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Antibiotic Prophylaxis for Gynecologic Procedures

Surgical site infection remains the most common surgical complication. Up to 5% of patients undergoing operative procedures will develop a surgical site infection leading to a longer hospital stay and increased cost (1). One of the advances in infection control practices has been the selective use of antibiotic prophylaxis. However, indiscriminate antibiotic use has been associated with the selection of antibiotic-resistant bacteria, which have acknowledged consequences for institutions as well as for individual patients. It is important for clinicians to understand when antibiotic prophylaxis is indicated and when it is inappropriate. The purpose of this document is to review the evidence for surgical site infection prevention and appropriate antibiotic prophylaxis for gynecologic procedures.

Background

Pathophysiology and Microbiology of Gynecologic Infections

As the number and virulence of contaminating bacteria increase in a surgical site, so does the risk for postoperative infection. Surgery and the use of foreign material, such as sutures, further increase the risk of infection. At the same time, systemic and local host immune mechanisms function to contain inoculated bacteria and prevent infection. Antibiotics in the tissues provide a pharmacologic means of defense that augments the natural host immunity. Bacterial resistance mechanisms may contribute to the pathogenesis of surgical site infection by enabling organisms to evade the prophylactically administered antibiotics (2).

For most surgical site infections, the source of pathogens is the endogenous flora of the patient's skin or vagina. When skin is incised, the exposed tissues

are at risk of contamination with endogenous flora. These organisms usually are aerobic gram-positive cocci (eg, staphylococci), but may include fecal flora (eg, anaerobic bacteria and gram-negative aerobes) when incisions are made near the perineum or groin (3). When the vagina is opened during surgery, the surgical site is exposed to a polymicrobial flora of aerobes and anaerobes (4). These operations are classified as clean–contaminated according to the Surgical Wound Classification system (see box). Bacterial vaginosis, a complex alteration of vaginal flora resulting in an increased concentration of potentially pathogenic anaerobic bacteria, is associated with an increased risk of posthysterectomy cuff cellulitis (5). These microorganisms also can be spread to the abdominal incision at the time of surgery. In addition, the skin microorganisms *Staphylococcus epidermidis* and *Staphylococcus aureus* may lead to an abdominal incision infection. Gynecologic surgical procedures, such as laparotomies or laparoscopies, do not breach surfaces colonized with bacteria from the vagina, and infections after these procedures more commonly result from contaminating skin bacteria only.

Procedures breaching the endocervix, such as hysterosalpingogram, sonohysterography, intrauterine device (IUD) insertion, endometrial biopsy, chromotubation, and dilation and curettage, may seed the endometrium and the fallopian tubes with microorganisms found in the upper vagina and endocervix. However, postprocedural

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Surgical Wound Classification System

Class I/Clean: An uninfected operative wound in which no inflammation is encountered and the alimentary, genital, and uninfected urinary tract is not entered. In addition, clean wounds are primarily closed and, if necessary, drained with closed drainage.

Class II/Clean-contaminated: An operative wound in which the alimentary, genital, or urinary tracts are entered under controlled conditions and without unusual contamination. Specifically, operations involving the appendix and vagina are included in this category, provided there is no evidence of infection or major break in technique is encountered.

Class III/Contaminated: Operations with major breaks in sterile technique or gross spillage from the gastrointestinal tract, and incisions in which acute, nonpurulent inflammation is encountered.

Class IV/Dirty-infected: Operative sites involving existing clinical infection or perforated viscera. This definition suggests that the organisms causing the postoperative infection were present in the operative field before the operation.

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infection is rare and tends to occur only in those patients with either a history of pelvic inflammatory disease (PID) or with findings at the time of surgery suggestive of prior PID (eg, hydrosalpinges). When choosing an antibiotic for prevention and treatment for postprocedural infections, for either endometritis or pelvic inflammatory disease, the polymicrobial nature of these infections should be taken into consideration.

Theory of Antimicrobial Prophylaxis

State-of-the-art aseptic technique has been associated with a dramatic decrease in surgical site infections, but bacterial contamination of the surgical site is inevitable. The in vivo interaction between the inoculated bacteria and a prophylactically administered antibiotic is one of the most important determinants of the state of the surgical site. Systemic antibiotic prophylaxis is based on the belief that antibiotics in the host tissues can augment natural immune-defense mechanisms and help to kill bacteria that are inoculated into the wound. Only a narrow window of antimicrobial efficacy is available, requiring the administration of antibiotics either shortly before or at the time of bacterial inoculation (eg, when the incision is made, the vagina is entered, or the pedicles are clamped). A delay of only 3–4 hours can result in ineffective prophylaxis (6, 7).

The induction of anesthesia represents a convenient time (within an hour before the incision) for initiating antibiotic prophylaxis in major gynecologic procedures. Data indicate that for lengthy procedures, additional intraoperative doses of an antibiotic, given at intervals of one or two times the half-life of the drug, maintain adequate levels throughout the operation (8). For cefazolin, this suggests the need for a second dose as the duration of surgery approaches 3 hours. A second dose of the prophylactic antibiotic also may be appropriate in surgical cases with an increased blood loss (greater than 1,500 mL) (9). Neither treatment for several days before a procedure, nor subsequent doses are indicated for prophylaxis, with the previously mentioned exceptions. The use of antibiotic prophylaxis implies that the patient is presumed to be free of infection at the time of the procedure and, therefore, additional doses are not indicated except in the previously described instances. During a procedure when a patient is found to be at greater risk for infection, use of therapeutic antibiotics should be considered.

Pharmacology and Spectrum of Activity

The cephalosporins have emerged as the drugs of choice for most operative procedures because of their broad antimicrobial spectrum and the low incidence of allergic

reactions and side effects. Cefazolin (1 g) is the most commonly used agent because of its reasonably long half-life (1.8 hours) and low cost. Most clinical studies indicate that it is equivalent to other cephalosporins that have improved in vitro activity against anaerobic bacteria in clean-contaminated procedures such as a hysterectomy. Table 1 lists antibiotic regimens by procedure.

The dose of the prophylactic antibiotic in morbidly obese patients should be increased. Morbidly obese patients can be defined in this context as having a body mass index greater than 35 or weight greater than 100 kg (220 pounds). One study showed lower blood levels and tissue levels of cefazolin in morbidly obese patients when compared with control patients (body mass index 22 plus or minus 4). The standard single cefazolin dose of 1 g should be doubled to 2 g (10).

Adverse Reactions to Antibiotics

Adverse effects include allergic reactions ranging in severity from minor skin rashes to anaphylaxis. Anaphylaxis, the most immediate and most life-threatening risk of prophylaxis, is rare. Anaphylactic reactions to penicillin reportedly occur in 0.2% of courses of treatment, with a fatality rate of 0.0001% (11).

Pseudomembranous colitis is an uncommon complication of antibiotic prophylaxis even though cephalosporins cause an increase in gastrointestinal colonization with *Clostridium difficile* (12). However, overall antibi-

Table 1. Antimicrobial Prophylactic Regimens by Procedure*

Procedure	Antibiotic	Dose (single dose)
Hysterectomy Urogynecology procedures, including those involving mesh	Cefazolin[†]	1 g or 2g[‡] IV
	Clindamycin[§] plus gentamicin or quinolone[ǁ] or aztreonam	600 mg IV 1.5 mg/kg IV 400 mg IV 1 g IV
	Metronidazole[§] plus gentamicin or quinolone[ǁ]	500 mg IV 1.5 mg/kg IV 400 mg IV
Laparoscopy Diagnostic Operative Tubal sterilization	None	
Laparotomy	None	
Hysteroscopy Diagnostic Operative Endometrial ablation Essure	None	
Hysterosalpingogram or Chromotubation	Doxycycline[¶]	100 mg orally, twice daily for 5 days
IUD insertion	None	
Endometrial biopsy	None	
Induced abortion/dilation and evacuation	Doxycycline Metronidazole	100 mg orally 1 hour before procedure and 200 mg orally after procedure 500 mg orally twice daily for 5 days
Urodynamics	None	

Abbreviations: IV, intravenously; IUD, intrauterine device

*A convenient time to administer antibiotic prophylaxis is just before induction of anesthesia.

[†]Acceptable alternatives include cefotetan, cefoxitin, cefuroxime, or ampicillin-sulbactam.

[‡]A 2-g dose is recommended in women with a body mass index greater than 35 or weight greater than 100 kg or 220 lb.

[§]Antimicrobial agents of choice in women with a history of immediate hypersensitivity to penicillin

[ǁ]Ciprofloxacin or levofloxacin or moxifloxacin

[¶]If patient has a history of pelvic inflammatory disease or procedure demonstrates dilated fallopian tubes. No prophylaxis is indicated for a study without dilated tubes.

otic-associated diarrhea rates in hospitals range from 3.2% to 29% (13, 14). Nearly 15% of hospitalized patients receiving β-lactam antibiotics develop diarrhea (14), and rates for those receiving clindamycin range from 10% to 25% (15). Predisposing host factors and circumstances affecting the frequency and severity of disease include advanced age, underlying illness, recent surgery, and recent administration of bowel motility-altering drugs (16). The induction of bacterial resistance may be a consequence of prolonged prophylactic antibiotic use. Thus, use of repeated prophylactic doses is not recommended.

Clinical Considerations and Recommendations

▶ *What constitutes appropriate antibiotic prophylaxis for the following situations?*

When choosing a prophylactic antimicrobial agent, the practitioner should consider the following factors. The agent selected must 1) be of low toxicity, 2) have an established safety record, 3) not be routinely used for the treatment of serious infections, 4) have a spectrum of activity that includes the microorganisms most likely to cause infection, 5) reach a useful concentration in relevant tissues during the procedure, 6) be administered for a short duration, and 7) be administered in a manner that will ensure it is present in surgical sites at the time of the incision (17).

Hysterectomy

Patients undergoing vaginal hysterectomy or abdominal hysterectomy should receive single-dose antimicrobial prophylaxis (18). A recent report noted that as many as one half of women undergoing hysterectomy receive either inappropriately timed prophylaxis or no antibiotic prophylaxis (19). Hospital policies can significantly increase the appropriate use of prophylactic preoperative antibiotics (20).

More than 30 prospective randomized clinical trials and two meta-analyses support the use of prophylactic antibiotics to substantially reduce postoperative infectious morbidity and decrease length of hospitalization in women undergoing hysterectomy (21–23). Most studies show no particular antibiotic regimen to be superior to all others. Although no trials have been conducted in patients undergoing laparoscopically assisted hysterectomy, laparoscopic supracervical hysterectomy, or laparoscopic total hysterectomy, antibiotic prophylaxis seems reasonable for these procedures. Patients included in the reports concerning the safety and effectiveness of these laparoscopic approaches all received antibiotic prophylaxis.

Bacterial vaginosis is a known risk factor for surgical site infection after hysterectomy. Preoperative treatment and postoperative treatment of bacterial vaginosis with metronidazole for at least 4 days beginning just before surgery significantly reduces vaginal cuff infection among women with abnormal flora (24).

Laparoscopy and Laparotomy

No data are available to recommend antibiotic prophylaxis in clean surgery not involving vaginal operations or intestinal operations. A single placebo-controlled, randomized clinical trial failed to show benefit of cephalosporin prophylaxis in women undergoing laparoscopy (25). Antibiotic prophylaxis is not recommended in patients undergoing diagnostic laparoscopy or exploratory laparotomy.

Hysterosalpingography, Chromotubation, Sonohysterography, and Hysteroscopy

Hysterosalpingography (HSG) is a commonly performed procedure to evaluate infertile couples for tubal factor infertility. Post-HSG PID is an uncommon (1.4–3.4%) but potentially serious complication in this patient population (26, 27). Patients with dilated fallopian tubes at the time of HSG have a higher rate (11%) of post-HSG PID (26). The possibility of lower genital tract infection with chlamydia should be considered before performing this procedure (27). In a retrospective review, investigators observed no cases of post-HSG PID in patients with nondilated fallopian tubes (0/398) (26).

In patients with no history of pelvic infection, HSG can be performed without prophylactic antibiotics. If HSG demonstrates dilated fallopian tubes, doxycycline, 100 mg twice daily for 5 days, should be given to reduce the incidence of post-HSG PID (26). In patients with a history of pelvic infection, doxycycline can be administered before the procedure and continued if dilated fallopian tubes are found. Because chromotubation at the time of diagnostic laparoscopy is similar to HSG, the recommendation for administering doxycycline if abnormal fallopian tubes are visualized is the same. However, there currently are no data to support this recommendation. In patients thought to have an active pelvic infection, neither HSG nor chromotubation should be performed.

No data are available on which to base a recommendation for prophylaxis in patients undergoing sonohysterography, but reported rates of postprocedure infection are negligible (0/300 in one series) (28). Prophylaxis should be based on the individual patient's risk of PID; routine use of antibiotic prophylaxis is not recommended.

Infectious complications after hysteroscopic surgery are uncommon and estimated to occur in 0.18–1.5% of cases (29). A prospective study of 2,116 surgical hysteroscopies (782 myoma resections, 422 polyp resec-

tions, 623 endometrial resections, 90 septectomies, and 199 lysis of synechiae) were performed without antibiotic prophylaxis (30). Only 18 (0.85%) cases of endometritis were noted postoperatively. A single prospective study has evaluated the usefulness of amoxicillin and clavulanate antibiotic prophylaxis in preventing bacteremia associated with hysteroscopic endometrial laser ablation or endometrial resection (31). Although the incidence of bacteremia was lower in the antibiotic group than in the placebo group (2% versus 16%), most of the microorganisms isolated were of dubious clinical significance (anaerobic staphylococci) and may have resulted from contamination. Postoperative fever was noted twice as often in the patients receiving antimicrobial prophylaxis. Postoperative infection requiring antibiotic therapy was not significantly different between the two groups: 11.4% and 9% of patients required antibiotics in the placebo group and antibiotic group, respectively.

Other retrospective case series evaluating endometrial ablation reported similar low rates of infection. In a series of 568 patients treated without antimicrobial prophylaxis, one woman (0.18%) developed endometritis (32). In a second series of 600 women, two (0.3%) developed mild pelvic infections, of whom one received antimicrobial prophylaxis (1/495) and one did not (1/105) (33). However, in a series of 200 women undergoing operative hysteroscopy without prophylactic antibiotics, investigators reported three cases of severe pelvic infection, although all three of these women had a history of PID (34). Given the low risk of infection and lack of evidence of efficacy, routine antibiotic prophylaxis is not recommended for the general patient population undergoing these procedures. However, as with other transcervical procedures such as HSG, chromotubation, and sonohysterography, prophylaxis may be considered in those patients with a history of PID or tubal damage noted at the time of the procedure.

Intrauterine Device Insertion and Endometrial Biopsy

The IUD is a highly effective contraceptive, but concern about the perceived risk of PID limits its use. Most of the risk of IUD-related infection occurs in the first few weeks to months after insertion, suggesting that contamination of the endometrial cavity at the time of insertion is the infecting mechanism rather than the IUD or string itself. Four randomized clinical trials have now been performed using doxycycline or azithromycin as antibiotic prophylaxis (35–38). Pelvic inflammatory disease occurred uncommonly with or without the use of antibiotic prophylaxis, and so prophylaxis is not indicated at the time of IUD insertion. A Cochrane Collaboration review concluded that either doxycycline or azithromycin

before IUD insertion confers little benefit (39). When the results of the four studies were combined, a reduction in unscheduled visits to the health care provider was seen, but not in the only trial performed in the United States. In the U.S. trial, however, all patients were screened for gonorrhea and chlamydia, and some with positive test results were excluded from the study. The cost-effectiveness of screening for sexually transmitted diseases before IUD insertion remains unclear because of limited data. The only randomized controlled trial performed in the United States concluded that in women screened for sexually transmitted diseases before IUD insertion, prophylactic antibiotics provide no benefit (35).

No data are available on infectious complications of endometrial biopsy. The incidence is presumed to be negligible. It is recommended that this procedure be performed without the use of antimicrobial prophylaxis.

Surgical Abortion

Eleven of 15 randomized clinical trials support the use of antibiotic prophylaxis at the time of suction curettage for elective abortion. In a meta-analysis of 11 placebo-controlled, blinded clinical trials, the overall summary relative risk (RR) estimate for developing postabortal infection of the upper genital tract in women receiving antibiotic therapy compared with those receiving placebo was 0.58 (95% confidence interval [CI], 0.47–0.71) (40). Of high-risk women, those with a history of PID had a summary RR of 0.56 (CI, 0.37–0.84); women with a positive chlamydia culture at abortion had a summary RR of 0.38 (CI, 0.15–0.92). Of low-risk women, those with no reported history of PID had a summary RR of 0.65 (CI, 0.47–0.90); in women with a negative chlamydia culture, the RR was 0.63 (CI, 0.42–0.97). The overall 42% decreased risk of infection in women given periabortal antibiotics confirms that prophylactic antibiotics are effective for these women, regardless of risk. The risk of infection after suction curettage for missed abortion should be similar to that after suction curettage for elective abortion. Therefore, despite the lack of data, antibiotic prophylaxis should also be considered for these patients.

The optimal antibiotic and dosage regimens remain unclear. Both tetracyclines and nitroimidazoles provide significant and comparable protection against postabortal PID. One of the most effective and inexpensive regimens reported in a meta-analysis was doxycycline, 100 mg orally 1 hour before the abortion followed by 200 mg after the procedure. It is estimated that the cost of treating a single case of postabortal PID as an outpatient far exceeds the cost of doxycycline prophylaxis (40). In a prospective, randomized trial, antibiotic prophylaxis showed no benefit before treatment of incomplete abortion (41).

Preoperative Bowel Preparation

Occasionally, the gynecologic surgeon runs the risk of both small-bowel injuries and large-bowel injuries because of the presence of pelvic adhesions resulting from either previous surgery or an inflammatory process, such as PID or endometriosis. In these cases, it is reasonable to consider using a parenteral antibiotic regimen that is effective in preventing infection among patients undergoing elective bowel surgery. There is no evidence that mechanical bowel preparation further reduces infection risk. The addition of oral antibiotics to the mechanical bowel preparation is associated with increased nausea, vomiting, and abdominal pain and has shown no advantages in the prevention of postoperative infectious complications and, therefore, are not recommended (42). Eight randomized clinical trials confirm the effectiveness of prophylactic parenteral antibiotics administered preoperatively with or without a prior oral antibiotic bowel preparation in decreasing the rate of postoperative infection, such as wound and intraabdominal infections (8). It is unclear whether any one regimen is superior, but broad-spectrum cephalosporins such as cefoxitin were commonly used. In a recent study, ertapenem was noted to be superior to cefotetan in the prevention of surgical-site infection in patients undergoing elective colorectal surgery but may be associated with an increase in *C difficile* infection (43).

Endocarditis Prophylaxis

The Guidelines from the American Heart Association for the prevention of infective endocarditis were revised in 2007. After an analysis of the relevant literature, the American Heart Association no longer recommends the administration of antibiotics solely to prevent endocarditis for those patients undergoing genitourinary or gastrointestinal tract procedures. This includes patients undergoing hysterectomy (44).

Urogynecologic Procedures

Several studies suggest that prophylactic antibiotics are not effective in preventing urinary tract infections resulting from urodynamic testing. One study identified 2 of 45 women (4%) not given antibiotics after urodynamic testing whose postprocedure urine cultures were positive, compared with 0 of 51 women given nitrofurantoin, 50 mg three times a day for 3 days after testing (45). A second study identified 10 of 49 women (18.9%) not given antibiotics after urodynamic testing whose urine cultures were positive, compared with 4 of 49 women (8.9%) who received prophylaxis and had positive urine cultures (46). The differences in both studies were not statistically significant. Because neither study reported on "symptomatic infection" or the microbiology of the postprocedure bacteriuria, the site could have been contaminated with a nonuropathogen. However, given the prevalence of asymptomatic bacteriuria in women, approximately 8% of women had unsuspected bacteriuria at the time of urodynamic testing. Because bacteriuria and urinary tract infection can cause detrusor instability, pretest screening by urine culture or urinalysis, or both, is recommended. Those with positive test results should be given antibiotic treatment.

Urinary tract infection after one-time bladder catheterization has been reported to be approximately 2% (47). No randomized trials have compared antibiotic prophylaxis with placebo in trying to further decrease the incidence of urinary tract infection. No data are available for adults, but a randomized clinical trial has shown that the use of antibiotic prophylaxis is not warranted in children undergoing clean, intermittent catheterization. In fact, the incidence of urinary tract infection was increased significantly in those continuing to use antibiotics (48). Therefore, given the low risk of infection, antibiotic prophylaxis is not indicated for bladder catheterization.

Patients undergoing colporrhaphy, either anterior or posterior, with or without hysterectomy, are candidates for antibiotic prophylaxis. This is reasonable in that the vaginal epithelium is incised and can be considered a clean-contaminated procedure by surgical wound classification. No prospective studies have been performed in this setting. Likewise, antibiotic prophylaxis has been routinely used in the studies evaluating the effectiveness of slings, including those using a mesh, placed transvaginally despite the lack of a randomized clinical trial.

Patients undergoing urogynecologic procedures often are discharged with indwelling urinary catheters. Limited evidence indicates that receiving ciprofloxacin, 250 mg, from postoperative day two until catheter removal reduced the rate of bacteriuria and other signs of infection such as pyuria and gram-negative isolates in urine in surgical patients with bladder drainage for at least 24 hours postoperatively. Daily antibiotic prophylaxis should be considered in women discharged with an indwelling urinary catheter after urogynecologic surgery (49). In a randomized trial, prophylactic antibiotics in patients with suprapubic catheters after urogynecologic surgery resulted in a 42% reduction in urinary tract infections up to 6 weeks postoperatively (50).

▶ *Which antibiotics should be used in the patient with penicillin allergy?*

Allergic reactions occur in 0.7–4% of courses of treatment with penicillin (51). Four types of immunopathologic reactions have been described, all of which have been seen with β-lactam antibiotics: 1) immediate hypersensitivity reactions, 2) cytotoxic antibodies, 3) immune

complexes, and 4) cell-mediated hypersensitivity (52). A history of reactions to β-lactam antibiotics is found in 5–20% of patients.

Like penicillins, cephalosporins possess a β-lactam ring; however, the five-membered thiazolidine ring is replaced by a six-membered dihydrothiazine ring. The overall incidence of adverse reactions from cephalosporins ranges from 1% to 10%, with rare anaphylaxis (less than 0.2%). In patients with histories of penicillin allergy, the incidence of cephalosporin reactions is increased minimally. Postmarketing studies of second-generation and third-generation cephalosporins showed no increase in allergic reactions to cephalosporins in patients with histories of penicillin allergy. One reaction occurred in 98 patients (1%) with positive penicillin skin test results, and six occurred in 310 patients (2%) with negative test results (53). The incidence of clinically relevant cross-reactivity between the penicillins and cephalosporins is small, but rare anaphylactic reactions have occurred (54). Patients with a history of an immediate hypersensitivity reaction to penicillin should not receive cephalosporin antibiotics, given that alternative drugs are available for prophylaxis. Cephalosporin prophylaxis is acceptable in those patients with a history of penicillin allergy not believed to be immunoglobulin E mediated (immediate hypersensitivity).

Metronidazole or clindamycin alone have been shown to reduce infection after hysterectomy, but broadening coverage results in a further lowering of infection rates (55). For this reason, combination regimens are recommended for use in women with an immediate hypersensitivity reaction to penicillin (see Table 1).

Summary of Recommendations and Conclusions

The following recommendations and conclusions are based on good and consistent scientific evidence (Level A):

▶ Patients undergoing hysterectomy should receive single-dose antimicrobial prophylaxis preoperatively.

▶ Pelvic inflammatory disease occurs uncommonly with or without the use of antibiotic prophylaxis and so prophylaxis is not indicated at the time of IUD insertion.

▶ Antibiotic prophylaxis is indicated for elective suction curettage abortion.

▶ Antibiotic prophylaxis is not recommended in patients undergoing diagnostic laparoscopy.

The following recommendations and conclusions are based on limited or inconsistent scientific evidence (Level B):

▶ In patients with no history of pelvic infection, HSG can be performed without prophylactic antibiotics. If HSG demonstrates dilated fallopian tubes, antibiotic prophylaxis should be given to reduce the incidence of post-HSG PID.

▶ Routine antibiotic prophylaxis is not recommended for the general patient population undergoing hysteroscopic surgery.

▶ Cephalosporin prophylaxis is acceptable in those patients with a history of penicillin allergy not felt to be immunoglobulin E mediated (immediate hypersensitivity).

▶ Patients found to have preoperative bacterial vaginosis should be treated before hysterectomy.

The following recommendations and conclusions are based primarily on consensus and expert opinion (Level C):

▶ Antibiotic prophylaxis is not recommended in patients undergoing exploratory laparotomy.

▶ For transcervical procedures such as HSG, chromotubation, and hysteroscopy, prophylaxis may be considered in those patients with a history of PID or tubal damage noted at the time of the procedure.

▶ Patients with a history of an immediate hypersensitivity reaction to penicillin should not receive cephalosporin antibiotics.

▶ Pretest screening for bacteriuria or urinary tract infection by urine culture or urinalysis, or both, is recommended in women undergoing urodynamic testing. Those with positive test results should be given antibiotic treatment.

Proposed Performance Measure

The percentage of women undergoing hysterectomy who received preoperative antibiotic prophylaxis

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The MEDLINE database, the Cochrane Library, and ACOG's own internal resources and documents were used to conduct a literature search to locate relevant articles published between January 1985 and May 2008. The search was restricted to articles published in the English language. Priority was given to articles reporting results of original research, although review articles and commentaries also were consulted. Abstracts of research presented at symposia and scientific conferences were not considered adequate for inclusion in this document. Guidelines published by organizations or institutions such as the National Institutes of Health and the American College of Obstetricians and Gynecologists were reviewed, and additional studies were located by reviewing bibliographies of identified articles. When reliable research was not available, expert opinions from obstetrician–gynecologists were used.

Studies were reviewed and evaluated for quality according to the method outlined by the U.S. Preventive Services Task Force:

I   Evidence obtained from at least one properly designed randomized controlled trial.

II-1   Evidence obtained from well-designed controlled trials without randomization.

II-2   Evidence obtained from well-designed cohort or case–control analytic studies, preferably from more than one center or research group.

II-3   Evidence obtained from multiple time series with or without the intervention. Dramatic results in uncontrolled experiments also could be regarded as this type of evidence.

III   Opinions of respected authorities, based on clinical experience, descriptive studies, or reports of expert committees.

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.

Level B—Recommendations are based on limited or inconsistent scientific evidence.

Level C—Recommendations are based primarily on consensus and expert opinion.