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Strategies to improve HIV care outcomes for people with HIV who are out of care

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Abstract

Objective: The aim of this study was to evaluate the effectiveness of five intervention strategies - patient navigation, appointment help/alerts, psychosocial support, transportation/appointment accompaniment, and data-to-care on HIV care outcomes among persons with HIV (PWH) who are out of care (OOC).

Design: A systematic review with meta-analysis.

Methods: We searched CDC's Prevention Research Synthesis (PRS) Project's cumulative HIV database to identify intervention studies conducted in the U.S., published between 2000 and 2020 that included comparisons between groups or prepost, and reported at least one relevant outcome (i.e., re-engagement or retention in HIV care, and viral suppression). Effect sizes were meta-analyzed using random-effect models to assess intervention effectiveness.

Results: Thirty-nine studies reporting on 42 unique interventions met the inclusion criteria. Overall, intervention strategies are effective in improving re-engagement in care [odds ratio (OR) = 1.79; 95% confidence interval (95% CI): 1.36 – 2.36, k = 14), retention in care (OR = 2.01; 95% CI: 1.64 – 2.64, k = 22), and VS (OR = 2.50; 95% CI: 1.87 – 3.34, k =27). Patient navigation, appointment help/alerts, psychosocial support, and transportation/appointment accompaniment improved all three HIV care outcomes. Data-to-care improved re-engagement and retention but had insufficient evidence for viral suppression.

Conclusions: Several strategies are effective for improving HIV care outcomes among PWH who are out of care. More work is still needed for consistent definitions of OCC and HIV care outcomes, better reporting of intervention and cost data, and identifying how best to implement and scale-up effective strategies to engage and retain OOC PWH in care and reach the ending the HIV epidemic goals.

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Keywords

HIV Care; meta-analysis; re-engagement; retention in HIV Care; systematic review; viral suppression

Introduction

Engaging and retaining persons with HIV (PWH) in HIV medical care are critical activities under the treatment pillar of the Ending the HIV Epidemic (EHE) initiative in the United States [1]. It is estimated that 43% of the new HIV transmissions in the U.S. occurred from PWH aware of their status, but not in care [2]. Care engagement of PWH who are out of care (OOC) is critical for reaching and maintaining viral suppression and preventing HIV transmission.

Various factors contribute to falling OOC [3–11] and thus re-engaging OOC PWH in HIV care may require different strategies [12]. One common strategy is patient navigation, a person-centered intervention that helps PWH access resources and traverse complex healthcare and social service systems. Strategies that attempt to reduce disengagement from HIV care by removing personal and structural barriers include offering transportation [13, 14], accompanying patients to appointments [15, 16], offering psychosocial support (e.g., education, individual counseling, emotional support, skills building) [17], using provider alert systems when PWH are in the clinic for non-HIV-related appointments [18] or when patients miss appointments [19], using phone apps for appointment reminders, and offering walk-in or same-day appointments [20, 21]. A more recent public health strategy is data-to-care, in which health department surveillance data and/or other patient health records (e.g., Medicaid administrative claims, pharmacy refill data) are used to identify and re-engage OOC PWH back into HIV care [22].

An evaluation of intervention strategies is needed for identifying best practices for re-engagement in care. Previous qualitative systematic reviews have noted few studies improved re-engagement in care among PWH [23, 24]. We expanded the scope of these previous qualitative reviews by including the most recent literature (2000–2020) and conducting meta-analyses to assess the effectiveness of five common intervention strategies: patient navigation, appointment help/alerts, psychosocial support, transportation/appointment accompaniment, and data-to-care on HIV care outcomes (i.e., re-engagement in care, retention in care, and VS) among PWH who are OOC.

Methods

Search Strategy

Our report followed the guidelines from the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) Statement [25]. A study protocol is not available for this systematic review. The Centers for Disease Control and Prevention's (CDC) Prevention Research Synthesis (PRS) Project's cumulative HIV, AIDS, and sexually transmitted disease (STD) research database was searched to identify relevant reports. Librarians with experience developing and conducting comprehensive systematic searches routinely update

the PRS database through electronic searches (e.g., MEDLINE, EMBASE, PsycINFO) and manual checks (i.e., journals, reference lists, listservs) of the literature [26] (Appendix A; [Supplemental Digital Content or SDC]). Every citation added to the PRS database undergoes a base level of coding to classify the prevention focus and label key outcomes to facilitate retrieval for research. For this review, a librarian performed searches on the screening classifications applied to over 100,000 citations in the PRS database published 1988 – 2020 with the last search in June 2021.

Inclusion criteria

Eligibility criteria were intervention studies conducted in the U.S., included comparisons between groups or pre-post, published between 2000 and 2020, tested interventions for helping care engagement of OCC PWH, and reported one of the following outcomes: re-engagement in care, retention in care, and VS. As noted in the previous qualitative systematic reviews [23, 24], there were substantial heterogeneity in definitions of outcomes and OCC populations in the literature. For comprehensiveness, we accepted author definitions. Common definitions of OCC were not having a medical visit or VL test in clinic records or not having CD4 or VL tests documented in surveillance reports with specified timeframes by authors. We included studies with a mixed sample of PWH who were OCC and those at risk of becoming OCC if authors did not respond when asked for stratified findings; the majority of the sample were OCC; or the authors described the intervention as being intended for OOC PWH.

Data abstraction

Two trained coders screened titles and abstracts, and reviewed full reports using DistillerSR (Evidence Partners, Ottawa, Canada). Coders resolved discrepancies via discussion. For included studies, the primary author abstracted study and sample characteristics, outcome definitions, intervention and comparison group strategies, and effects. A second author verified the abstracted data. We contacted seven authors to obtain stratified findings for OOC PWH. Four authors (57%) responded.

Study Quality

We assessed study quality with the Effective Public Health Practice Project (EPHPP) quality assessment tool for quantitative studies EPHPP Tools – McMaster Evidence Review & Synthesis Centre (merst.ca) using two coders. The EPHPP tool evaluates six components: selection bias, study design, confounders, blinding, data collection methods, and withdrawals/dropouts. For each component, a study can receive a strong, moderate, or weak rating. A global rating for each study consisted of ‘strong’ if it did not have any weak components, ‘moderate’ if it had only one weak component, and ‘weak’ if it had two or more weak components. Discrepancies were resolved via discussion.

Data Analyses

We conducted descriptive analyses with study, sample, intervention characteristics, and correlations among five strategies using SPSS Version 21 (IBM, Armonk, New York,

USA). To determine intervention effectiveness, we conducted standard meta-analyses using Comprehensive Meta Analyses 2.0.

The following rules guided effect size abstractions. For studies reporting multiple follow-up assessments, we used the shortest follow-up assessment for the re-engagement outcome because engaging OOC PWH sooner than later in HIV care is more desirable. We used 12-month follow-up assessments for retention in care and VS if multiple assessments were conducted. If 12-month assessments were not conducted, we used the longest follow up assessment available since longer periods of time remaining in care or being virally suppressed may suggest continuity of care and longer-term VS.

We examined overall intervention effects for each outcome and analyzed intervention effects for each outcome, stratified by five non-mutually exclusive intervention strategies. Meta-analyses were also conducted by study design [i.e., randomized controlled trial [RCT] vs. non-RCT] for each outcome[27, 28]. We assessed between-group differences (Q_B) using the mixed-effects model to determine whether intervention and study design were associated with effect sizes [29].

Effect sizes were estimated using odds ratios (OR) because studies frequently reported dichotomous outcomes. For studies reporting means and standard deviation values on continuous outcomes, we calculated and converted standardized mean differences into ORs. Random-effects models with two-tailed tests were used to calculate aggregated effects for outcomes of interest. [30] An OR more than 1 indicates a greater increase in odds of being re-engaged in care, retained in care, or being virally suppressed.

We used the I^2 statistic to indicate the proportion of variance across studies due to heterogeneity [30]. We also calculated prediction intervals to indicate the extent of dispersion in the same units as the effect size, a way of examining heterogeneity for outcomes with 10 or more studies [30]. For handling outliers, we identified each effect size that was more than 2 standard deviations from the mean of all effect sizes for an outcome and recoded them to the value at 2 standard deviations (i.e., winsorizing) [29]. We conducted sensitivity analyses to test the robustness of the findings. One study at a time was removed from each set of aggregated analyses to determine if any one study affected the aggregated effect size. When studies reported more than one follow-up assessment, we conducted sensitivity tests to examine whether there were substantial differences in the point estimates for the overall outcomes. We also compared the results with and without winsorizing outliers. For assessing publication bias, we conducted a funnel plot, Egger's regression intercept [31], and Duval and Tweedie's Trim and Fill [30] for each outcome.

Results

The PRISMA study flow diagram summarizes the study selection process (Appendix B; SDC). We identified 39 studies reporting on 42 unique interventions that met the inclusion criteria. Table 1 summarizes study, participant, and intervention characteristics (Appendix C; SDC provides detailed description of individual studies). Most studies were non-RCTs (81%) [13–16, 18, 21, 32–56]. For the eight RCTs, comparison arms were care as usual

[19, 57, 58], wait-list control [59], featured content unrelated to re-engaging in care [60, 61] or they did not receive an enhanced component that the intervention arm received [16, 62].

The most common study locations were the Northeast and South. The median study sample size was 231 (min to max: 16 to 5714) with a total of 26154 participants. Across studies, the majority were males (71%) and African Americans (64%). The mean age was 42 years old. For study quality, two (7%) interventions were considered strong [19, 61], 16 (38%) were rated as moderate quality [16, 21, 32, 41, 44, 45, 54, 58, 60, 62, 63], and 24 (57%) were determined as weak [13–15, 18, 35–40, 42, 43, 46, 47, 49–53, 55–57, 59, 64]. The most common intervention strategies were patient navigation, followed by appointment help/alert, psychosocial support, data to care, and transportation/appointment accompaniment (Table 2). About 73% of interventions used more than one intervention strategy; however, the correlation coefficients showed low degree of correlation among strategies (below .29). The two strategies that showed moderate degree of correlation are patient navigation and transportation/appointment accompaniment ($r = .451$, $p = 0.003$).

The most common timeframe for the OCC definition was being out of care between 6 and 12 months [14, 16, 18, 32–34, 36, 40, 42, 43, 47, 48, 51–55, 58–63]. followed by 3–4 months [13, 19, 39, 57] and over 12 months [35, 41, 44, 45, 50]. Five studies included PWH who were OOC and at risk for becoming OOC [15, 21, 49, 53, 56].

Among the three outcomes, definitions for re-engagement and retention varied, but less so for VS. For re-engagement in care, the most common definition was having a HIV medical visit or record of a viral load test between two and six months [14, 15, 18, 19, 48, 50, 52] while for retention in care, the most common definition was the HRSA HAB definition (at least one medical visit in each 6-month period of a 24-month measurement period with a minimum of 60 days between medical visits) [16, 38, 44, 46, 48, 56, 61]. For viral suppression, the most common definition was having a viral load < 200 mL [14, 16, 21, 34, 37–39, 41, 44–48, 51, 54, 55, 59, 62].

Meta-analyses and sensitivity analyses

Overall—Table 2 presents the meta-analysis results for each outcome. We winsorized one intervention for re-engagement[35] and two for viral suppression outcomes[51, 56]. Overall, the findings showed positive point estimates for re-engagement in care (OR = 1.79; 95% Confidence Intervals [CI]: 1.36 – 2.36), retention in care (OR = 2.01; 95%CI: 1.64 – 2.46), and viral suppression (OR = 2.50; 95%CI: 1.87 – 3.34). Forest plots are shown in Figures 1 and 2. Sensitivity tests did not substantially change the effect sizes for any outcome. There was no evidence that effect-size estimates for all three outcomes were biased by the included studies based on publication bias assessments examined with funnel plots, Egger's regression intercept, and Duval and Tweedie's Trim and Fill (See Appendices D, E, F [SDC], http://links.lww-com/QAD/C445, http://links.lww.com/QAD/C446,http://links.lww.com/QAD/C447).

To assess the effect of study design on the findings, the Q_B statistics showed that the aggregated effect sizes in RCTs were significantly smaller than the ones observed in non-RCTs for retention ($Q_B = 10.21$, $p = 0.001$), but not for VS ($Q_B = 3.42$, $p = 0.06$). We

did not conduct a stratified meta-analysis for re-engagement because only one study was an RCT [58].

Patient Navigation—Twenty-six interventions from 24 studies used patient navigation to help patients become linked to medical and social services. In addition to using labels such as patient or peer navigator, case manager or social worker, study authors also used terms such as linkage specialist/coordinator [36, 43, 44] health coach [60], state bridge counselor [14], service linkage worker [48], and community health outreach workers[40] to describe staff who provided navigation-like services. Six interventions used nurse navigators [13, 21, 51, 56, 57, 59] and seven interventions (five studies) used peer navigators [40, 51, 56, 59, 60]. We found positive point estimates for re-engagement (OR = 1.76; 95%CI: 1.36 – 2.34), retention (OR = 2.20; 95%CI: 1.72 – 2.81), and VS (OR = 3.05; 95%CI: 2.19 – 4.26; Table 2). Sensitivity tests indicated little change in the point estimates for all three outcomes.

Appointment Help/alerts—Twenty-three interventions included appointment assistance as an intervention component. Appointment assistance encompassed multiple activities: scheduling [40, 44, 47, 48, 57], sending reminders via phone calls, texts or apps [18, 21, 43, 46, 50, 54, 58, 62, 63], coordination [15], follow up if appointments missed [43, 45], and using automated alerts notifying providers that patients were OOC and needed appointments [19, 33, 37, 38, 41, 52]. Positive effects were found for re-engagement (OR = 1.72; 95%CI: 1.30–2.27), retention (OR = 1.84; 95%CI: 1.48 – 2.29), and viral suppression (OR = 2.06; 95%CI: 1.54 – 2.75; Table 2). Overall effects for all three outcomes did not change substantially when we removed one study at a time.

Psychosocial services—Eighteen interventions included some type of psychosocial services in their interventions. These services included counseling or motivational interviewing [13, 35, 36, 41, 45, 48, 50, 53, 61], providing emotional support and positive reinforcement in person or via texts, apps or phone calls [15, 46, 54, 59, 62, 63], education [15, 16, 40, 41, 46, 49, 59–61] and skills building [15, 59, 63]. Overall estimates showed that psychosocial support improved re-engagement (OR = 1.95; 95%CI: 1.31 – 2.91), retention (OR = 2.01; 95%CI: 1.57 −2.57), and viral suppression (OR = 2.05; 95%CI: 1.52 – 2.76; Table 2). Sensitivity tests for all three outcomes did not affect overall effects.

Transportation/Appointment Accompaniment—Fourteen interventions from 13 studies included help with transportation [13, 14, 36, 38, 43, 44, 48], appointment accompaniment [16, 39, 40, 50] or both [13, 15, 57]. For the study by Andersen *et al.* [13], one intervention tested only providing transportation to HIV appointments while the other intervention offered additional services such as home visits, counseling, referrals to drug treatment, and appointment accompaniment provided by a nurse navigator. Transportation-related strategies improved re-engagement (OR = 1.65; 95%CI: 1.17 – 2.34), retention (OR = 2.02; 95%CI: 1.62 – 2.53), and viral suppression (OR = 2.62; 95%CI: 1.62 – 4.23; Table 2). Sensitivity tests revealed no substantial differences in effect sizes.

Given the moderate degree of correlation between patient navigation and transportation/appointment accompaniment, we compared PWH receiving the combined strategies vs. not. PWH who received the combination of patient navigation and transportation/appointment

accompaniment showed greater improvement in the three outcomes than PWH who did not receive the combined strategies (re-engagement: OR = 1.96, 95%CI: 1.74–2.22; retention: OR = 2.06, 95%CI: 1.67–2.55; viral suppression: OR = 2.68, 95%CI: 1.86–3.86).

Data-to-Care—Fourteen interventions included data-to-care strategies that involved identifying OOC PWH and verifying OOC status with surveillance records or other databases, and using other strategies to re-engage persons into care such as appointment help [44, 50], patient navigation [14, 36, 44, 47, 50, 55], alerts [33, 41, 52], motivational interviewing [41, 50] enhanced partner services [32, 35], and using disease intervention specialists [36, 45] or health care provider staff [34]. For data-to-care, the aggregated estimates were positive for re-engagement (OR = 1.61; 95%CI: 1.14 – 2.27) and retention (OR = 2.30; 95%CI: 1.75 – 3.04; Table 2). The overall effects did not substantially change for re-engagement or retention with sensitivity tests. For viral suppression, the overall effect was positive and greater than 1, but the confidence intervals covered 1(OR = 1.60; 95%CI: 0.97 – 2.62, z = 1.86, $P = 0.06$). When the studies by Donovan et al. [47] and Dombrowski *et al.* [45] studies were removed one at a time, the intervention effect increased.

Discussion

Re-engaging and retaining OOC PWH in HIV medical care are vital for viral suppression and preventing HIV transmission. Our findings indicate strategies such as patient navigation and provision of appointment help/alerts, psychosocial support, and transportation/appointment accompaniment may be effective for improving HIV care outcomes. Data-to-care is also effective for engaging OOC PWH back into care and retaining them in care, but for viral suppression, the evidence is less clear. The overall study quality of studies included in this review was moderate to weak, suggesting that more rigorous testing of interventions and better reporting are warranted.

Patient navigation is the most common strategy and is associated with offering transportation and accompanying patients to appointments. Although there is no standardized definition of patient navigation [65], transportation and appointment accompaniment are often conducted as part of navigation services and may be important activities for reducing structural barriers to achieving HIV care outcomes [65]. Not surprisingly, interventions that helped with appointment scheduling, followed up when patients missed clinic visits, and sent reminders were found to be effective. While it is unknown if appointment scheduling and alerts by themselves would be effective at improving HIV care outcomes, these strategies may be relatively low cost to implement.

The findings on data-to-care suggest that the approach may have immediate benefits (e.g., re-engaging PWH into care), but longer-term benefits such as helping PWH reach viral suppression are less clear. A recent RCT comparing a collaborative data-to-care model with usual care found data-to-care to be effective for re-engaging OOC PWH within 90 days and retention in care at 12 months, but less so with viral suppression at 12 months.[66] OOC PWH and those who experience difficulties staying in care may be facing multiple structural and personal barriers, and may need additional psychological and emotional reinforcement to navigate often complex health and social services [67] that go beyond data-to-care. Data-

to-care might need enhancement by incorporating these additional strategies for facilitating successful engagement in care [67] as evident in two studies included in this review [40, 44] that are considered best practices for re-engagement in CDC's PRS Compendium. [68] Most of data-to-care studies had weak study quality which calls for more rigorous evaluation, especially testing data-to-care in combination with other strategies and its effect on viral suppression.

Limitations

Several limitations warrant comments. First, 73% of the interventions had more than one strategy with low degree of correlation between strategies (except patient navigation and transportation/appointment accompaniment). Disentangling which individual strategy contributed to improvements in outcomes requires more primary studies that directly compare the relative effect of each strategy, which are not yet readily available. Second, our findings are based on the published literature. However, assessments of publication bias did not indicate any evidence that effect-size estimates for all three outcomes were biased by the included studies. Third, a small number of studies (n=5) consisted of mixed samples of OCC PWH and PWH at risk for becoming OOC. However, most participants in these samples were OCC, and OCC PWH and those at risk are likely to face similar barriers to engaging in continuous care.[69] Fourth, we examined heterogeneity among studies that might be attributed to study design, but other possible explanations (e.g., different definitions of OOC or measurement differences) were not pursued due to power issues. Fifth, we did not specify thresholds for effect sizes that might be considered as clinically significant or meaningful from a public health perspective. Although the intervention effects for the three outcomes are positive with ORs ranging from 1.79 to 2.50, more work is needed to determine the thresholds of effect sizes by outcomes and strategies that are meaningful from a public health perspective.

Future Research Directions

Several research directions emerged from our systematic review. As many of the included interventions comprised multiple strategies, conducting primary studies that include component analyses to help disentangle effects of individual strategies, identify core components or which combination of strategies have the most impact on outcomes may be a potential research direction[70]. Another consideration is using stronger research designs that reduce the risk of bias and allow for comparison. Because RCTs may be impractical to implement in real world settings, alternate innovative methods such as constructing a comparison group from surveillance data or using a stepped-wedge design are worth considering [16, 45]. Working toward a common definition of out of care and standardized HIV care outcome measurements [23, 24, 71] and thresholds for clinical significance that are meaningful from a public health perspective would further facilitate evaluation and research synthesis of the re-engagement literature. Similarly, establishing a standard for re-engagement that parallels the national indicator for linkage to care for persons who are newly diagnosed may help with evaluating re-engagement programs. Cost data were not reported in most of the studies. Cost analyses for implementing different strategies can be another useful research endeavor. In light of the COVID-19 pandemic, e-health might be a helpful tool to increase HIV prevention and care services. Conducting implementation

research to better understand how to improve the implementation of effective strategies (including using e-health) may be key to amplify the impact of prevention and care efforts.

Conclusions

This systematic review and meta-analysis identified several effective strategies such as patient navigation, appointment/alert assistance, psychosocial support, transportation/appointment accompaniment, and data-to-care for improving HIV care outcomes for PWH who are out of care. The evidence for the effectiveness of data-to-care for viral suppression is uncertain, needing more rigorous evaluation. More work is also needed for consistent definitions of OCC and HIV care outcomes, better reporting of intervention and cost data, and identifying how best to implement and scale-up effective strategies to engage and retain OOC PWH in care and reach EHE goals.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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DHH conceptualized the study, conducted data abstraction analyses, assessed study quality, drafted and edited the manuscript.

NC conducted data abstraction and analyses, drafted and edited the manuscript.

MMM conducted the search, drafted and edited the manuscript.

AAJ conducted data abstraction, assessed study quality, and drafted the manuscript.

JKLG conducted data abstraction and edited the manuscript.

CD assessed study quality and edited the manuscript.

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References

1. Fauci AS, Redfield RR, Sigounas G, Weahkee MD, Giroir BP. Ending the HIV epidemic: a plan for the United States. JAMA 2019; 321(9):844–845. [PubMed: 30730529]
2. Li Z, Purcell DW, Sansom SL, Hayes D, Hall HI. Vital Signs: HIV transmission along the continuum of care - United States, 2016. MMWR Morb Mortal Wkly Rep 2019; 68(11):267–272.
3. Bulsara SM, Wainberg ML, Newton-John TRO. Predictors of adult retention in HIV care: a systematic review. AIDS Behav 2018; 22(3):752–764. [PubMed: 27990582]
4. Craw JA, Bradley H, Gremel G, West BT, Duke CC, Beer L, et al. Retention in care services reported by HIV care providers in the United States, 2013 to 2014. J Int Assoc Provid AIDS Care 2017; 16(5):460–466.
5. Dandachi D, May SB, Davila JA, Cully J, Amico KR, Kallen MA, 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(1):64–72. [PubMed: 30272637]

6. Geter A, Herron AR, Sutton MY. HIV-related stigma by healthcare providers in the United States: a systematic review. AIDS Patient Care STDS 2018; 32(10):418–424. [PubMed: 30277814]
7. Hall BJ, Sou KL, Beanland R, Lacky M, Tso LS, Ma Q, et al. Barriers and facilitators to interventions improving retention in HIV care: a qualitative evidence meta-synthesis. AIDS Behav 2017; 21(6):1755–1767. [PubMed: 27582088]
8. McLean CP, Gay NG, Metzger DA, Foa EB. Psychiatric symptoms and barriers to care in HIV-infected individuals who are lost to care. J Int Assoc Provid AIDS Care 2017; 16(5):423–429. [PubMed: 28578611]
9. Reback CJ, Runger D, Fletcher JB. Drug use is associated with delayed advancement along the HIV care continuum among transgender women of color. AIDS Behav 2019.
10. Summers NA, Colasanti JA, Feaster DJ, Armstrong WS, Rodriguez A, Jain MK, et al. Predictors for poor linkage to care among hospitalized persons living with HIV and co-occurring substance use disorder. AIDS Res Hum Retroviruses 2020; 36(5):406–414. [PubMed: 31914790]
11. Tiruneh YM, Li X, Bovell-Ammon B, Iroh P, Flanigan TP, Montague BT, et al. Falling through the cracks: Risk factors for becoming lost to HIV care after incarceration in a southern jail. AIDS Behav 2020; 24(8):2430–2441. [PubMed: 32006154]
12. Maulsby C, Kinsky S, Jain KM, Charles V, Riordan M, Holtgrave DR. Unpacking linkage and reengagement in HIV care: a day in the life of a positive charge care coordinator. AIDS Educ Prev 2015; 27(5):405–417. [PubMed: 26485231]
13. Andersen M, Hockman E, Smereck G, Tinsley J, Milfort D, Wilcox R, et al. Retaining women in HIV medical care. J Assoc Nurses AIDS Care 2007; 18(3):33–41. [PubMed: 17570298]
14. Fadul N, Willis SJ, Donovan J, Wilkin A, Durr Heine A, LeViere A, et al. Characteristics of out-of-care patients who required a referral for re-engagement services by public health bridge counselors following a brief clinic-based retention intervention. AIDS Behav 2019; 23(Suppl 1):52–60. [PubMed: 29637387]
15. Bradford JB, Colman S, Cunningham W. HIV system navigation: an emerging model to improve HIV care access. AIDS Patient Care STDS 2007; 21(Suppl. 1):S49–S58. [PubMed: 17563290]
16. Robertson MM, Penrose K, Irvine MK, Robbins RS, Kulkarni S, Braunstein SL, et al. Impact of an HIV care coordination program on durable viral suppression. J Acquir Immune Defic Syndr 2019; 80(1):46–55. [PubMed: 30299346]
17. Chang EJ, Fleming M, Nunez A, Dombrowski JC. Predictors of successful HIV care re-engagement among persons poorly engaged in HIV care. AIDS Behav 2019; 23(9):2490–2497. [PubMed: 30980279]
18. Lubelchek RJ, Fritz ML, Finnegan KJ, Trick WE. Use of a real-time alert system to identify and re-engage lost-to-care HIV patients. J Acquir Immune Defic Syndr 2016; 72(2):e52–e55. [PubMed: 26918542]
19. Robbins GK, Lester W, Johnson KL, Chang Y, Estey G, Surrao D, et al. Efficacy of a clinical decision-support system in an HIV practice: a randomized trial. Ann Intern Med 2012; 157(11):757–766. [PubMed: 23208165]
20. Beima-Sofie K, Begnel ER, Golden MR, Moore A, Ramchandani M, Dombrowski JC. “It’s me as a person, not me the disease”: patient perceptions of an HIV care model designed to engage persons with complex needs. AIDS Patient Care STDS 2020; 34(6):267–274. [PubMed: 32484744]
21. Asamsama OH, Squires L, Tessema A, Rae E, Hall K, Williams R, et al. HIV nurse navigation: charting the course to improve engagement in care and HIV virologic suppression. J Int Assoc Provid AIDS Care 2017; 16(6):603–607. [PubMed: 29017375]
22. Sweeney P, DiNenno EA, Flores SA, Dooley S, Shouse RL, Muckleroy S, et al. HIV data to care-using public health data to improve HIV care and prevention. J Acquir Immune Defic Syndr 2019; 82 Suppl 1:S1–S5. [PubMed: 31425388]
23. Risher KA, Kapoor S, Daramola AM, Paz-Bailey G, Skarbinski J, Doyle K, et al. Challenges in the evaluation of interventions to improve engagement along the HIV care continuum in the United States: a systematic review. AIDS Behav 2017; 21(7):2101–2123. [PubMed: 28120257]
24. Blanco N, Lavoie MC, Koech E, Riedel DJ, Ngeno C, Adebajo S, et al. Re-engagement into HIV care: A systematic review. AIDS Behav 2021.

25. Page M, McKenzie J, Bossuyt P, Boutron I, Hoffmann T, Mulrow C, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021; 347:n71
26. DeLuca JB, Mullins MM, Lyles CM, Crepaz N, Kay L, Thadiparthi S. Developing a comprehensive search strategy for evidence based systematic reviews. Evid Based Lib Info Prac 2008; 3(1):3–32.
27. Becker BJ, Aloe AM, Duvendack M, Stanley TD, Valentine JC, Fretheim A, et al. Quasi-experimental study designs series-paper 10: synthesizing evidence for effects collected from quasi-experimental studies presents surmountable challenges. J Clin Epidemiol 2017; 89:84–91. [PubMed: 28365308]
28. Higgins JPT, Thomas J, Chandler J, Cumpston M, Li T, Page MJ, et al. Cochrane Handbook for Systematic Reviews of Interventions version 6.1 (updated September 2020). Available at:www.training.cochrane.org/handbook [Accessed 10 March 2021].
29. Lipsey MW, Wilson DB. Practical Meta-Analysis. Thousand Oaks, California: Sage Publications; 2000.
30. Borenstein M. Common mistakes in meta-analysis and how to avoid them. Englewood, NJ: Biostat Inc; 2019.
31. Egger M, Davey Smith G, Schneider M, Minder C. Bias in meta-analysis detected by a simple, graphical test. BMJ 1997; 315(7109):629–634. [PubMed: 9310563]
32. Hart-Malloy R, Brown S, Bogucki K, Tesoriero J. Implementing data-to-care initiatives for HIV in New York state: Assessing the value of community health centers identifying persons out of care for health department follow-up. AIDS Care 2018; 30(3):391–396. [PubMed: 28791877]
33. Magnus M, Herwehe J, Gruber D, Wilbright W, Shepard E, Abrams A, et al. Improved HIV-related outcomes associated with implementation of a novel public health information exchange. Int J Med Inform 2012; 81(10):e30–e38. [PubMed: 22883431]
34. Saafir-Callaway B, Castel AD, Lago L, Olejemeh C, Lum G, Frison L, et al. Longitudinal outcomes of HIV- infected persons re-engaged in care using a community-based re-engagement approach. AIDS Care 2020; 32(1):76–82. [PubMed: 31129991]
35. Tesoriero JM, Johnson BL, Hart-Malloy R, Cukrovany JL, Moncur BL, Bogucki KM, et al. Improving retention in HIV care through New York's expanded partner services data-to-care pilot. J Public Health Manag Pract 2017; 23(3):255–263. [PubMed: 27902561]
36. Anderson S, Henley C, Lass K, Burgess S, Jenner E. Improving Engagement in HIV Care Using a Data-to-Care and Patient Navigation System in Louisiana, United States. J Assoc Nurses AIDS Care 2020; 31(5):553–565. [PubMed: 31899701]
37. Avoundjian T, Golden MR, Ramchandani MS, Guthrie BL, Hughes JP, Baseman JG, et al. Evaluation of an emergency department and hospital-based data exchange to improve HIV care engagement and viral suppression. Sex Transm Dis 2020; 47(8):535–540. [PubMed: 32404856]
38. Dombrowski JC, Galagan SR, Ramchandani M, Dhanireddy S, Harrington RD, Moore A, et al. HIV care for patients with complex needs: a controlled evaluation of a walk-in, incentivized care model. Open Forum Infect Dis 2019; 6(7):ofz294.
39. Kral AH, Lambdin BH, Comfort M, Powers C, Cheng H, Lopez AM, et al. A strengths-based case management intervention to reduce HIV viral load among people who use drugs. AIDS Behav 2018; 22(1):146–153. [PubMed: 28916898]
40. Messeri P, Yomogida M, Ferat RM, Garr L, Wirth D. An HIV health plan patient navigation program: Engaging HIV positive individuals in primary medical care. Journal of HIV/AIDS & Social Services 2020; 19(1):55–73.
41. Sharp J, Angert CD, McConnell T, Wortley P, Pennisi E, Roland L, et al. Health information exchange: a novel re-linkage intervention in an urban health system. Open Forum Infect Dis 2019; 6(10):ofz402.
42. Udeagu C, Huang J, Eason L, Pickett L. Health department-HIV clinic integration of data and human resources to re-engage out of care HIV-positive persons into clinical care in a New York City locale. AIDS Care 2019; 31(11):1420–1426. [PubMed: 30821484]
43. Sohail M, Rastegar J, Long D, Rana A, Levitan EB, Reed-Pickens H, et al. Data for Care (D4C) Alabama: clinic-wide risk stratification with enhanced personal contacts for retention in HIV

care via the Alabama quality management group. J Acquir Immune Defic Syndr 2019; 82(Suppl. 3):S192–s198. [PubMed: 31764254]

44. Bove J, Golden MR, Dhanireddy S, Harrington RD, Dombrowski JC. Outcomes of a clinic-based, surveillance-informed intervention to relink patients to HIV care. J Acquir Immune Defic Syndr 2015; 70(3):262–268. [PubMed: 26068720]
45. Dombrowski JC, Hughes JP, Buskin SE, Bennett A, Katz D, Fleming M, et al. A cluster randomized evaluation of a health department data to care intervention designed to increase engagement in HIV care and antiretroviral use. Sex Transm Dis 2018; 45(6):361–367. [PubMed: 29465679]
46. Dillingham R, Ingersoll K, Flickinger TE, Waldman AL, Grabowski M, Laurence C, et al. PositiveLinks: a mobile health Iitervention for retention in HIV care and clinical outcomes with 12-month follow-up. AIDS Patient Care STDS 2018; 32(6):241–250. [PubMed: 29851504]
47. Donovan J, Sullivan K, Wilkin A, Fadul N, Heine A, Keller J, et al. Past care predicts future care in out-of-care people living with HIV: results of a clinic-based retention-in-care intervention in North Carolina. AIDS Behav 2018; 22(8):2687–2697. [PubMed: 29611094]
48. Flash CA, Pasalar S, Hemmige V, Davila JA, Hallmark CJ, McNeese M, et al. Benefits of a routine opt-out HIV testing and linkage to care program for previously diagnosed patients in publicly funded emergency departments in Houston, TX. J Acquir Immune Defic Syndr 2015; 69(Suppl. 1):S8–S15. [PubMed: 25867782]
49. Plimpton E. A quality improvement project to increase patient portal enrollment and utilization in women living with HIV at risk for disengagement in care. J Assoc Nurses AIDS Care 2020; 31(1):60–65. [PubMed: 31834101]
50. Sachdev DD, Mara E, Hughes AJ, Antunez E, Kohn R, Cohen S, et al. “Is a bird in the hand worth 5 in the bush?”: A comparison of 3 data-to-care referral strategies on HIV care continuum outcomes in San Francisco. Open Forum Infect Dis 2020; 7(9):ofaa369.
51. Shacham E, López JD, M. BT, Tippit K, Ritz A. Enhancing adherence to care in the HIV care continuum: The Barrier Elimination and Care Navigation (BEACON) Project Evaluation. AIDS Behav 2018; 22(1):258–264. [PubMed: 28597342]
52. Shade SB, Steward WT, Koester KA, Chakravarty D, Myers JJ. Health information technology interventions enhance care completion, engagement in HIV care and treatment, and viral suppression among HIV-infected patients in publicly funded settings. J Am Med Inform Assoc 2015; 22(e1):e104–e111. [PubMed: 25030033]
53. Wohl AR, Garland WH, Wu J, Au CW, Boger A, Dierst-Davies R, et al. A youth-focused case management intervention to engage and retain young gay men of color in HIV care. AIDS Care 2011; 23(8):988–997. [PubMed: 21390879]
54. Zurlo J, Du P, Haynos A, Collins V, Eshak T, Whitener C. OPT-In For Life: a mobile technology-based intervention to improve HIV care continuum for young adults living with HIV. Health Promot Pract 2020; 21(5):727–737. [PubMed: 32757835]
55. Wohl AR, Dierst-Davies R, Victoroff A, James S, Bendetson J, Bailey J, et al. The Navigation Program: An intervention to re-engage lost patients at 7 HIV clinics in Los Angeles County, 2012–2014. J Acquir Immune Defic Syndr 2016; 71(2):e44–e50. [PubMed: 26484741]
56. Maulsby C, Jain KM, Weir BW, Enobun B, Werner M, Riordan M, et al. Cost-utility of access to care, a national HIV linkage, re-engagement and retention in care program. AIDS Behav 2018; 22(11):3734–3741. [PubMed: 29302844]
57. Andersen M, Tinsley J, Milfort D, Wilcox R, Smereck G, Pfoutz S, et al. HIV health care access issues for women living with HIV, mental illness, and substance abuse. AIDS Patient Care STDS 2005; 19(7):449–459. [PubMed: 16053402]
58. Corado K, Jain S, Morris S, Dube MP, Daar ES, He F, et al. Randomized trial of a health coaching intervention to enhance retention in care: California collaborative treatment group 594. AIDS Behav 2018; 22(8):2698–2710. [PubMed: 29725790]
59. Enriquez M, Cheng AL, McKinsey D, Farnan R, Ortego G, Hayes D, et al. Peers Keep It Real: re-engaging adults in HIV care. J Int Assoc Provid AIDS Care 2019; 18:2325958219838858.

60. Giordano TP, Cully J, Amico KR, Davila JA, Kallen MA, C. H, 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(5):678–686. [PubMed: 27217266]

61. Smith LR, Amico KR, Fisher JD, Cunningham CO. 60 Minutes for health: examining the feasibility and acceptability of a low-resource behavioral intervention designed to promote retention in HIV care. AIDS Care 2018; 30(2):255–265. [PubMed: 28657333]

62. Christopoulos KA, Riley ED, Carrico AW, Tulsky J, Moskowitz JT, Dilworth S, et al. A randomized controlled trial of a text messaging intervention to promote virologic suppression and retention in care in an urban safety-net human immunodeficiency virus clinic: The Connect4Care Trial. Clin Infect Dis 2018; 67(5):751. [PubMed: 29474546]

63. Gardner LI, Giordano TP, Marks G, Wilson TE, Craw JA, Drainoni ML, et al. Enhanced personal contact with HIV patients improves retention in primary care: a randomized trial in six U.S. HIV clinics. Clin Infect Dis 2014; 59(5):725–734. [PubMed: 24837481]

64. Magnus M, Herwehe J, Gruber D, Wilbright W, Shepard E, Abrams A, et al. Improved HIV-related outcomes associated with implementation of a novel public health information exchange. Int J Med Inform 2012; 81(10):e30. [PubMed: 22883431]

65. Mizuno Y, Higa DH, Leighton CA, Roland KB, Deluca JB, Koenig LJ. Is HIV patient navigation associated with HIV care continuum outcomes? AIDS 2018; 32(17):2557–2571. [PubMed: 30102661]

66. Neblett Fanfair R, Shrestha RK, Randall L, Lucas C, Nichols L, Camp NM, et al. Implementing data to care-what are the costs for the health department? J Acquir Immune Defic Syndr 2019; 82 Suppl 1:S57–s61.

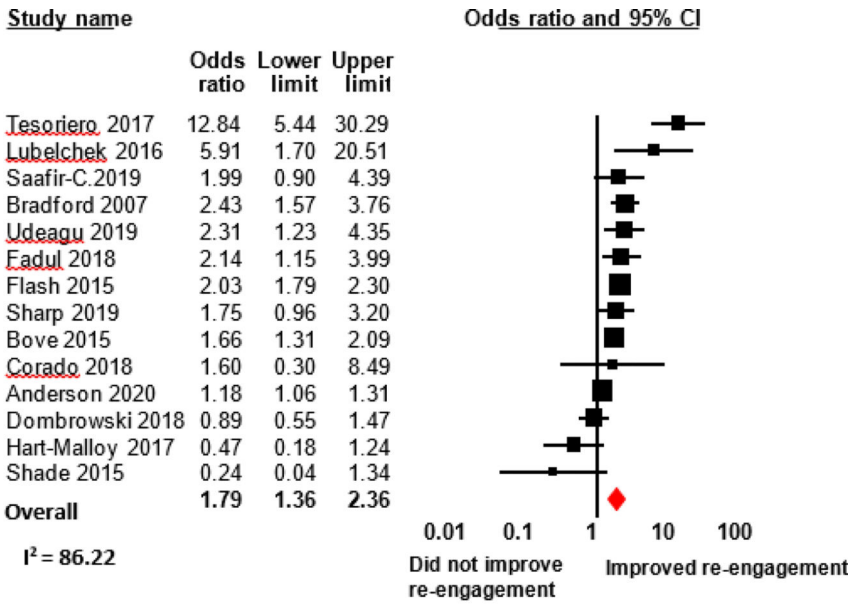
67. Roland KB, Higa DH, Leighton CA, Mizuno Y, DeLuca JB, Koenig LJ. Client perspectives and experiences with HIV patient navigation in the United States: a qualitative meta-synthesis. Health Promot Pract 2020; 21(1):25–36. [PubMed: 31597497]

68. Centers for DIsease Control and Prevention. Compendium of Evidence-Based Interventions and Best Practices for HIV Prevention. Available at:https://www.cdc.gov/hiv/research/interventionresearch/compendium/index.html [Accessed 15 March 2021].

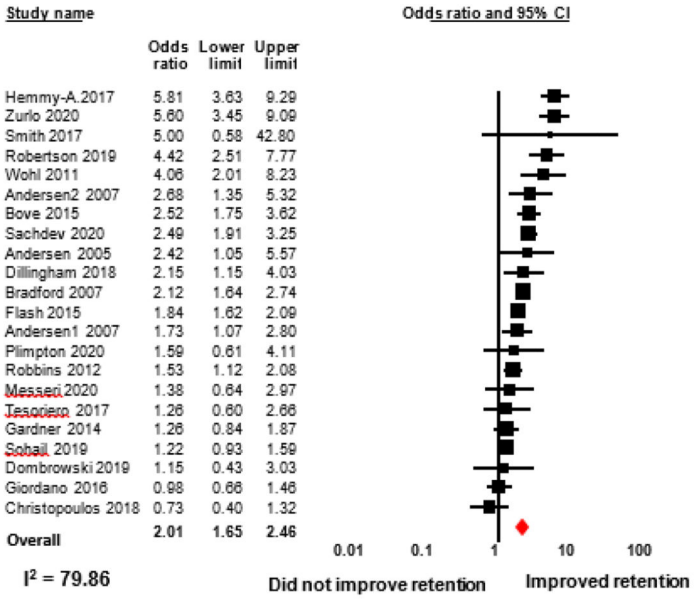
69. Tobias C, Cunningham WE, Cunningham CO, Pounds MB. Making the connection: the importance of engagement and retention in HIV medical care. AIDS Patient Care STDS 2007; 21(Suppl. 1):S3–8. [PubMed: 17563287]

70. King H, Magnus M, Hedges LV, Cyr C, Young-Hyman D, Kettel Khan L, et al. Childhood obesity evidence base project: methods for taxonomy development for application in taxonomic meta-analysis. Child Obes 2020; 16(S2):S27–s220. [PubMed: 32936039]

71. Benbow ND, Mokotoff ED, Dombrowski JC, Wohl AR, Scheer S. The HIV Treat Pillar: An update and summary of promising approaches. Am J Prev Med 2021; 61(5 Suppl 1):S39–s46. [PubMed: 34686289]



1A: Re-engagement in HIV Care



1B: Retention in HIV Care

Figure 1:
Forest plots for Re-engagement and Retention in HIV Care

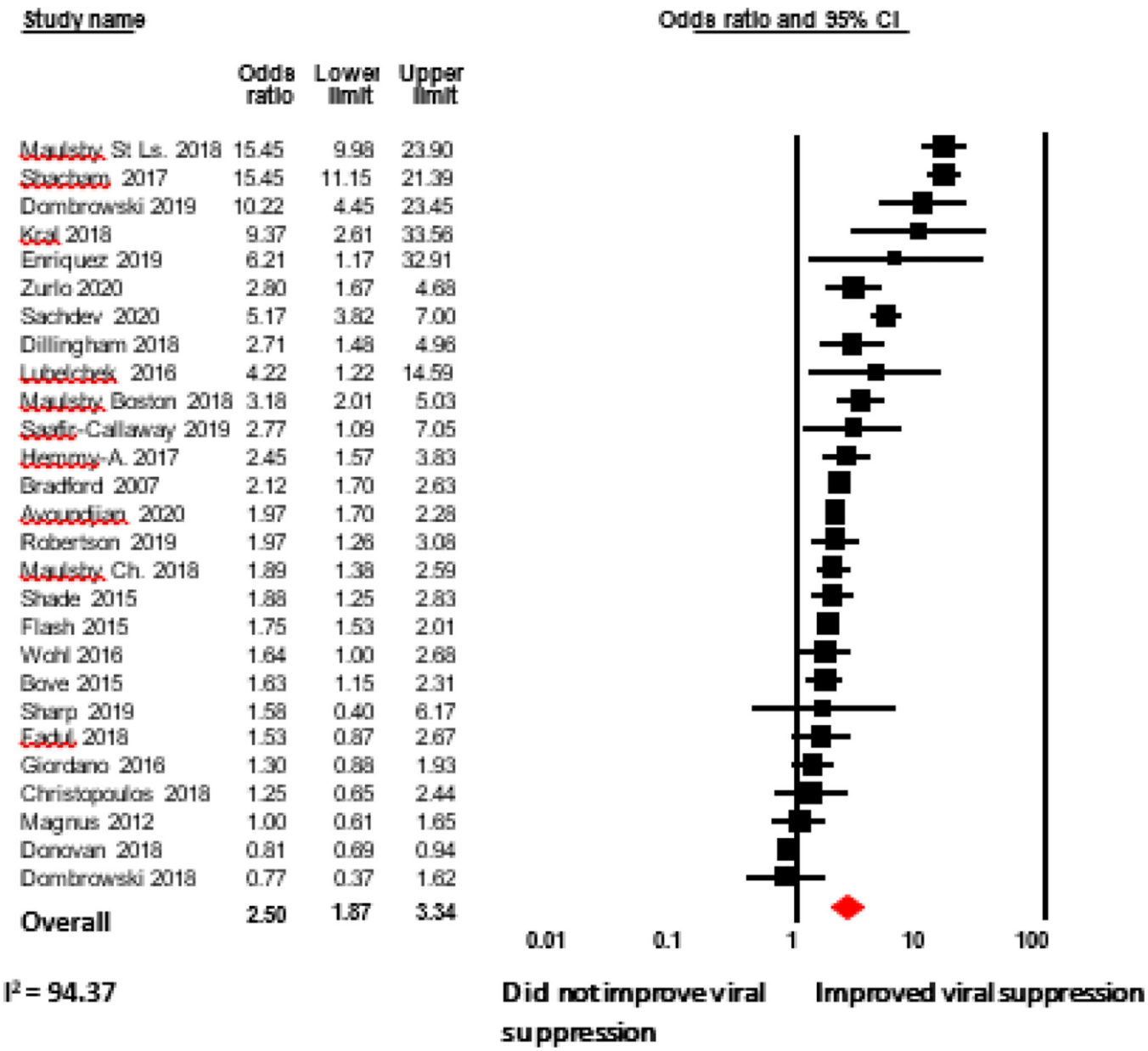


Figure 2:
Forest plot for Viral suppression

Table 1.

Study, Participant, and Intervention Characteristics (n = 42 interventions from 39 studies)

	Overall (n = 42)	Patient Navigation (n = 26)	Appointment Help and Alerts (n = 23)	Psychosocial Support (n = 18)	Transportation and Appointment Accompaniment (n = 14)	Data to Care (n = 14)
Study Design						
Randomized	8	4	6	5	1	0
Non-randomized	34	22	17	13	13	14
One group pre-post	17	10	9	7	8	9
Non-randomized group	17	12	8	6	5	5
Study quality						
Strong	2	0	2	1	0	0
Moderate	16	9	11	9	4	6
Weak	24	17	10	8	10	8
Study Location						
Northeast	11					
South	10					
West	9					
Midwest	8					
Multiple/Missing	4					
Race (median %)						
Black	64%					
Hispanic/Latino	16%					
White	24%					
Other	8%					
Sex (median %)						
Male	71%					
Female	28%					
Transgender	2%					
Mean age	42					
Median study sample (min, max)	231 (16, 5714)					
Total number of study participants	26,154					

Patient Navigation includes activities mentioning navigation or navigation like services (e.g., help accessing services).
Appointment Help and Alerts include activities such as sending appointment reminders, scheduling appointments, calling persons with HIV (PWH) when appointments are missed, sending alerts to providers when PWH miss appointments.
Psychosocial Support includes activities such as counseling, education, skills building, giving positive reinforcement.
Transportation and Appointment Accompaniment include activities such as subsidizing transportation costs and taking PWH to appointments.
Data-to-Care includes activities that involve the use of surveillance data or other sources of data to identify PWH who are out of care.

Table 2.

Meta-analysis findings for intervention strategies (n= 42 interventions from 39 studies)

Intervention Strategies[a]	Re-engagement in HIV Care	Retention in HIV Care	Viral suppression
Overall	**OR[a] = 1.79; 95% CI[b]: 1.36 – 2.36, z = 4.17, p = 0.000, k = 14; I^2 = 86.22; PI[c]**: 0.72 – 2.87	**OR = 2.01; 95% CI: 1.64 – 2.46, z = 6.79, p = 0.000, k = 22; I^2 = 79.86; PI: 1.07–2.96**	**OR = 2.50; 95% CI: 1.87 – 3.34, z = 6.19, p =0.000, k = 27; I^2 = 94.37; PI: 0.80 – 4.19**
Overall: RCTs[d] only	Unable to calculate because k =1	OR = 1.26; 95% CI: 0.93 – 1.71, z = 1.47, p = 0.141, k = 6; I^2 = 51.19	OR = 1.47; 95% CI: 0.87 – 2.47, z = 1.46, p = 0.14, k = 3; I^2 =39.34
Overall: non-RCTs only	OR = 1.92; 95% CI: 1.34 – 2.75, z = 3.57, p = 0.000, k = 10; I^2 = 83.05	OR = 2.34; 95% CI: 1.87 – 2.93, z = 7.44, p = 0.000, k = 16; I^2 = 79.28; PI: 1.32 −3.36	OR = 2.60; 95% CI: 1.91– 3.54, z = 6.05, p = 0.000, k = 24; I^2 = 94.93; PI: 0.82–4.38
Patient Navigation (26 interventions)	OR = 1.76; 95% CI: 1.32 – 2.34, z = 3.86, p = 0.000, k = 7; I^2 = 87.86	OR = 2.20; 95% CI:1.72 – 2.81, z = 6.31, p = 0.000, k = 13; I^2 = 81.83; PI: 1.13–3.26	OR = 3.05; 95% CI: 2.19 – 4.26, z = 6.60, p = 0.000, k = 18; I^2 = 94.1; PI: 1.15–4.95
Appointment help/alert (23 interventions)	OR = 1.72; 95% CI: 1.30 – 2.27, z = 3.79, p = 0.000, k = 8; I^2 = 67.41	OR = 1.84; 95% CI: 1.48 – 2.29, z = 5.49, p = 0.000, k = 13; I^2 = 79.20; PI: 0.96 – 2.72	OR = 2.06; 95% CI: 1.54 – 2.75, z = 4.85, p = 0.000, k = 16; I^2 = 92.07; PI: 0.71 – 3.40
Psychosocial support (18 interventions)	OR = 1.95; 95% CI: 1.31 – 2.91, z = 3.29, p = 0.001, k = 6; I^2 = 93.42	OR = 2.01; 95% CI: 1.57 – 2.57, z = 5.57, p = 0.000, k = 15; I^2 = 78.78; PI: 0.97 – 3.04	OR = 2.05; 95% CI: 1.52 – 2.76, z = 4.73, p = 0.000, k = 11; I^2 = 83.10; PI: 0.81–3.29
Transportation/ Appointment Accompaniment (14 interventions)	OR = 1.65; 95% CI: 1.17 – 2.34, z = 2.84, p = 0.004, k = 4; I^2 = 93.29	OR = 2.02; 95% CI: 1.62 – 2.53, z = 6.14, p = 0.000, k = 10; I^2 = 69.03; PI: 1.16 −2.88	OR = 2.62; 95% CI: 1.62– 4.23, z = 3.91, p = 0.000, k = 6; I^2 = 91.38
Data to care (14 interventions)	OR = 1.61; 95% CI: 1.14 – 2.72, z = 2.68, p = 0.007, k = 10; I^2 = 82.90; PI: 0.31 −2.90	OR = 2.30; 95% CI: 1.75 – 3.04, z = 5.90, p = 0.000, k = 3; I^2 = 33.02	OR = 1.60; 95% CI: 0.97 – 2.62, z = 1.86, p = 0.06, k = 10; I^2 = 92.93; PI: −0.48 – 3.67

CI, confidence interval; OR, odds ratios; PI, prediction interval;, RCT randomized controlled trial.

[a] Intervention strategies are not mutually exclusive.