

## Are missed- and kept-visit measures capturing different aspects of retention in HIV primary care?

D. Scott Batey, Emma Sophia Kay, Andrew O. Westfall, Anne Zinski, Mari-Lynn Drainoni, Lytt I. Gardner, Thomas Giordano, Jeanne Keruly, Allan Rodriguez, Tracey E. Wilson, Michael J. Mugavero & on behalf of the Retention in Care (RIC) Study Group

To cite this article: D. Scott Batey, Emma Sophia Kay, Andrew O. Westfall, Anne Zinski, Mari-Lynn Drainoni, Lytt I. Gardner, Thomas Giordano, Jeanne Keruly, Allan Rodriguez, Tracey E. Wilson, Michael J. Mugavero & on behalf of the Retention in Care (RIC) Study Group (2020) Are missed- and kept-visit measures capturing different aspects of retention in HIV primary care?, *AIDS Care*, 32:1, 98-103, DOI: [10.1080/09540121.2019.1659918](https://doi.org/10.1080/09540121.2019.1659918)

To link to this article: <https://doi.org/10.1080/09540121.2019.1659918>



Published online: 28 Aug 2019.



Submit your article to this journal [↗](#)



Article views: 123



View related articles [↗](#)



View Crossmark data [↗](#)



## Are missed- and kept-visit measures capturing different aspects of retention in HIV primary care?

D. Scott Batey<sup>a</sup>, Emma Sophia Kay<sup>b</sup>, Andrew O. Westfall<sup>c</sup>, Anne Zinski<sup>d</sup>, Mari-Lynn Drainoni<sup>e,f</sup>, Lytt I. Gardner<sup>g</sup>, Thomas Giordano<sup>h</sup>, Jeanne Keruly<sup>i</sup>, Allan Rodriguez<sup>j</sup>, Tracey E. Wilson<sup>k</sup>, Michael J. Mugavero<sup>l</sup> and on behalf of the Retention in Care (RIC) Study Group<sup>a</sup>

<sup>a</sup>Department of Social Work, University of Alabama at Birmingham, Birmingham, AL, USA; <sup>b</sup>School of Social Work, University of Michigan, Ann Arbor, MI, USA; <sup>c</sup>School of Public Health, Department of Biostatistics, University of Alabama at Birmingham, Birmingham, AL, USA; <sup>d</sup>School of Medicine, Department of Medical Education, University of Alabama at Birmingham, Birmingham, AL, USA; <sup>e</sup>Department of Medicine, Boston University School of Medicine, Boston, MA, USA; <sup>f</sup>Department of Health Law, Policy & Management, Boston University School of Public Health, Boston, MA, USA; <sup>g</sup>Centers for Disease Control and Prevention, Atlanta, GA, USA; <sup>h</sup>Baylor College of Medicine, Houston, TX, USA; <sup>i</sup>School of Medicine, Johns Hopkins University, Baltimore, MD, USA; <sup>j</sup>School of Medicine, University of Miami, Miami, FL, USA; <sup>k</sup>Downstate Medical Center, State University of New York, Brooklyn, NY, USA; <sup>l</sup>School of Medicine, Department of Medicine, University of Alabama at Birmingham, Birmingham, AL, USA

### ABSTRACT

The literature recognizes six measures of retention in care, an integral component of the HIV Continuum of Care. Given prior research showing that different retention measures are differentially associated with HIV health outcomes (e.g., CD4 count and viral suppression), we hypothesized that different groups of people living with HIV (PLWH) would also have differential retention outcomes based on the retention measure applied. We conducted a cross-sectional analysis of multisite patient-level medical record data ( $n = 10,053$ ) from six academically-affiliated HIV clinics using six different measures of retention. Principal component analysis indicated two distinct retention constructs: kept-visit-measures and missed-visit measures. Although black (compared to white) PLWH had significantly poorer retention on the three missed-visit measures, race was not significantly associated with any of the three kept-visit measures. Males performed significantly worse than females on all kept-visit measures, but sex differences were not observed for any missed-visit retention measures. IDU risk transmission group and younger age were associated with poorer retention on both missed- and kept-visit retention measures. Missed- and kept-visit measures may capture different aspects of retention, as indicated in the observed differential associations among race, sex, age, and risk transmission group. Multiple measures are needed to effectively assess retention across patient subgroups.

### ARTICLE HISTORY

Received 4 February 2019  
Accepted 19 August 2019

### KEYWORDS

HIV; retention in care; continuum of care; missed visits; kept visits

## Introduction

Since the introduction of HIV antiretroviral therapy (ART) and the subsequent ability to improve quality and duration of life, retention in HIV medical care has become increasingly important (Mugavero, Davila, Nevin, & Giordano, 2010). Poor retention in care (RiC) has been independently associated with patient mortality (Giordano et al., 2007; Horberg et al., 2013; Mugavero et al., 2009), a finding not surprising as patients irregularly attending medical appointments have inconsistent access to ART and provider monitoring of medication regimens, laboratory results, and comorbid conditions. In light of this, in 2015 the National HIV/AIDS Strategy (NHAS) directed federal agencies to improve outcomes at every step of the

continuum, including improvement in RiC (White House 2015). By 2020, the NHAS seeks to improve the number of persons living with HIV (PLWH) who are successfully retained in care to 90%, a ten-point increase from the 2010 NHAS (White House 2015). The Institute of Medicine (IOM) also includes retention as one of nine core indicators related to HIV clinical care in recognition of evidence that successful RiC provides opportunities for treatment of comorbid conditions, screening, and prophylaxis, as well as monitoring of ART and CD4 count and viral load results (Institute of Medicine 2012).

Recent studies have lamented the absence of a “gold standard” to document RiC (Althoff et al., 2014; Mugavero et al., 2012; Yehia et al., 2012). To measure RiC, multiple visits at varying intervals must be

**CONTACT** D. Scott Batey  [dsbatey@uab.edu](mailto:dsbatey@uab.edu)  University of Alabama at Birmingham, Humanities Building, #302F, 900 13th Street, South, Birmingham, AL 35294, USA

Data from this study was presented in part at the 8th International Conference on HIV Treatment and Prevention Adherence, Miami, Florida, June 2–4, 2013.

© 2019 Informa UK Limited, trading as Taylor & Francis Group

considered. There are six commonly used measures of RiC (Table 1), including those that account for missed (“no show”) visits and others that focus on kept (“completed”) visits. Although kept-visit measures are conducive to administrative settings since they do not include unattended visits, it is recommended that researchers use both measures when studying retention to maximize clinical prognostic value (Mugavero et al., 2010, 2012; Mugavero, Amico, Horn, & Thompson, 2013).

Individual factors such as age, sex, race, mental and physical health, substance use disorder, and insurance status may influence retention (Crawford, Sanderson, & Thornton, 2013; Kissinger et al., 1995; Marx, Malka, Ravishankar, & Schwartz, 2011; Napravnik et al., 2006; Rumpitz et al., 2007; Tobias, Cunningham, Cunningham, & Pounds, 2007; Ulett et al., 2009). Several retrospective studies suggest that retention may also be differentially associated with CD4 count and viral suppression. For instance, having more *missed visits*, but not fewer *attended visits* (i.e., gaps in care) is associated with an AIDS-defining CD4 count of  $<200$  cells/mm<sup>3</sup> (Reveles et al., 2015). Furthermore, some, but not all, of the commonly-used retention measures are significantly associated with viral suppression (Crawford et al., 2013). In one retrospective cohort study, all six measures of RiC were significantly associated with viral suppression; however, no single measure predicted viral suppression with both high specificity and high sensitivity (Mugavero et al., 2012).

Among participants in a Centers for Disease Control and Prevention (CDC)/Health Resources and Services Administration (HRSA) trial, correlations among missed-visit measures only (0.72–0.77) and kept-visit measures only (0.83–0.85) were higher than correlations between individual measures of retention (0.16–0.57), although all measures were significantly associated ( $p < .001$ ) with 12-month viral load suppression (Mugavero et al., 2012). Since research suggests that retention is a composite rather than unitary construct, we hypothesized that different groups of PLWH would be differentially categorized as *retained* based on the retention measure used, as well. Thus, the purpose of this research is to further evaluate differences for missed-visit compared to kept-visit measures among different subgroups of PLWH, which may help inform the development of RiC construct-specific tailored interventions to increase retention among specific populations of PLWH.

## Methods

The data reported here were collected as the pre-intervention stage of a clinic-wide “low-effort” intervention

**Table 1.** Six commonly-used retention measures.

Retention measure	Definition	RiC measure type	Modeling approach
Missed visits (count)	Count of “no show” primary care appointments	Missed	Poisson regression
Missed visits (dichotomous)	Any “no show” scheduled primary care appointments (dichotomous measure)	Missed	Logistic regression
Visit adherence	Completed primary care visits/Scheduled (missed + completed) primary care visits	Missed	Ordinary least squares regression
Visit constancy	At least 1 primary care visit completed in each 4-month time period	Kept	Ordinal logistic regression
Gaps in care	Length of time ( $\geq 189$ days) between completed primary care visits	Kept	Logistic regression
IOM	$\geq 2$ primary care visits separated by $\geq 3$ months during a 12-month period	Kept	Logistic regression

called “Stay Connected” that used posters and messages (Gardner et al., 2012). These data were collected during the 12 months preceding the launch of the Stay Connected intervention (May 2008–April 2009). Patient-level data included systematically captured, de-identified sociodemographic and clinical variables. To identify established clinic patients for whom retention could be measured, eligibility criteria consisted of (1) at least one kept primary HIV care appointment in the year preceding the study (April 2007–2008) and (2) at least one scheduled primary HIV care appointment during the first six months of the 12-month study period. Study sites included six academically-affiliated HIV clinics in the United States, and the study was approved by institutional review boards at all study sites.

Outcomes examined in the current study were six commonly-used retention measures calculated for each patient during the 12-month observation period. Detailed descriptions of these retention measures are provided in Table 1 and have been described elsewhere (Mugavero et al., 2012). In calculating retention measures, only scheduled visits with a primary HIV medical provider with prescribing privileges (i.e., MDs, CRNPs, and PAs) were included; walk-in, urgent care, subspecialty, or supportive services visits were excluded. Three of the retention measures (*missed visits-count*, *missed visits-dichotomized*, and *visit adherence*) incorporated missed clinic visits in their calculation. Missed visits included only those visits that were not attended and were not canceled in advance of the scheduled appointment by the patient, provider, or clinic. Missed

visits were either summed (count measure) or dichotomized (either “any” or “none” during study period), and visit adherence was calculated as a proportion, equal to the number of kept appointments (those attended by the patient) over scheduled appointments (which included both missed and kept visits).

Three retention measures were calculated based solely on kept visits. The *four-month constancy measure* calculated the number of four-month intervals in which a patient had at least one kept visit (range = 0–3). The *six-month gap measure* captured whether a patient had more than 189 days between sequential kept visits, and the *Institute of Medicine (IOM) measure* calculated whether a patient had two kept visits separated by more than 90 days during the 12-month observation period. Except for the missed visits-count measure (i.e., values < 1 indicate fewer missed visits and therefore better retention in care), the other five retention measures were aligned with a positive directionality to facilitate the interpretation of study results.

Separate multivariable regression models evaluated the association of sociodemographic factors with each measure (Table 1). Independent variables consisted of demographic characteristics, including sex, race, ethnicity, and HIV transmission risk.

We tested the assumption that the missed- and kept-based measures reflected two distinct constructs using principal component analysis with a varimax (orthogonal) rotation. The principal component analysis is a variable reduction technique useful for assessing whether multiple variables are measuring the same construct (O’Rourke & Hatcher, 2013).

**Table 2.** Selected sample demographics.

Characteristic (N = 10,053)	Mean ± SD or frequency (%)
Age (years)	46.0 ± 10.0
Sex	
Male	6549 (65.1%)
Female	3465 (34.5%)
Race	
Black	6435 (64.0%)
White	3004 (29.9%)
Other/Unknown	614 (6.1%)
Risk transmission group	
MSM	2837 (28.2%)
IDU	1318 (13.1%)
Heterosexual	4947 (49.2%)
Site	
1	2904 (28.9%)
2	1053 (10.5%)
3	1883 (18.7%)
4	922 (9.2%)
5	1307 (13.0%)
6	1984 (19.7%)
Baseline plasma HIV RNA ( $\log_{10}$ c/mL)	2.59 ± 1.17
Baseline CD4+ T lymphocyte count (cells/ $\mu$ L)	456 ± 296

## Results

Among 10,053 participants, the mean age was 46 years; near two-thirds were male (65%) and black (64%); 80% were non-Hispanic; and 49% (including 56% of the women and 44% of the men) reported their HIV transmission risk as heterosexual sex (Table 2). The distribution of participants across study sites ranged from 922 to 2904. Mean log viral load ( $\log_{10}$  c/mL) at baseline, defined as the closest value to 1 May 2008 ( $\pm 120$  days) was 2.59, and mean CD4 count (cells/ $\mu$ L) at baseline was 456. Approximately 63% of participants were virally suppressed ( $\leq 400$  c/mL) at the end of the 12-month period. MSM, men, and white PLWH had the lowest mean number of missed visits (1.49, 1.61, and 1.42, respectively), while IDU risk (1.89) and black PLWH (1.79) had the highest mean number of missed visits (Table 3).

When comparing measures of retention, multivariable analyses revealed differences based on race, age, and HIV transmission risk (Table 4). Across all six RiC measures, younger age was significantly associated with poorer retention. For the three measures incorporating missed visits, black race and IDU transmission risk significantly predicted poorer retention. Poorer retention for the four-month constancy and IOM measures was predicted by IDU transmission risk (Table 4). In contrast, parameter estimates for black vs. white race for the four-month visit constancy, six-month gap, and the IOM measures hover around 1.0, suggesting equivalent retention for black PLWH relative to their white counterparts when it comes to measures based upon kept clinic visits. Although there were no significant demographic differences for the missed-visit measures, men performed significantly worse than women on all kept-visit measures.

Principal component analysis of the six RiC measures yielded two distinct components, one including the missed-visit measures and the other the kept-visit measures which, combined, accounted for 84% of the total variance.

**Table 3.** Selected descriptive statistics for missed and kept visits.

	Mean number of kept visits (SD)	Mean number of missed visits (SD)
Risk transmission group		
MSM	3.16 (2.05)	1.20 (1.49)
IDU	3.72 (2.48)	1.96 (1.89)
Heterosexual	3.45 (2.19)	1.52 (1.70)
Sex		
Male	3.33 (2.18)	1.41 (1.61)
Female	3.57 (2.30)	1.69 (1.85)
Race		
White	3.15 (2.07)	1.13 (1.42)
Black	3.50 (2.26)	1.69 (1.79)
Other/Unknown	3.73 (2.51)	1.38 (1.71)

**Table 4.** Separate multivariable regression models for six commonly used measures of retention in care.

	Missed visit (count) <sup>a</sup> IRR (95% CI)	Missed visit (dichotomous) <sup>b</sup> OR (95% CI)	Visit adherence <sup>c</sup> $\beta$ (95% CI)	4-mo visit constancy <sup>d</sup> OR (95% CI)	6-mo gap <sup>e</sup> OR (95% CI)	IOM <sup>f</sup> OR (95% CI)
Age (per 10 years)	<b>0.83 (0.81,0.85)</b>	<b>1.37 (1.31,1.43)</b>	<b>0.06 (0.05,0.06)</b>	<b>1.32 (1.27,1.38)</b>	<b>1.36 (1.30,1.42)</b>	<b>1.40 (1.34,1.48)</b>
Male	0.97 (0.92,1.01)	1.00 (0.90,1.12)	-0.01 (-0.02,0.00)	<b>0.90 (0.82,0.99)</b>	<b>0.86 (0.78,0.96)</b>	<b>0.87 (0.77,0.97)</b>
Female	Ref	Ref	Ref	Ref	Ref	Ref
Black	<b>1.40 (1.32,1.50)</b>	<b>0.61 (0.54,0.68)</b>	<b>-0.05 (-0.06,-0.03)</b>	1.08 (0.97,1.21)	1.11 (0.98,1.25)	1.10 (0.96,1.26)
Other	<b>1.21 (1.09,1.34)</b>	<b>0.71 (0.57,0.87)</b>	<b>-0.03 (-0.06,0.00)</b>	0.89 (0.74,1.06)	0.98 (0.79,1.21)	0.90 (0.71,1.14)
White	Ref	Ref	Ref	Ref	Ref	Ref
Hispanic	<b>1.10 (1.02,1.19)</b>	0.88 (0.75,1.03)	0.01 (-0.01,0.03)	<b>1.60 (1.40,1.84)</b>	<b>1.53 (1.31,1.79)</b>	<b>1.56 (1.31,1.86)</b>
Non-Hispanic	Ref	Ref	Ref	Ref	Ref	Ref
IVDU*	<b>1.49 (1.40,1.58)</b>	<b>0.57 (0.49,0.65)</b>	<b>-0.08 (-0.09,-0.06)</b>	<b>0.88 (0.78,0.99)</b>	0.90 (0.79,1.03)	<b>0.75 (0.65,0.87)</b>
MSM*	0.94 (0.89,1.00)	<b>1.19 (1.05,1.34)</b>	<b>0.03 (0.01,0.04)</b>	1.08 (0.97,1.20)	<b>1.22 (1.08,1.38)</b>	1.13 (0.99,1.29)
Other	<b>1.13 (1.04,1.22)</b>	0.88 (0.74,1.05)	-0.02 (-0.04,0.00)	0.94 (0.81,1.09)	1.06 (0.89,1.27)	1.06 (0.87,1.29)
Heterosexual	Ref	Ref	Ref	Ref	Ref	Ref

Statistically significant results ( $p$ -value < 0.05) are **bolded**. All models also include site.

\*IVDU = Intravenous drug user, MSM = Men who have sex with men

<sup>a</sup>Count of number of missed visits modeled using multivariable Poisson regression model (N = 9907). Incidence rate ratios (IRR) and corresponding 95% confidence intervals (CIs) shown in table. IRR values < 1 indicate better retention in care (fewer missed visits).

<sup>b</sup>Missed visit (Y/N) modeled using multivariable logistic regression (N = 9907). Odds ratios (ORs) and corresponding 95% CIs shown in table. Having no missed visits is the event modeled so ORs > 1 indicate better retention (increased odds of having no missed visits).

<sup>c</sup>Visit adherence modeled using multivariable ordinary least squares linear regression model (N = 9826). Parameter estimates ( $\beta$  coefficients) and corresponding 95% CIs shown in table. Coefficients > 0 indicate better retention (higher adherence).

<sup>d</sup>4-month constancy modeled using multivariable ordinal logistic regression model (N = 9907). ORs and corresponding 95% CIs shown in table. ORs > 1 indicate better retention in care (increased odds of being in a higher constancy category).

<sup>e</sup>Greater than 6-month gap in care (Y/N) modeled using multivariable logistic regression (N = 9907). ORs and corresponding 95% CIs are shown in table. Not having a gap in care is the event modeled so ORs > 1 indicate better retention (increased odds of not having a gap in care during study year).

<sup>f</sup>IOM measure met (Y/N) modeled using multivariable logistic regression (N = 9907). ORs and corresponding 95% CIs are shown in table. Meeting the IOM measure is the event modeled so odds ratios greater than 1 indicate better retention in care (increased odds of meeting the IOM measure).

## Discussion

In a sample of over 10,000 PLWH from six clinic sites, we identified an essential difference between missed- and kept-visit measures of RiC based on the sociodemographic group. While black vs. white race was associated with poorer RiC for all three missed-visit measures, this association was not present in analyses with any of the kept-visit measures. In contrast, men had worse retention according to all three kept-visit measures, but not with the missed-visit measures. These disparate outcomes illustrate the multidimensionality of RiC and help contextualize the two distinct RiC components found in the principal component analysis. Our findings suggest that missed- and kept-visit measures may be capturing different dimensions of HIV care engagement, and they raise questions about health disparities revealed in clinic-based measures of retention in care.

These results raise several important questions about how to best capture retention, as well as how to interpret and apply these seemingly disparate findings to research, practice, and policy. It may be that missed-visit measures are not simply negatively correlated with kept-visit measures. While lower correlation coefficients across missed- and kept-visit measures were observed previously in this sample (Mugavero et al., 2012) these new findings regarding disparate associations for key subgroups raise novel questions pertaining to the NHAS goal of overcoming health disparities. When applying the IOM quality indicator for RiC, black

PLWH observed similar retention outcomes to white PLWH across multiple clinic sites. As a stand-alone finding, these results could suggest progress towards NHAS goals and attenuation of engagement in care disparities. However, the greater the likelihood of missed visits among black vs. white PLWH calls this conclusion into question. Indeed, a recent study demonstrated increased mortality risk among PLWH with more missed visits, independent of whether or not they achieved the IOM retention indicator (Mugavero et al., 2014), suggesting that retention based on the IOM measure alone does not a comprehensive indicator of HIV health. In addition, men and black PLWH were less likely to be retained according to the missed visits RiC measure. Although we do not have survival data to examine mortality risk in the present dataset, our findings may inform clinical practice by identifying unique patterns of clinic attendance among patient subgroups (e.g., men, younger PLWH, black PLWH, and IDU risk).

It is imperative that future research evaluates patient perspectives on missed- and kept-visit retention measures, particularly as those perspectives relate to observed health disparities. It is essential to gain further knowledge and insight on the seemingly distinct missed- and kept-visit retention constructs, including factors that contribute to PLWH both missing and attending visits. Given that missed- and kept-based visits are distinct constructs, as confirmed in principal component analysis, it is helpful to consider which psychosocial and/or

structural barriers may contribute to each. Broadly speaking, adequate access to supportive services, such as transportation and housing, may have a greater impact on patients' ability to attend scheduled clinic visits, whereas psychosocial factors such as stigma, disclosure, and depression may have more substantial roles in missing visits. In order to achieve optimal health outcomes for all PLWH, an understanding of modifiable factors uniquely contributing to missed and kept visits is essential to allow for tailored interventions that maximize performance across both types of retention measure outcomes (Reveles et al., 2015). Results of this study suggest that black PLWH could particularly benefit from interventions addressing missed-visit correlates, whereas kept-visit interventions may be a priority for male patients. Moreover, younger PLWH and PLWH who report IDU appear to have challenges with retention according to both missed- and kept-visit RiC measures, and may need to have both components addressed in interventions.

### Limitations

As with all observational studies, we are unable to ascribe causality. While we have established associations between social demographic characteristics and retention measures, we are unable to suggest that having specific characteristics will definitively affect one's retention in HIV primary medical care according to each measure. Additionally, the use of a study sample derived from large, academically-affiliated clinics may affect generalizability. Indeed, although encompassing a multi-site cohort, this sample does not include PLWH outside of a medical clinic – likely the most poorly engaged individuals. While the six study sites serve diverse populations, these findings might not translate to other treatment settings or to non-academically affiliated clinics.

The sampling frame also comes with some limitations. Since the study sample consisted only of patients who had previously established care in order to include a comparable observation period, this excluded persons new to HIV medical care. Our study participants may, therefore, have been more adherent, regardless of their retention status, which introduces a degree of selection bias. We were unable to systematically capture and account for those individuals who may have transferred to a different medical facility during the one-year observation period. Deaths that occurred during the study period were not captured, as well. Future research would benefit from a longer observation period. We also note the study period is somewhat dated. However, for the research questions addressed regarding missed- versus kept-visit measures, the strengths of the large,

diverse, multi-site sample afforded by the CDC/HRSA RiC study are more important and scientifically germane, although it would be advantageous to validate our findings in more contemporary and distinctive clinic-based cohorts.

### Conclusions

Principal component analyses revealed two distinct components, missed- and kept-visit measures, accounting for 84% of the variance and which were differentially associated with race and sex. The findings suggest that these missed- and kept-visit measures may capture different aspects of RiC for PLWH. Additional research is warranted to further evaluate retention-based measures, including modifiable correlates of missed- and kept-visit measures, and the impact of the RiC measures on clinical outcomes within the sociodemographic subsets. Moreover, the variability in demographic correlates across retention measures demonstrates the caution with which researchers should interpret subgroup findings.

While there might not be a “gold standard” approach for measuring RiC (Mugavero et al., 2012), researchers can identify the range of methods needed to sufficiently explain correlates of retention. Careful analysis can help increase retention data interoperability, as well as inform HIV providers with knowledge about how to best retain at-risk populations in care. Populations at risk for missed visits may be distinct from those with fewer kept visits (i.e., longer gaps in care or lower visit constancy). Black PLWH may particularly benefit from interventions targeted at reducing missed visits, while men may benefit from kept-visit-based interventions. Finally, PLWH who are younger or who have a risk of IDU may benefit from interventions that address both components of retention in care.

### Disclosure statement

No potential conflict of interest was reported by the authors.

### Funding

This work was supported by the Centers for Disease Control and Prevention (CDC) and the Health Resources and Services Administration (HRSA) (CDC contracts 200-2007-23685 to Baylor College of Medicine, 200-2007-23690 to Boston Medical Center, 200-2007-23689 to Johns Hopkins University School of Medicine, 200-2007-23687 to Research Foundation of the State University of New York, SUNY Downstate Medical Center, 200-2007-23684 to the University of Alabama at Birmingham, and 200-2007-23692 to the University of Miami Miller School of Medicine).

**ORCID**

Emma Sophia Kay  <http://orcid.org/0000-0002-8425-9196>

**References**

- Althoff, K. N., Rebeiro, P., Brooks, J. T., Buchacz, K., Gebo, K., Martin, J., ... North American AIDS Cohort Collaboration on Research and Design (NA-ACCORD). (2014). Disparities in the quality of HIV care when using US Department of Health and Human Services indicators. *Clinical Infectious Diseases*, 58(8), 1185–1189. doi:10.1093/cid/ciu044
- Crawford, T. N., Sanderson, W. T., & Thornton, A. (2013). A comparison study of methods for measuring retention in HIV medical care. *AIDS and Behavior*, 17, 3145–3151.
- Gardner, L. I., Marks, G., Craw, J. A., Wilson, T. E., Drainoni, M. L., Moore, R. D., ... Retention in Care Study Group. (2012). A low-effort, clinic-wide intervention improves attendance for HIV primary care. *Clinical Infectious Diseases*, 55(8), 1124–1134. doi:10.1093/cid/cis623
- Giordano, T. P., Gifford, A. L., White, A. C., Suarez-Almazor, M. E., Rabeneck, L., Hartman, C., ... Morgan, R. O. (2007). Retention in care: A challenge to survival with HIV infection. *Clinical Infectious Diseases*, 44(11), 1493–1499.
- Horberg, M. A., Hurley, L. B., Silverberg, M. J., Klein, D. B., Quesenberry, C. P., & Mugavero, M. J. (2013). Missed office visits and risk of mortality among HIV-infected subjects in a large healthcare system in the United States. *AIDS Patient Care and STDs*, 27, 442–449.
- Institute of Medicine. (2012). *Monitoring HIV care in the United States: Indicators and data systems*. Washington, DC: The National Academies Press. doi:10.17226/13225
- Kissinger, P., Cohen, D., Brandon, W., Rice, J., Morse, A., & Clark, R. (1995). Compliance with public sector HIV medical care. *Journal of the National Medical Association*, 87, 19–24.
- Marx, K. A., Malka, E. S., Ravishankar, J., & Schwartz, R. M. (2011). Measurement of retention in care among adults infected with HIV in an urban clinic. *AIDS Care*, 23, 1298–1304.
- Mugavero, M. J., Amico, K. R., Horn, T., & Thompson, M. A. (2013). The state of engagement in HIV care in the United States: From cascade to continuum to control. *Journal of Biochemistry and Molecular Biology*, 57, 1164–1171.
- Mugavero, M. J., Davila, J. A., Nevin, C. R., & Giordano, T. P. (2010). From access to engagement: Measuring retention in outpatient HIV clinical care. *AIDS Patient Care and STDs*, 24, 607–613.
- Mugavero, M. J., Lin, H.-Y., Willig, J. H., Westfall, A. O., Ulett, K. B., Routman, J. S., & Allison, J. J. (2009). Missed visits and mortality among patients establishing initial outpatient HIV treatment. *Clinical Infectious Diseases*, 48(2), 248–256. doi:10.1086/595705
- Mugavero, M. J., Westfall, A. O., Cole, S. R., Geng, E. H., Crane, H. M., Kitahata, M. M., ... Centers for AIDS Research Network of Integrated Clinical Systems (CNICS). (2014). Beyond core indicators of retention in HIV care: Missed clinic visits are independently associated with all-cause mortality. *Clinical Infectious Diseases*, 59(10), 1471–1479. doi:10.1093/cid/ciu603
- Mugavero, M. J., Westfall, A. O., Zinski, A., Davila, J., Drainoni, M. L., Gardner, L. I., ... Retention in Care (RIC) Study Group. (2012). Measuring retention in HIV care. *JAIDS Journal of Acquired Immune Deficiency Syndromes*, 61, 574–580.
- Napravnik, S., Eron Jr., J. J., McKaig, R. G., Heine, A. D., Menezes, P., & Quinlivan, E. (2006). Factors associated with fewer visits for HIV primary care at a tertiary care center in the Southeastern U.S. *AIDS Care*, 18(Suppl. 1), 45–50.
- O'Rourke, N., & Hatcher, L. (2013). *A step-by-step approach to using SAS for factor analysis and structural equation modeling* (2nd ed.). Cary, NC: SAS Institute.
- Reveles, K. R., Juday, T. R., Labreche, M. J., Mortensen, E. M., Koeller, J. M., Seekins, D., ... Frei, C. R. (2015). Comparative value of four measures of retention in expert care in predicting clinical outcomes and health care utilization in HIV patients. *PLoS One*, 10, e0120953.
- Rumptz, M. H., Tobias, C., Rajabiun, S., Bradford, J., Cabral, H., Young, R., & Cunningham, W. E. (2007). Factors associated with engaging socially marginalized HIV-positive persons in primary care. *AIDS Patient Care and STDs*, 21(Suppl. 1), S-30–S-39.
- Tobias, C., Cunningham, W. E., Cunningham, C. O., & Pounds, M. B. (2007). Making the connection: The importance of engagement and retention in HIV medical care. *AIDS Patient Care and STDs*, 21(Suppl. 1), S-3–S-8.
- Ulett, K. B., Willig, J. H., Lin, H. Y., Routman, J. S., Abrams, S., Allison, J., ... Mugavero, M. J. (2009). The therapeutic implications of timely linkage and early retention in HIV care. *AIDS Patient Care and STDs*, 23, 41–49.
- White House (2015). *National HIV/AIDS strategy: Updated to 2020*. Retrieved from <https://www.hiv.gov/federal-response/national-hiv-aids-strategy/nhas-update>
- Yehia, B. R., Fleishman, J. A., Metlay, J. P., Korhuit, P. T., Agwu, A. L., Berry, S. A., ... HIV Research Network. (2012). Comparing different measures of retention in outpatient HIV care. *AIDS*, 26, 1131–1139.