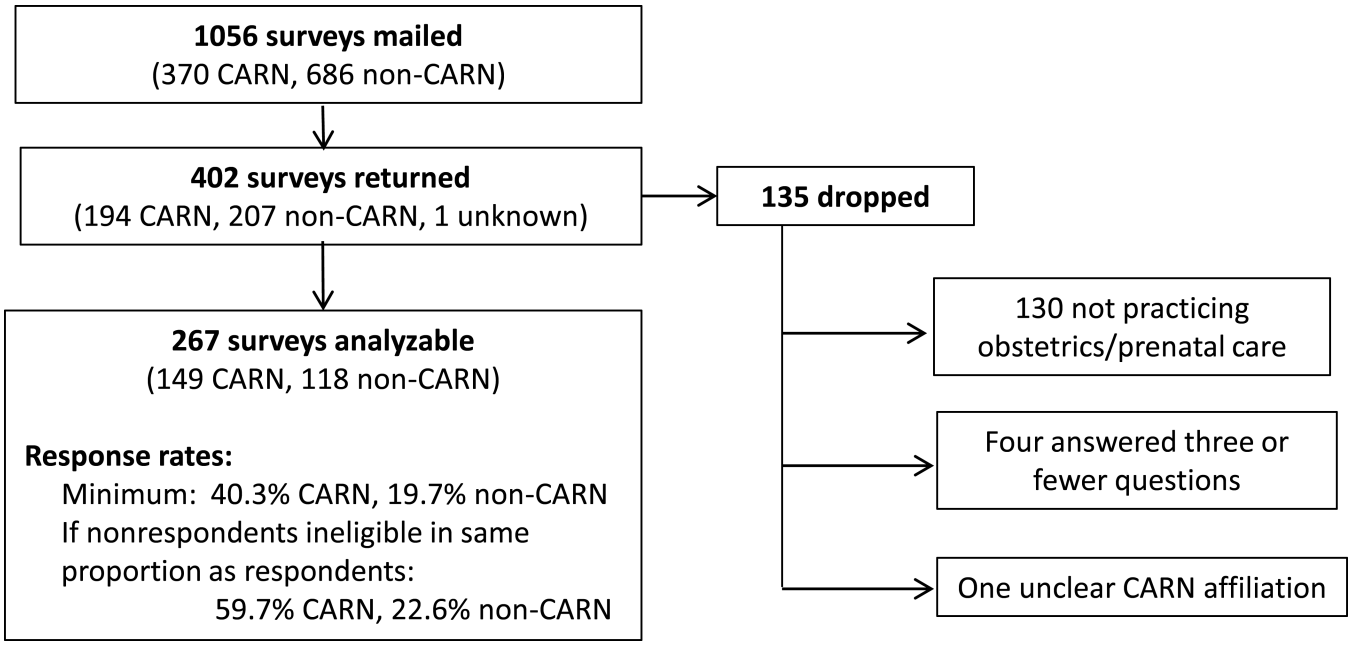

Figure 1.
Respondent Flowchart

TABLE 1

Demographic characteristics of respondents

		Total (N = 267)			
Question	**Answer**	**n**	**N**	**%**	**95% CI**
Gender	Male	122	266	45.9	(39.9, 52.2)
	Female	144	266	54.1	(48.0, 60.0)
Geographic area	Midwest	70	266	26.3	(20.9, 31.8)
	Northeast	45	266	16.9	(12.7, 22.1)
	South	88	266	33.1	(27.6, 39.2)
	West	59	266	22.2	(17.4, 27.8)
	Outside Continental US	4	266	1.5	(0.4, 3.8)
Practice location	Urban: inner city	33	266	12.4	(8.7,16.0)
	Urban: other	81	266	30.5	(25.1, 36.5)
	Suburban	117	266	44.0	(37.7, 50.0)
	Rural	35	266	13.2	(9.4, 17.9)
	Military	0	266	0.0	-
Practice structure	Solo private practice	49	266	18.4	(13.9, 23.5)
	Group practice	168	266	63.2	(56.8, 68.7)
	University	34	266	12.8	(9.0, 17.3)
	Hospital-based	8	266	3.0	(1.3, 5.8)
	Other	8	266	3.0	(1.3, 5.8)
Specialty	General OB/Gyn	233	266	87.6	(83.6, 91.5)
	Gynecology only	15	266	5.6	(2.9, 8.4)
	Obstetrics only	8	266	3.0	(1.3, 5.9)
	Maternal-fetal Medicine	9	266	3.4	(1.2, 5.6)
	Other	2	266	0.8	(0, 1.8)
Primary Race/Ethnicity served	White, non-Hispanic	183	266	68.8	(63.5, 74.6)
	White, Hispanic	25	266	9.4	(5.9, 13.0)
	Asian/Pacific Isl.	11	266	4.1	(1.8, 6.6)
	Native American/Alaska native	1	266	0.4	(0.0, 1.1)
	African-Amer., non-Hispanic	18	266	6.8	(3.8, 9.8)
	African-Amer., Hispanic	6	266	2.3	(0.5, 4.1)
	Multiracial	17	266	6.4	(3.5, 9.4)
	unsure	4	266	1.5	(0.0, 2.3)

TABLE 2

Ob/gyn provider experience with, knowledge of, and approach to *toxoplasma gondii* infection in pregnancy: selected answers

Question	Answer	Total			
		n	N	%	95% CI
CLINICAL					
How often does a pregnant patient receive counseling in your practice about preventing acute *T. gondii* infection? (CHECK ALL THAT APPLY)	At the initial exam	197	267	73.8	(68.1, 79.0)
	At every visit	0	267	0.0	_
	When she asks questions	80	267	30.0	(24.5, 35.9)
	When she mentions she was ill	20	267	7.5	(4.6, 11.3)
	If I consider her at high risk	68	267	25.5	(20.4, 31.1)
	Never	8	267	3.0	(1.3, 5.8)
	Don't know	5	267	1.9	(0.6, 4.3)
	Other	6	267	2.2	(0.4, 4.0)
For each exposure please indicate whether you consider it a risk factor and if so, whether your counseling includes it.					
a) Changing cat litter without gloves[a]	Risk factor (RF)	250	263	95.1	(91.7, 97.3)
	Counseled on	218	224	97.3	(94.3, 99.0)
b) Permitting a pet cat to go outdoors [a]	Risk factor	201	251	80.1	(75.1, 85.0)
	Counseled on	155	180	86.1	(80.2, 90.1)
c) Changing cat litter every few days (vs. daily)[a]	Risk factor	139	257	54.1	(47.8, 60.3)
	Counseled on	86	121	71.1	(62.1, 79.0)
d) Petting a cat	Risk factor	42	259	16.2	(11.9, 21.3)
	Counseled on	27	35	77.1	(60.9, 90.0)
e) Having a litter of kittens at home [a]	Risk factor	55	260	21.2	(16.4, 26.6)
	Counseled on	26	40	65.0	(48.3, 79.4)
f) Contact with sand from an uncovered sandbox [a]	Risk factor	198	251	78.9	(73.3, 83.8)
	Counseled on	95	166	57.2	(49.3, 64.9)
g) Eating raw or undercooked meat[a]	Risk factor	219	263	83.3	(78.2, 87.6)
	Counseled on	152	181	84.0	(77.8, 89.0)
h) Eating raw or undercooked oysters, mussels or clams [a]	Risk factor	64	254	25.2	(20.0, 31.0)
	Counseled on	35	48	72.9	(58.2, 84.7)
i) Handling raw meat without washing afterward [a]	Risk factor	176	260	67.7	(61.6, 73.3)
	Counseled on	91	145	62.8	(54.4, 70.6)
j) Eating unwashed raw fruits or vegetables [a]	Risk factor	87	259	33.6	(27.9, 39.7)
	Counseled on	52	74	70.3	(58.5, 80.3)
k) Gardening without gloves [a]	Risk factor	160	260	61.5	(55.3, 67.5)
	Counseled on	87	160	61.2	(56.2, 73.0)
l) Exposure to wild pigeon feces	Risk factor	72	256	28.1	(22.7, 34.1)
	Counseled on	20	57	35.1	(22.9, 48.9)

Question	Answer	Total			
		n	N	%	95% CI
m) Drinking untreated water from a stream, lake or pond[a]	Risk factor	94	257	36.6	(30.7, 42.8)
	Counseled on	38	77	49.4	(37.8, 61.0)
n) Travelling to some foreign countries without taking food and water precautions [a]	Risk factor	165	261	63.2	(57.1, 69.1)
	Counseled on	79	127	62.2	(53.2, 70.1)
o) Employment that involves soil exposure [a]	Risk factor	149	260	57.3	(51.1, 63.4)
	Counseled on	58	113	51.3	(41.7, 60.8)
p) Living in a home with a cockroach infestation	Risk factor	28	261	10.7	(7.3, 15.1)
	Counseled on	9	23	39.1	(19.7, 61.5)
How is counseling information provided? (CIRCLE ALL THAT APPLY):	Verbally by you	211	267	79.0	(73.7, 83.8)
	Verbally by nurse	113	267	42.3	(36.3, 48.5)
	Verbally by other office staff	19	267	7.1	(4.3, 10.9)
	Pamphlet	44	267	16.5	(12.2, 21.5)
Which of the following laboratories would you use for *T. gondii* initial screening and confirmatory serologic testing if you felt they were indicated in a pregnant woman? (CHECK ALL THAT APPLY)					
a) Never request this type of serologic testing	Initial	21	263	8.0	(4.7, 11.3)
	Confirmatory	16	262	6.1	(3.5, 9.7)
b) A local hospital lab	Initial	115	263	43.7	(37.7, 49.7)
	Confirmatory	62	262	23.7	(18.7, 29.3)
c) A commercial lab (e.g., SKB, LabCorp)	Initial	145	263	55.1	(48.9,61.3)
	Confirmatory	91	262	34.7	(29.0, 40.1)
d) State or local public health laboratory	Initial	24	263	9.1	(5.9, 13.3)
	Confirmatory	37	262	14.1	(10.1, 18.9)
e) Palo Alto Research Institute	Initial	5	263	1.9	(0.6, 4.4)
	Confirmatory	29	262	11.1	(7.5, 15.5)
f) Other	Initial	3	262	1.1	(0.2, 3.3)
	Confirmatory	5	262	1.9	(0.6, 4.4)
g) Don't know	Initial	16	263	6.1	(3.5, 9.7)
	Confirmatory	22	262	8.4	(5.3, 12.4)
By total proportion of **respondents**: How do you decide whether to do serologic screening for acute *T. gondii* infection in asymptomatic pregnant women? (CIRCLE ONE): If other, what?	Do serologic screening in all	10	126	7.9	(3.9, 14.1)
	Do serologic screening if there is no previous positive *T. gondii* IgG test	5	126	4.0	(1.3, 9.0)
	Ask about exposures and/or symptoms; do serologic screening if present	70	126	55.6	(46.4, 64.4)
	Ask about exposures and/or symptoms; do serologic screening if present AND there is no previous positive T. gondii IgG test	35	126	27.8	(20.2, 36.5)
	Other patient request, in torch[b] testing, ultrasound findings; state-	7	126	5.6	(2.3, 11.1)

Question	Answer	Total			
		n	N	%	95% CI
	mandated in OR since 1977; if prior positive IGG flu titer				
Which of the following would you use as a serologic test to confirm a screening result suggestive of acute *T. gondii* infection in a pregnant woman? (CIRCLE ALL THAT APPLY):	T. gondii IgG and IgM (+/− any other answer)	55	264	20.8	(16.1, 26.2)
	T. gondii titer only	21	264	8.0	(5.0, 11.9)
	Other	123	264	46.6	(40.5, 52.8)
	Don't know	65	264	24.6	(19.4, 29.8)
If you were to make a diagnosis of acute maternal *T. gondii* infection in a pregnant woman AT 14 WEEKS gestation, which of the following would you do INITIALLY? (CIRCLE ALL THAT APPLY):*	Make a presumptive diagnosis	31	264	11.7	(8.1, 16.3)
	Begin antimicrobial therapy	38	264	14.4	(10.4, 19.2)
	Perform amniocentesis for *Toxoplasma* PCR as soon as clinically safe to perform	20	264	7.6	(4.7, 11.5)
	Perform amniocentesis for *Toxoplasma* PCR around 18 weeks gestation	8	264	3.0	(1.3, 5.9)
	Consult specialist	243	264	92.0	(88.1, 95.0)
	Other	9	264	3.4	(1.6, 6.4)
	Don't know	9	264	3.4	(1.6, 6.4)
If you were to make a diagnosis of acute maternal *T. gondii* infection in a pregnant woman AT 23 WEEKS gestation, which of the following would you do INITIALLY? (CIRCLE ALL THAT APPLY):	Make a presumptive diagnosis	39	264	14.8	(10.7, 19.6)
	Begin antimicrobial therapy	22	257	8.6	(5.3, 12.3)
	Perform amniocentesis for *Toxoplasma* PCR as soon as possible	25	264	9.5	(6.2, 13.7)
	Consult with a specialist, e.g., in infectious disease or perinatology	247	264	93.6	(89.9, 96.2)
	Other	6	264	2.3	(0.8, 4.9)
	Don't know	7	264	2.7	(1.1, 5.4)
If you were to make a diagnosis of FETAL toxoplasmosis, after explaining the options, which of the following would you be most likely to recommend as INITIAL management? (CIRCLE ONE):	Antimicrobial treatment for toxoplasmosis	29	263	11.0	(7.5, 15.5)
	Immediate fetal ultrasound	27	263	10.3	(6.9, 14.6)
	Termination of pregnancy	2	263	0.8	(0.0, 2.7)
	Consultation with an infectious disease specialist or perinatologist	222	263	84.4	(79.5, 88.6)
	Do not make a recommendation, only explain options	8	263	3.0	(1.6, 6.4)
	Other	4	263	1.5	(0.4, 3.9)
	Don't know	7	263	2.7	(1.1, 5.4)
For each characteristic, circle the type of serologic test to which it applies. (CIRCLE ONE):					
Frequent false positives	*T. gondii* IgG	16	253	6.3	(3.7, 10.2)
	T. gondii IgM [a]	20	253	7.9	(4.7, 11.7)
	Both	32	253	12.6	(9.0, 17.7)
	Neither	28	253	11.1	(6.9, 14.9)
	Not sure	157	253	62.1	(56.3, 68.7)

Question	Answer	Total			
		n	N	%	95% CI
Frequent false negatives	*T. gondii* IgG	4	254	1.6	(0.4, 4.1)
	T. gondii IgM	11	254	4.3	(1.9, 7.2)
	Both	24	254	9.4	(6.3, 14.0)
	Neither[a]	35	254	13.8	(9.6, 18.5)
	Not sure	180	254	70.9	(65.2, 76.7)
A true positive indicates infection within the past 3-6 months	*T. gondii* IgG	15	252	6.0	(3.4, 9.7)
	T. gondii IgM	108	252	42.9	(36.6, 49.2)
	Both	41	252	16.3	(11.7, 21.1)
	Neither[a]	9	252	3.6	(1.7, 6.7)
	Not sure	79	252	31.3	(25.9, 37.8)
A true positive indicates infection within the past 12-18 months	*T. gondii* IgG	73	245	29.8	(23.9, 35.7)
	T. gondii IgM[a]	16	245	6.5	(3.8, 10.4)
	Both	37	245	15.1	(10.9, 20.3)
	Neither	25	245	10.2	(6.7, 14.8)
	Not sure	94	245	38.4	(32.4, 45.0)
A true positive indicates infection at some point in the past	*T. gondii* IgG [a]	161	256	62.9	(56.9, 69.2)
	T. gondii IgM	5	256	2.0	(0.7, 4.6)
	Both	28	256	10.9	(7.6, 15.8)
	Neither	1	256	0.4	(0.0, 2.2)
	Not sure	58	256	22.7	(18.1, 28.9)
How effective do you believe treatment with spiramycin for a pregnant woman with acute *T. gondii* infection is in preventing congenital toxoplasmosis? (CIRCLE ONE):	Highly effective (70-100%)	28	263	10.6	(7.2, 15.0)
	Moderately effective (40-70%)	56	263	21.3	(16.5, 26.8)
	Somewhat effective (10-40%)	21	263	8.0	(5.0, 12.0)
	Weakly effective or not effective	4	263	1.5	(0.4, 3.9)
	Not known or controversial[a]	19	263	7.2	(4.4, 11.1)
	Don't know	135	263	51.3	(45.1, 57.5)
What does the Toxoplasma IgG avidity test help determine? (CIRCLE ONE):*	Whether *T. gondii* infection occurred in the last 3-4 months[a]	33	260	12.7	(8.9, 17.4)
	Whether *T. gondii* infection occurred in the last 6-12 months	18	260	6.9	(4.2, 10.7)
	Whether *T. gondii* infection actually occurred but not when it occurred	47	260	18.1	(13.6, 23.3)
	Other:	2	260	0.8	(0.0, 2.8)
	Don't know	160	260	61.5	(55.3, 67.5)

[a] True risk factor for *T. gondii* transmission

[b] Toxoplasmosis, Other (syphilis, varicella-zoster, parvovirus B19), Rubella, Cytomegalovirus (CMV), and Herpes.

* Differences between CARN and non-CARN respondent answer distributions significant at $p < .05$; see text for description