

PROVIDER-INITIATED HIV TESTING: EVIDENCE REVIEW

1. DEFINITIONS

Provider-initiated HIV testing (PIHT): This refers to HIV testing which is recommended by health care providers to persons attending health care facilities as a standard component of medical care to:

- Enable specific clinical decisions to be made and/or specific services to be offered that would not be possible without knowledge of the person's HIV status, or
- Identify unrecognized or unsuspected HIV infection in persons attending health facilities in order to provide these services (WHO, 2007)¹.

PIHT is sometimes equated with *opt-out* testing but is recognized by the WHO to also include *opt-in* testing. PIHT can either be implemented for specific target populations or clients/patients or alternatively can be offered routinely to everyone attending a specific health care setting (*routine offer of HIV testing*).

Client-initiated HIV testing: This is also known as voluntary testing and counselling (VCT) and involves individuals actively seeking HIV testing and counselling at a facility that offers these services. Client-initiated HIV testing and counselling emphasizes individual risk assessment and client centered counselling².

Opt-out testing: While both opt-in and opt-out testing include the right to decline the test offering, in opt-out testing a physician or other healthcare provider tests the client/patient for HIV unless he/she specifically refuses the test after being informed of the intention to test. WHO³ makes clear that opt-out testing can only take place in a setting where mechanisms exist for counselling after testing and referral for medical and psychosocial support. In opt-out testing, no post-test counselling is usually provided if the test is negative⁴.

For the WHO, the ability to refuse the test is conditional on receiving pre-test information. This information (or counselling, if this is provided) should be sufficient to provide informed consent. Informed consent is analogous to that required for common clinical investigations such as chest X-rays and other non-invasive investigations and has also been referred to as **opt-out consent**⁵. Thus, unless the patient/client specifically refuses the investigation, it is undertaken. Likewise, the CDC guidelines⁶ emphasize that 'assent is inferred unless the patient declines testing' but stipulate that 'oral or written information should include an explanation of HIV infection and the meanings of positive and negative test results, and the patient should be offered an opportunity to ask questions and to decline testing'. While a general consent form may be part of a health care encounter, a separate consent form specifically for HIV testing is not recommended (CDC, 2006).

¹ WHO. Guidance on Provider-Initiated HIV Testing and Counselling in Health Facilities. 2007. At: http://whqlibdoc.who.int/publications/2007/9789241595568_eng.pdf

² Kiene SM, et al. Provider-initiated HIV testing in health care settings: Should it include client-centered counselling? *Journal des Aspects Sociaux du VIH/SIDA*. 2009; 6(3): 115-119. At: <http://ajol.info/index.php/saharaj/article/viewFile/49740/36068>

³ UNAIDS/WHO. Policy Statement on HIV Testing, June 2004. Available online at http://www.who.int/ethics/topics/en/hivtestingpolicy_who_unaids_en_2004.pdf

⁴ NCCID. Routine opt-out HIV screening. Evidence review. June, 2008. At: http://www.nccid.ca/en/files/Evidence_reviews/Routine_HIV_Screening_Eng.pdf

⁵ 2010 Revision to Wisconsin HIV Statutes Related to Act 209. At: <http://www.dhs.wisconsin.gov/aids-hiv/ClinicianResources/Act209LegislationSummary.pdf>

⁶ CDC. September 22, 2006. Revised Recommendations for HIV Testing of Adults, Adolescents, and Pregnant Women in Health-Care Settings. *Morbidity and Mortality Weekly Report*.

Opt-in testing: With this approach, patients must affirmatively agree to the test being performed after pre-test information or counselling has been received. Informed consent here is analogous to that required for special investigations or interventions such as liver biopsy or surgical interventions (WHO, 2007) which are not performed without clear and specified agreement that the investigation can be undertaken.

WHO notes that populations most at-risk for HIV may be 'more susceptible to coercion, discrimination, violence, abandonment, incarceration or other negative consequences upon disclosure of an HIV-positive test result, and that an opt-in approach to informed consent may merit consideration for highly vulnerable populations'⁷.

WHO generally avoids the terms opt-in and opt-out in favour of provider initiated HIV testing (PIHT) and counselling which is seen to incorporate the informed right of the patient in either situation to decline the recommendation of an HIV test. In this document PIHT is used accordingly to include opt-out and opt-in testing initiated by providers.

2. RATIONALE FOR PIHT

a. *Reducing onward transmission:*

A significant proportion of those infected is thought to be unaware of their HIV positive status. PHAC estimates that approximately 19% of infected persons in the MSM exposure category and 25% of infected persons in the IDU exposure category were unaware of their HIV infection, whereas there was a much higher proportion unaware (35%) in the heterosexual exposure category (endemic and non-endemic combined)⁸. Increasing knowledge of status is hypothesized to reduce onward transmission through risk reduction following diagnosis of HIV infection and / or reducing infectivity through reduction in viral load following HAART.

Expanded HIV testing using current testing platforms (antibody screening) could result in more frequent testing among repeat testers and those enrolled into testing programs which would increase the probability of identifying recently acquired infections. Persons with recent acquired infections are likely to still be connected to their risk networks and this could facilitate more efficient partner counselling referral (contact tracing) with respect to identifying additional positive cases.

In addition, employment of advanced testing technologies including 4th generation (combination ELISA and p24 antigen testing) and / or NAAT technology, could identify persons with acute HIV infection (AHI). If persons with AHI, who are relatively more infectious than those with established infections, decrease risk during this hyperinfectious phase, this would have prevention impacts.

Selected evidence to support these prevention rationale for expanded testing includes the following:

- In the US the estimated transmission is 3.5 times higher among persons who are unaware of their infection than among persons who are aware of their infection⁹ and a

⁷ WHO. Guidance on Provider-Initiated HIV Testing and Counselling in Health Facilities. 2007. At: http://whqlibdoc.who.int/publications/2007/9789241595568_eng.pdf

⁸ PHAC. Summary: Estimates of HIV Prevalence and Incidence in Canada, 2008. Available at: <http://www.phac-aspc.gc.ca/aids-sida/publication/survreport/estimat08-eng.php>

⁹ Marks G, Crepaz N, Janssen RS. Estimating sexual transmission of HIV from persons aware and unaware that they are infected with the virus in the USA. AIDS 2006;20:1447–50.

meta-analysis has indicated that HIV-infected persons reduced high-risk behavior substantially when they became aware of their infection¹⁰.

- A fall in infectivity of 2.45 for each tenfold decrease in viral load has been reported^{11,12}. In a study from San Francisco, researchers showed that a decline in community viral load was associated with a significant decrease in new HIV cases, from 796 in 2004 to 434 in 2008, approaching a 50% decline¹³. Findings from various cohort studies support the hypothesis that reduced viral load results in lowered infectivity amongst heterosexual^{14,15} and MSM populations^{16,17}.

b. *Decreasing HIV morbidity and mortality:*

There is considerable evidence to support the impact of HAART on reducing HIV morbidity and mortality and late diagnosis has been shown to be associated with an increased risk of mortality¹⁸. A proportion of those eligible for treatment are unaware of their status and need to be reached through expanded screening.

Summary: The rationale for expanded HIV screening seems clear. Equally, there appears to be growing support for the recent conclusions reached in a JAMA editorial that “the optimal models for HIV screening in health care settings are not yet known and most likely will not be a one-size-fits-all approach” and that “research is needed to determine who should initiate screening, as well as how, and when screening should be conducted during medical care”¹⁹.

3. OPTIONS FOR PIHT

a. **Routine testing within all health care settings**

The WHO framework for the consideration of PIHT, in *concentrated low level HIV epidemics* asserts that health care providers should not recommend routine HIV testing and counselling to all persons attending health facilities. This is in contrast to the CDC recommendations for PIHT that all clients/patients, aged 15-64 years, visiting health care settings should be screened for HIV unless prevalence of undiagnosed HIV infection in patients attending a specific health care service has been documented to be <0.1%. This HIV prevalence comes from modelling initiatives to assess cost effectiveness of routine testing in the US which assume a prevalence

¹⁰ Marks G, Crepaz N, Senterfitt JW, Janssen RS. Meta-analysis of high risk sexual behavior in persons aware and unaware they are infected with HIV in the United States: implications for HIV prevention programs. *J Acquir Immune Defic Syndr* 2005;39:446–53.

¹¹ Quinn TC, Wawer MJ, Sewankambo N, Serwada D, Li C, Wabwire-Mangen F, et al. Viral load and heterosexual transmission of human immunodeficiency virus type 1. *N Engl J Med* 2000;342:921-9.

¹² Porco TC, Martin JN, Page-Shafer KA et al. Decline in HIV infectivity following the introduction of highly active antiretroviral therapy. *AIDS* 2004; 18: 81–88.

¹³ M Das-Douglas, P Chu, G-M Santos, and others. Decreases in Community Viral Load Are Associated with a Reduction in New HIV Diagnoses in San Francisco. 17th Conference on Retroviruses & Opportunistic Infections (CROI 2010). San Francisco. February 16-19, 2010. Abstract 33.

¹⁴ Donnell, D. B. Heterosexual HIV 1 Transmission after Initiation of Antiretroviral Therapy: A Prospective Cohort Analysis. *Lancet*. 2010;

¹⁵ Attia, S. E. Sexual Transmission of HIV According to Viral Load and Antiretroviral Therapy: Systematic Review and Meta-analysis. *AIDS*. 2009;1397-1404.

¹⁶ Cowan, S. C. New Paradigm for Positive Prevention: "Test and Treat" Testing for and Treating HIV has Lowered Transmission Rate in Denmark in Spite of Increased Unsafe Sex Among MSM. XVIII International AIDS Conference. Vienna, Austria.

¹⁷ Das, M. C. M. Decreases in Community Viral Load Are Associated by Reductions in New HIV Infections in San Francisco. *PLoS ONE*. 2010.

¹⁸ Delpierre C, Cuzin L, Lert F. Routine testing to reduce late HIV diagnosis in France. *BMJ* 2007;334:1354-1356.

¹⁹ Merchant RC, Waxman MJ "HIV screening in health care settings: Some progress, even more questions" *JAMA* 2010; 304(3): 348-349.

of 0.1 percent and an annual incidence of 0.01 percent in the general population based on an estimate of 280,000 undetected, prevalent HIV infections and 40,000 infections annually in a population of roughly 290 million²⁰.

It is important to note that modeling attempts to shed insight on scenarios for expanded HIV testing emphasize a key limitation of this work, namely that these analyses do not address the difficulty of determining the prevalence and incidence of undetected HIV infection in a given patient population²¹.

In the absence of existing data for HIV prevalence, the CDC recommends that health-care providers should initiate voluntary HIV screening until they establish that the diagnostic yield is <1 per 1,000 patients screened, at which point such screening is no longer warranted. This extends the conclusions reached by the US Preventive Services Task Force that the yield from screening higher-prevalence populations would be substantially higher than that from screening the general population²² and the “C” grade provided by the USPSTF²³ for routine HIV testing (C grade definition: The USPSTF recommends against routinely providing the service. There may be considerations that support providing the service in an individual patient. There is at least moderate certainty that the net benefit is small.)

Rationale for the strategy

The CDC recommendations are based on studies suggesting that HIV screening is as cost-effective as other established screening programs for chronic diseases (e.g., hypertension, colon cancer, and breast cancer). Because of the substantial survival advantage resulting from earlier diagnosis of HIV infection when therapy can be initiated before severe immunologic compromise occurs, these studies suggest that screening reaches conventional benchmarks for cost-effectiveness even before including the important public health benefit from reduced transmission to sex partners^{24,25,26} and that this can be improved if testing is initiated by a nurse with streamlined counselling²⁷.

Further support for this strategy has recently emerged from a modelling exercise considering routine HIV screening in France. The authors found that a one-time HIV screen increased life expectancy by 0.01 quality-adjusted life months (QALM) in the general population and increased costs by €50/person, for a cost-effectiveness ratio (CER) of €57,400 per quality-adjusted life year (QALY). The authors concluded that a one-time routine, voluntary HIV test in the French general population decreases the delay from HIV infection to diagnosis, increases mean CD4 count at diagnosis, improves survival among HIV-infected patients, reduces secondary infections at ten years, and achieves cost-effectiveness ratios that are viewed as acceptable by French standards. Input data included mean age (42 years), undiagnosed HIV

²⁰ Paltiel AD, Weinstein MC, Kimmel AD, et al. Expanded screening for HIV in the United States—an analysis of cost-effectiveness. *N Engl J Med* 2005;352:586–95.

²¹ Paltiel AD, et al. Expanded HIV Screening in the United States: Effect on Clinical Outcomes, HIV Transmission, and Costs. *Ann Intern Med*. 2006;145:797-806.

²² Chou R, et al. Screening for HIV: A Review of the Evidence for the U.S. Preventive Services Task Force. *Ann Intern Med*. 2005; 143:55-73.

²³ US Preventive Services Task Force: Grade Definitions. At: <http://www.uspreventiveservicestaskforce.org/uspstf/grades.htm>

²⁴ Walensky RP, Weinstein MC, Kimmel AD, et al. Routine human immunodeficiency virus testing: an economic evaluation of current guidelines. *Am J Med* 2005;118:292–300.

²⁵ Paltiel AD, Weinstein MC, Kimmel AD, et al. Expanded screening for HIV in the United States—an analysis of cost-effectiveness. *N Engl J Med* 2005;352:586–95.

²⁶ Sanders GD, Bayoumi AM, Sundaram V, et al. Cost-effectiveness of screening for HIV in the era of highly active antiretroviral therapy. *N Engl J Med* 2005;352:570–85.

²⁷ Sanders, G. D. Cost-effectiveness of Strategies to Improve HIV Testing and Receipt of Results: Economic Analysis of a Randomized Controlled Trial. *Journal of General Internal Medicine*. 2010; 25:556-663.

prevalence (0.10%), annual HIV incidence (0.01%), test acceptance (79%), linkage to care (75%) and cost/test (€43). Sensitivity analyses demonstrate that the CER is most sensitive to undiagnosed HIV prevalence and frequency of testing and less so to HIV incidence rates

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Table 1 summarizes the CER findings from these studies. Selected figures from these studies are also shown to demonstrate the sensitivity analyses. The various studies demonstrate the sensitivity of underlying prevalence of undiagnosed HIV infection on cost-effectiveness ratios per quality-adjusted life year as well as the impact of testing frequencies on CER/QALY. CER ratios increase dramatically when the underlying HIV prevalence of undiagnosed HIV infection falls below 0.1%. CER ratios also increase as one considers moving from once-off testing towards more frequent testing, e.g. annually, every 3 years or every 5 years.

Potential benefits of the strategy

Studies are underway to assess the CDC recommendations for routine testing. At this time, there is insufficient data to empirically examine the cost effective modelling inferences or challenges to these. As noted in a recent review²⁹, “Widespread implementation of PIHT is relatively new. Therefore, data on the effects of national PIHT rollout on actual reduction of HIV incidence, increased and earlier entry into care, and long-term risk behaviour change is not yet available”.

Some data from an initiative in Washington, DC, to promote routine HIV testing with improved linkage to care, following the CDC testing guidelines, was reported at CROI 2010³⁰. Researchers documented a dramatic rise in the number of HIV tests performed annually, significant increases in the number of HIV diagnoses, shortening in the mean time between estimated date of infection and diagnosis, significant increase in the median CD4 count at the time of diagnosis, and decrease in the percentage of people who developed symptomatic AIDS within 1 year after diagnosis. Researchers aim to continue surveillance to help determine whether these findings will translate into improved clinical outcomes and reduced HIV transmission.

While these findings are impressive it is important to note that the site for this study was Washington, DC, which has the highest HIV/AIDS rate in the U.S. - an estimated 3% overall seroprevalence. Further work is needed to assess whether these outcomes would be achievable in settings with lower overall prevalence rates and to assess the potential barriers to HIV testing. A recent systematic review concluded that barriers are centralized around low-risk perception; fear and worries; accessibility of health services, and reluctance to address HIV and to offer the test³¹.

b. Repeat screening following routine testing

28 Yazdanpanah Y, Sloan CE, Charlois-Ou C, Le Vu S, Semaille C, et al. (2010) Routine HIV Screening in France: Clinical Impact and Cost-Effectiveness. PLoS ONE 5(10): e13132. doi:10.1371/journal.pone.0013132. At:

²⁹ Rapid Response Service. *Provider-initiated HIV testing and counseling: Rapid Review Response*. Toronto, ON: Ontario HIV Treatment Network; 2010. At: http://www.ohtn.on.ca/Documents/Knowledge-Exchange/rapid-response_summary_32_opt-out-testing_2010-06-29.pdf

³⁰ A Caste, R Samala, A Griffin, and others. Monitoring the Impact of Expanded HIV Testing in the District of Columbia Using Population-based HIV/AIDS Surveillance Data. 17th Conference on Retroviruses & Opportunistic Infections (CROI 2010). San Francisco. February 16-19, 2010. Abstract 34.

³¹ Deblonde J, et al. Barriers to HIV testing in Europe: a systematic review. *Eur J Public Health*. 2010; 20(4): 422 – 432.

The CDC recommends that following an initial screen, health-care providers should test all persons 'likely to be at high risk for HIV' at least annually. Suggestions of persons at high risk include injection-drug users and their sex partners, persons who exchange sex for money or drugs, sex partners of HIV-infected persons, and MSM or heterosexual persons who themselves or whose sex partners have had more than one sex partner since their most recent HIV test. CDC also recommends that health-care providers should encourage patients and their prospective sex partners to be tested before initiating a new sexual relationship. No published studies examining experiences of repeat screening following PIHT strategies were located. However, sensitivity analyses of the French cost-effective study referenced above yielded the following insights for repeat screening.

- Among IDU, annual screening led to cost effectiveness ratios of €51,200 compared to screening every 5 years.
- Adding a one-time routine HIV test to current practice among MSM increased life expectancy by 0.08 QALM and increased mean costs by €210, leading to a cost-effectiveness ratio of €32,400/QALY compared to current practice. Screening annually led to higher survival and costs, but a less favorable incremental cost-effectiveness ratio (€97,200/QALY) compared to a one-time HIV test.
- Among heterosexuals, adding a one-time routine HIV test to current practice led to a cost-effectiveness ratio of €145,200/QALY. Screening annually was more expensive and produced no health benefit.

c. PIHT in selected health care settings and/or for selected clients/patients/target populations

The WHO recommends that the priority for countries with concentrated and low level epidemics should be to ensure that HIV testing is recommended to all adults, adolescents and children who present to health facilities *with signs and symptoms suggestive of underlying HIV infection*, including tuberculosis; and for children known to have been perinatally exposed to HIV.

Excluding clinical situations where signs and symptoms suggest the need to investigate underlying HIV infection, WHO recommends that HIV testing in countries with concentrated and low level epidemics should be recommended for the following settings with the qualifier that "decisions about whether and how to implement provider initiated HIV testing and counselling in selected health facilities in low-level and concentrated epidemics should be guided by an assessment of the epidemiological and social context":

- Women attending antenatal, childbirth and postpartum services
- Persons attending tuberculosis services.
- All persons presenting at STI or sexual health services, or who present at other types of health services with an STI. Patients diagnosed with an STI should be encouraged to propose HIV testing and counselling to their partners.
- Sexual partners of index cases (partner counseling referral services or partner notification). Sexual partners are notified of their risk by health care workers or the index patient and are then referred for counselling and testing. The degree to which partners of index cases are followed up can be extended in an effort to locate sexual and/or parenteral substance using networks. This includes identifying locations / settings where the index case (and partners of the index case) may have linked up with sexual partners and/or contacts to share parenteral delivered substances. Sexual networks include situations where infection may be occurring within family and/or extended family networks through intimate partner violence, trans-generational sex and sex between siblings or other extended family members.
- Population groups at higher risk for HIV. These may include sex workers and their clients, injecting drug users, men who have sex with men, prisoners, migrants and refugees. Provider-initiated HIV testing (and counselling) for these population groups

should be complemented by efforts to expand access to client-initiated HIV testing (and counselling).

WHO notes that populations most at-risk for HIV may be:

- More likely to attend specific health services, such as acute care, harm reduction services, drug addiction treatment services, all inmates during medical examinations. Thus, consideration should be given to recommending HIV testing (and counseling) to all patients who attend those facilities or services if this is epidemiologically appropriate and socially acceptable.
- More susceptible to coercion, discrimination, violence, abandonment, incarceration or other negative consequences upon disclosure of an HIV-positive test result. WHO suggests that an opt-in approach to informed consent may merit consideration for highly vulnerable populations.

Further settings that have emerged in the literature as potential sites for expanded HIV testing are:

- Dental clinics. It has been proposed that routine opt-out screening for HIV infection should become an element in a standard dental examination, along with x-rays, charting for caries and periodontal disease, and a head and neck exam³².
- Services for oncology patients. It has recently been argued that routine HIV screening of cancer patients occur to identify undiagnosed HIV before the administration of immunosuppressive treatments³³.
- Patients with viral hepatitis or being tested for viral hepatitis³⁴.

Selected evidence for expanded HIV screening in these clinical settings

a) STI testing settings

STI clinics are a key setting for HIV testing services and a significant proportion of HIV infections are diagnosed in these settings. For example, in the US, in many areas of the country, STI clinics diagnose 10-35% of all HIV cases with high yields well in excess of the minimum 1 per 1000 required by the US CDC recommendations for routine testing³⁵.

Screening of all attendees attending STI clinics in Amsterdam was estimated at net costs of 82 552 Euros per secondary infection averted. The cost-effectiveness ranges between E680 and E9335 per life-year gained, depending on the value of key parameters used in the model³⁶. Strategies that emerged from this modelling study to increase the acceptability of routine HIV testing in STI clinics included the introduction of rapid testing, changes in sequence of clinical procedures, and an opt-out consent process³⁷. In addition to acceptability of being tested, it has

³² Svendsen B. HIV screening in dental clinics. Does HIV Look Like Me? International. August, 2010. At: www.doeshivlooklikeme.org

³³ Chiao EY, Dezube BJ, Krown SE, et al. Time for oncologists to opt in for routine opt-out HIV testing? *JAMA*. 2010;304(3):334-339.

³⁴ Geretti AM, et al. Missed opportunities: Undiagnosed HIV infection in patients with viral hepatitis. *BMJ*. 2008;336:1451-1452.

³⁵ Campos-Outcalt D. Integrating Routine HIV Testing into a Public Health STD Clinic. *Pub Health Reports*. 2006; 21"175-180.

³⁶ Bos JM, et al. Cost-effectiveness of HIV screening of patients attending clinics for sexually transmitted diseases in Amsterdam. *AIDS*. 2001; 15:2031-2036.

³⁷ Brooks L, et al. Normalizing HIV Testing in a Busy Urban Sexually Transmitted Infections Clinic. *Sex Trans Dis*. 2009; 36(3):127-128.

also been shown that receiving testing at STI clinics may be associated with not receiving HIV test results. Rapid HIV testing at STI clinics may help to improve this situation³⁸.

Opt-out testing in STI clinics has been shown to be feasible and effective in increasing uptake of HIV testing and awareness of HIV status but that specific attention for people who refuse HIV tests in an opt-out setting is needed to identify those who are high risk and provide them with more tailored HIV testing and counselling^{39,40}.

Thus, there appears to be wide support for the WHO recommendation that HIV testing should be recommended to all persons presenting at STI or sexual health services, or who present at other types of health services with an STI. WHO also recommends that patients diagnosed with an STI should be encouraged to propose HIV testing and counselling to their partners. Such testing can be done either in the health facility, for example, following counselling of the couple, or through referral of the partner to client-initiated HIV testing and counselling services (WHO, 2007).

b) Acute care settings

A common site where the CDC recommendations for routine HIV screening are applied is the emergency department and led the CDC to fund a large evaluation of this strategy⁴¹. The findings demonstrated disappointing results. While significantly more patients were tested during the non-targeted, opt-out screening phase than during a comparative clinician-initiated testing phase, the non-targeted, opt-out screening phase yielded few more previously undiagnosed HIV-infected patients than were identified during the clinician-initiated testing phase. In addition, the uptake of HIV screening was low with only 24% of patients choosing not to opt out of rapid HIV testing leading the authors of the JAMA editorial to conclude that this finding seemed “to challenge the hope for the opt-out approach in the emergency medicine setting”⁴². The editorial emphasized that the manner in which testing is presented to patients can be a crucial determinant of the yield and that underlying prevalence rates of undiagnosed HIV infection will be a key determinant of deciding to implement routine HIV screening in emergency room settings.

Notwithstanding these findings, it is important to note that the use of POC testing technologies has greatly improved the uptake of HIV testing in emergency departments. For example, 59.7% of patients offered POC testing in an ER in an urban university hospital in Washington, DC, accepted the test. In this study, 27.6% of the 14,986 attending the ER over the study period were offered an HIV test. This study also demonstrated the challenges of linking all HIV positive cases to care. Thirteen of the 26 HIV positive cases were lost to follow up after a their screening test. However, 8 of the 9 patients with confirmed HIV infection were successfully linked to follow-up care⁴³.

³⁸ Usman HR. 2009 National HIV Prevention Conference: Abstracts 116M and 132T. Presented August 24 and 25, 2009.

³⁹ Dukers-Muijers N, Niekamp A, Vergoossen M, Hoebe C. Effectiveness of an opting-out strategy for HIV testing: Evaluation of 4 years of standard HIV testing in a STI clinic. *Sexually Transmitted Infections* 2009;85(3):226-30.

⁴⁰ Heijman R, Stolte I, Thiesbrummel H, van Leent E, Coutinho R, Fennema J et al. Opting out increases HIV testing in a large sexually transmitted infections outpatient clinic. *Sexually Transmitted Infections* 2009;85(4):249-55.

⁴¹ Haukoos JS, Hopkins E, Conroy AA, et al. Routine opt-out rapid HIV screening and detection of HIV infection in emergency department patients. *JAMA*. 2010; 304(3):284-292.

⁴² Merchant RC, Waxman MJ "HIV screening in health care settings: Some progress, even more questions" *JAMA* 2010; 304(3): 348-349.

⁴³ Brown J, et al. Routine HIV Screening in the Emergency Department Using the New US Centers for Disease Control and Prevention Guidelines: Results From a High-Prevalence Area. *J Acquir Immune Defic Syndr* 2007;46:395–401.

Table 1: Summary of Cost effectiveness Studies of Expanded HIV Screening

Study (population)	Mean age	Undiagnosed HIV prevalence	Annual incidence	CER/QALY	Model
Paltiel ¹ , 2005 (US, general)		3.0	1.2	\$36,000 (once off) \$50,000 (every 5yrs) \$63,000 (every 3 yrs)	CEPAC*
		1.0	0.12	\$38,000 (once off) \$75,000 (every 5yrs) \$85,000 (every 3 yrs)	CEPAC*
		0.1	0.01	\$113,000 (once off) \$169,000 (every 5yrs) \$1,002,000 (every 3 yrs)	CEPAC*
Sanders ² , 2005 (US, general)	43	1.0	0.03	<u>Index only:</u> \$41,736 (once off) \$123,614 (every 5 yrs) <u>Index plus sex partner:</u> \$15,078 (once off) \$57,138 (every 5 yrs)	Markov
Sanders ³ , 2010 (US, general)	49	0.398	0.03		Markov
-traditional (A)				\$48,650	Markov
-nurse initiated plus traditional (B)				\$48,710	Markov
-nurse initiated plus streamlined (C)				\$36,390	Markov
-C plus reduced HIV transmission				\$10,660	Markov
Yazdanpanah ⁴ , 2010 (France, general)	42	0.1	0.01	€57,400 (once off) €332,200 (every 5 yrs)	CEPAC*
		0.05	0.01	€161,000 (once off)	CEPAC*
		0.05	0.18	€44,400 (once off)	CEPAC*
Yazdanpanah, 2010 (France, IDU)		6.17	0.17	€30,000 (once off) €41,200 (every 5 yrs) €51,200 (annually)	CEPAC*
Yazdanpanah, 2010 (France, MSM)		1.7	0.99	€32,400 (once off) Dominated* (every 5 yrs) €97,200 (annually)	CEPAC*
Yazdanpanah, 2010 (France, heterosexual)		0.04	0.01	€145,200 (once off) €963,000 (every 5 yrs) Dominated* (annually)	CEPAC*

<u>Study (population)</u>	<u>Mean age</u>	<u>Undiagnosed HIV prevalence</u>	<u>Annual incidence</u>	<u>CER/QALY</u>	<u>Model</u>
Yazdanpanah, 2010 (France, French Guyana)		0.41	0.35	Dominated* (once off) €28,800 (every 5 yrs) €46,500 (annually)	CEPAC*

*A dominated strategy has a higher cost and an equal or lower quality-adjusted life expectancy than some combination of other strategies.

**The Cost-Effectiveness of Preventing AIDS Complications

1. Paltiel AD, Weinstein MC, Kimmel AD, et al. Expanded screening for HIV in the United States—an analysis of cost-effectiveness. *N Engl J Med* 2005;352:586–95.
2. Sanders GD, Bayoumi AM, Sundaram V, et al. Cost-effectiveness of screening for HIV in the era of highly active antiretroviral therapy. *N Engl J Med* 2005;352:570–85.
3. Sanders, GD, et al. Cost-effectiveness of Strategies to Improve HIV Testing and Receipt of Results: Economic Analysis of a Randomized Controlled Trial. *Journal of General Internal Medicine*. 2010; 25:556-663.
4. Yazdanpanah Y, Sloan CE, Charlois-Ou C, Le Vu S, Semaille C, et al. (2010) Routine HIV Screening in France: Clinical Impact and Cost-Effectiveness. *PLoS ONE* 5(10): e13132. doi:10.1371/journal.pone.0013132.

Selected figures to demonstrate sensitivity analyses from cost effective studies looking at expanded HIV screening options.

1. Sanders GD, Bayoumi AM, Sundaram V, et al. Cost-effectiveness of screening for HIV in the era of highly active antiretroviral therapy. *N Engl J Med* 2005;352:570–85. (Pg 579)

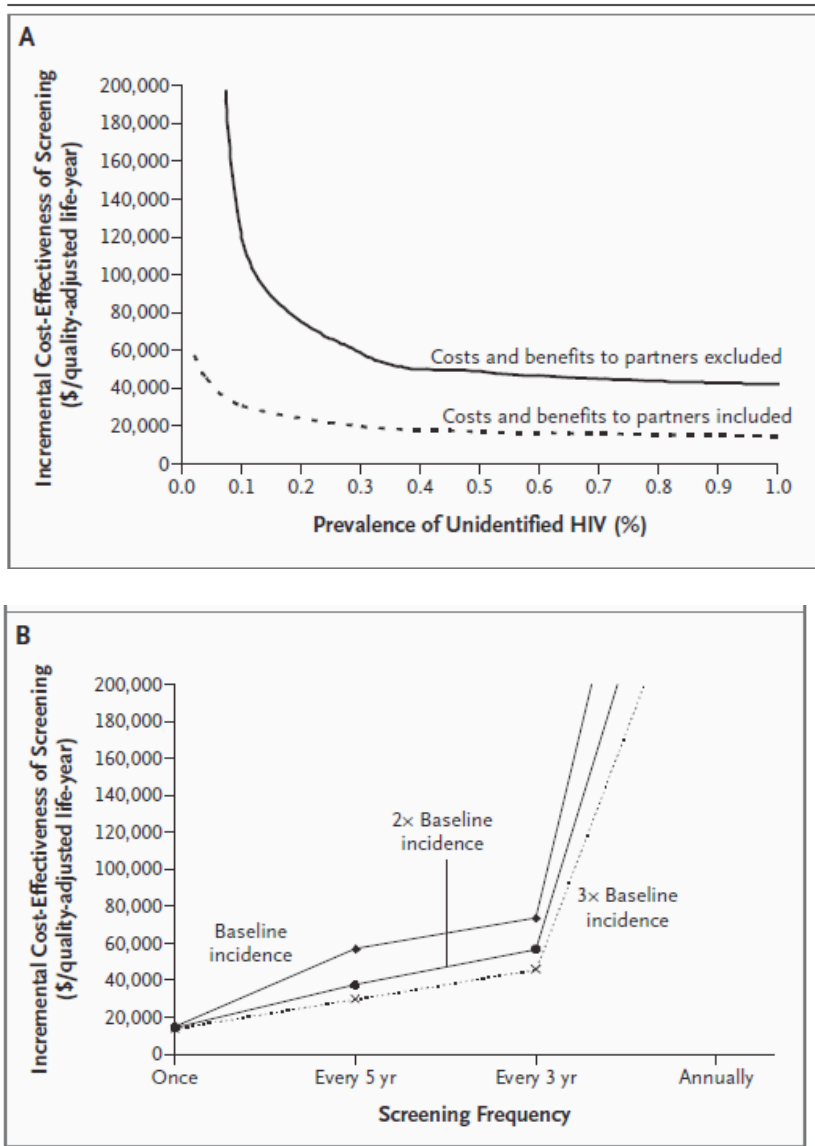


Figure 2. Sensitivity Analysis of the Effect of the Prevalence of Unidentified HIV on the Incremental Cost-Effectiveness of One-Time Screening, as Compared with Current Practice (**Panel A**), and the Effect of Screening Frequency on the Incremental Cost-Effectiveness of Screening at Various HIV Incidence Rates (**Panel B**). In **Panel B**, the solid line marked with diamonds represents the baseline incidence, the solid line marked with circles represents the cost-effectiveness of recurrent screening when the incidence of HIV infection is twice the baseline rate, and the dashed line represents the cost-effectiveness of recurrent screening when the incidence of HIV infection is three times the baseline rate. The incremental cost-effectiveness ratio compares screening every A years with screening every B years, where B refers to the screening frequency directly to the left of A on the x axis (i.e., comparing screening every five years with one-time screening).

2. [Yazdanpanah Y, Sloan CE, Charlois-Ou C, Le Vu S, Semaille C, et al. \(2010\) Routine HIV Screening in France: Clinical Impact and Cost-Effectiveness. PLoS ONE 5\(10\): e13132. doi:10.1371/journal.pone.0013132.](https://doi.org/10.1371/journal.pone.0013132)

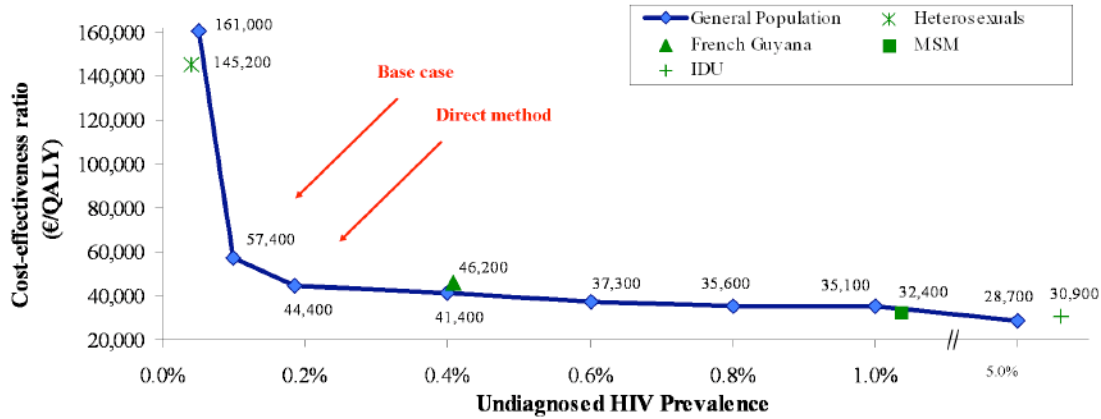


Figure 1. Effect of undiagnosed HIV prevalence on the cost effectiveness a one-time routine, voluntary HIV test vs. "current practice", with base case incidence. Incidence rates are as follows: general population, 0.01/100PY; heterosexuals, 0.01/100PY; French Guyana, 0.35/100PY; MSM, 0.99/100PY; and IDU, 0.17/100PY. MSM: men who have sex with men; IDU: injection drug users; PY: person-year. doi:10.1371/journal.pone.0013132.g001

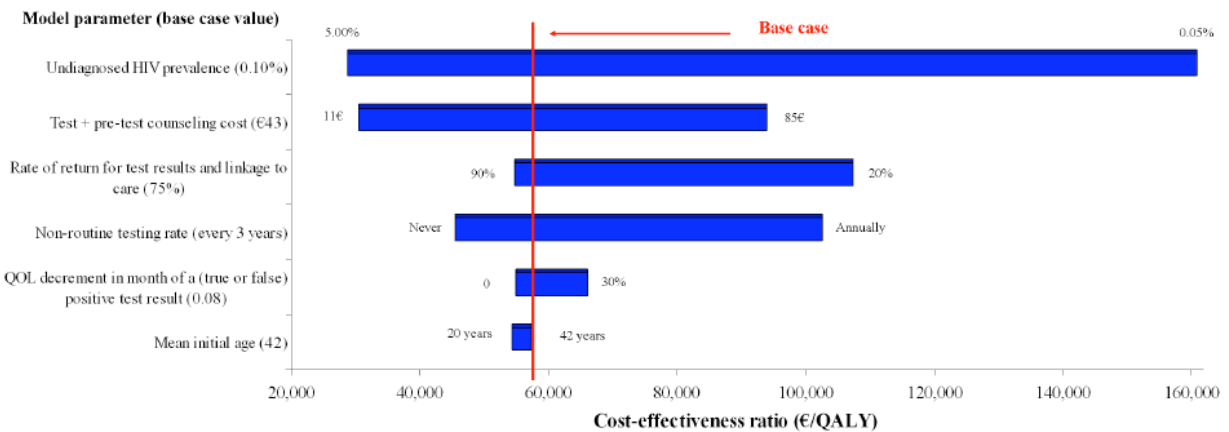


Figure 2. Sensitivity analyses: One-time routine, voluntary HIV test vs. "current practice" in the general population, with base case prevalence and incidence. The width of the bar indicates the variation in the incremental cost-effectiveness ratio associated with alternative parameter values for that input. The numbers to the right and left of the bars indicate the lower- and upper-bounds of the ranges used in sensitivity analyses. doi:10.1371/journal.pone.0013132.g002

3. Sanders, G. D. Cost-effectiveness of Strategies to Improve HIV Testing and Receipt of Results: Economic Analysis of a Randomized Controlled Trial. Journal of General Internal Medicine. 2010; 25:556-663.

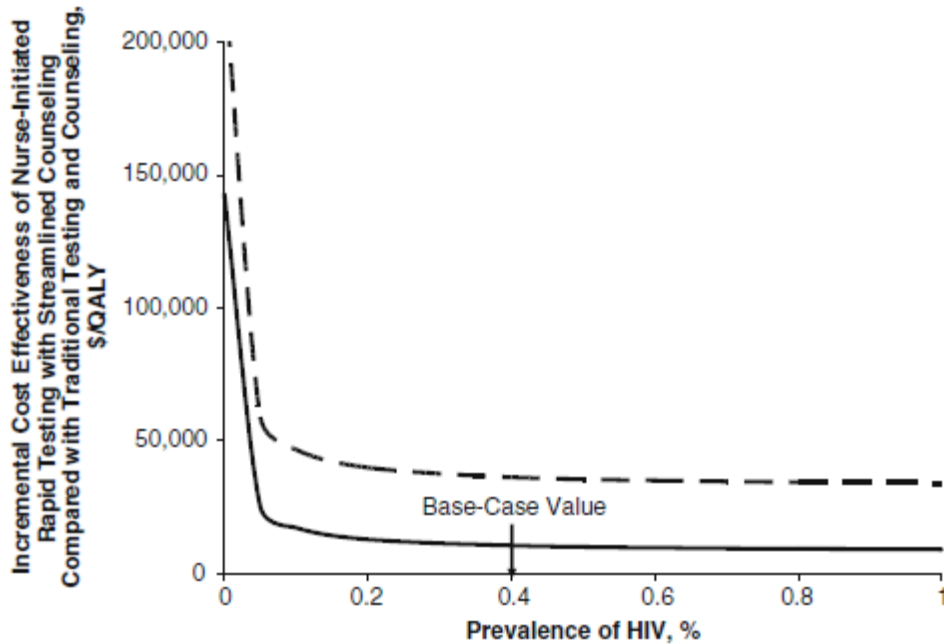


Figure 4. Sensitivity analysis of the effect of unidentified HIV prevalence on the incremental cost-effectiveness of the nurse-initiated rapid testing and streamlined counseling strategy (Model C) compared with traditional counseling and testing (Model A). The solid line includes the costs and benefits to partners, while the dashed line excludes these effects.