

Integrating HIV Screening into Routine Health Care in Resource-Limited Settings

Ingrid V. Bassett^{1,2} and Rochelle P. Walensky^{1,2,3,4}

Divisions of ¹Infectious Disease and ²General Medicine, Massachusetts General Hospital, ³Division of Infectious Disease, Brigham and Women's Hospital, and ⁴Harvard Center for AIDS Research, Boston, Massachusetts

The United Nations is committed to achieving universal access to human immunodeficiency virus (HIV) care, treatment, and prevention. Although the gateway to HIV care and secondary prevention is knowledge of serostatus, use of voluntary counseling and testing in resource-limited settings with the highest burden of HIV infection and AIDS has been limited. On the basis of evidence of increased patient uptake and the opportunity to avoid missed HIV testing opportunities in health care facilities, in 2007, the World Health Organization recommended provider-initiated HIV testing as a standard part of medical care in settings with generalized HIV epidemics. Although provider-initiated testing has shown promise, optimal implementation strategies that ensure broad coverage, while preserving human rights, remain an active area of research. We review the benefits of knowledge of HIV serostatus and evidence from multiple countries surrounding the successes and pitfalls of provider-initiated testing in health care and home-based settings.

In 2006, the United Nations General Assembly issued a political declaration to “scale up significantly” efforts to achieve universal prevention, treatment, and care for human immunodeficiency virus (HIV) and AIDS worldwide [1]. In low- and middle-income countries most affected by the epidemic, access to antiretroviral therapy (ART) is increasing, with 3 million persons receiving treatment at the end of 2007 [2]. However, prevention and treatment efforts are severely hampered by poor HIV testing coverage. In a recent 17-country survey, a median of only 11% of women and 10% of men had ever received an HIV test and result [2]. An estimated 20% of persons infected with HIV in 12 low- and middle-income countries are aware of their seropositive status (Table 1) [2, 3].

Knowledge of HIV status is the gateway to HIV care and stands alone as a prevention measure [4–7]. With increasing ART availability, researchers and policy makers in resource-limited settings advocate aggressive case

finding and partner testing at both health care and community-based sites [8–10]. In 2007, the World Health Organization (WHO) recommended provider-initiated HIV testing in health care facilities as a standard part of medical care in generalized HIV epidemics, intending to expand current practices of client-initiated dedicated voluntary counseling and testing (VCT) [11]. Provider-initiated testing capitalizes on all patient contacts with the medical system, using each as a potential opportunity for HIV testing, diagnosis, and linkage to care [8, 11, 12]. HIV testing uptake is affected by multiple factors, including poor access to health facilities or VCT centers, failure of risk-based assessments as the basis for testing, stigma, fear, and practical obstacles, such as transportation and cost [10, 13, 14]. We review the literature on the public health benefits of HIV testing and the implications for expanded HIV testing strategies in resource-limited settings.

PUBLIC AND INDIVIDUAL HEALTH IMPACT OF VOLUNTARY COUNSELING AND TESTING

Timely diagnosis of HIV infection is an entry point for receiving ART and opportunistic disease prophylaxis, but it is also increasingly recognized as an opportunity to provide social and behavioral benefits for secondary

Reprints or correspondence: Dr Ingrid V. Bassett, Massachusetts General Hospital, 50 Staniford St, 9th Fl, Boston, MA 02114 (ibassett@partners.org).

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Table 1. Percentages of Adults (age, 15–49 years) Infected with HIV Who Underwent HIV Testing and Received a Result before the Serosurvey, Selected Countries, 2005–2007

Country	Year	Percentage of HIV-infected persons who underwent testing and received results		
		Women	Men	Overall
Benin	2006	24.9	...	23.5
Côte d'Ivoire	2005	13.6	23.6	16.5
Democratic Republic of Congo	2007	8.7	...	10.7
Ethiopia	2005	8.4	5.6	7.6
Guinea	2005	5.4	...	5.4
Mali	2006	13.0	...	12.9
Rwanda	2005	31.3	31.6	31.4
Swaziland	2007	44.0	28.8	38.7
Zimbabwe	2005–2006	26.3	19.3	23.7
Haiti	2005	30.7	15.6	24.5
Dominican Republic	2007	72.6	49.1	60.7
India	2005–2006	6.8	12.8	10.3

NOTE. Adapted from [2].

prevention [4–7]. Voluntary counseling and testing sites, long the cornerstone of HIV testing [11], provide the most evidence for behavioral risk reduction. A randomized controlled trial in Kenya, Tanzania, and Trinidad compared VCT with basic health information. The percentage of unprotected sexual acts with nonprimary partners decreased significantly more at 6 months among those receiving VCT than among those receiving basic health information (35%–39% reduction vs 13%–17% reduction); the effect was sustained at 1 year [4]. In Pune, India, counseling and testing at 3-month intervals for men was associated with an increase in consistent condom use with sex workers [15]. In a meta-analysis of 7 studies in developing countries, the odds of VCT recipients engaging in unprotected sex were significantly less, compared with their pretest behavior or with participants who had not received VCT (pooled effect size odds ratio, 1.69; 95% confidence interval, 1.25–2.31) [7]. These studies reveal the positive impact of VCT on sexual risk-taking behavior.

The impact of VCT on behavior has been particularly striking among serodiscordant couples, who without appropriate counseling, may harbor misconceptions about the risk of transmitting HIV to the uninfected partner [16]. Among Zambian cohabiting heterosexual serodiscordant couples, <3% reported condom use before VCT; however, >80% reported condom use during the year after the diagnosis of infection in a partner [5]. After VCT and a new HIV diagnosis, rural Zimbabwean women reported significantly higher levels of condom use in their regular partnership up to 3 years later [17]. Despite the benefits of knowledge of HIV serostatus on risk behaviors, only a small proportion of HIV-infected individuals know their partner's status. For example, in Uganda, 21% of HIV-infected

adults knew their own HIV status, but only 9% knew their partners' status [6]. These results are typical, although data from numerous surveys performed in sub-Saharan Africa suggest that testing with a partner is preferred [18, 19].

Participation in client-initiated VCT has improved somewhat in recent years because of the increasing use of rapid HIV testing with same-day results [11]. However, persons infected with HIV are often tested and presenting for care with advanced clinical disease; in 18 ART programs in low-income countries, the median baseline CD4 cell count was 108 cells/ μ L [20]. Even among persons who do actively seek VCT, many are self-selected on the basis of sociodemographic features (eg, can afford transportation) and low-risk sexual activity [10, 17, 21]; thus, a broader approach is needed.

ROUTINE AND OPT-OUT HIV TESTING

Provider-initiated testing—also called routine HIV testing—refers to HIV testing and counseling recommended at health care facilities as a standard component of medical care [11, 22]. In generalized epidemics (prevalence of HIV infection among pregnant women, >1%) and, more selectively, in concentrated and low-level epidemics, the WHO recommends an opt-out approach, in which a patient must specifically decline an HIV test in the health care setting [11]. Opt-out testing promotes simplified pretest information and advocates oral rather than written consent [11]. Data in both well-resourced and resource-limited settings suggest that patients often have multiple medical contacts before an HIV test is offered [23–28]. For example, 88% of individuals with newly diagnosed HIV infection at a Ugandan emergency unit had sought medical care during the previous 6 months and had not been tested [27]. Patients attributed lack of prior testing to no perceived risk (77% of patients) and the cost of testing (25%) [27]. Routine testing dispenses with ineffective risk-based testing referral [12], reduces stigma and discrimination [18], and ultimately, increases engagement in HIV care [11]. We review the experience of several countries as examples of routine testing implementation.

The Botswana experience. Botswana's efforts to improve rates of HIV testing are exemplary. Its comparatively high per capita income, well-developed health care infrastructure, and strong government commitment to HIV/AIDS programs distinguishes it from other African countries with a high prevalence of HIV infection [18, 29, 30]. With >30% HIV seroprevalence [29], Botswana established universal access to ART in 2002 for all eligible patients [31]; however, by the end of 2003, attendance at VCT sites was still lower than expected [32]. In his Christmas radio address of 2003, Botswana President Festus Mogae endorsed “routine but not compulsory” testing at health facilities to make “HIV testing....as simple and as accessible as checking blood pressure” [30].

Eleven months after the initiation of the routine testing, media, and public health campaign, a cross-sectional survey of adults in Botswana revealed that 81% were in favor of routine testing because it decreases barriers to testing (89%), HIV-related stigma (60%), and violence toward women (55%), while increasing access to ART (93%) [18]. Although overall impressions were positive, 68% of individuals felt unable to refuse the test, and 43% believed that routine testing could lead to avoidance of medical care for fear of being tested [18]. A 2006 household survey found that 81% of respondents had visited a government facility during the 2 years since initiation of the routine testing policy and that 92% were satisfied with their visit; nearly half of those who had visited a government facility reported being tested for HIV [33]. The Botswana Ministry of Health reported a tripling of testing rates in the public sector in the first part of 2006 [34]. As a surrogate marker of testing success, one of the National Antiretroviral Program sites reported a concomitant decrease in the proportion of patients being assessed for treatment with a CD4 cell count ≤ 100 cells/ μL (49%–34%) [34].

The Uganda experience. Uganda predated the WHO with 2005 national guidelines recommending provider-initiated, opt-out HIV testing in health care facilities that have a link with HIV/AIDS services [35]. Mulago and Mbarara Hospitals, the largest public, tertiary hospitals in Uganda, offered HIV testing only by request and for a fee. In November 2004, the hospitals established a routine, rapid testing program, expanded to 25 wards and clinics, that was free of charge to patients using dedicated HIV counselors; they offered testing to >50,000 patients, with an uptake of 98% [36]. The prevalence of newly diagnosed HIV infection was 25%. More than 10,000 patient relatives and household members present in the hospital were also offered HIV testing; 93% accepted, and the prevalence of HIV infection among family members was 20%, nearly as high as that among the index patients.

The South Africa experience. South Africa has >5 million people infected with HIV [37]—the most citizens of any country with plans to expand provider-initiated testing [38]. Although there are >4000 VCT sites in the country [39], only 30% of South Africans report ever having been tested for HIV [40]. One study in the outpatient department of an urban medical center in Durban compared physician referral to a self-pay VCT site in the hospital complex with a free, routine testing intervention. During the 14-week VCT period, physicians referred 435 patients for testing, but only 32% of patients underwent testing within 4 weeks after the referral; the prevalence of newly diagnosed HIV infection was 75%. During the 12-week routine testing period, >2000 individuals were offered testing; 49% of these persons agreed, and 33% were infected with HIV [41]. In this study, routine testing was acceptable to patients and led to a substantially higher rate of newly identified

HIV infections, compared with testing based on physician referral.

The Haiti experience. The Groupe Haitien d'Etude du Sarcome de Kaposi et des Infections Opportunistes (GHESKIO) has provided VCT in Haiti since 1985; Haiti is the poorest country and has the most heavy burden of HIV infection in the Western Hemisphere [42]. In a 15-year experience, tuberculosis care, sexually transmitted disease management, family planning, nutritional support, prenatal services, and HIV post-exposure prophylaxis were integrated in VCT services [43]. GHESKIO reported a rapid increase in clients from 142 in 1985 to >8000 in 1999; 36% of patients presenting for VCT have benefited from at least one other offered service [43]. Although not strictly provider-initiated testing, this experience demonstrates the successes of comprehensive medical encounters that include HIV testing. Successful implementation of doctor- or nurse-initiated HIV testing led to few missed opportunities in a rural public medical clinic; 85% of HIV-infected patients received a diagnosis at the first medical encounter [44].

These examples from several generalized HIV epidemics reveal that provider-initiated testing integrated in routine health care is acceptable to patients, increases testing participation, and may identify HIV-infected individuals at an earlier disease stage [12, 18, 27, 34, 36, 41]. Despite these encouraging data, in 2007, only 12 (44%) of 27 countries with generalized epidemics had guidelines stating that health care providers should recommend HIV testing and counseling during all encounters [2].

ANTENATAL AND INTRAPARTUM HIV TESTING

The United Nations Programme on HIV/AIDS has called for the elimination of mother-to-child HIV transmission in all countries by 2015 [45]. However, in 2007, only 18% of the total estimated number of pregnant women in low- and middle-income countries received an HIV test, which is the essential gateway to ART and other prevention of mother-to-child transmission services (Figure 1).

Despite its failure to reach all women in need, some of the greatest HIV screening successes in less-resourced countries have been in antenatal testing [46]. In 1998, Thailand became the first resource-limited country to implement and financially support a national program for routine HIV testing coupled with prevention of mother-to-child transmission [47]. Success was evident by 2001, when 96% of women who delivered a newborn in Thailand received antenatal care; 94% of these women had a known HIV test result, and 76% of those infected with HIV received zidovudine for prevention of mother-to-child transmission [47, 48]. Routine testing in Botswana's antenatal clinics resulted in 95% testing acceptance; women were not deterred from seeking care because of the new routine HIV testing policy [49]. Very high rates of HIV test uptake have also been documented in routine antenatal and labor testing pro-

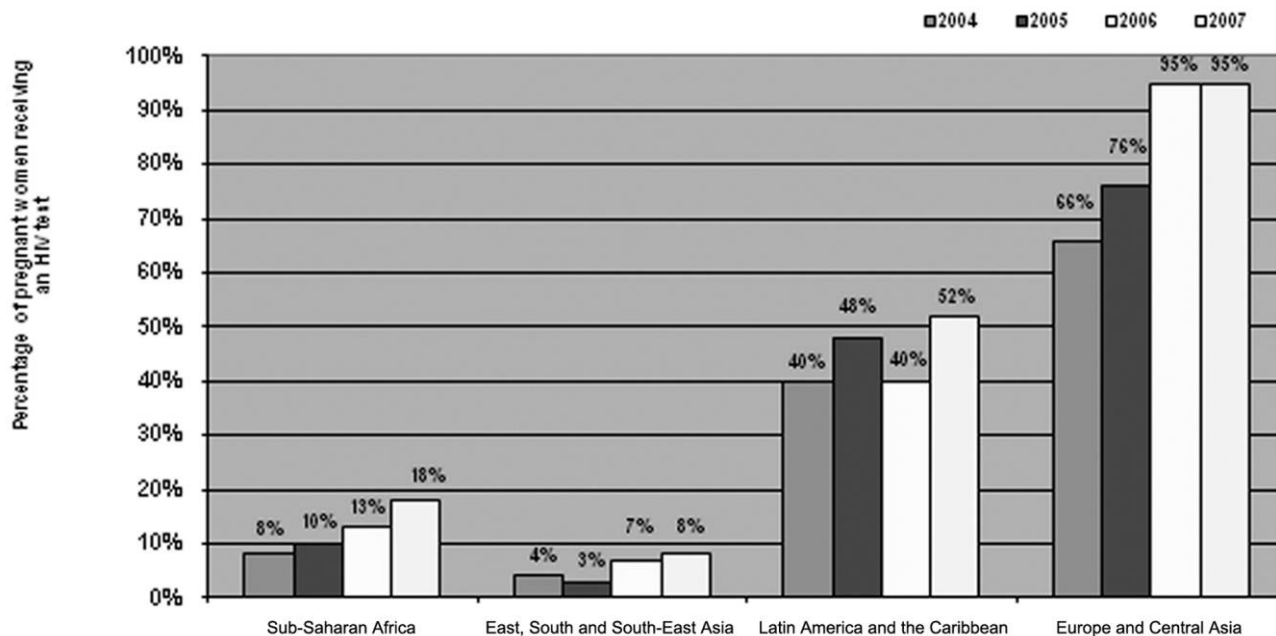


Figure 1. Percentage of pregnant women in low- and middle-income countries who received an HIV test, 2004–2007. No data are available from the Middle East or North Africa. Adapted with permission from [2].

grams in Uganda [28], Malawi [50, 51], Zimbabwe [52, 53], South Africa [54], Brazil [55], and India [56]. In rural India, where half of the women who present to a health care facility while in labor have not received prior antenatal care, 98% of eligible women accepted testing in the labor ward in a 24-h program offering rapid oral fluid HIV testing [56].

Women are generally more often aware of their HIV status than are men, at least in part because of antenatal services [33, 34, 57]; innovative efforts to reach men are urgently needed. Despite the high rates of discordant serostatus among couples [36, 58, 59], partner testing during the antenatal period and labor has had variable success. In a Malawi antenatal program in which, among 95% of the mothers who were tested for HIV, 22% were seropositive for HIV, only 8% of partners of HIV-infected mothers underwent HIV testing [50]. Similarly, a successful Zimbabwean prevention of mother-to-child transmission program encouraged all women who underwent testing, regardless of the result, to bring their partners for free testing; only 7% of partners underwent testing [52]. Partner testing programs were more successful in Uganda, where among women who underwent testing, 97% and 98% of accompanying men were tested in the antenatal clinic and maternity ward, respectively [28]. When partner counseling and testing does occur during the antenatal period, women are more likely to return for prevention of mother-to-child transmission inter-

ventions [60, 61]; efforts are needed to improve outreach for partner testing.

HOME-BASED ROUTINE HIV TESTING

Routine and antenatal HIV testing at health care facilities, by definition, reaches only persons who seek medical care. Such services often exclude partners and family members of HIV-infected individuals, rural populations living remotely from testing facilities, and those with lower socioeconomic status who cannot afford transportation or time off from work [2, 10]. Home-based provision of HIV counseling and testing services has been recommended as a means of achieving universal HIV testing in Africa and increasing partner testing [59].

In Malawi, household members in the lowest-income quartile were significantly less likely to have ever used facility-based HIV testing than was the rest of the population but were 70% more likely to use the home-based rapid HIV testing program [10]. A Ugandan study compared 4 HIV testing strategies: stand-alone VCT, hospital-based provider-initiated testing, home-based provider-initiated testing, and household member home-based testing [62]. Although hospital-based testing was associated with the highest proportion of individuals receiving a diagnosis of HIV infection (prevalence, 27%), home-based and household member home-based testing reached the

greatest proportion of previously untested adults (>90% of all clients) [62].

A Zambian trial found that persons randomized to an optional testing location (most often home testing) were >4 times more likely to accept VCT than were those assigned to testing at a health care facility [63]. Similarly, testing participation increased from 10% to 37% in Uganda when individuals learned their HIV test results at home, compared with at a counseling site [64]. District-wide door-to-door HIV testing reached 63% of all households in Bushenyi District, Uganda, increasing the proportions of persons ever testing for HIV (20% vs 63%; $P < .001$) and reporting disclosure of their serostatus (72% vs 81%; $P = .04$) [65]. Home-based HIV testing was also found to be acceptable in Thailand, where the majority of household contacts (74%) of patients with tuberculosis consented to HIV screening in Chiang Rai [66]. These studies illustrate that home-based testing is a feasible and acceptable method for expanding access to HIV testing.

PRE-ART LOSS TO FOLLOW-UP

An important metric of the success of HIV testing programs is the rate at which patients are linked to and retained in care after receipt of a new HIV diagnosis. Many studies do not report data on postpartum linkage to HIV care for mothers' health; the problem of postpartum loss to follow-up is an emerging concern [50, 67]. For example, although testing uptake was high in a Malawi antenatal clinic, cumulative rates of loss to follow-up among HIV-infected women were also high, starting in the antenatal period (55% by the 36-week antenatal visit, 68% by delivery, 70% by the first postnatal visit, and 81% by the 6-month postnatal visit) [50]. The vast majority (87%) of deliveries occurred at peripheral clinical sites where ART for prevention of mother-to-child transmission or, later, for maternal health, was not available [50]. In 4 community health care clinics in South Africa, pregnant women with a CD4 cell count ≤ 200 cells/ μL were 3 times more likely to be lost to follow-up than men with a CD4 cell count > 200 cells/ μL [67]. A study in Burkina Faso found that ~20% of HIV-infected women who received their diagnosis at antenatal clinics were lost to follow-up by the time their infant was 18 months of age [68].

Pre-ART loss to follow-up is also increasingly recognized as a problem outside the prevention of mother-to-child transmission. A Durban study of patients enrolled before HIV testing in the medical outpatient department revealed that only 39% of those who underwent CD4 cell count testing within 90 days after HIV testing and were deemed to be ART eligible were known to have initiated ART at 1 year. Of those who were ART eligible, 20% died by 1 year, with 82% of deaths occurring before ART initiation or with unknown ART initiation status

[69]. Many HIV testing programs do not report outcomes of linkage to care after testing, particularly in home-based settings; this critical topic mandates further study.

COSTS

Although resources are limited, few studies have reported the costs and cost-effectiveness of HIV screening in resource-limited settings. In Uganda, costs per client tested ranged from \$8.29 for door-to-door testing to \$11.68 for hospital-based testing, \$13.85 for household member testing, and \$19.26 for stand-alone testing. Because of differential yield in case detection, costs per HIV infection identified were most expensive for household testing (\$231.65) and were least for hospital-based testing (\$43.10) [62]. In the Durban experience, routine HIV screening cost $< \$25$ per HIV infection identified [41]. A South African-based cost-effectiveness analysis using conservative assumptions regarding HIV-related stigma, linkage to care, and ART access reported that routine HIV screening every 5 years, even annually, is a very cost-effective intervention (\$1650 per year of life saved and \$1940 per year of life saved, respectively) [70].

CONTINUED AREAS OF CONCERN

Although routine health care facility-based and home-based testing increase uptake of HIV testing, areas of uncertainty related to appropriate implementation and scale-up remain. Should testing be opt-in or opt-out to simultaneously maximize patient understanding, consent, and participation [18]? Which providers should be offering and discussing testing with patients: doctors and nurses [44] or dedicated HIV counselors [41, 52]? Rapid test kits, which have greatly expanded the scope and availability of HIV testing in resource-limited settings, have had disappointing performance in some settings [71–75], necessitating careful in-country validation and labor-intensive evaluation of rapid test kits [76].

Aggressive screening strategies must effectively balance individual rights with public health; true informed consent with the preserved ability to refuse testing is critical [18, 77]. A comparative study involving HIV-infected persons in India, Indonesia, Thailand, and the Philippines found that discrimination was prominent in the health sector, with high rates of breaches of confidentiality and delays in health care provision [78]. A concern with increased routine antenatal and health care-based testing initiatives is that newly identified HIV-infected women and girls would be subject to abuse [77]. This has not been reported systematically in the literature thus far. No reports of discrimination, stigmatization, or increased violence as a result of routine testing have been described in Botswana [33, 34]. However, increased rates of partner violence have been reported for HIV-infected women, compared with

HIV-uninfected women, at a VCT site in Tanzania [79], and fear of partner's reaction has been cited as a barrier to HIV test acceptance in antenatal clinics in Uganda [80]. Ensuring adequate follow-up and social services, at least through local referral, is an essential element of provider-initiated testing and counseling [11].

The failed Lesotho experience provides understanding that scale-up of testing services must be done in concert with crucial attention to detail to prevent harm. Lesotho has the third-highest prevalence of HIV infection in the world [81]. On World AIDS Day in 2005, the Lesotho government announced plans to offer countrywide community-based testing to 1.3 million citizens aged ≥ 12 years—a campaign that was lauded by the WHO HIV/AIDS program [82]. In 2008, Human Rights Watch reported that the program fell short of its goals both in program implementation and in safeguarding the rights of persons tested [83]. The report notes poor training and supervision of lay counselors in performing rapid tests, inadequate funding and infrastructure for posttest referral, and insufficient human rights protections [83]. The Lesotho experience poignantly shows the need for careful planning, sufficient funding, adequate training, and oversight for a successful community-wide testing campaign.

CONCLUSIONS

As ART becomes more widely available in resource-limited settings, increasingly, the challenge is case identification so that patients may benefit from ART and secondary prevention [12]. Provider-initiated testing in a variety of settings has demonstrated improved HIV testing participation [41, 49, 64], and knowledge of serostatus has been shown to decrease risky behavior [4, 7]. Survey data indicate that patients seeking health care are in favor of making HIV testing a routine part of medical care [18, 27] and that offering HIV testing does not deter individuals from seeking care [49]. By routinely offering HIV testing, the test will become normalized, decreasing stigma and removing highly personal prerequisite discussions about the risk of HIV infection [41]. Testing in the community and at home can broaden coverage to include couples, low-income individuals, rural populations, and men less likely to visit health care facilities [10, 22, 34, 62].

Questions about how best to implement routine testing, including ensuring confidentiality, dignity, and availability of care and treatment services after a new HIV diagnosis, remain. However, evidence of widespread support for making HIV testing a routine part of care promises to improve access to life-sustaining treatment for millions of persons with HIV infection worldwide.

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References

1. United Nations General Assembly. Political declaration on HIV/AIDS. United Nations General Assembly document 60/262. http://data.unaids.org/pub/Report/2006/20060615_HLM_PoliticalDeclaration_ARES60262_en.pdf. Accessed 19 May 2009.
2. World Health Organization. Towards universal access: scaling up priority HIV/AIDS interventions in the health sector: progress report 2008. http://www.who.int/hiv/pub/towards_universal_access_report_2008.pdf. Accessed 19 May 2009.
3. Demographic and Health Surveys. <http://www.measuredhs.com/>. Accessed 19 May 2009.
4. Efficacy of voluntary HIV-1 counselling and testing in individuals and couples in Kenya, Tanzania, and Trinidad: a randomised trial. The Voluntary HIV-1 Counseling and Testing Efficacy Study Group. *Lancet* **2000**; 356:103–112.
5. Allen S, Meinken-Derr J, Kautzman M, et al. Sexual behavior of HIV discordant couples after HIV counseling and testing. *AIDS* **2003**; 17: 733–740.
6. Bunnell R, Opio A, Musinguzi J, et al. HIV transmission risk behavior among HIV-infected adults in Uganda: results of a nationally representative survey. *AIDS* **2008**; 22:617–624.
7. Denison JA, O'Reilly KR, Schmid GP, Kennedy CE, Sweat MD. HIV voluntary counseling and testing and behavioral risk reduction in developing countries: a meta-analysis, 1990–2005. *AIDS Behav* **2008**; 12: 363–373.
8. De Cock KM, Bunnell R, Mermin J. Unfinished business—expanding HIV testing in developing countries. *N Engl J Med* **2006**; 354:440–442.
9. De Cock KM, Marum E, Mbori-Ngacha D. A serostatus-based approach to HIV/AIDS prevention and care in Africa. *Lancet* **2003**; 362: 1847–1849.
10. HELLERINGER S, KOHLER HP, FRIMPOG JA, MKANDAWIRE J. Increasing uptake of HIV testing and counseling among the poorest in sub-Saharan countries through home-based service provision. *J Acquir Immune Defic Syndr* **2009**; 51:185–193.
11. World Health Organization/United Nations Program on HIV/AIDS. Guidance on provider-initiated HIV testing and counseling in health facilities. http://whqlibdoc.who.int/publications/2007/9789241595568_eng.pdf. Accessed 19 May 2009.
12. Beckwith CG, Flanigan TP, del Rio C, et al. It is time to implement routine, not risk-based, HIV testing. *Clin Infect Dis* **2005**; 40: 1037–1040.
13. Obermeyer CM, Osborn M. The utilization of testing and counseling for HIV: a review of the social and behavioral evidence. *Am J Public Health* **2007**; 97:1762–1774.
14. Kalichman SC, Simbayi LC. HIV testing attitudes, AIDS stigma, and voluntary HIV counselling and testing in a black township in Cape Town, South Africa. *Sex Transm Infect* **2003**; 79:442–447.
15. Bentley ME, Spratt K, Shepherd ME, et al. HIV testing and counseling among men attending sexually transmitted disease clinics in Pune,

- India: changes in condom use and sexual behavior over time. *AIDS* **1998**; 12:1869–1877.
16. Bunnell RE, Nassozi J, Marum E, et al. Living with discordance: knowledge, challenges, and prevention strategies of HIV-discordant couples in Uganda. *AIDS Care* **2005**; 17:999–1012.
 17. Sherr L, Lopman B, Kakowa M, et al. Voluntary counselling and testing: uptake, impact on sexual behaviour, and HIV incidence in a rural Zimbabwean cohort. *AIDS* **2007**; 21:851–860.
 18. Weiser SD, Heisler M, Leiter K, et al. Routine HIV testing in Botswana: a population-based study on attitudes, practices, and human rights concerns. *PLoS Med* **2006**; 3:e261.
 19. Irungu TK, Varkey P, Cha S, Patterson JM. HIV voluntary counselling and testing in Nakuru, Kenya: findings from a community survey. *HIV Med* **2008**; 9:111–117.
 20. Braithstein P, Brinkhof MW, Dabis F, et al. Mortality of HIV-1-infected patients in the first year of antiretroviral therapy: comparison between low-income and high-income countries. *Lancet* **2006**; 367:817–824.
 21. Morin SF, Khumalo-Sakutukwa G, Charlebois ED, et al. Removing barriers to knowing HIV status: same-day mobile HIV testing in Zimbabwe. *J Acquir Immune Defic Syndr* **2006**; 41:218–224.
 22. Matovu JK, Makumbi FE. Expanding access to voluntary HIV counselling and testing in sub-Saharan Africa: alternative approaches for improving uptake, 2001–2007. *Trop Med Int Health* **2007**; 12:1315–1322.
 23. Liddicoat RV, Horton NJ, Urban R, Maier E, Christiansen D, Samet JH. Assessing missed opportunities for HIV testing in medical settings. *J Gen Intern Med* **2004**; 19:349–356.
 24. McDonald EA, Currie MJ, Bowden FJ. Delayed diagnosis of HIV: missed opportunities and triggers for testing in the Australian Capital Territory. *Sex Health* **2006**; 3:291–295.
 25. Moyer LB, Brouwer KC, Brodine SK, et al. Barriers and missed opportunities to HIV testing among injection drug users in two Mexico–US border cities. *Drug Alcohol Rev* **2008**; 27:39–45.
 26. Stekler JD, Golden MR. Learning from the missed opportunities for HIV testing. *Sex Transm Infect* **2009**; 85:2–3.
 27. Nakanjako D, Kanya M, Daniel K, et al. Acceptance of routine testing for HIV among adult patients at the medical emergency unit at a national referral hospital in Kampala, Uganda. *AIDS Behav* **2007**; 11:753–758.
 28. Homsy J, Kalamya JN, Obonyo J, et al. Routine intrapartum HIV counseling and testing for prevention of mother-to-child transmission of HIV in a rural Ugandan hospital. *J Acquir Immune Defic Syndr* **2006**; 42:149–154.
 29. World Health Organization. Botswana: Country health system fact sheet, 2006. http://www.afro.who.int/home/countries/fact_sheets/botswana.pdf. Accessed 19 May 2009.
 30. President Festus Mogae. Christmas and New Year message to the nation. December 23, 2003, Gaborone, Botswana. <http://www.gov.bw/cgi-bin/news.cgi?d=20031223>. Accessed 24 February 2010.
 31. de Korte D, Mazonde P, Darkoh E. Introducing ARV therapy in the public sector in Botswana: case study, 2004. http://www.who.int/hiv/pub/prev_care/botswana.pdf. Accessed 19 May 2009.
 32. Epidemiological Fact Sheet on HIV and AIDS: Uganda 2008. http://apps.who.int/globalatlas/predefinedReports/EFS2008/full/EFS2008_UG.pdf. Accessed 19 May 2009.
 33. Cockcroft A, Andersson N, Milne D, Mokoena T, Masisi M. Community views about routine HIV testing and antiretroviral treatment in Botswana: signs of progress from a cross sectional study. *BMC Int Health Hum Rights* **2007**; 7:5.
 34. Steen TW, Seipone K, Gomez Fde L, et al. Two and a half years of routine HIV testing in Botswana. *J Acquir Immune Defic Syndr* **2007**; 44:484–488.
 35. Uganda Ministry of Health. Uganda national policy guidelines for HIV counseling and testing, 2005. http://www.who.int/hiv/topics/vct/UG_HCT%20Policy%20DRAFTFeb05.pdf. Accessed 18 May 2009.
 36. Wanyenze RK, Nawavvu C, Namale AS, et al. Acceptability of routine HIV counselling and testing, and HIV seroprevalence in Ugandan hospitals. *Bull World Health Organ* **2008**; 86:302–309.
 37. Epidemiological Country Profile on HIV and AIDS: South Africa 2008. http://www.who.int/globalatlas/predefinedReports/EFS2008/short/EFSCountryProfiles2008_ZA.pdf. Accessed 19 May 2009.
 38. HIV and AIDS and STI Strategic Plan for South Africa, 2007–2011. <http://www.info.gov.za/otherdocs/2007/aidsplan2007/index.html>. Accessed 19 May 2009.
 39. AVERT. HIV and AIDS in South Africa. <http://www.avert.org/aidsouthafrica.htm>. Accessed 18 May 2009.
 40. Shisana O, Rehle T, Simbayi LC, et al. South African national HIV prevalence, HIV incidence, behaviour and communication survey, 2005. Cape Town: HSRC Press, **2005**.
 41. Bassett IV, Giddy J, Nkera J, et al. Routine voluntary HIV testing in Durban, South Africa: the experience from an outpatient department. *J Acquir Immune Defic Syndr* **2007**; 46:181–186.
 42. Epidemiological Country Profile on HIV and AIDS: Haiti 2008. http://apps.who.int/globalatlas/predefinedReports/EFS2008/full/EFS2008_HT.pdf. Accessed 19 May 2009.
 43. Peck R, Fitzgerald DW, Liautaud B, et al. The feasibility, demand, and effect of integrating primary care services with HIV voluntary counselling and testing: evaluation of a 15-year experience in Haiti, 1985–2000. *J Acquir Immune Defic Syndr* **2003**; 33:470–475.
 44. Ivers LC, Freedberg KA, Mukherjee JS. Provider-initiated HIV testing in rural Haiti: low rate of missed opportunities for diagnosis of HIV in a primary care clinic. *AIDS Res Ther* **2007**; 4:28.
 45. UNAIDS. UNAIDS calls for virtual elimination of mother to child transmission of HIV by 2015. Press release: 21 May 2009. http://data.unaids.org/pub/PressRelease/2009/20090521_pr_priorityareas_en.pdf. Accessed 21 May 2009.
 46. McIntyre J, Lallemand M. The prevention of mother-to-child transmission of HIV: are we translating scientific success into programmatic failure? *Curr Opin HIV AIDS* **2008**; 3:139–145.
 47. Kanshana S, Simonds RJ. National program for preventing mother-child HIV transmission in Thailand: successful implementation and lessons learned. *AIDS* **2002**; 16:953–959.
 48. Chasombat S, Lertpiriyasuwat C, Thanprasertsuk S, Suebsaeng L, Lo YR. The National Access to Antiretroviral Program for PHA (NAPHA) in Thailand. *Southeast Asian J Trop Med Public Health* **2006**; 37:704–715.
 49. Creek TL, Ntunye R, Seipone K, et al. Successful introduction of routine opt-out HIV testing in antenatal care in Botswana. *J Acquir Immune Defic Syndr* **2007**; 45:102–107.
 50. Manzi M, Zachariah R, Teck R, et al. High acceptability of voluntary counselling and HIV-testing but unacceptable loss to follow up in a prevention of mother-to-child HIV transmission programme in rural Malawi: scaling-up requires a different way of acting. *Trop Med Int Health* **2005**; 10:1242–1250.
 51. Moses A, Zimba C, Kamanga E, et al. Prevention of mother-to-child transmission: program changes and the effect on uptake of the HIVNET 012 regimen in Malawi. *AIDS* **2008**; 22:83–87.
 52. Chandisarewa W, Stranix-Chibanda L, Chirapa E, et al. Routine offer of antenatal HIV testing (“opt-out” approach) to prevent mother-to-child transmission of HIV in urban Zimbabwe. *Bull World Health Organ* **2007**; 85:843–850.
 53. Perez F, Zvandaziva C, Engelsmann B, Dabis F. Acceptability of routine HIV testing (“opt-out”) in antenatal services in two rural districts of Zimbabwe. *J Acquir Immune Defic Syndr* **2006**; 41:514–520.
 54. Van Wyk E, Giddy J, Roberts C, et al. The efficiency of opt-out HIV testing compared with provider-initiated voluntary counselling and testing in an antenatal clinic in Durban, South Africa. In : Program and abstracts of the Conference on Retroviruses and Opportunistic Infections (Montreal, Canada). 2009. Poster 1049.
 55. Veloso VG, Portela MC, Vasconcelos MT, et al. HIV testing among pregnant women in Brazil: rates and predictors. *Rev Saude Publica* **2008**; 42:859–867.

56. Pai NP, Barick R, Tulsy JP, et al. Impact of round-the-clock, rapid oral fluid HIV testing of women in labor in rural India. *PLoS Med* **2008**; 5:e92.
57. Le Coeur S, Collins IJ, Pannetier J, Lelievre E. Gender and access to HIV testing and antiretroviral treatments in Thailand: why do women have more and earlier access? *Soc Sci Med* **2009**; 69:846–853.
58. Were WA, Mermin JH, Wamai N, et al. Undiagnosed HIV infection and couple HIV discordance among household members of HIV-infected people receiving antiretroviral therapy in Uganda. *J Acquir Immune Defic Syndr* **2006**; 43:91–95.
59. Bunnell R, Cherutich P. Universal HIV testing and counselling in Africa. *Lancet* **2008**; 371:2148–2150.
60. Farquhar C, Kiarie JN, Richardson BA, et al. Antenatal couple counseling increases uptake of interventions to prevent HIV-1 transmission. *J Acquir Immune Defic Syndr* **2004**; 37:1620–1626.
61. Msuya SE, Mbizvo EM, Hussain A, Uriyo J, Sam NE, Stray-Pedersen B. Low male partner participation in antenatal HIV counselling and testing in northern Tanzania: implications for preventive programs. *AIDS Care* **2008**; 20:700–709.
62. Menzies N, Abang B, Wanyenze R, et al. The costs and effectiveness of four HIV counseling and testing strategies in Uganda. *AIDS* **2009**; 23: 395–401.
63. Fylkesnes K, Siziya S. A randomized trial on acceptability of voluntary HIV counselling and testing. *Trop Med Int Health* **2004**; 9:566–572.
64. Wolff B, Nyanzi B, Katongole G, Ssesanga D, Ruberantwari A, Whitworth J. Evaluation of a home-based voluntary counselling and testing intervention in rural Uganda. *Health Policy Plan* **2005**; 20:109–116.
65. Nuwaha F, Tumwesigye E, Kasasa S, et al. Population-level changes in knowledge of HIV status, stigma and HIV risk behavior after district-wide door-to-door voluntary counseling and testing: Bushenyi District, Uganda. In: Program and abstracts of the Conference on Retroviruses and Opportunistic Infections (Montreal, Canada). **2009**. Abstract 139.
66. Suggaravetsiri P, Yanai H, Chongsuvivatwong V, Naimpasan O, Akarasewi P. Integrated counseling and screening for tuberculosis and HIV among household contacts of tuberculosis patients in an endemic area of HIV infection: Chiang Rai, Thailand. *Int J Tuberc Lung Dis* **2003**; 7:S424–S431.
67. Wang B, Losina E, Stark R, et al. Loss to follow-up in community clinics in South Africa: role of CD4 count, gender, and pregnancy. In: Program and abstracts of the Conference on Retroviruses and Opportunistic Infections (Boston). **2008**. Abstract 841.
68. Pignatelli S, Simpoire J, Pietra V, et al. Factors predicting uptake of voluntary counselling and testing in a real-life setting in a mother-and-child center in Ouagadougou, Burkina Faso. *Trop Med Int Health* **2006**; 11:350–357.
69. Bassett IV, Regan S, Chetty S, et al. Who starts ART in Durban, South Africa?...not everyone who should. *AIDS* **2010**; 24(Suppl 1):S37–S44.
70. Walensky RP, Fofana MO, Wood R, et al. The clinical impact and cost-effectiveness of routine, voluntary HIV testing in South Africa. In: Program and abstracts of the Conference on Retroviruses and Opportunistic Infections (Montreal, Canada). **2009**. Abstract 1050.
71. Bassett IV, Chetty S, Giddy J, et al. False negative rapid HIV tests in an outpatient department in Durban, South Africa. In: Program and abstracts of the Conference on Retroviruses and Opportunistic Infections (Boston). **2008**. Poster 908.
72. Claassen M, van Zyl GU, Korsman SN, Smit L, Cotton MF, Preiser W. Pitfalls with rapid HIV antibody testing in HIV-infected children in the Western Cape, South Africa. *J Clin Virol* **2006**; 37:68–71.
73. Gray RH, Makumbi F, Serwadda D, et al. Limitations of rapid HIV-1 tests during screening for trials in Uganda: diagnostic test accuracy study. *BMJ* **2007**; 335:188.
74. Walensky RP, Arbelaez C, Reichmann WM, et al. Revising expectations from rapid HIV tests in the emergency department. *Ann Intern Med* **2008**; 149:153–160.
75. Aghokeng A, Dimodi H, Atem-Tambe A, et al. Inaccurate HIV diagnosis in developing countries: an unresolved issue. In: Program and abstracts of the Conference on Retroviruses and Opportunistic Infections (Montreal, Canada). **2009**. Abstract 1051.
76. World Health Organization. Guidelines for appropriate evaluations of HIV testing technologies in Africa, 2002. <http://wwwn.cdc.gov/dls/pdf/HIV%20Test%20Guidelines%20Africa.pdf>. Accessed 19 May 2009.
77. Csete J, Schleifer R, Cohen J. “Opt-out” testing for HIV in Africa: a caution. *Lancet* **2004**; 363:493–494.
78. Paxton S, Gonzales G, Uppakaew K, et al. AIDS-related discrimination in Asia. *AIDS Care* **2005**; 17:413–424.
79. Maman S, Mbwambo JK, Hogan NM, et al. HIV-positive women report more lifetime partner violence: findings from a voluntary counseling and testing clinic in Dar es Salaam, Tanzania. *Am J Public Health* **2002**; 92:1331–1337.
80. Dahl V, Mellhammar L, Bajunirwe F, Bjorkman P. Acceptance of HIV testing among women attending antenatal care in south-western Uganda: risk factors and reasons for test refusal. *AIDS Care* **2008**; 20: 746–752.
81. UNAIDS. A global view of HIV infection, 2007. <http://www.unaids.org/en/KnowledgeCentre/HIVData/GlobalReport/2008/>. Accessed 19 May 2009.
82. Mills EJ, Chong S. Lesotho embarks on universal HIV testing. *HIV AIDS Policy Law Rev* **2006**; 11:27–28.
83. Human Rights Watch. A testing challenge: the experience of Lesotho’s universal HIV counseling and testing campaign. 2008. <http://www.hrw.org/en/reports/2008/11/17/testing-challenge>. Accessed 19 May 2009.