

# BMJ Open Effect of rapid HIV testing on HIV incidence and services in populations at high risk for HIV exposure: an equity-focused systematic review

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## ABSTRACT

**Objective:** To assess the effects of rapid voluntary counselling and testing (VCT) for HIV on HIV incidence and uptake of HIV/AIDS services in people at high risk for HIV exposure.

**Design:** Cochrane systematic review and meta-analysis.

**Data sources:** We searched PubMed, EMBASE, AIDSearch, LILACS, Global Health, Medline Africa, PsychInfo, CINAHL, Cochrane CENTRAL, Cochrane HIV/AIDS Group Specialized Register and grey literature from 1 January 2001 to 5 June 2014 without language restriction.

**Data selection:** We included controlled studies that compared rapid VCT with conventional testing among people at risk for HIV exposure.

**Data extraction:** Two reviewers extracted data. We used Cochrane risk of bias tool and GRADE criteria: risk of bias, inconsistency, indirectness, imprecision and publication bias. For observational studies we used the Newcastle-Ottawa Scale. We used the PRISMA-Equity reporting guideline.

**Results:** From 2441 articles, we included 8 randomised controlled trials and 5 observational studies. Rapid VCT was associated with a threefold increase in HIV-testing uptake (relative risk (RR)=2.95 95% CI 1.69 to 5.16) and a twofold increase in the receipt of test results (RR=2.14, 95% CI 1.08 to 4.24). Women accepted testing more often than men in rapid VCT arm, but no differences in effect for age or socioeconomic status. Observational studies also showed rapid VCT led to higher rates of uptake of testing. Heterogeneity was high. A cluster-randomised trial reported an 11% reduction in HIV incidence in intervention communities (RR=0.89, 95% CI=0.63 to 1.24) over 3 years trial.

**Conclusions:** Rapid VCT in health facilities and communities was associated with a large increase in HIV-testing uptake and receipt of results. This has implications for WHO guidelines. The routine use of rapid VCT may also help avoid human rights violations among marginalised populations where testing may occur without informed consent and where existing stigma may create barriers to testing.

## Strengths and limitations of this study

- This Cochrane systematic review included randomised controlled trials (RCTs) and observational studies from four continents and included a range of groups at high risk for HIV exposure.
- This review included rapid voluntary counselling and testing (VCT) interventions from health facilities and community-based interventions.
- RCTs showed that rapid VCT was associated with a large increase in HIV-testing uptake and receipt of results but these studies did not report on antiretroviral treatment.
- Observational studies showed increased acceptance of HIV testing and did not show age, sex or income differences.
- Across the studies there was significant heterogeneity likely due to variations in settings and implementation.
- We found only a small number of RCTs (seven) and comparisons were limited for the various rapid VCT interventions with significant heterogeneity likely due to setting and implementation setting differences.

## INTRODUCTION

HIV counselling and testing is the starting point for treatment and care and play a key role in the UNAIDS' 'Getting to zero' strategy.<sup>1</sup> According to 2012 UNAIDS data, about 50% of people living with HIV are unaware of their diagnosis.<sup>1-3</sup> Delays in diagnosis result in lost opportunity for prevention and treatment, resulting in poorer health outcomes.<sup>4-6</sup> While early diagnosis and treatment has been shown to improve clinical outcomes, quality of life and economic productivity.<sup>7-9</sup>

HIV remains a disease of public health importance.<sup>10</sup> Recently, outbreaks have been identified in people who inject drugs in North America, Europe and parts of

Australia.<sup>11 12</sup> A disparate proportion of new infections in the USA is accounted for by youth, African-American, Latino as well as Aboriginal populations who are also less likely to get tested, receive results, access and remain in HIV care.<sup>1 13–15</sup> The disease continues to be fuelled by unsafe sexual practice between and within sexes.<sup>16</sup> These inequities are associated with HIV-related stigma, fear, financial constraints, transportation and system barriers, and a lack of supports within marginalised communities.<sup>17–22</sup>

Conventional testing, ordering an HIV blood test and having the patient return for results, has not performed well in marginalised communities.<sup>13 14</sup> Persons at high risk for HIV exposure include persons who inject drugs, men who have sex with men, persons from HIV epidemic countries (prevalence >1%), street youth, pregnant women, sex workers, low-income and socially disadvantaged people, Aboriginal persons, and other minorities.<sup>18 19 23</sup> Alternative HIV counselling and testing strategies have emerged to improve uptake of services in these populations. These include home-based, work-based and parole office-based testing, peer-based and community-based (CB) voluntary counselling and testing (VCT), mobile testing and universal population testing.<sup>24 25</sup> Improved uptake was documented in a Cochrane review on home-based testing and a trial on workplace testing.<sup>26 27</sup>

The accuracy of rapid HIV tests is now approaching that of laboratory-based ELISA and western blot testing.<sup>28</sup> A variety of rapid-test kits exist ranging from oral kits to single use blood drop-based kits. In high-income countries CB rapid VCT may cost up to four times more than facility-based testing.<sup>29</sup> Research however, from low-income, high-prevalence settings suggests CB rapid VCT is cost-effective.<sup>30 31</sup> Greater cost-effectiveness is associated with outreach-based programmes that use rapid VCT rather than conventional testing.<sup>30 32</sup> Others have argued that rapid VCT approaches linked to treatment programmes optimise uptake of treatment for high-risk populations.<sup>33–35</sup> Very few systematic review explicitly report on equity. In order to study the effect of rapid VCT on high-risk populations we used an equity-focused systematic review approach to identify, extract and synthesise evidence on equity.

Rapid VCT is a complex intervention aimed to increase the participation of marginalised populations in HIV testing and treatment programmes. Rapid VCT consists of three components: (1) voluntary enrolment, (2) rapid testing (results within 24 h) and (3) counselling and delivery of results and treatment options. A recent systematic review on home-based testing synthesised 19 observational studies from sub-Saharan Africa found the vast majority of participants accepted testing, however comparison groups were limited.<sup>36</sup> Another systematic review of mainly observational studies showed 66% increase in uptake of testing among pregnant Kenyan women in antenatal clinics with rapid VCT.<sup>37</sup> Thornton *et al*<sup>38</sup> assessed feasibility, acceptability and effectiveness

of HIV-testing strategies in high-income countries and reported high overall client satisfaction and positive staff attitudes towards CB testing but called for more data to evaluate the actual strategies, confidentiality concerns and post-test counselling. The 2013 WHO HIV guidelines recommend CB and other HIV testing be done in conjunction with treatment and counselling, but they do not define the critical components of the testing to treatment intervention.<sup>39</sup> In order to effectively scale up HIV testing, treatment and viral load suppression more precise knowledge is needed to guide interventions for people at high risk for HIV exposure.

## METHODS

### Primary objective

The aim of our review was to assess the effects of rapid VCT on the following HIV-related outcomes for populations at high risk for HIV exposure: (1) uptake, (2) receipt of results, (3) repeat testing, (4) HIV incidence compared with conventional laboratory testing approaches and (5) stigma.

This review is reported according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses-Equity Extension (PRISMA-E) 2012 reporting guideline for equity-focused reviews.<sup>40</sup> The review protocol was peer reviewed and published on the *Cochrane Database of Systematic Reviews*.<sup>41</sup>

### Search methods

We searched PubMed via NLM, EMBASE via OVID, AIDSearch via the web, LILACS via the web, Global Health, Medline Africa, PsychInfo via OVID, CINAHL via EbscoHost, Cochrane CENTRAL via Wiley, Cochrane HIV/AIDS Group Specialized Register, abstracts of important meetings (eg, International AIDS Conference) and AIDS specialty journals. We also contacted experts for unpublished research, trials and dissertations along with trial registers of HIV/AIDS Cochrane Centre and the Cochrane Infectious Diseases review group. All database searches were from 1 January 2001 to 5 June 2014. Details of the search strategy are listed in online supplementary appendices 1–3.

### Study selection

After identification of relevant studies and removal of duplicates, two reviewers screened titles and abstracts. Two reviewers then screened full text of relevant articles to determine whether they met eligibility criteria. When disagreements arose, they were resolved with a third reviewer. We contacted authors for additional information when needed.

### Data abstraction and selection

Two authors using pretested standard forms independently extracted data including study details, study characteristics, interventions and intervention effects (HIV uptake of testing, HIV incidence and uptake into

treatment programmes including the reported measures of association). In addition, we sought information on age, sex, minority status and socioeconomic status (SES).

### Eligibility criteria

We included studies that met the following criteria.

*Population:* Those focused on marginalised populations at high risk for HIV exposure (as defined earlier).

*Intervention:* We included studies that met the criteria for rapid VCT with three main components: (1) facilitated voluntary enrolment; (2) use of a rapid-testing approach (providing results within 24 h) and (3) outreach counselling, delivery of results and treatment options. Use of the rapid test alone was not sufficient to be considered a rapid VCT.

*Comparison:* We included 'conventional approaches', which could include one or more of the above elements, but not all three. 'Conventional approaches' refers to HIV testing in health facilities using traditional laboratory testing approaches where the client has to wait for more than 24 h before results are received.

*Study designs:* Randomised controlled trials (RCTs), interrupted time series, prospective or retrospective cohort studies and controlled before and after designs that met the above eligibility criteria.

*Outcomes* of interest include uptake of HIV testing, receipt of HIV tests, repeat HIV testing or retesting,<sup>42</sup> HIV incidence and HIV-related stigma.

### Assessment of study quality and data synthesis

We assessed risk of bias for the randomised trials using the Cochrane risk of bias tool.<sup>43 44</sup> Studies were judged to be low, high or unclear risk of bias.

The included studies vary with respect to the intervention duration, type and settings. We undertook the analysis using the intention-to-counsel and screen principles including all participants in the study arm to which they were originally allocated. We used Review Manager V.5.2 (The Cochrane Collaboration, Oxford, UK) to aggregate data for each outcome using a random effects model. We chose the random effects model to control for unobserved heterogeneity that we assumed would exist among the included studies. We present all pooled effect estimates as relative risks (RR) with 95% CIs. We tested for study heterogeneity using the  $I^2$  statistic. We did a sensitivity analysis for gender, SES and education level. A summary of findings table was produced showing relative and absolute effects using GRADE Pro (V.3.6 for Windows). In addition, we conducted a GRADE (Grading of Recommendations Assessment, Development and Evaluation) evidence assessment and profile for each selected outcome.

For cluster-randomised studies, we checked whether studies were adjusted for clustering in the statistical analysis. If results were not adjusted, we adjusted them using the variance inflation factor, as described in section 8.11.2.3 of the Cochrane Handbook.<sup>45</sup> We used an intracluster correlation coefficient (ICC) factor of 0.026 obtained from a previous HIV-related study conducted

in Zambia.<sup>46</sup> The design effect was calculated using the formula:  $1 + (\text{cluster size} - 1) \times \text{ICC}$ .

For the observational studies, we appraised studies using the Newcastle-Ottawa Scale (NOS) for assessing the quality of non-randomised studies and report the individual study cohort star template.<sup>47</sup>

## RESULTS

### Study selection

The search resulted in 2441 records and 13 met our inclusion criteria (see figure 1).<sup>20 29 48–57</sup> All randomised trials and observational studies were conducted among populations at high risk for exposure and compared rapid VCT with conventional testing. Intervention descriptions and quality assessment of the randomised trials included in the quantitative analysis are shown in tables 1–3.<sup>20 48–52 57</sup>

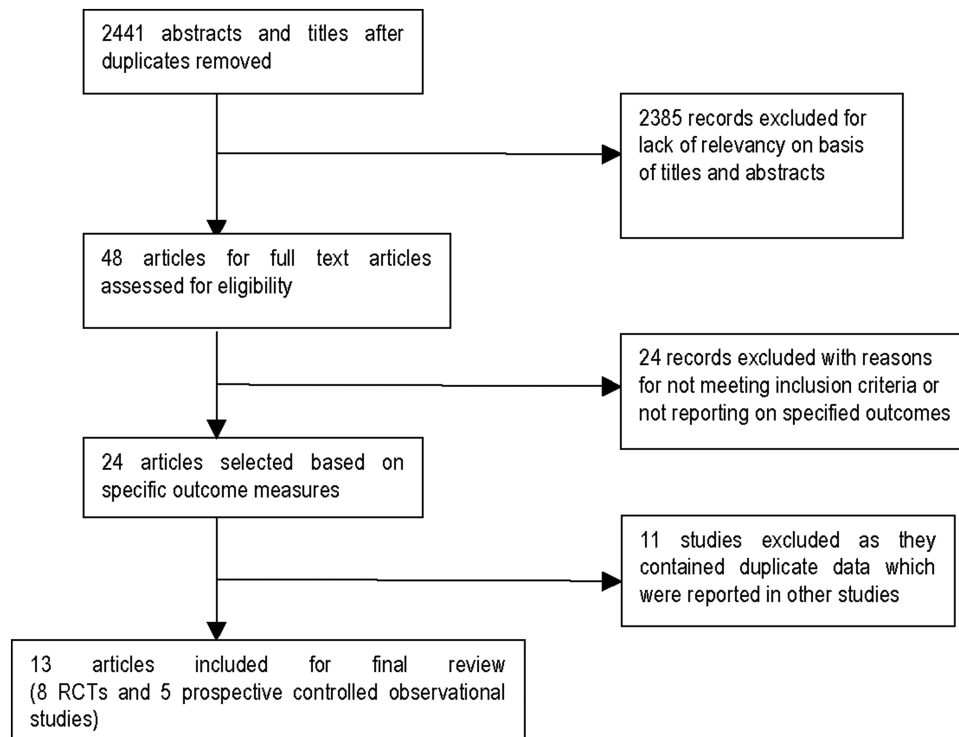
One cluster RCT of 16–32-year-olds also referred to as Project Accept in South Africa, Tanzania, Zimbabwe and Thailand examined community-mobilisation/outreach, mobile rapid testing and post-test counselling compared with conventional VCT on uptake of tests, retesting and incidence of HIV.<sup>20</sup> Another RCT looked at incidence of testing between rapid VCT versus conventional testing in men from sexually transmitted disease (STD) clinics in Australia.<sup>58</sup> An RCT looked at rapid VCT versus conventional testing in women in an antenatal clinic in Kenya and looked at receipt of results and uptake of treatment.<sup>50</sup> An RCT in US emergency departments (ED) looked at a HIV counsellor-facilitated rapid VCT versus rapid testing by ED staff (laboratory technicians) on testing uptake.<sup>48</sup> A cluster RCT looked at rapid VCT in home setting compared with conventional testing in Uganda.<sup>51</sup> Another RCT in the USA looked at the effect of nurse-facilitated rapid VCT versus conventional testing on HIV-testing rates in veterans' affairs hospital.<sup>49</sup> The final RCT conducted among high-risk populations at a needle exchange programme and bathhouses in the USA examined four alternative testing approaches and assessed the effect on uptake of testing.<sup>52</sup>

We found data on the following outcomes: uptake of testing (n=5 studies), receipt of HIV test results (n=3 studies), HIV incidence (n=1 study), repeat testing (n=1 study) and stigma (n=1 study).

Observational studies included four cohort studies. A description and appraisal of the studies and main outcomes is provided in tables 4 and 5.<sup>29 53–56</sup>

### Unit of analysis issues

Our analysis included three cluster-randomised trials and we adjusted these clusters using the methods described in section 8.11.2.3 of the Cochrane Handbook.<sup>45</sup> We used the ICC derived from a Zambian HIV study.<sup>46</sup> Adjustments were not made for the individually randomised studies.



**Figure 1** Selection of studies for inclusion in the review (RCT, randomised controlled trial).

### Risk of bias

All RCTs reported adequate randomisation. No study, however, provided explicit statements about allocation concealment. The risk due to blinding study participants was unclear across studies likewise was the risk due to incomplete outcome data. We particularly do not think the attrition rate across studies was significant to introduce a risk of bias in our analysis (table 1).

The five observational studies showed moderately representative cohorts, comparability between cohorts and adequacy of selected outcomes (see table 4).

### Uptake of HIV testing

All randomised trials compared rapid VCT with conventional testing and reported uptake of HIV testing as an individual outcome. We report the findings from Anaya

*et al* separately because this was conducted in a community healthcare facility unlike the other three CB studies.<sup>20 48 51</sup> We excluded one study from the meta-analysis because randomisation was done after the participants had already accepted voluntary HIV testing.<sup>50</sup>

As shown in figure 2A, these studies show a threefold increase in uptake of HIV testing in the rapid VCT arm (RR=2.95, 95% CI 1.69 to 5.16). Heterogeneity between the studies was high  $I^2=99%$ . When the results from the Sweat study, a large, tri-country pragmatic CB trial, are considered, there is significant heterogeneity in the site estimates but there is a consistency in the increased likelihood of the participants to accept HIV testing with rapid VCT.<sup>20 57</sup> The heterogeneity suggests different modes of implementation and varied populations between these countries. This is further highlighted by

**Table 1** Risk of bias as assessed using the Cochrane risk of bias tool

Study	Random sequence generation	Allocation concealment	Blinding of participants and personnel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data (attrition bias)
Anaya <i>et al</i> <sup>49</sup>	Unclear risk	Unclear risk	Low risk	Unclear risk	Low risk
Coates <i>et al</i> <sup>59</sup>	Low risk	High risk	Low risk	Unclear risk	Low risk
Lugada <i>et al</i> <sup>51</sup>	Low risk	Unclear risk	Low risk	Unclear risk	Low risk
Malonza <i>et al</i> <sup>50</sup>	Low risk	Unclear risk	Low risk	Unclear risk	Low risk
Read <i>et al</i> <sup>58</sup>	Low risk	High risk	High risk	Unclear risk	Low risk
Spielberg <i>et al</i> <sup>62</sup>	Low risk	High risk	Low risk	Unclear risk	Low risk
Sweat <i>et al</i> <sup>20</sup>	Low risk	High risk	Low risk	Unclear risk	Low risk
Walensky <i>et al</i> <sup>48</sup>	Low risk	Unclear risk	Low risk	Unclear risk	Low risk

**Table 2** Characteristics of included studies—randomised controlled trials

Study	Study method	Participants	Country	Intervention arm	Control arm	Target period (if applicable)	Outcome measures
Anaya <i>et al</i> <sup>49</sup>	Randomised controlled trial	Age: 18–65 years Sex: male and female Setting: adult clinic waiting room patients within the Department of Veteran Affairs	USA	1. Nurse initiated streamlined VCT with rapid testing: 84 participants 2. Nurse initiated traditional VCT: 84 participants	Conventional VCT: 83 participants		Testing rates
Coates <i>et al</i> <sup>59 60</sup>	Cluster randomised controlled trial	Age: 16–32 years Sex: male and female Setting: area of HIV prevalence >1%	Tanzania, Zimbabwe, Thailand, and South Africa	Community-based rapid VCT: 63 000 participants	Conventional VCT: 52 900 participants	36 months	HIV incidence
Lugada <i>et al</i> <sup>61</sup>	Cluster randomised controlled trial	Age: 15–49 years Sex: male and female Setting: five SE districts in Uganda* HIV prevalence: 5.6%	Uganda	Home-based rapid VCT with ART programme: 4798 participants	Conventional clinic-based ART programme: 2386 participants	2 years	Uptake of testing; HIV prevalence
Malonza <i>et al</i> <sup>60</sup>	Randomised controlled trial	Age: 18–44 years Sex: female Setting: antenatal clinic attendees HIV prevalence: 15–35%	Kenya	Rapid VCT in health facility: 627 participants	Conventional HIV testing (ELISA) test: 622 participants	1 year	Wait period for tests; receipt of test results; uptake into antiretroviral treatment programmes
Read <i>et al</i> <sup>68</sup>	Randomised controlled trial	Age: Sex: male Setting: sexual health service	Australia	Rapid VCT 200 participants	Conventional VCT 200 participants	18 months	Incidence of HIV testing, including testing outside study clinic
Spielberg <i>et al</i> <sup>62</sup>	Cluster randomised trial	Age: 14 years and older Sex: male and female Setting: needle exchange and bathhouse	USA	1. Rapid testing with standard counselling: 3965 2. Oral fluid testing with standard counselling: 4185	1. Traditional testing with standard counselling: 4364 2. Traditional testing with option of counselling: 4496	221 days	Uptake of HIV testing; receipt of test results
Sweat <i>et al</i> <sup>20 57</sup>		Age: 16–32 years Sex: male and female		Community-based rapid VCT: 28 240 participants	Conventional VCT: 28 916 participants	3 years	

Continued



Table 2 Continued

Study	Study method	Participants	Country	Intervention arm	Control arm	Target period (if applicable)	Outcome measures
Walensky <i>et al</i> <sup>48</sup>	Cluster randomised controlled trial Prospective randomised controlled trial	Setting: area of HIV prevalence >1% Age: mean=37.1 years Sex: male and female Setting: emergency department patients in a large Boston Hospital	Tanzania, Zimbabwe, Thailand USA	Counsellor facilitated rapid VCT in emergency department: 2446 participants	Convention HIV testing in emergency department 2409 participants	18 months	HIV prevalence; uptake of HIV testing; repeat testing Overall testing: offer, acceptance

\*Jinja, Kamuli, Iganga, Mayuge and Mukuno. ART, antiretroviral therapy; VCT, voluntary counselling and testing.

the failure to measure some outcomes such as repeat testing rates in Thailand. The HIV-testing programmes were not limited to specific participants and there was a higher degree of contamination within geographically accessible cluster sites.

Results from two observational studies also showed that participants were more likely to get tested for HIV using a rapid approach.<sup>54 55</sup>

### Receipt of HIV test results

Results for the receipt of HIV tests from three randomised trials reporting this outcome showed an almost twofold increased likelihood among participants randomised to the rapid approach study arms to receive test results (RR=2.14, 95% CI 1.08 to 4.24). Heterogeneity between the studies was high ( $I^2=93%$ ;  $p<0.0001$ ; figure 2).<sup>49 50</sup>

These estimates were supported by evidence from one of the observational studies conducted among bathhouse patrons in a large US city with a significant proportion being men who had sex with men.<sup>55</sup> The results showed a significant difference in the proportion of men who received results of HIV tests: among HIV-positive men there was a 34.6% risk difference, and among HIV-negative men a 26% risk difference, when rapid VCT was compared with conventional testing.

### Repeat HIV testing and test incidence rate

The international cluster RCT<sup>20</sup> sought to indirectly measure personal awareness, entry of participants into a HIV care and treatment programme, and maturation of prevention initiatives. This study included three countries: Tanzania, Zimbabwe and Thailand that recruited 10, 8 and 14 community clusters, respectively. Because each country reported data separately, and because there appeared to be differences in methods, we treated each country as a separate study in this meta-analysis. Thailand was not included in our repeat testing meta-analysis because data was not available for this outcome. The analysis showed an RR=2.28, 95% CI 0.35 to 15.07 suggesting increased HIV repeat testing among those in the intervention arm (RR=2.28, 95% CI 0.35 to 15.07; figure 3).<sup>20</sup> Sweat *et al* also reported a consistent increase in repeat HIV testing in Thailand and Zimbabwe reaching 28% of all testing done in the CB VCT sites.

The Australia RCT of men known to the public sexual health service reported a test incidence rate ratio 1.15, 95% CI 0.96 to 1.38.<sup>58</sup> Men randomised to the conventional testing reported the wait for the test result was too long ( $p<0.001$ ) and reported anxiety because of the wait ( $p<0.002$ ) while men in the rapid VCT reported convenience in obtaining results ( $p<0.001$ ). Other RCTs did not report on repeat testing preferences.

### HIV incidence

HIV incidence data by Coates *et al*<sup>59 60</sup> over a 36-month period in five countries showed an 11% reduction in estimated incidence in intervention vs control communities (RR=0.89, 95% CI=0.63 to 1.24; see figure 4).

**Table 3** GRADE evidence profile and summary of findings for use of rapid approaches for improving health outcomes

Outcomes	Effects of rapid testing approaches on HIV outcomes	Relative effect (95% CI)	Anticipated absolute effect with control	Risk difference with intervention	Number of participants (studies)	Quality of the evidence (GRADE)
<b>Uptake of testing</b> Follow-up: 12–36 months	Three RCTs included in the analysis provided consistent point estimates showing uptake of testing was significantly better among participants randomised to rapid testing approaches	RR=2.95 (1.69 to 5.16)	145 more per 1000	282 cases more per 1000 (100–602)	80 400 (4 studies) 18 350*	⊕⊕⊕⊖ Moderate†
<b>Receipt of results</b> Follow-up: 12–24 months	Two RCTs reported rapid approaches resulted in higher receipt of HIV test results. However due to the heterogeneity-variations in population characteristics, the pooled estimates were not statistically significant	RR=2.14 (1.04 to 4.24)	213 more per 1000	243 cases per 1000 (17–691)	18 426 (3 studies) 4680*	⊕⊕⊕⊖ Moderate†
<b>Combined effect of repeat testing</b> Follow-up: 36 months	One large Cluster RCT found a very large effect for this outcome with participants randomised to rapid testing approaches twice more likely to have repeat HIV tests	RR=2.28 (0.35 to 15.07)	97 more per 1000	124 cases per 1000 (63 fewer–1000 more)	10 706 (1 study)	⊕⊕⊕⊖ Moderate†
<b>HIV incidence</b> Follow-up: 36 months	HIV incidence did decrease in intervention clusters compared with control clusters, but this effect was not statistically significant	RR=0.89 (0.63 to 1.24)	81 more per 1000	9 cases per 1000 (30 fewer–19 more)	115 300 (1 study) 7189*	⊕⊕⊖ Low‡ §

GRADE Working Group grades of evidence.

High quality: Further research is very unlikely to change our confidence in the estimate of effect.

Moderate quality: Further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate.

Low quality: Further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate.

Very low quality: We are very uncertain about the estimate.

\*Adjusted sample size after applying the intracluster correlation coefficient.

†Outcome of HIV incidence was downgraded because allocation concealment was unclear, blinding of intervention not possible and inability to determine blinding of researchers.

‡Outcome of HIV incidence was downgraded because allocation concealment was unclear, blinding of intervention not possible and inability to determine blinding of researchers and imprecision of estimates.

§Number of participants included in the analysis is not available from the abstracts.

RCT, randomised controlled trial; RR, relative risk.

### Treatment programme uptake

Malonza *et al*<sup>50</sup> reported that all of the women in the study were offered free antiretroviral drugs irrespective of study arm and the study found OR=1.7, 95% CI 0.8 to 3.7 for the uptake of perinatal HIV-1 interventions between rapid VCT versus conventional VCT.

### HIV-related stigma

HIV-related stigma was assessed only in Project Accept and showed that stigma was low at baseline with little room for further decrease.<sup>59</sup>

### Heterogeneity and sensitivity analysis

Our analysis included studies conducted in a range of countries, contexts, settings and populations. The studies also involved different variants of rapid VCT.

Heterogeneity was statistically significant for all outcomes with more than one study.

*Age:* Sweat *et al* reported a reduction in HIV incidence of 1.5% among 18–24-year-olds and a 25% reduction in HIV incidence among participants aged 25–32 years (RR=0.75; 95% CI 0.54 to 1.04, p=0.08).<sup>60</sup> In Uganda, Lugada *et al*<sup>51</sup> reports that persons aged 15–24 years were least likely to get tested.

*Sex/gender:* We were only able to report subgroup analysis on gender in one trial because data was not disaggregated in the other studies.<sup>20 57</sup> The Sweat study reported a greater reduction in HIV incidence in men than women in the intervention arm. An 11.6% reduction in HIV incidence among women was reported (RR=0.89; 95% CI 0.73 to 1.07, p=0.17) and 19.3% in men (RR=0.81; 95% CI 0.57 to 1.15, p=0.19). In

**Table 4** Newcastle-Ottawa Quality Assessment Scale—Observational Study Star Template

Study	Selection	Comparability	Outcome/ exposure
Appiah <i>et al</i> <sup>56</sup>	***/*	*/**	**/*
Huebner <i>et al</i> <sup>55</sup>	***/*	*/**	**/*
Liang <i>et al</i> <sup>64</sup>	***/*	*/**	**/*
Shrestha <i>et al</i> <sup>29</sup>	***/*	*/**	**/*
White <i>et al</i> <sup>53</sup>	****/*	*/**	**/*

Selection—maximum of 4 stars (representativeness of exposed cohort; selection of non-exposed cohort; and exposure).  
Comparability—maximum of 2 stars (comparability between cohorts).  
Outcome/ Exposure—maximum of 3 stars (adequacy of outcome, follow-up duration).  
Adapted from Wells *et al*.<sup>47</sup> Available at <http://www.evidencebasedpublichealth.de>.

addition, women older than 24 years in the intervention arm had a 30.2% reduction in HIV incidence versus conventional testing (95% CI 0.54 to 0.90,  $p=0.009$ ).<sup>20 57 60</sup>

In another RCT, females were significantly more likely to accept HIV testing than men, adjusted OR (1.18, 95% CI 1.07 to 1.30).<sup>51</sup>

**Education:** Subgroup analyses by Lugada *et al*<sup>51</sup> and Malonza *et al*<sup>50</sup> also showed that irrespective of level of education, participants were more likely to accept HIV testing if it employed a rapid VCT.

### Applicability and quality of evidence

This review aimed to be relevant for people at high risk for exposure to HIV. The GRADE summary of findings table with patient important outcome and certainty estimates can be found in [table 3](#).<sup>44 61–63</sup> The evidence for uptake of HIV testing, receipt of results and repeat testing were considered moderate quality because of randomisation and allocation concerns. The evidence for HIV incidence is considered low quality due to concerns of risk of bias and the imprecision of the estimates. We did not downgrade for indirectness because the included studies were conducted in community and health facility settings making the estimates applicable across a wide range of settings.

## DISCUSSION

While HIV awareness is improving, many communities and individuals still face barriers to HIV testing and viral load suppression. Our systematic review studied a complex intervention with three critical components designed to improve voluntary counselling and uptake of testing (engagement), reduce travel and improve receipt of test results (convenience), and to facilitate provision of results with appropriate information on treatment and counselling (long-term intervention). Rapid VCT was studied in health facility and CB interventions and in diverse settings where there is a high

risk for HIV exposure; such as bathhouses, STD clinics, inner city ED, tuberculosis (TB) programmes and antenatal programmes in endemic regions. Rapid VCT showed large increase in uptake of testing and receipt of test results. Observational studies have also shown that VCT is associated with a reduction in the HIV disease burden.<sup>39</sup>

In the studies analysed, no harms were identified despite hypothetical concerns of test inaccuracy, lack of privacy and abuse to healthcare workers in non-hospital environments. A recent systematic review of observational studies focusing on home-based rapid VCT also failed to identify harms.<sup>27</sup>

Until recently, some organisations have argued that HIV testing should continue using the conventional clinic or hospital testing approach.<sup>11</sup> This is changing and our findings clearly suggest high-risk populations benefit from rapid VCT compared with conventional testing, especially in terms of uptake and receipt of results.<sup>35 64</sup> CB VCT, which also uses a facilitated rapid approach with community engagement, has received considerable WHO and research attention.<sup>39 65</sup> Our systematic review corroborates these and other CB findings.<sup>26</sup>

Our review however specifically focused on populations at high risk of exposure to HIV, with the hypothesis that use of rapid VCT will increase HIV testing and receipt of testing rates and increase access to HIV-related treatment and services. Evidence from our study showed consistency of effect across settings, evidence for improved uptake in men, no uptake difference with low education status. These findings were corroborated by the evidence from prospective observational studies.<sup>54 55</sup> Sweat *et al*<sup>20</sup> and Coates *et al*<sup>60</sup> reported CB rapid VCT was associated with improved behaviour change and prevention. The results from our study are applicable across a variety of settings; for example, among at-risk youth, women and hard to reach men in Zimbabwe and Thailand, repeat testing rates were comparable with those found in facilitated testing in high-risk men who have sex with men population in the USA.<sup>55</sup> Lugada *et al*<sup>51</sup> demonstrated that men used rapid-testing approaches but that this usage was slightly less than women. This is an important finding because men are usually harder to reach for HIV testing and treatment programmes.<sup>14 66</sup> The findings of our review are also similar to a recent meta-analysis that shows increased receipt of HIV testing with rapid HIV VCT in medical facilities.<sup>67</sup>

Rapid VCT has emerged as a complex intervention that can be used in community settings and health facilities in low-income and high-income countries. Previous systematic reviews have not included rapid VCT studies conducted in health facilities, thus leaving rapid VCT approach primarily directed at CB initiatives; for example, the WHO HIV guidelines highlights CB VCT, but not rapid VCT for health facilities.

Finally, our study highlights the importance of three key components within a counselling and testing



Table 5 Characteristics of included studies—observational studies

Authors	Study method	Participants	Country	Intervention arm	Control arm	Target period (if applicable)	Outcome measures
Appiah <i>et al</i> <sup>56</sup>	Cross-sectional observational study	Tuberculosis clinic patients and VCT clients	Ghana	Tuberculosis clinic-based testing	VCT clinic-based testing	1–6 months	Uptake of testing and results
Huebner <i>et al</i> <sup>55</sup>	Controlled before and after studies	Bathhouse patrons	USA	Rapid VCT	Conventional VCT	11–13 months	Uptake of testing; receipt of test results
Liang <i>et al</i> <sup>54</sup>	Prospective cohort study	Men who have sex with men, injection drug users and commercial sex workers	USA	Rapid HIV testing	Traditional serum-based HIV testing	9 months	Uptake of testing; HIV prevalence; post-test counselling
Shrestha <i>et al</i> <sup>29</sup>	Cohort study	High-risk members of the population <sup>11</sup>	USA	Outreach-based HIV testing	Clinic-based HIV testing	23 months	Cost per notification
White <i>et al</i> <sup>24</sup>	Retrospective cohort study	Emergency department patients	USA	Point-of-care HIV testing	Laboratory-based HIV testing	6 months	HIV-testing rates

VCT, voluntary counselling and testing.

strategy. Complex interventions include components with varying degrees of interaction.<sup>68</sup> We suggest ongoing research is needed to improve HIV testing and viral load suppression; and this should include recognition of interacting components within the intervention, the number and difficulty of behaviours required by those delivering or receiving the intervention, the number of organisational levels targeted by the intervention, the number and variability of outcomes, and the degree of flexibility or tailoring of the intervention.<sup>69</sup> Understanding this variability is also important for economic analysis.

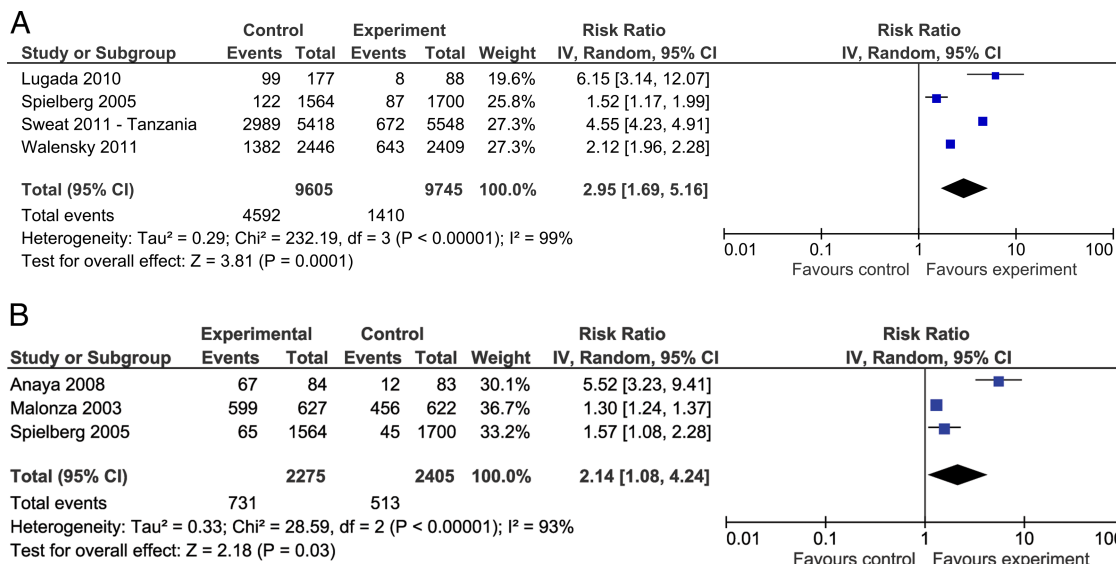
### IMPLICATION FOR POLICY AND PRACTICE

Our study has shown the benefit of rapid VCT on uptake of HIV testing and receipt of results.<sup>70</sup> This testing approach was effective in health facilities as well as community settings. CB VCT has received explicit attention in the recent WHO HIV testing and treatment guidelines and WHO consolidated guidelines for key populations.<sup>39 42</sup> Our work supports CB VCT, but also finds that persons at high risk of exposure to HIV who use health facilities benefit from rapid VCT. This finding is not yet reflected in the WHO Consolidated Guidelines for key populations.<sup>42</sup> We also found some emerging evidence for increased HIV awareness in most care settings.<sup>71</sup>

Implementing rapid VCT, with testing components tailored for high-risk communities, could improve health equity through earlier HIV diagnosis with possible retention in viral suppression programmes, reduced transmission and longer lifespans.<sup>7–9</sup> In high-income countries, our results have particular importance for Aboriginal population, persons who inject drugs, prison populations, and certain migrant and minority populations. Additionally, routine use of rapid VCT may avoid human rights violations among marginalised populations where testing may occur without informed consent and were existing stigma may create barriers to testing and treatment. Given the significant heterogeneity in the trials, we suggest more research to study the components of the rapid VCT and identify what works, for whom and in what settings.

### STRENGTHS AND LIMITATIONS

We used a rigorous and transparent systematic review method, with an a priori protocol. The equity-focus allowed us to explicitly report how we assessed effects in populations at high risk of exposure to HIV; for example, by using explicit data collection methods to assess robustness of effect across SES, sex and level of education.<sup>40</sup> In addition, our analysis included studies from various geographical areas covering four continents (Africa, Asia, Australia and North America) and diverse high-risk populations and testing settings (community and hospital), unlike previous reviews.<sup>26</sup> Three of eight studies in our analysis were cluster RCTs, a



**Figure 2** Forest plot of rapid HIV voluntary counselling and testing versus conventional care (A) on uptake of HIV testing and (B) on receipt of HIV results

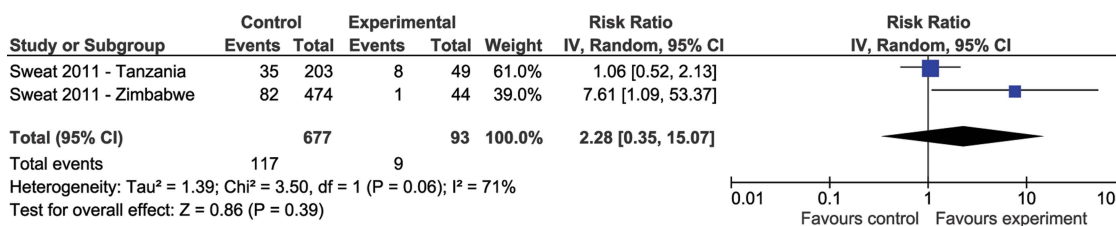
design that is good for evaluating health service and CB interventions where the intervention is delivered at a group level.<sup>20 51 72</sup>

Despite the strengths of our analysis, there are a number of limitations. First, the components of the rapid VCT intervention varied across studies yet our data did not allow for quantitative comparisons of the components. Second, the studies were conducted in a variety of community and health facility settings and these settings also contributed to variations in implementation and convention testing. Third, while our analysis included studies from four continents, there were no studies from Europe and only eight RCTs in total. Fourth, we identified limited allocation concealment in the CB studies as well as healthcare facility-based studies. Finally, the studies that were included did not report on the impact on HIV-related stigma.

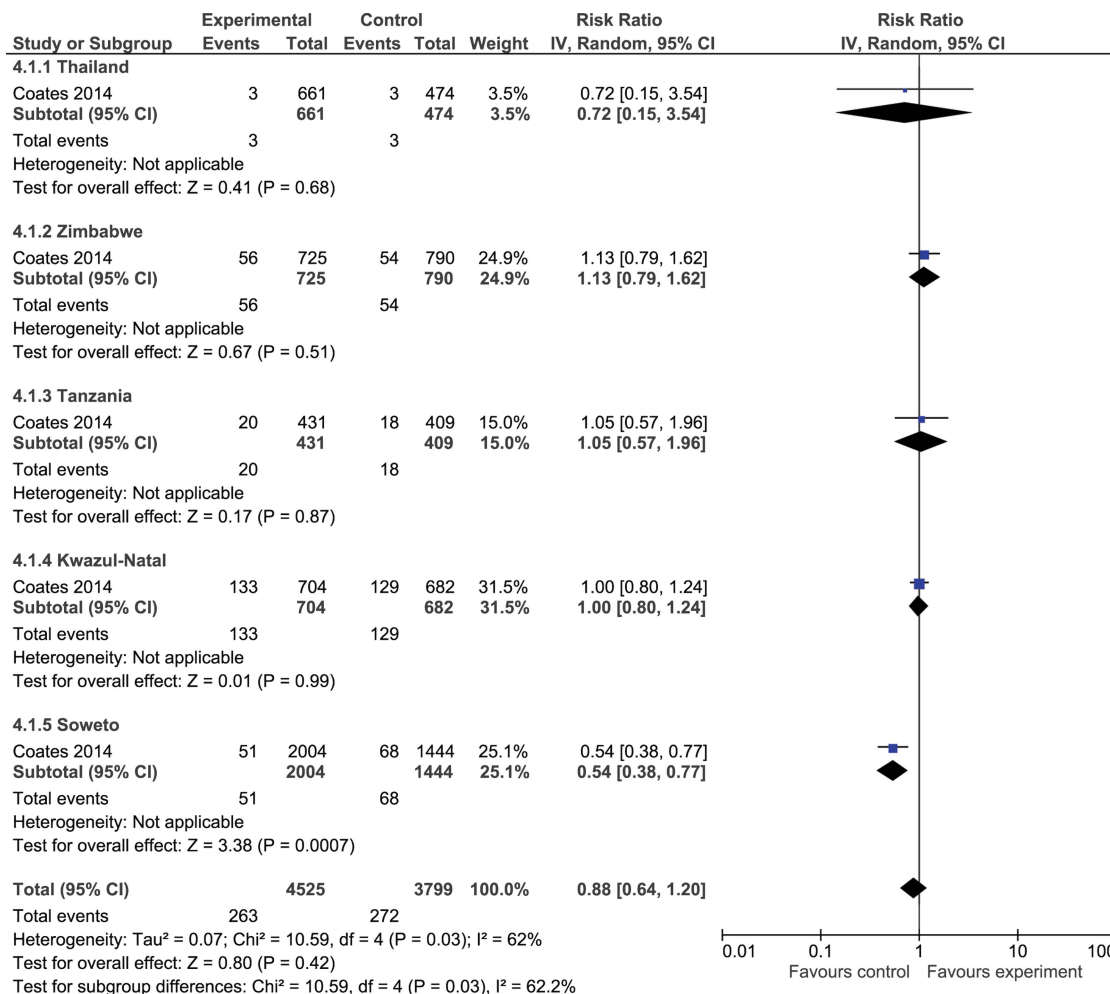
**CONCLUSION**

There still exist a significant proportion of HIV-infected people who are unaware of their status, lack access to HIV services such as VCT and are at risk of transmitting the virus within their communities. Our review focused on people at high risk of exposure to HIV to study the effect of rapid VCT

compared with conventional testing. We studied a complex intervention with three critical components to improve initial counselling and update, optimise receipt of results and to facilitate trust in provision of results, counselling and treatment. Rapid VCT showed large increases in update of testing and in receipt of test results. Results were applicable to health facilities or CB interventions and in diverse settings such as bathhouses, prisons, home-based testing, ED, antenatal programmes, TB programmes and primary care clinics. No significant harms were identified in this testing approach. Evidence from our studies showed consistency of effect, evidence for favourable uptake in men in Africa and an 11% decrease in HIV incidence after 3 years of CB testing; however, precision of this estimate was low. These findings contribute new evidence for HIV-testing components that are relevant for HIV guidelines, supporting CB rapid VCT and highlighting a role for more health facility-based rapid VCT for populations at high risk of exposure. More research is needed to examine the relative effectiveness of the three components within rapid VCT and to study the association of rapid VCT and uptake of HIV treatment and long-term viral suppression.



**Figure 3** Forest plot of effect of rapid voluntary counselling and testing testing approaches versus conventional care on repeat testing.



**Figure 4** Forest plot of effect of rapid voluntary counselling and testing versus convention testing on HIV incidence.

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GW reviewed and provided additional expertise for the complex intervention and statistical analysis plan. All authors approved the final version.

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