Acceptability of HIV testing for adolescents and young adults by delivery model: a systematic review

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ABSTRACT

HIV infections are prevalent among adolescents and young adults, of whom 44% remain unaware of their diagnosis. HIV screening presents numerous challenges including stigma, fear, and concerns about confidentiality, which may influence young people's acceptance of HIV screening and linkage to care differently from individuals in other age groups. It is imperative to understand which care delivery models are most effective in facilitating these services for youth. This systematic review analyzes the rates of HIV test acceptance and linkage to care by care delivery model for adolescents and young adults. Studies were classified into emergency department (ED), primary care/inpatient setting, community-based program, or sexually transmitted infection clinic models of care. From 6395 studies initially identified, 59 met criteria for inclusion in the final analyses. Rate of test acceptance and linkage to care were stratified by model of care delivery, gender, race, age ranges (13–17, 18–24 years) as well as site (North America vs rest of the world). A significant difference in acceptance of HIV testing was found between care models, with high rates of test acceptance in the ED setting in North America and primary care/hospital setting in the rest of the world. Similarly, linkage to care differed by model of care, with EDs having high rates of linkages to HIV care in North America. Future studies are needed to test mechanisms for optimizing outcomes for each care delivery model in addressing the unique challenges faced by adolescents and young adults.

INTRODUCTION

Adolescents and young adults account for 1 in 5 new HIV infections, yet it is estimated that 44% of these patients living with HIV do not know their status.[1] Despite Centers for Disease Control and Prevention (CDC) guidelines recommending routine HIV screening for patients aged 13–64, adolescents and young adults report low rates of HIV test utilization, even among those sexually active.[2 3]

HIV testing is fraught with many barriers, including fear of results or stigma, lack of knowledge about testing, and low perceived risk by patients, as well as lack of experience with testing by providers.[4] Adolescents and young adults also encounter a number of age-specific barriers such as result confidentiality,

Significance of this study

What is already known about this subject?

► Although the Centers for Disease Control and Prevention recommends routine screening for HIV infection, an estimated 44% of infected adolescents and young adults remain unaware of their diagnosis.

► In adolescents and young adults, HIV screening is frequently associated with stigma, fear, concerns about confidentiality, parental consent issues, and other challenges.

► Thus, the response of young adults to efforts to increase screening and linkage to care may differ from that of older adults. It is essential to identify which models of care most effectively provide these services for this unique demographic.

What are the new findings?

► Our review demonstrates significant differences between care models in HIV test acceptance and linkage to care.

► In North America, emergency departments (EDs) had the highest acceptance of HIV testing (77.7%), whereas the primary care/hospital setting had the highest acceptance of testing (93.3%) in the rest of the world.

► Only studies in North American EDs reported using opt-in versus opt-out strategies, with the opt-in strategy resulting in a higher test acceptance rate (82%), compared with the opt-out strategy (75%).

How might these results change the focus of research or clinical practice?

► EDs may play a critical role in HIV screening and linkage to care for adolescents and young adults.

► Since it is crucial that young people are screened for HIV and those who test positive are linked to appropriate care in a timely manner, all models of care may be important in accomplishing this.

► Future studies are needed in order to test mechanisms for optimization of outcomes for each care delivery model in addressing the unique challenges faced by adolescents and young adults.

inconsistent guidelines on parental consent requirements, and lack of same-day test results.[5-7] Thus, adolescents and young adults may seek out HIV testing differently from individuals in other age groups.[8 9] More effective screening and care delivery models would be expected to address the unique challenges of this population.

Few systematic reviews have compared the effectiveness of different care delivery models on the rate of HIV test acceptance and subsequent HIV care for adolescents and young adults. Govindasamy and colleagues performed a systematic review comparing the acceptance of HIV testing and counseling for children and adolescents accessing these services through inpatient, outpatient, and community (eg, school-based testing, mobile outreach) settings in sub-Saharan Africa. They found that acceptance of HIV testing was highest in the inpatient setting, followed by outpatient settings.[10] These findings suggest that HIV testing rates may vary by care delivery model; however, little is known about the relative effectiveness of other care delivery models such as emergency departments (ED) and sexually transmitted infection (STI) clinics.

The success of HIV treatment and prevention initiatives targeted at adolescents and young adults depends on identifying patterns of healthcare delivery for these patients. We conducted a systematic review and qualitative analysis of the literature to determine which care delivery models have the highest rates of HIV test acceptance and subsequent linkage to HIV care.

MATERIALS AND METHODS

A systematic review of the peer-reviewed English language literature was conducted according to Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines. PubMed and PsycINFO were searched for the following search terms: HIV testing, HIV screening, human immunodeficiency virus testing, human immunodeficiency virus screening, youth, adolescent, young adult, teen, young people, high school, and college. These searches were conducted in July 2019. This study did not involve human subjects and thus did not seek Institutional Review Board approval.

Studies were included if the participants were adolescents (ages 13–17) or young adults (ages 18–24) who were offered HIV testing. Participants who were pregnant or acquired HIV via vertical (mother to infant) transmission were excluded. Participants tested as part of a home-based screening initiative were also excluded due to low external validity, particularly for North American adolescents and young adults.

During the initial search, 6395 studies were identified, and there were 1073 duplicates removed prior to title and abstract screening (figure 1). The remaining 5322 abstracts were screened by a single reviewer. This initial screening excluded 4760 studies that did not address the research question in the title and abstract and/or met the exclusion criteria previously described. Following this
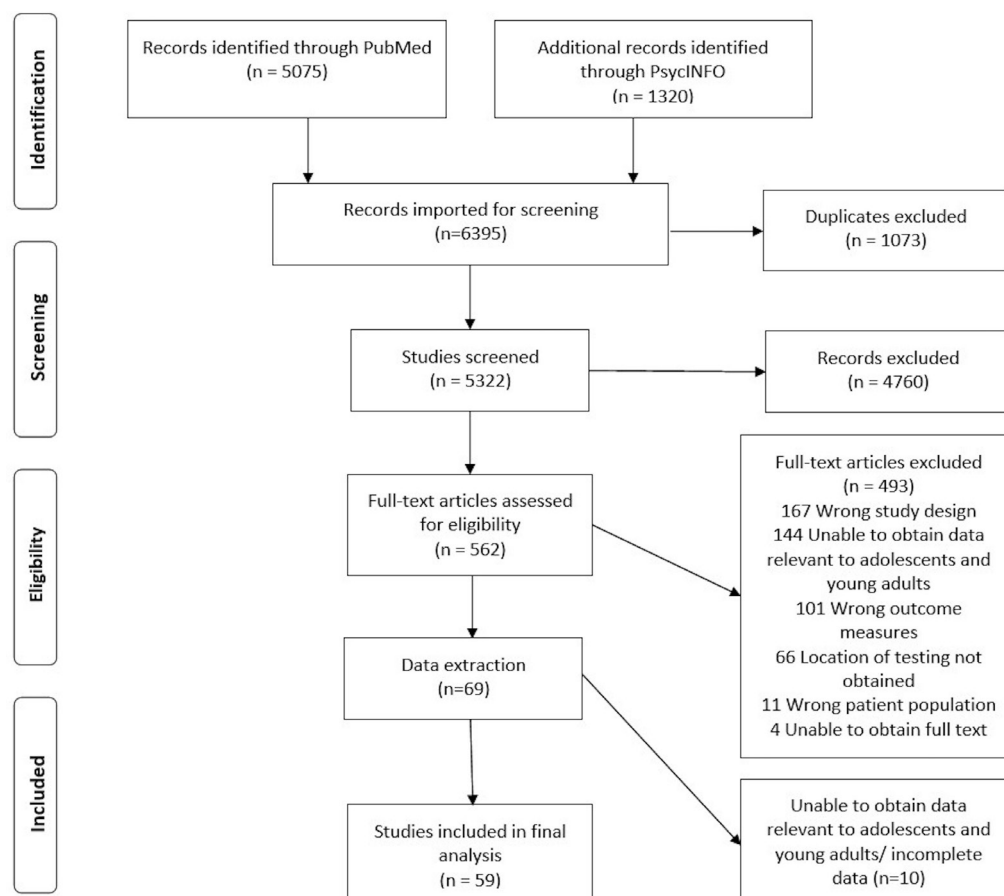
Figure 1 Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram.

initial screening, 562 studies were sent to full-text review. To ensure precision of screening, a random sample of 500 studies was performed by a second reviewer, resulting in greater than 98% agreement between reviewers. Full-text review was performed by both reviewers, with differences resolved by consensus. Of the 562 studies sent to full-text review, 59 were ultimately selected for data review and analysis.[11–55] The most common reason for exclusion was that the study design did not involve participants receiving HIV testing, followed by inability to extract data specific to adolescents and young adults, incorrect outcome measures, and absence of a delivery of care model description. Ten studies were excluded during data extraction and statistical analysis due to inability to extract data relevant to adolescents and young adults or otherwise incomplete data.

The outcomes of interest were acceptance of HIV testing and linkage to care of HIV-positive adolescents and young adults. These measures were stratified by model of care delivery, as well as patient gender, race, and age group (13–17, 18–24 years old). Additional comparisons were made between North America and the 'rest of the world' (Africa, Asia, Australia, and Europe).

The summary statistics were as follows: HIV tests accepted as a percentage of those offered, and patients referred to HIV treatment as a percentage of positive HIV tests. Tests of significance between mean acceptance and linkage to care by model of care were calculated via χ^2 test or Fisher's exact test where appropriate. Analyses were performed using SPSS V.27.0. An outcome of $p<0.05$ was considered significant.

Models of care defined

For the purposes of this systemic review, studies are classified into ED, primary care/inpatient setting, community-based program (CBP), or STI clinic models of care. The ED model of care encompasses studies using either opt-in (ie, testing offered and only provided once consent is obtained) or opt-out (ie, testing obtained as part of routine care with patients informed that they may decline the test) HIV testing strategies. Primary care and inpatient care settings are considered together for the purpose of this review because they both entail comprehensive preventative care from a medical provider in a dedicated medical care facility. CBPs encompass counseling, testing, and referral to care via outreach initiatives to sites beyond dedicated medical care facilities. For example, CBPs performed HIV testing and linkage to care in settings such as schools, saunas, and mobile testing centers, as well as HIV self-testing kit dissemination. STI clinics are defined as medical facilities exclusively providing family planning and the diagnosis and treatment of STIs including HIV.

RESULTS

Sample characteristics

The 59 studies encompassed male and female adolescents and young adults from 5 continents (North America, Africa, Asia, Australia, and Europe), with the majority of studies (n=39) taking place in North America.[11–55] Reported utilization of model of care differed by continent, with the most common model of care in North America being the ED (n=17), followed by community settings (n=11). African studies (n=13) were predominantly implemented in the community setting (n=10), followed by the primary care/hospital setting (n=2). In other parts of the world (Europe, Australia, Asia; n=7), STI clinics were the predominant model of care delivery (n=5).

Since not all studies reported the number of patients screened relative to those enrolled (21 studies reported this metric), we estimate that the number of subjects screened for the combined studies is over 374,045, which encompasses the number of screened reported (n=291,103) plus the number enrolled for the studies not reporting screening (n=82,942). Enrollment rates ranged from 0.26% to 100%, with an overall average rate of 12.7% representing 36,829 participants from 291,103 individuals screened.

While demographic characteristics of race and gender were less likely to be reported, male and female patients of multiple racial backgrounds were included. Three studies focused specifically on men who have sex with men, and 2 included only female participants.

Acceptance of HIV testing by delivery model

There were 48 studies that contained complete data for HIV tests offered versus those accepted, with 2 of these studies reporting data from both community and primary care/hospital models of care. Thus, 50 groups of adolescents or young adults were included, with 17 conducted in the ED, 19 in CBPs, 5 in outpatient primary care or inpatient hospital settings, and 9 in STI clinics.

There was a statistically significant difference in overall test acceptance by model of care (table 1). This finding was also true for both North America ($p<0.001$) and the rest of the world ($p<0.001$). In the North American context, the greatest acceptance of HIV testing occurred in the ED setting (77.7%), while in the rest of the world acceptance of testing was highest in the primary care/hospital setting (93.3%) (figure 2).

There was no significant difference found between acceptance of testing by adolescent versus young adult status (p=0.314). However, acceptance of testing did differ by gender ($p<0.001$), with male participants accepting testing at a lower rate than their female counterparts (table 1).

The literature shows that in the ED setting, the highest acceptance of testing reported was in a retrospective study of an opt-in HIV testing program using a multimedia tool provided by a trained counselor.[56] In this study, all patients aged 13–21 presenting to the ED were given access to tablet computer kiosks, which provided a rapid, technology-driven screening method that resulted in 95% acceptance rate of HIV testing. In contrast, Mollen *et al* also used a specially trained educator to recruit adolescents and young adults in a pediatric ED; however, not all presenting patients were approached for HIV screening.[57] Despite using a standard script, patient education was done on an in-person basis. This methodology achieved a relatively low success rate, with only 49% of patients approached accepting HIV testing. This emphasizes the importance of effective counseling to address stigma associated with HIV and low perceived risk among adolescents and young adults.

For the primary care/hospital setting, the highest acceptance of testing was among young adults who were parents to pediatric inpatients, with a 93% acceptance rate.[58]

Table 1 Tests accepted by continent, demographics and model of care

	Tests offered	Tests declined (%)	Tests accepted (%)	P value
Facility type (total studies included)				
Emergency department (17)	39,027	8706 (22.3)	30,321 (77.7)	**<0.001**
Community (19)	37,320	16,423 (44.0)	20,897 (56.0)	
Primary care/hospital (5)	3331	1045 (31.4)	2286 (68.6)	
STI clinic (9)	11,483	6513 (56.7)	4970 (43.3)	
Continent				
Africa (10)	28,517	15,838 (55.5)	12,679 (44.5)	**<0.001**
Asia (3)	9817	1079 (11.0)	8738 (89.0)	
Australia (1)	532	262 (49.2)	270 (50.8)	
Europe (3)	7309	6896 (94.3)	413 (5.7)	
North America (31)	50,826	14,751 (29.0)	36,075 (71.0)	
Age group				
Adolescents (13–17 years)	8784	2590 (29.5)	6194 (70.5)	0.314
Young adults (18–24 years)	7692	2213 (28.8)	5479 (71.2)	
Gender				
Male	2986	868 (29.1)	2118 (70.9)	**<0.001**
Female	5620	2375 (42.3)	3245 (57.7)	
Site—North America				
Emergency department (17)	39,027	8706 (22.3)	30,321 (77.7)	**<0.001**
Community (8)	2823	1186 (42.0)	1637 (58.0)	
Primary care/hospital (3)	1802	896 (49.7)	906 (50.3)	
STI clinic (3)	6559	3628 (55.3)	2931 (44.7)	
Site—Africa/Asia/Australia/Europe				
Emergency department (0)	0	0 (0)	0 (0)	**<0.001**
Community (11)	34,447	15,207 (44.1)	19,240 (55.9)	
Primary care/hospital (2)	1430	96 (6.7)	1334 (93.3)	
STI clinic (6)	4458	2633 (59.1)	1825 (40.9)	

Bolded values represent statistical significance (p<0.05).
STI, sexually transmitted infection.

In contrast, a randomized trial in Uganda among those who shared a household with someone taking antiretroviral therapy (ART) found that adolescents and young adults were the age group least likely among those in the primary care/hospital setting to accept HIV testing, with 7.5% accepting testing.[59] However, these findings should be interpreted with caution, as uptake of HIV testing was limited by transportation and time constraints. In a more urban resource-limited setting in South Africa, acceptance of HIV testing in an outpatient clinic was 64.8%.[60]

### Acceptance of HIV testing in the ED by testing strategy

Among the 17 studies that used the ED model of delivery within the North American context, testing was performed via either an opt-in (n=11) or opt-out (n=6) strategy. While those EDs using opt-in and opt-out testing had similar demographic characteristics (figure 3), a separate analysis was performed examining test acceptance and linkage to care for ED studies by testing strategy.

There was a significant association (p<0.001) found between opt-in/opt-out strategy and test status (accepted or declined), with the opt-in strategy resulting in a higher acceptance rate (82%), compared with the opt-out strategy (75%). Linkage to care was only reported for studies using an opt-in strategy, so no analysis could be performed regarding linkage to care by testing strategy.

Linkage to care by delivery model

Of the 17 studies that had linkage to care as an outcome measure, 7 took place in CBPs, 2 in STI clinics, 3 in EDs, and 5 in the primary care/hospital setting,
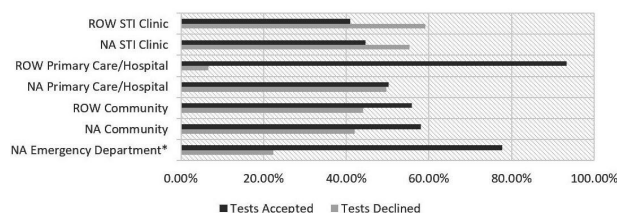
Figure 2 Test acceptance by care setting: North America (NA) versus rest of the world (ROW). *Studies reported only for North America. STI, sexually transmitted infection.
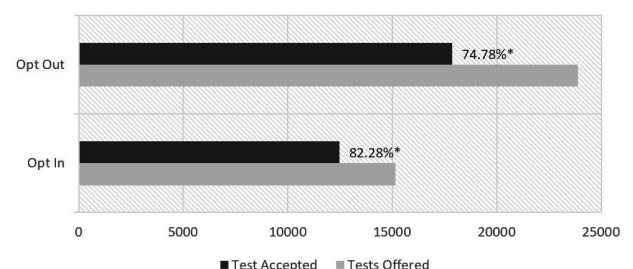
Figure 3 Test acceptance in the emergency department (ED) setting: opt-in versus opt-out. *P<0.001.

Table 2 Linkage to care by continent, demographics and model of care

	HIV positive	Not linked to care (%)	Linked to care (%)	P value
Facility type (total studies included)				
Emergency department (3)	31	2 (6.5)	29 (93.5)	<0.001
Community (7)	1561	440 (28.2)	1121 (71.8)	
Primary care/hospital (5)	452	49 (10.8)	403 (89.2)	
STI clinic (2)	928	159 (17.1)	769 (82.9)	
Continent				
Africa (2)	494	21 (4.3)	473 (95.7)	<0.001
Asia (1)	14	8 (57.1)	6 (42.9)	
North America (12)	2809	713 (25.4)	2096 (74.6)	
Age group				
Adolescents (13–17 years)	115	20 (17.4)	95 (82.6)	0.005
Young adults (18–24 years)	1190	837 (29.7)	932 (70.3)	
Gender				
Male	56	11 (19.6)	45 (80.4)	N/A
Female	0	0		
Site—North America				
Emergency department (3)	31	2 (6.5)	29 (93.5)	<0.001
Community (5)	1407	424 (30.1)	983 (69.9)	
Primary care/hospital (1)	49	30 (61.2)	19 (38.8)	
STI clinic (3)	853	159 (18.6)	694 (81.4)	
Site—Africa/Asia/Australia/Europe				
Emergency department	0	0 (0)	0 (0)	0.059
Community (1)	105	10 (9.5)	95 (90.5)	
Primary care/hospital (1)	403	19 (4.7)	384 (95.3)	
STI clinic	0	0 (0)	0 (0)	

Bolded values represent statistical significance (p<0.05)
N/A, not available; STI, sexually transmitted infection.

Linkage to care significantly differed by model of care (table 2), with the highest linkage to care reported in the ED setting, followed by the primary care/hospital setting. In North America, there was also a statistically significant difference in linkage to care by model of care (p<0.001), with the greatest reported linkage to care occurring in the ED setting (93.5%), and lowest linkage to care occurring in the primary care/hospital setting (38.8%) (figure 4). There was not a statistically significant difference in linkage to care by model of care in the rest of the world (p=0.059), but this metric was only reported in 2 studies.

Comparisons between age groups showed significant differences for linkage to care, with younger participants reported as having higher rates of linkage. Due to

under-reporting of data, we were unable to draw conclusions regarding the impact of gender on linkage to care.

Both ED studies were performed in urban areas, but one (Lyons *et al*) was described as a low-prevalence area, which may explain why of the 2 patients identified as HIV positive, both were referred to care.[61] Nevertheless, both studies saw high rates of linkage to care. CBP studies were least successful worldwide in linking HIV-positive adolescents and young adults to care, but some studies still exhibited success via this model of care delivery. MacKellar *et al* used a peer case management linkage to care strategy for participants using a community-based, mobile HIV-testing, point-of-diagnosis HIV care center in Eswatini.[62] Peer-to-peer counseling and outreach may be a particularly effective strategy for adolescents and young adults with HIV who are identified in the community or via other models of care.

Interventional studies

Interventional studies provide increased insight into the efficacy of a model of care. Three studies track efforts to promote testing efforts by providers and uptake of testing by patients.[63–65]

Choko *et al* performed a community-based prospective study promoting HIV self-testing over 24 months.[63] During the first 12 months, uptake of self-testing was relatively high for participants between the ages of 16 and 19, with uptake of test kits exceeding the total number of patients in that demographic due to repeat testing. Revised uptake numbers reveal that 89.3% of men and 100% of women accepted HIV testing during the months 1–12, while in months 13–24 rates for men and women were 92.3% and 99.6%, respectively. These findings indicate that CBPs can sustain community engagement and improve uptake of HIV testing over time.

Ni *et al* evaluated the acceptance of HIV counseling and testing in a Portland, Oregon STI clinic from 1989 to 1995.[65] Among participants under the age of 20, acceptance of testing increased from 22% in 1989 to 56.6% in the period of 1994–1995. These findings were in line with clinic findings across all ages, in which the proportion of clients accepting HIV testing increased from 28.2% in 1989 to 60.1% in 1995. Thus, it is possible that initiatives with the goal of increasing HIV testing among other age groups are also effective in increasing the uptake of HIV testing among adolescents and young adults. While adolescents and young adults encounter unique barriers to HIV
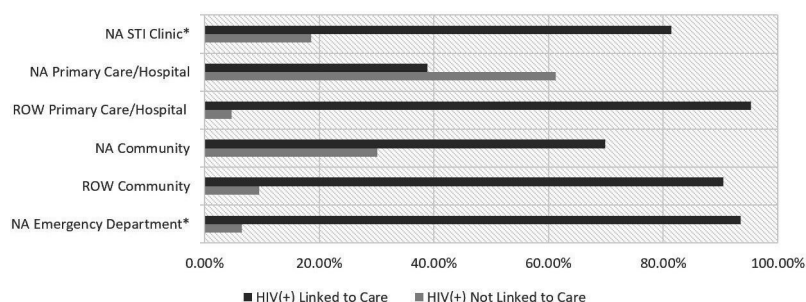
Figure 4 HIV-positive linkage to care by setting: North America (NA) versus rest of the world (ROW). *Studies reported only for North America. STI, sexually transmitted infection.

testing, appropriate screening and counseling of patients may increase rates of testing across multiple age groups.

Kose et al's study was conducted in the primary care setting and was a preintervention and postintervention analysis of dispensaries, hospitals, and health centers in Western Kenya.[64] The investigators found that after a program to increase screening and data recording, increase training for staff, and extend facility hours, linkage to care increased from 66.4% to 95.3% for adolescents aged 15–19 years.[64] This was the only interventional study to report on linkage to care. In a systematic review of interventions to increase HIV screening and linkage to care, Zanoni et al[66] found that of the 36 interventional studies they identified, only 6 discussed linkage to care. This highlights how many initiatives to increase testing among adolescents and young adults such as self-testing, alternative venue community testing, and technology-based referral to testing are limited in their ability to gather data on results of testing and refer participants to HIV treatment.

Risk of bias

Study designs included 18 retrospective cohort studies, 39 prospective cohort studies, 1 quasiexperimental study, and 1 randomized controlled trial. There was a large range of sample sizes, with 8 studies enrolling under 100 participants and 28 studies having more than 1000 participants. However, sample sizes were well distributed by model of care.

By continent, North America is most represented, with 39 studies (37 USA, 2 Haiti) having been performed there. South America does not appear in the data set likely because publication in English was a requirement for inclusion.

Risk of bias was assessed for all included studies using the Newcastle-Ottawa Quality Assessment Scales for case–control and cohort studies and Cochrane risk of bias tool for randomized controlled trials, as appropriate. Overall risk of bias was found to be low.

DISCUSSION
Acceptance of HIV testing and linkage to care by delivery model

In the North American context, the greatest acceptance of HIV testing occurred in the ED setting, while in the rest of the world acceptance of testing was highest in the primary care/hospital setting. Similarly, linkage to care was highest in the ED setting for North America; however, conclusions were unable to be drawn regarding linkage to care in the rest of the world. This has important implications for future HIV testing, and it may also point to ways in which the ED supplements the primary care system in North America, particularly in the USA.

HIV testing in the ED: opt-in versus opt-out strategy

The ED is a largely under-recognized model of care for HIV testing. We found that EDs are successful in both gaining acceptance of HIV screening and referring HIV-positive adolescents and young adults to care. Of the 17 studies on the ED model of care, 6 performed 'opt out' testing, in which the adolescents and young adults were tested for HIV as part of routine care unless they refused.

Opt-out testing has been studied in several models of care as a way to increase test acceptance. In a systematic review and meta-analysis of outpatient settings in the USA, Gebrezgi et al[67] reported a 58.7% acceptance of HIV testing for adult participants offered HIV testing in this manner. They concluded that while effective, opt-out outpatient testing is heterogeneous in rates of tests offered and accepted such that effectiveness varies by participant sociodemographic factors and system-level implementation.

Henriquez-Camacho et al compared the opt-in and opt-out testing strategies in a systematic review on adults accessing the ED, with opt-out and opt-in studies reporting a 44% and 19% acceptance of testing, respectively.[68] Thus, opt-out testing appears to be successful in increasing acceptance of HIV testing in the ED, despite lower absolute rates of test acceptance relative to the outpatient setting. In this review, we found that opt-in testing among adolescents and young adults had a higher rate of test acceptance than opt-out testing. Thus, while opt-out testing may represent a strategy that increases acceptance of HIV testing in the ED, further study is needed on the role of opt-out strategy in the engaging adolescents and young adults in HIV testing.

Adult acceptance of HIV testing and linkage to care by model of care: how adolescents and young adults compare

Data regarding acceptance of HIV testing and linkage to care by model of care among the adult population offer an important point of contrast with the findings presented in this systematic review. While data regarding adults are similarly limited, several studies have addressed this topic. Suthar et al performed a systematic review and meta-analysis on studies of the community-based testing model and found acceptance of HIV testing to be 88%, 87%, 87%, 80%, 67%, and 62% for index testing, self-testing, mobile testing, door-to-door testing, workplace testing, and school-based testing, respectively.[69] This is higher than our reported rates of test acceptance in the community for adolescents and young adults in both North America (58.0%) and the rest of the world (55.9%). Furthermore, linkage to care was also studied, with 80.1% of participants receiving CD4 count measurement after diagnosis with HIV and 73.1% of those participants initiating ART once CD4 testing indicated their eligibility. Interestingly, this was higher than the linkage to care rate in North America (69.9%) but lower than that reported in the rest of the world (90.5%). Nevertheless, it appears that community-based testing may be less effective for adolescents and young adults relative to their adult counterparts. While traditionally thought of as an effective venue for HIV testing, community-based testing may be less preferred by adolescents and young adults given the emotionally sensitive nature of HIV testing and increased difficulty of post-testing counseling and results reporting.

Limitations

While acceptance of HIV testing and linkage to care among adolescents and young adults has been studied worldwide, all studies on the ED model of care occurred in a North American setting, limiting generalizability. While EDs may outperform CBPs, STI clinics, and the outpatient primary care and inpatient hospital settings, there may be

socioeconomic or cultural factors specific to the North American context that contribute to their success.

Worldwide, the outpatient primary care and inpatient hospital settings are understudied. We analyzed data from these settings as one model of care, as they both entail comprehensive preventative care from a medical provider in a dedicated medical care facility. However, there may exist important differences between the two that are not captured due to lack of available data.

Lastly, we were limited in our approach to capturing acceptance and linkage to care by race and gender, as many of the studies included in our analysis were excerpted from larger data sets which did not focus on the specific attributes of the adolescent and young adult participants. Participants from studies which focused exclusively on adolescents and young adults may also differ in other demographic characteristics from those screened as part of an all-ages 13–64 cohort based on CDC guidelines. Participant race was not reported by enough studies to provide meaningful basis for analysis.

Future directions
Further research is needed regarding effective identification of HIV-positive adolescents and young adults and how to retain them in care. Current literature on this topic suffers from a number of limitations, including lack of standardized assessment metrics and reporting. Cross-sectional studies often fail to report the number of tests offered in favor of number of tests accepted and the number of HIV-positive participants identified. Similarly, studies evaluating linkage to care may report this metric as CD4 measurement, seeing a primary care provider or HIV specialist after diagnosis, or participation in ART within anywhere from 30 to 120 days without additional data regarding retention in ART therapy or achievement of undetectable viral load.

Future studies should focus on the ways in which each care delivery model is uniquely suited to addressing the challenges faced by adolescents and young adults. Possible study designs to address this topic include randomization of ED participants to opt-in versus opt-out strategy; prospective studies regarding incentives for HIV testing in the community, ED, primary care, or STI clinic setting; and studies that include multiple models of care within 1 geographic area or serving 1 age subset. Furthermore, means of enhancing linkage to care in each model requires further study, especially in the primary care and ED settings.

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