Fighting the rise of STI rates with rapid testing and early detection

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Disclosures & Acknowledgments

- Financial disclosures:
  - Roche diagnostics
  - Clinical Care Options
  - UpToDate
  - GSK
  - Chembio
- **A NOTE: In this lecture if I use cisgender centric language it is either for ease of discussion, clarity, or due to the language used in the research cited, and is not in any way intended as an erasure for other important demographics (e.g., trans men, trans women, nonbinary and intersex people) who may also be affected by STIs**

Objectives

- Review the most current U.S. HIV and syphilis surveillance data.
- Explain the current testing guidelines for HIV and syphilis.
- Summarize HIV and syphilis testing methods and algorithms.
- Describe the importance of dual testing for HIV and syphilis and the benefits of rapid testing.

HIV

HIV in the US (10/27/2022)

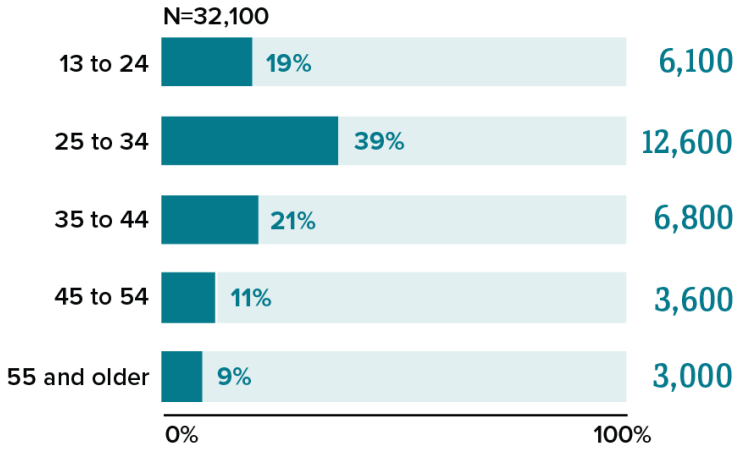
- Approximately 1.2 million people in the U.S. have HIV.
- About **13 percent are unaware (156,000)**.
- HIV - disproportionate impact on certain populations, particularly racial and ethnic minorities and gay, bisexual, and other men who have sex with men.
- In 2020, 30,635 people diagnosed in U.S. and 6 dependent areas—a **17% decrease from the prior year**, likely due to the impact of the COVID-19 pandemic on HIV prevention, testing, and care-related services.
- The highest rates of new diagnoses continue to occur in the South.

https://www.hiv.gov/hiv-basics/overview/data-and-trends/statistics/
2019 National HIV Surveillance System Reports | NCHHSTP | CDC

HIV in the US – updates (5/23/2023)

- Estimated annual new HIV infections were **12%** lower in 2021 compared to 2017
  - Dropping from about 36,500 infections to about 32,100
  - The decline was driven by a **34% decrease in new infections among 13- to 24**-year-olds, mostly among gay and bisexual males.

People aged 13 to 34 accounted for more than half (58%) of estimated HIV infections in 2021.

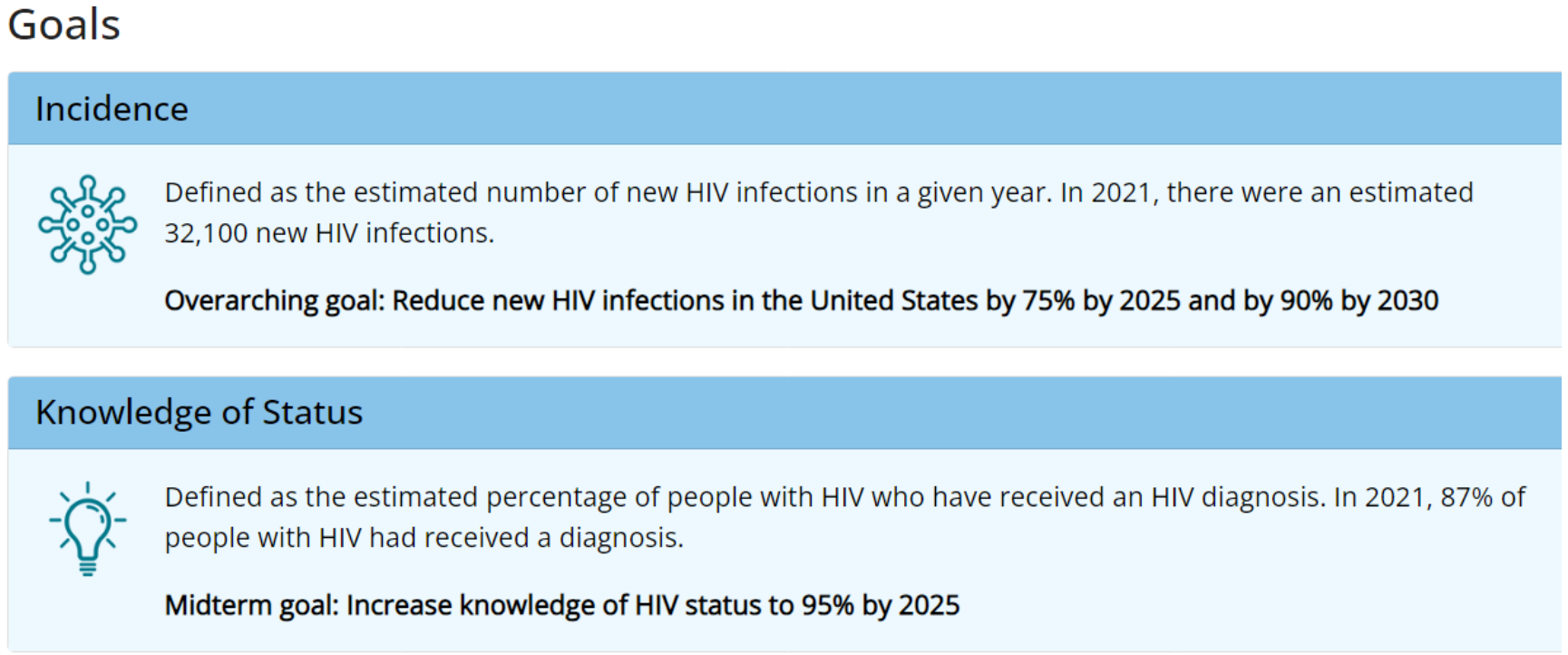


Source: CDC. Estimated HIV incidence and prevalence in the United States 2017–2021. *HIV Surveillance Supplemental Report* 2023;28(3).

https://www.cdc.gov/hiv/library/reports/hiv-surveillance/vol-28-no-3/index.html

Ending the HIV epidemic (EHE)

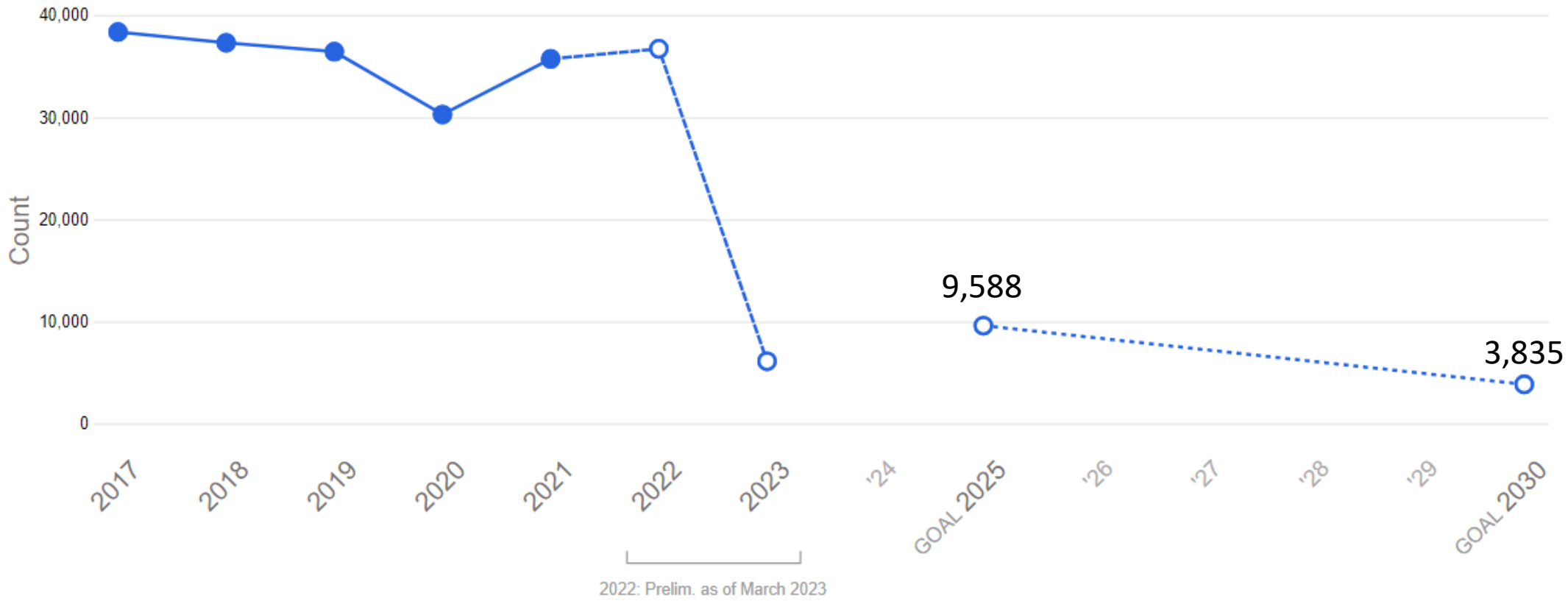
- Reducing new HIV infections in the United States by 75% by 2025 and by 90% by 2030
- 4 pillars:
  - **Diagnose**
  - Treat
  - Prevent
  - Respond



Latest U.S. HIV Data | EHE Progress | Ending the HIV Epidemic in the U.S. Initiative | CDC
https://www.cdc.gov/nchhstp/newsroom/2021/2019-national-hiv-surveillance-system-reports.html#Graphics

National Goals	Decrease confirmed HIV diagnoses by 75% by 2025 and 90% by 2030.	In 2021, 35,716 people were diagnosed with HIV.

Number of people diagnosed with HIV for a given year nationwide.



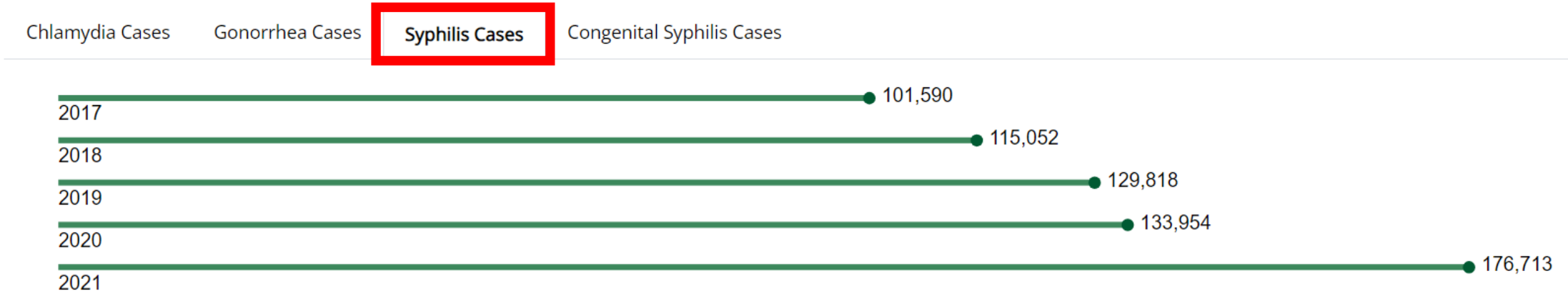
Diagnoses is one of the six EHE indicators. Diagnoses is the number of people with HIV infection diagnosed in a given year confirmed by laboratory or clinical evidence.

SYPHILIS

Syphilis in the US

Centers for Disease Control and Prevention
CDC 24/7: Saving Lives, Protecting People™

Sexually Transmitted Disease Surveillance 2021



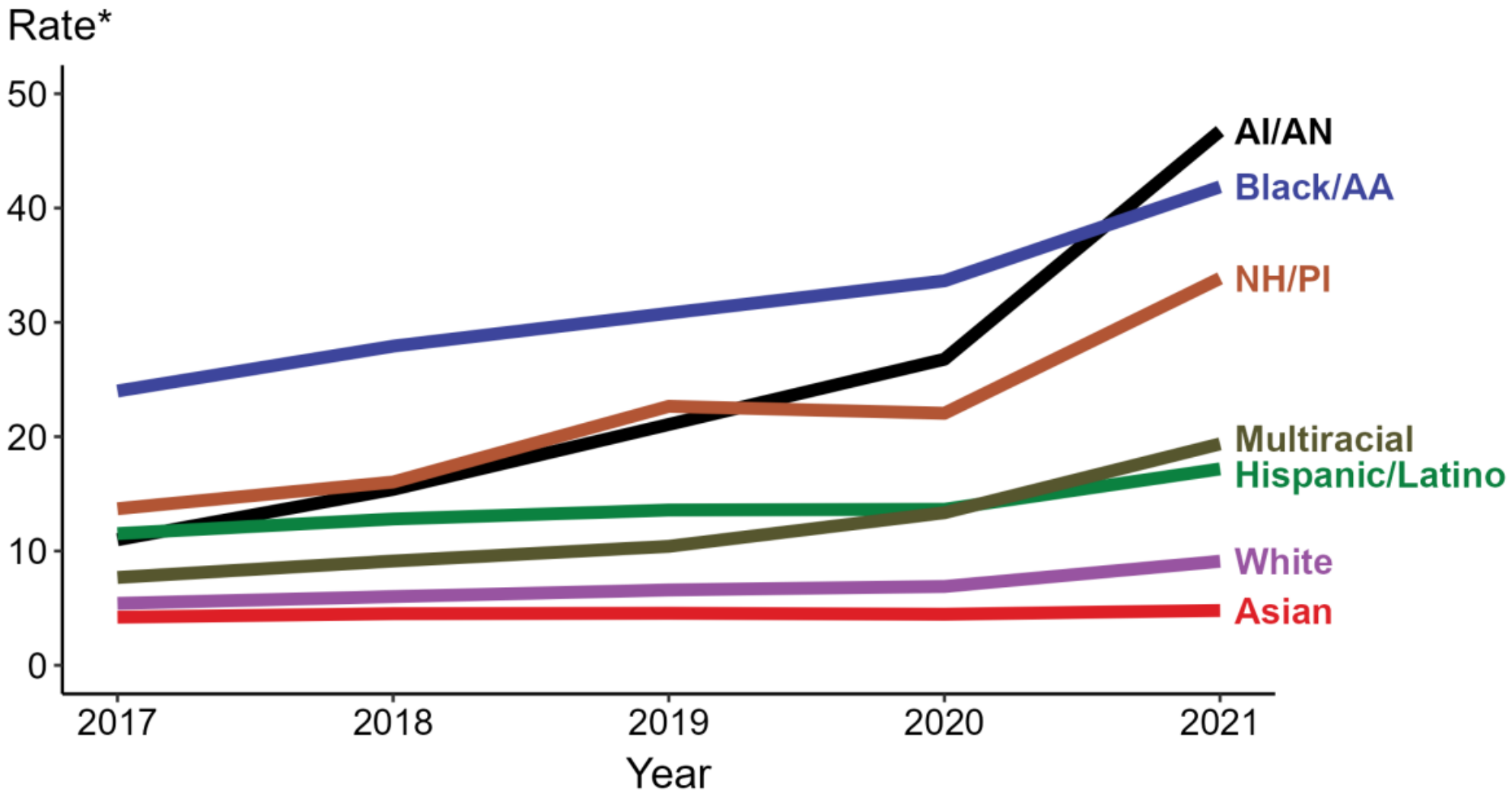
Syphilis – epidemiology

- **2021**, 176,713 cases of syphilis (all stages and congenital syphilis)
  - 53,767 cases of primary and secondary (P&S) syphilis.
- Historic lows in 2000 and 2001, P&S syphilis rates increased almost every year
  - +28.6% 2020-2021.
- Rates increased among both males and females, in all regions, and age groups.
- **MSM** disproportionately impacted (46.5%) of all male P&S syphilis cases in 2021.
- Rates of P&S syphilis are lower among **women** but have increased +55.3% during 2020 to 2021
  - 217.4% during 2017–2021, highlighting the sustained increase in the **heterosexual syphilis** epidemic in the United States.

https://www.cdc.gov/std/statistics/2021/overview.htm

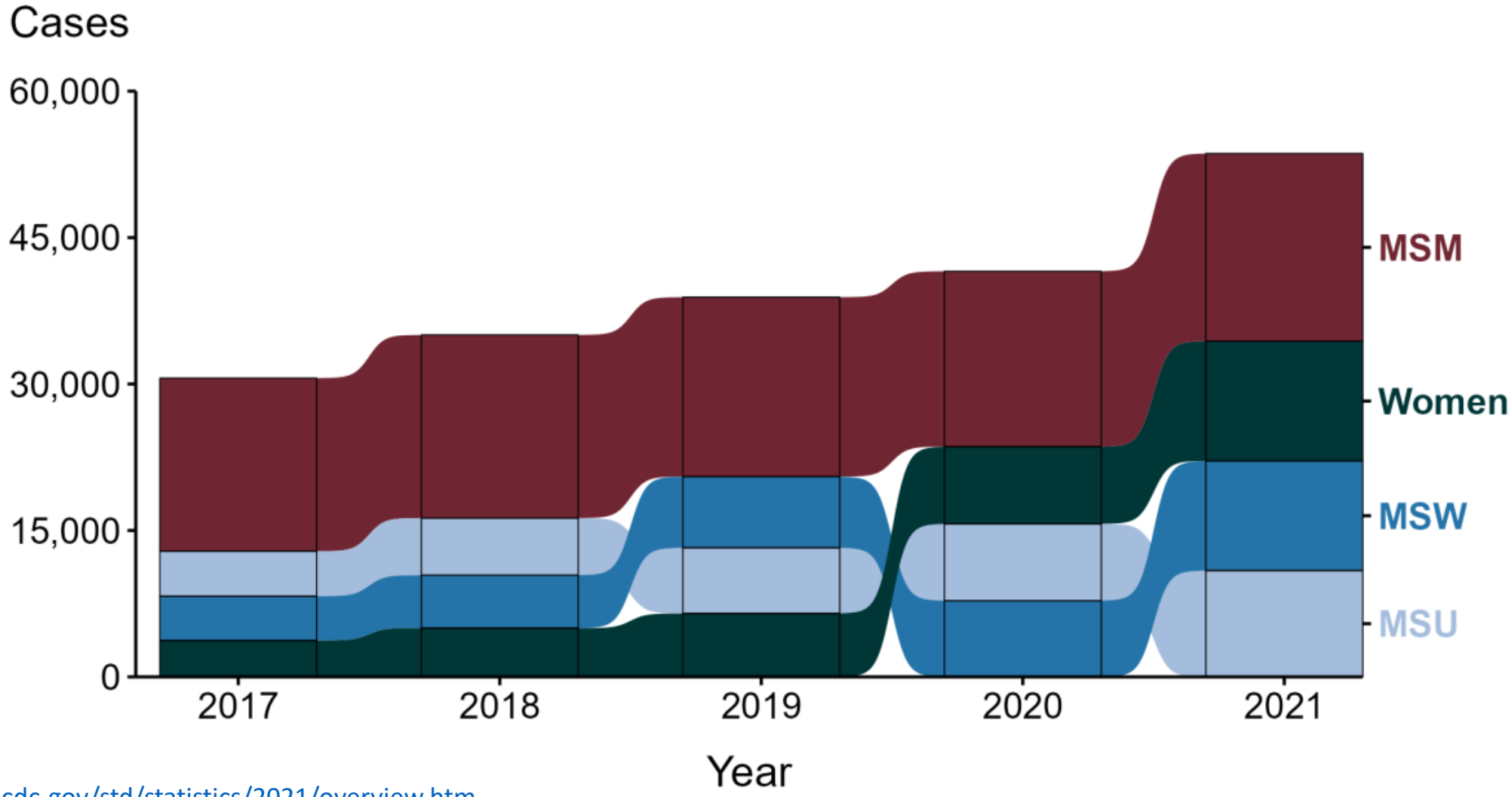
Primary and Secondary Syphilis — Rates of Reported Cases by Race/Hispanic Ethnicity, United States, 2017–2021

ACRONYMS:
AI/AN = American Indian or Alaska Native;
Black/AA = Black or African American;
NH/PI = Native Hawaiian or other Pacific Islander



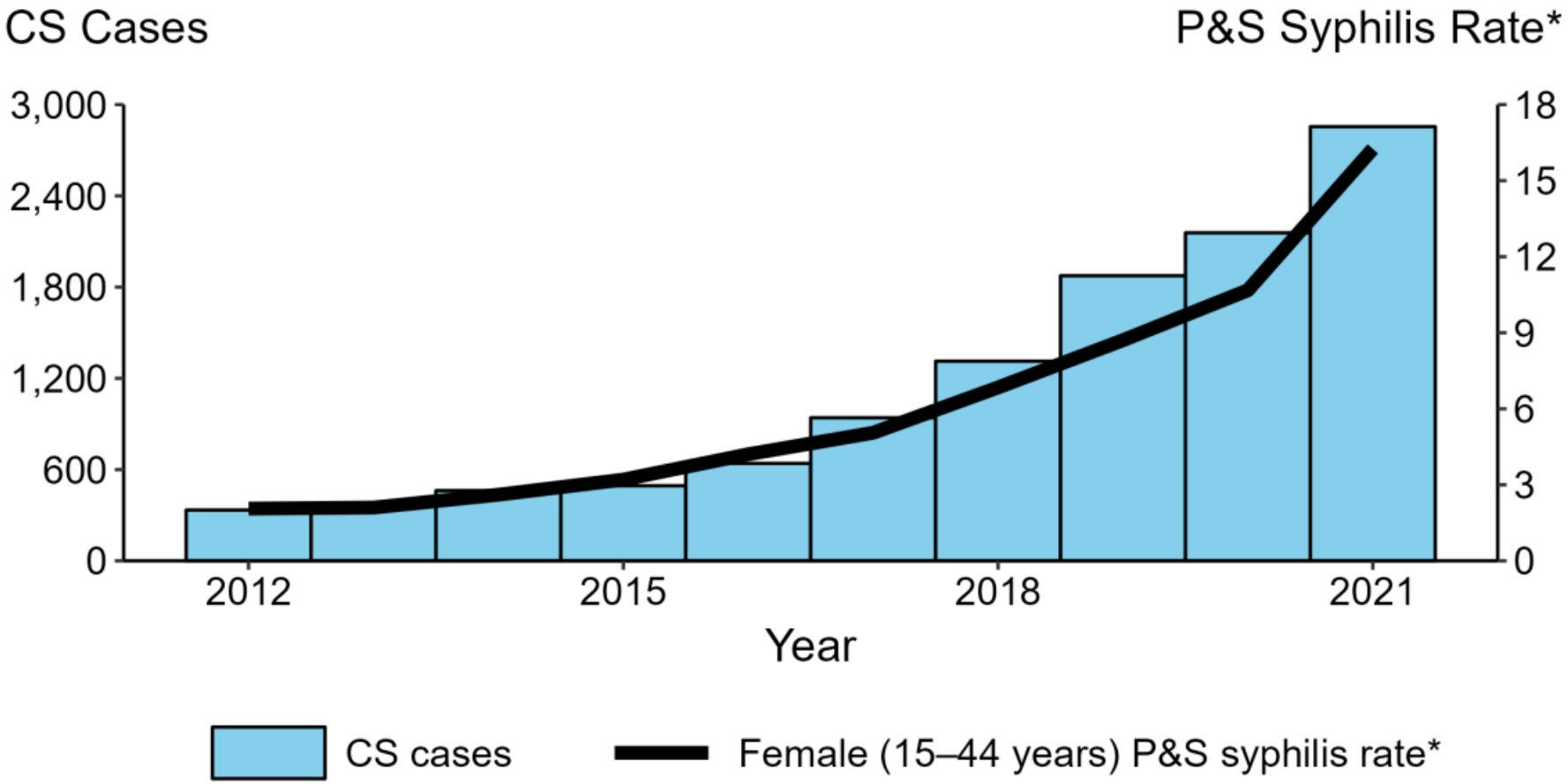
https://www.cdc.gov/std/statistics/2021/overview.htm

Primary and Secondary Syphilis — Reported Cases by Sex and Sex of Sex Partners, United States, 2017–2021



https://www.cdc.gov/std/statistics/2021/overview.htm

Congenital Syphilis — Reported Cases by Year of Birth and Rates of Reported Cases of Primary and Secondary Syphilis Among Women Aged 15–44 Years



https://www.cdc.gov/std/statistics/2021/overview.htm

Congenital syphilis – the facts

CS can cause:

- **Miscarriage**, **Stillbirth**.
- **Prematurity**, low birth **weight**.
- **Death** shortly after birth.

For babies born with CS:

- Deformed **bones**.
- Severe **anemia** (heart failure).
- Enlarged liver and spleen, jaundice (yellowing of the skin or eyes).
- **Brain** and nerve problems, like **blindness** or **deafness**, **meningitis**, and rashes.

https://www.cdc.gov/std/syphilis/stdfact-congenital-syphilis.htm

Congenital syphilis – the facts

CS can cause:

- **Miscarriage, Stillbirth**
- **Premat**
- **Death**

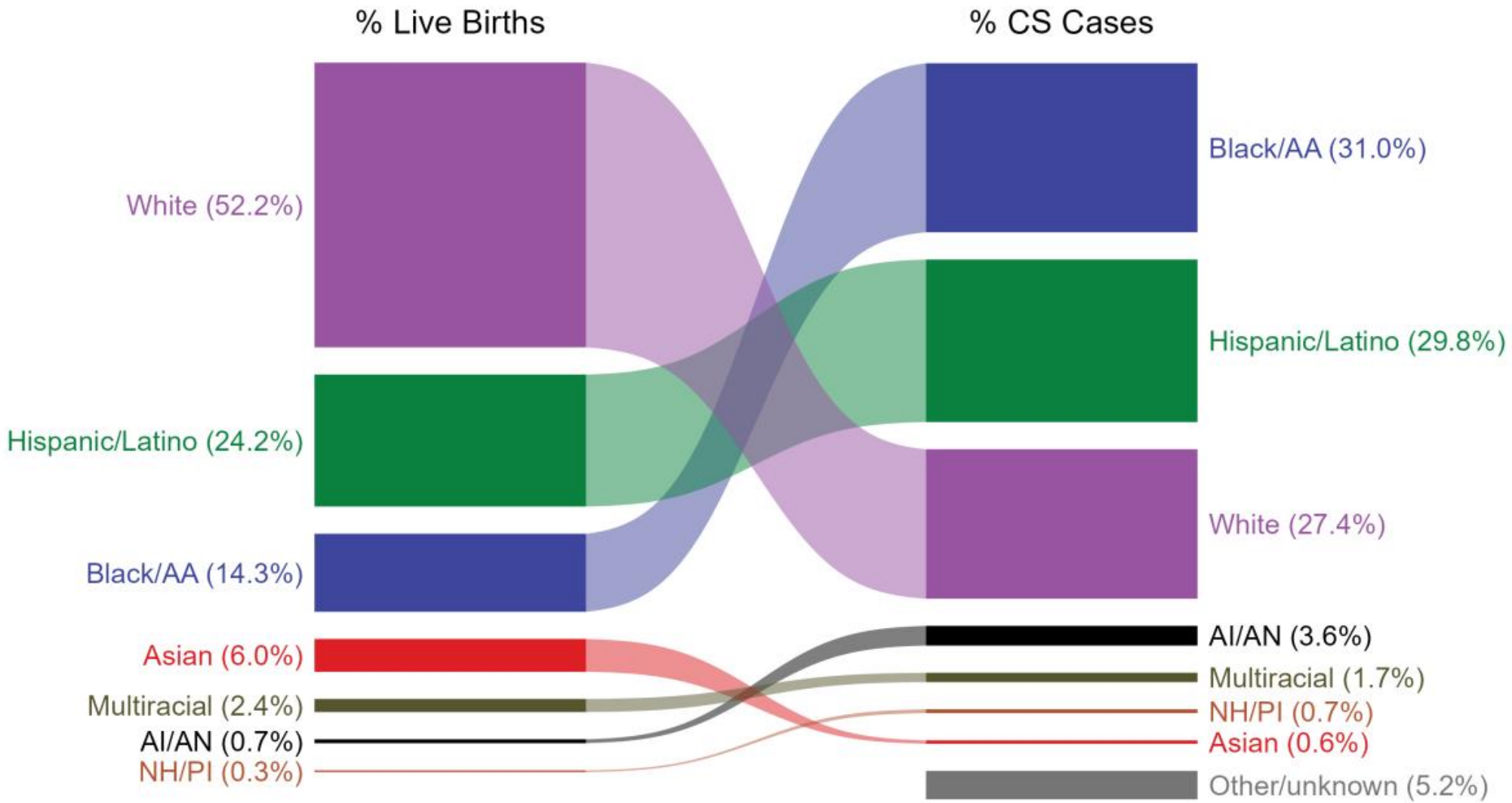
For bab

- Deform
- Severe
- Enlarged
- **Brain** and nerve problems, like **blindness** or **deafness**, **Meningitis**, and Skin rashes.

Congenital syphilis is preventable (early diagnosis and treatment).
Every case of congenital syphilis is a failure of public health in the U.S.

https://www.cdc.gov/std/syphilis/stdfact-congenital-syphilis.htm

Disparities in congenital syphilis



https://www.cdc.gov/std/statistics/2021/figures/disp-1.htm

HIV AND SYPHILIS

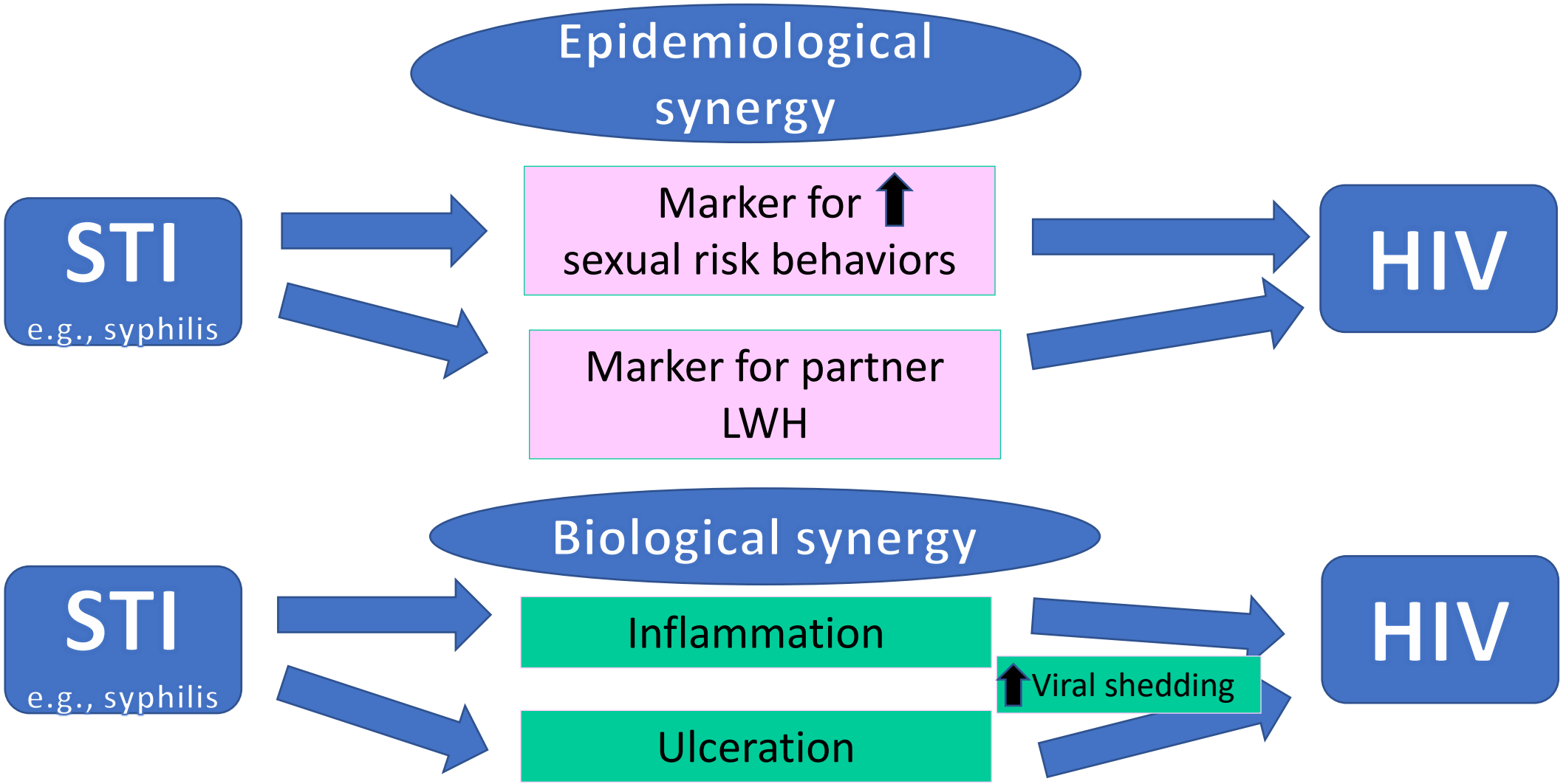
HIV and syphilis – acquisition

STD	HIV TXN	Unadj. OR (95% CI)	Location	Study
Syphilis	M→M	3.5 (1.9-6.2)	San Francisco	Darrow, 1987
	M→M	2.3 (1.3-4.1)	Amsterdam	Kuiken, 1990
	All	2.9 (1.9-4.3)	Miami	Otten, 1994
	M→M	3.8 (1.3-10.8)	Vancouver	Craib, 1995
	M→F	3.7 (101-12)	Bell Glade	Dominguez, 1996
HSV-2	M→M	2.5 (1.1-6.2)	San Francisco	Holmberg, 1988
Anogenital HSV	M→M	3.9 (1.7-9.8)	Amsterdam	Keet, 1990

HIV and syphilis – transmission

Syndrome	Risk Estimate – Median (range)
Genital ulcers	4.7 (3.3 - 18.2)
Syphilis	3.0 (2.0 - 9.9)
Genital Herpes	3.3 (1.9 - 8.5)
Chlamydial Infection	4.5 (3.2 – 5.7)
Gonorrhea	4.7 (3.5 – 8.9)
Trichomonas	2.7
Anogenital Warts	3.7

Biological and epidemiological interactions between HIV & STIs



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Pathela P, Braunstein SL, Blank S, Schillinger JA. HIV incidence among men with and those without sexually transmitted rectal infections: estimates from matching against an HIV case registry. Clin Infect Dis 2013;57:1203-1209.

Cohen MS, Hoffman IF, Royce RA, et al. Reduction of concentration of HIV-1 in semen after treatment of urethritis: implications for prevention of sexual transmission of HIV-1. Lancet 1997;349:1868-1873.

Schacker T, Ryncarz AJ, Goddard J, Diem K, Shaughnessy M, Corey L. Frequent recovery of HIV-1 from genital herpes simplex virus lesions in HIV-1—infected men. JAMA 1998;280:61-66.

Cohen MS, Council OD, Chen JS. Sexually transmitted infections and HIV in the era of antiretroviral treatment and prevention: the biologic basis for epidemiologic synergy. Journal of the International AIDS Society 2019, 22(s6)e25355.

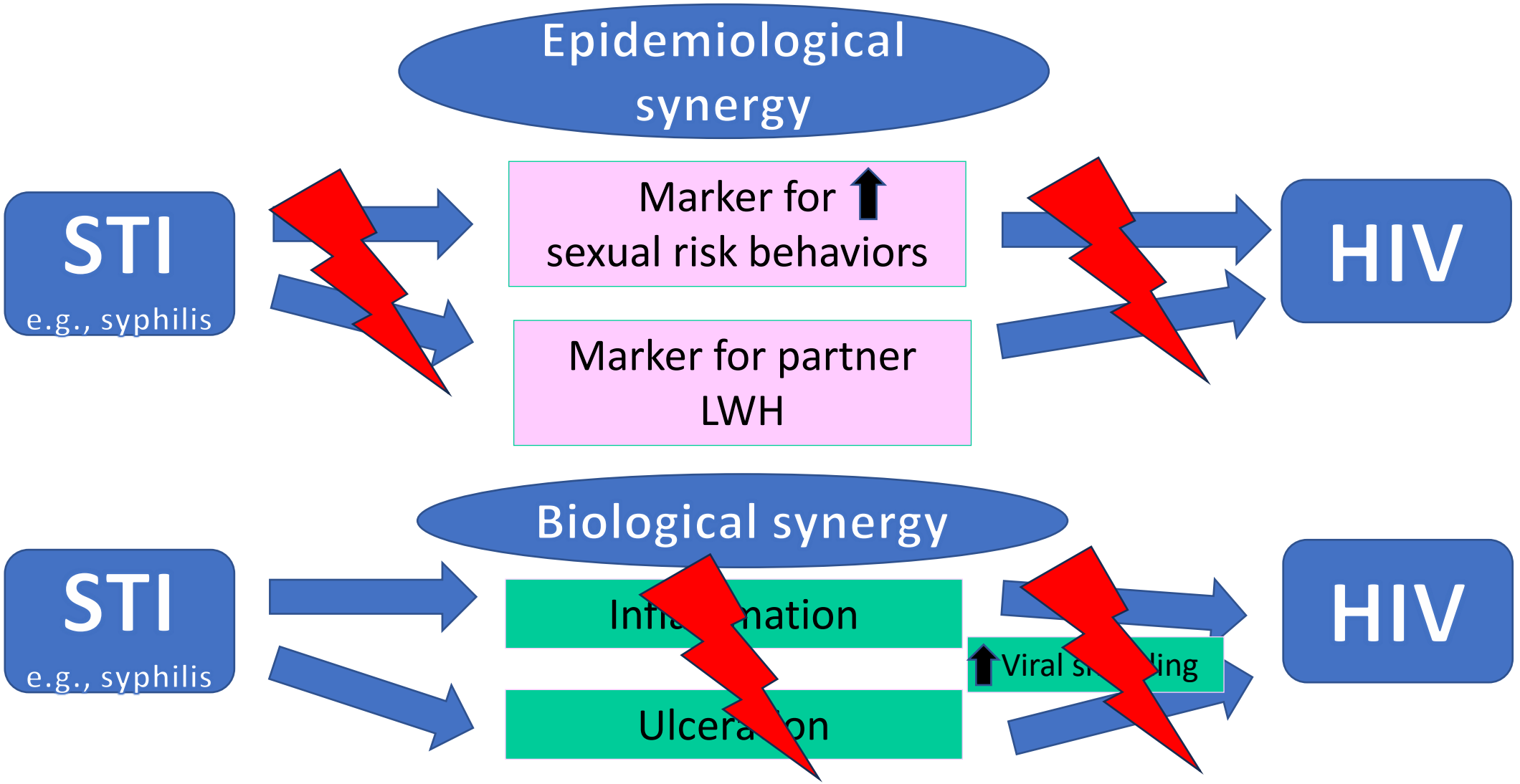
Pathela P, Braunstein SL, Schillinger JA, Shepard C, Sweeney M, Blank S. Men who have sex with men have a 140-fold higher risk for newly diagnosed HIV and syphilis compared with heterosexual men in New York City. J Acquir Immune Defic Syndr 2011;58:408-416.

Kaul R, Kimani J, Nagelkerke NJ, et al. Monthly antibiotic chemoprophylaxis and incidence of sexually transmitted infections and HIV-1 infection in Kenyan sex workers: a randomized controlled trial. JAMA 2004;291:2555-2562.

Watson-Jones D, Weiss HA, Rusizoka M, et al. Effect of herpes simplex suppression on incidence of HIV among women in Tanzania. N Engl J Med 2008;358:1560-1571.

Celum C, Wald A, Hughes J, et al. Effect of acyclovir on HIV-1 acquisition in herpes simplex virus 2 seropositive women and men who have sex with men: a randomized, double-blind, placebo-controlled trial. Lancet 2008;371:2109-2119.

Biological and epidemiological interactions between HIV & STIs



Testing for HIV and syphilis

- Who to offer testing to?
- When to test?
- How to test?

HIV - Screening Recommendations

CDC and **USPSTF** recommend HIV screening **at least once** for all persons aged 15–65 years.

https://www.cdc.gov/std/treatment-guidelines/hiv.htm

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CDC:

- All persons seeking STI evaluation who are not already known to have HIV infection.
- Persons at higher risk, including sexually active **MSM**, should be screened for HIV at least annually.
  - Consider more frequent screening (e.g., every 3–6 months).
- All **pregnant** women during the first prenatal visit. A second test during the third trimester, preferably at <36 weeks' gestation, should be considered and is recommended for women who are at high risk for acquiring HIV infection.

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- Providers should use a **lab-based antigen/antibody** combination assay as the first test for HIV, unless persons are unlikely to follow up where screening with a **rapid POC test** can be useful.

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- Preliminary **positive screening** tests require supplemental testing to establish the diagnosis.

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- Preliminary **positive screening** tests require supplemental testing to establish the diagnosis.
- HIV RNA used if initial testing according to the HIV testing algorithm recommended by CDC is negative or indeterminate when concerned about **acute HIV infection** (https://stacks.cdc.gov/view/cdc/50872).
  - Providers should not assume that a laboratory report of a negative HIV Ag/Ab or antibody test indicates that the requisite HIV RNA testing for acute HIV infection has been conducted.

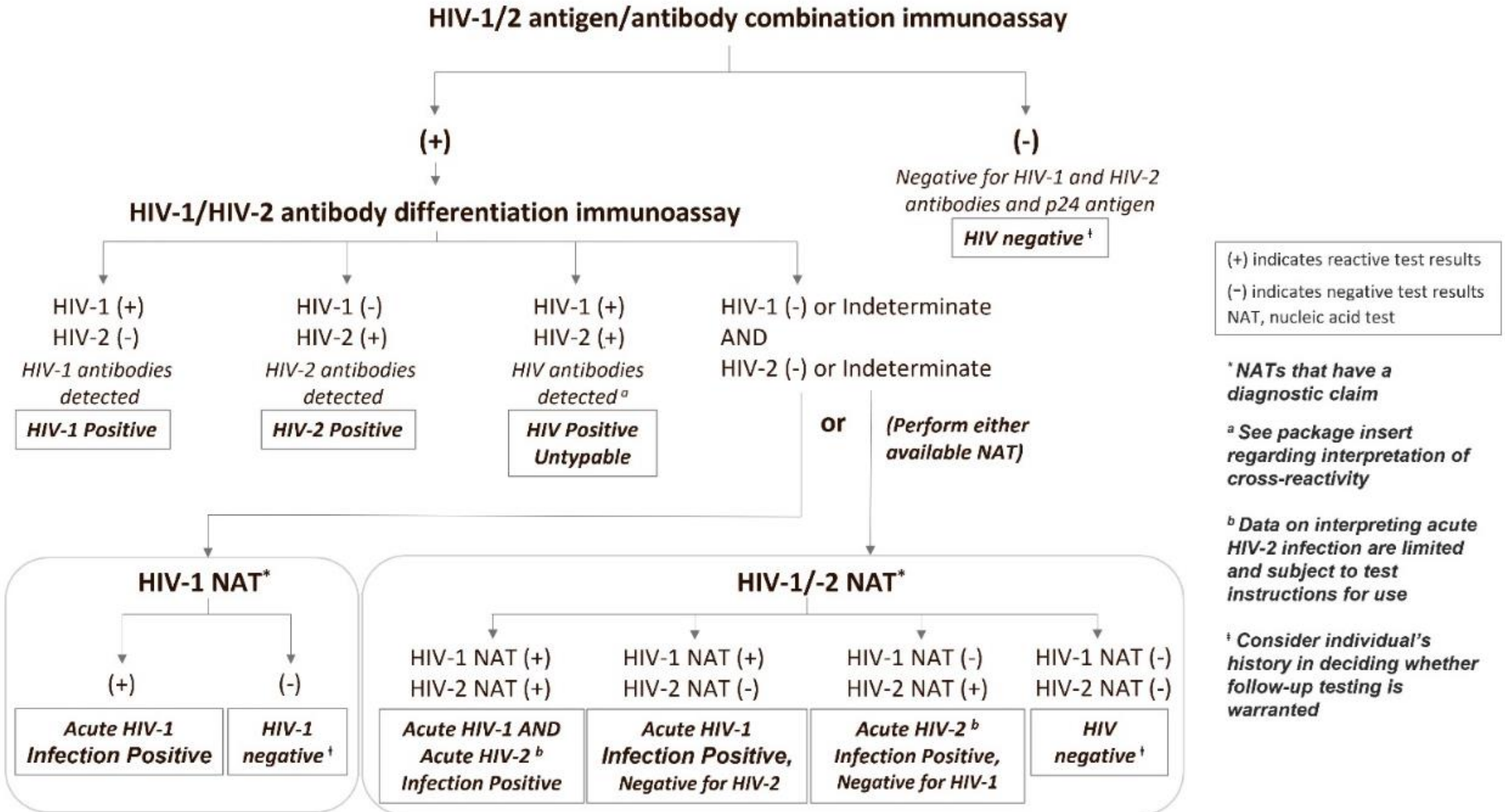
https://www.cdc.gov/std/treatment-guidelines/hiv.htm

HIV nucleic acid tests (NATs) for HIV diagnosis

- May 2023. Three HIV (NATs) approved by the U.S. Food and Drug Administration (FDA) for diagnostic use:
  - the cobas® HIV-1/HIV-2 Qualitative test ("HIV-1/HIV-2 Qualitative test," approved August 2020, Roche Molecular Systems Inc., Branchburg NJ),
  - the Aptima® HIV-1 Quant Dx Assay (approved November 2020, Hologic Inc., San Diego, CA),
  - the Alinity m HIV-1 Assay ("HIV-1 Assay," approved July 2022, Abbott Molecular, Inc., Des Plaines, IL); the latter two assays provide both a qualitative and quantitative result.

- CDC and Association of Public Health Laboratories (APHL) have not changed the recommendation that laboratories perform an HIV-1/HIV-2 antibody differentiation supplemental immunoassay as the second step after a reactive antigen/antibody screening immunoassay.

Technical Update for HIV Nucleic Acid Tests Approved for Diagnostic Purposes (cdc.gov)



[Technical Update for HIV Nucleic Acid Tests Approved for Diagnostic Purposes (cdc.gov)]

Syphilis – screening recommendations

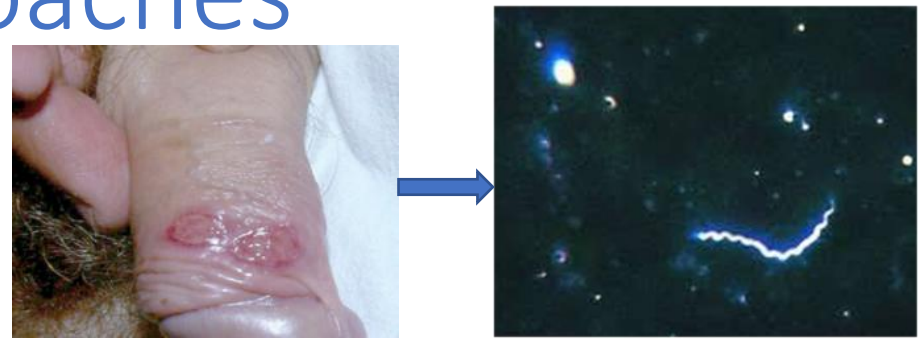
Population	Recommendations (based on CDC)
Women	Consider screening if they **exchanged** sex for drugs or money in the past year; have a **new sex** partner, >1 sex partner, a sex partner with concurrent partners, or a sex partner who has an STI; or are receiving care in **high-prevalence settings**
MSW	Screen those at increased risk (based on history of **incarceration** or **transactional** sex work, geography, race and ethnicity, and <29 y) and consider testing at least annually those at high risk (e.g., **exchanging** sex for money, using **methamphetamines**, injection drugs, heroin, or having sex with a person who injects drugs or for those receiving care in high-prevalence settings, such as STI clinics)
MSM/Transgender and other gender diverse people/PWH	At least annually
Pregnancy*	First prenatal visit; At 28 wk and at delivery if high risk or based on local laws
People using HIV PrEP	
MSM/TGW who have sex with men	At least every 6 mo; every 3 mo (or 4 mo if receiving cabotegravir PrEP) among those at high risk (multiple sex partners or had syphilis, *C trachomatis*, or *N gonorrhoeae* at prior visits)
Women/MSW	Every 6 months

https://www.cdc.gov/std/treatment-guidelines/hiv.htm

Tuddenham S , Hamill MM, Ghanem KG. Diagnosis and Treatment of Sexually Transmitted Infections: A Review. JAMA. 2022;327(2):161–172. doi:10.1001

*State Statutory and Regulatory Language Regarding Prenatal Syphilis Screenings in the United States. https://www.cdc.gov/std/treatment/syphilis-screenings.htm#legal

Current syphilis diagnostic approaches



- Primary-stage lesions:
  - PCR from swab of lesion exudate or biopsy specimen, Darkfield microscopy on lesion exudate (not for oral lesions)
  - Direct fluorescent antibody testing on lesion exudate
  - Silver stain on tissue biopsy
- In the absence of primary-stage lesions, serological testing using a combination of treponemal and nontreponemal (antiphospholipid) antibody tests.
- For neurosyphilis, CSF examination assessing for pleocytosis, protein concentration, and VDRL and/or treponemal antibodies.

Tuddenham S, Hamill MM, Ghanem KG. Diagnosis and Treatment of Sexually Transmitted Infections: A Review. JAMA. 2022;327(2):161–172. doi:10.1001
Patient image: https://dermnetnz.org/topics/syphilis

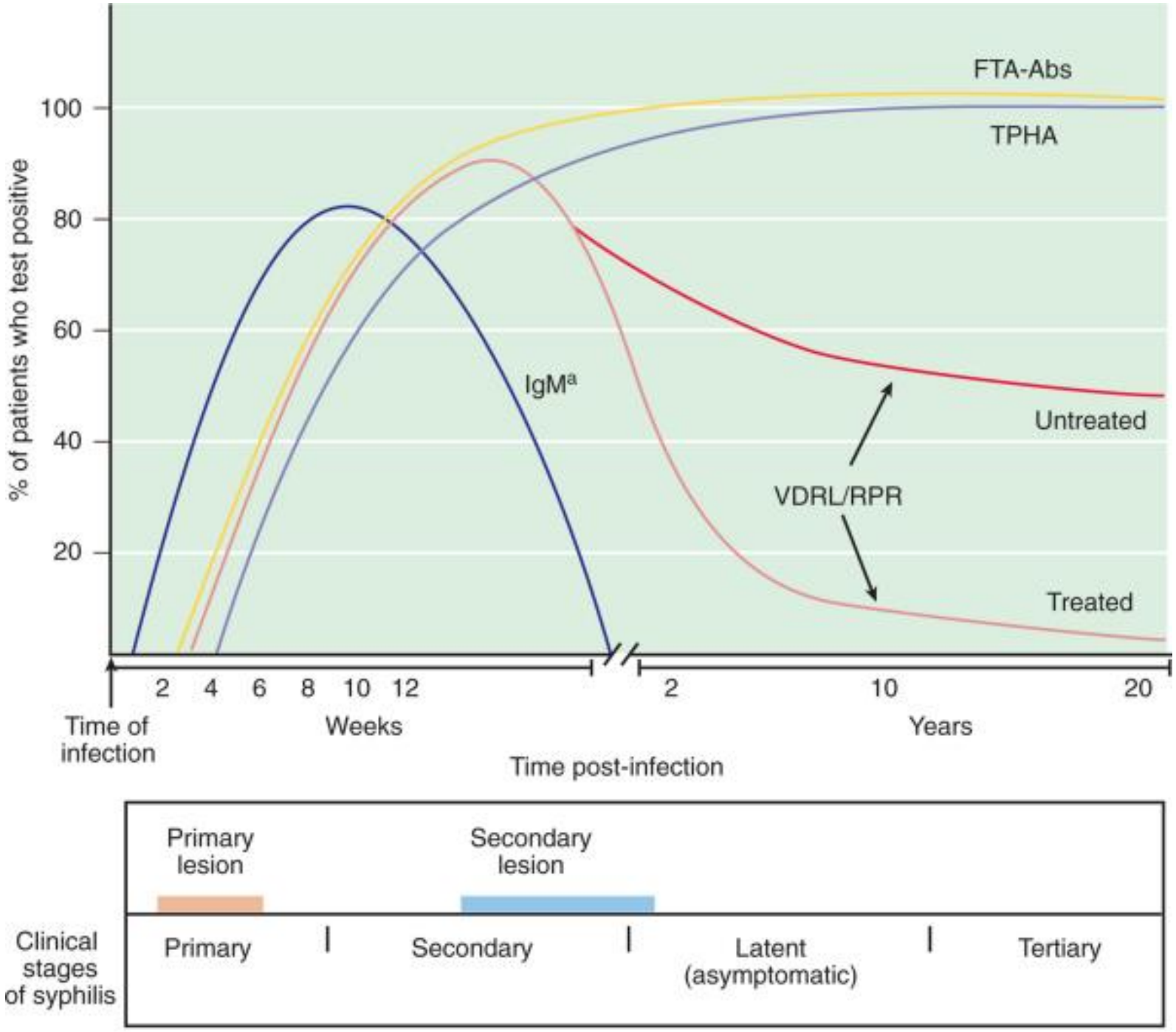
Diagnosing Syphilis

Non treponemal tests: (RPR, VDRL)

- Nonspecific tests that are very sensitive.
- If negative (and you don't suspect primary syphilis), then the patient is very unlikely to have syphilis and no more testing is needed.
- If positive, then you need to confirm the positive test result by ordering a TREPONEMAL test.
- NTT provide a dilutional 'titer'. These go up and down with treatment (and time) e.g., 1:64→1:32→1:2.

Treponemal Tests (TPPA, FTA-ABS, EIAs)

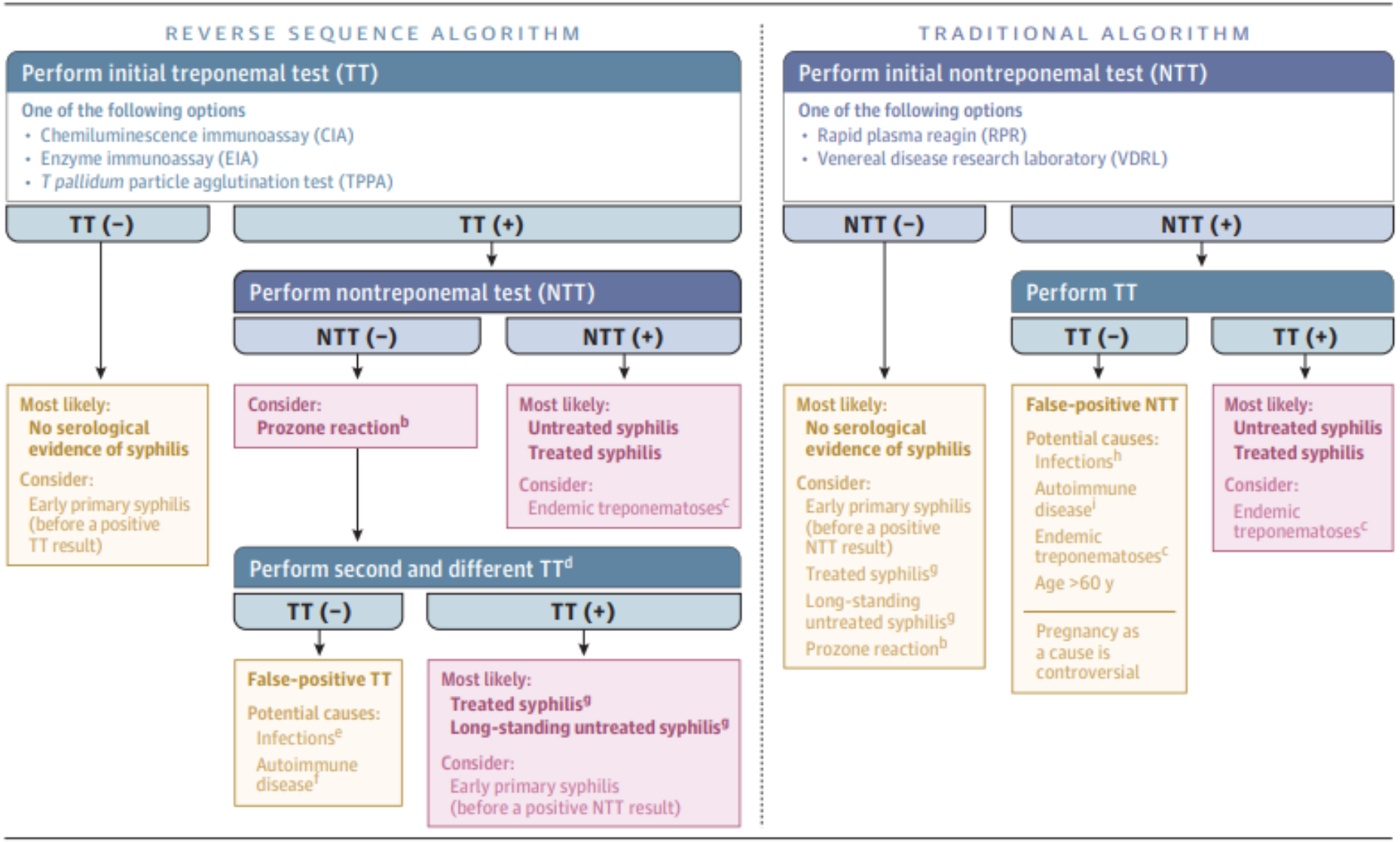
- Test for the presence of antibodies that are treponemal-specific. These tests are very specific for syphilis.
- These tests do NOT provide a titer that we can follow after therapy.
- Once positive ALWAYS positive even after treatment.



Peeling et al. Bulletin of WHO 2004; 82(6):439-46

Park IU et al. Clin Infect Dis. 2020 Jun 24;71(Suppl 1):S13-S20. doi: 10.1093/cid/ciaa349.
Tuddenham S et al. Clin Infect Dis. 2020 Jun 24;71(Suppl 1):S21-S42. doi: 10.1093/cid/ciaa306

Methods of testing for syphilis



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Syphilis testing algorithms

- Are complex.
- Are multi-step including TT and NTTs.
- Results can be difficult to interpret.
- Cause confusion for patients and providers.

https://www.stdccn.org/render/Public

What are the key features for POCT?

- <20 minutes – willingness to wait threshold unless you change clinic workflow.
- Easy to perform – able to be performed by paraprofessionals.
- Affordable – low cost of goods (COGS) for device and consumables.
- Small footprint – many labs in clinics have limited space.
- Multiplex or parallelization, random access.

Widdice LE STD 2018; Gettinger J STD 2020
Robinson M IEEE Open J Eng Med Biol. 2021

Rapid diagnostics – what do we need?

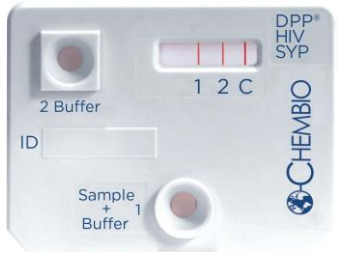
- **R**: real-time connectivity
- **E**: ease of specimen collection, environmental friendliness
- **A**: affordable
- **S**: sensitive
- **S**: specific
- **U**: user-friendly
- **R**: rapid
- **E**: equipment-free
- **D**: delivered

- **Low cost without compromising quality**
- **Consideration of cost of goods up front**

Land KJ Nat Microbiol 2019; Mabey D Nat Rev Microbiol 2004;

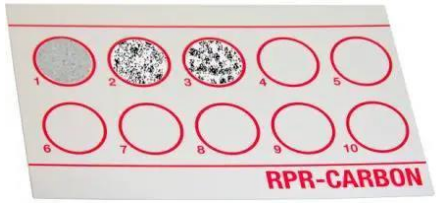
Where are we now? Limited Menu of Assays in US

POC



Chembio HIV/syphilis

Trinity syphilis



Rapid Plasma Reagin*

Solana TV*

Visby NG/CT/TV

Cepheid NG/CT*

Osom TV

Binx NG/CT

*CLIA-waiver not granted

Manabe YC Clin Chem 2021

POCT for HIV and syphilis – the evidence

RPR – performance characteristics

- Castro et al, 2003. Prospective cross-sectional study n = 25 with **secondary** syphilis
  - Gold standard: FTA-ABS+ and clinical findings
  - Sensitivity: RPR+: 25/25 = 100%
- Singh et al, 2008. Retrospective case series n = 1303 with **late latent** syphilis
  - Gold standard: FTA-ABS or MHA-TP, and clinical context
  - Sensitivity: RPR+: 791/1303 = 61%

Tuddenham S et al. Clin Infect Dis. 2020 Jun 24;71(Suppl 1):S21-S42. doi: 10.1093/cid/ciaa306

Performance characteristics – Syphilis Health Check (SHC) (Trinity)

- Fingerstick whole blood and serum specimens from 562 adult patients without prior syphilis history presenting at 2 health department STD clinics in North Carolina.
- The fingerstick:
  - Sensitivity of 100% (7 of 7) [RPR and EIA reactive]
  - Specificity of 95.7% (531 of 555) [RPR and EIA reactive]
  - Sensitivity of 50% (8 of 16), [treponemal EIA]
  - Specificity of 95.9% (523 of 546), [treponemal EIA]
- STD clinic staff reported difficulty reading the test line for the SHC

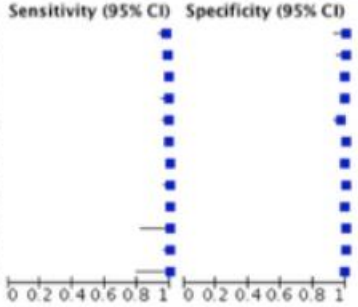
Fakile YF, Brinson M, Mobley V, Park IU, Gaynor AM. Performance of the Syphilis Health Check in Clinic and Laboratory-Based Settings. Sex Transm Dis. 2019 Apr;46(4):250-253. doi: 10.1097/OLQ.0000000000000974

Performance characteristics of dual platforms

a) Diagnostic test accuracy for HIV, stratified by manufacturer

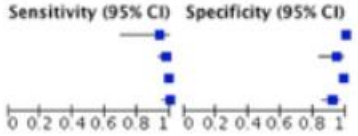
i) SD Bioline: HIV component

Study	TP	FP	FN	TN	Sensitivity (95% CI)	Specificity (95% CI)
[33] Humphries (SD Bioline)	94	0	2	53	0.98 [0.93, 1.00]	1.00 [0.93, 1.00]
[45] Black	185	0	2	62	0.99 [0.96, 1.00]	1.00 [0.94, 1.00]
[38] Yin (SD Bioline)	721	8	7	778	0.99 [0.98, 1.00]	0.99 [0.98, 1.00]
[41] Bristow	104	2	1	308	0.99 [0.95, 1.00]	0.99 [0.98, 1.00]
[42] Bristow	128	5	1	164	0.99 [0.96, 1.00]	0.97 [0.93, 0.99]
[30] Ondondo	345	0	1	352	1.00 [0.98, 1.00]	1.00 [0.99, 1.00]
[35] Bristow	1123	4	1	1208	1.00 [1.00, 1.00]	1.00 [0.99, 1.00]
[36] Dagnra	107	0	0	203	1.00 [0.97, 1.00]	1.00 [0.98, 1.00]
[39] Shimelis	200	1	0	199	1.00 [0.98, 1.00]	0.99 [0.97, 1.00]
[44] Shakya	19	0	0	9981	1.00 [0.82, 1.00]	1.00 [1.00, 1.00]
[31] Chiappe	91	0	0	571	1.00 [0.96, 1.00]	1.00 [0.99, 1.00]
[34] Omoding	16	1	0	203	1.00 [0.79, 1.00]	1.00 [0.97, 1.00]



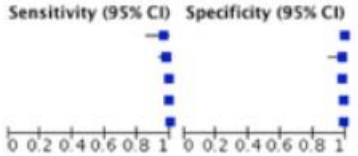
ii) MedMira: HIV component

Study	TP	FP	FN	TN	Sensitivity (95% CI)	Specificity (95% CI)
[43] Bristow	15	0	1	159	0.94 [0.70, 1.00]	1.00 [0.98, 1.00]
[33] Humphries (MedMira)	94	3	2	49	0.98 [0.93, 1.00]	0.94 [0.84, 0.99]
[38] Yin (Medmira)	724	13	4	773	0.99 [0.99, 1.00]	0.98 [0.97, 0.99]
[37] Bristow	74	10	0	114	1.00 [0.95, 1.00]	0.92 [0.86, 0.96]



iii) Chembio: HIV component

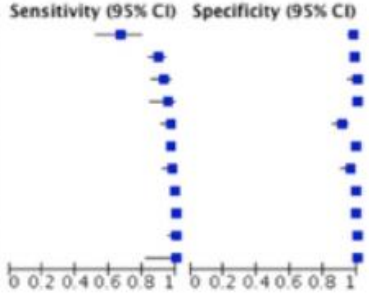
Study	TP	FP	FN	TN	Sensitivity (95% CI)	Specificity (95% CI)
[32] Hess	44	2	2	606	0.96 [0.85, 0.99]	1.00 [0.99, 1.00]
[33] Humphries (Chembio)	94	1	2	52	0.98 [0.93, 1.00]	0.98 [0.90, 1.00]
[38] Yin (Chembio)	725	17	3	769	1.00 [0.99, 1.00]	0.98 [0.97, 0.99]
[47] Kalou	426	9	1	554	1.00 [0.99, 1.00]	0.98 [0.97, 0.99]
[40] Leon	151	4	0	295	1.00 [0.98, 1.00]	0.99 [0.97, 1.00]



b) Diagnostic test accuracy for syphilis, stratified by manufacturer

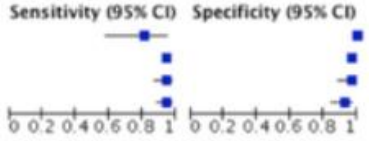
i) SD Bioline: Syphilis component

Study	TP	FP	FN	TN	Sensitivity (95% CI)	Specificity (95% CI)
[45] Black	34	4	17	194	0.67 [0.52, 0.79]	0.98 [0.95, 0.99]
[41] Bristow	149	3	18	243	0.89 [0.84, 0.93]	0.99 [0.96, 1.00]
[33] Humphries (SD Bioline)	80	0	6	64	0.93 [0.85, 0.97]	1.00 [0.94, 1.00]
[44] Shakya	42	13	2	9943	0.95 [0.85, 0.99]	1.00 [1.00, 1.00]
[42] Bristow	109	17	4	168	0.96 [0.91, 0.99]	0.91 [0.86, 0.95]
[38] Yin (SD Bioline)	710	7	25	772	0.97 [0.95, 0.98]	0.99 [0.98, 1.00]
[39] Shimelis	83	4	2	96	0.98 [0.92, 1.00]	0.96 [0.90, 0.99]
[35] Bristow	609	4	2	1444	1.00 [0.99, 1.00]	1.00 [0.99, 1.00]
[31] Chiappe	198	2	0	465	1.00 [0.98, 1.00]	1.00 [0.98, 1.00]
[30] Ondondo	85	0	0	559	1.00 [0.96, 1.00]	1.00 [0.99, 1.00]
[34] Omoding	19	0	0	201	1.00 [0.82, 1.00]	1.00 [0.98, 1.00]



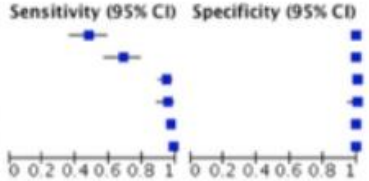
ii) MedMira: syphilis component

Study	TP	FP	FN	TN	Sensitivity (95% CI)	Specificity (95% CI)
[43] Bristow	17	0	4	153	0.81 [0.58, 0.95]	1.00 [0.98, 1.00]
[38] Yin (Medmira)	692	22	43	757	0.94 [0.92, 0.96]	0.97 [0.96, 0.98]
[33] Humphries (MedMira)	81	2	5	62	0.94 [0.87, 0.98]	0.97 [0.89, 1.00]
[37] Bristow	104	6	6	77	0.95 [0.89, 0.98]	0.93 [0.85, 0.97]



iii) Chembio: syphilis component

Study	TP	FP	FN	TN	Sensitivity (95% CI)	Specificity (95% CI)
[32] Hess	37	3	41	576	0.47 [0.36, 0.59]	0.99 [0.98, 1.00]
[46] Bowen	55	6	25	1702	0.69 [0.57, 0.79]	1.00 [0.99, 1.00]
[40] Leon	142	0	8	300	0.95 [0.90, 0.98]	1.00 [0.99, 1.00]
[33] Humphries (Chembio)	82	0	4	64	0.95 [0.89, 0.99]	1.00 [0.94, 1.00]
[38] Yin (Chembio)	713	3	22	776	0.97 [0.96, 0.98]	1.00 [0.99, 1.00]
[47] Kalou	639	2	8	341	0.99 [0.98, 0.99]	0.99 [0.98, 1.00]



Differences by evaluation setting and sample type

Gliddon HD et al. Sex Transm Infect. 2017 Dec;93(S4):S3-S15. doi: 10.1136/sextrans-2016-053069;

Chembio DPP evaluation

- In 2013, 990 serum samples from the Georgia Public Health Laboratory in Atlanta, Georgia, United States.
  - HIV reference testing combined third-generation Enzyme Immunoassay and Western Blot.
  - Reference testing for syphilis was conducted by the *Treponema pallidum* passive particle agglutination method and the TrepSure assay.
- HIV, sensitivity was 99.8% and specificity was 98.4%.
- Syphilis, sensitivity was 98.8% and specificity was 99.4%. ^
- Immunodiagnostic test and electronic reader for detection of HIV and *Treponema pallidum* antibodies in 450 previously characterized serum specimens.
- For visual or electronic reader **HIV** antibody
  - Sensitivity was 100%.
  - Specificity was 98.7%.
- For **visual** *T. pallidum* antibody detection
  - Sensitivity was 94.7%
  - Specificity was 100.0%;
- For **electronic reader**
  - Sensitivity was 94.7%
  - Specificity was 99.7%.*

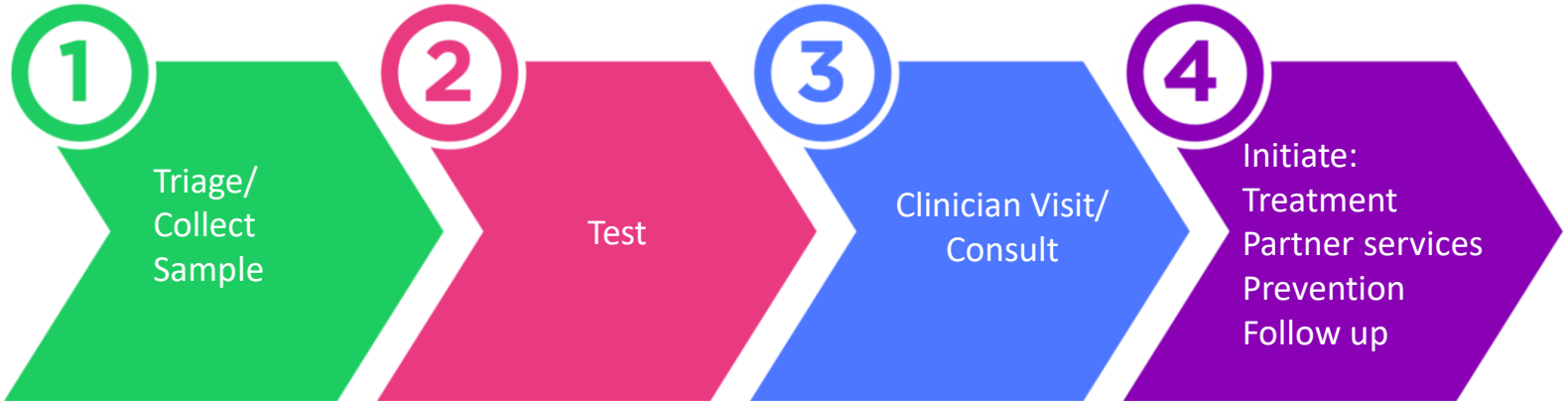
^Kalou MB et al.. Afr J Lab Med. 2016 Sep 15;5(1):433. doi: 10.4102/ajlm.v5i1.433. *Leon SR at al. J Clin Microbiol. 2016 Feb;54(2):492-4. doi: 10.1128/JCM.03152-15.

Benefits of dual pathogen testing

- Detection of both infections – recognizes shared risks for infections.
- Diagnosing HIV in the context of syphilis allows rapid treatment and **prevention of onward transmission** (and vice versa).
  - Reduces duration of infectivity
  - Allows rapid partner notification
- Facilitates a **'test and treat'** approach for syphilis and HIV so decreasing loss to follow up.
- Diagnosis of syphilis facilitates **same day PrEP start**.
- Patient and staff **satisfaction**.
- Provides some diagnostic certainty – HIV and syphilis are both known as the 'great mimics' – diagnosing a rash and treating on the same day has public health and individual benefits.
- Easy to **scale up** dual testing for example in ED and UCC providing the will is there.
- A potentially important tool for reversing the epidemic of congenital syphilis.

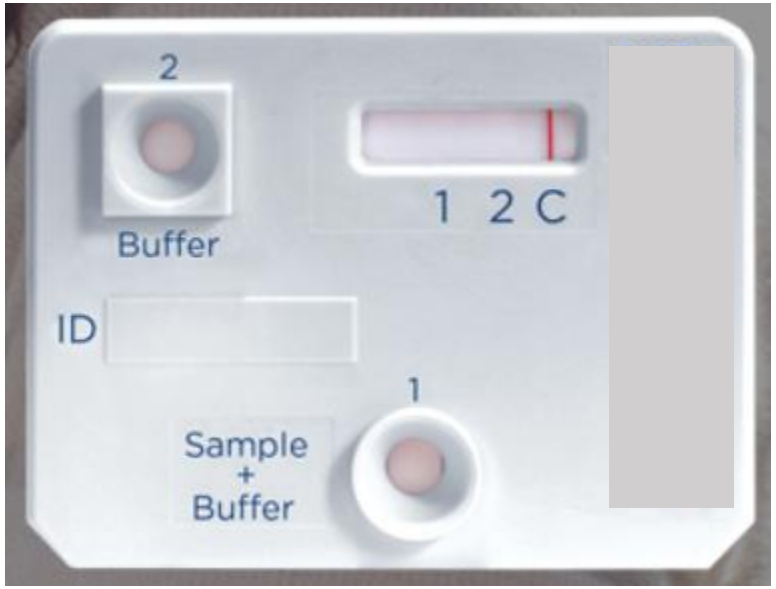
Rapid testing – downsides and opportunities

- False positive results – anxiety, unnecessary treatment.
- False negative results in early infection (primary syphilis and early HIV).
- Treponemal antibody persists so not useful in people with history of syphilis.
- Costs.
- Requires dedicated lab space and personnel.
- Requires change in clinic workflow (test first).



The future of rapid diagnostics – syphilis and HIV

- Treponemal plus non treponemal assays for syphilis.
- Multiplex PCR with antimicrobial gene detection.
- New directions – proteomics, metabolomics.
- Biomarkers for syphilis with proven clinical endpoints.
- HIV viral load assays at POC on fingerstick sample (diagnostic and monitoring).



Lorenz ZW et al. Sex Transm Dis. 2023 Aug 1;50(8):472-478. doi: 10.1097/OLQ.

The *Lancet* Commission on diagnostics: transforming access to diagnostics

Kenneth A Fleming, Susan Horton, Michael L Wilson, Rifat Atun, Kristen DeStigter, John Flanigan, Shahin Sayed, Pierrick Adam, Bertha Aguilar, Savvas Andronikou, Catharina Boehme, William Cherniak, Annie NY Cheung, Bernice Dahn, Lluis Donoso-Bach, Tania Douglas, Patricia Garcia, Sarwat Hussain, Hari S Iyer, Mikashmi Kohli, Alain B Labrique, Lai-Meng Looi, John G Meara, John Nkengasong, Madhukar Pai, Kara-Lee Pool, Kaushik Ramaiya, Lee Schroeder, Devanshi Shah, Richard Sullivan, Bien-Soo Tan, Kamini Walia

- 47% of the global population has little to no access to diagnostics
- Democratization of diagnostics will empower patients.
- Affects major global health priorities: universal health coverage, antimicrobial resistance, and global health security.

Innovation without access is not innovation at all.

Oct 6, 2021 Lancet Commission

Additional slides

Effect of HIV ART on HIV transmission in the presence of STI (2019 update)

J Int AIDS Soc. 2019 Aug; 22(Suppl Suppl 6): e25355.
Published online 2019 Aug 30. doi: 10.1002/jia2.25355
PMCID: PMC6715951
PMID: 31468737

Sexually transmitted infections and HIV in the era of antiretroviral treatment and prevention: the biologic basis for epidemiologic synergy

Myron S Cohen,[1] Olivia D Council,[2] and Jane S Chen[3]

"We do not understand the biology of shedding of HIV in the genital tract that persists despite clearance in the blood with ART"

- Is the virus viable
- Differences in resistance patterns
- In the presence of ART, HIV Tx does not occur (see U=U references at the end)

Platforms with HIV viral load tests

Company	Platform	Sample Type	Sample Volume	Limit of Detection	TAT (min)
Cepheid (USA)	Xpert	Plasma	1 ml	40 copies /ml	92 min
Diagnostics for the Real World (UK)	SAMBA II	Blood	120 µl	1,000 copies /ml	90 min
Abbott (USA)	m-PIMA	Plasma	50 µl	800 copies /ml	52 min
Molbio (India)	TrueNat	Plasma	500 µl	500 copies /ml	40+ min extraction time (20 min)
		Blood	250 µl		

Tradeoffs Between Sample Volume and Limit of Detection

Diagnostic considerations

- HIV infection can be diagnosed by HIV 1/2 Ag/Ab combination immunoassays.
- All FDA-cleared HIV tests are highly sensitive and specific. Available serologic tests can detect **all known subtypes of HIV-1**. The majority also detect HIV-2 and uncommon variants of HIV-1 (e.g., group O and group N).
- CDC recommends HIV testing begin with a lab-based HIV-1/HIV-2 Ag/Ab assay, which, if repeatedly reactive, is followed by a laboratory-based assay with a supplemental HIV-1/HIV-2 antibody differentiation assay.
  - This algorithm confers an additional advantage because it can detect HIV-2 antibodies after the initial immunoassay.
- RNA testing should be performed on all specimens with reactive immunoassay but negative supplemental antibody test results to determine if discordance represents acute HIV infection.
- Rapid POC HIV tests - preliminary diagnosis of HIV infection in <20 minutes.
  - False negative among persons recently infected (e.g., acutely infected persons).
  - HIV home-test kits only detect HIV antibodies and therefore will not detect acute HIV infection.
- Early or acute infection suspected with negative RDT, confirmatory testing laboratory-based assays or RNA testing should be performed.
- CDC recommends that reactive RDTs → laboratory-based Ag/Ab assay.

https://www.cdc.gov/std/treatment-guidelines/hiv.htm

EHE National indicators

National Indicators

Progress on the indicators below will have the greatest impact on ending the HIV epidemic in the United States by 2030.

Diagnoses

Defined as the number of people who receive an HIV diagnosis in a given year that is confirmed by laboratory or clinical evidence. In 2021, data showed 36,189 people received an HIV diagnosis.

Goal: Decrease the yearly number of new HIV diagnoses by 75% by 2025 and 90% by 2030

Linkage to HIV Medical Care

Defined as the estimated percentage of people with HIV who have received an HIV diagnosis. In 2021, 87% of people with HIV had received a diagnosis.

Midterm goal: Increase knowledge of HIV status to 95% by 2025

Viral Suppression

Defined as the percentage of people with diagnosed HIV in a given year who have an amount of HIV that is less than 200 copies per milliliter of blood. In 2021, data showed 66% of people with diagnosed HIV were virally suppressed.

Goal: Increase the percentage of people with diagnosed HIV who are virally suppressed to 95% by 2025

PrEP Coverage

Defined as the estimated percentage of individuals with indications for PrEP classified as having been prescribed PrEP. In 2021, data showed 30% of people who could benefit from PrEP were prescribed it.

Goal: Increase PrEP coverage to 50% by 2025