HIV/AIDS basics, epidemic, diagnosis and behaviors

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Outline

- HIV/AIDS – some facts
  - HIV progression and AIDS
  - HIV transmission
  - HIV treatment, life expectancy, costs of care
- HIV/AIDS epidemic
  - Global overview
  - Disparities in the U.S.
- HIV under-diagnosis in the U.S.
- HIV diagnosis and risk behaviors
  - My research
  - Other issues surrounding HIV-related behaviors

What is HIV/AIDS?

- **HIV** stands for the **human immunodeficiency virus**. It is one of a group of viruses known as retroviruses. After getting into the body, the virus kills or damages cells of the body's immune system.

- **AIDS**, the **acquired immunodeficiency syndrome**, is the consequence of progression from HIV infection.

HIV progression and AIDS

- Three stages of HIV infection have been described.
  - **Primary infection**, which occurs within weeks of acquiring the virus, is often characterized by a “flu-” like illness that generally resolves within weeks
  - **Chronic asymptomatic infection**, a long duration of infection without symptoms, which can last an average of 8 to 10 years
  - **Symptomatic infection**, in which the body’s immune system has been suppressed and complications have developed

AIDS

HIV Transmission

HIV is spread through …

- Sex with an infected partner
- Injection-drug using infected needles or syringes
- Women-to-children transmission during pregnancy or birth, or through breastfeeding
- Accidental needle sticks or contact with contaminated fluids in health care settings

- Transfusion of contaminated blood or blood components
- Transplant of organs from an infected person
- People who already have a sexually transmitted infections are more likely to acquire HIV infection during sex with an infected partner

HIV Transmission

HIV is NOT spread through …

- Casual contact such as preparing food, sharing towels and bedding, or via swimming pools, telephones, or toilet seats

- Contact with saliva, unless it is contaminated with blood

HIV treatment, life expectancy of people with HIV/AIDS, costs of care

- No cure for HIV
- Treatment for HIV works by preventing the virus in your body from replication.
  - The effectiveness depends on initiation time with regard to CD counts (immune system) in the body and other morbidities.
  - Eventually, the virus may become resistant to the available drugs, and the AIDS may develop.

HIV treatment, **life expectancy of people with HIV/AIDS**, **costs of care**

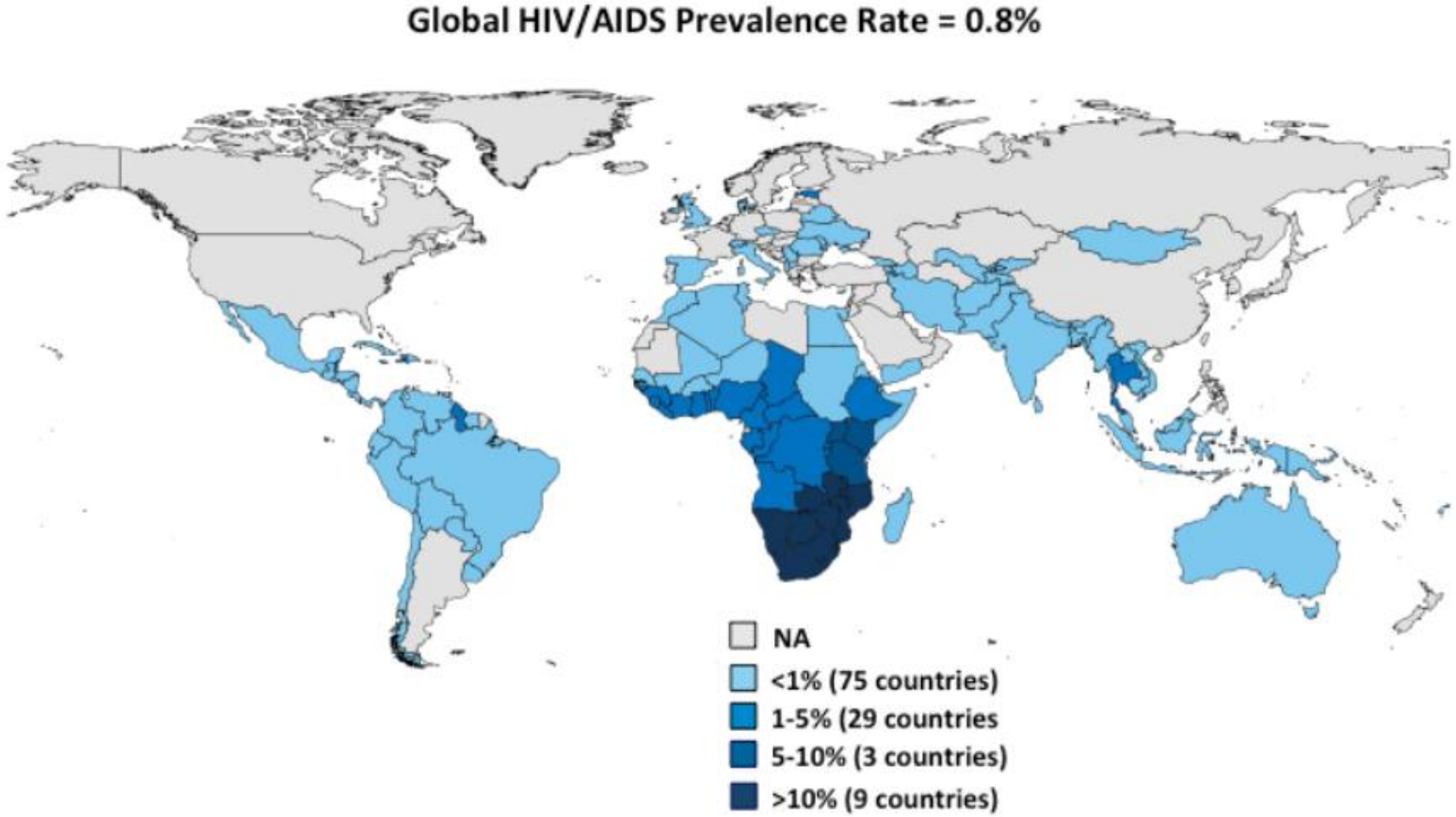
- Without any effective treatment: develop AIDS within **~10** years, and live an additional [redacted] years
- With timely and effective treatment: life expectancy is [redacted] years, discounted lifetime cost is $385,200, from the time of entering HIV care. (Schackman et al. 2006)

HIV treatment, **life expectancy of people with HIV/AIDS**, **costs of care**

- Without any effective treatment: develop AIDS within **~10** years, and live an additional **1-2** years
- With timely and effective treatment: life expectancy is **24.2** years, discounted lifetime cost is $385,200, from the time of entering HIV care. (Schackman et al. 2006)

- **Other factors** include overall level of health, lifestyle choices, adherence to care, and education decisions

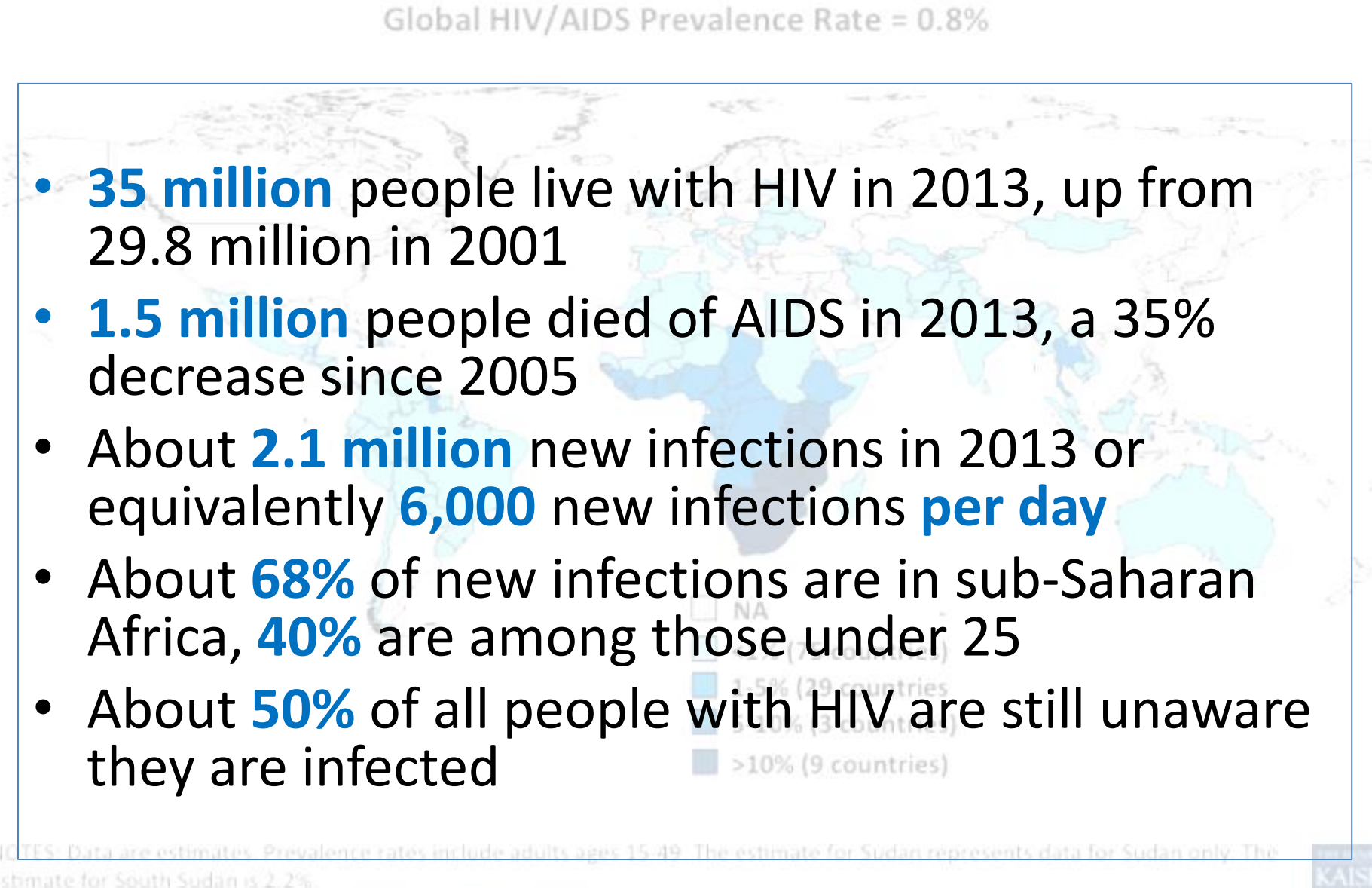
Global HIV/AIDS epidemic



NOTES: Data are estimates. Prevalence rates include adults ages 15-49. The estimate for Sudan represents data for Sudan only. The estimate for South Sudan is 2.2%.
SOURCE: Kaiser Family Foundation, www.GlobalHealthFacts.org, based on UNAIDS, GAP Report; 2014.

THE HENRY J. KAISER FAMILY FOUNDATION

Global HIV/AIDS epidemic



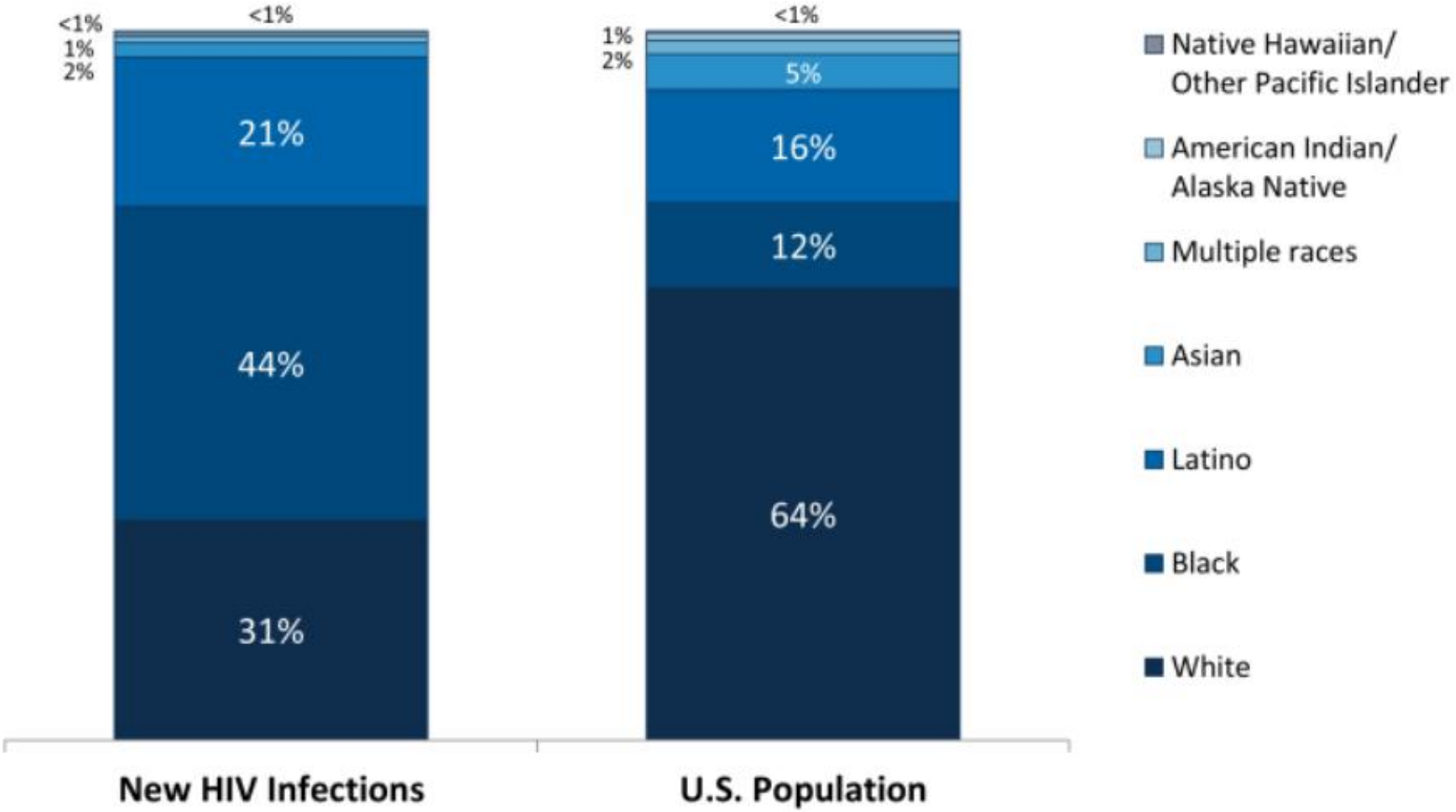
- **35 million** people live with HIV in 2013, up from 29.8 million in 2001
- **1.5 million** people died of AIDS in 2013, a 35% decrease since 2005
- About **2.1 million** new infections in 2013 or equivalently **6,000** new infections **per day**
- About **68%** of new infections are in sub-Saharan Africa, **40%** are among those under 25
- About **50%** of all people with HIV are still unaware they are infected

NOTES: Data are estimates. Prevalence rates include adults ages 15-49. The estimate for Sudan represents data for Sudan only. The estimate for South Sudan is 2.2%.
SOURCE: Kaiser Family Foundation, www.GlobalHealthFacts.org, based on UNAIDS, GAP Report, 2014.

HIV/AIDS in the U.S. – Overview

- First case of AIDS reported in **1981** in **Los Angeles**
- **1.1 million** people live with HIV, 2010
- About **47,500** new HIV infections, 2010
- Accumulative **658,992** AIDS deaths since beginning of epidemic
- Huge racial/ethnic **disparities**
- Men who have sex with men (**MSM**) are increasingly and disproportionately affected
- Disparities exist in every single stage from diagnosis to viral suppression (Zanoni Brian C. and Mayer Kenneth H. 2014)

New HIV Infections & U.S. Population, by Race/Ethnicity, 2010



NOTE: HIV data are estimates and do not include U.S. dependent areas.
SOURCES: CDC, HIV Surveillance Report, Vol. 23; February 2013. CDC, Fact Sheet: New HIV Infections in the United States; December 2012. U.S. Census Bureau, 2010 Population Estimates.

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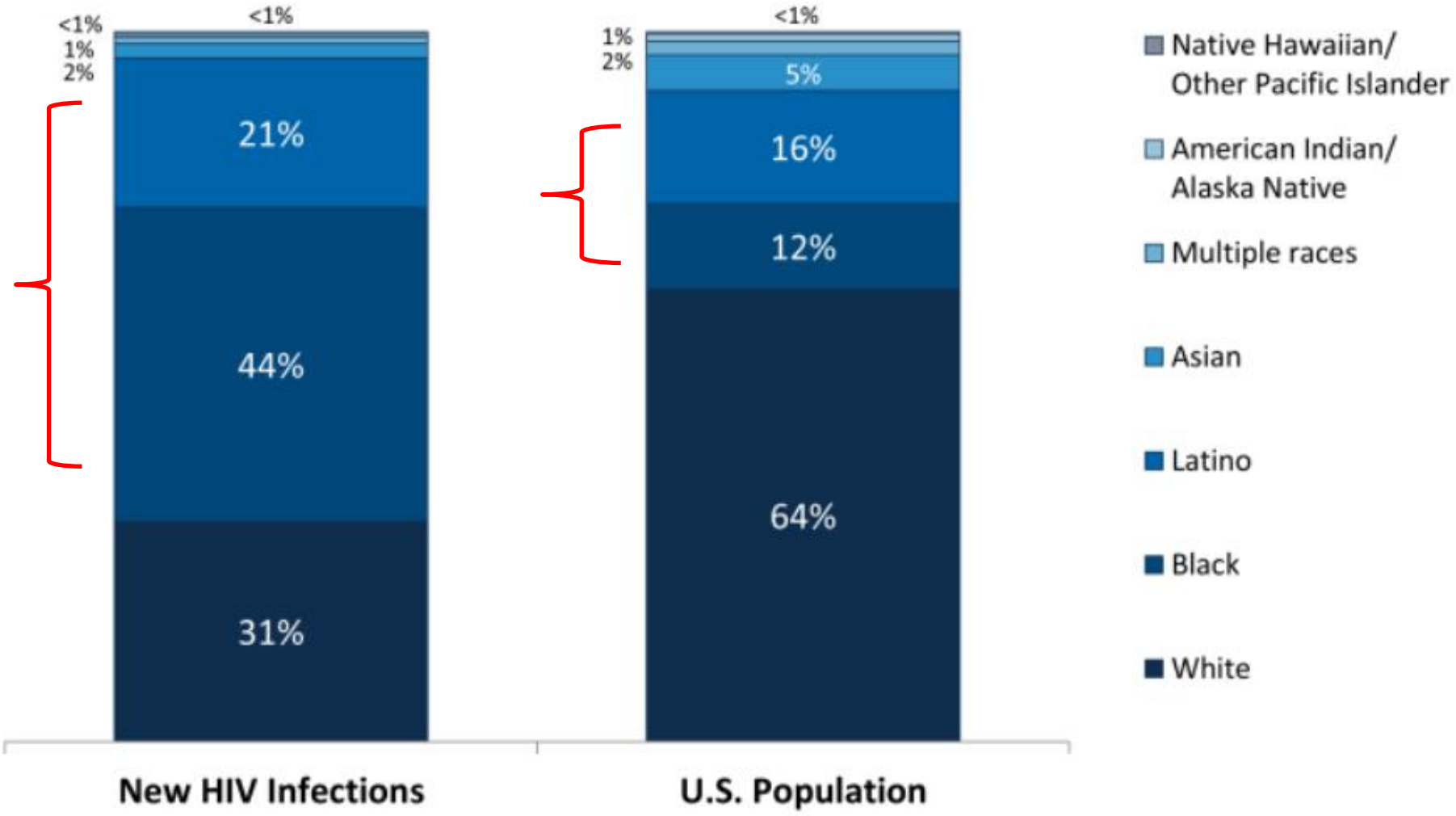

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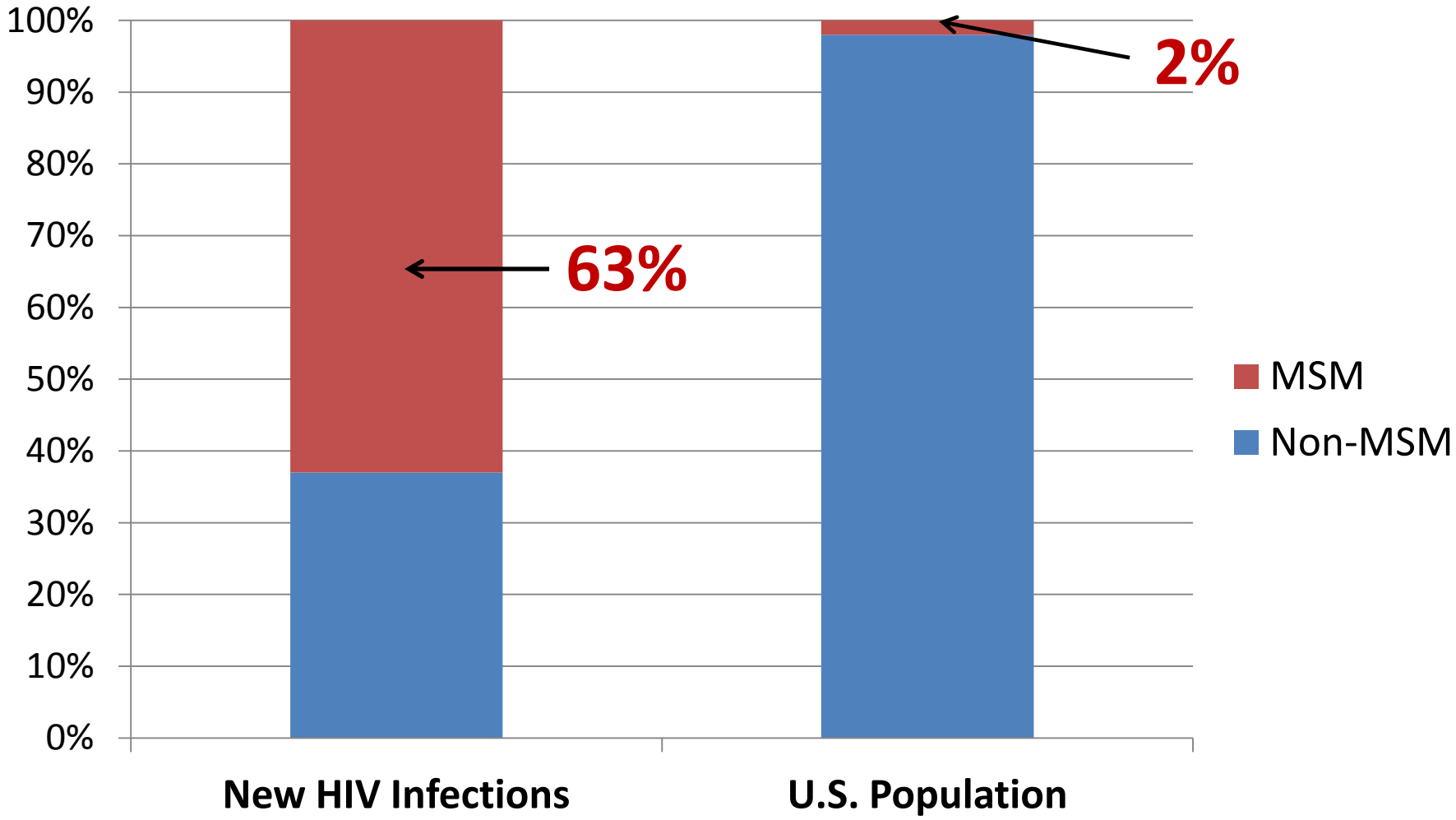
New HIV Infections & U.S. Population, by risk group, 2010



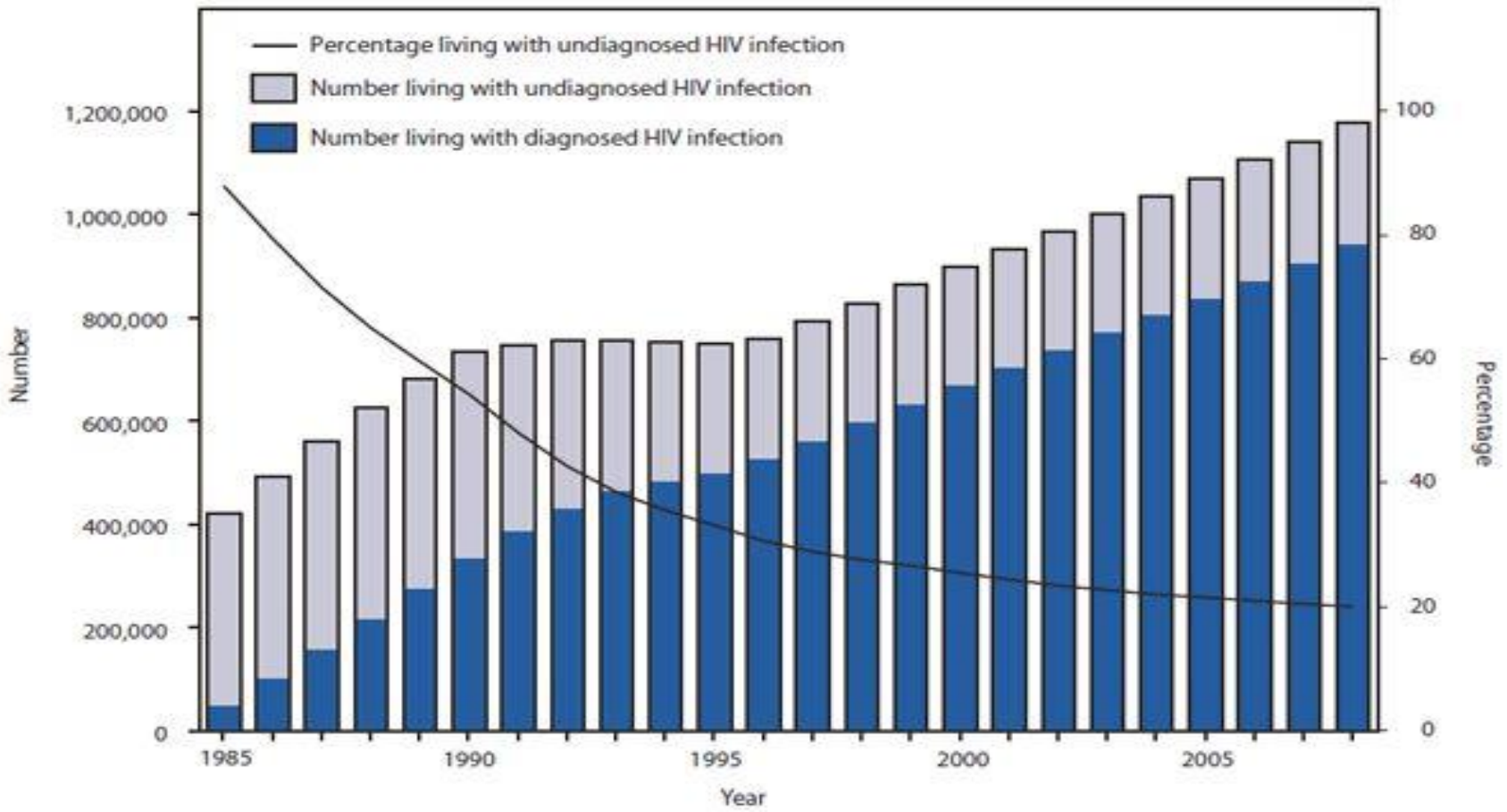
HIV under-diagnosis in the U.S.

- Many people at high risk for HIV in the US do not get proper tests thus are unaware of their infection status
  - Among the **1.1 million** HIV-infected adults and adolescents (13 years and older) in the United States at the end of 2006, about **20%** are unaware of their infection. (CDC MMWR 2010)
  - **38%** of patients diagnosed with HIV progressed to AIDS within a year. (CDC MMWR 2008)
  - Under-diagnosis is the most serious among the most vulnerable population, in particular young men who have sex with men (MSM). (Zanoni Brian C. and Mayer Kenneth H. 2014)

HIV under-diagnosis in the U.S.

- Recent years have seen emerging nationwide efforts to promote HIV testing for targeted population
  - 2006: CDC recommended HIV testing and counseling as a routine part of regular medical care.
  - July 2010: The US Federal set the national goal of increasing the proportion of people living with HIV who know their status from 79% to 90% by 2015.
  - April 2013: US Preventive Services Task Force (USPSTF)'s granted an "A" rating to routine HIV screening for all individuals aged 15-65.

HIV under-diagnosis is improving over time



Source: CDC Morbidity and Mortality Weekly Report
Estimated number of persons aged ≥13 years living with diagnosed and undiagnosed HIV infection and percentage with undiagnosed HIV infection — National HIV Surveillance System, United States, 1985–2008

HIV diagnosis and risk behaviors

- Ambiguous predictions about behavioral effects of HIV infection or perceived risks of infection
  - Fatalism:
    - Baird et al. 2014, based on RCT in Africa
    - Kerwin 2014, based on RCT in Africa
  - Self-protection:
    - Fonner et al. 2012, a review study of VCT interventions in low- and middle-income countries

HIV diagnosis and risk behaviors

- Zhu (2015) analyzes the behavioral effects of HIV diagnosis using a longitudinal data in the US
  - Of relevance to evaluating public policies designed to promote voluntary testing
- The dataset comes from a semi-annual survey on health, medical histories, and behaviors of about 7000 MSM in the four cities in the US, spanning from 1984 to 2008 (49 waves)
  - Blood specimens are collected during each wave for laboratory tests
- The study sample focuses on 575 men who became newly infected with HIV during the survey

HIV diagnosis and risk behaviors

- Research questions
  - How does becoming newly infected with HIV affect risk-taking? (1)
  - Is mental health driving the behavioral effects? (2)
  - Definition of **mentally healthy**: individuals who have never had depression symptoms as indicated by clinical scales
  - Outcomes of interest: sexual behaviors, drinking, recreational drug use

- Basic econometric model

$$Behavior_{i,t+1} = \alpha \times PostDiagnosis_{i,t} + \beta \times X_{i,t} + individualFE + TimeTrend + \epsilon_{i,t+1}$$

  - *First, estimate the model using the full sample (question 1)*
  - *Second, estimate the model using a sample of **mentally healthy** (question 2)*

Data Summary

	All ages	By age group		
		18-29	30-49	50+
Panel A: Sexual activity		(12%)	(67%)	(21%)
engaged in sexual activities since last wave	0.882 (0.32)	0.966 (0.18)	0.905 (0.29)	0.758 (0.43)
engaged in sexual activities with male since last wave	0.879 (0.33)	0.965 (0.18)	0.903 (0.30)	0.755 (0.43)
more than 2 partners since last 6 months	0.63448 (0.48)	0.743 (0.44)	0.644 (0.48)	0.535 (0.50)
more than 2 male partners since last 6 months	0.63446 (0.48)	0.742 (0.44)	0.643 (0.48)	0.533 (0.50)
Panel B: Drinking				
daily/almost daily drinker since last 6/12 months	0.30 (0.46)	0.35 (0.48)	0.29 (0.46)	0.28 (0.45)
3 or more drinks/day (when drinking)	0.41 (0.49)	0.54 (0.50)	0.43 (0.49)	0.26 (0.44)
Panel C: Recreational drug use				
take Marijuana or Hashish since last wave	0.44 (0.50)	0.61 (0.49)	0.45 (0.50)	0.30 (0.46)
weekly+ user of Marijuana/Hashish since last 6 months	0.18 (0.38)	0.23 (0.42)	0.18 (0.38)	0.14 (0.34)
take Poppers since last wave	0.41 (0.49)	0.49 (0.30)	0.43 (0.49)	0.32 (0.47)
weekly+ user of Poppers since last 6 months	0.15 (0.36)	0.17 (0.37)	0.16 (0.36)	0.12 (0.32)

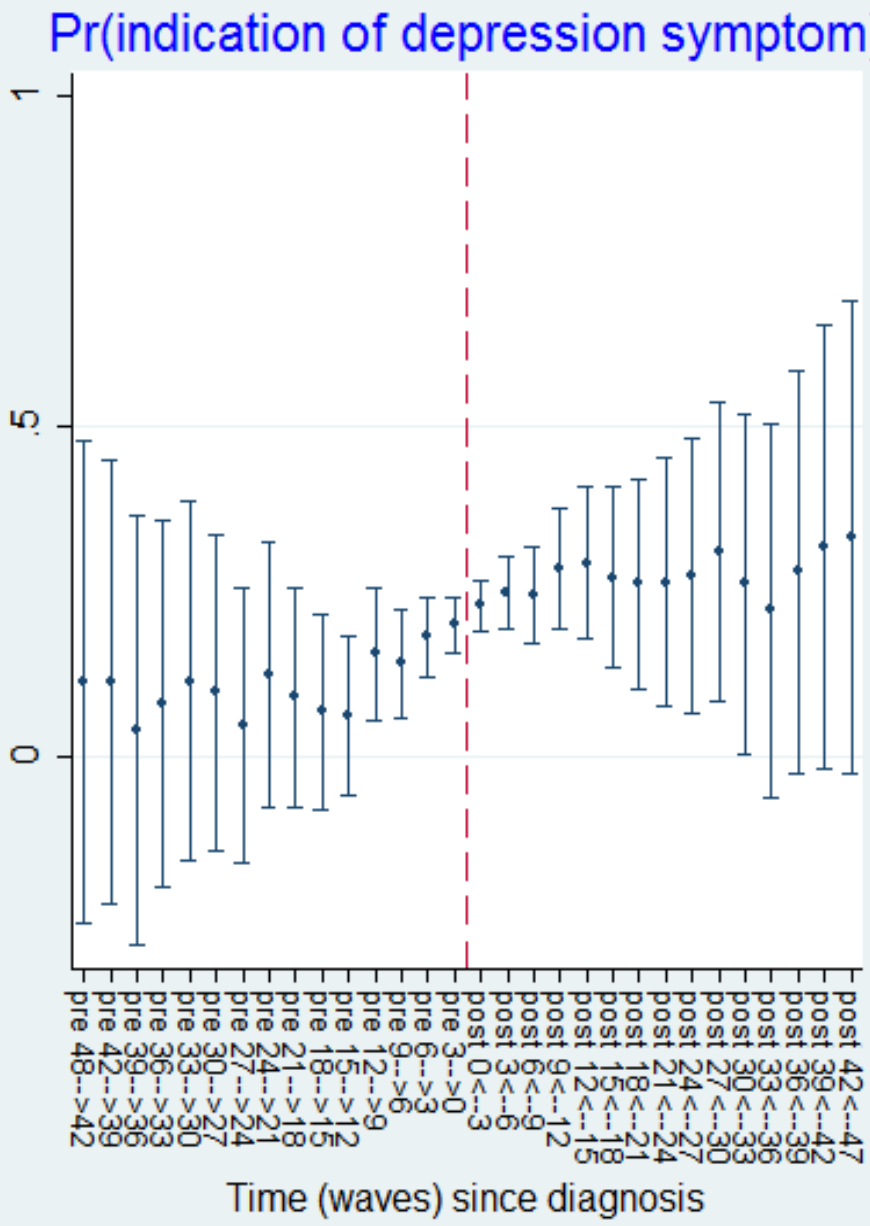
Behavioral effects of HIV diagnosis

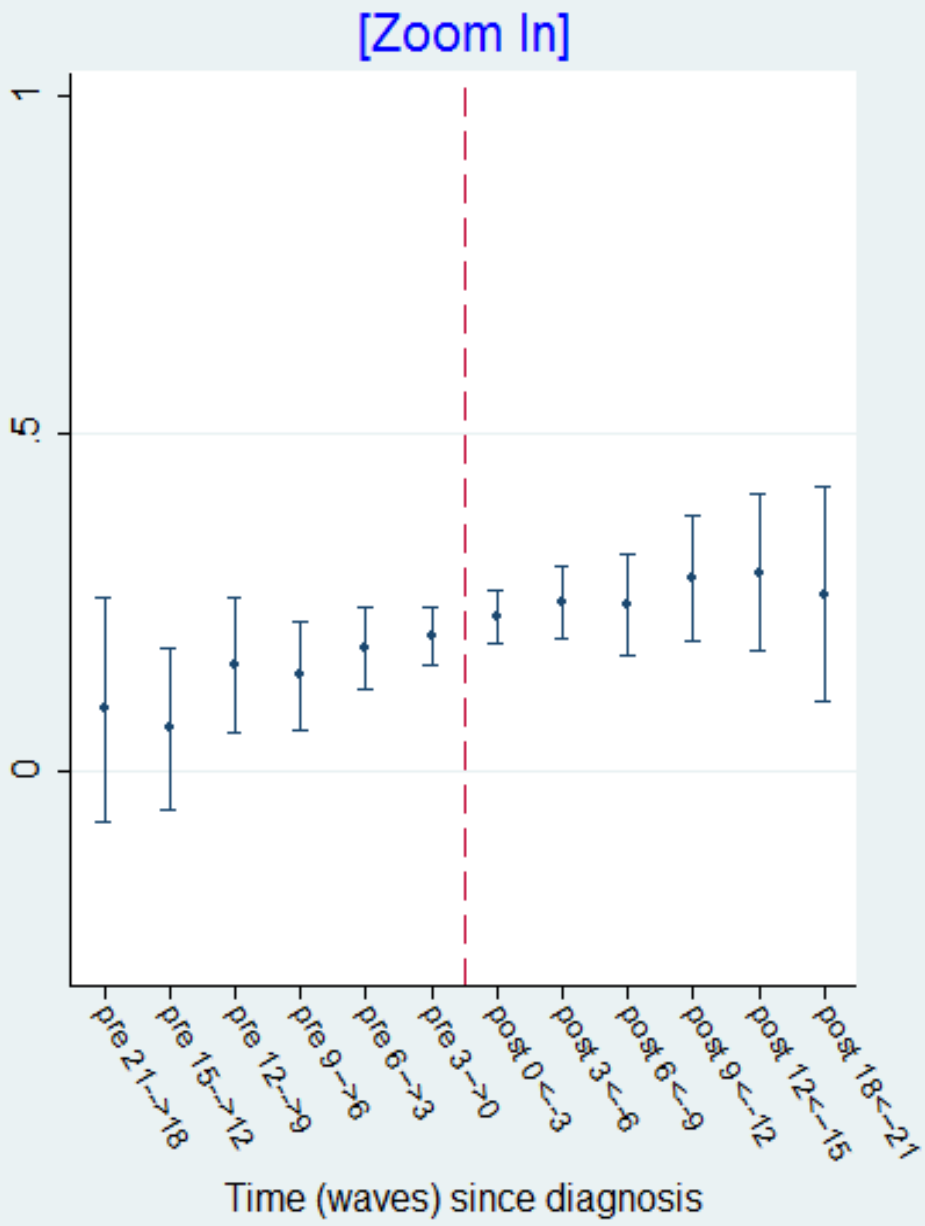
Dependent Variable	Full sample
Any sex	-0.068*** (0.015)
Any sex with men	-0.070*** (0.015)
2+ sexual partner	-0.181*** (0.023)
2+ male partner	-0.180*** (0.023)
N (persons)	575

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.10

Regression-adjusted trend of mental health





Behavioral effects of HIV diagnosis

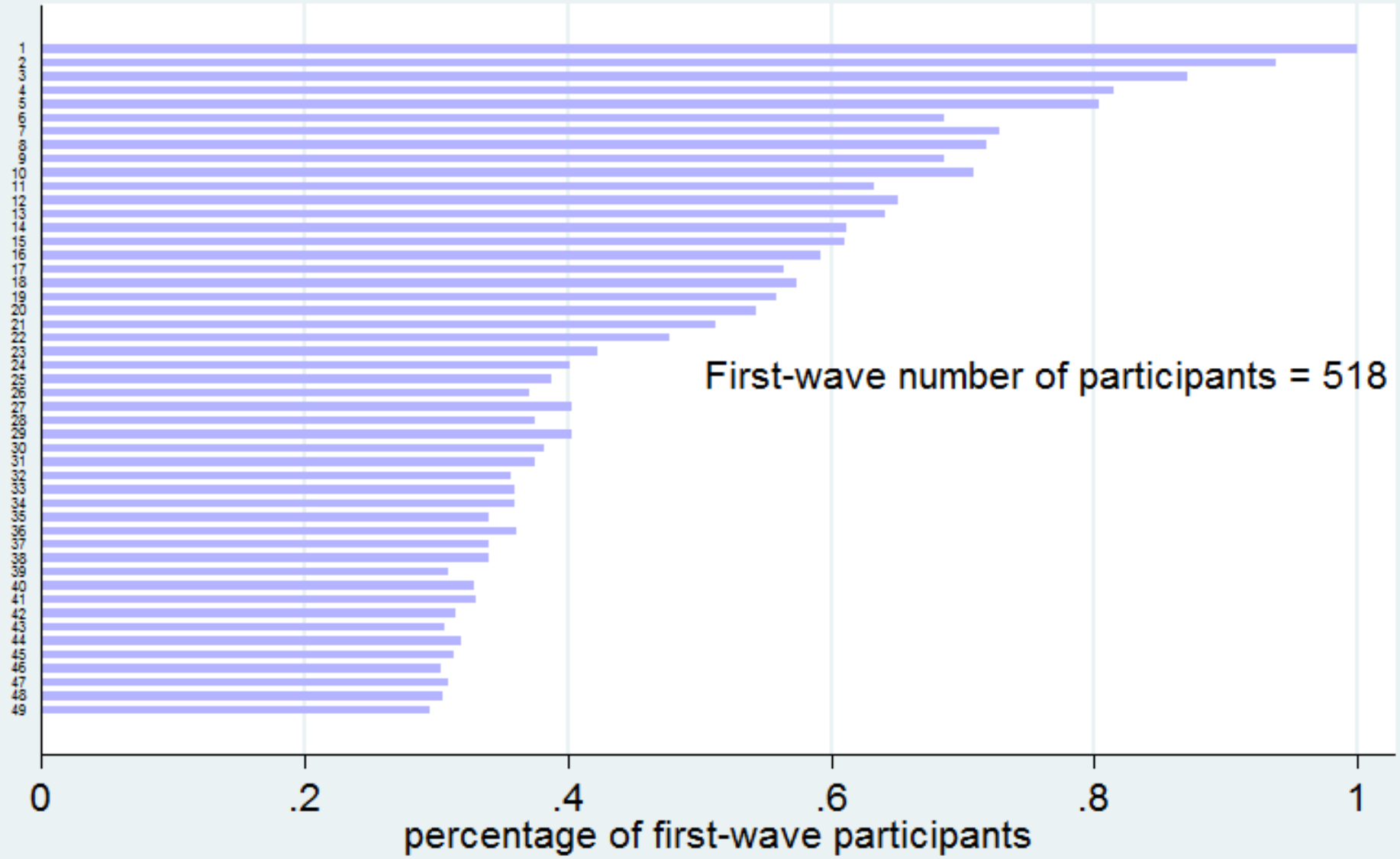
Dependent Variable	Full sample	Subsample (**mentally healthy**)
Any sex	-0.068*** (0.015)	-0.063*** (0.023)
Any sex with men	-0.070*** (0.015)	-0.063*** (0.023)
2+ sexual partner	-0.181*** (0.023)	-0.213*** (0.047)
2+ male partner	-0.180*** (0.023)	-0.212*** (0.047)
N (persons)	575	175

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.10

Attritions?

Attritions among HIV converters recruited at first wave



Source: The Multicenter AIDS Cohort Study 1984-2008

Attrition at t+1 | in survey at t

Explanatory Variable	(1)	(2)	(3)	(4)	(5)	(6)
	Probability of attrition at t+1 | in survey at t					
Engaged in sexual activities with male since last visit	-0.048***					-0.017
	(0.013)					(0.015)
More than one male sexual partner since last 6 months	-0.016*					-0.007
	(0.008)					(0.009)
Daily/almost daily drinker since last 6/12 months			-0.004			0.009
			(0.010)			(0.010)
3+ drinks/day (when drinking) since last 6/12 months			-0.012			-0.007
			(0.009)			(0.010)
taken Marijuana or Hashish since last visit				-0.011		-0.006
				(0.010)		(0.011)
Weekly+ user of Marijuana or Hashish since last 6 months				0.008		0.004
				(0.013)		(0.015)
taken Poppers since last visit				-0.017*		-0.011
				(0.009)		(0.010)
Weekly+ user of Poppers since last 6 months				-0.018		-0.013
				(0.013)		(0.015)
CES-D 20-item scale					0.001*	-0.000
					(0.000)	(0.001)
Observations	12,309	13,026	10,652	12,346	11,970	9,235
R-squared	0.014	0.015	0.013	0.014	0.011	0.014
Number of newid	571	571	552	571	571	545

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.10

Permanent Attrition at t+1 | in survey at t

Explanatory Variable	(1)	(2)	(3)	(4)	(5)	(6)
	Probability of attrition for good at t+1 | in survey at t					
Engaged in sexual activities with male since last visit	-0.058***					-0.020**
	(0.009)					(0.009)
More than one male sexual partner since last 6 months	-0.018***					-0.011***
	(0.004)					(0.004)
Daily/almost daily drinker since last 6/12 months			-0.016***			-0.007
			(0.005)			(0.004)
3+ drinks/day (when drinking) since last 6/12 months			-0.002			0.004
			(0.004)			(0.004)
taken Marijuana or Hashish since last visit				-0.012**		-0.009*
				(0.005)		(0.005)
Weekly+ user of Marijuana or Hashish since last 6 months				-0.002		0.001
				(0.006)		(0.006)
taken Poppers since last visit				-0.023***		-0.010**
				(0.004)		(0.004)
Weekly+ user of Poppers since last 6 months				-0.013**		-0.008
				(0.005)		(0.006)
CES-D 20-item scale					0.001***	0.000*
					(0.000)	(0.000)
Observations	12,126	12,843	10,525	12,164	11,804	9,119
R-squared	0.038	0.026	0.021	0.028	0.023	0.023
Number of newid2	571	571	552	571	571	545

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.10

Results summary (Zhu 2015)

- Applying a fixed effects model on a longitudinal data in the US, I find an overall reduced behaviors associated with HIV diagnosis
- Although the data suggest an average worse mental health status following HIV diagnosis, there is no evidence that mental health is likely to drive the behavioral effects of HIV diagnosis
- Examination of attrition patterns suggests that my results may underestimate the behavioral effects of HIV diagnosis

Other HIV-related behavioral issues

- The option value of medical innovation
  - With the availability of HAART, healthy, forward-looking people well informed of the potential consequences of their behaviors change relevant behaviors even when they are healthy and before becoming infected (Chan, Hamilton, Papageorge 2013)
- "Sero-sorting"
  - The practice of having sex only with people of the same serostatus
  - Because there is less unprotected sex between positive and negative partners, the practice decreases the HIV incidence
  - However, because serosorting removes the incentive to use protected vs. safer sex, the rate of other sexually transmitted diseases (STDs) actually increases
  - Also, serosorting does not prevent the HIV infected from being infected with new strains of HIV
- Hans Rosling on HIV: https://www.youtube.com/watch?v=3qRtDnsnSwk

HIV/AIDS basics, epidemic, diagnosis and behaviors

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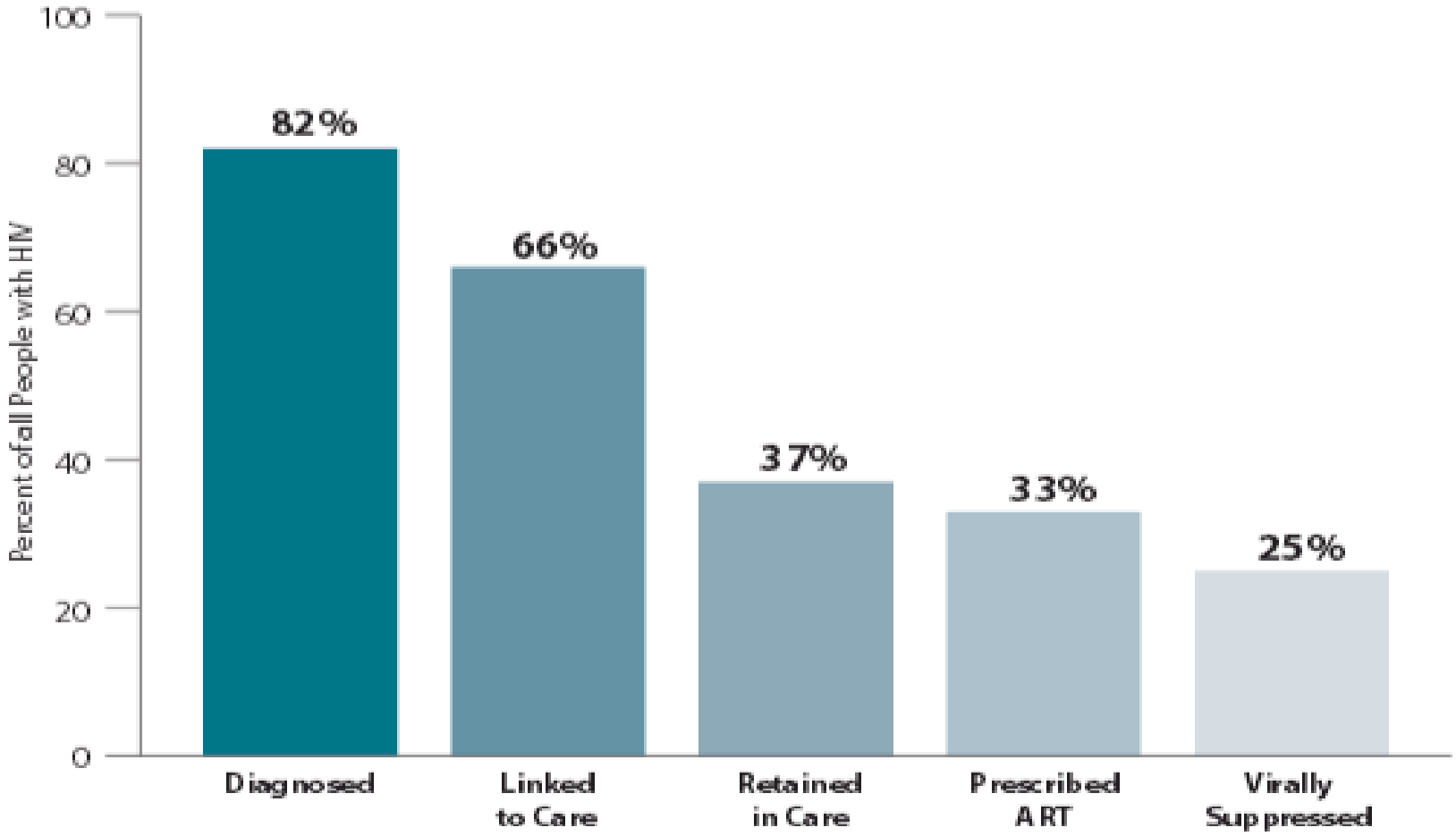
How is HIV/AIDS prevalence/incidence estimated?

- Estimation of HIV prevalence
  - Collect data from sero-conversion surveys in different populations and different geographic regions
  - "Back calculation" where we estimate the number of HIV infections in the past that gave rise to the reported AIDS cases today by using an estimate of the incubation period distribution.

- Estimation of HIV incidence
  - Repeated cross-sectional surveys with unique identifiers linked to participants
  - "Back calculation" from reported AIDS cases
  - NEW! Identifying recent seroconverters from a cross-sectional sample using two HIV antibody tests of differing sensitivity for HIV antibodies – a newly infected person will test positive on the sensitive assay and negative on the less sensitive assay

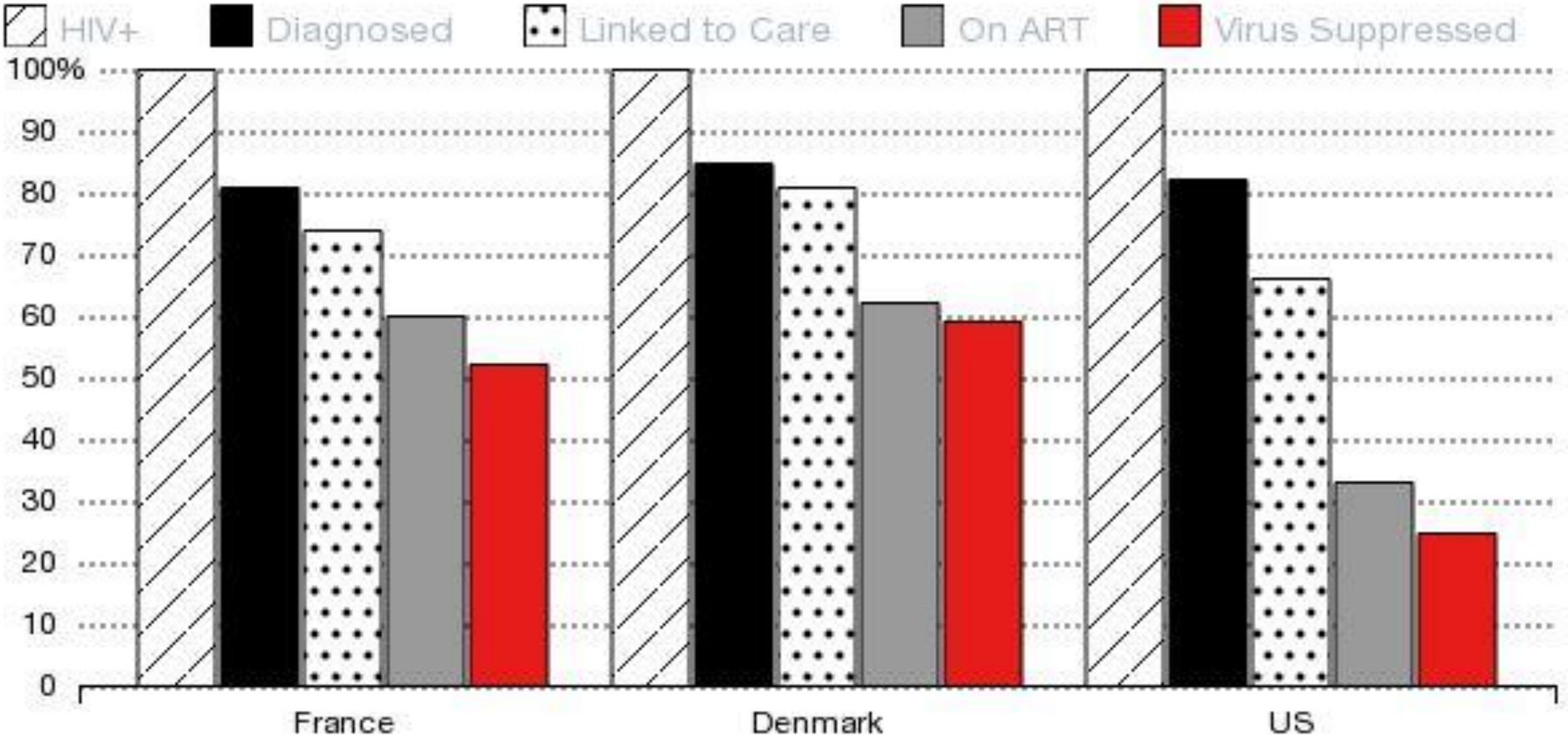
HIV Treatment Cascade in the U.S.



Source: CDC Fact Sheet 2012

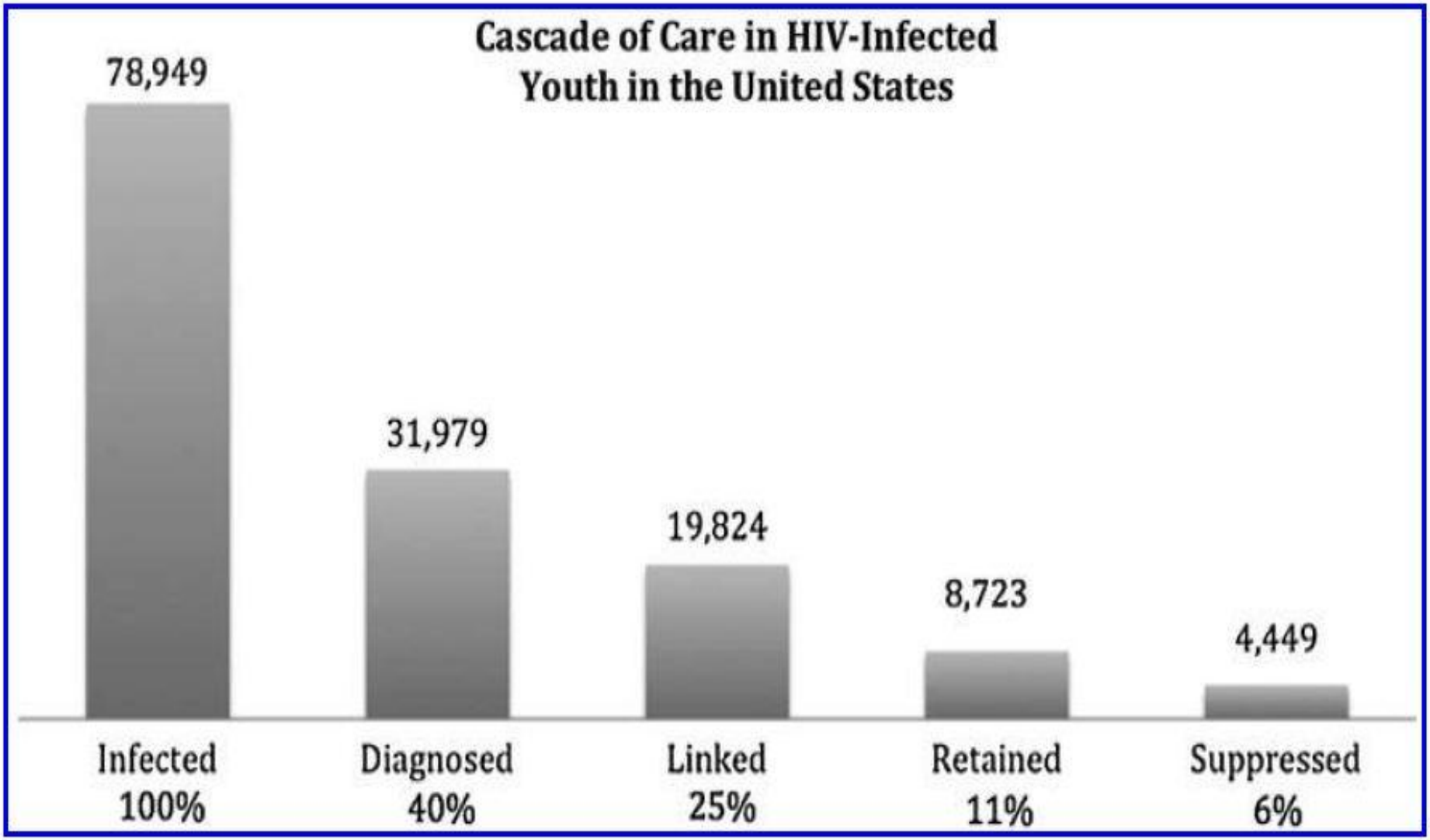
People Fall Off Care More in the U.S.

More than half HIV patients in France and Denmark have the virus under control



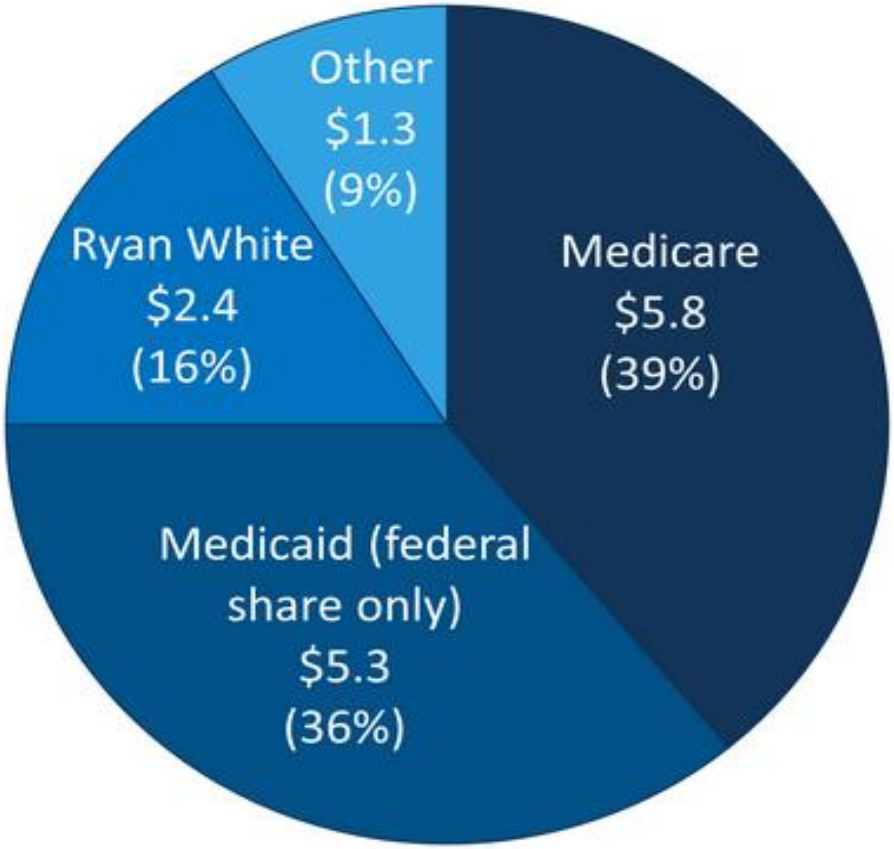
Source: Journal of the International AIDS Society, 2010-2012 estimates

http://www.bloomberg.com/bw/articles/2014-12-01/cdc-fewer-than-half-of-hiv-patients-are-getting-treatment



Source: Zanoni Brian C. and Mayer Kenneth H., "The Adolescent and Young Adult HIV Cascade of Care in the United States: Exaggerated Health Disparities", AIDS Patient Care and STDs. March 2014, 28(3): 128-135. doi:10.1089/apc.2013.0345.

Federal Funding for HIV/AIDS Care by Program, FY 2012



Total = $14.8 Billion

SOURCES: KFF, U.S. Federal Funding for HIV/AIDS: The President's FY 2013 Budget Request; February 2012. KFF, analysis of data from OMB; 2012.