

Brief History and Scientific Highlights of the MACS/WIHS Combined Cohort Study

The Longest Running
Observational Study of
People Living with HIV(PLWH) and
People Vulnerable to HIV

MWCCS Dossier

October 2022



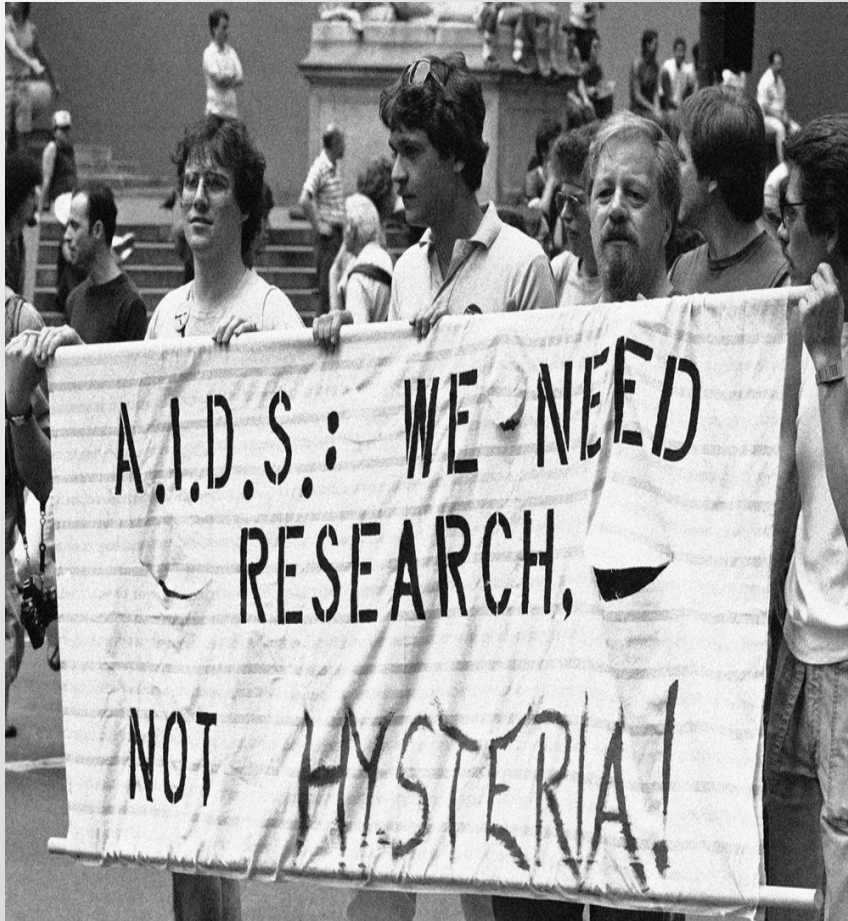
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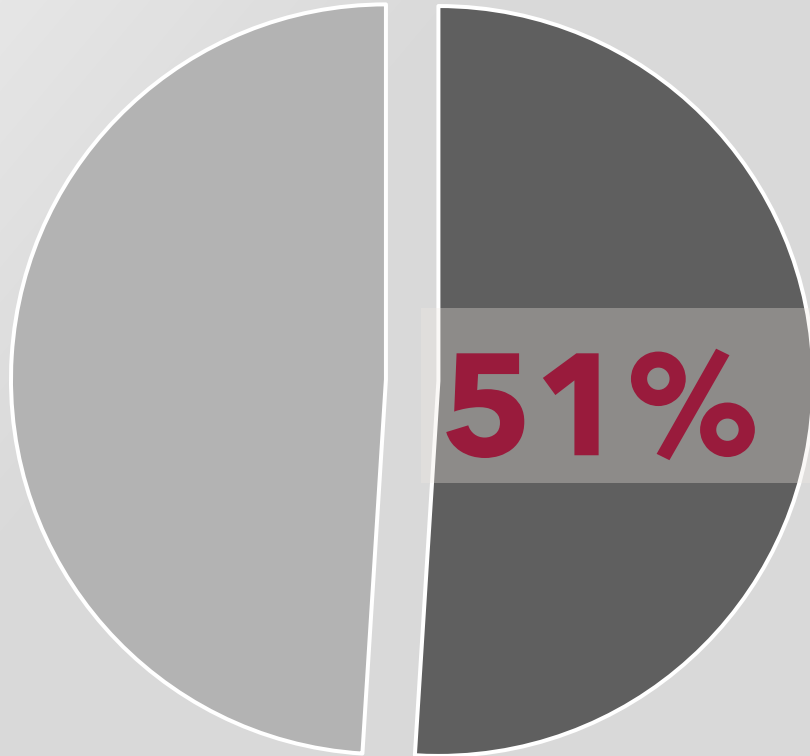
Twitter: [@MACSWIHSCCS](https://twitter.com/MACSWIHSCCS)

In the beginning of the AIDS epidemic, many people living with HIV were told that they may have only 6 months to live.

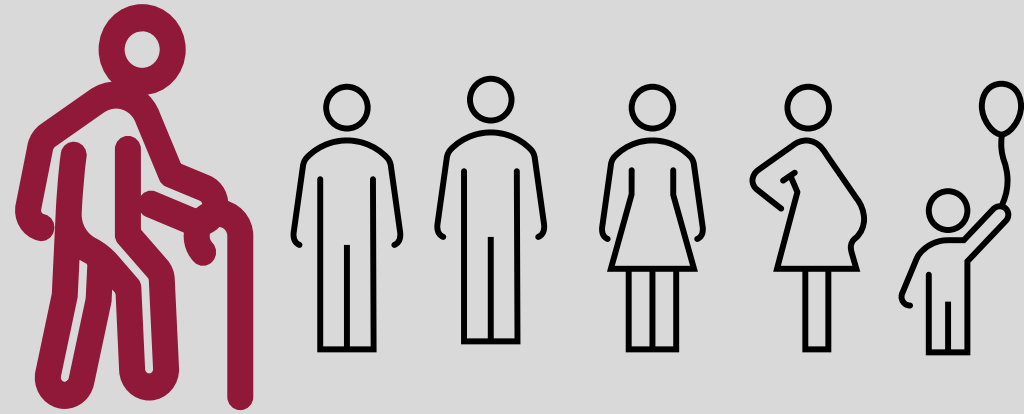


Through the advent of therapies, the lives of people with HIV/AIDS changed.

The trajectory of HIV research is changing as the population with HIV/AIDS is aging.



In 2018, half of **people with HIV** in the US are **50 years and above**.



1 in 6 people diagnosed with HIV is aged 50+

In 2019 two longstanding cohorts, the MACS and WIHS merged into the MWCCS

MACS

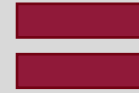
MULTICENTER AIDS
COHORT STUDY

Established 1983



WIHS
Women's
Interagency
HIV Study

Established 1993



MWCCS

MACS/WIHS COMBINED COHORT STUDY

Merged 2019

MACS, a cohort study of men with and without HIV, and

WIHS, a cohort study of women with and without HIV

have merged to form **MWCCS**, a combined cohort study with more participants representing a

broader, more diverse population with a harmonized database
to study a wider range of HIV/AIDS focus areas and other co-morbidities.

MWCCS has (as of 10/12/22):

- **>4000 Active Participants**
- **>3000 Publications**
- **Increased focus on Aging and Co-morbidities**

MACS/WIHS Timelines

1984 1989 1994 1999 2004 2009 2014 2019

Enrollment
Waves

1984-85

1987-90

1995 admin censoring
of some HIV-¹

2001-3
(Add subsites;
Focus: minority)

2010+
(Focus: early stage HIV)

MACS was ongoing for 35 years

Enrollment
Waves

1994-95

1997
WDMAC

2001-2

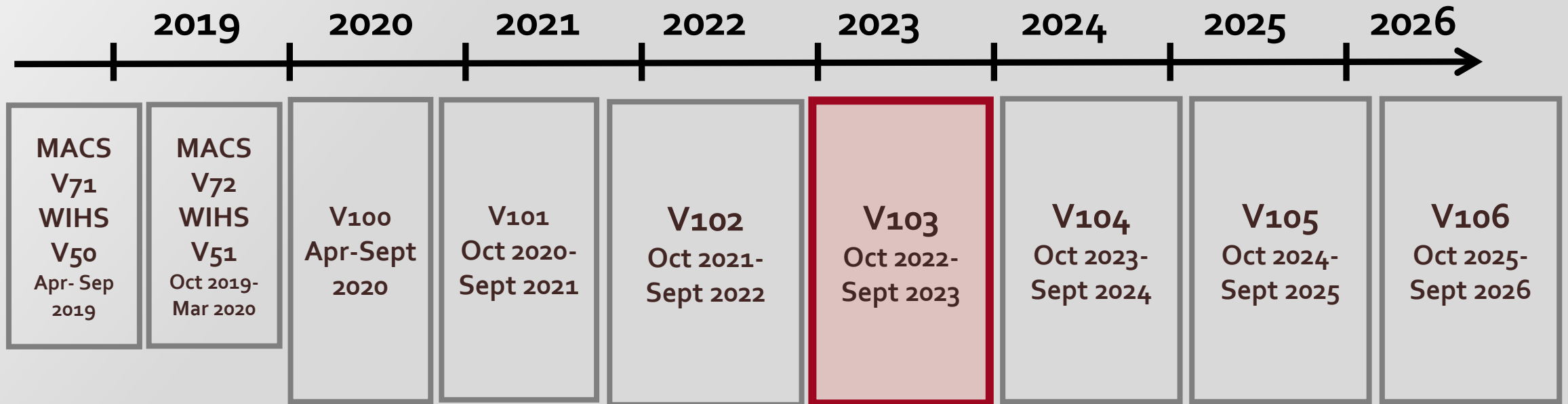
2011-13
(Replenishment/
Closing of LA site)

2013-15
(Southern Sites)

WIHS was ongoing for 25 years

¹ In April 1995, 2255 HIV-negative men were administratively censored from further follow-up, per an NIH decision.

MWCCS *Timeline*



**Historic data (1984-2020)
now in a harmonized
database**

During 2020-2022,

- Covid-19 pandemic: phone only data collection (Mar-Sept '20)
- 1st CCS visit (V101): in-person & virtual (Oct '20-Sept '21)
- Enrollment of new participants (V101-103)
- Annual Specimen collection
- 2 visits per year (core visit, shorter visit)



MACS/WIHS COMBINED COHORT STUDY

Participants

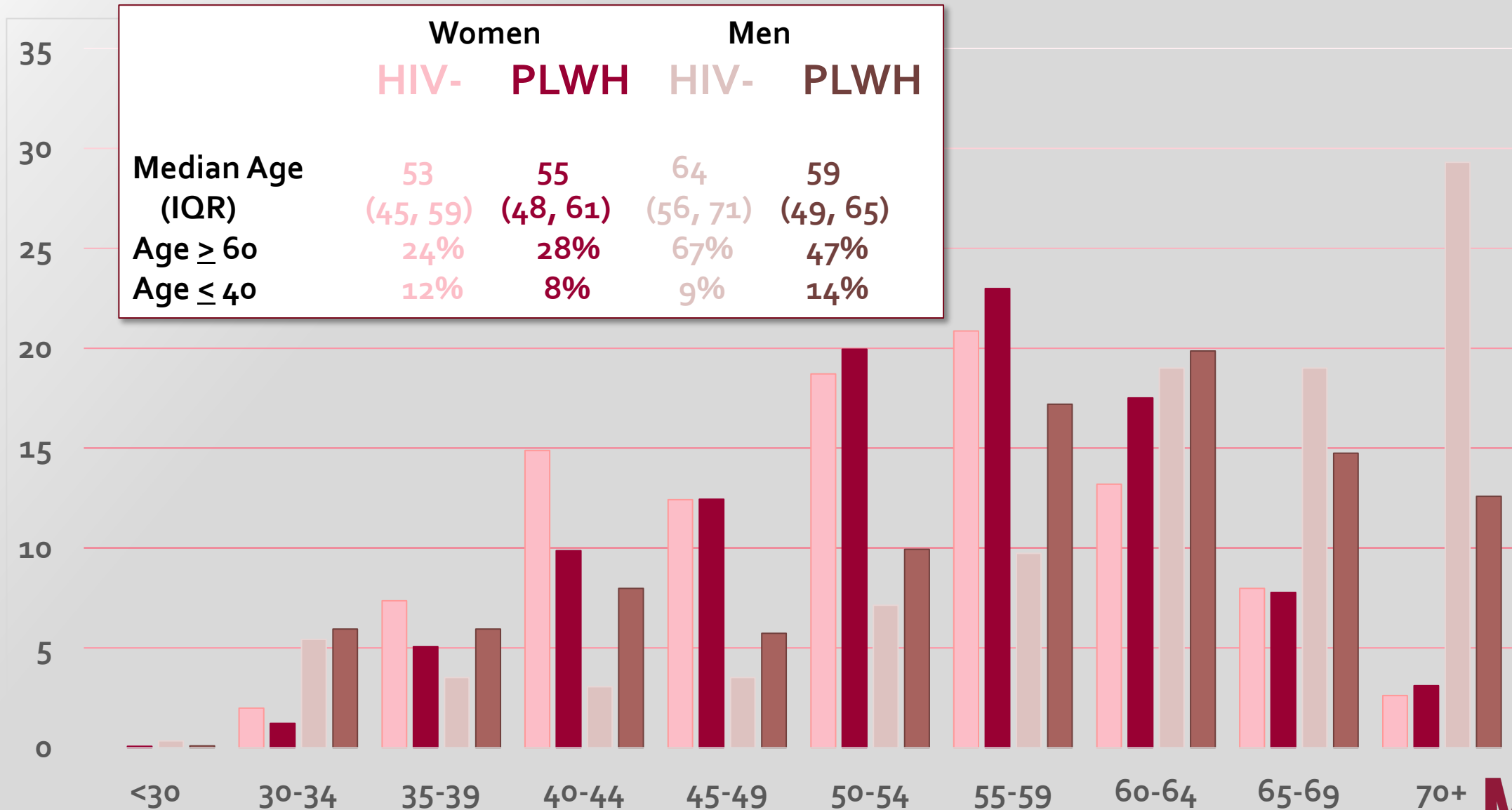
Enrollment (as of 10/12/22)

Site	# Enrolled:
Atlanta, GA	321
Baltimore, MD	372
Birmingham, AL / Jackson, MS	299
Bronx, NY	408
Brooklyn, NY	293
Chapel Hill, NC	247
Chicago (Cook County), IL	298
Chicago (Northwestern), IL	323
Los Angeles, CA	482
Miami, FL	224
Pittsburgh, PA	348
San Francisco, CA	345
Washington DC	262
TOTAL:	4222

Participant Characteristics, By HIV Status, Gender and Age (10/12/22)

Characteristics		Carryover Participants [N=3,316] N (%)	New Enrollees [N=903] N (%)	Total [N = 4,219] N (%)
HIV Status	PLWH	2,056 (62)	557 (62)	2,613 (62)
	HIV-	1,260 (38)	346 (38)	1,606 (38)
Gender	CIS Male	1,494 (45)	501 (56)	1,995 (47)
	CIS Female	1,817 (55)	365 (40)	2,182 (52)
	Trans Man	2 (< 1)	3 (< 1)	5 (< 1)
	Trans Woman	3 (< 1)	23 (3)	26 (< 1)
	Gender Fluid	-	9 (1)	9 (< 1)
	Identity not Listed	-	2 (< 1)	2 (0)
Age in years: Median (IQR)	PLWH	57 (50, 63)	50 (39, 56)	55 (47, 62)
	HIV-	61 (51, 68)	52 (41, 58)	58 (49, 66)

Age Distribution of Active Participants (10/12/22)



Enrollment: Race/Ethnicity (10/12/22)

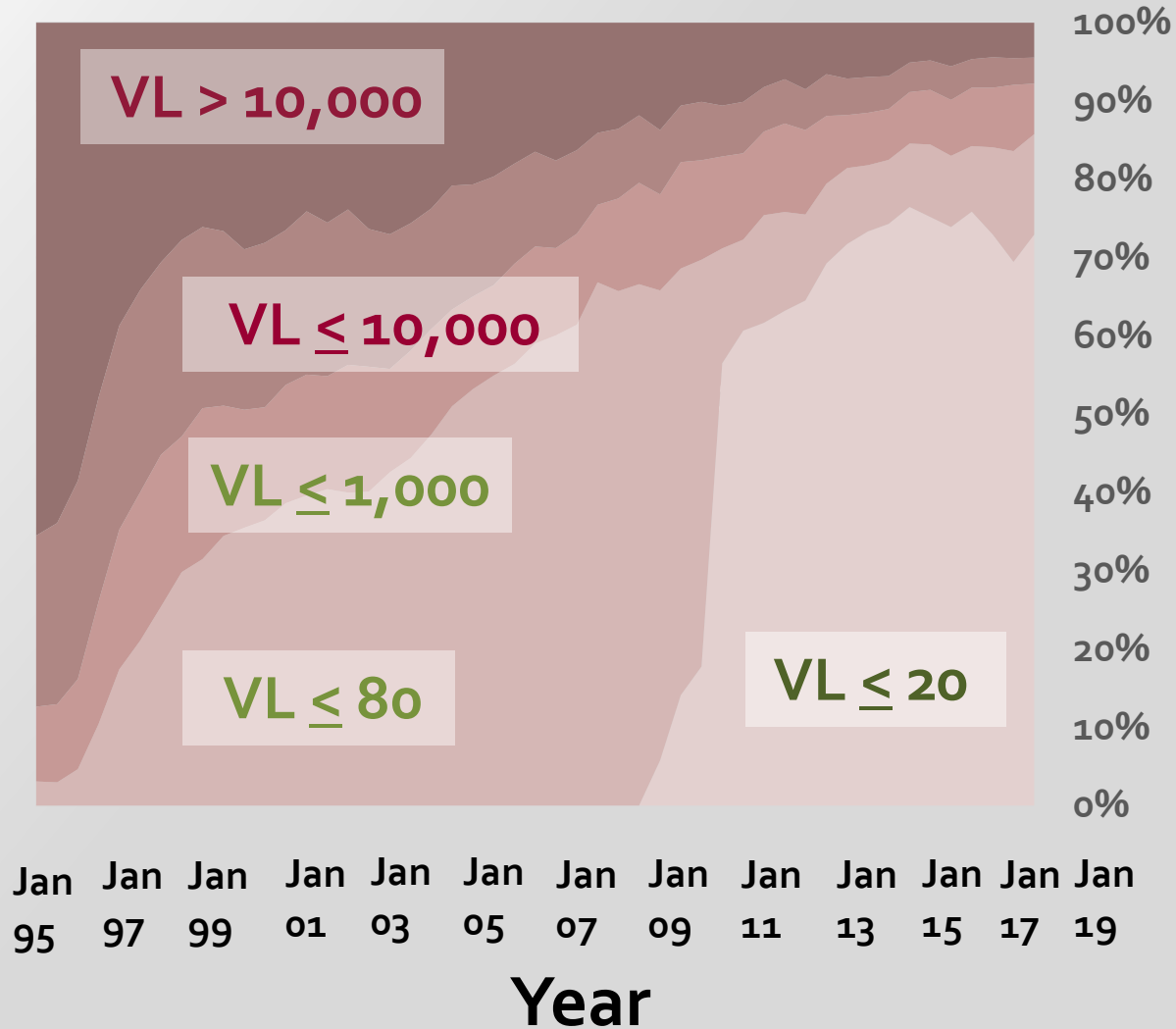
Carryover + New	*Female: †Hispanic/Latinx	Male: Hispanic/Latinx	Female: Not Hispanic/ Latinx	Male: Not Hispanic/ Latinx	TOTAL (%)
Black/ African American	56	21	1,587	637	2,301 (55)
American Indian / Alaskan Native	5	10	9	3	27 (< 1)
White	86	149	192	1,024	1,451 (35)
Asian	0	1	8	9	18 (< 1)
Multiracial	22	19	57	26	124 (3)
Native Hawaiian / Pacific Islander	0	0	3	2	5 (< 1)
Other	150	84	27	13	274 (7)
TOTAL (%)	319 (8)	284 (7)	1,883 (45)	1,714 (41)	4,200 (100)

*Gender: "Female" includes both CIS and Trans; "Male" includes both CIS and Trans.

Fluid and unlisted identity excluded due to small numbers (N=11)

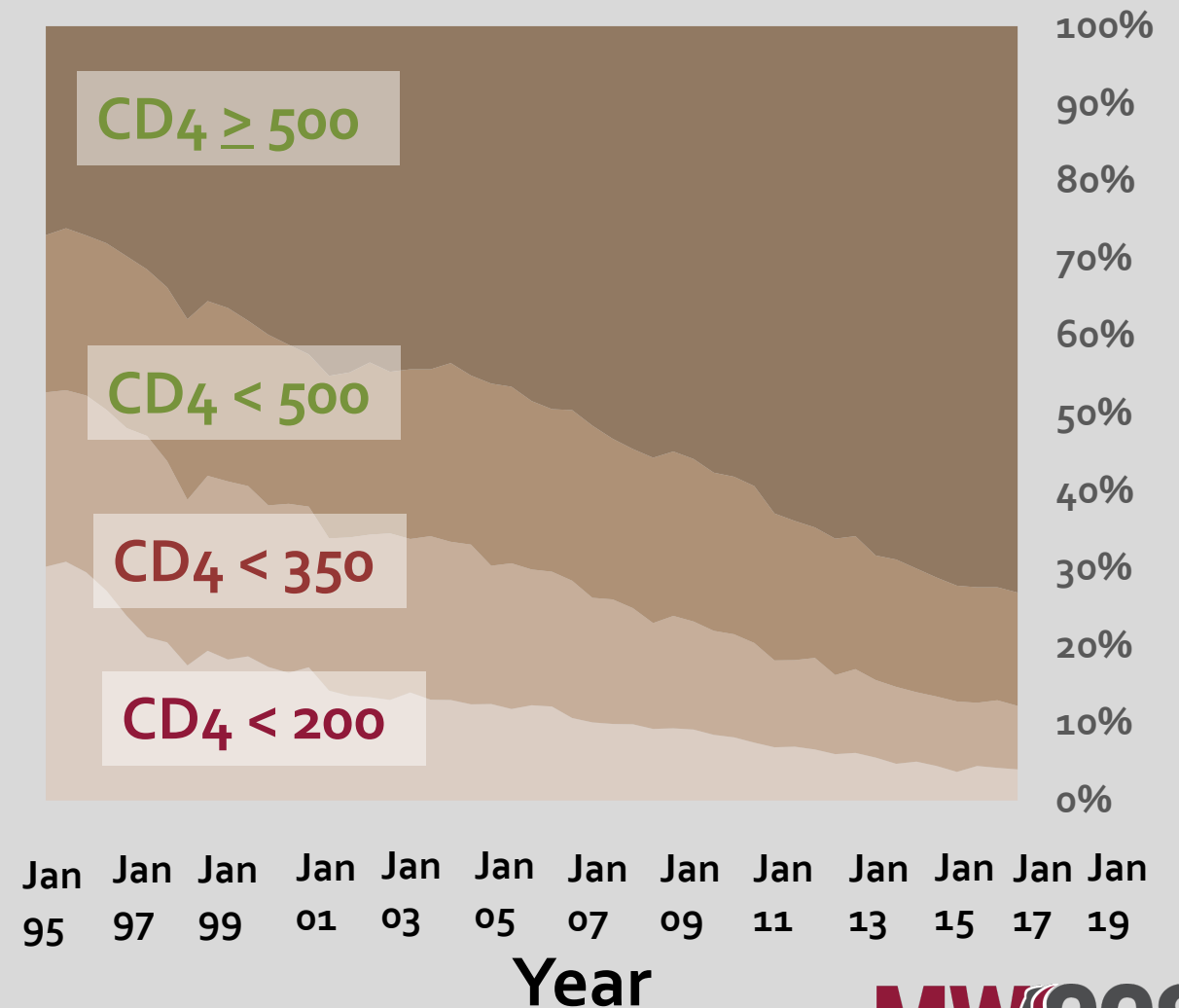
†Ethnicity: Unknown ethnicity excluded due to small numbers (N=8)

Changes in Viral Load Profiles Among PLWH



TaqMan v2.0 HIV-1, sensitive to 20 copies HIV RNA/mL, implemented in 2009

Changes in CD4 Count Profiles Among PLWH



CD4, Viral Load, and ART use among PLWH (10/12/22)

	N (%)		
Characteristic	Women [N=1479]	Men [N=977]	Total [N=2456]
Current CD4	N=1238	N=473	N=1711
<200	65 (5)	13 (3)	78 (5)
200-349	105 (8)	38 (8)	143 (8)
350-499	138 (11)	96 (20)	234 (14)
≥ 500	930 (75)	326 (69)	1256 (73)
Current HIV RNA	N=1177	N=408	N=1585
Undetectable (no signal) ¹	657 (56)	225 (55)	882 (56)
Below limit for quantification (< 20 cp/mL) ²	169 (14)	85 (21)	254 (16)
Detectable (≥ 20 cp/mL)	351 (30)	98 (24)	449 (28)
Current ART use	N=1467	N=924	N=2391
Reported ART at V101 interview	1407 (96)	902 (98)	2309 (97)

¹ 1 woman had lower limit of 30 cp/mL (no signal)

² 2 women had lower limit of 30 cp/mL (Below limit for quantification)

MWCCS studies many areas, including, but not limited to...

Cardiovascular
and Pulmonary
disease

Sleep
Quality

Neuro-
cognitive
ability

Frailty and
Physical
disability

Cancer

HIV
Pathogenesis

Metabolic,
liver, and
kidney
dysfunction

Psychosocial
and
Behavioral
conditions

Health
disparities

For more information on our study aims:

<https://statepi.jhsph.edu/mwccs/science/>

For information on our scientific working groups:

<https://statepi.jhsph.edu/mwccs/working-groups/>

Chronic Health Indicators (10/12/22)

	PLWH [N = 2403]		HIV- [N = 1486]		Total
	Women [N= 1461] ¹	Men [N =942] ¹	Women [N = 657] ¹	Men [N = 829] ¹	[N = 3889]
BMI: Median (IQR) ² % BMI >30 [% BMI >40]	31.6 (26.4, 38.0) 58 [21]	27.4 (24.3, 31.0) 31 [5]	32.5 (26.8, 38.7) 61 [23]	27.7 (24.6, 31.6) 33 [6]	29.7 (25.4, 35.5) 48 [15]
Hypertension ³ : N(%)	834 (57)	460 (49)	372 (57)	411 (50)	2077 (54)
Systolic BP [mm Hg] (IQR) ⁴	127 (115, 141)	124 (116, 134)	128 (115, 143)	127 (117, 139)	127 (115, 139)
Diastolic BP [mm Hg] (IQR) ⁴	76 (68, 84)	76.5 (69, 83.5)	76 (69, 84)	77 (69, 84)	76 (68, 84)
Diabetes ⁵ N(%)	337 (24)	191 (20)	138 (22)	155 (19)	821 (22)
Fasting Glucose[mg/dl] (IQR) ⁶	93 (84, 105)	94 (87, 103.5)	91 (83, 103)	94 (87, 104)	93 (85, 104)
High Cholesterol ⁷ N(%)	708 (52)	481 (60)	256 (42)	407 (56)	1852 (53)

¹ Sex at birth used for gender classification as it was used to calculate CVD risk, eGFR and other gender-based variables in chronic health dataset

² BMI % calculated among subset without missing data. Total for BMI = 3230: PLWH women = 1357, PLWH men = 708, HIV- female = 601 and HIV- male = 564

³ Hypertension: SBP ≥ 130, DBP ≥ 80, use of medication with ever self-reported diagnosis

⁴ Total for BP = 3067: PLWH women = 1377, PLWH men = 636, HIV- female = 610 and HIV- male = 444

⁵ Diabetes: ever self- reported medication, confirmation of a) fasting glucose ≥ 126 or HbA1c ≥ 6.5 % or self reported diabetes. Once participant meets DM definition, then DIABETES becomes yes thereafter; only defined for women who are not pregnant at visit

⁶ Total for fasting Glucose = 2275: PLWH female = 1061, PLWH male = 396, HIV- female = 476, HIV- male = 342

⁷ High cholesterol: Total cholesterol ≥ 200 mg/dl, fasting LDL ≥ 130 mg/dl, HDL < 40 mg/dl, fasting triglycerides ≥ 150 mg/dl, med use with self-report or diagnosis in past. High cholesterol % calculated among subset without missing data. Total for high cholesterol = 3510: PLWH female = 1373, PLWH male = 800, HIV- female = 615 and HIV- male = 722

Chronic Health Indicators (10/12/22)

	N (%)				
	PLWH [N = 2469]		HIV- [N = 1548]		Total [N = 4017] ²
	Women [N = 1480] ¹	Men [N = 988] ¹	Women [N = 664] ¹	Men [N = 883] ¹	
Cancer history N(%) ³	168 (15)	200 (26)	55 (13)	195 (29)	618 (21)
ACC/AHA CVD Risk Score (IQR) ⁴	0.05 (0.02, 0.10)	0.10 (0.05, 0.18)	0.05 (0.01, 0.11)	0.13 (0.06, 0.23)	0.06 (0.02, 0.14)
Race-free Estimated Glomerular Rate (eGFR): median [mL/min/1.73 m2] (IQR) ⁵	79.0 (64.7, 94.6)	80.4 (66.8, 94.6)	88.4 (73.4, 102.1)	88.4 (76.2, 98.2)	82.8 (68.1, 97.5)
eGFR classification: ⁵					
≥90 (normal or high)	386 (31)	157 (32)	255 (46)	186 (46)	984 (37)
60- 89 (mildly decreased)	627 (50)	252 (52)	230 (42)	194 (48)	1303 (48)
45-59 (mildly to moderately decreased)	163 (13)	57 (12)	42 (8)	20 (5)	282 (10)
30-44 (moderately to severely decreased)	46 (4)	12 (2)	15 (3)	6 (1)	79 (3)
<30 (severely decreased to kidney failure)	29 (2)	8 (2)	9 (2)	2 (0.4)	48 (2)

¹ Sex at birth used for gender classification as it was used to calculate CVD risk, eGFR and other gender-based variables in chronic health dataset

² Sum of women and men is not equal to total because two participant are transgender and their sex at birth is missing

³ Cancer hx % calculated among subset without missing data. Total = 3002: PLWH female = 1115, PLWH male = 768, HIV- female = 438 and HIV- male = 681

⁴ ACC/AHA CVD Risk Score or Pooled Cohort Equation. Total = 2025: PLWH women = 1033, PLWH men = 305, HIV-women = 442, HIV- men = 245

⁵ eGFR classification calculated among subset without missing data. Total = 2696: PLWH female = 1251, PLWH male = 486, HIV- female = 551 and HIV- male = 408

Cardiovascular and Pulmonary Characteristics (10/12/22)¹

	N (%)				
	PLWH [N=2469]		HIV- [N=1548]		Total
	Women	Men	Women	Men	[N=4017]
Hospitalized angina ²	31 (2)	25 (3)	17 (3)	23 (3)	96 (2)
Heart attack / Myocardial infarction (MI)	53 (4)	46 (5)	26 (4)	28 (3)	153 (4)
Hospitalized heart failure (HF) ²	24 (2)	10 (1)	15 (2)	9 (1)	58 (1)
Stroke	44 (3)	34 (4)	17 (3)	11 (1)	106 (3)
Transient Ischemic Attack (TIA)	55 (4)	35 (4)	20 (3)	24 (3)	134 (3)
Atrial fibrillation	6 (<1)	23 (2)	1 (<1)	48 (5)	78 (2)
Atrial flutter	0 (0)	13 (1)	2 (<1)	20 (2)	35 (1)
Any heart/blood vessel procedure	49 (3)	71 (7)	25 (4)	81 (9)	227 (6)
Hospitalized Chronic Obstructive Pulmonary Disease (COPD), Emphysema, Chronic bronchitis ³	57 (4)	13 (1)	31 (5)	11 (1)	112 (3)
Hospitalized pneumonia	82 (6)	122 (12)	27 (4)	60 (7)	294 (7)
Hospitalized asthma	96 (7)	26 (3)	65 (10)	34 (4)	222 (6)

¹ Self-reported history from BLHH and FPHH (ever). Added FPHH when able; due to use by carryover participants at baseline

² PHH does not ask about hospitalized angina or heart failure, so only BL data is presented

³ COPD in past two reports used 'EVER' COPD vs. Hospitalized COPD, which is why numbers have changed

COVID-19 Metrics (10/12/22)

	N (%)		
Metric	PLWH [N=2421]	HIV- [N=1516]	Total [N=3937]
Ever Tested for COVID-19	2010 (83)	1234 (81)	3244 (82)
Ever Infected with COVID-19	479 (20)	269 (18)	748 (19)
COVID-19 Hospitalizations			
Yes	88 (4)	40 (3)	128 (3)
No	1912 (79)	1196 (79)	3108 (79)
Unknown	421 (17)	280 (18)	701 (18)
Metric	PLWH [N=2206]	HIV- [N=1369]	Total [N=3575]
COVID Vaccination Status			
More than 1 Booster	168 (8)	138 (10)	306 (9)
Boosted	844 (38)	430 (31)	1274 (36)
Fully Vaccinated	654 (30)	374 (27)	1028 (29)
Partially Vaccinated	107 (5)	73 (5)	180 (5)
Unvaccinated	232 (11)	165 (12)	397 (11)
Unknown	201 (9)	189 (14)	390 (11)

Ongoing Sub-studies Enrollment (10/1/22)

Substudy	Enrollment Plan	# Enrolled*	Enrollment Goal^
Fibroscan	V101-V106	1978	4156 (All)
Hearing & Balance	V101-V102	3727	4156 (All)
STI Testing	V101-V103	2101`	4156 (All)
Microbiome	V101-V106	3115~	4156 (All)
(BRACE) Brainbaseline Assessment of Cognition and Everyday Function	V102-V106	2108	3306 (All CO)
(CAT-MH) Computerized Adaptive Test for Mental Health	V102-V106	2273	4156 (All)
(CIDI) Composite International Diagnostic Interview	V102-V105	602	2315 (70% CO)
(PFTs) Pulmonary Function Tests	V102-V105	568	3306 (All CO)
Sleep (select sites)	V102-V103	7	260
Echo Reproducibility (Baltimore and DC only)	V102	161	161

*Numbers from enrollment forms in Gemini as of 10/03/22, or received labs (for STI)

^Enrollment data from 9/15/22 Enrollment Report

~Microbiome enrollment number represents stool collection only

`2,101 people have had an STI test, 1,972 people tested for Chlamydia, 1,970 people tested for Gonorrhea, 853 people tested for Syphilis

CO= carryover participants

Data and Specimen Collection

We collect data on:

Demographics
HIV medication and adherence
Frailty, aging
Neuropsychology
Attitude and beliefs
Healthcare utilization
Quality of life, depression
Behaviors (substance use and sexual behavior)
Medical conditions and medication
Chronic conditions and co-infection

Lab results performed on:

Blood Chemistries, Complete Blood Count,
Hepatitis, T-Cell flow cytometry, HIV Viral Load,
Lipid Panel
Physical Examination performed
Outcome verification and adjudication
Biorepository of samples
Registry matching:
National Death Index, Cancer Registry, Renal
Disease Registry

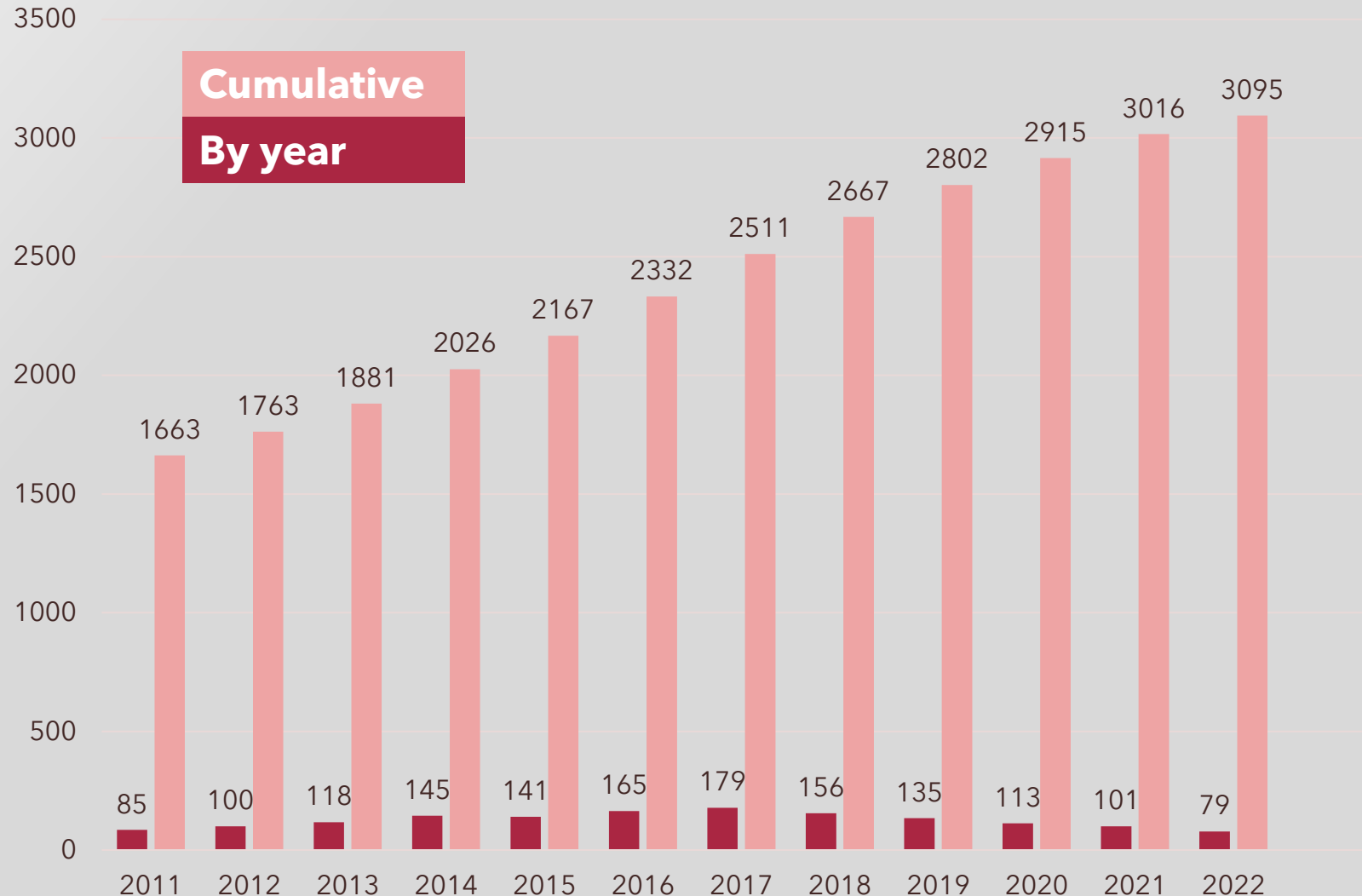
For more information on data collection forms: <https://statepi.jhsph.edu/mwccs/data-collection-forms/>²⁰
Or info on data/specimen collection procedures: <https://statepi.jhsph.edu/mwccs/manual-of-operations/>

Specimens in Central Repository (05/01/20)

Specimen	Date Range Collected		Current Participants		
	MACS	WIHS	PLWH	HIV (-)	TOTAL
Plasma	1984-2019	1994-2019	78,244	48,176	107,922
Plasma (EDTA)	2006-2019	2014-2019	40,841	17,169	58,010
Serum	1984-2019	1994-2019	72,345	48,176	120,521
Peripheral Blood	1994-2019	1994-2019	76,704	29,234	105,938
Cell Pellets	1994-2019	1994-2019	38,637	15,337	53,974
Urine (clean void)	1984-2019	1994-2019	44,060	16,864	60,924
Urine (supernatant)	NC	1994-2019	15,253	6,293	21,546
Cervicovaginal Lavage (CVL)	NC	1994-2019	38,043	16,021	54,064
Oral sample	1984-1993	1995-2004	1,558	607	2,165
B cell lines	N/A	NC	509	195	704
Stool	1984-1985	NC	2798	1,148	3,946
Semen	1984-1993	N/A	1,437	372	1,809

Table was summarized from Table 6 of : <https://pubmed.ncbi.nlm.nih.gov/33675224/>

Publications: 2010-2022



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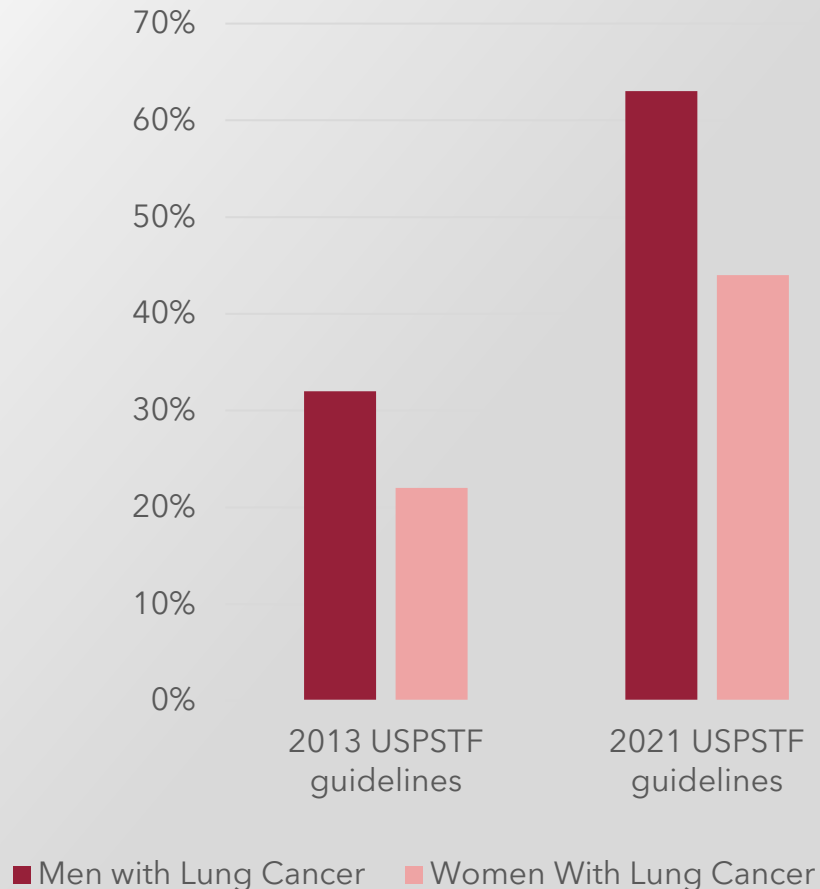
MACS/WIHS COMBINED COHORT STUDY

Selected Studies and Scientific Highlights

Characteristics of the MACS/WIHS Combined Cohort Study: Opportunities for Research on Aging With HIV in the Longest US Observational Study of HIV (D'Souza, et al, 2021)

- Data protocols for the MACS and WIHS were similar but not identical, this study described how these two cohorts were merged to have a unified protocol.
- This study was able to:
 - Harmonized definition for co-morbidities
 - Harmonized database and specimen collection of the two cohorts
 - Present key characteristics of participants in the two cohorts
 - Key demographics, race/ethnicity, gender
 - Co-morbidity profiles of participants
 - Health Behavioral and Mental Status Characteristics
- This will bring forth a new era in HIV/AIDS research as we learn more about the effect of HIV seropositivity, aging and other co-morbidities
- Please look at their findings in: <https://pubmed.ncbi.nlm.nih.gov/33675224/>

Optimal lung cancer screening criteria among persons living with HIV (Sellers, et al, 2022)



- PLWH are at a higher risk for lung cancer but were not well-represented in the National Lung Screening Trial which was the basis for 2013 USPSTF lung cancer screening guidelines
- Retrospective analysis was done using MWCCS data
- 52 women and 19 men with lung cancer; 1950 women and 1599 men without lung cancer
- 11 women (22%) and 6 men (32%) met the 2013 guidelines
- 22 women (44%) and 12 men (63%) met the 2021 guidelines
- More PLWH with lung cancer are eligible for screening based on the 2021 USPSTF guidelines
- Increased sensitivity of 2021 guidelines is attributed to decreased age and tobacco exposure thresholds in women

The online pre-print can be found at:

<https://pubmed.ncbi.nlm.nih.gov/35125470/>

Examples of Recent Articles (2021)

Article Title	Journal	Authors	Topic Area
Prevalence of COVID-19-Related Social Disruptions and Effects on Psychosocial Health in a Mixed-Serostatus Cohort of Men and Women.	Journal of Acquired Immune Deficiency Syndromes	M. Friedman et al.	Psychosocial and Behavior Covid-19
The IDOze Study: The Link between Sleep Disruption and Tryptophan-Kynurenine Pathway Activation in Women with HIV	Journal of Infectious Diseases	A. Rogando et al.	Sleep
HIV serostatus and incident coronary artery stenosis in men with a baseline zero coronary artery calcium	AIDS	S. Sarkar et al.	Cardiovascular
Risk of smoking-related cancers among women and men living with and without HIV.	AIDS	N. Hessol et al.	Cancer

Examples of Recent Articles (2022)

Article Title	Journal	Authors	Topic Area
SARS-CoV-2 Infection Among People Living With HIV Compared With People Without HIV: Survey Results From the MACS-WIHS Combined Cohort Study	Journal of Acquired Immune Deficiency Syndromes	G. D'Souza et al.	HIV Pathogenesis Covid-19
Distinct Lipidomic Signatures in People Living With HIV: Combined Analysis of ACTG 5260s and MACS/WIHS	The Journal of Clinical Endocrinology and Metabolism	J. Jao et al.	Metabolic Dysfunction
Optimal Lung Cancer Screening Criteria among persons living with HIV	Journal of Acquired Immune Deficiency Syndromes	S. Sellers et al.	Pulmonary Cancer
Polypharmacy is Associated with Falls in Women With and Without HIV	Journal of Acquired Immune Deficiency Syndromes	C. Psomas et al.	Aging/Frailty



MACS/WIHS COMBINED COHORT STUDY

Interested in working with us?

Please visit

<https://statepi.jhsph.edu/mwccs/work-with-us/>

for a comprehensive guide of the process

Administered by NHLBI and co-funded by 13 institutes:

NIAID, NICHD, NHGRI, NIA, NIDCR, NINDS, NIMH, NIDA, NINR, NCI, NIAAA, NIDCD and NIDDK