

Bacterial Vaginosis

This is a PDF version of the following document:

Module 1: [Question Bank Topics](#)
Lesson 2: [Bacterial Vaginosis](#)

You can always find the most up-to-date version of this document at
<https://www.std.uw.edu/go/2021-guidelines/vaginosis/core-concept/all>.

References

- Abad CL, Safdar N. The role of lactobacillus probiotics in the treatment or prevention of urogenital infections--a systematic review. *J Chemother.* 2009;21:243-52.
[\[PubMed Abstract\]](#) -
- Allsworth JE, Peipert JF. Prevalence of bacterial vaginosis: 2001-2004 National Health and Nutrition Examination Survey data. *Obstet Gynecol.* 2007;109:114-20.
[\[PubMed Abstract\]](#) -
- Amsel R, Totten PA, Spiegel CA, Chen KC, Eschenbach D, Holmes KK. Nonspecific vaginitis. Diagnostic criteria and microbial and epidemiologic associations. *Am J Med.* 1983;74:14-22.
[\[PubMed Abstract\]](#) -
- Antonio MA, Meyn LA, Murray PJ, Busse B, Hillier SL. Vaginal colonization by probiotic *Lactobacillus crispatus* CTV-05 is decreased by sexual activity and endogenous Lactobacilli. *J Infect Dis.* 2009;199:1506-13.
[\[PubMed Abstract\]](#) -
- Balkus JE, Manhart LE, Lee J, et al. Periodic Presumptive Treatment for Vaginal Infections May Reduce the Incidence of Sexually Transmitted Bacterial Infections. *J Infect Dis.* 2016;213:1932-7.
[\[PubMed Abstract\]](#) -
- Bautista CT, Wurapa E, Sateren WB, Morris S, Hollingsworth B, Sanchez JL. Bacterial vaginosis: a synthesis of the literature on etiology, prevalence, risk factors, and relationship with chlamydia and gonorrhea infections. *Mil Med Res.* 2016;3:4.
[\[PubMed Abstract\]](#) -
- Beigi RH, Austin MN, Meyn LA, Krohn MA, Hillier SL. Antimicrobial resistance associated with the treatment of bacterial vaginosis. *Am J Obstet Gynecol.* 2004;191:1124-9.
[\[PubMed Abstract\]](#) -
- Berger BJ, Kolton S, Zenilman JM, Cummings MC, Feldman J, McCormack WM. Bacterial vaginosis in lesbians: a sexually transmitted disease. *Clin Infect Dis.* 1995;21:1402-5.
[\[PubMed Abstract\]](#) -
- Bilardi JE, Walker S, Temple-Smith M, et al. The burden of bacterial vaginosis: women's experience of

the physical, emotional, sexual and social impact of living with recurrent bacterial vaginosis. PLoS One. 2013;8:e74378.

[PubMed Abstract] -

- Bradshaw CS, Brotman RM. Making inroads into improving treatment of bacterial vaginosis - striving for long-term cure. BMC Infect Dis. 2015;15:292.
[PubMed Abstract] -
- Bradshaw CS, Morton AN, Garland SM, Horvath LB, Kuzevska I, Fairley CK. Evaluation of a point-of-care test, BVBlue, and clinical and laboratory criteria for diagnosis of bacterial vaginosis. J Clin Microbiol. 2005;43:1304-8.
[PubMed Abstract] -
- Bradshaw CS, Sobel JD. Current Treatment of bacterial vaginosis-limitations and need for innovation. J Infect Dis. 2016;214 Suppl 1:S14-20.
[PubMed Abstract] -
- Bradshaw CS, Tabrizi SN, Fairley CK, Morton AN, Rudland E, Garland SM. The association of *Atopobium vaginae* and *Gardnerella vaginalis* with bacterial vaginosis and recurrence after oral metronidazole therapy. J Infect Dis. 2006;194:828-36.
[PubMed Abstract] -
- Bradshaw CS, Vodstrcil LA, Hocking JS, et al. Recurrence of bacterial vaginosis is significantly associated with posttreatment sexual activities and hormonal contraceptive use. Clin Infect Dis. 2013;56:777-86.
[PubMed Abstract] -
- Brocklehurst P, Gordon A, Heatley E, Milan SJ. Antibiotics for treating bacterial vaginosis in pregnancy. Cochrane Database Syst Rev. 2013;CD000262.
[PubMed Abstract] -
- Brotman RM, Klebanoff MA, Nansel TR, et al. Bacterial vaginosis assessed by gram stain and diminished colonization resistance to incident gonococcal, chlamydial, and trichomonal genital infection. J Infect Dis. 2010;202:1907-15.
[PubMed Abstract] -
- Bunge KE, Beigi RH, Meyn LA, Hillier SL. The efficacy of retreatment with the same medication for early treatment failure of bacterial vaginosis. Sex Transm Dis. 2009;36:711-3.
[PubMed Abstract] -
- Burtin P, Taddio A, Ariburnu O, Einarson TR, Koren G. Safety of metronidazole in pregnancy: a meta-analysis. Am J Obstet Gynecol. 1995;172:525-9.
[PubMed Abstract] -
- Carey JC, Klebanoff MA, Hauth JC, et al. Metronidazole to prevent preterm delivery in pregnant women with asymptomatic bacterial vaginosis. National Institute of Child Health and Human Development Network of Maternal-Fetal Medicine Units. N Engl J Med. 2000;342:534-40.
[PubMed Abstract] -
- Cartwright CP, Lembke BD, Ramachandran K, et al. Development and validation of a semiquantitative, multitarget PCR assay for diagnosis of bacterial vaginosis. J Clin Microbiol. 2012;50:2321-9.
[PubMed Abstract] -
- Chernes TL, Meyn LA, Krohn MA, Lurie JG, Hillier SL. Association between acquisition of herpes simplex

virus type 2 in women and bacterial vaginosis. Clin Infect Dis. 2003;37:319-25.
[PubMed Abstract] -

- Chernes TL, Wiesenfeld HC, Melan MA, et al. The associations between pelvic inflammatory disease, *Trichomonas vaginalis* infection, and positive herpes simplex virus type 2 serology. Sex Transm Dis. 2006;33:747-52.
[PubMed Abstract] -
- Cohen CR, Lingappa JR, Baeten JM, et al. Bacterial vaginosis associated with increased risk of female-to-male HIV-1 transmission: a prospective cohort analysis among African couples. PLoS Med. 2012;9:e1001251.
[PubMed Abstract] -
- Egan ME, Lipsky MS. Diagnosis of vaginitis. Am Fam Physician. 2000;62:1095-104.
[PubMed Abstract] -
- Erickson SH, Oppenheim GL, Smith GH. Metronidazole in breast milk. Obstet Gynecol. 1981;57:48-50.
[PubMed Abstract] -
- Esber A, Vicetti Miguel RD, Chernes TL, Klebanoff MA, Gallo MF, Turner AN. Risk of Bacterial Vaginosis Among Women With Herpes Simplex Virus Type 2 Infection: A Systematic Review and Meta-analysis. J Infect Dis. 2015;212:8-17.
[PubMed Abstract] -
- Ferris MJ, Masztal A, Aldridge KE, Fortenberry JD, Fidel PL Jr, Martin DH. Association of *Atopobium vaginae*, a recently described metronidazole resistant anaerobe, with bacterial vaginosis. BMC Infect Dis. 2004;4:5.
[PubMed Abstract] -
- Fethers KA, Fairley CK, Hocking JS, Gurrin LC, Bradshaw CS. Sexual risk factors and bacterial vaginosis: a systematic review and meta-analysis. Clin Infect Dis. 2008;47:1426-35.
[PubMed Abstract] -
- Fethers KA, Fairley CK, Morton A, et al. Early sexual experiences and risk factors for bacterial vaginosis. J Infect Dis. 2009;200:1662-70.
[PubMed Abstract] -
- Fredricks DN, Fiedler TL, Thomas KK, Oakley BB, Marrazzo JM. Targeted PCR for detection of vaginal bacteria associated with bacterial vaginosis. J Clin Microbiol. 2007;45:3270-6.
[PubMed Abstract] -
- Hauth JC, Goldenberg RL, Andrews WW, DuBard MB, Copper RL. Reduced incidence of preterm delivery with metronidazole and erythromycin in women with bacterial vaginosis. N Engl J Med. 1995;333:1732-6.
[PubMed Abstract] -
- Hemmerling A, Harrison W, Schroeder A, et al. Phase 2a study assessing colonization efficiency, safety, and acceptability of *Lactobacillus crispatus* CTV-05 in women with bacterial vaginosis. Sex Transm Dis. 2010;37:745-50.
[PubMed Abstract] -
- Hillier SL, Nugent RP, Eschenbach DA, et al. Association between bacterial vaginosis and preterm delivery of a low-birth-weight infant. The Vaginal Infections and Prematurity Study Group. N Engl J Med. 1995;333:1737-42.

[\[PubMed Abstract\]](#) -

- Jamieson DJ, Duerr A, Klein RS, et al. Longitudinal analysis of bacterial vaginosis: findings from the HIV epidemiology research study. *Obstet Gynecol.* 2001;98:656-63.
[\[PubMed Abstract\]](#) -
- Joesoef MR, Hillier SL, Wiknjosastro G, et al. Intravaginal clindamycin treatment for bacterial vaginosis: effects on preterm delivery and low birth weight. *Am J Obstet Gynecol.* 1995;173:1527-31.
[\[PubMed Abstract\]](#) -
- Karani A, De Vuyst H, Luchters S, et al. The Pap smear for detection of bacterial vaginosis. *Int J Gynaecol Obstet.* 2007;98:20-3.
[\[PubMed Abstract\]](#) -
- Klebanoff MA, Nansel TR, Brotman RM, et al. Personal hygienic behaviors and bacterial vaginosis. *Sex Transm Dis.* 2010;37:94-9.
[\[PubMed Abstract\]](#) -
- Koss CA, Baras DC, Lane SD, et al. Investigation of metronidazole use during pregnancy and adverse birth outcomes. *Antimicrob Agents Chemother.* 2012;56:4800-5.
[\[PubMed Abstract\]](#) -
- Koumans EH, Markowitz LE, Hogan V. Indications for therapy and treatment recommendations for bacterial vaginosis in nonpregnant and pregnant women: a synthesis of data. *Clin Infect Dis.* 2002;35:S152-72.
[\[PubMed Abstract\]](#) -
- Koumans EH, Sternberg M, Bruce C, et al. The prevalence of bacterial vaginosis in the United States, 2001-2004; associations with symptoms, sexual behaviors, and reproductive health. *Sex Transm Dis.* 2007;34:864-9.
[\[PubMed Abstract\]](#) -
- Lamont RF, Duncan SL, Mandal D, Bassett P. Intravaginal clindamycin to reduce preterm birth in women with abnormal genital tract flora. *Obstet Gynecol.* 2003;101:516-22.
[\[PubMed Abstract\]](#) -
- Lamont RF, Nhan-Chang CL, Sobel JD, Workowski K, Conde-Agudelo A, Romero R. Treatment of abnormal vaginal flora in early pregnancy with clindamycin for the prevention of spontaneous preterm birth: a systematic review and metaanalysis. *Am J Obstet Gynecol.* 2011;205:177-90.
[\[PubMed Abstract\]](#) -
- Larsson PG, Carlsson B. Does pre- and postoperative metronidazole treatment lower vaginal cuff infection rate after abdominal hysterectomy among women with bacterial vaginosis? *Infect Dis Obstet Gynecol.* 2002;10:133-40.
[\[PubMed Abstract\]](#) -
- Larsson PG, Platz-Christensen JJ, Thejls H, Forsum U, Påhlson C. Incidence of pelvic inflammatory disease after first-trimester legal abortion in women with bacterial vaginosis after treatment with metronidazole: a double-blind, randomized study. *Am J Obstet Gynecol.* 1992;166:100-3.
[\[PubMed Abstract\]](#) -
- Laxmi U, Agrawal S, Raghunandan C, Randhawa VS, Saili A. Association of bacterial vaginosis with adverse fetomaternal outcome in women with spontaneous preterm labor: a prospective cohort study. *J Matern Fetal Neonatal Med.* 2012;25:64-7.

[\[PubMed Abstract\]](#) -

- Liu CM, Hungate BA, Tobian AA, et al. Penile microbiota and female partner bacterial vaginosis in Rakai, Uganda. *MBio*. 2015;6:e00589.
[\[PubMed Abstract\]](#) -
- Livengood CH 3rd, Ferris DG, Wiesenfeld HC, et al. Effectiveness of two tinidazole regimens in treatment of bacterial vaginosis: a randomized controlled trial. *Obstet Gynecol*. 2007;110:302-9.
[\[PubMed Abstract\]](#) -
- Marrazzo JM, Thomas KK, Fiedler TL, Ringwood K, Fredricks DN. Relationship of specific vaginal bacteria and bacterial vaginosis treatment failure in women who have sex with women. *Ann Intern Med*. 2008;149:20-8.
[\[PubMed Abstract\]](#) -
- Martin DH, Marrazzo JM. The vaginal microbiome: current understanding and future directions. *J Infect Dis*. 2016;214 Suppl 1:S36-41.
[\[PubMed Abstract\]](#) -
- Mastromarino P, Macchia S, Meggiorini L, et al. Effectiveness of Lactobacillus-containing vaginal tablets in the treatment of symptomatic bacterial vaginosis. *Clin Microbiol Infect*. 2009;15:67-74.
[\[PubMed Abstract\]](#) -
- McClelland RS, Richardson BA, Hassan WM, et al. Improvement of vaginal health for Kenyan women at risk for acquisition of human immunodeficiency virus type 1: results of a randomized trial. *J Infect Dis*. 2008;197:1361-8.
[\[PubMed Abstract\]](#) -
- McDonald HM, O'Loughlin JA, Vigneswaran R, et al. Impact of metronidazole therapy on preterm birth in women with bacterial vaginosis flora (*Gardnerella vaginalis*): a randomised, placebo controlled trial. *Br J Obstet Gynaecol*. 1997;104:1391-7.
[\[PubMed Abstract\]](#) -
- McElligott KA, Havrilesky LJ, Myers ER. Preoperative screening strategies for bacterial vaginosis prior to elective hysterectomy: a cost comparison study. *Am J Obstet Gynecol*. 2011;205:500.e1-7.
[\[PubMed Abstract\]](#) -
- McGregor JA, French JI, Jones W, et al. Bacterial vaginosis is associated with prematurity and vaginal fluid mucinase and sialidase: results of a controlled trial of topical clindamycin cream. *Am J Obstet Gynecol*. 1994;170:1048-59.
[\[PubMed Abstract\]](#) -
- McGregor JA, French JI, Jones W, et al. Bacterial vaginosis is associated with prematurity and vaginal fluid mucinase and sialidase: results of a controlled trial of topical clindamycin cream. *Am J Obstet Gynecol*. 1994;170:1048-59.
[\[PubMed Abstract\]](#) -
- Mehta SD. Systematic review of randomized trials of treatment of male sexual partners for improved bacteria vaginosis outcomes in women. *Sex Transm Dis*. 2012;39:822-30.
[\[PubMed Abstract\]](#) -
- Meltzer MC, Desmond RA, Schwebke JR. Association of *Mobiluncus curtisi* with recurrence of bacterial vaginosis. *Sex Transm Dis*. 2008;35:611-3.
[\[PubMed Abstract\]](#) -

- Mitchell C, Marrazzo J. Bacterial vaginosis and the cervicovaginal immune response. *Am J Reprod Immunol.* 2014;71:555-63.
[\[PubMed Abstract\]](#) -
- Morales WJ, Schorr S, Albritton J. Effect of metronidazole in patients with preterm birth in preceding pregnancy and bacterial vaginosis: a placebo-controlled, double-blind study. *Am J Obstet Gynecol.* 1994;171:345-7.
[\[PubMed Abstract\]](#) -
- Myer L, Kuhn L, Stein ZA, Wright TC Jr, Denny L. Intravaginal practices, bacterial vaginosis, and women's susceptibility to HIV infection: epidemiological evidence and biological mechanisms. *Lancet Infect Dis.* 2005;5:786-94.
[\[PubMed Abstract\]](#) -
- Nelson DB, Hanlon A, Hassan S, et al. Preterm labor and bacterial vaginosis-associated bacteria among urban women. *J Perinat Med.* 2009;37:130-4.
[\[PubMed Abstract\]](#) -
- Ness RB, Hillier SL, Kip KE, et al. Bacterial vaginosis and risk of pelvic inflammatory disease. *Obstet Gynecol.* 2004;104:761-9.
[\[PubMed Abstract\]](#) -
- Nugent RP, Krohn MA, Hillier SL. Reliability of diagnosing bacterial vaginosis is improved by a standardized method of gram stain interpretation. *J Clin Microbiol.* 1991;29:297-301.
[\[PubMed Abstract\]](#) -
- Nyirjesy P, McIntosh MJ, Steinmetz JI, Schumacher RJ, Joffrion JL. The effects of intravaginal clindamycin and metronidazole therapy on vaginal mobiluncus morphotypes in patients with bacterial vaginosis. *Sex Transm Dis.* 2007;34:197-202.
[\[PubMed Abstract\]](#) -
- Oakeshott P, Kerry S, Hay S, Hay P. Bacterial vaginosis and preterm birth: a prospective community-based cohort study. *Br J Gen Pract.* 2004;54:119-22.
[\[PubMed Abstract\]](#) -
- Odendaal HJ, Popov I, Schoeman J, Smith M, Grové D. Preterm labour--is bacterial vaginosis involved? *S Afr Med J.* 2002;92:231-4.
[\[PubMed Abstract\]](#) -
- Owusu-Edusei K Jr, Chesson HW, Gift TL, et al. The estimated direct medical cost of selected sexually transmitted infections in the United States, 2008. *Sex Transm Dis.* 2013;40:197-201.
[\[PubMed Abstract\]](#) -
- Passmore CM, McElnay JC, Rainey EA, D'Arcy PF. Metronidazole excretion in human milk and its effect on the suckling neonate. *Br J Clin Pharmacol.* 1988;26:45-51.
[\[PubMed Abstract\]](#) -
- Patterson JL, Stull-Lane A, Girerd PH, Jefferson KK. Analysis of adherence, biofilm formation and cytotoxicity suggests a greater virulence potential of *Gardnerella vaginalis* relative to other bacterial-vaginosis-associated anaerobes. *Microbiology.* 2010;156:392-9.
[\[PubMed Abstract\]](#) -
- Peterman TA, Tian LH, Metcalf CA, et al. High incidence of new sexually transmitted infections in the

year following a sexually transmitted infection: a case for rescreening. Ann Intern Med.

2006;145:564-72.

[PubMed Abstract] -

- Piper JM, Mitchel EF, Ray WA. Prenatal use of metronidazole and birth defects: no association. Obstet Gynecol. 1993;82:348-52.
[PubMed Abstract] -
- Reichman O, Akins R, Sobel JD. Boric acid addition to suppressive antimicrobial therapy for recurrent bacterial vaginosis. Sex Transm Dis. 2009;36:732-4.
[PubMed Abstract] -
- Satterwhite CL, Torrone E, Meites E, et al. Sexually transmitted infections among US women and men: prevalence and incidence estimates, 2008. Sex Transm Dis. 2013;40:187-93.
[PubMed Abstract] -
- Schwebke JR, Desmond R. A randomized trial of metronidazole in asymptomatic bacterial vaginosis to prevent the acquisition of sexually transmitted diseases. Am J Obstet Gynecol. 2007;196:517.e1-6.
[PubMed Abstract] -
- Schwebke JR, Desmond R. Risk factors for bacterial vaginosis in women at high risk for sexually transmitted diseases. Sex Transm Dis. 2005;32:654-8.
[PubMed Abstract] -
- Schwebke JR, Hillier SL, Sobel JD, McGregor JA, Sweet RL. Validity of the vaginal gram stain for the diagnosis of bacterial vaginosis. Obstet Gynecol. 1996;88:573-6.
[PubMed Abstract] -
- Schwebke JR, Muzny CA, Josey WE. Role of *Gardnerella vaginalis* in the pathogenesis of bacterial vaginosis: a conceptual model. J Infect Dis. 2014;210:338-43.
[PubMed Abstract] -
- Screening for bacterial vaginosis in pregnancy to prevent preterm delivery: U.S. Preventive Services Task Force recommendation statement. Ann Intern Med. 2008;148:214-9.
[PubMed Abstract] -
- Senok AC, Verstraelen H, Temmerman M, Botta GA. Probiotics for the treatment of bacterial vaginosis. Cochrane Database Syst Rev. 2009 Oct 7:CD006289.
[PubMed Abstract] -
- Sewankambo N, Gray RH, Wawer MJ, et al. HIV-1 infection associated with abnormal vaginal flora morphology and bacterial vaginosis. Lancet. 1997;350:546-50.
[PubMed Abstract] -
- Skinner CJ, Stokes J, Kirlew Y, Kavanagh J, Forster GE. A case-controlled study of the sexual health needs of lesbians. Genitourin Med. 1996;72:277-80.
[PubMed Abstract] -
- Sobel J, Peipert JF, McGregor JA, et al. Efficacy of clindamycin vaginal ovule (3-day treatment) vs. clindamycin vaginal cream (7-day treatment) in bacterial vaginosis. Infect Dis Obstet Gynecol. 2001;9:9-15.
[PubMed Abstract] -
- Sobel JD, Ferris D, Schwebke J, et al. Suppressive antibacterial therapy with 0.75% metronidazole

vaginal gel to prevent recurrent bacterial vaginosis. Am J Obstet Gynecol. 2006;194:1283-9.
[PubMed Abstract] -

- Soper DE. Bacterial vaginosis and postoperative infections. Am J Obstet Gynecol. 1993;169:467-9.
[PubMed Abstract] -
- Tokyol C, Aktepe OC, Cevrioğlu AS, Altındış M, Dilek FH. Bacterial vaginosis: comparison of Pap smear and microbiological test results. Mod Pathol. 2004;17:857-60.
[PubMed Abstract] -
- Ugwumadu A, Manyonda I, Reid F, Hay P. Effect of early oral clindamycin on late miscarriage and preterm delivery in asymptomatic women with abnormal vaginal flora and bacterial vaginosis: a randomised controlled trial. Lancet. 2003;361:983-8.
[PubMed Abstract] -
- Ugwumadu A, Reid F, Hay P, Manyonda I. Natural history of bacterial vaginosis and intermediate flora in pregnancy and effect of oral clindamycin. Obstet Gynecol. 2004;104:114-9.
[PubMed Abstract] -
- Vermeulen GM, Bruinse HW. Prophylactic administration of clindamycin 2% vaginal cream to reduce the incidence of spontaneous preterm birth in women with an increased recurrence risk: a randomised placebo-controlled double-blind trial. Br J Obstet Gynaecol. 1999;106:652-7.
[PubMed Abstract] -
- Vodstrcil LA, Walker SM, Hocking JS, et al. Incident bacterial vaginosis (BV) in women who have sex with women is associated with behaviors that suggest sexual transmission of BV. Clin Infect Dis. 2015;60:1042-53.
[PubMed Abstract] -
- Wasserheit JN. Epidemiological synergy. Interrelationships between human immunodeficiency virus infection and other sexually transmitted diseases. Sex Transm Dis. 1992;19:61-77.
[PubMed Abstract] -
- Weinstock H, Berman S, Cates W Jr. Sexually transmitted diseases among American youth: incidence and prevalence estimates, 2000. Perspect Sex Reprod Health. 2004;36:6-10.
[PubMed Abstract] -
- Workowski KA, Bolan GA; Centers for Disease Control and Prevention. Sexually transmitted diseases treatment guidelines, 2015. Diseases characterized by vaginal discharge: Bacterial vaginosis. MMWR Recomm Rep. 2015;64(No. RR-3):1-137.
[2015 STD Treatment Guidelines] -
- Yudin MH, Landers DV, Meyn L, Hillier SL. Clinical and cervical cytokine response to treatment with oral or vaginal metronidazole for bacterial vaginosis during pregnancy: a randomized trial. Obstet Gynecol. 2003;102:527-34.
[PubMed Abstract] -
- Zozaya M, Ferris MJ, Siren JD, et al. Bacterial communities in penile skin, male urethra, and vaginas of heterosexual couples with and without bacterial vaginosis. Microbiome. 2016;4:16.
[PubMed Abstract] -