# Retention in Care and Viral Load Improvement After Discharge Among Hospitalized Out-of-Care People With HIV Infection: A Post Hoc Analysis of a Randomized Controlled Trial

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*Background.* Understanding factors influencing retention in care (RIC) and viral load improvement (VLI) in people with HIV (PWH) who are out of care and hospitalized will assist in intervention development for this vulnerable population.

*Methods.* The study was a post hoc analysis of prospectively collected data. Hospitalized participants were enrolled if they were newly diagnosed with HIV during the hospitalization or out of HIV care. Participants completed surveys at baseline and 6 months postenrollment and laboratory studies of viral load (VL). Outcomes were RIC (2 completed visits, 1 within 30 days of discharge) and VLI (VL <400 or at least a 1-$\log_{10}$ decrease) 6 months after discharge. Univariate and multivariate regression analyses were conducted examining the contributions of predisposing, enabling, and need factors to outcomes.

*Results.* The study cohort included 417 participants enrolled between 2010 and 2013. The population was 73% male, 67% non-Hispanic black, 19% Hispanic, and 70% uninsured. Sixty-five percent had a baseline CD4 <200 cells/mm$^3$, 79% had a VL >400 copies/mL or missing, and the population was generally poor with low educational attainment. After discharge from the hospital, 60% did not meet the definition for RIC, and 49% did not have VLI. Modifiable factors associated with the outcomes include drug use (including marijuana alone and other drugs), life instability (eg, housing, employment, and life chaos), and using avoidance coping strategies in coping with HIV.

*Conclusions.* Hospitalized out-of-care PWH in the United States are at high risk of poor re-engagement in care after discharge. Interventions for this population should focus on improving socioeconomic stability and coping with HIV and reducing drug use.

*Keywords.* HIV/AIDS; hospitalization; mental health; retention in care; vulnerable populations.

Antiretroviral therapy (ART) has transformed HIV infection into a treatable chronic condition. Unfortunately, about 40% of people diagnosed with HIV infection are not regularly engaged in HIV primary care in the United States [1–3]. Poor retention in HIV primary care affects access to ART and survival [4, 5] and leads to lower rates of HIV viral suppression, which is only 50% in the United States and is lower in the US South (where about half the people with HIV [PWH] live) than in the Northeast and West [6, 7]. Furthermore, because so many persons are out of

care with detectable viremia, the population poorly retained in care is thought responsible for more HIV transmissions (43%) than both the population in care but not suppressed (20%) and the undiagnosed population (38%) [6]. Retention in care (RIC) and viral load suppression (VLS) are thus clinical outcomes that are critical to ending the HIV epidemic. Poor retention also exacerbates racial and ethnic disparities in health outcomes [8, 9].

To date, successful strategies to improve RIC are based on HIV care clinics and serve persons at risk of poor retention or with a history of poor retention, not persons who are encountered outside the clinic [10–12]. The Centers for Disease Control and Prevention (CDC) actively maintains a list of interventions proven to improve RIC [13], and 7 interventions are rated "evidence based," though none of these interventions were developed for or have been tested in nonincarcerated PWH found outside the clinic.

Hospitalization presents a rare opportunity to find and relink out-of-care PWH as it remains relatively common in PWH, especially in persons with uncontrolled or advanced HIV infection and living in the US South [14–17]. According

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to most recent estimates, the hospitalization rate among PWH is 13 to 23 per 100 person-years and may be twice as high as in the general population [18–20]. Rates of follow-up and VLS after discharge are well below goals, despite embedded navigation services. Navigators assist with appointment scheduling, linkage to needed services after discharge, applications for funding and support programs, and motivation to seek care. In a study from the Grady Hospital in Atlanta, among persons out of care for >14 months at hospitalization in 2017, only 33% were linked to care within 30 days, and 39% had VLS by 6 months, despite intensive service linkage delivered during the hospitalization [21]. In a large multisite randomized trial from the United States, Hospital Visit as Opportunity for Prevention and Engagement for HIV-Infected Drug Users (HOPE), 58% had a completed visit by 6 months after discharge, 38% and 39% had VLS at 6 and 12 months, respectively, and by 12 months 12% of participants were dead, again despite embedded linkage services. Three interventions have been tested in hospitalized PWH, and all failed: peer mentoring in a study by our group, patient navigation alone, and navigation combined with financial incentives in the HOPE study. None of these interventions had a sustained effect on RIC and VLS [22, 23]. Thus, no efficacious interventions exist for out-of-care PWH found in in the hospital.

Although factors associated with RIC and VLS have been comprehensively studied in general populations with HIV, these factors have not been well studied in the hospitalized and out-of-care population. Better knowledge is necessary to inform tailored interventions to improve outcomes for this highly vulnerable population. The Gelberg-Andersen Behavioral Model for Vulnerable Populations (Figure 1) was adapted to determine why this population is not accessing care. The model emphasizes social, structural, and personal determinants of health care utilization and is comprised of 3 domains: predisposing, enabling, and need factors. Predisposing factors are described as characteristics that exist before the perception of illness. Enabling factors are those that either facilitate or impede health care utilization, while need factors relate to illness severity, including HIV, mental health, and physical functioning [24]. We therefore conducted a post hoc analysis of data from our randomized controlled trial using the Gelberg-Andersen Behavioral Model for Vulnerable Populations to identify factors that predict RIC and viral load improvement in out-of-care hospitalized patients with HIV infection.
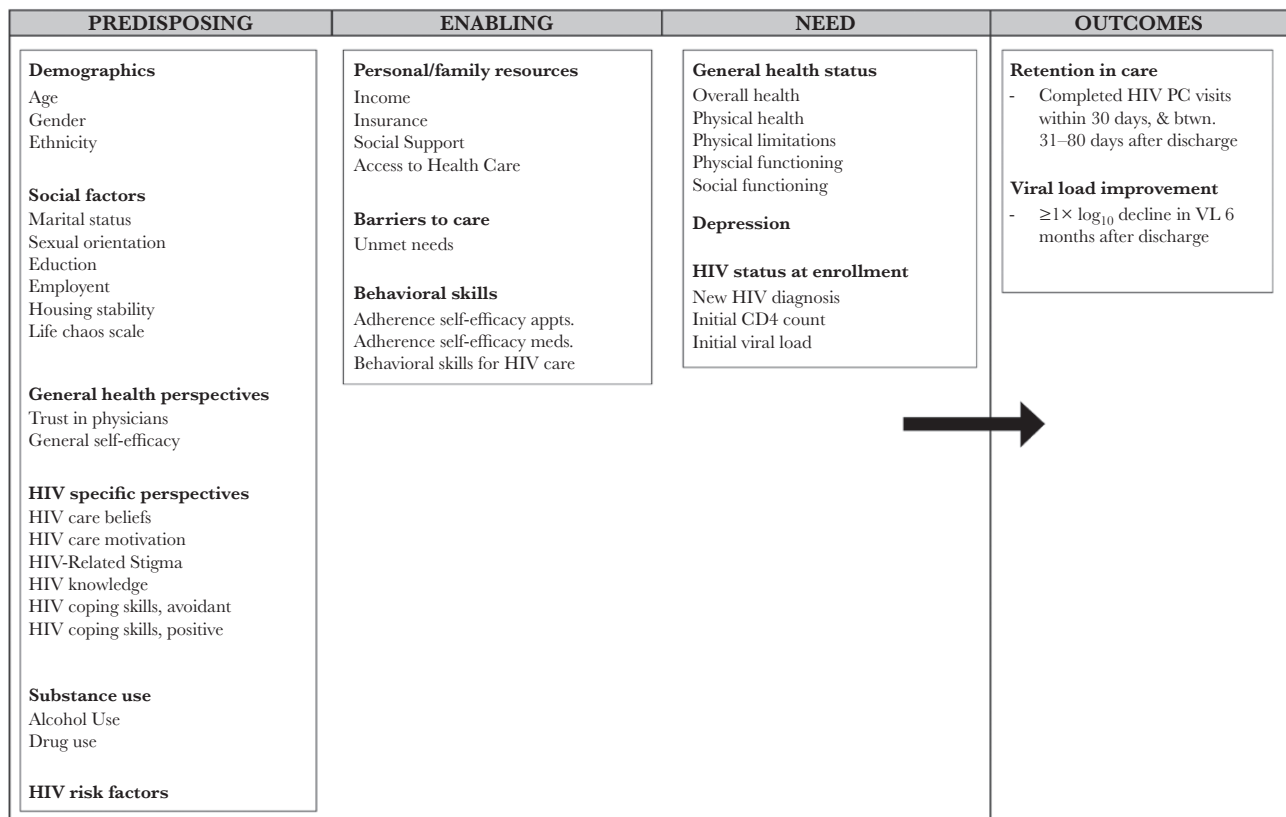


**Figure 1.** Modified Gelberg-Andersen Behavioral Model for Vulnerable Populations applied to retention in care and viral load improvement for hospitalized out-of-care people with HIV infection.

## METHODS

The Mentor Approach for Promoting Patient Self-Care (MAPPS) study enrolled patients between 2010 and 2013 in the Ben Taub Hospital, part of the Harris Health System, in Houston, Texas. This study tested the efficacy of a peer mentor intervention, which was designed to improve RIC and VL in out-of-care hospitalized patients with HIV, against a time- and attention-matched educational control intervention. Additional information about the intervention has been published elsewhere [22, 25].

### Participants

Hospitalized PWH were recruited regardless of reason for hospital admission. Eligibility criteria included the following: expected to spend at least 1 more night in the hospital to allow time for intervention delivery; age at least 18 years; able to speak English or Spanish; intending to use Harris Health System's HIV clinic, Thomas Street Health Center (TSHC), for HIV primary care following discharge from the hospital because the mentoring was TSHC-specific; and cognitively and physically able to provide informed consent and participate in the study. Potential participants were excluded if they were currently incarcerated or if, in the opinion of the primary medical team, they were likely to be discharged to hospice or a nursing home. Finally, to be eligible, patients could not be "in care," which we defined as having completed an HIV primary care visit at TSHC in at least 3 of the 4 previous quarter-years and having had at least 3 consecutive VL results of <400 copies/mL for >6 months, the most recent of which was within 3 months of enrollment. All persons not in care were defined as "out of care," including persons who had been diagnosed with HIV infection within <1 year and patients who intended to transfer care to TSHC after discharge. Participants were excluded from the current analyses if they had incomplete responses to the baseline survey.

### Measures

Participants completed surveys and had VL and CD4 cell counts at enrollment and at 6 months. The survey assessed the following predisposing factors (Figure 1): demographics, sexual identity, education, employment, housing status, life chaos [26], trust in physicians [27], general self-efficacy [28], alcohol and substance use [29, 30], and HIV-specific information such as HIV care beliefs, motivation for HIV care, HIV-related stigma [31], HIV knowledge and coping with HIV [32], and HIV risk factors. Enabling factors included income, health insurance, social support [33], perceived access to health care [34], unmet needs [35], adherence self-efficacy related to medications [36] and appointments, and behavior skills related to HIV care. Need factors included perceived health status (overall, physical, and social functioning) [37], depression [38], and HIV status at enrollment (eg, whether a new diagnosis and CD4 cell count and VL). The scale for belief in the efficacy of HIV care was developed for the primary study, as were the knowledge (information), motivation, and behavioral skills scales, based on previous work [39].

### Outcomes

Because the participants were out of care and hospitalized at the time of enrollment, RIC was defined as attending at least 1 HIV primary care visit within 30 days of discharge and at least 1 HIV primary care visit between 31 and 180 days after discharge. VLI was defined as achieving at least a 1-$\log_{10}$ decrease in VL or a VL <400 copies/mL if the baseline VL was <4000 copies/mL at 6 months after discharge. Outcomes were analyzed with a prespecified modified intent-to-treat (MITT) study design; therefore, participants with missing variables used to define the outcomes (ie, missing VL at 6 months) were considered to have failed the outcome [22].

### Data Analysis

Univariate analyses were performed to assess the associations between baseline survey variables and both outcomes using Pearson's chi-square test for categorical variables or univariate logistic regression for continuous variables. Because of their clinical significance, age, gender, race/ethnicity, new vs established HIV diagnosis, initial VL, initial CD4 count, and randomized treatment arm were forced into the final multivariate analyses. Other factors were included if they had a $P$ value <.20 in univariate analyses, and the multivariate model was further reduced by removing the least significant variables individually using a backwards selection process until all variables not forced into the model had a $P$ value <.05. Because of the large number of variables under consideration, separate multivariate logistic regression models were fit for each of the 3 major domains (predisposing, enabling, and need factors) for each outcome. Thus, the analysis included the development of 3 interim models for each outcome, with the most influential factors from each model being incorporated into the final model for each outcome. Adjusted odds ratios (ORs) and accompanying 95% confidence intervals (CIs) were calculated. All analyses were performed using SAS (SAS, version 9.4; SAS Institute, Cary, NC, USA).

The institutional review board for the Baylor College of Medicine and Affiliated Hospitals approved the study. All participants provided written informed consent.

## RESULTS

The study enrolled 460 participants, and 417 were ultimately included in the MITT analysis after excluding the 43 participants who became incarcerated (n = 15), moved (n = 10), withdrew consent (n = 14), or were withdrawn by researchers due to cognitive decline or for safety considerations during follow-up (n = 4). Among these 417 participants, 73% were male, 67% were non-Hispanic black, 14% were non-Hispanic white, and

19% were Hispanic. Thirteen percent of the participants were younger than 30 years of age, while 25% were age 50 years or older. Of the 415 participants with complete baseline surveys, 35% were men who reported sex with men as their primary risk factor for HIV infection, while 14% reported intravenous drug use. The participants had low socioeconomic status: 79% were unemployed, 57% reported an income of <$10 000 annually, 100% of participants' annual income was <$25 000, and 70% of participants were not insured. At enrollment, 11% of participants were newly diagnosed with HIV infection, 65% had a CD4 count <200 cells/mm$^3$, and 79% had a VL that was >400 copies/mL (327 participants) or missing (5 participants).

### Outcomes

As previously reported, the MAPPS mentoring intervention did not improve outcomes compared with the control intervention. In both groups, 40% of participants met the definition for RIC (*P* = .93), and VLI was achieved by 51% of the participants (54% vs 48% in the MAPPS group vs the control group, respectively; *P* = .18) [22]. Of note, 8.4% of participants were dead by 6 months, with no difference between arms.

### Univariate Analysis

In univariate analyses, the predisposing characteristics (Table 1) predictive of higher rates of RIC were housing status, reporting a lower level of life chaos, reporting less avoidance coping, having a high sense of general self-efficacy, and reporting no alcohol or drug use in the last 3 months. Enabling factors associated with higher rates of RIC were having a higher income, not having health insurance, and reporting a higher level of behavioral skills for HIV care (Table 2). The only need factor associated with a higher rate of RIC was new HIV diagnosis, compared with participants who were diagnosed before being hospitalized (Table 3).

Regarding VLI, the predisposing characteristics (Table 1) associated with higher rates of VLI were male sex compared with female and Hispanic race/ethnicity compared with non-Hispanic black and non-Hispanic white race/ethnicity. Other predisposing factors associated with higher rates of VLI included being employed, housing status, reporting lower level of life chaos, reporting less HIV stigma, reporting less avoidant coping, and reporting no drug use in the previous 3 months. The enabling characteristics (Table 2) associated with higher rates of VLI were higher income levels, not having health insurance, reporting higher levels of social support, and reporting higher behavioral skills for HIV care. The need factors associated with higher rates of VLI were new diagnosis of HIV infection and baseline VL <400 copies/mL.

### Multivariate Analysis

In multivariate analysis (Table 4) of RIC, among the predisposing factors, participants who reported living in the home of a friend

or family member were nearly twice as likely to meet the RIC definition (OR, 1.86; 95% CI, 1.15–2.99; *P* = .01) compared with participants who reported owning or renting their own home. Participants who reported use of marijuana without other substance use in the 3 months before hospitalization and those who reported use of any other drugs (with or without marijuana) had about half the odds of RIC compared with non–drug users (OR, 0.48; 95% CI, 0.28–0.93; *P* = .03; and OR, 0.44; 95% CI, 0.25–0.78; *P* = .01; respectively). Participants who reported a higher level of avoidant coping were less likely to achieve RIC (OR, 0.93 per point on the scale; 95% CI, 0.87–0.99; *P* = .02). None of the enabling factors was significant in the multivariable model. Among the need factors, participants with at least moderate depression (indicated by a Patient Health Questionnaire–8 [PHQ-8] score >10) were nearly twice as likely to be retained in care as those with a lower score (OR, 1.97; 95% CI, 1.22–3.17; *P* = .01). Participants with a CD4 count between 200 and 350 cells/mm$^3$ were less than half as likely to achieve RIC compared with participants with a >350 CD4 cell count (OR, 0.44; 95% CI, 0.20–0.98; *P* = .04).

Based on multivariate regression analysis (Table 4) of VLI, participants aged 40–49 had about twice the rate of VLI as persons aged <30 (OR, 2.10; 95% CI, 1.02–4.30; *P* = .04). The other predisposing factors that were significant were unemployment and high life chaos; each was associated with odds of achieving VLI in nearly half of those who reported employment and low life chaos levels (OR, 0.57; 95% CI, 0.33–0.98; *P* = .04; and OR, 0.54; 95% CI, 0.35–0.84; *P* < .01; respectively). None of the enabling factors was significant in the multivariable model. With regard to needs factors, people who were newly diagnosed with HIV were almost 3 times as likely to achieve VLI (OR, 2.99; 95% CI, 1.40–6.38; *P* < .01) as those not newly diagnosed. Participants with an initial VL >400 copies/mL were less than half as likely to achieve VLI as participants with a VL of <400 copies/mL (OR, 0.34; 95% CI, 0.19–0.61; *P* < .01).

## DISCUSSION

In this study of 417 people hospitalized and out-of-care with HIV infection, 60% did not meet the definition for RIC, 49% did not meet the definition for VLI, and 8.4% were dead by 6 months after hospital discharge. PWH who are hospitalized and out-of-care are at high risk for poor outcomes after discharge. Some of the strongest factors predictive of lower rates of RIC in multivariate analyses included housing status, drug use (even marijuana), avoidant coping, and lack of depression. Lower rates of VLI were seen in participants with more life chaos, while higher rates were seen in participants who were newly diagnosed with HIV and in PLW with baseline VLS.

Perhaps our most important finding is that, among the many variables studied as predictors of RIC and VLI in this longitudinal study, the only modifiable risk factors identified are

**Table 1. Predisposing Factors: Total Population Characteristics and Association of Survey Variables With Retention in Care and Viral Load Improvement**

| Predisposing Factors | Total Population, No. (%) or Mean ± SD | Retention in Care, No. (%) or OR (95% CI) | RIC P Value | Viral Load Improvement, No. (%) or OR (95% CI) | VLI P Value |
|---|---|---|---|---|---|
| Demographics | | | | | |
| Age | | | .34 | | .27 |
| <30 y | 52 (13) | 24 (46) | | 21 (40) | |
| 30–39 y | 114 (27) | 51 (45) | | 60 (53) | |
| 40–49 y | 146 (35) | 53 (36) | | 81 (56) | |
| ≥50 y | 105 (25) | 38 (36) | | 51 (49) | |
| Gender | | | .72 | | .02 |
| Female | 112 (27) | 43 (38) | | 47 (42) | |
| Male | 305 (73) | 123 (40) | | 166 (54) | |
| Race/ethnicity | | | .07 | | <.01 |
| Hispanic | 81 (19) | 35 (43) | | 56 (69) | |
| White, non-Hispanic | 58 (14) | 30 (52) | | 31 (54) | |
| Black, non-Hispanic | 278 (67) | 101 (36) | | 126 (45) | |
| Social factors | | | | | |
| Marital status | | | .17 | | .64 |
| Single or living alone | 234 (56) | 102 (44) | | 118 (50) | |
| Married or living with someone | 70 (17) | 26 (37) | | 39 (56) | |
| Separated, divorced, widowed | 111 (27) | 37 (33) | | 54 (49) | |
| Sexual identity | | | .06 | | .06 |
| Heterosexual | 255 (61) | 89 (35) | | 117 (46) | |
| Gay or lesbian | 117 (28) | 58 (50) | | 70 (60) | |
| Bisexual | 32 (8) | 13 (41) | | 19 (59) | |
| Not sure or in transition | 11 (3) | 5 (46) | | 5 (45) | |
| Education | | | .08 | | .58 |
| At least some college | 135 (32) | 64 (47) | | 73 (54) | |
| High school diploma or equivalent | 128 (31) | 44 (34) | | 61 (48) | |
| Never finished high school | 152 (37) | 57 (38) | | 77 (51) | |
| Employment | | | .15 | | <.01 |
| Employed | 86 (21) | 40 (47) | | 56 (65) | |
| Unemployed | 329 (79) | 125 (38) | | 155 (47) | |
| Housing status | | | .04 | | .04 |
| Home you own or rent | 246 (62) | 94 (38) | | 136 (55) | |
| Home of a friend or family | 129 (33) | 64 (50) | | 56 (43) | |
| Halfway house, rehab, shelter, or street | 19 (5) | 5 (26) | | 7 (37) | |
| Life chaos | | | .03 | | <.01 |
| Low chaos | 250 (60) | 110 (44) | | 144 (58) | |
| High chaos | 165 (40) | 55 (33) | | 68 (41) | |
| General perspectives on health | | | | | |
| Trust in physicians | | | .27 | | .06 |
| High trust | 307 (74) | 126 (41) | | 147 (48) | |
| Low trust | 106 (26) | 37 (35) | | 62 (59) | |
| General self-efficacy | | | .01 | | .23 |
| High control | 196 (47) | 90 (46) | | 106 (54) | |
| Low control | 220 (53) | 75 (34) | | 106 (48) | |
| Perspectives on HIV | | | | | |
| HIV care beliefs | | | .82 | | .18 |
| High belief in care | 179 (43) | 72 (40) | | 98 (55) | |
| Low belief in care | 235 (57) | 92 (39) | | 113 (48) | |
| HIV care motivation | | | .15 | | .06 |
| High motivation | 202 (49) | 87 (43) | | 113 (56) | |
| Low motivation | 210 (51) | 76 (36) | | 98 (47) | |
| HIV-related stigma, mean ± SD | 25.8 ± 4.86 | 0.99 (0.95–1.03) | .57 | 0.96 (0.92–1.00) | .04 |
| HIV knowledge | | | .23 | | .28 |
| More knowledge | 127 (31) | 45 (35) | | 70 (55) | |
| Less knowledge | 288 (69) | 120 (42) | | 142 (49) | |
| HIV coping skills, avoidant, mean ± SD | 17.3 ± 3.99 | 0.94 (0.89–0.99) | .01 | 0.94 (0.90–0.99) | .02 |

**Table 1. Continued**

| Predisposing Factors | Total Population, No. (%) or Mean ± SD | Retention in Care, No. (%) or OR (95% CI) | RIC P Value | Viral Load Improvement, No. (%) or OR (95% CI) | VLI P Value |
|---|---|---|---|---|---|
| HIV coping skills, positive, mean ± SD | 14.2 ± 2.96 | 1.04 (0.97–1.11) | .25 | 1.07 (1.00–1.14) | .06 |
| Substance use | | | | | |
| Heavy alcohol use, last year | | | .02 | | .17 |
| Yes | 130 (31) | 41 (32) | | 60 (46) | |
| No | 285 (69) | 124 (44) | | 152 (53) | |
| Drug use, last 3 mo | | | <.01 | | <.01 |
| Only marijuana | 61 (15) | 20 (33) | | 24 (39) | |
| Any other drug use +/- marijuana | 111 (27) | 32 (29) | | 45 (41) | |
| None | 240 (58) | 112 (47) | | 141 (59) | |
| HIV risk factors | | | .11 | | .09 |
| Male, MSM | 146 (35) | 68 (47) | | 85 (58) | |
| Injection drug use +/- MSM | 58 (14) | 21 (36) | | 26 (45) | |
| Neither MSM nor injection drug use | 213 (51) | 77 (36) | | 102 (48) | |

Abbreviations: CI, confidence interval; MSM, men who have sex with men; OR, unadjusted odds ratio; RIC, retention in care; VLI, viral load improvement.

**Table 2. Enabling Factors: Total Population Characteristics and Association of Survey Variables With Retention in Care and Viral Load Improvement**

| Enabling Factors | Total Population, No. (%) | Retention in Care, No. (%) | RIC P Value | Viral Load Improvement, No. (%) | VLI P Value |
|---|---|---|---|---|---|
| Personal and family resources | | | | | |
| Income | | | .04 | | .01 |
| $0–$4999 | 144 (35) | 54 (38) | | 59 (41) | |
| $5000–$9999 | 91 (22) | 27 (30) | | 46 (51) | |
| $10 000–$14 999 | 123 (29) | 55 (45) | | 68 (55) | |
| $15 000–$24 999 | 57 (14) | 29 (51) | | 38 (67) | |
| Health insurance | | | .02 | | <.01 |
| Private, Medicare, or Medicaid | 123 (30) | 38 (31) | | 49 (40) | |
| No insurance | 287 (70) | 125 (44) | | 160 (56) | |
| Social support | | | .22 | | .02 |
| High social support | 204 (49) | 87 (43) | | 116 (57) | |
| Low social support | 212 (51) | 78 (37) | | 96 (45) | |
| Perceived access to health care | | | .16 | | .17 |
| High access | 234 (56) | 100 (43) | | 112 (48) | |
| Low access | 181 (44) | 65 (36) | | 99 (55) | |
| Barriers to care | | | | | |
| Unmet needs | | | .19 | | <.01 |
| ≥5 unmet needs | 144 (35) | 57 (40) | | 62 (43) | |
| 3 or 4 unmet needs | 90 (22) | 30 (33) | | 38 (42) | |
| 1 or 2 unmet needs | 108 (26) | 42 (39) | | 64 (59) | |
| No unmet needs | 72 (17) | 36 (50) | | 48 (67) | |
| Behavioral skills | | | | | |
| Adherence self-efficacy for appointments | | | .15 | | .06 |
| High efficacy | 277 (67) | 103 (37) | | 133 (48) | |
| Low efficacy | 137 (33) | 61 (45) | | 79 (58) | |
| Adherence self-efficacy for medications | | | .41 | | .25 |
| High efficacy | 221 (53) | 92 (42) | | 107 (48) | |
| Low efficacy | 194 (47) | 73 (38) | | 105 (54) | |
| Behavioral skills for HIV care | | | .01 | | .05 |
| High skills | 192 (46) | 90 (47) | | 108 (56) | |
| Low skills | 221 (54) | 75 (34) | | 103 (47) | |

Abbreviations: RIC, retention in care; VLI, viral load improvement.

**Table 3.** Need Factors: Total Population Characteristics and Association of Survey Variables With Retention in Care and Viral Load Improvement

| Need Factors | Total Population, No. (%) | Retention in Care, No. (%) | RIC P Value | Viral Load Improvement, No. (%) | VLI P Value |
|---|---|---|---|---|---|
| Perceived overall health status | | | | | |
| General health | | | .93 | | .10 |
| High general health | 205 (50) | 81 (40) | | 113 (55) | |
| Low general health | 208 (50) | 83 (40) | | 98 (47) | |
| Physical limitations | | | .24 | | .06 |
| High physical limitations | 154 (37) | 67 (44) | | 88 (57) | |
| Low physical limitations | 260 (63) | 98 (38) | | 124 (48) | |
| Physical functioning | | | .67 | | .23 |
| High physical functioning | 211 (51) | 83 (41) | | 110 (54) | |
| Low physical functioning | 203 (49) | 82 (40) | | 102 (48) | |
| Social functioning | | | .85 | | .90 |
| High social functioning | 171 (41) | 67 (39) | | 88 (52) | |
| Low social functioning | 242 (59) | 97 (40) | | 123 (51) | |
| Depression | | | .12 | | .65 |
| Depressed (PHQ ≥ 10) | 170 (41) | 75 (44) | | 85 (50) | |
| Not depressed (PHQ < 10) | 241 (59) | 88 (37) | | 126 (52) | |
| HIV status at enrollment | | | | | |
| New HIV diagnosis | | | .01 | | <.01 |
| Yes | 46 (11) | 27 (59) | | 34 (74) | |
| No | 371 (89) | 139 (38) | | 179 (48) | |
| Initial CD4 count, cells/mm$^3$ | | | .27 | | .16 |
| <200 | 269 (65) | 113 (42) | | 130 (48) | |
| 200–350 | 56 (13) | 17 (30) | | 29 (52) | |
| >350 | 90 (22) | 36 (40) | | 54 (60) | |
| Initial viral load, copies/mL | | | .32 | | <.01 |
| <400 | 85 (21) | 30 (35) | | 60 (71) | |
| ≥400, or missing | 327 (79) | 135 (41) | | 153 (47) | |

Abbreviations: PHQ, Patient Health Questionnaire; RIC, retention in care; VLI, viral load improvement.

mental health and psychosocial factors: substance use, avoidance coping, life instability as measured by the life chaos scale, employment, and housing. Two interventions were tested in HOPE: (1) patient navigation with strengths-based case management to link persons to comprehensive treatment and (2) patient navigation with financial incentives. Both interventions failed to significantly improve outcomes at 6 months postintervention [23]. In MAPPS, peer mentoring that was focused on motivating and modeling positive results of engagement with the health care system failed to improve outcomes. In a qualitative study that we completed with MAPPS participants, participants suggested that a more robust mental health intervention might be needed [40]. In previous analyses of the MAPPS database, we found that unmet substance use needs were particularly challenging [41]. The findings from the present analyses, the qualitative and quantitative data from MAPPS, and the negative findings in MAPPS and HOPE suggest that more robust interventions delivered by a mental health professional who can directly address mental health issues might be needed to improve outcomes in this critical population. Strategies that may benefit this group include expedited engagement in substance and mental health counseling that begins during hospitalization, strong linkages to service organizations that provide employment and housing support to decrease life chaos, and connecting patients to a counseling and/or a social support network that can improve coping skills. Models of differentiated care may be particularly suited to this population [42]. A 1-intervention-fits-all approach is likely not sufficient given these findings, and interventions that are flexible and transdiagnostic are likely requisite.

Among the predisposing factors, living with family or friends, compared with renting or owning one's own home, was associated with significantly improved odds of RIC. Living with friends or family likely provides an opportunity for emotional support and may also provide functional benefits such as conserved financial resources, shared transportation, or help with appointment reminders from housemates. A recent large study found that, among homeless PWH, improved housing status was associated with improved RIC and VLS [43]. Unemployment and higher levels of life chaos, likely other markers of social instability, and financial vulnerability were found to be associated with decreased odds of VLI. Drug use in the previous 3 months, including marijuana alone and other drugs with or without marijuana use, was associated with poor RIC. Previous research has reported significantly lower odds of RIC for PWH who use illicit drugs [10, 44]. In a randomized trial that tested the effects

**Table 4. Multivariate Analysis. Estimated Odds Ratios and 95% Confidence Intervals for Retention in Care and Viral Load Improvement**

| Outcome: Retention in Care | | |
|---|---|---|
| Factors | Odds Ratio (95% CI) | P Value |
| Predisposing factors | | |
| Age (vs <30 y) | | |
| ≥50 y | 0.76 (0.36–1.63) | .48 |
| 40–49 y | 0.62 (0.30–1.25) | .18 |
| 30–39 y | 0.81 (0.40–1.66) | .57 |
| Gender (vs male) | | |
| Female | 1.01 (0.61–1.66) | .98 |
| Race/ethnicity (vs non-Hispanic white) | | |
| Hispanic | 0.57 (0.27–1.24) | .16 |
| Black | 0.60 (0.31–1.15) | .13 |
| Housing status (vs own or rent) | | |
| Home of a friend or family | 1.86 (1.15–2.99) | .01 |
| Halfway house, rehab, shelter, or street | 0.50 (0.16–1.55) | .23 |
| Drug use (vs none in last 3 mo) | | |
| Only marijuana | 0.48 (0.25–0.93) | .03 |
| Any other drug use +/- marijuana | 0.44 (0.25–0.78) | <.01 |
| HIV coping skills, avoidant | 0.93 (0.87–0.99) | .02 |
| Need factors | | |
| Depression (vs PHQ <10) | | |
| Depressed, PHQ ≥10 | 1.97 (1.22–3.17) | .01 |
| New HIV diagnosis (vs no) | | |
| Yes | 1.96 (0.94–4.07) | .07 |
| Initial VL (vs VL <400), copies/mL | | |
| ≥400 or missing | 1.19 (0.65–2.16) | .57 |
| Initial CD4 count (vs >350), cells/mm$^3$ | | |
| 200–350 | 0.44 (0.20–0.98) | .04 |
| <200 | 0.72 (0.40–1.32) | .29 |
| Intervention arm | | |
| Mentored (vs no) | | |
| Yes | 0.81 (0.53–1.28) | .38 |
| Outcome: Viral load improvement | | |
| Factors | Odds Ratio (95% CI) | P Value |
| Predisposing factors | | |
| Age (vs <30 y) | | |
| ≥50 y | 1.58 (0.75–3.34) | .23 |
| 40–49 y | 2.10 (1.02–4.30) | .04 |
| 30–39 y | 1.71 (0.82–3.58) | .15 |
| Gender (vs male) | | |
| Female | 0.68 (0.42–1.10) | .11 |
| Race/ethnicity (vs non-Hispanic white) | | |
| Hispanic | 2.13 (0.99–4.57) | .05 |
| Black | 0.85 (0.46–1.59) | .62 |
| Employment (vs employed) | | |
| Unemployed | 0.57 (0.33–0.98) | .04 |
| Life chaos (vs low chaos) | | |
| High chaos | 0.54 (0.35–0.84) | <.01 |
| Need factors | | |
| New HIV diagnosis (vs no) | | |
| Yes | 2.99 (1.40–6.38) | <.01 |
| Initial VL (vs VL <400), copies/mL | | |
| ≥400 or missing | 0.34 (0.19–0.61) | <.01 |
| Initial CD4 (vs >350), cells/mm$^3$ | | |
| 200–350 | 0.74 (0.35–1.58) | .44 |
| <200 | 0.74 (0.42–1.30) | .30 |

**Table 4. Continued**

| Outcome: Viral load improvement | | |
|---|---|---|
| Factors | Odds Ratio (95% CI) | P Value |
| Intervention arm | | |
| Mentored (vs no) | | |
| Yes | 1.16 (0.76–1.78) | .48 |

Abbreviations: CI, confidence interval; PHQ, Patient Health Questionnaire; VL, viral load.

of enhanced personal contact in PWH who were at risk for poor RIC, people who reported illicit drug use were found to have the lowest rates of visit consistency and visit adherence of all subgroups [10]. These results suggest that financial, household, and social stability, along with drug use, are important predisposing factors predicting outcomes in PWH.

Coping with HIV is a relatively understudied construct compared with the other factors assessed in this study. We found that persons who reported higher levels of avoidance coping specific to their HIV infection—for example, trying to push the diagnosis out of their mind, keeping their feelings to themselves, and making themselves feel better by drinking or taking drugs—were less likely to achieve RIC in follow-up. Avoidance coping has been related to lower motivation to attend appointments in qualitative data and predictive of lower rates of viral suppression in South Africa [45–47]. If patients are strongly avoidant due to stigma or anxiety, they may choose to forgo important health behaviors such as attending clinic visits. To avoid difficult internal experiences, they may turn to risky health behaviors (eg, drug and alcohol use) to cope. Although avoidant coping can lead to short-term relief, it results in negative long-term consequences. Pilot data have shown that the coping strategies PWH use can be changed [48]. Without addressing avoidance-based coping, optimal treatment outcomes may be more difficult to achieve.

Several need factors were important predictors of outcomes. Contrary to studies that show a correlation between depression and poor adherence to ART including missed appointments [49], in this analysis moderate depression was a predictor of higher rates of RIC. As part of the study's safety protocol, study staff alerted the hospital providers if persons screened high for depression. Actions taken by the providers in response to that notification were outside the protocol, so we cannot test if the notification resulted in intervention or other different outcomes. For whatever reason, depression may have been a driver of health care use for this hospitalized cohort.

None of the enabling factors that we studied were statistically significant factors predicting RIC or VLI in the multivariate models. This finding may be explained by the inclusion of other variables that were related to these enabling factors. For example, income, employment status, housing status, social support, and unmet needs are all measuring constructs that likely interact. It is not hard to imagine that improving income could

improve RIC, for example, even though the effect may not be the most significant observed in our data set.

Participants newly diagnosed with HIV during their enrollment hospitalization were significantly more likely to achieve VLI and tended to have better RIC. Newly diagnosed participants have not yet had a chance to fail to obtain care, unlike the previously diagnosed persons who were eligible for this study; thus, it is perhaps not surprising that the newly diagnosed had better outcomes. Likewise, an initial VL of <400 copies/mL was associated with higher odds of achieving VLI. Though they were eligible for the study based on poor RIC at baseline, persons with a baseline VL <400 copies/mL clearly had some degree of success and were more likely to maintain that success during follow-up. CD4 counts in the 200–350-cell/mm³ range at baseline were associated with a poorer rate of RIC; however, persons with CD4 cell counts of <200 cell/mm³ had a higher rate of RIC. These participants may have had a greater perceived need for HIV care. Persons with a CD4 cell count >350 cells/mm³ were retained at a higher rate than persons with intermediate CD4 cell counts. It is unclear why individuals with a higher CD4 cell count more frequently sought continued care over those individuals with intermediate CD4 cell counts. Hospitalized PWH with a high VL who have been previously diagnosed with HIV are particularly vulnerable to poor outcomes and need intervention.

The limitations of this post hoc analysis include an insufficient sample size to adequately explore factors that might be important in subgroups. The parent study enrolled participants from a single hospital in the United States, which may affect generalizability. Additionally, the definition of "in care" used in the parent study was more stringent than current definitions and could have allowed participants into the study who now would be considered to be in care. The prospective follow-up period of the study was 6 months, which is relatively short.

Hospitalization is one of the few opportunities for prolonged interaction with a PWH who is not retained in outpatient care for HIV. Hospitalized out-of-care PWH comprise a distinctly vulnerable population, who are not successfully re-engaging in care after discharge from the hospital. Given the low rate of success in RIC and VLI observed in this study, screening tools and interventions for high-risk, hospitalized, out-of-care people with HIV should be further developed and tested in clinical trials.

## References

1. Bradley H, Hall HI, Wolitski RJ, et al. Vital signs: HIV diagnosis, care, and treatment among persons living with HIV–United States, 2011. MMWR Morb Mortal Wkly Rep **2014**; 63:1113–7.
2. Marks G, Gardner LI, Craw J, Crepaz N. Entry and retention in medical care among HIV-diagnosed persons: a meta-analysis. AIDS **2010**; 24:2665–78.
3. Centers for Disease Control and Prevention. Understanding the HIV Care Continuum. Atlanta: Centers for Disease Control and Prevention; **2019**.
4. Giordano TP, Gifford AL, White AC Jr, et al. Retention in care: a challenge to survival with HIV infection. Clin Infect Dis **2007**; 44:1493–9.
5. Giordano TP, White AC Jr, Sajja P, et al. Factors associated with the use of highly active antiretroviral therapy in patients newly entering care in an urban clinic. J Acquir Immune Defic Syndr **2003**; 32:399–405.
6. Li Z, Purcell DW, Sansom SL, et al. Vital signs: HIV transmission along the continuum of care - United States, 2016. MMWR Morb Mortal Wkly Rep **2019**; 68:267–72.
7. Centers for Disease Control and Prevention. HIV in the United States by Region. *HIV Surveillance Report.* Atlanta: Centers for Disease Control and Prevention; **2018**.
8. Howe CJ, Napravnik S, Cole SR, et al. African American race and HIV virological suppression: beyond disparities in clinic attendance. Am J Epidemiol **2014**; 179:1484–92.
9. Zinski A, Westfall AO, Gardner LI, et al. The contribution of missed clinic visits to disparities in HIV viral load outcomes. Am J Public Health **2015**; 105:2068–75.
10. Gardner LI, Giordano TP, Marks G, et al; Retention in Care Study Group. Enhanced personal contact with HIV patients improves retention in primary care: a randomized trial in 6 US HIV clinics. Clin Infect Dis **2014**; 59:725–34.
11. Gardner LI, Marks G, Craw JA, et al; Retention in Care Study Group. A low-effort, clinic-wide intervention improves attendance for HIV primary care. Clin Infect Dis **2012**; 55:1124–34.
12. Rajabiun S, Mallinson RK, McCoy K, et al. "Getting me back on track": the role of outreach interventions in engaging and retaining people living with HIV/AIDS in medical care. AIDS Patient Care STDS **2007**; 21(Suppl 1):S20–9.
13. Thompson MA, Mugavero MJ, Amico KR, et al. Guidelines for improving entry into and retention in care and antiretroviral adherence for persons with HIV: evidence-based recommendations from an International Association of Physicians in AIDS Care panel. Ann Intern Med **2012**; 156:817–33, W–284, W–5, W–6, W–7, W–8, W–9, W–90, W–91, W–92, W–93, W–94.
14. Berry SA, Fleishman JA, Moore RD, Gebo KA; HIV Research Network. Trends in reasons for hospitalization in a multisite United States cohort of persons living with HIV, 2001-2008. J Acquir Immune Defic Syndr **2012**; 59:368–75.
15. Ford N, Shubber Z, Meintjes G, et al. Causes of hospital admission among people living with HIV worldwide: a systematic review and meta-analysis. Lancet HIV **2015**; 2:e438–44.
16. Metsch LR, Bell C, Pereyra M, et al. Hospitalized HIV-infected patients in the era of highly active antiretroviral therapy. Am J Public Health **2009**; 99:1045–9.
17. Nijhawan AE, Kitchell E, Etherton SS, et al. Half of 30-day hospital readmissions among HIV-infected patients are potentially preventable. AIDS Patient Care STDS **2015**; 29:465–73.
18. Davy-Mendez T, Napravnik S, Wohl DA, et al. Hospitalization rates and outcomes among persons living with HIV in the Southeastern United States, 1996–2016. Clin Infect Dis. **In press**.
19. Hellinger FJ. Hospital use by persons with HIV in the 21st century: a 5-state study. Med Care **2016**; 54:639–44.
20. Lazar R, ed. Inpatient hospitalizations among people with HIV/AIDS in New York City, 2016. Paper presented at: 11th International Conference on HIV Treatment and Prevention Adherence; 9–11 May, 2016; Fort Lauderdale, FL.
21. Sharp J, Angert CD, Mcconnell T, et al. Health information exchange: a novel re-linkage intervention in an urban health system. Open Forum Infect Dis **2019**; 6:XXX–XX.
22. Giordano TP, Cully J, Amico KR, et al. A randomized trial to test a peer mentor intervention to improve outcomes in persons hospitalized with HIV infection. Clin Infect Dis **2016**; 63:678–86.
23. Metsch LR, Feaster DJ, Gooden L, et al. Effect of patient navigation with or without financial incentives on viral suppression among hospitalized patients with HIV infection and substance use: a randomized clinical trial. JAMA **2016**; 316:156–70.
24. Stein JA, Andersen R, Gelberg L. Applying the Gelberg-Andersen behavioral model for vulnerable populations to health services utilization in homeless women. J Health Psychol **2007**; 12:791–804.

25. Cully JA, Mignogna J, Stanley MA, et al. Development and pilot testing of a standardized training program for a patient-mentoring intervention to increase adherence to outpatient HIV care. AIDS Patient Care STDS **2012**; 26:165–72.

26. Wong MD, Sarkisian CA, Davis C, et al. The association between life chaos, health care use, and health status among HIV-infected persons. J Gen Intern Med **2007**; 22:1286–91.

27. Hall MA, Zheng B, Dugan E, et al. Measuring patients' trust in their primary care providers. Med Care Res Rev **2002**; 59:293–318.

28. Huba GJ, Melchior LA; Staff of The Measurement Group, HRSA/HAB's SPNS Cooperative Agreement Steering Committee. Module 64: self-efficacy form 1996. Available at: www.themeasurementgroup.com. Accessed 26 December 2008.

29. Bush K, Kivlahan DR, McDonell MB, et al. The AUDIT alcohol consumption questions (AUDIT-C): an effective brief screening test for problem drinking. Ambulatory Care Quality Improvement Project (ACQUIP). Alcohol Use Disorders Identification Test. Arch Intern Med **1998**; 158:1789–95.

30. Humeniuk R, Ali R, Babor TF, et al. Validation of the Alcohol, Smoking and Substance Involvement Screening Test (ASSIST). Addiction **2008**; 103:1039–47.

31. Wright K, Naar-King S, Lam P, et al. Stigma scale revised: reliability and validity of a brief measure of stigma for HIV+ youth. J Adolesc Health **2007**; 40:96–8.

32. Fleishman JA, Fogel B. Coping and depressive symptoms among people with AIDS. Health Psychol **1994**; 13:156–69.

33. Sherbourne CD, Stewart AL. The MOS social support survey. Soc Sci Med **1991**; 32:705–14.

34. Bozzette SA, Berry SH, Duan N, et al. The care of HIV-infected adults in the United States. HIV Cost and Services Utilization Study Consortium. N Engl J Med **1998**; 339:1897–904.

35. Rumptz MH, Tobias C, Rajabiun S, et al. Factors associated with engaging socially marginalized HIV-positive persons in primary care. AIDS Patient Care STDS **2007**; 21(Suppl 1):S30–9.

36. Reynolds NR, Testa MA, Marc LG, et al; Protocol Teams of ACTG 384, ACTG 731 and A5031s. Factors influencing medication adherence beliefs and self-efficacy in persons naive to antiretroviral therapy: a multicenter, cross-sectional study. AIDS Behav **2004**; 8:141–50.

37. Ware JE Jr, Sherbourne CD. The MOS 36-item short-form health survey (SF-36). I. Conceptual framework and item selection. Med Care **1992**; 30:473–83.

38. Kroenke K, Strine TW, Spitzer RL, et al. The PHQ-8 as a measure of current depression in the general population. J Affect Disord **2009**; 114:163–73.

39. Smith LR, Fisher JD, Cunningham CO, Amico KR. Understanding the behavioral determinants of retention in HIV care: a qualitative evaluation of a situated information, motivation, behavioral skills model of care initiation and maintenance. AIDS Patient Care STDS **2012**; 26:344–55.

40. Minick SG, May SB, Amico KR, et al. Participants' perspectives on improving retention in HIV care after hospitalization: a post-study qualitative investigation of the MAPPS study. PLoS One **2018**; 13:e0202917.

41. Dandachi D, May SB, Davila JA, et al. The association of unmet needs with subsequent retention in care and HIV suppression among hospitalized patients with HIV who are out of care. J Acquir Immune Defic Syndr **2019**; 80:64–72.

42. Dombrowski JC, Ramchandani M, Dhanireddy S, et al. The max clinic: medical care designed to engage the hardest-to-reach persons living with HIV in Seattle and King County, Washington. AIDS Patient Care STDS **2018**; 32:149–56.

43. Rajabiun S, Tryon J, Feaster M, et al. The influence of housing status on the HIV continuum of care: results from a multisite study of patient navigation models to build a medical home for people living with HIV experiencing homelessness. Am J Public Health **2018**; 108:S539–45.

44. Aharonovich E, Stohl M, Cannizzaro D, Hasin D. HealthCall delivered via smartphone to reduce co-occurring drug and alcohol use in HIV-infected adults: a randomized pilot trial. J Subst Abuse Treat **2017**; 83:15–26.

45. Earnshaw VA, Bogart LM, Laurenceau JP, et al. Internalized HIV stigma, ART initiation and HIV-1 RNA suppression in South Africa: exploring avoidant coping as a longitudinal mediator. J Int AIDS Soc **2018**; 21:e25198.

46. Katz IT, Bogart LM, Dietrich JJ, et al. Understanding the role of resilience resources, antiretroviral therapy initiation, and HIV-1 RNA suppression among people living with HIV in South Africa: a prospective cohort study. AIDS **2019**; 33(Suppl 1):71–9.

47. Michlig GJ, Westergaard RP, Lam Y, et al. Avoidance, meaning and grief: psychosocial factors influencing engagement in HIV care. AIDS Care **2018**; 30:511–7.

48. Moitra E, LaPlante A, Armstrong ML, et al. Pilot randomized controlled trial of acceptance-based behavior therapy to promote HIV acceptance, HIV disclosure, and retention in medical care. AIDS Behav **2017**; 21:2641–9.

49. Zuniga JA, Yoo-Jeong M, Dai T, et al. The role of depression in retention in care for persons living with HIV. AIDS Patient Care STDS **2016**; 30:34–8.