# STD

# SEXUALLY TRANSMITTED DISEASES TESTING IN CALIFORNIA

## 2009 Clinical Laboratory Survey Summary

**TABLE OF CONTENTS**


**ACRONYMS** ..... 2

**OVERVIEW** ..... 3

**BACTERIAL STD TESTING** ..... 8

- ***Chlamydia testing*** ..... 8
- ***Gonorrhea testing*** ..... 10
- ***Syphilis testing*** ..... 13
- ***Chancroid testing*** ..... 16

**VIRAL STD Testing** ..... 16

- ***Human Immunodeficiency Virus (HIV) testing*** ..... 17
- ***Hepatitis B Virus (HBV) testing*** ..... 19
- ***Hepatitis C Virus (HCV) testing*** ..... 19
- ***Herpes Simplex Virus (HSV) testing*** ..... 20
- ***Human Papillomavirus (HPV) testing*** ..... 21

**CERVICAL CYTOLOGY** ..... 22

**CERVICAL HISTOLOGY** ..... 23

**ELECTRONIC REPORTING READINESS** ..... 24

**TECHNICAL NOTES** ..... 25

**ADDITIONAL RESOURCES** ..... 27

**ACRONYMS**

| | |
|---|---|
| APHL | Association of Public Health Laboratories |
| Ab/Ag | Antibody/Antigen |
| ASC-US | Atypical squamous cells of undetermined significance |
| CDC | Centers for Disease Control |
| CDPH | California Department of Public Health |
| CIA | Chemiluminescence Assay |
| CF | Complement fixation |
| DCDC | Division of Communicable Disease Control |
| DFA | Direct fluorescence antibody |
| DNA | Deoxyribonucleic acid |
| EIA | Enzyme immunoassay |
| FDA | Food and Drug Administration |
| FTA-ABS | Fluorescence treponemal antibody absorbance |
| GISP | Gonococcal Isolate Surveillance Project |
| HBV | Hepatitis B virus |
| HCV | Hepatitis C virus |
| Hep | Hepatitis |
| HIV | Human immunodeficiency virus |
| HMO | Health maintenance organization |
| HPV | Human papillomavirus |
| HSV | Herpes simplex |
| HSIL | High-Grade Squamous Intra-epithelial Lesion |
| IFA | Indirect fluorescence antibody |
| IgG | Immunoglobulin G |
| IgM | Immunoglobulin M |
| LHJ | Local health jurisdiction |
| LSIL | Low-Grade Squamous Intra-epithelial Lesion |
| MHA | Microhemagglutination |
| MIF | Microimmunofluorescence |
| NAAT | Nucleic acid amplification test |
| PCR | Polymerase chain reaction |
| RIBA | Recombinant immunoblot assay |
| RNA | Ribonucleic acid |
| RPR | Rapid plasma reagin |
| SDA | Strand displacement amplification |
| STD | Sexually transmitted disease |
| TP-PA | *Treponemal pallidum*-particle agglutination |
| TMA | Transcription mediated amplification |
| VDRL | Venereal Disease Research Laboratory |

## OVERVIEW

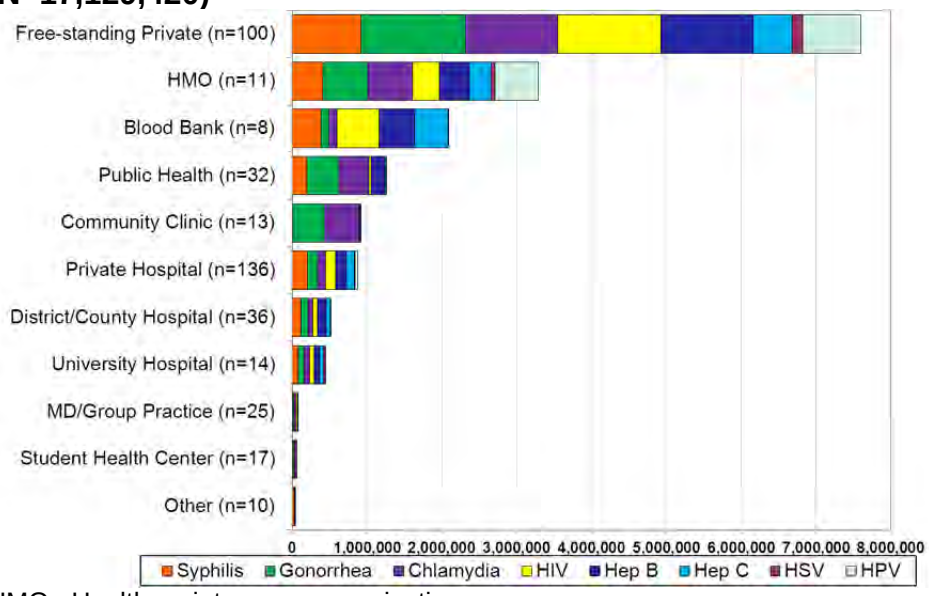
Since 1996, the California Department of Public Health (CDPH) (formerly California Department of Health Services), Center for Infectious Diseases (formerly Prevention Services), Division of Communicable Disease Control (DCDC), Sexually Transmitted Diseases (STD) Control Branch has surveyed clinical laboratories throughout California that perform testing for STDs. The Clinical Laboratory Survey assists disease control efforts by identifying the number and types of laboratories performing STD testing, the number of tests performed, and trends in the use of test technologies over time. This report summarizes information from the 2009 Clinical Laboratory Survey and compares findings with prior surveys. Summary data on 2009 STD trends are also presented.[1]

Timely, accurate, and complete laboratory reporting of communicable diseases is essential to health department efforts to effectively identify public health problems and to design cost-effective interventions. California regulations require both laboratories and healthcare providers to report findings indicative of syphilis, gonorrhea, chlamydia, hepatitis B, hepatitis C, chancroid, human immunodeficiency virus (HIV), and acquired immune deficiency syndrome (AIDS) to local health departments for case follow-up activity and epidemiologic analysis.[2,3] The majority of these disease reports are initially, and often only, received from laboratories. Although herpes simplex virus (HSV) and human papillomavirus (HPV) are not reportable conditions, data for HSV and HPV testing are also collected in this laboratory survey.

The 2009 California Clinical Laboratory Survey was sent to 1,624 licensed California laboratories that potentially conducted testing for reportable sexually transmitted diseases (STDs). Of the 1,409 (86.8 percent) laboratories that responded to the survey, 402 (24.8 percent) reported having conducted STD and/or Pap tests in 2009. The overall response rate was 73.0 percent.

Over 17 million laboratory tests were performed to detect STDs in 2009. Private sector laboratories performed the majority of reported STD tests (Figure 1). Free-standing private facilities (a subset of all private sector laboratories) performed the largest proportion, nearly half (44.4 percent) of all tests combined. Public health laboratories performed 7.4 percent of all tests.

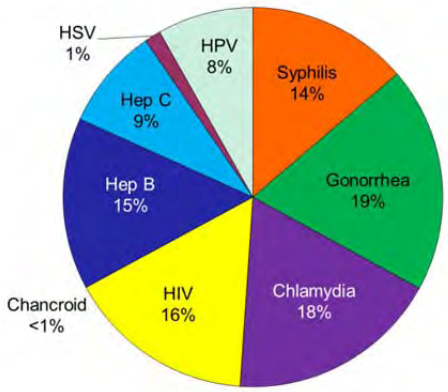
**Figure 1. Number of STD Tests Performed, by Type of Laboratory, 2009 (N=17,129,420)**




HMO: Health maintenance organization
HIV: Human immunodeficiency virus
Hep: Hepatitis
HSV: Herpes simplex virus
HPV: Human papillomavirus
Prepared by the California Department of Public Health

Of all laboratory tests performed to detect STDs, over a third were for chlamydia and gonorrhea (Figure 2). The relative distribution of STD tests in 2009 was similar to that of previous years, although the proportion of chlamydia tests decreased from 2007 to 2009.

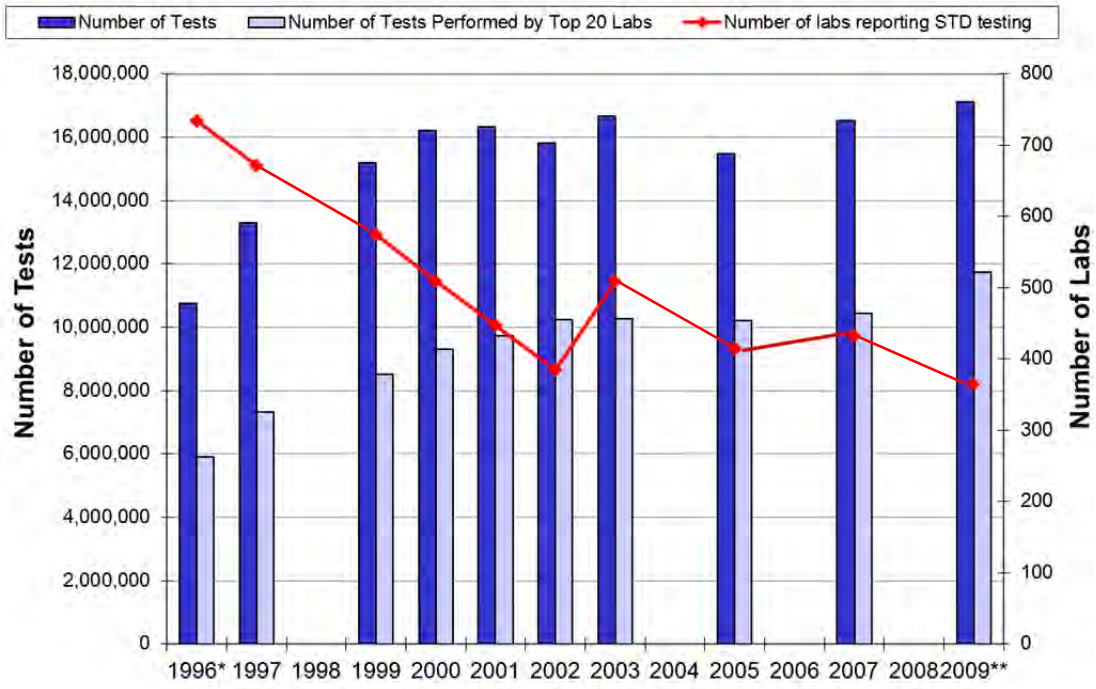
**Figure 2. Type of STD Tests Performed, 2009 (N=17,129,420)**




HIV: Human immunodeficiency virus
Hep: Hepatitis
HSV: Herpes simplex virus
HPV: Human papillomavirus
Prepared by the California Department of Public Health

Over the past decade, reported test volume has increased considerably, by approximately 60 percent, from 10,754,426 STD tests in 1996 to 17,129,420 tests in 2009. At the same time, the number of laboratories reporting testing has decreased by half (49.6 percent), from 734 to 364 in the same period (Figure 3). The percentage of overall STD tests performed by the 20 highest-volume laboratories has increased from 55.0 percent in 1996 to 68.5 percent in 2009.

**Figure 3. Total Number of STD Tests, Number of Tests Performed by 20 Highest-Volume Laboratories, and Number of Laboratories Reporting STD Testing, 1996-2009**

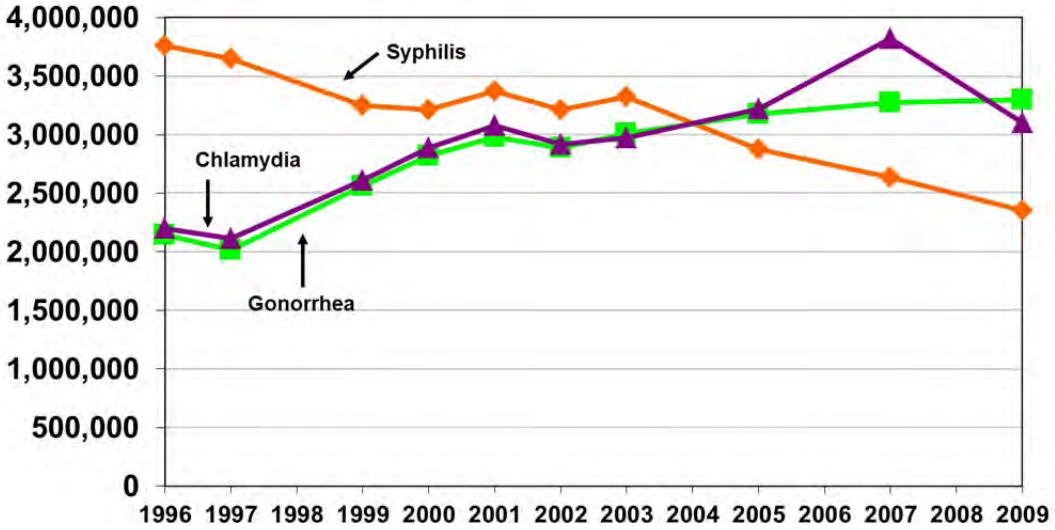



*1996 survey did not include hepatitis B tests.
**2009 survey included hepatitis C tests for the first time.

Prepared by the California Department of Public Health

The total annual test volume during 1996 to 2009 for chlamydia, gonorrhea, and syphilis is shown in Figure 4. Reported syphilis test volume continued to decline from 2007 to 2009 (8.9 percent), while gonorrhea test volume remained steady (0.5 percent increase). After several years of substantial increases in test volume, reported chlamydia tests decreased from 2007 to 2009 (18.9 percent).

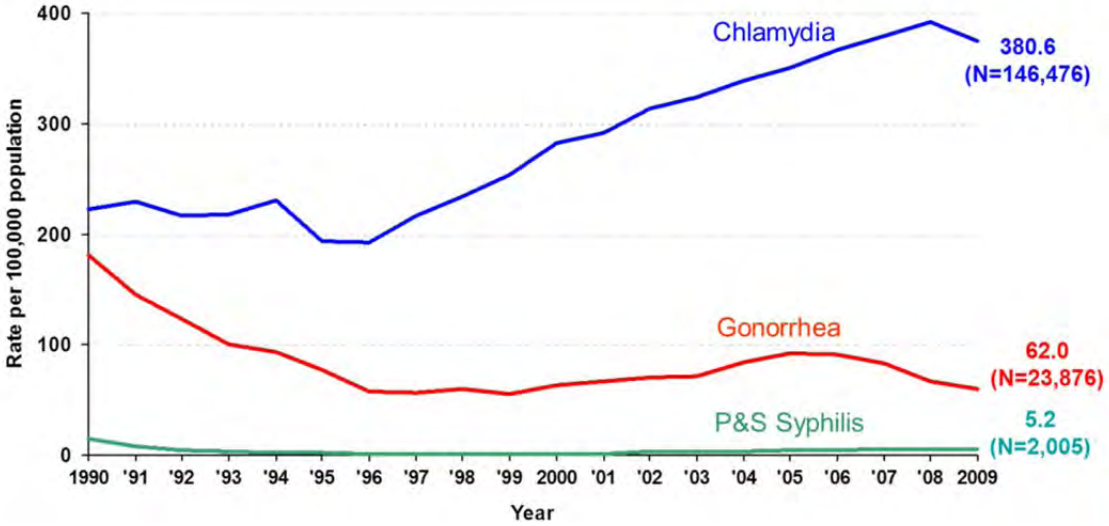
**Figure 4. Chlamydia, Gonorrhea, and Syphilis: Total Number of Tests, 1996-2009**




Prepared by the California Department of Public Health

To provide a context for interpreting laboratory testing trends, rates of each of the reportable bacterial STDs from California's case-based surveillance system[1] are shown in Figure 5.

**Figure 5. Chlamydia, Gonorrhea, and Primary and Secondary (P&S) Syphilis, California Rates, 1990-2009**

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Chlamydia remains the most commonly reported infectious disease in California and in the United States. Increases in chlamydia rates since 1996 mirror increases in chlamydia test volume during the same period; increases in chlamydia test volume likely reflect increasing adherence to national and state screening recommendations that target adolescent and young adult females. Concurrently, the use of nucleic acid

amplification tests (NAATs) to detect chlamydia and gonorrhea continued to increase in 2009, accounting for 94.3 percent and 88.4 percent of all chlamydia and gonorrhea tests, respectively. NAATs provide the greatest sensitivity, can be performed with self-collected specimens, and are the tests recommended by the Association of Public Health Laboratories (APHL) and the Centers for Disease Control and Prevention (CDC).[4] Increases in chlamydia rates since 1996 also likely reflect increased case detection.

Increasing use of tests that combine chlamydia and gonorrhea testing in one specimen resulted in similar increases in gonorrhea testing since 1996. However, gonorrhea rates during the same period have not increased, but rather have remained relatively stable when compared with chlamydia rates. While NAAT testing has increased, culture testing for gonorrhea has declined. Culture testing for gonorrhea accounted for only 5.5 percent of gonorrhea tests in 2009, and less than one-fourth of laboratories (22.9 percent) that performed cultures reported the ability to perform antibiotic susceptibility testing on positive cultures. The decrease in culture testing by California laboratories may adversely affect antibiotic resistance testing and monitoring of emerging trends in resistant gonococcal strains.

In 2009, primary and secondary syphilis rates in California remained low compared with chlamydia and gonorrhea. However, higher male rates and increases observed since 2000 have been the focus of local STD prevention efforts (10.0 cases per 100,000 among males versus 0.4 cases per 100,000 among females). Higher rates of both gonorrhea and syphilis in men have been associated with increases among men who have sex with men. Reported syphilis testing in 2009 decreased slightly since the last survey (2007). Decreases in non-treponemal screening tests since 2007 have been partially offset by the increasing use of automated treponemal enzyme immunoassays (EIA) and chemiluminescence immunoassays (CIA) as primary screening tests.

Migration to web-based systems of reporting STD test results to local public health departments has been slow. Only 12.9 percent of laboratories reported electronically transmitting data on reportable infectious diseases to local health departments in 2009, although this does represent an increase over the 9.4 percent of laboratories in 2007 with this capability.

# BACTERIAL STD TESTING

## Chlamydia testing

- Laboratories surveyed reported performing a total of 3,099,234 chlamydia tests in 2009 (Table 1), a decrease of 18.9 percent from 2007 (Figure 4). The decrease was associated with several of the high chlamydia test volume laboratories from the 2007 survey not participating in the 2009 survey and highlights the need for caution when interpreting trends when survey participation is not consistent over time.

- In 2009, use of NAATs for chlamydia testing continued to increase and is now the near-universal method (94.3 percent), while DNA probe use continued to decrease (4.2 percent). Culture, direct fluorescent antibody (DFA), enzyme immunoassay (EIA), hybrid capture, and serologic tests accounted for the remaining 1.5 percent (Table 1, Figure 6).

- The most frequently used NAATs in 2009 were based on transcription-mediated amplification (TMA) and strand displacement amplification (SDA) tests, accounting for 47.8 percent and 45.2 percent of all NAATs, respectively. Use of NAATs based on polymerase chain reaction (PCR) declined in 2009 to 6.2 percent of NAATs (Table 1).

**Table 1. Chlamydia (CT) Test Types Reported by California Laboratories, 2009**

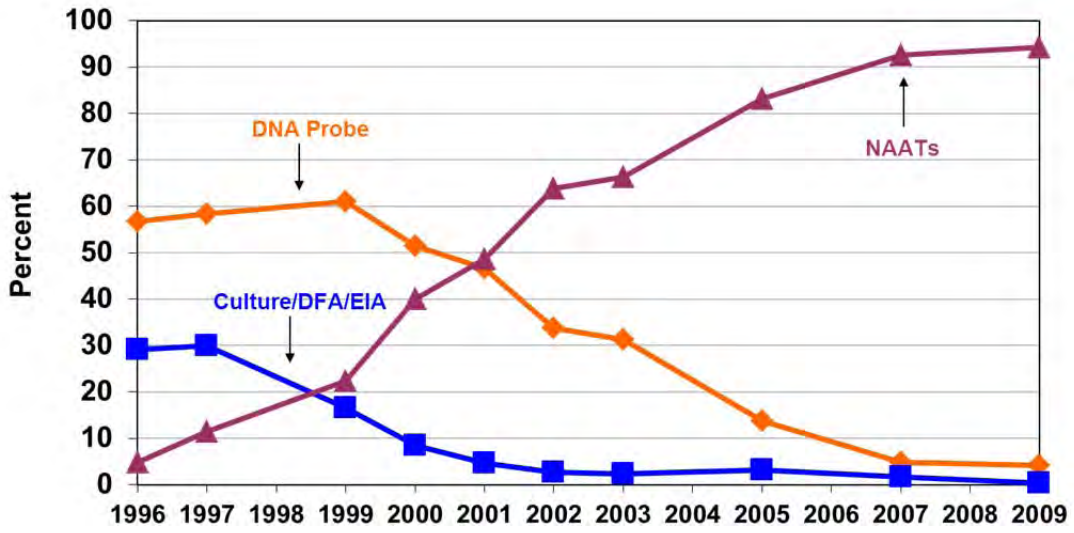
| Chlamydia Test Type | Number of Labs | Number of Tests Performed | Percentage of all CT Tests* | Number of Positive Tests | Percent Positive** |
|---|---|---|---|---|---|
| *Non-Nucleic Acid Amplification Tests (Non-NAATs)* | | | | | |
| Culture | 15 | 3,859 | 0.1% | 78 | 2.1% |
| DFA | 16 | 2,048 | < 0.1% | 92 | 4.8% |
| EIA | 10 | 5,901 | 0.2% | 137 | 2.3% |
| DNA Probe | 26 | 129,082 | 4.2% | 3,278 | 2.5% |
| Hybrid Capture | 7 | 24,064 | 0.8% | 365 | 1.5% |
| Other Non-NAATs | 1 | 503 | < 0.1% | 13 | 2.6% |
| Total Non-NAATs | 64 | 165,457 | 5.3% | | |
| *Nucleic Acid Amplification Tests (NAATs)* | | | | | |
| PCR | 24 | 180,512 | 5.8% | 6,583 | 3.7% |
| TMA | 44 | 1,397,714 | 45.1% | 58,050 | 4.2% |
| SDA | 56 | 1,322,398 | 42.7% | 55,895 | 4.3% |
| Other NAATs | 5 | 22,680 | 0.7% | 257 | 1.1% |
| Total NAATs | 125 | 2,923,304 | 94.3% | | |
| *Serologic Tests* | | | | | |
| MIF | 3 | 7,850 | 0.3% | 1,233 | 15.7% |
| EIA | 3 | 2,434 | < 0.1% | 586 | 24.1% |
| CF | 0 | . | . | . | . |
| Other Serology | 1 | 189 | < 0.1% | 1 | 0.5% |
| Total Serology | 6 | 10,473 | 0.3% | | |
| Total CT Tests | 175 | 3,099,234 | 100.0% | | |

*(Number of tests performed/Total number of CT tests)*100
**(Number of tests positive/Number of tests performed among laboratories reporting positives)*100
DFA: direct fluorescent antibody EIA: enzyme immunoassay PCR: polymerase chain reaction TMA: transcription mediated amplification SDA: strand displacement amplification MIF: Micro-immunofluorescence test CF: Complement fixation test

Prepared by the California Department of Public Health

- NAAT use has increased over the past decade from 4.9 percent of chlamydia tests in 1996 to 94.3 percent in 2009 (Figure 6) and reflects increased adherence to national chlamydia screening recommendations. NAATs provide the greatest sensitivity, can be performed with self-collected specimens, and are the tests recommended by APHL and CDC.[4]

**Figure 6. Percent of Chlamydia Tests by Test Type, 1996-2009**

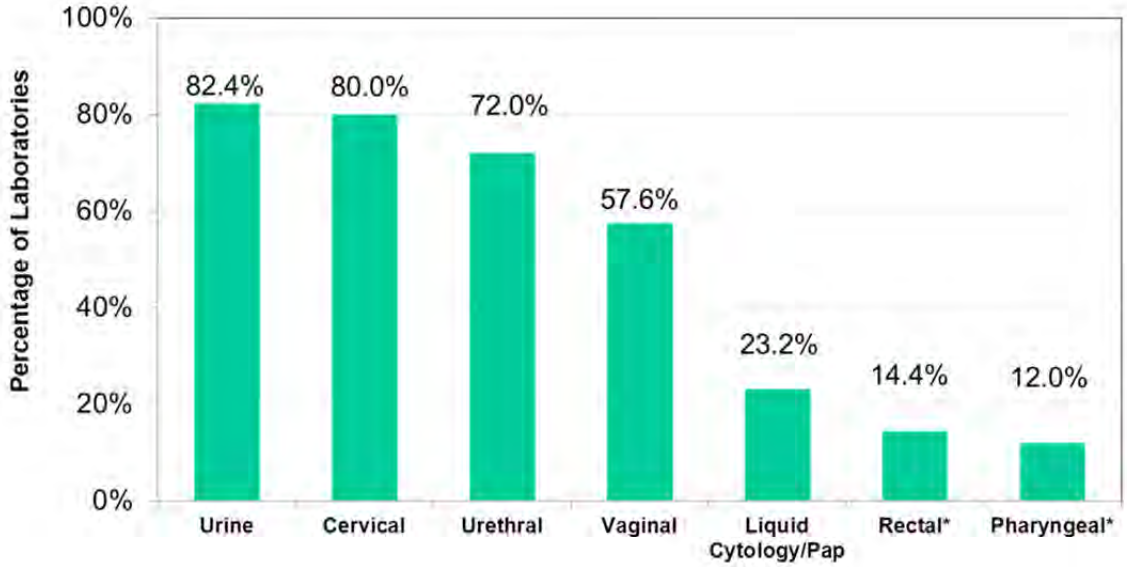



NAAT: nucleic acid amplification test
DFA: direct fluorescent antibody
EIA: enzyme immunoassay

Prepared by the California Department of Public Health

- Urine, urethral, and cervical specimens were the most commonly accepted specimens for NAAT testing (Figure 7). Of the 125 laboratories that run NAATs, 18 laboratories accepted rectal specimens and 15 accepted pharyngeal specimens. Although NAAT testing for rectal and pharyngeal infections has not yet been cleared by the Food and Drug Administration (FDA), CDC and APHL recommend NAAT testing for these specimen types in selected populations because of higher sensitivity compared with that of culture.[4]

**Figure 7. Specimen Types Accepted by Laboratories Performing Chlamydia NAAT, 2009 (N=125)**




NOTE: Categories are not mutually exclusive.
NAAT: nucleic acid amplification test
*Rectal and pharyngeal sites are not FDA-cleared for NAAT testing and require individual laboratory verification study to be conducted.

Prepared by the California Department of Public Health

## Gonorrhea testing

- Laboratories surveyed reported performing a total of 3,295,541 gonorrhea tests in 2009 (Table 2); there was little change in numbers of tests compared to 2007 (Figure 4).

- In 2009, NAATs remained the most commonly used test for gonorrhea (88.4 percent), followed by culture (5.5 percent). DNA probes accounted for an additional 3.8 percent of gonorrhea tests (Table 2, Figure 8). Although there were more laboratories that reported gonorrhea testing (270) than chlamydia testing (175), the difference was due to laboratories that performed gram stains but no other combined tests for gonorrhea and chlamydia.

- TMA accounted for 47.9 percent of all gonorrhea NAATs performed in 2009. SDA and PCR accounted for 45.9 percent and 5.4 percent, respectively (Table 2).

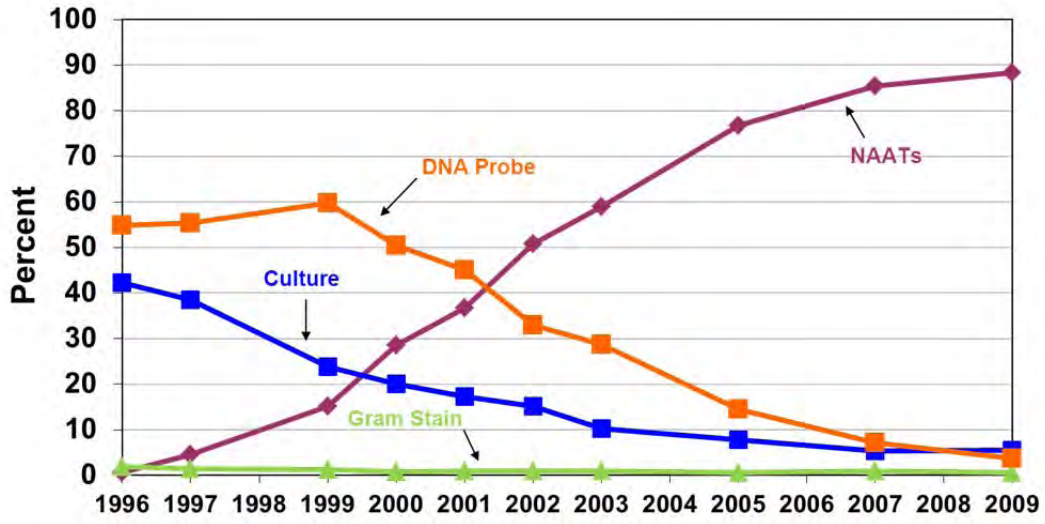
**Table 2. Gonorrhea (GC) Tests Reported by California Laboratories, 2009**

| Gonorrhea Test Type | Number of Labs | Number of Tests Performed | Percentage of all GC Tests* | Number of Positive Tests | Percent Positive** |
|---|---|---|---|---|---|
| *Nucleic Acid Amplification Tests (NAAT)* | | | | | |
| TMA | 43 | 1,395,442 | 42.3% | 13,837 | 1.0% |
| SDA | 54 | 1,335,714 | 40.5% | 7,090 | 0.5% |
| PCR | 22 | 158,451 | 4.8% | 1,757 | 1.1% |
| Other NAAT | 5 | 22,680 | 0.7% | 60 | 0.3% |
| Total NAAT | 122 | 2,912,287 | 88.4% | | |
| *Non-Nucleic Acid Amplification Tests (Non-NAAT)* | | | | | |
| Culture | 188 | 181,381 | 5.5% | 1,164 | 0.6% |
| DNA Probe | 25 | 126,369 | 3.8% | 2,660 | 2.1% |
| Hybrid Capture | 8 | 47,151 | 1.4% | 183 | 0.4% |
| Urethral Gram Stain | 132 | 19,386 | 0.6% | 1,180 | 7.4% |
| Other Non-NAAT | 2 | 8,967 | 0.3% | 270 | 3.0% |
| Total Non-NAAT | 212 | 383,254 | 11.6% | | |
| Total | 270 | 3,295,541 | 100.0% | | |

*(Number of tests performed/Total number of GC tests)*100
**(Number of tests positive/Number of tests performed among laboratories reporting positives)*100
TMA: transcription mediated amplification SDA: strand displacement PCR: polymerase chain reaction
Prepared by the California Department of Public Health

- NAAT use for gonorrhea testing has increased dramatically over the past decade, from 0.6 percent of tests in 1996 to 88.4 percent in 2009 (Figure 8). As with chlamydia, NAATs are the tests recommended by APHL and CDC.[4]

**Figure 8. Percent of Gonorrhea Tests by Test Type, 1996-2009**

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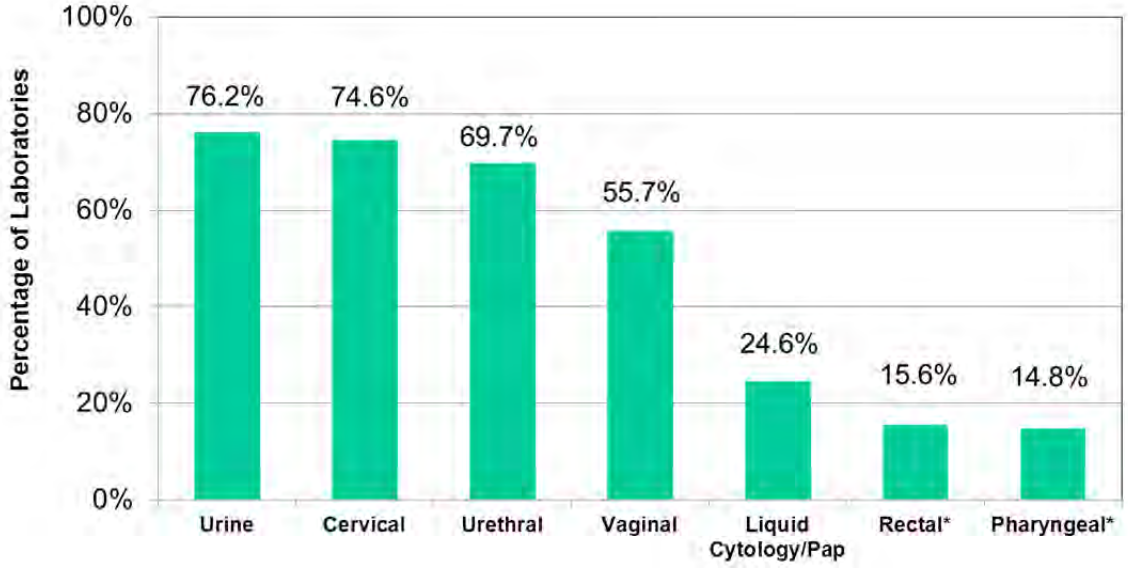
- Urine, urethral, and cervical specimens were the most commonly accepted specimens for NAAT testing (Figure 9). Of the 122 laboratories that run NAATs, 19 laboratories accepted rectal specimens, and 18 accepted pharyngeal specimens.

Although NAAT testing for rectal and pharyngeal infections has not yet been cleared by FDA, CDC and APHL recommend NAAT testing for these specimen types in selected populations due to higher sensitivity compared to culture.[4]

**Figure 9. Specimen Types Accepted by Laboratories Performing Gonorrhea NAAT, 2009 (N=122)**




NOTE: Categories are not mutually exclusive.
*Rectal and pharyngeal sites are not Food and Drug Administration (FDA)-cleared for NAAT testing and require individual laboratory verification study.
NAAT: nucleic acid amplification test

Prepared by the California Department of Public Health

- Of all 402 laboratory respondents, 188 or approximately half reported gonorrhea culture capacity. Among the 270 laboratories that conduct gonorrhea tests, the majority (70 percent) reported culture capacity. Use of culture decreased from 42.3 percent of all gonorrhea tests to 5.5 percent between 1996 and 2009 (Figure 8), coincident with increased NAAT testing. However, culture specimens are required for traditional antibiotic susceptibility testing, and reduced culture collection consequently reduces laboratories' ability to monitor antibiotic resistance.

- Only 22.9 percent of laboratories that reported culture testing for gonorrhea reported having the capacity to perform antibiotic susceptibility testing on positive cultures.

- Since 1999, California's Gonococcal Isolate Surveillance Project (GISP) has observed substantial increases in antibiotic resistance among isolates from men visiting four public STD clinics across the state. Increasing prevalence of fluoroquinolone-resistant gonorrhea prompted new treatment guidelines in California in 2002. In response to more recent concerns of emerging resistance to cephalosporins, in 2010 the CDC revised national treatment guidelines to recommend dual therapy for gonorrhea.[5]

## Syphilis testing

- Laboratories surveyed reported 2,354,953 tests for syphilis in 2009 (Table 3), an 8.9 percent decrease in testing volume from 2007 (Figure 4).

**Table 3. Syphilis Tests Reported by California Laboratories, 2009**

| Syphilis Test Type | Number of Labs | Number of Tests Performed | Percent of All Tests* | Number of Positive Tests | Percent Positive** |
|---|---|---|---|---|---|
| *Non-Treponemal Serology* | | | | | |
| RPR (Qualitative) | 224 | 1,445,451 | 59.9% | 51,080 | 3.7% |
| RPR (Quantitative) | 150 | 65,972 | 2.7% | | |
| VDRL (Qualitative) | 14 | 33,162 | 1.4% | 2,806 | 8.6% |
| VDRL (Quantitative) | 14 | 4,105 | 0.2% | | |
| VDRL on CSF | 29 | 6,123 | 0.3% | 163 | 2.8% |
| Other Non-Treponemal | 2 | 42 | 0.0% | 0 | 0.0% |
| Total Non-Treponemal | 238 | 1,484,778 | 63.0% | | |
| *Treponemal Serology* | | | | | |
| EIA (IgG/IgM) | 7 | 256,139 | 10.6% | 7,667 | 3.1% |
| CIA | 4 | 161,864 | 6.7% | 3,079 | 1.9% |
| TP-PA | 46 | 37,599 | 1.6% | 18,811 | 51.8% |
| FTA-ABS | 23 | 12,756 | 0.5% | 5,462 | 43.0% |
| Other Treponemal | 2 | 83 | < 0.1% | 34 | 41.0% |
| Total Treponemal | 72 | 468,441 | 19.9% | | |
| *Direct Detection* | | | | | |
| DFA-TP | 2 | 11,581 | 0.5% | 529 | 4.6% |
| Dark-field | 14 | 4,413 | 0.2% | 97 | 2.2% |
| Other Direct Detection | 2 | 25 | < 0.1% | 13 | 52.0% |
| Total Direct Detection | 16 | 16,019 | 0.7% | | |
| Blood Bank Screening | 11 | 385,715 | 16.4% | 314 | 0.1% |
| Total Syphilis Tests | 250 | 2,354,953 | 100.0% | | |

*(Number of tests performed/Total number of syphilis tests)*100
**(Number of tests positive/Number of tests performed among laboratories reporting positives)*100
Quantitative (titer) tests not included in table totals.
RPR: rapid plasma reagin; VDRL: Venereal Disease Research Laboratory; CSF: cerebrospinal fluid
EIA: enzyme immunoassay; IgG: immunoglobulin G; IgM: immunoglobulin M;
CIA: chemiluminescence immunoassay; TP-PA: *Treponema pallidum* particle agglutination; FTA-ABS: fluorescent treponemal antibody absorption; DFA-TP: direct fluorescent antibody-*Treponema pallidum*

Prepared by the California Department of Public Health

- Of all tests for syphilis, the majority (63.0 percent) was for non-treponemal serology tests, and 19.9 percent were treponemal serology tests. Few (less than one percent) were dark-field or other direct detection tests (Table 3). Rapid plasma reagin (RPR) and Venereal Disease Research Laboratory (VDRL) screening tests accounted for 97.4 percent and 2.2 percent, respectively, of all non-treponemal serology tests performed.

- Of the 224 laboratories that performed RPR tests, 150 laboratories performed a total of 65,972 RPR titers. All 14 laboratories that performed VDRL tests also determined VDRL titers.

- Of the 119 laboratories that performed RPR or VDRL tests and reported on procedures related to prozone reactions, 78 (65.5 percent) reported diluting all "rough" tests to rule out prozone reactions. An additional 8 laboratories (6.7 percent) reported diluting most "rough" tests, while another 33 (27.7 percent) diluted some "rough" tests. This practice is recommended by CDC to increase the sensitivity of these tests in early syphilis and to reduce false-negative test results.[6]

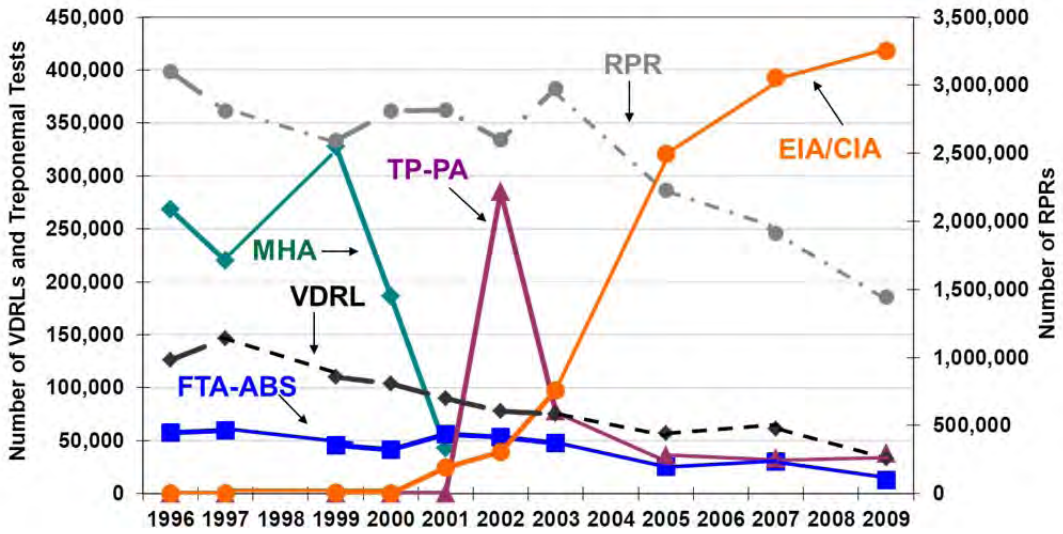
- Of the 200 laboratories that performed RPR or VDRL tests and provided data on confirmatory testing, 137 (68.5 percent) routinely confirmed positive qualitative RPRs/VDRLs with a treponemal test. An additional 63 laboratories (31.5 percent) routinely sent the sample to another laboratory for confirmation.

- Of the 210 laboratories that performed RPR or VDRL tests and provided data on titer determination, 175 (83.3 percent) routinely reflexed positive qualitative RPRs/VDRLs to a quantitative test (titer). An additional 35 laboratories (16.7 percent) routinely sent the sample to another laboratory for titer determination.

- Of the 25 laboratories that performed VDRL tests on cerebrospinal fluid (CSF), 24 (96.0 percent) routinely reported positives to the local health department.

- EIA/CIA tests accounted for 89.2 percent of treponemal serology tests in 2009, increasing from 0.2 percent in 1999. Although non-treponemal serologic tests (RPR and VDRL) comprised the majority (63.0 percent) of all syphilis tests in 2009, use of non-treponemal serologic tests decreased in the same time period, consistent with the increasing use of EIA/CIAs for syphilis screening (Figure 10).

**Figure 10. Syphilis Test Volume by Test Type, 1996-2009**




MHA: microhemagglutination. The laboratory survey discontinued data collection for MHA in 2002.
RPR: rapid plasma reagin
EIA: enzyme immunoassay
CIA: chemiluminescence immunoassay
TP-PA: Treponema pallidum particle agglutination
VDRL: Venereal Disease Research Laboratory
FTA-ABS: fluorescent treponemal antibody absorption

Prepared by the California Department of Public Health

- Six of nine responding laboratories that perform syphilis EIA or CIA tests routinely repeated all equivocal or positive tests to confirm results; one laboratory repeated tests with equivocal results only. Two laboratories did not routinely repeat equivocal or positive tests.

- Nine (81.8 percent) of the eleven laboratories performing syphilis EIA/CIA tests routinely reflexed all positives to a non-treponemal test. If results were discrepant, four (44.4 percent) of the nine laboratories reflex tested the specimen with a different treponemal test. For laboratories that screen for syphilis utilizing treponemal testing followed by reflex to a non-treponemal test, CDC recommends that all specimens with discrepant treponemal versus non-treponemal results be re-tested with a second different treponemal test.[7]

- Nine (81.8 percent) of the eleven laboratories performing syphilis EIA/CIA tests have generally replaced non-treponemal screening tests with EIA/CIA as the initial screening test. Screening for syphilis with EIA/ treponemal CIA immunoassays and then reflex testing reactive specimens with non-treponemal tests is more cost-saving for large-volume laboratories than the traditional sequence of screening with a non-treponemal test and confirming positive results with a treponemal test. However, it is unclear whether newer algorithms employing EIA/CIA as the initial screening test

are more sensitive for capturing early syphilis infections than traditional screening algorithms.[8]

- Other treponemal tests used in 2009 included *Treponema pallidum* particle agglutination (TP-PA), which accounted for 8.0 percent of treponemal tests, and FTA-ABS, accounting for 2.7 percent of all treponemal tests (Table 3, Figure 10). These tests are generally used as confirmatory rather than screening tests, which may explain high positivity percentages for these tests.

### Chancroid testing

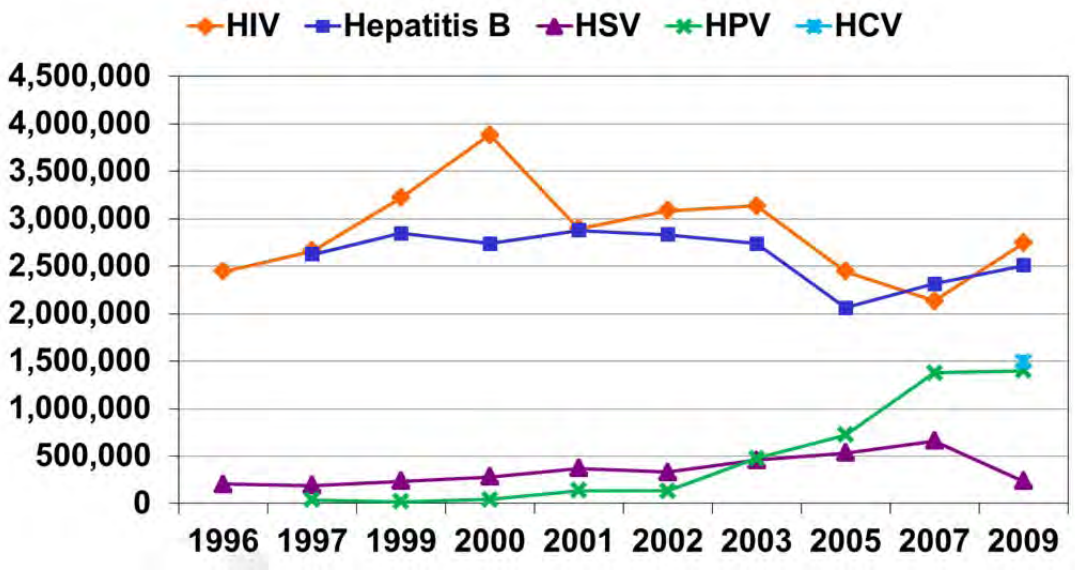
- Twenty-eight laboratories reported 677 tests for chancroid in 2009. Of these tests, 502 (74.2 percent) were *Haemophilus ducreyi* cultures, and 175 (25.8 percent) were gram stains.

- None of the tests were reported positive. No cases of chancroid were reported in California in 2009 consistent with very low levels of cases reported in prior years.

## VIRAL STD Testing

The total annual volume of reported tests in the period 1996 through 2009 for HIV, hepatitis B, HSV, and HPV are displayed in Figure 11. From 2007 to 2009, HIV test volume increased by 28.6 percent and may reflect impact of 2006 CDC guidelines recommending baseline HIV tests for persons aged 13-64 years. During this period, hepatitis B testing also increased by 8.4 percent. Testing for HSV, also a non-reportable condition decreased considerably by 64.2 percent from 2007 to 2009 and remains at a much lower volume compared with the other viral STDs. HPV testing has steadily increased since 2002 and particularly since 2007. These trends were concurrent with guidelines to co-test women age 30 and older with abnormal Pap smear findings.

**Figure 11. Human Immunodeficiency Virus (HIV), Hepatitis B, Herpes Simplex Virus (HSV), and Human Papillomavirus (HPV): Total Number of Tests, 1996-2009**




NOTE: HIV test numbers do not include viral loads or CD4 cell counts.
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## Human Immunodeficiency Virus (HIV) testing

- Of the laboratories surveyed, 252 performed a total of 2,744,397 HIV tests (Table 4) in 2009.

- The majority (78.6 percent) of the tests performed were EIA screening tests. Western blot and immunofluorescent assay (IFA) confirmatory testing accounted for less than one percent of all tests. Qualitative PCR testing comprised 1.0 percent, and pooled RNA screening, a newer test technology, comprised 5.5 percent of all HIV testing. HIV viral load testing and CD4 counts comprised 9.5 percent of HIV testing (Table 4).

**Table 4. Human Immunodeficiency Virus (HIV) Tests Reported by California Laboratories, 2009**

| HIV Test Type | Number of Labs | Number of Tests Performed | Percentage of all HIV Tests* | Number of Positive Tests | Percent Positive** |
|---|---|---|---|---|---|
| *HIV EIA Tests* | | | | | |
| Serum EIA Tests | 134 | 2,044,256 | 74.5% | 8,143 | 0.9% |
| Rapid Serum Tests | 117 | 86,731 | 3.2% | 859 | 1.1% |
| Oral EIA Tests | 15 | 24,304 | 0.9% | 662 | 2.7% |
| Urine EIA Tests | 1 | 1,361 | < 0.1% | 0 | 0.0% |
| Rapid Oral Tests | 7 | 386 | < 0.1% | 3 | 0.8% |
| Total EIA Tests | 235 | 2,157,038 | 78.6% | | |
| *Other HIV Tests* | | | | | |
| Viral Load | 29 | 152,060 | 5.5% | N/A | N/A |
| Pooled RNA Screening | 5 | 151,800 | 5.5% | 122 | 0.1% |
| CD4 Count | 30 | 108,638 | 4.0% | N/A | N/A |
| Qualitative RNA (PCR) | 6 | 26,956 | 1.0% | 1,343 | 5.0% |
| Serum Western Blot | 25 | 16,158 | 0.6% | 8,274 | 51.2% |
| Serum IFA | 15 | 2,795 | 0.1% | 2,301 | 82.9% |
| Oral Western Blot | 15 | 1,260 | < 0.1% | 1,070 | 85.4% |
| 4th Generation Ab/Ag (p24) | 2 | 1,068 | < 0.1% | 19 | 1.8% |
| Other HIV Tests | 13 | 126,624 | 4.6% | 793 | 1.9% |
| Total Other Tests | 72 | 587,359 | 21.4% | | |
| Total HIV Tests | 252 | 2,744,397 | 100.0% | | |

*(Number of tests performed/Total number of HIV tests)*100
**(Number of tests positive/Number of tests performed among laboratories reporting positives)*100
EIA: enzyme immunoassay PCR: polymerase chain reaction IFA: immunofluorescent assay
Ag/Ab: Antigen/Antibody

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## Hepatitis B Virus (HBV) testing

- Of the laboratories surveyed, 161 reported a total of 2,508,984 hepatitis B tests. The majority (95.4 percent) of tests were hepatitis B surface antigen tests (Table 5), most likely conducted for routine screening.

**Table 5. Hepatitis B Virus (HBV) Tests Reported by California Laboratories, 2009**

| Hepatitis B Test Type | Number of Labs | Number of Tests Performed | Percent of All Tests* | Number of Positive Tests | Percent Positive** |
|---|---|---|---|---|---|
| HBV Surface Antigen | 155 | 2,394,535 | 95.4% | 30,098 | 1.3% |
| HBV e-Antigen | 13 | 23,291 | 0.9% | 3,685 | 16.3% |
| HBV DNA | 17 | 91,158 | 3.6% | 9,222 | 11.3% |
| Total | 161 | 2,508,984 | 100.0% | | |

*(Number of tests performed/Total number of hepatitis B tests)*100
**(Number of tests positive/Number of tests performed among laboratories reporting positives)*100
DNA: Deoxyribonucleic acid Prepared by the California Department of Public Health.

## Hepatitis C Virus (HCV) testing

- Of the laboratories surveyed, 144 reported a total of 1,488,748 hepatitis C tests. The majority (63.8 percent) of tests were EIA or chemiluminescence immunoassay (CIA) tests (Table 6).

**Table 6. Hepatitis C Virus (HCV) Tests Reported by California Laboratories, 2009**

| Hepatitis C Test Type | Number of labs | Number of Tests Performed | Percentage of all HCV Tests* | Number of Positive Tests | Percent Positive** |
|---|---|---|---|---|---|
| *Antibody (Anti-HCV) Tests* | | | | | |
| EIA | 93 | 503,620 | 33.8% | 43,403 | 7.9% |
| CIA | 43 | 446,021 | 30.0% | 19,668 | 4.4% |
| RIBA (Chiron) | 4 | 2,765 | 0.2% | 1,436 | 51.9% |
| Total Antibody Tests | 136 | 952,406 | 64.0% | | |
| *Nucleic Acid Amplification Tests (NAATs)* | | | | | |
| HCV RNA (PCR, TMA, or bDNA) | 30 | 153,391 | 10.3% | 53,530 | 35.6% |
| Blood Bank Screening | 6 | 382,951 | 25.7% | - | - |
| Total | 144 | 1,488,748 | 100.0% | | |

*(Number of tests performed/Total number of hepatitis C tests)*100
**(Number of tests positive/Number of tests performed among laboratories reporting positives)*100
EIA: enzyme immunoassay; CIA: chemiluminescence immunoassay; RIBA: recombinant immunoblot assay; PCR: polymerase chain reaction; TMA: transcription mediated amplification

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- Of the 144 laboratories that conducted HCV testing, 45 (31.3 percent) routinely reported the signal-to-cutoff ratio or index value for the HCV antibody tests to their local health departments; of those 45 reporting laboratories, 27 (60.0 percent) included a comment on signal-to-cutoff/index value interpretation in their lab reports.

- Of the 144 laboratories that conducted HCV testing, 33 (22.9 percent) had the ability to automate reporting for only those positive antibody tests for which the signal-to-cutoff ratio was predictive of a true positive; 37 (25.7 percent) had the ability to report only those positive antibody tests confirmed by a more specific assay (e.g., RIBA, PCR).

## Herpes Simplex Virus (HSV) testing

- Of the laboratories included in the survey, 68 performed 236,018 HSV tests. Of these, 71.9 percent were serologic tests, 21.6 percent were cultures, 3.8 percent were PCR tests, and 2.8 percent were direct antigen tests (Table 7).

**Table 7. Herpes Simplex Virus (HSV) Tests and Positivity Reported by California Laboratories, 2009**

| HSV Test Type | Number of Labs | Number of Tests Performed | Percentage of all HSV Tests* | Number of Tests Positive | Percent Positive** |
|---|---|---|---|---|---|
| Culture | 41 | 50,967 | 21.6% | 20,040 | 39.3% |
| PCR | 12 | 8,927 | 3.8% | 1731 | 19.4% |
| *Direct Antigen Tests* | | | | | |
| EIA | 5 | 3,438 | 1.5% | 1690 | 49.2% |
| DFA | 21 | 2,249 | 1.0% | 143 | 6.4% |
| Other Direct Antigen | 1 | 847 | 0.4% | 17 | 2.0% |
| Total Direct Antigen | 25 | 6,534 | 2.8% | | |
| *Serologic Tests* | | | | | |
| Type-specific HSV-2 IgG | 29 | 81,948 | 34.7% | 13,410 | 17.0% |
| Type-specific HSV-1 | 25 | 70,507 | 29.9% | 24,791 | 36.9% |
| Type-specific HSV-2 IgM | 4 | 11,877 | 5.0% | 3,891 | 32.8% |
| Non-type-specific antibody | 5 | 4,611 | 2.0% | 1,501 | 32.6% |
| Other Serology | 2 | 647 | 0.3% | 24 | 3.7% |
| Total Serology | 32 | 169,590 | 71.9% | | |
| Total HSV Tests | 68 | 236,018 | 100.0% | | |

*(Number of tests performed/Total number of HSV tests)*100
**(Number of tests positive/Number of tests performed among laboratories reporting positives)*100
PCR: polymerase chain reaction EIA: enzyme immunoassay
DFA: direct fluorescent antibody
IgG: Immunoglobulin G IgM: Immunoglobulin M

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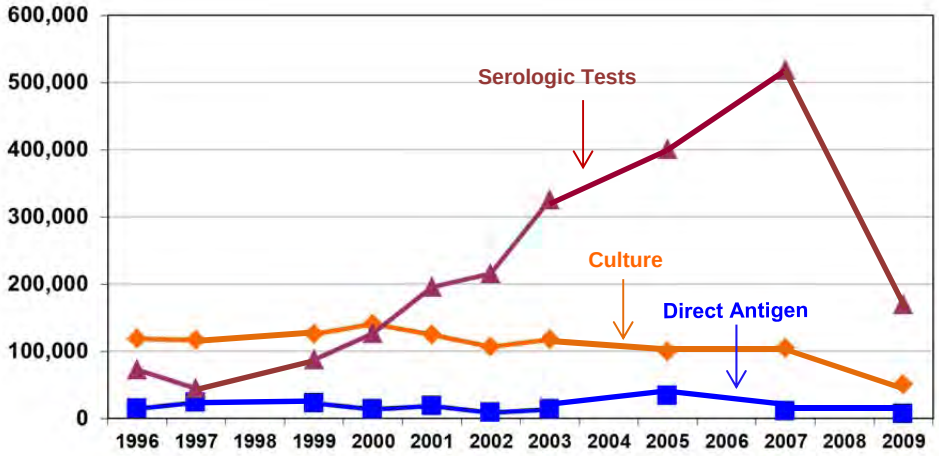
- 55.3 percent of HSV serologic tests were HSV-2 type-specific; 41.6 percent were HSV-1 type-specific. An additional 2.7 percent of HSV serology tests were non-

type-specific (Table 7); tests that do not distinguish between HSV-1 and HSV-2 have limited clinical value and are not recommended.[9]

- Reported HSV test volume decreased dramatically, by 64.2 percent, from 2007 to 2009, after a period of increased testing from 1996 to 2007, mostly consisting of increases in serologic tests (Figure 12). 2003 California guidelines recommend increased availability of type-specific serology for diagnostic testing in conjunction with virologic tests.[9]

**Figure 12. Herpes Simplex Virus Test Volume by Test Type, 1996-2009**

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## Human Papillomavirus (HPV) testing

- Fifty-eight laboratories offered HPV DNA testing in 2009, performing a total of 1,400,868 tests. Of these, 93.2 percent were hybrid capture assays (Table 8). HPV testing increased slightly (1.7 percent) between 2007 and 2009, following a large increase in volume from 2005 to 2007 (90.7 percent).

**Table 8. Human Papillomavirus (HPV) Tests and Positivity Reported by California Laboratories, 2009**

| HPV Test Type | Number of Labs | Number of Tests Performed | Percentage of all HPV Tests* | Number of Positive Tests | Percent Positive** |
|---|---|---|---|---|---|
| *Nucleic Acid Tests* | | | | | |
| Hybrid Capture II (High-Risk) | 38 | 1,280,697 | 91.4% | 173,803 | 13.6% |
| Hybrid Capture II (Low-Risk) | 8 | 12,187 | 0.9% | 1,187 | 9.7% |
| Hybrid Capture II (Combined) | 5 | 13,162 | 0.9% | 3,198 | 24.3% |
| Cervista (High risk) | 6 | 25,512 | 1.8% | 4,806 | 18.8% |
| Cervista (Type-specific 16/18) | 1 | 252 | < 0.1% | 139 | 55.2% |
| NAAT | 8 | 66,614 | 4.8% | 13,774 | 20.7% |
| Other HPV Tests | 3 | 2,444 | 0.2% | 349 | 14.3% |
| Total | 58 | 1,400,868 | 100.0% | | |

*(Number of tests performed/Total number of HPV tests)*100
**(Number of tests positive/Number of tests performed among laboratories reporting positives)*100
NAAT: nucleic acid amplification test

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- Multiple national organizations recognize the utility of high-risk HPV type testing for: 1) management of women with atypical squamous cells of undetermined significance (ASC-US) cervical cytology results, 2) selected clinical evaluation for cervical dysplasia, and 3) adjunct screening with cytology for women ages 30 to 65.[10,11,12] However, low-risk HPV type tests, conducted alone or combined with high-risk tests, do not have clinical utility in screening or diagnosis.[10]

## CERVICAL CYTOLOGY

- Of the laboratories surveyed, 159 laboratories performed 3,729,164 cervical cytology tests. Of these, 98 (61.6 percent) reported performing 2,966,737 liquid-based Pap tests, while 71 (44.7 percent) performed 762,427 conventional (dry slide) cytology tests.

- Of 3,659,326 cervical cytology tests performed in laboratories that were able to report abnormal results, 236,918 (6.5 percent) were reported out with an abnormal result. Of these, most were classified as ASC-US (60.8 percent) and low-grade squamous intra-epithelial lesion (LSIL) (29.0 percent) (Table 9).

**Table 9. Pap Smear Results Reported by California Laboratories, 2009**

| Classification | Number Reported | Percentage of all Paps* |
|---|---|---|
| No Evidence of Dysplasia | 3,422,408 | 93.5% |
| Abnormal Result | | |
| Atypical Squamous Cells of Undetermined Significance (ASC-US) | 143,939 | 3.9% |
| Atypical Squamous Cells, Cannot Exclude HSIL (ASC-H) | 6,016 | 0.2% |
| Low-Grade Squamous Intra-epithelial Lesion (LSIL) | 68,716 | 1.9% |
| High-Grade Squamous Intra-epithelial Lesion (HSIL) | 7,954 | 0.2% |
| Atypical Glandular Cells | 6,521 | 0.2% |
| Cancer (Squamous Cell Carcinoma or Adenocarcinoma) | 440 | < 0.1% |
| Other Abnormal Result | 3,332 | 0.1% |
| Total Abnormal Results | 236,918 | 6.5% |

*Of 3,659,326 tests performed in laboratories able to report abnormal results

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## CERVICAL HISTOLOGY

- Of the laboratories surveyed, 130 reported evaluating 138,094 cervical histology specimens (i.e., biopsy, endocervical curettage, loop electrical excision procedure, or surgical specimens). Of histology specimens evaluated, 125,357 (90.8 percent) were evaluated in laboratories that were able to report abnormal results.
- Of histology tests performed in laboratories that were able to report abnormal results, 49,625 (39.6 percent) were reported out with an abnormal result (Table 10).

**Table 10. Cervical Histology Results Reported by California Laboratories, 2009**

| Classification | Number Reported | Percentage* |
|---|---|---|
| No Evidence of Dysplasia | 75,732 | 60.4% |
| *Abnormal Result* | | |
| Mild Dysplasia | 31,784 | 25.4% |
| Moderate/Severe Dysplasia (including adenocarcinoma in situ) | 15,954 | 12.7% |
| Cervical Cancer | 1,887 | 1.5% |
| Total Abnormal Results | 49,625 | 39.6% |

*Of 125,357 specimens evaluated in laboratories that were able to report abnormal results

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## ELECTRONIC REPORTING READINESS

- Of the 342 laboratories that responded to the questions regarding electronic reporting capabilities in 2009:

    - 12.9 percent (44 laboratories) reported that their electronic reporting capability was fully developed and they were sending data electronically to local health jurisdictions (LHJs). Most of these laboratories reported a high volume of STD tests;
    - 6.7 percent (23 laboratories) reported that their electronic reporting capability was fully developed but they were not sending data to LHJs;
    - 21.3 percent (73 laboratories) reported that systems for electronic reporting were planned but not developed;
    - 59.1 percent (202 laboratories) reported that systems for electronic reporting were neither planned nor developed.

- Laboratories reporting fully developed electronic reporting capabilities were also asked about their ability to send formed Health Level Seven (HL7) messages. Of the 62 laboratories that responded:

    - 74.2 percent (46 laboratories) responded “Yes”; 6.5 percent (4 laboratories) responded “No” and 19.4 percent (12 laboratories) responded “Don’t know.”
    - Of laboratories that reported the HL7 version used, 84.4 percent (27 laboratories) were using Version 2 and 15.6 percent (5 laboratories) were using Version 3.

- Laboratories that did not have developed electronic reporting capabilities and had no plans for such were asked to explain why; of laboratories that responded (N=141 of 202):

    - 51.8 percent (73 laboratories) identified financial constraints;
    - 44.0 percent (62 laboratories) identified lack of technical resources;
    - 32.6 percent (46 laboratories) cited other reasons, including low/no volume, no request for change, current or planned conversion of computer systems taking priority;
    - 22.0 percent (31 laboratories) stated that there was no perceived utility.

## TECHNICAL NOTES

The 2009 California Clinical Laboratory Survey sample was based on a list of all licensed laboratories in California in 2010 (N=3346), provided by the CDPH Laboratory Field Services Branch. Laboratories were eligible for survey recruitment if the state ID prefix was CLF (state licensed non-physician operated with federal CLIA certificate that can perform waived, moderate, and high complexity testing) or CPH (public health laboratory). Laboratories were excluded if the state ID prefix was CLR (clinical laboratory with state certificate of registration that can perform waived tests, i.e., has federal CLIA certificate of waiver), CLP (physician office laboratory that is performing physician performed microscopy), CLM (physician office laboratory that is not accredited and can perform waived and non-waived testing with federal CLIA certificate of accreditation), COS (non-California laboratory with a federal CLIA certificate), CNC (non-licensed/registered laboratory), or CMS (multiple sites under one license or registration).

Of the 1,624 eligible California laboratories that were sent surveys to collect 2009 testing data, 1,409 (86.8 percent) returned the surveys. Of the 215 non-responders, 24 laboratories (11.2 percent) had closed since the previous survey; 4 laboratories (1.9 percent) were draw stations only; 2 laboratories (0.9 percent) refused to complete the survey; 38 (17.7 percent) appear, based on previous surveys, to not perform STD tests; 78 (36.3 percent) had unknown STD testing status, and 69 (32.1 percent) were known from previous surveys to perform STD tests in prior years. Of the 1,409 responders, 39 (2.8 percent) were draw stations only, 968 (68.7 percent) did not perform STD or Pap testing, and 402 (28.5 percent) reported STD testing, Pap testing, or both STD and Pap testing. These 402 laboratories were considered the analytic sample in this survey summary.

The response rate was calculated by dividing the number of laboratories that responded and reported STD or Pap testing (N = 402) by the number of laboratories considered eligible or potentially eligible (N = 551). Eligible laboratories included those known to perform STD or Pap testing; potentially eligible laboratories included those with unknown STD testing status. The response rate was 73.0 percent.

Follow-up contact was attempted with all laboratories that did not respond to the survey, and contact was also attempted with laboratories that reported performing tests but did not report numbers of tests performed or numbers positive. Those laboratories that reported testing but did not provide testing numbers were included in the analysis and were counted towards the numbers of laboratories performing tests; however, numbers of tests and/or numbers of positives may be underestimated, due to missing data.

Follow-up efforts were more comprehensive in 2009, 2007 and 2003 than in 2005, due to staffing shortages during the implementation of the 2005 survey. Thus, testing volume data collected for 2005 may have been impacted, and comparisons of 2005 data with that of latter or previous years should be interpreted with caution.

Two final notes on analysis and interpretation of data: First, among the California laboratories that responded to the survey, some laboratories were known to perform tests on specimens from patients outside of California. Similarly, some California specimens were sent to laboratories outside of California for testing, and this survey did not capture information on those specimens. Thus, comparisons of testing volume data with California disease trends also should be interpreted with caution.

Second, in recent years, there has been increased use of rapid STD tests and point-of-care STD tests in clinic settings; there is likely to be under-reporting of these tests conducted outside of licensed laboratories, which must also be considered in the interpretation of testing data.

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Suggested citation:

California Department of Public Health. Sexually Transmitted Disease Testing in California: 2009 Clinical Laboratory Survey Summary. Available at www.std.ca.gov.

## ADDITIONAL RESOURCES

[1]Current laboratory reports and disease trend information are available on the CDPH/ DCDC/STD Control Branch website: http://www.cdph.ca.gov/data/statistics/Pages/STDData.aspx. Information on previous laboratory reports and disease trends may be requested from the California Department of Public Health, STD Control Branch, Epidemiology Unit at stdepi@cdph.ca.gov or 510-620-3400.

[2]Information on infectious disease reporting, including a list of reportable diseases and reporting laws, can be found at the CDPH/DCDC website. See "Reportable Diseases": http://www.cdph.ca.gov/HealthInfo/Pages/ReportableDiseases.aspx

[3]Information on HIV reporting can be found at the CDPH Office of AIDS website: http://www.cdph.ca.gov/programs/aids/Pages/tOAHIVRptgSP.aspx

[4]Laboratory Diagnostic Testing for *Chlamydia trachomatis* and *Neisseria gonorrhoeae*: Expert Consultation Meeting Summary Report (January 2009): http://www.aphl.org/aphlprograms/infectious/std/Documents/ID_2009Jan_CTGCLab-Guidelines-Meeting-Report.pdf

[5]Update to CDC's *Sexually Transmitted Diseases Treatment Guidelines, 2010*: Oral Cephalosporins No Longer a Recommended Treatment for Gonococcal Infections. MMWR Aug 12, 2012; 61(31);590-594. http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6131a3.htm?s_cid=mm6131a3_w

[6]CDC guidelines for syphilis laboratory testing can be found on the CDC website: http://www.cdc.gov/std/program/med&lab.pdf

[7]CDC-recommended algorithm for reverse sequence syphilis screening: MMWR Feb 11, 2011; 60(5);133-137. http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6005a1.htm

[8]Review of syphilis testing algorithms using treponemal tests for initial screening: MMWR Aug 15, 2008; 57(32);872-875. http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5732a2.htm

[9]California Guidelines for the Use of Herpes Simplex Virus (HSV) Type 2 Serologies: http://www.cdph.ca.gov/HealthInfo/discond/Documents/Herpes-Full-Guide.pdf

[10]ACS, ASCCP, ASCP screening guidelines for the prevention and early detection of cervical cancer: http://journals.lww.com/jlgtd/PublishingImages/ASCCP%20Guidelines.pdf#zoom=80

[11]ACSSP Consensus Guidelines for Managing Abnormal Cervical Cancer Screening Tests and Cancer Precursors (2012)
http://www.asccp.org/ConsensusGuidelines/tabid/7436/Default.aspx

[12]US Preventive Services Task Force recommendations on cervical cancer screening:
http://www.uspreventiveservicestaskforce.org/uspstf/uspscerv.htm