

Clinical Guidelines

Prevention of infection after induced abortion

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Abstract

One known complication of induced abortion is upper genital tract infection, which is relatively uncommon in the current era of safe, legal abortion. Currently, rates of upper genital tract infection in the setting of legal induced abortion in the United States are generally less than 1%. Randomized controlled trials support the use of prophylactic antibiotics for surgical abortion in the first trimester. For medical abortion, treatment-dose antibiotics may lower the risk of serious infection. However, the number-needed-to-treat is high. Consequently, the balance of risk and benefits warrants further investigation. Perioperative oral doxycycline given up to 12 h before a surgical abortion appears to effectively reduce infectious risk. Antibiotics that are continued after the procedure for extended durations meet the definition for a treatment regimen rather than a prophylactic regimen. Prophylactic efficacy of antibiotics begun after abortion has not been demonstrated in controlled trials. Thus, the current evidence supports pre-procedure but not post-procedure antibiotics for the purpose of prophylaxis. No controlled studies have examined the efficacy of antibiotic prophylaxis for induced surgical abortion beyond 15 weeks of gestation. The risk of infection is not altered when an intrauterine device is inserted immediately post-procedure. The presence of *Chlamydia trachomatis*, *Neisseria gonorrhoeae* or acute cervicitis carries a significant risk of upper genital tract infection; this risk is significantly reduced with antibiotic prophylaxis. Women with bacterial vaginosis (BV) also have an elevated risk of post-procedural infection as compared with women without BV; however, additional prophylactic antibiotics for women with known BV has not been shown to reduce their risk further than with use of typical pre-procedure antibiotic prophylaxis. Accordingly, evidence to support pre-procedure screening for BV is lacking. Neither povidone-iodine nor chlorhexidine have been shown to alter the risk of infection when used as cervicovaginal preparation. However, chlorhexidine appears to be more effective than povidone iodine at reducing bacteria within the vagina. The Society of Family Planning recommends the routine use of antibiotic prophylaxis, preferably with doxycycline, before surgical abortion. Use of treatment doses of antibiotics with medical abortion may decrease the rare risk of serious infection but universal requirement for such treatment has not been established.

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Keywords: Antibiotic prophylaxis; Induced abortion; Infection; Preventing infective complications; Doxycycline**Background**

These guidelines examine the risk of infection, identifiable risk factors, and prophylactic measures for infection with the most common methods of induced abortion: suction dilation and curettage (D&C), dilation and evacuation (D&E), and early medical abortion. The microbiology and epidemiology are similar for this group of procedures, as the vagina and cervix are the portals through which all are performed. However, the majority of data come from studies of suction D&C procedures since first trimester surgical abortions are the most common method of induced abortion.

Induced abortion is one of the most common surgical procedures in the United States with over 1.3 million performed in 2003 [1]. In the United States, the annual

abortion rate is 16–21 per 1000 women. Nearly half of all women have faced an unintended pregnancy and approximately one-third of women have had an induced abortion [1–3].

The rate of upper genital tract infection after induced abortion, regardless of method, is generally very low, less than 1% in most clinical settings in the United States [4,5]. Nevertheless, because abortion is so common, small improvements in post-procedural infection rates can have profound impacts on the absolute number of post-procedure infections. Although death associated with legally induced abortion is also rare (overall 0.7 per 100,000 procedures), approximately 30% of abortion-related deaths are attributable to infection [6].

In procedures that access the endometrial cavity through the cervix, some bacterial contamination is inevitable [7].

Clinically important infection, however, is relatively uncommon. The availability of legal abortion services in which safe aseptic surgical technique is utilized has dramatically decreased the number of septic abortions [8]. Routine antibiotic prophylaxis has further reduced infectious risk.

The features of antibiotics appropriate for use as prophylaxis are: (1) low toxicity; (2) established safety record; (3) not routinely used for treatment of serious infections; (4) spectrum of activity includes micro-organisms most likely to cause infection; (5) reaches useful concentration in relevant tissues during procedure; (6) administered for short duration; (7) administered such that it is present in surgical sites at the start of the procedure.

The selective use of antibiotics for prophylaxis is one of the key advances in infection control. Clinicians should understand when antibiotic prophylaxis is indicated and when it is not. Indeed, inappropriate use of antibiotics contributes to the development of antibiotic resistant bacteria and can therefore also lead to morbidity [9–11]. Therefore, the goal of these guidelines is to review the infectious risks associated with abortion procedures and strategies for minimizing those risks, including the judicious use of antibiotics.

Clinical questions and recommendations

1. What is the risk of infection following induced abortion?

First-trimester abortion

The reported infection rate following first trimester surgical abortion ranges widely due to various clinical practices and degrees of ascertainment and diagnostic biases, often resulting in overdiagnosis of infection (Table 1). When objective measures are used, such as temperature $\geq 38^{\circ}\text{C}$, the infection rate ranges from 0.01% to 2.44% [5,16,17]. However, when the diagnosis is based only on physician concern, the rate increases and widens considerably. Post-abortal infection rates are uniformly higher in Scandinavia than North America for a combination of reasons that likely stem from issues of definition, clinical triggers for antibiotic treatment, and larger numbers of providers, each of whom perform fewer procedures than US providers [16,17]. In randomized trials of antibiotic prophylaxis, the infection rates in placebo groups reveal this variability (Table 2).

Second-trimester abortion

The overall risk of infection is low after D&E [32,33]. In the United States, prior to the routine use of prophylactic antibiotics, the rate of postabortal fever following D&E was 0.8% (95% CI 0.6–1.0%) in one large case series [34] and 1.6% in a teaching hospital (95% CI 1.0–2.4%) [35].

Infection rates for labor induction are more difficult to document because there is a higher incidence of medication-induced pyrexia, a common side-effect with

prostaglandin use. When examining the available literature for infection rates rather than simple pyrexia, a post-induction infection rate of 1–3% is reported [36–41]. This infection rate, though still relatively low, is higher than infection rates for D&E. Prophylactic antibiotics are not typically given for labor induction abortions in the United States and no studies could be identified on this topic. In general, infection prevention and treatment during labor induction abortion is most analogous to infection prevention and treatment in labor.

Most D&E procedures are performed after cervical preparation with prostaglandin analogues (misoprostol or gemeprost) or osmotic dilators, most commonly laminaria (a natural osmotic dilator made from the stalks of *Laminaria* species, a common type of seaweed) or Dilapan (a synthetic osmotic dilator). None of the three types of osmotic dilators has been shown to increase the risk of infection when left in place for up to 24 h before a D&E [42–46]. In randomized comparisons of laminaria before first-trimester abortion, the use of laminaria decreased the risk of infection compared to rigid dilation [43,47]. The risk of infection associated with osmotic dilators is not well studied with use for more than 24 h or with use of more than one set of osmotic dilators prior to D&E. No studies have been performed that address whether antibiotic administration at the time of dilator insertion would confer additional benefit. With use of misoprostol for cervical preparation prior to D&E, the risk of infection appears to be low [48–50]. Two studies report no or few complications with misoprostol for cervical preparation but do not specifically report the number of observed infections [51,52].

Early medical abortion

The risk of infection is low after medical abortion in the first trimester. Most commonly, early first-trimester medical abortions are performed using a combination of mifepristone and misoprostol. Because medical abortion is a noninvasive procedure, there is an expectation that infection after medical abortion should be less frequent than after surgical abortion. The best estimate of infectious morbidity after medical abortion, based on prospective studies that report infection as an outcome, appears to be approximately 0.3% (Table 3) [53–58]. No serious infections are reported in these studies. There are many other prospective studies of medical abortion that only report patient symptoms (fever) rather than clearly reporting infections and several imply that no infections occurred. If studies with zero infections are excluded, 0.3% may slightly overestimate the infection risk. In a systematic review of 65 studies of heterogeneous design (prospective, retrospective, and randomized), the overall frequency of diagnosed or treated infection after medical abortion in over 46,000 patients was 0.9% [59]. In these studies, as in most of the suction D&C studies discussed earlier, the diagnostic criteria for infection were variable leading to an overestimate of infectious morbidity. A large retrospective analysis of medical abortions from the Planned Parenthood Federation

Table 1
Summary of infection rates after abortion by suction D&C in cohort studies

Study	Number of abortions	Years	Diagnostic criteria for infection	Number of infections	Infection rate (%)	Gestational age (weeks)	Facility type, location	Antibiotic prophylaxis	Ascertainment method
Hakim-Elahi [5] (1990)	170000	1971–1987	Physician concern, tenderness, fever not required	784	0.46%	≤14	3 free-standing clinics,	None	Retrospective
Hodgson [12] (1975)	20248	1972–1973	≥2 days of fever ≥40°C	6	0.00%	≤12	New York City free-standing clinic,	“As indicated”	Prospective
			Bleeding, fever, and/or pain, with or without re-aspiration	135	0.67%		Washington, DC, USA		
Wulf and Freiman [13] (1977)	16410	1973–1976	Bleeding, fever, and/or pain, without re-aspiration	45	0.22%	≤14	Free-standing clinic, St. Louis, MO, USA	All patients	Retrospective
			Infection, JPSA criteria	16	0.10%				
Wadhwa [14] (1982)	351789	1975–1980	“Infection”	633	0.18%	≤15	all facilities, Canada (national data)	Uncertain	Retrospective
Joint study of RCGP and RCOG [15] (1985)	6105	1976–1979	Infection	218	3.60%	≤15	Hospital, Great Britain (national data)	Uncertain	Prospective
			PID	100	1.60%				
Heisterberg and Kringelbach [16] (1987)	5851	1980–1985	Re-admission, fever ≥38°C	143	2.40%	≤12	Hospital, Copenhagen, Denmark	None	Retrospective
			Re-admission, antibiotic therapy	190	3.20%				
Fried et al. [17] (1989)	1000	1987	Infection	47	4.70%	≤15	Hospital, Stockholm, Sweden	Doxycycline if <i>Chlamydia</i> (+)	Prospective
			Fever ≥38°C	16	1.60%				

Table 2
Randomized controlled trials of antibiotic prophylaxis separated by infection risk in placebo group above or below 8%

Infection risk <8% in placebo group	Author	Year	Antibiotic	Dosing Method			Total N	Antibiotic group			Placebo group			Relative Risk
				Pre-procedure	Post-procedure	Total Days		Infxn	No Infxn	Rate	Infxn	No Infxn	Rate	
	Levallois [18]	1988	Doxycycline	100 mg	200 mg	1	1074	3	532	0.60%	26	513	4.80%	0.12
	Darj [19]	1987	Doxycycline	400 mg	–	1	769	8	378	2.10%	24	359	6.30%	0.33
	Brewer [20]	1980	Doxycycline	500 mg	–	1	2950	1	1518	0.10%	8	1423	0.60%	0.12
	Henriques ^a [21]	1994	Ceftriaxone	1 gram i.v.	–	1	549	2	273	0.70%	10	264	3.60%	0.2
	Summary					1	5342	14	2701	0.50%	68	2559	2.60%	0.2
Infection risk >8% in placebo group	Author	Year	Antibiotic	Dosing Method			Total N	Antibiotic group			Placebo group			Relative Risk
				Pre-procedure	Post-procedure	Total Days		Infxn	No Infxn	Rate	Infxn	No Infxn	Rate	
	Krohn [22]	1981	Tinidazole	2 g	–	1	210	6	98	5.80%	11	95	10.40%	0.56
	Sonne-Holm [23]	1981	Penicillin G and pivampicillin	PcnG 2 mil IU	Pcn G 2 mil IU; then Piva. 350 mg tid×4 days	5	493	14	240	5.50%	26	213	10.90%	0.51
	Westrom [24]	1981	Tinidazole	2 g	–	1	212	10	92	9.80%	17	93	15.50%	0.63
	Heisterberg [25]	1985	Lymecycline	300 mg	300 mg bid×7 days	8	532	25	244	9.30%	25	238	9.50%	0.98
	Heisterberg [26]	1985	Metronidazole	400 mg	400 mg at 4 and 8 h	1	100	2	49	3.90%	10	39	20.40%	0.19
	Heisterberg [27]	1987	Metronidazole	400 mg	400 mg at 4 and 8 h	1	118	7	57	10.90%	7	47	13.00%	0.84
	Heisterberg [28]	1988	Lymecycline	300 mg	300 mg bid×14 days	15	55	2	22	8.30%	7	24	22.60%	0.37
	Sorensen [29]	1992	Erythromycin	500 mg	500 mg bid×7 days	8	378	20	169	10.60%	30	159	15.90%	0.67
	Larsson [30]	1992	Metronidazole	500 mg tid×7 days	500 mg tid×3 days	10	174	3	81	3.60%	11	79	12.20%	0.29
	Neilson [31]	1993	Ofloxacin	400 mg	–	1	1073	55	470	10.50%	73	475	13.30%	0.79
	Summary					0	3345	144	1522	8.60%	217	1462	12.90%	0.67

^a Blinded but not placebo-controlled.

of America, reported 19 infections requiring hospital treatment among 95,163 procedures (0.02%, 95% CI 0.01–0.03%) [60].

Serious infections do rarely occur in patients after medical abortion. A recent retrospective analysis of serious infection after medical abortions from the Planned Parenthood Federation of America as defined by fever and pelvic pain treated with intravenous antibiotics or sepsis or death caused by infection showed a baseline risk of 9.3/10,000 medical abortions (0.09%) [61].

Clostridial species have been implicated in several cases of serious infection associated with medical abortion. As of 2010, eight cases of fatal postabortal clostridial toxic shock syndrome have occurred in the United States (seven have cultured and tested gene-positive for *Clostridium sordellii*; one for *C. perfringens* [62,63]. The specific connection between these organisms and medical abortion remains unclear. These organisms are similarly also associated with other obstetrical and gynecologic procedures, including spontaneous abortion, term delivery, surgical abortion, and cervical cone or laser for cervical dysplasia [62,64]. Although rare, clostridial species are a more common cause of pelvic infection than previously recognized [64]. Sustained fever, severe abdominal pain or pelvic tenderness, or general malaise with or without fever occurs more than 24 h after administration of misoprostol should increase suspicion of a serious infection. Cases of clostridial toxic shock are difficult to diagnose early in their course because they often resemble flu-like illness, characterized by general malaise with minimal pelvic-related symptoms and variable low-grade or absent fever. Clostridial toxic shock infections are often associated with refractory hypotension, hemoconcentration, and a significant leukocytosis.

2. What are risk factors for postabortal infection?

Although numerous risk factors are discussed below, many postabortal infections occur in women without any identifiable risk factors apart from the abortion procedure.

Most data come from studies of patients undergoing first-trimester suction D&C abortions.

Cervicitis

Cervical infections with sexually transmitted pathogens, like *Chlamydia* and gonorrhea, are common. In a national sample of females in the United States aged 14–39, the prevalence of *Chlamydia trachomatis* infection was 2.5% and *Neisseria gonorrhoeae* was 0.3% [65]. Of women with gonorrhea, 46% also tested positive for chlamydial infection. For both chlamydial and gonorrheal infection, the prevalence is higher among younger and poorer women and among women with sexual risk factors (more partners, earlier coitarche, and a history of gonorrheal or chlamydial infection within the past 12 months) [65]. A recent cross-sectional study in the US of women seeking first-trimester abortion in the US found 11% to have a positive *Chlamydia* test and 3% a positive gonorrhea test [66]. Untreated cervical gonorrhea [67] and *Chlamydia* [68,69] significantly increase the risk of postabortal endometritis. In a 1984 cohort study of 1032 women in Sweden who underwent first trimester surgical abortion without prophylactic antibiotics, the presence of *Chlamydia* prior to first trimester abortion increased the risk of laparoscopically confirmed salpingitis by 30-fold [relative risk (RR) 30, 95% CI 11–85, $p < .0001$] and of endometritis (without salpingitis) by fourfold (RR 4.1, 95% CI 2.5–6.7, $p < .0001$) [70]. In a randomized trial of prophylactic antibiotics with excellent follow-up, Levallois and Rioux [18] found that the presence of *Chlamydia* increased the risk of pelvic inflammatory disease (PID) by ninefold. Although an increase in RR occurred regardless of whether prophylactic antibiotics were given, the absolute risk with antibiotic prophylaxis was significantly lower.

There is one published study that examines a “screen and treat” strategy for *Chlamydia* as compared to universal provision of antibiotics at the time of abortion services. This study showed that provision of universal antibiotics reduced the postabortal diagnosis of infection and was more cost-effective than a screen and treat strategy [71,72]. Notably,

Table 3

Infection risk after medical abortion using mifepristone and prostaglandin analogs from prospective studies [35–40]

Study	Infections ^a	Study Population	Prostaglandin, route ^b	Infection Risk	95% Confidence Interval	
					Lower	Upper
Silvestre [53] 1990	2	2115	gemeprost, p.v., or sulprostone, i.m.	0.09%	0.01%	0.34%
Ulmann [54] 1992	43	16173	gemeprost, p.v. or i.m.	0.27%	0.19%	0.36%
Spitz [55] 1998	10	2121	misoprostol, p.o.	0.47%	0.23%	0.87%
Schaff [56] 1999	2	933	misoprostol, p.v.	0.21%	0.03%	0.77%
Creinin [57] 2004	3	1080	misoprostol, p.v.	0.28%	0.06%	0.81%
Creinin [58] 2007	10	1128	misoprostol, p.v.	0.89%	0.43%	1.62%
TOTAL	68	21435		0.32%	0.23%	0.38%

None of the studies used antibiotic prophylaxis.

^a Defined as any evidence of infection beyond an isolated fever, a known side-effect of prostaglandin analogs.

^b Route are per vagina (p.v.), per os (p.o.), or intramuscular (i.m.).

the antibiotic regimen given to the subjects in the antibiotic arm was a treatment-dose regimen that included a 7-day course of doxycycline. There are no studies that compare subjects that receive antibiotic prophylaxis prior to abortion with and without the addition of screening for *Chlamydia* and gonorrhea.

Current recommendations by the US Preventative Services Task Force (USPSTF) include universal *Chlamydia* screening annually for all sexually active women <25 years of age and for all women with at increased risk (including having a new sexual partner) regardless of age [73]. The USPSTF also recommends gonorrhea screening for all sexually active women at increased risk. Many patients who present for abortion services with unintended pregnancy also fall within the recommended categories for gonorrhea and *Chlamydia* screening as outlined by the USPSTF. If appropriate, screening may be done immediately prior to induced abortion as long as there is a mechanism for contacting and treating all patients with positive results.

Bacterial vaginosis

Bacterial vaginosis (BV) is a complex alteration of vaginal flora resulting in a predominance of potentially pathogenic anaerobic bacteria in the vagina. Limited epidemiologic data exist on BV as a risk factor for postabortal upper genital tract infection [74]. The magnitude of the association is not well defined. To date, there have been four randomized controlled trials evaluating the use of antibiotics aimed at treating BV (metronidazole or clindamycin) to reduce postabortal infectious morbidity [30,75–77]. Three of these studies showed no statistical significance in placebo compared to treatment groups. One study found, for women with BV diagnosed at preoperative visits, treatment with metronidazole 500 mg orally three times daily for 10 days starting 7 days before the abortion procedure significantly reduced the risk of developing PID post-procedure [30]. Although the Royal College of Obstetricians and Gynaecologists recommends that all women receive metronidazole 1 g rectally at the time of abortion plus either doxycycline 100 mg BID for 7 days commencing on the day of abortion or azithromycin 1 g on the day of abortion [78], there are no trials that examine prophylactic metronidazole in women who are unscreened for BV. In fact, adding metronidazole treatment to post-procedure doxycycline treatment in women with BV does not reduce the risk of infection beyond that seen with doxycycline alone [77]. It remains unknown whether a screen-and-treat strategy for BV would provide any additional benefit in women routinely given prophylactic antibiotics. No studies of vaginal use of misoprostol in women with BV were identified.

The Society of Family Planning recommends following the USPSTF screening recommendations for *Chlamydia* and gonorrhea. The USPSTF recommends universal *Chlamydia* screening annually for all sexually active

women <25 years of age and *Chlamydia* and gonorrhea screening for all women with at increased risk (including having a new sexual partner) regardless of age [73]. This screening may be performed immediately prior to abortion as long as there is a mechanism for contacting and treating all patients with positive results. The Society also does not recommend treatment of asymptomatic bacterial vaginosis at the time of abortion.

3. *What are the sequelae of postabortal infection?*

In a follow up survey of women who either did or did not have postabortal infection, Heisterberg et al. [79] found that women who developed PID after abortion were significantly more likely to have secondary infertility, dyspareunia, pelvic pain, and future spontaneous abortions (Table 4). These sequelae are similar and occur at the same rates as in women who develop PID unrelated to a surgical procedure. However, the data are limited and encompass only one Scandinavian study. Long-term follow-up in the United States of postabortal infection is lacking, and obtaining these data would be difficult.

4. *Does antibiotic prophylaxis lower the risk of infection following surgical abortion?*

Thirteen placebo-controlled randomized trials examine the efficacy of antibiotic prophylaxis to prevent infection after surgical abortion, along with one blinded but not placebo-controlled trial (Table 2). All were limited to first-trimester procedures. Although many different antibiotics and regimens were studied, in all 14 studies, antibiotics were either given before the procedure or begun before the procedure and continued afterwards. In all of the studies, the risk of infection was lower in the group receiving antibiotics, though the difference was not statistically significant in eight studies.

A caveat limiting the generalizability of some of the placebo-controlled trials is the unusually high risk of infection, with over 10% of women being diagnosed with infection in the group receiving antibiotics. The majority of studies with high infection rates originate in Scandinavia. In studies with lower infection rates, a more substantial lowering of risk is identified. This suggests the importance of diagnosing postabortal infection specifically rather than for solitary postabortal low-grade fevers without other signs of infection, as a true test of the efficacy of antibiotic prophylaxis in reducing postabortal infection (Table 2).

Despite multiple studies showing a benefit, the issue of antibiotic prophylaxis for surgical abortion was controversial until a meta-analysis was published by Sawaya et al. [80] in 1996. The meta-analysis showed that a variety of antibiotics and regimens are effective for women of all risk strata with an overall RR of developing upper genital tract infection for women receiving antibiotics vs. placebo of 0.58 (95% CI 0.47–0.71). Furthermore, based on the studies included in the meta-analysis, the protective effect

Table 4
Sequelae by postabortal PID status, adapted from Heisterberg 1986 [79]

Sequelae	Post-abortal PID				No Post-abortal PID				p ^a	RR ^b	95% CI	
	Total	(+)	(-)	Rate	Total	(+)	(-)	Rate			Lower	Upper
Recurrent PID	27	11	16	40.70%	299	15	284	5.00%	<0.001	8.1	4.2	15.9
Infertility	31	3	28	9.70%	323	6	317	1.90%	0.04	5.2	1.4	19.8
Chronic pelvic pain	29	4	25	13.80%	323	7	316	2.20%	0.01	6.4	2	20.5
Dyspareunia	30	6	24	20.00%	308	15	293	4.90%	0.01	4.1	1.7	9.8
Ectopic pregnancy	38	0	38	0.00%	323	5	318	1.50%	1	–	–	–
Spontaneous abortion	32	7	25	21.90%	293	15	278	5.10%	0	4.3	1.9	9.7

^a For difference between PID and No PID groups, by Fisher's Exact test.

^b Of having sequelae if postabortal PID.

of antibiotics was easily demonstrable regardless of what subgroup was analyzed: women with a history of PID (RR 0.56, 95% CI 0.37–0.84), women with *Chlamydia* at the time of the procedure (RR 0.38, 95% CI 0.15–0.92), low risk women (RR 0.65, 95% CI 0.47–0.90), and women without *Chlamydia* at the time of the procedure (RR 0.63, 95% CI 0.42–0.97). Therefore, the authors concluded that no further placebo-controlled trials should ethically be performed given that there are a variety of regimens known to be effective for prophylaxis.

The benefits of antibiotic prophylaxis are less clear in a population at very low risk. As the infection risk decreases, the number of women who need to receive antibiotics to prevent one infection increases dramatically (Table 5), while the risks of side effects and adverse reactions from the antibiotics persist. The point at which the infection risk is so low that antibiotic prophylaxis is no longer warranted is unclear.

Although risk-based strategies for the use of prophylactic antibiotics (as opposed to universal prophylaxis) have been proposed, there is little evidence to support this strategy. Indeed, several studies examining the cost-effectiveness of universal prophylaxis as compared with universal screening with treatment only for positive results, uniformly show that universal prophylactic treatment is more cost-effective, even when azithromycin, which is far more expensive than doxycycline, is used for prophylaxis [81,82]. One study in a relatively low-risk setting suggested a risk-based strategy would use 71% less antibiotic while preventing 62% of the cases of PID compared to universal prophylaxis [18]. However, given the marginal improvement in efficiency at the cost of increasing the number of cases of a preventable disease with long-term sequelae, this strategy would only be acceptable in settings where there is an insufficient supply of antibiotics to provide universal prophylaxis [83].

Since suction curettage for early pregnancy failure, including incomplete and missed abortion, is the same procedure as that for induced abortion, the infection risk attributable to uterine aspiration should be the same and the benefits similar. The benefits may actually be greater since pre-existing infection may be the cause of, or result from early pregnancy failure. However, few studies have been

conducted in this population, and a meta-analysis found insufficient data to make conclusions about the use of antibiotic prophylaxis with suction curettage for treatment of incomplete or missed abortion [84]. No evidence to date supports the routine use of prophylactic antibiotics for either expectant or medical management of early pregnancy failure.

In the absence of any studies establishing the inflection point where infection risk is lower than the risk of using prophylactic antibiotics, the Society of Family Planning recommends that all women undergoing surgical abortion procedures receive antibiotic prophylaxis. The use of prophylactic antibiotics prior to surgical management of early pregnancy failure is reasonable but not proven to be beneficial.

5. Does antibiotic prophylaxis lower the risk of infection following medical abortion?

Randomized trials of antibiotic prophylaxis for medical abortion have not been conducted. A retrospective cohort study from the Planned Parenthood Federation of America found a significant association between the risk of serious infection and two interventions: (1) switching from vaginal to buccal administration of misoprostol and (2) giving doxycycline for one week starting on the day of mifepristone administration [61]. In this study, serious infection was defined by the receipt of parenteral antibiotics in an emergency department or inpatient unit. Infections treated solely with oral agents were omitted. These authors showed

Table 5
The NNT to prevent one infection, assuming that the RR of infection with antibiotic prophylaxis is 0.20

Infection risk without antibiotics	Relative risk	Infection risk with antibiotic prophylaxis	NNT ^a
5.00%	0.2	1.00%	25
2.50%	0.2	0.50%	50
1.00%	0.2	0.20%	125
0.50%	0.2	0.10%	250
0.20%	0.2	0.04%	625
0.10%	0.2	0.02%	1250
0.05%	0.2	0.01%	2500

^a NNT=1/[risk(without abx)–risk(with abx)].

that the baseline risk of serious infection with medical abortion of 0.093% was reduced to 0.025% when the misoprostol route was changed from vaginal to buccal, and was further reduced to 0.006% when routine provision of antibiotic prophylaxis was initiated. Hence, the provision of oral doxycycline 100 mg twice daily for 1 week at the time of medical abortion gave a RR reduction of 76% and an attributable risk reduction (ARR) of 0.019%. With this low ARR, the number needed to treat (NNT) with a week of doxycycline is more than 5000 women to prevent one serious infection requiring intravenous antibiotics. The study did not evaluate compliance. Moreover, because the study used historical controls, the addition of a treatment course of antibiotics cannot be separated from the effect of the switch in the route of misoprostol administration. Adverse effects of giving this large number of women a treatment course of oral antibiotics for the purpose of prevention in the absence of a diagnosed infection also need to be considered. Although individual practitioners may decide to use antibiotics with provision of medical abortion, the Society of Family Planning does not believe universal antibiotics is required for all women having a medical abortion.

6. Which antibiotic is best for prevention of postabortal infection?

Both nitroimidazoles (metronidazole and tinidazole) and tetracyclines are effective [80]. Although multiple regimens for several different antibiotics have been compared to placebo, few studies have compared different antibiotics directly or different regimens of the same antibiotic. Hence, the optimal prophylactic regimen remains unclear.

Doxycycline is commonly recommended for prophylaxis [85] and is used by over 80% of US abortion providers who use prophylactic antibiotics [86,87]. Doxycycline has been shown to substantially reduce the risk of post-abortion infection in several randomized placebo-controlled trials when used as a short course at the time of abortion (Table 2). Doxycycline also has the advantages of being inexpensive and equally effective orally and parenterally [88]. Doxycycline rarely causes allergic reactions and has few adverse reactions when given as a short course. The most common adverse reactions to doxycycline are nausea and emesis. When taken on an empty stomach in the second trimester in one study, approximately 65% of woman reported moderate or severe nausea following 200 mg of doxycycline pre-operatively [89]. However, when given following a meal in this study, the occurrence of nausea was similar in both doxycycline and placebo groups [89]. In longer courses, doxycycline is an effective treatment against *Chlamydia*, the microorganism most frequently associated with post-abortion infection [18,90].

A nitroimidazole, such as metronidazole, is an alternate choice. With both doxycycline and metronidazole, there is a very low incidence of allergic reactions and the major adverse effect is nausea. Five trials have

demonstrated that nitroimidazoles are effective in lowering the risk of infection with a summary RR of 0.49 (95% CI 0.31–0.80) [80]. All five studies were conducted in Scandinavia and infection was diagnosed in more than 10% of women in each, raising concerns about the generalizability of the results.

Three studies give strong support to the use of doxycycline only on the day of the abortion [18–20]. The first of these studies, published in 1980 by Brewer [20] evaluated doxycycline 500 mg or placebo at the time of abortion in 2950 women at a high-volume British clinic. The study was randomized by using drug or placebo for calendar blocks in a blinded fashion. Patients were asked to report any subsequent infections and they showed an 88% reduction in risk of PID after abortion during the active drug calendar blocks (RR 0.12, 95% CI 0.02–0.94). Although the follow-up methodology is suboptimal, the operation and protocol as an outpatient site resembles the outpatient clinics where most abortions are performed.

Darj et al. [19] conducted a randomized placebo-controlled trial comparing a single pre-operative dose of 400 mg of doxycycline to placebo the night before the abortion procedure. Using standardized diagnostic criteria, PID was diagnosed in 2.1% of women who received doxycycline and 6.2% of women who received placebo (RR 0.33, 95% CI 0.15–0.73, $p < .005$) [19]. This study represents the only clinical trial of postabortal infection prophylaxis that gave antibiotics so far in advance (10–12 h). In many institutions where patients must be nil per os (*nil per os*) after midnight, this regimen may be a good alternative to having women take doxycycline on the morning of the procedure on an empty stomach. Despite allowing women to take the doxycycline with food on the night prior, nausea and vomiting among women who took doxycycline was fivefold higher than placebo-controls (26% vs. 5%, RR 5.1, 95% CI 3.2–8.0, $p < .001$) [19]. The overall high frequency of nausea may be due to the large dose (400 mg) of doxycycline.

Levallois and Rioux [18] showed in a randomized double-blinded placebo-controlled trial of 1074 subjects that an abbreviated regimen of doxycycline was highly effective in reducing the risk of post-abortion infection in a low-risk population. The study included all women presenting to a hospital-based family planning clinic in Quebec but excluded women with positive gonorrhea cultures. The investigators stratified women into those with and without *Chlamydia*. The prophylactic antibiotic regimen consisted of doxycycline 100 mg one hour before and 200 mg 1 1/2 h after the abortion. This regimen reduced the incidence of infection significantly in both women with *Chlamydia* (RR 0.12, 95% CI 0.02–0.85) and those without *Chlamydia* (RR 0.12 0.04–0.38) [18]. The absolute risk however was much higher among the women with *Chlamydia*. Twelve of the 29 PID cases were in the 75 women with *Chlamydia*. The follow-up rate was exceptionally high; only three subjects did not return for a follow-up

examination. Despite the fact that subjects were examined shortly after the abortion, infection was diagnosed in only 29 of the 1074 women (2.7%, 95% CI 1.8–3.9%), a rate consistent with that commonly observed in clinical practice. By removing women with gonorrhea and stratifying women with *Chlamydia*, this study was able to demonstrate that an abbreviated course of doxycycline is very effective in a low-risk population.

Only one study was identified that examined a parenteral antibiotic for infection prophylaxis with surgical abortion. This double-blind study examined the use of ceftriaxone administered by the anesthesiologist after induction of anesthesia [21]. The control group did not receive a placebo. This study divided women into high and low risk based on a history of any STI or PID. The high-risk women were all given 1 gram of ceftriaxone while the low-risk women were randomized to 1 gram of ceftriaxone or no antibiotics. Among the low-risk women, ceftriaxone reduced the risk of postabortal PID by 76% (RR 0.24, 95%CI 0.06–0.93). Although this regimen may be useful in some settings where parenteral antibiotics are needed, and doxycycline is not available, it is not an appropriate prophylactic antibiotic for general use, especially because ceftriaxone is not an effective treatment for *Chlamydia*. The Society of Family planning recommends a short course of doxycycline prophylaxis for general use in most abortion settings. Preoperative administration of doxycycline appears to be the best option for the prevention of postabortal infection, and if possible, doxycycline should not be given on an empty stomach.

7. When should antibiotics be given to prevent infection with surgical abortion?

In general, the use of systemic antibiotic prophylaxis is based on the premise that the presence of antibiotics in host tissues at the time of initial exposure to bacteria can augment natural host defenses by reducing the titers of endogenous and clinically introduced bacteria before they multiply and become pathogenic. Studies of prophylaxis for surgical site infections that involve skin incisions suggest that only a narrow window exists for prophylaxis; giving the prophylaxis too early does not benefit the patient and only increases risks of adverse effects, whereas delaying the prophylaxis even 3 h after the surgical exposure can result in ineffective prophylaxis [91,92]. Well-conducted animal studies also show that antibiotics given more than 3 h after direct bacterial inoculation of surgical incisions have virtually no effect on reducing the incidence of infection [92]. In comparison, when animals were given prophylactic antibiotics either 1-hour prior or at the time of incision, the animals had the same rate of infection as control animals that were either not inoculated with bacteria or were inoculated with killed bacteria. Furthermore, when antibiotics were administered between 1 and 3 h after surgical

incision and bacterial inoculation, they had intermediate levels of infection.

Several randomized controlled trials that evaluate timing of antibiotic prophylaxis at the time of Cesarean section have demonstrated a significant reduction in post-surgical infections, including endometritis, when the prophylactic antibiotics are administered prior to skin incision as compared to after cord clamping [93–95]. A meta-analysis that further evaluated the timing of prophylactic antibiotics at the time of cesarean section specifically found that preoperative administration as compared to administration following cord clamping reduced post-partum endometritis by more than 50% (RR 0.47; 95% CI, 0.26–0.85) [96].

Only one published study was identified that compared the timing of initiation of antibiotic prophylaxis at induced abortion [97]. This Italian study randomized 466 women undergoing first-trimester surgical abortion to one of three regimens of prulifloxacin, a fluoroquinolone: (1) a 3-day course starting preoperatively; (2) a 3-day course starting postoperatively and (3) a 5-day course starting postoperatively. Women were equally distributed based on age, parity, prior delivery type, and history of spontaneous abortion. Infection was diagnosed in 2.5%, 7.1% and 10.5% of women in each group, respectively ($p < .05$).

All 14 placebo-controlled trials in Table 2 initiated antibiotic therapy prior to the abortion procedure. This practice models prophylaxis for major abdominal and gynecologic surgery, which is based on good evidence that prophylactic antibiotics are most effective when given immediately preoperatively [91].

No studies have directly compared treatment length when antibiotics are started pre-operatively. A placebo-controlled study of doxycycline found that 100 mg preoperative followed by 200 mg immediately postoperatively lowered the risk of infection by 87% [18]. This study, with excellent follow-up, suggests that antibiotics do not need to be extended beyond the immediate postoperative period.

Data from major surgery provide useful insight into the timing and duration of antibiotic prophylaxis. In general, major abdominal and vaginal surgeries have higher risk of post-procedure infection than induced abortion procedures. For instance, the rate of endometritis following cesarean section is 1–5% as compared to <1% following surgically induced abortion [96]. For major abdominal and gynecologic surgery, multiple studies have demonstrated that post-procedural continuation of antibiotics has no effect on the risk of infection [98–100]. For colorectal surgery, a single preoperative dose of antibiotics is recommended based on 182 randomized trials [98]. No benefit of postoperative antibiotics could be demonstrated in 24 randomized trials comparing single pre-operative to multiple pre- and postoperative doses. Similarly, a Cochrane review of antibiotic prophylaxis at cesarean delivery found that multiple-dose regimens increase significantly the risk of urinary tract infection but do not reduce the incidence of postoperative fever, endometritis, or wound infection

compared to a single perioperative dose [99]. Since surgically induced abortions and cesarean sections are similarly classified as clean contaminated procedures, it is likely that presurgical prophylaxis alone is sufficient for surgically induced abortion as it is for cesarean section.

Currently, many institutions providing abortions begin routine antibiotics only post-procedurally for the purpose of prophylaxis. Because single-dose post-abortion prophylaxis has never been examined in placebo-controlled clinical trials, these institutions have largely been giving a full treatment course of doxycycline rather than a single prophylactic dose. Two studies suggest that a maximum of 3 days of doxycycline is needed with similar outcomes for 3- and 7-day antibiotic courses [101,102].

The Society of Family Planning recommends that antibiotic prophylaxis for surgical abortion be initiated before the procedure to maximize efficacy. The evidence supporting pre-operative administration of antibiotic prophylaxis is consistent. Based on the principles of prophylaxis for abortion should not include regimens that treat patients after the procedure. Antibiotic prophylaxis should most ideally be limited to the day of the procedure and definitely not be provided for more than 3 days.

8. What are the disadvantages of antibiotic prophylaxis for abortion?

Any considerations of disadvantages of antibiotic prophylaxis for abortion stem from the fact that the risk of infection after induced abortion is relatively low. For every 1000 induced abortions, it would be uncommon to have more than 20 infections (2%). Therefore, at least 980 women would not benefit from antibiotic prophylaxis yet would incur all of the risks of side effects and adverse reactions. Even with effective strategies, like prophylactic antibiotics, the NNT becomes very large as the risk that the adverse event (postabortal infection) becomes small (Table 5). In most settings in the United States, with a low postabortal infection rate, the number of women who must be treated to prevent one infection is over 100.

The risks of giving antibiotic prophylaxis include side effects, adverse reactions, and increased bacterial resistance to antibiotics. These risks all increase with increased duration of antibiotic exposure [103–105]. There is also a risk of disturbance to the vaginal flora, resulting in yeast vaginitis or bacterial vaginosis with prolonged antibiotic exposure [106], though this risk is largely theoretical. The most common side effect of antibiotics in pregnant women taking doxycycline is nausea. Emesis is also common. In a study of doxycycline taken pre-operatively for D&E, ingesting doxycycline with food significantly decreased symptoms [89]. The risk of emesis decreased from 50% in n.p.o. preoperative patients to 15% in patients allowed to accompany the medication with food. When taken with food, nausea after taking doxycycline did not differ from placebo [89].

Although there have been no studies that evaluate the risks of antibiotic prophylaxis directly, there is ample evidence to support the benefits of antibiotic prophylaxis to decrease the risk of infection after surgically induced abortion (Table 2). Infection can have significant sequelae including secondary infertility, dyspareunia, pelvic pain, future spontaneous abortions and death [79]. Antibiotic prophylaxis has also been shown to be cost-effective [71]. The risks associated with antibiotic use are minimized when the dose and duration of antibiotic use are also minimized, such as use of a single pre-operative dose. No reports of induced doxycycline resistance have emerged. Accordingly, the Society of Family Planning recommends global provision of antibiotic prophylaxis for surgical abortion because the benefits clearly outweigh any disadvantages.

9. What means other than antibiotics have been studied to prevent postabortal infection?

Local application of antiseptic solution to the cervix and vagina is common practice in an attempt to reduce the risk of infection with surgical abortion. It is usually assumed that vaginal preparation with anti-bacterial solutions is beneficial, but data to support this conclusion are lacking. Although povidone-iodine decreases vaginal bacterial counts substantially within 10 min, this effect does not persist [107]. Within 30 min after application of povidone-iodine solution, the vaginal bacterial counts are not significantly different from those prior to its application [107].

Perhaps more important for all transcervical procedures is evidence that povidone-iodine fails to eliminate bacteria from the endocervix, a location from which bacteria can easily be passed upward into the uterus. Osborne and Wright [108] examined the ability of povidone-iodine surgical preparation to eliminate bacteria from the vagina compared to the endocervix. Fifty pre-menopausal women received a 3-min wash with povidone-iodine soap followed by a 2-min wash with povidone-iodine solution. Although the average number of recoverable bacterial species in the vagina went from 5.6 to 0.1 per patient, the number of species in the endocervix decreased only from 3.9 to 1.7 per patient. The reduction in vaginal bacterial species was not correlated with the change in the number of endocervical bacterial species. Notably, of two patients with *Neisseria gonorrhoeae* before the preparation, both still had this pathogen within the endocervix after the povidone-iodine vaginal wash.

A recent randomized study compared povidone-iodine to chlorhexidine for vaginal preparation prior to vaginal hysterectomy [109]. At 30 min, 17 of 27 vaginal cultures (62%) showed growth in the povidone-iodine group compared to five of 23 (22%) in the chlorhexidine group ($p<.005$). All subjects received prophylactic antibiotics and no infections were seen clinically. Although this study was not powered to examine clinical outcomes, it does suggest that chlorhexidine is a more effective vaginal preparation than iodine at reducing the bacterial load in the vagina.

A double-blind randomized controlled trial of chlorhexidine (0.5% chlorhexidine digluconate) for vaginal preparation prior to first-trimester induced abortion was performed in Sweden [110]. Subjects were randomized to routine chlorhexidine vaginal preparation ($n=372$) or a vaginal preparation with a single pad moistened with saline ($n=350$). Subjects with positive gonorrhea cultures or signs of active infection were excluded. *Chlamydia* testing was not performed. The authors did not specify if perioperative antibiotics were used. Additionally, 40% of subjects had immediate postabortal intrauterine device (IUD) placement. In the full chlorhexidine preparation group, 21 (5.6%) had evidence of post-procedural upper genital infections compared with 16 (4.6%) in the brief saline preparation group, which was not significantly different.

The Society of Family Planning finds no evidence that vaginal preparation with chlorhexidine or povidone-iodine is superior to saline alone. However, there appears to be no harm from using these solutions, either. The failure by vaginal preparations to sterilize the endocervix [108] may explain how transcervical surgical procedures such as dilation and curettage seed the upper genital tract. The theoretical advantage of systemic pre-operative antibiotic prophylaxis over vaginal preparation may lie in their ability to more effectively eliminate bacteria from the endocervix.

10. Does the risk of infection change with immediate insertion of an intrauterine device?

Immediate insertion of an IUD after surgical abortion is a safe way to provide effective contraception [111–113]. Despite concerns about leaving a foreign body within the uterine cavity after abortion, there is no evidence that post-abortion IUD insertion increases the risk of infection [111–113]. In a study of prophylactic doxycycline before abortion by Darj et al. [19], one third of subjects elected to receive an IUD after their abortion; doxycycline reduced the risk of infection with concurrent IUD placement by approximately 50%. Furthermore, there was no significant increase in the risk of post-procedure infection in the patients who elected IUD placement. Nulliparous adolescents seeking abortion are among those with the highest risk for infection after abortion. In a 1979 report from Israel, Goldman et al. [114], randomized 162 nulliparous adolescents to one of three plastic or copper IUDs and found only three cases of “mild pelvic inflammation” (1.8%).

More recent studies, of both copper and levonorgestrel-releasing IUDs, suggest that immediate postabortal IUD insertion does not increase the risk of infection [115–117]. Preliminary data from two randomized studies comparing immediate to delayed postabortal insertion also found no increase in the risk of infection [118,119].

The Society of Family Planning concludes that insertion of an IUD immediately following a surgical abortion does not appear to significantly alter the risk of infection.

Conclusions and recommendations

Based on the highest level of evidence found in the data, recommendations are provided and graded according to the following categories:

Level A: recommendations are based on good and consistent scientific evidence.

- Antibiotic prophylaxis lowers the risk of infection following surgical abortion and therefore should be provided to all patients undergoing surgically induced abortion.
- Prophylactic antibiotics should be given pre-operatively for maximal effect and the lowest risk of adverse reactions.
- The shortest possible course of antibiotics should be used to minimize the risks of adverse reactions and bacterial development of antibiotic resistance. In most cases, a single dose given preoperatively would be optimal.
- Preoperative doxycycline is a safe and effective prophylactic antibiotic for surgically induced abortion, whether used as a single dose or short perioperative course.
- When doxycycline is taken with dinner the night preceding the abortion procedure, nausea, a common side effect, may be reduced.
- The presence of *N. gonorrhoeae* and *C. trachomatis* at the time of induced abortion increases the risk of infection. Universal prophylaxis with a variety of regimens, including those not recommended by the United States Centers for Disease Control for the treatment of gonorrhea or *Chlamydia* have proven effective in significantly reducing postabortal infection among asymptomatic women who screen positive for gonorrhea, *Chlamydia*, or both. In addition to provision of universal antibiotic prophylaxis, when possible, appropriate screening for gonorrhea and *Chlamydia* should be performed so that those testing positive may be treated.
- Immediate insertion of intrauterine contraception does not increase the risk of infection following induced surgical abortion.

Level B: recommendations are based on limited or inconsistent scientific evidence.

- Nitroimidazoles, such as metronidazole and tinidazole, are appropriate alternative choices of antibiotic prophylaxis for induced abortion. The lack of studies in low-risk populations limits generalizability.
- A 1-week course of doxycycline begun at the time of medical abortion may lower the risk of serious infection at the time of early medical abortion.
- Chlorhexidine may be more effective than povidone iodine at reducing bacteria within the vagina, although neither alters the risk of post-procedure infection.

- The addition of metronidazole is unlikely to further reduce the risk of infection in women with bacterial vaginosis already receiving prophylactic antibiotics.

Level C: recommendations are based primarily on consensus and expert opinion.

- Initiation of antibiotics after induced abortion is unlikely to be beneficial. This practice has not been shown to lower infection risk in placebo-controlled studies.
- The same infection-reducing antibiotic prophylaxis regimens used in first-trimester induced abortion are probably effective in second-trimester induced abortion, but these regimens have not yet been subject to comparison studies specifically for second-trimester procedures.

Important questions to be answered

1. What is the best regimen for antibiotic prophylaxis? No trials could be identified which directly compared regimens of different antibiotics (e.g., doxycycline versus metronidazole). Thus far, only two published trials could be identified that compare regimens of the same antibiotic.
2. Is antibiotic prophylaxis warranted for early medical abortion? No randomized controlled trials of antibiotic prophylaxis at medical abortion have been performed. Although the risk of serious infection is low, recent data indicate that there may be significant reduction in the risk of serious infection by providing treatment doses of Doxycycline starting at the time the medical abortion treatment is initiated.
3. Is there a role for antibiotic prophylaxis in the setting of second-trimester induction of labor abortion?
4. Would initiation of antibiotic prophylaxis at the time of dilator placement prior to D&E be beneficial in reducing infectious morbidity?
5. At what prevalence of *Chlamydia* infection does global treatment become more cost-effective than prophylaxis?
6. Is there a benefit in providing antibiotic prophylaxis before suction aspiration in the setting of incomplete or missed abortion? This question warrants further study as the only published trial was underpowered.
7. Does use of vaginal misoprostol to induce abortion in women with BV confer additional infectious risk? Currently there are no data available that address this question.

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Sources

Sources were identified using MEDLINE by crossing the terms “infection,” “antibiotics,” and “prophylaxis” with “elective abortion,” “legal abortion,” and “therapeutic abortion.” Additional articles were identified by reviewing the bibliographies of the identified articles and by examining articles citing the identified articles.

Authorship

These guidelines were prepared by Sharon L. Achilles, MD, PhD and Matthew F. Reeves, MD, MPH and reviewed and approved by the Board of Directors of the Society of Family Planning.

Conflict Of Interest

Sharon L. Achilles, MD, PhD, and Matthew F. Reeves, MD, MPH, have no significant financial relationships or

conflicts of interest to disclose. The Society of Family Planning receives no direct support from pharmaceutical companies or other industries.

Intended Audience

This guideline has been developed by the Society of Family Planning for its members and other clinicians who perform abortions. This guideline may also be of interest to other professional groups that set practice standards for family planning services. The purpose of this document is to review the medical literature evaluating infection risk after abortion and strategies designed to minimize infection risk. Clinicians may choose to use this evidence-based review as a guide in selection of infection prophylaxis measures including antibiotic type, dose, timing of administration, and duration of use. This guideline is not intended to dictate clinical care.