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# Sexually Transmitted Infections

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# SEXUALLY TRANSMITTED INFECTIONS

Sexually transmitted infections (STIs) pose a major socioeconomic threat to humans around the globe. CDC estimates that 19 million new Chlamydia, Gonorrhea, and Syphilis infections occur each year in the U.S. alone, with healthcare costs ranging as high as $17 billion yearly.[1]

While some STIs cause incurable, lifelong disease, such as Hepatitis B, Herpes, or HIV/AIDS, others cause acute infection, such as gonorrhea, trichomoniasis, or candidiasis, which can typically be cleared with antimicrobial treatment. However, with the emergence of antimicrobial-resistant organisms, new drugs and drug regimens are being explored as alternatives to traditional treatments.

In addition to the development of novel therapeutics and vaccines, early diagnosis and repeat testing during treatment are vital elements necessary for improving patient outcomes. For this reason, assay developers are actively pursuing rapid, PCR-based methods of detection to replace more subjective and time-consuming, culture-based methods of testing.

Let ATCC Genuine Cultures® and ATCC® Genuine Nucleics provide you with the reliability of fully authenticated cells, microorganisms, and nucleic acids for use as reference standards in the development of novel therapeutics, vaccines, and rapid detection methods. The use of high-quality ATCC reference materials in assay development allows for fast, accurate, and reproducible verification of assay performance, such as inclusivity/exclusivity testing and limits of detection.

To get you started, we have provided a list of our most popular STI strains isolated from a variety of clinical and geographic sources. To locate additional strains, please visit us online at www.atcc.org. Or, contact one of our Sales Representatives for assistance in selecting strains for inclusivity/exclusivity studies.

# ATCC® GENUINE CULTURES

### *Candida albicans*

| ATCC® No. | Description | Strain | Isolation |
|---|---|---|---|
| MP-8™ | *Candida albicans* Drug Resistance Panel | Panel of strains exhibiting different levels of drug resistance | Human; various clinical and geographic sources |
| 90028™ | *Candida albicans* | NCCLS 11 | Blood; Iowa |
| 64124™ | *Candida albicans* | Darlington | Mouth swab |
| 14053™ | *Candida albicans* | NIH 3172 | Human blood; Maryland |
| MYA-2876™ | *Candida albicans* | SC5314 | Clinical specimen - human |
| 64550™ | *Candida albicans* | AD | Human skin |
| 24433™ | *Candida albicans* | Wasson | Nail infection |
| 90029™ | *Candida albicans* | NCCLS 67 | Blood; Iowa |
| 36801™ | *Candida albicans* | 207 [NCPF 3153] | Human |
| 34133™ | *Candida albicans* | Ca 16 | Clinical specimen; Minnesota |
| 62342™ | *Candida albicans* | B41628 [NCPF 3363] | Human mouth; England |

### *Chlamydia trachomatis*

| ATCC® No. | Description | Strain | Isolation |
|---|---|---|---|
| VR-885™ | *Chlamydia trachomatis* | UW-3/Cx; Serovar D | Human cervix - asymptomatic |
| VR-348B™ | *Chlamydia trachomatis* | BOUR; Serovar E | Adult with probable clinical inclusion conjunctivitis and active trachoma; California |
| VR-880™ | *Chlamydia trachomatis* | UW-12/Ur; Serovar I | Male urethra with non-gonococcal urethritis |
| VR-886™ | *Chlamydia trachomatis* | UW-36/Cx; Serovar J | Human cervix, cervicitis; Seattle, Washington |
| VR-346™ | *Chlamydia trachomatis* | IC-Cal-3; Serovar F | Eye of nine-day-old baby; California |
| VR-878™ | *Chlamydia trachomatis* | UW-57/Cx; Serovar G | Human cervix (epithelial tissue), cervicitis; Seattle, Washington |
| VR-879™ | *Chlamydia trachomatis* | UW-43/Cx; Serovar H | Human cervix (epithelial tissue), cervicitis; Seattle, Washington |
| VR-571B™ | *Chlamydia trachomatis* | Har-13; Serovar A | Human conjunctiva from 4-year-old with trachoma |
| VR-887™ | *Chlamydia trachomatis* | UW-31/Cx; Serovar K | Human cervix, cervicitis; Seattle, Washington |
| VR-1477™ | *Chlamydia trachomatis* | TW-3; Serovar C | Specimen from human conjunctiva, Taiwan |
| VR-347™ | *Chlamydia trachomatis* | Apache-2; Serovar Ba | Eye of an Apache Indian child from San Carlos; Arizona |
| VR-573™ | *Chlamydia trachomatis* | Strain Har-36; Serovar B | Human conjuctiva from a 12 month old male with trachoma (trachoma II follicles and papillae); Saudi Arabia |
| VR-901B™ | *Chlamydia trachomatis* | 440; LGV Type 1 | Lymphogranuloma venereum (LGV I) |
| VR-902B™ | *Chlamydia trachomatis* | 434; LGV Type 2 | Lymphogranuloma venereum (LGV II) |
| VR-903™ | *Chlamydia trachomatis* | 404; LGV Type 3 | Lymph node from human with LGV; Lymphogranuloma venereum (LGV III) |

## DOES CHRONIC CHLAMYDIAL PERSISTENCE OCCUR *IN VIVO*?

The question is still open for debate. While *Chlamydia trachomatis* has been shown to enter a dormant phase *in vitro* during periods of bacterial stress unfavorable for growth, proof of *in vivo* persistence still needs to be established. Current methods of testing measure the host's immune response, and are limited by the lowest level of antibody that can be detected in blood. Researchers suggest that both nucleic acid detection and verification of organism viability are together required to establish true *in vivo* persistence.[2]

### *Haemophilus ducreyi*

| ATCC® No. | Description | Strain | Isolation |
|---|---|---|---|
| 33940™ | *Haemophilus ducreyi* | CIP 542 [X2] | |
| 700724™ | *Haemophilus ducreyi* | 35000HP | Skin from the upper arm of an experimentally infected human subject |
| 33921™ | *Haemophilus ducreyi* | HD 9468 | Clinical isolate; Nairobi, Kenya |
| 51566™ | *Haemophilus ducreyi* | CCUG 13605 [HD 82010] | Human chancroid; Paris, France |
| 51620™ | *Haemophilus ducreyi* | V-1168 | Clinical isolate; Brazil |
| 51622™ | *Haemophilus ducreyi* | CF101 | Clinical isolate; Seattle, Washington |

### Human herpesvirus 1

| ATCC® No. | Description | Strain | Isolation |
|---|---|---|---|
| VR-733™ | Human herpesvirus 1 | F | Facial vesicle |
| VR-539™ | Human herpesvirus 1 | MacIntyre | Brain, human, encephalitis |
| VR-260™ | Human herpesvirus 1 | HF | Vesicle fluid from patient with recurrent herpes simplex; New York |
| VR-1493™ | Human herpesvirus 1 | KOS | Lip lesion of human with cold sore |
| VR-1789™ | Human herpesvirus 1 | ATCC-2011-9 | Clinical patient positive for HSV-1; Virginia |

### Human herpesvirus 2

| ATCC® No. | Description | Strain | Isolation |
|---|---|---|---|
| VR-734™ | Human herpesvirus 2 | G | Human genital infection |
| VR-540™ | Human herpesvirus 2 | MS | Brain of a 50 year old female with multiple sclerosis; Iceland |
| VR-1779™ | Human herpesvirus 2 | ATCC-2011-2 | Clinical sample from a patient positive for HSV-2; Virginia |
| VR-1781™ | Human herpesvirus 2 | ATCC-2011-4 | Clinical isolate; Virginia |

### *Neisseria gonorrhoeae*

| ATCC® No. | Description | Strain | Isolation |
|---|---|---|---|
| 43069™ | *Neisseria gonorrhoeae* | CDC Ng-116 | Cervix; Illinois |
| 49226™ | *Neisseria gonorrhoeae* | F-18 [89-018314, CDC 10,001, P935] | |
| 19424™ | *Neisseria gonorrhoeae* | NCTC 8375 [B 5025] | |
| 700825™ | *Neisseria gonorrhoeae* | FA1090 | Male patient with disseminated gonococcal infection |
| 49981™ | *Neisseria gonorrhoeae* | NHI 1 | Clinical isolate |
| 49759™ | *Neisseria gonorrhoeae* | MS11-N198 | Patient with gonorrhea; New York |
| 21823™ | *Neisseria gonorrhoeae* | B-585 | Patient with gonorrhea; New York |
| 35201™ | *Neisseria gonorrhoeae* | C-58 [D-10] | Blood |
| 31399™ | *Neisseria gonorrhoeae* | 19 | Patient with symptomatic gonorrhea |
| BAA-1842™ | *Neisseria gonorrhoeae* | PID24-1 | Cervix of a woman with clinically staged severe pelvic inflammatory disease |
| BAA-1839™ | *Neisseria gonorrhoeae* | 1291 | Urethral exudate of an infected 22-year-old male |
| BAA-1844™ | *Neisseria gonorrhoeae* | DGI18 | Patient with typical disseminated gonococcal infection (DGI) symptoms |
| BAA-1847™ | *Neisseria gonorrhoeae* | SK-93-1035 | Blood isolate from a woman diagnosed with disseminated gonococcal infection; Seattle, Washington |
| 43070™ | *Neisseria gonorrhoeae* | CDC Ng-98 | Cervix |
| 31148™ | *Neisseria gonorrhoeae* | GC/CB/001 [CDC M-2] | Human gonorrhea patient |
| BAA-1837™ | *Neisseria gonorrhoeae* | F62 | Uncomplicated infection |
| BAA-1838™ | *Neisseria gonorrhoeae* | FA19 | Uncomplicated infection |

## HOST-PATHOGEN CELL MODELS FOR GONORRHEA RESEARCH

Piliated, but not nonpiliated, *Neisseria gonorrhoea* strain F62 variants (e.g., ATCC® BAA-1837™) actively invade the ectocervical Ect/E6E7 (ATCC® CRL-2614™) and endocervical End1/E6E7 (ATCC® CRL-2615™) epithelial cell lines. Invasion of these cells by green fluorescent protein-expressing gonococci is characterized by colocalization of gonococci with F actin.

### *Neisseria gonorrhoeae* (continued)

| ATCC® No. | Description | Strain | Isolation |
|---|---|---|---|
| 51803™ | *Neisseria gonorrhoeae* | CCUG 8657 [I]; Serogroup WI; Serovar Abedgkih | Sweden |

### *Trichomonas vaginalis*

| ATCC® No. | Description | Strain | Isolation |
|---|---|---|---|
| 30001™ | *Trichomonas vaginalis* | C-1:NIH | Vaginal exudate from human adult female with acute vaginitis |
| 30236™ | *Trichomonas vaginalis* | JH 31A #4 | Endocervical swab, Johns Hopkins Hospital; Maryland |
| 50143™ | *Trichomonas vaginalis* | CDC 085 | Human; Ohio |
| 30184™ | *Trichomonas vaginalis* | 123414 | Vaginal swab; Tennessee |
| PRA-98™ | *Trichomonas vaginalis* | G3 | Clinical specimen - human; United Kingdom |
| 30092™ | *Trichomonas vaginalis* | 11769 | Human, Colorado General Hospital; Colorado |
| 30238™ | *Trichomonas vaginalis* | JH 32A #4 | Endocervical swab, Johns Hopkins Hospital; Maryland |
| 50167™ | *Trichomonas vaginalis* | B7RC2 | Human vagina; North Carolina |
| 30093™ | *Trichomonas vaginalis* | 45422 | Human, Colorado General Hospital; Colorado |
| 30186™ | *Trichomonas vaginalis* | 123413 | Vaginal swab; Tennessee |
| 30187™ | *Trichomonas vaginalis* | 165307-1 | Endocervical swab, Colorado General Hospital; Colorado |
| PRA-92™ | *Trichomonas vaginalis* | JRS-TV-141 | Clinical specimen - human; Alabama |
| PRA-96™ | *Trichomonas vaginalis* | MT87 | Clinical specimen - human; Alabama |
| 30185™ | *Trichomonas vaginalis* | 129155-8 | Vaginal swab; Colorado |
| 30188™ | *Trichomonas vaginalis* | RP | Human Vagina; England |
| 50138™ | *Trichomonas vaginalis* | IR78 | Human; Austria |

### WILL *TRICHOMONAS VAGINALIS* BECOME DRUG RESISTANT?

It's possible. The current class of drugs used to treat trichomoniasis are the Nitroimadazoles (e.g., metronidazole and trinidazole). Recent analysis of 538 clinical *T. vaginalis* isolates revealed 4.3% exhibited low-level *in vitro* metronidazole resistance.[3] Novel treatment options need to be explored to prevent the development of drug resistance through the overuse of a single class of antimicrobials.

# ATCC® GENUINE NUCLEICS

### Genomic Nucleic Acids

| ATCC® No. | Description | Strain | Isolation |
|---|---|---|---|
| 11006D-5 | *Candida albicans* genomic DNA | [ATCC 42266, CBS 1905, CCRC 20518, CECT 1439, DBVPG 6157, IFO 1397, JCM 1543] | |
| VR-348BD | *Chlamydia trachomatis* genomic DNA | BOUR; Serovar E | Adult with probable clinical inclusion conjunctivitis and active trachoma; California |
| VR-885D | *Chlamydia trachomatis* genomic DNA | UW-3/Cx; Serovar D | Human cervix - asymptomatic |
| VR-878D | *Chlamydia trachomatis* genomic DNA | UW-57/Cx; Serovar G | Human cervix (epithelial tissue), cervicitis; Seattle, Washington |
| VR-886D | *Chlamydia trachomatis* genomic DNA | UW-36/Cx; Serovar J | Human cervix, cervicitis; Seattle, Washington |
| VR-901BD | *Chlamydia trachomatis* genomic DNA | LGV Serovar I | |
| VR-902BD | *Chlamydia trachomatis* genomic DNA | LGV Serovar II | |
| VR-903D | *Chlamydia trachomatis* genomic DNA | LGV Serovar III | |
| 700724D-5 | *Haemophilus ducreyi* genomic DNA | 35000HP | Skin from the upper arm of an experimentally infected human subject |
| VR-539D | Human herpesvirus 1 DNA | MacIntyre | Brain, human, encephalitis |
| VR-539DQ | Quantitative Human herpesvirus 1 genomic DNA | MacIntyre | Brain, human, encephalitis |
| VR-1493D | Human herpesvirus 1 DNA | KOS | Lip lesion of human with cold sore |
| VR-540DQ | Quantitative Human herpesvirus 2 genomic DNA | MS | Brain of a 50 year old female with multiple sclerosis, Iceland, 1961 |

### Genomic Nucleic Acids (continued)

| ATCC® No. | Description | Strain | Isolation |
|---|---|---|---|
| VR-540D | Human herpesvirus 2 DNA | MS | Brain of a 50 year old female with multiple sclerosis; Iceland |
| VR-734D | Human herpesvirus 2 DNA | G | Human genital infection |
| 700825D-5 | *Neisseria gonorrhoeae* genomic DNA | FA1090 | Male patient with disseminated gonococcal infection |
| 53423D | *Neisseria gonorrhoeae* genomic DNA | [ATCC 9793] | |
| 53421D | *Neisseria gonorrhoeae* genomic DNA | Supplemental deposit of ATCC® 2763™ | Patient with gonorrhea |
| 53421D-5 | *Neisseria gonorrhoeae* genomic DNA | | Supplemental deposit of ATCC® 27631™ for patent purposes. |
| 53422D | *Neisseria gonorrhoeae* genomic DNA | Supplemental deposit of ATCC® 31426™ | |
| 700825DQ | Quantitative *Neisseria gonorrhoeae* genomic DNA | FA1090 | Male patient with disseminated gonococcal infection, 1983 |
| 30001D | *Trichomonas vaginalis* genomic DNA | C-1:NIH | Vaginal exudate from human adult female with acute vaginitis |
| PRA-98D | *Trichomonas vaginalis* genomic DNA | G3 | Clinical specimen - human; United Kingdom |

### Synthetic Molecular Standards

| ATCC® No. | Description | Strain |
|---|---|---|
| VR-3232SD | Hepatitis B virus | Fragments from the highly conserved precore, core, P, S, and X regions |
| VR-3233SD | Hepatitis C virus | Fragments from 5'UTR and X-tail region (3'UTR) |
| VR-3240SD | Human papillomavirus 16 | Full length genome of human papillomavirus type 16 derived from a plasmid clone (ATCC® 45113D) |
| VR-3241SD | Human papillomavirus 18 | Full length genome of human papillomavirus type 18 derived from a plasmid clone (ATCC® 45152D) |
| BAA-2641SD | *Mycoplasma genitalium* | Fragments from the 16S gene, *mgpA*, and *gap* |
| BAA-2642SD | *Treponema pallidum* | Fragments from the *polA*, *tpr*, 23S gene, *arp*,16S gene, *flaA*, 47kDa protein gene, and *bmp* |

**CAN'T FIND THE NUCLEIC ACIDS YOU NEED?**

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# ATCC® CELL LINES CONTAINING VIRAL NUCLEIC ACID SEQUENCES

### Human Papillomavirus (HPV)

| ATCC® No. | Designation | Organism | Source | Comments |
|---|---|---|---|---|
| CRL-1550™ | Ca Ski | Human | Cervix, epidermoid carcinoma; derived from metastatic site: small intestine | Ca Ski cells are reported to contain an integrated human papillomavirus type 16 genome (HPV-16, about 600 copies per cell) as well as sequences related to HPV-18. |
| HTB-33™ | ME-180 | Human | Cervix, epidermoid carcinoma; derived from metastatic site: omentum | ME-180 cells contain human papillomavirus (HPV) DNA with greater homology to HPV-39 than HPV-18. |
| CRL-1594™ | C-4 I | Human | Cervix, carcinoma | The C-4 I cell line contains human papillomavirus type 18 (HPV-18) DNA sequences, and expresses HPV-18 RNA. |
| CRL-1595™ | C-4 II | Human | Cervix, carcinoma | The C-4 II cell line contains human papillomavirus type 18 (HPV-18) DNA sequences, and expresses HPV-18 RNA. |
| CRL-11609™ | RWPE-1 | Human | Prostate, normal epithelial | RWPE-1 cells are comprised of epithelial cells derived from the peripheral zone of a histologically normal adult human prostate, which were transfected with a single copy of the human papilloma virus 18 (HPV-18). |
| HTB-35™ | SiHa | Human | Cervix, squamous cell carcinoma | The SiHa cell line is reported to contain an integrated human papillomavirus type 16 genome (HPV-16, 1 to 2 copies per cell). |
| HTB-34™ | MS751 | Human | Cervix, epidermoid carcinoma; derived from metastatic site: lymph node | MS751 cells have been reported to contain human papilloma virus 18 (HPV-18) sequences. More recently, it has been shown that MS751 cells contain a partial HPV-45 genome, and that HPV-45 sequences from the E6/E7 region are expressed as poly(A)+ RNA. |
| CCL-2™ | HeLa | Human | Cervix, adenocarcinoma | HeLa cells have been reported to contain human papilloma virus 18 (HPV-18) sequences. |

**Hepatitis B Virus (HBV) (continued)**

| ATCC® No. | Designation | Organism | Source | Comments |
|---|---|---|---|---|
| CRL-8024™ | PLC/PRF/5 | Human | Liver, hepatoma | The PLC/PRF/5 cells secrete hepatitis virus B surface antigen (HBsAg). |
| HB-8064™ | Hep 3B2.1-7 | Human | Liver, hepatocellular carcinoma | The Hep 3B2.1-7 cell line contains an integrated hepatitis B virus genome. |
| CRL-2233™ | SNU-398 | Human | Liver, hepatocellular carcinoma | Hepatitis B virus (HBV) DNA was detected by Southern blot hybridization. HBV genomic RNA was not expressed. |
| CRL-2236™ | SNU-475 | Human | Liver, grade II-IV/V hepatocellular carcinoma | Hepatitis B virus (HBV) DNA was detected by Southern blot hybridization. HBV genomic RNA was not expressed. |
| CRL-2235™ | SNU-182 | Human | Liver, grade III/IV hepatocellular carcinoma | Hepatitis B virus (HBV) DNA was detected by Southern blot hybridization. HBV genomic RNA was not expressed. |
| CRL-2238™ | SNU-423 | Human | Liver, grade III/IV pleomorphic hepatocellular carcinoma | Hepatitis B virus (HBV) DNA was detected by Southern blot hybridization. HBV genomic RNA was not expressed. |
| CRL-2237™ | SNU-387 | Human | Liver, grade IV/V pleomorphic hepatocellular carcinoma | Hepatitis B virus (HBV) DNA was detected by Southern blot hybridization. HBV genomic RNA was not expressed. |

**Human Immunodeficiency Virus (HIV)**

| ATCC® | Designation | Organism | Source | Comments |
|---|---|---|---|---|
| CRL-8993 | 8E5 | Human | Lymphocyte, peripheral blood | The 8E5 cells contain a single defective proviral genome of HTLV III (HIV, LAV), and express most human immunodeficiency virus (HIV, HTLV III, LAV) structural proteins. No infectious virus is produced; however, co-cultivation with Leu-3 + cells leads to syncytia formation. |
| CRL-8543 | H9/HTLV-IIIB | Human | Lymphoblast, acute lymphoblastic leukemia | The H9/HTLV-IIIB cells produce HTLV III, and express HTLV III (HIV) genes. |

# ATCC® MOLECULARLY-CLONED VIRUSES

**Human Papillomavirus (HPV)**

| ATCC® | Designation | Organism | Source | Comments |
|---|---|---|---|---|
| 40549™ | HPV 56 clone 2C | Purified plasmid DNA | Papilloma virus type 56, complete genome | DNA from human cervical intraepithelial neoplasia I |
| 45113™ | pHPV-16 | Plasmid in E. coli | Papilloma virus type 16, complete genome | |
| 65446™ | pHPV31 | Plasmid in E. coli | Papilloma virus type 31, complete genome | DNA from human cervical dysplasia |

**Hepatitis B Virus (HBV)**

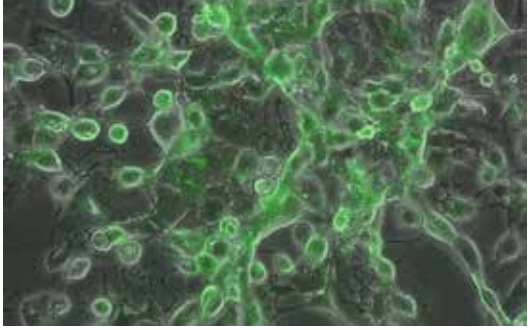
| ATCC® | Designation | Organism | Source | Comments |
|---|---|---|---|---|
| 31518™ | pEco63 | Plasmid in E. coli | Hepatitis B virus, complete genome | |
| 39630™ | AM6 [EC-AM6, pAM6] | Plasmid in E. coli | Hepatitis B virus, complete genome | Isolated from plasma (subtype adw) from an HBsAg-positive donor) |
| 45020D™ | AM6 [EC-AM6, pAM6] | Purified plasmid DNA | Hepatitis B virus, complete genome | Isolated from plasma (subtype adw) from an HBsAg-positive donor) |

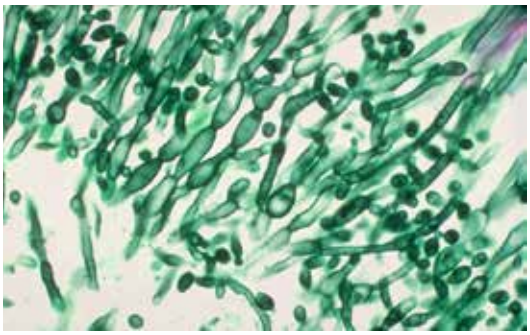
**Human Immunodeficiency Virus (HIV)**

| ATCC® | Designation | Organism | Source | Comments |
|---|---|---|---|---|
| 53069™ | pBT-1 | Plasmid in E. coli | Human immunodeficiency virus 1, complete genome | Cloned from human immunodefiency virus 1BRU |

## REFERENCES


1. Centers for Disease Control and Prevention (CDC). STD Trends in the United States: 2010 National Data for Gonorrhea, Chlamydia, and Syphilis. Available online: http://www.cdc.gov/std/stats10/trends.htm.
2. Hafner L, Beagley K & Timms P. *Chlamydia trachomatis* infection: host immune responses and potential vaccines. *Mucosal Immunol* (2008) 1(2):116-130
3. Kirkcaldy RD, Augostini P, Asbel LE, Bernstein KT, Kerani RP, Mettenbrink CJ, et al. *Trichomonas vaginalis* antimicrobial drug resistance in 6 US cities, STD Surveillance Network, 2009–2010. *Emerg Infect Dis* (2012) June. Available online: http://dx.doi.org/10.3201/eid1806.111590





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