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Improved HIV testing coverage after scale-up of antiretroviral therapy programs in urban Zambia: Evidence from serial hospital surveillance

N.G. Kancheya[1,2,3], A.K. Jordan[4], I.S. Zulu[1,2,5], D. Chanda[6], S.H. Vermund[3,4,7]

[1]Department of Medicine; [2]University of Zambia School of Medicine, Lusaka, Zambia; [3]Centre for Infectious Disease Research in Zambia, Lusaka, Zambia: [4]Institute for Global Health; [5]Centers for Disease Control and Prevention, Lusaka, Zambia; [6]Virology Laboratory, Department of Microbiology, University Teaching Hospital, Lusaka, Zambia; [7]Department of Pediatrics, Vanderbilt University School of Medicine, Nashville, Tennessee, USA;

ABSTRACT

Background: We evaluated changing HIV testing coverage and prevalence rates before and after expanding city-wide antiretroviral therapy (ART) programs in Lusaka, Zambia.

Methods: We conducted serial cross-sectional surveys on the University Teaching Hospital medical ward to assess HIV prevalence among inpatients of unknown status in 2003 and 2006. Willing participants received counseling and dual HIV rapid tests. We compared the proportion of inpatients receiving their test results in 2003 (off-the-ward testing) to 2006 (on-the-ward).

Results: In 2003, none of 103 inpatients knew their HIV status or took ART; 99.0% (102/103) agreed to testing. In 2006, 49.3% (99 of 201) patients knew they were HIV-infected and were on ART; of those with unknown status, 98.0% (100/102) agreed to testing. In 2003, only 54.9% (56/102) received post-test counseling and 98.2% (55/56) learned their status. In 2006, 99.0% (99/100) received post-test counseling and 99.1% (98 of 99) learned their status. In 2003, 62.8% (64 of 102) of status-unknown inpatients who agreed to testing were seropositive by dual rapid test, compared to 48.0% (48 of 100) of status-unknown inpatients in 2006. When including inpatients who already knew their seropositive status plus those unknowns who tested seropositive, the proportion of inpatients that was seropositive in 2006 was 73.1% (147 of 201), higher than in 2003.

Conclusions: After ART program expansion, inpatients in 2006 were far more likely than their 2003 counterparts to know their HIV status and to be taking ART. In both years, 63-73% of medical inpatients were HIV-infected and 98.5% of inpatients agreed to testing. On-the-ward testing in 2006 avoided the 2003 problem of patient discharge before learning of their test results. Hospital-based HIV testing is an essential clinical service in high prevalence settings and can serve further as a surveillance system to help track the community impact of outpatient AIDS services in Africa.

The HIV epidemic in sub-Saharan Africa is the worst in the world [1]. Hospital inpatients in sub-Saharan Africa have a high likelihood of having HIV, even when admitted for non-infectious problems [2-21]. Most inpatients do not know their HIV status, unless the hospital has routine counseling and HIV testing of inpatients [22]. Zambia is one of the countries most greatly affected by HIV/AIDS (estimated16.5% of the adult population in 2004) [23-25], yet routine inpatient testing is rarely available.

***Corresponding Author**
Sten H. Vermund, MD, PhD
Vanderbilt Institute for Global Health
2215 Garland Drive (319 Light Hall)
Nashville, TN 37232-0242
Phone: +1 615 322-9374
Fax: +1 615 322-9400
Email: sten.vermund@vanderbilt.edu

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We conducted a survey of inpatients in 2003, just prior to the 2004-2005 rapid expansion of HIV care and treatment with antiretroviral therapy (ART) in Lusaka, Zambia [26]. We then repeated the survey in 2006 to assess how community availability of ART might have altered HIV-related hospital inpatient characteristics.

METHODS

The University Teaching Hospital (UTH) has 9 medical wards: one medical admissions ward, 6 "low cost" wards serving very low income patients, and 2 "high cost" wards for which patients pay extra fees. Our two cross-sectional surveys were conducted on the same medical admissions ward (serving all persons without extra fees) during May-June 2003 and again during May-June 2006. Every adult inpatient aged ≥17 years old admitted to the medical admissions ward was eligible unless they were so critically ill, intoxicated, or mentally impaired that they could not give consent and/or be interviewed. Patients chosen for the study were randomly selected from the ward roster and approached by a nurse-counselor, a physician, or a medical student in a private area. After thoroughly explaining the study, the practitioner gained verbal informed consent from willing inpatients. Participants completed a short questionnaire, received pre-test counseling, and a 2 mL blood sample was drawn.

In 2003, patients were counseled and tested off the ward in the hospital's outpatient voluntary HIV counseling and testing (VCT) center. In 2006, the counseling and testing was done on or near the ward itself. All willing and available patients received post-test counseling and HIV test results. Bias from the person administrating the questionnaire was minimized by having trained counselors who were unaware of the patients' HIV status at the time of the interview.

For both the 2003 and 2006 surveys, we recruited at least 100 willing patients of unknown status to determine a 56% ±9% prevalence with 95% confidence. Dual positivity on two rapid tests was diagnostic for HIV infection. We used Determine™ (Abbott Laboratories, Minato-Ku Tokyo, Japan) and Genie II HIV-1/HIV-2™ (Bio-Rad Laboratories, Marne-la-Coquette, France) tests, with further testing using a Magnetic Elisa Bionor™ test (Bionor A/S, Skien, Norway) if the Determine™ and Genie II™ assays were discordant.

The questionnaire assessed patient demographics, including age, sex, symptoms, diagnosis, education level, fluency in English, and native language. We only collected data on those inpatients who had no prior knowledge of seropositive status. Data were entered into spreadsheets (Excel™, Microsoft Corp, Redmond, WA, USA) and analyzed with SAS™ version 9.1 (SAS, Inc., Cary, NC, USA) and with EpiInfo™ version 3.5.1 (Centers for Diseases Control and Prevention, Atlanta, GA, USA). Differences in frequencies were assessed with a Chi-square test using Yates' correction. Ethical approval for the study was obtained from the Research Ethics Committee at the University of Zambia (both years) and the Institutional Review Boards of the University of Alabama at Birmingham (2003 survey) and Vanderbilt University (2006 survey).

RESULTS

Table 1. Comparisons between inpatients of 2003 and 2006 in their acceptance of voluntary counseling and testing (VCT), prior knowledge of status, and receipt of post-test counseling and HIV test results on the medical admission ward of the University Teaching Hospital, Lusaka, Zambia

	2003	2006
HIV status unknown to patient, and patient willing to participate in the study and receive HIV VCT	102/103 (99.0%)	100/102 (98.0%)
Patient had prior knowledge of HIV seropositive status*	0/103 (0%)	99/201 (49.3%)
Patient received post-test counseling*	56/102 (54.9%)	99/100 (99.0%)
Patient receiving post-test counseling who agreed to learn HIV test results	55/56 (98.2%)	98/99 (99.0%)

* $p<0.000001$ by Chi square test with Yates' correction.

Note: In 2003, patients received their post-test counseling off-the-ward at the hospital VCT center and fully 45.1% of patients were discharged home before they could see the counseling and learn their status. In 2006, we provided the counseling and

testing on the ward itself, such that only 1 person (1.0%) was discharged home before receiving post-test counseling and test results.

In 2003, no one who was asked to participate in the study was aware of being HIV-seropositive and no one was on ART. In 2003, 99.0% (102 of 103) of inpatients agreed to participate and receive VCT. In 2006, 49.3% (99 of 201) of inpatients who were asked to participate knew they were HIV-seropositive and all 99 persons were on ART. Of the remaining persons of unknown status in 2006, 98.0% (100 of 102) agreed to participate and receive VCT (Table 1).

In 2003, 62.8% (64 of 102) of status-unknown inpatients agreeing to testing were seropositive by dual rapid test; a somewhat higher proportion of women was infected than men (67.9% vs. 57.1%, respectively; p=0.4). In 2006, 48.0% (48 of 100) of status-unknown inpatients agreeing to testing were seropositive by dual rapid test; a slightly higher proportion of women was infected than men (50% vs. 46.0%, respectively; p=0.8). When including inpatients who already knew their seropositive status, plus those unknowns who tested seropositive, the proportion of inpatients that was seropositive in 2006 was 73.1% (147 of 201). Status-unknown inpatients in 2003 were more likely to be HIV-infected in 2003 than in 2006 (odds ratio = 1.8; 95% CI: 1.0-3.3; p=0.05), though among all inpatients approached (including those who knew their HIV-seropositive status), the proportion infected was lower in 2003 than in 2006, although this difference was not statistically significant (odds ratio = 0.62; 95% CI: 0.36-1.1; p=0.08). No one in either year had indeterminate HIV status.

In 2003, only 54.9% (56 of 102) of inpatients received post-test counseling and 98.2% (55 of 56) agreed to receive their HIV test results (Table 1). By the time post-test counseling was provided by the hospital VCT center for the 2003 inpatients, 45.1% of them had been discharged, none of whom (among 46 persons) returned subsequently to the hospital VCT center for test results. In 2006 when VCT was made available on or near the ward itself, 99.0% of inpatients (99 of 100) received post-test counseling and 99.1% (98 of 99) of them learned their status. Characteristics of inpatients of unknown HIV status were largely similar between the 2003 and 2006 surveys, though higher seroprevalence among persons ≥40 years old was noted in 2003 compared to 2006 (Table 2).

Table 2: Characteristics of HIV-seropositive and seronegative inpatients with initially unknown serostatus on the medical admissions ward of the University Teaching Hospital, Lusaka, Zambia, in parallel 2003 and 2006 surveys

	2003		2006	
Number (Row %)	HIV (+) n=64 (62.7%)	HIV (-) n=38 (37.3%)	HIV (+) n=48 (48.0%)	HIV (-) n=52 (52.0%)
Age in years: 17-29	17 (47.2%)	19 (52.8%)	9 (42.9%)	12 (57.1%)
30-39	29 (78.4%)	8 (21.6%)	26 (76.5%)	8 (23.5%)
≥40*	17 (63.0%)	10 (27.0%)	13 (31.7%)	28 (68.3%)
Age unknown/missing	1	1	0	4
Sex: Men	28 (57.1%)	21 (42.9%)	23 (46.0%)	27 (54.0%)
Women	36 (67.9%)	17 (32.1%)	25 (50.0%)	25 (50.0%)
Education:				
No higher than Primary	33 (55.9%)	26 (44.1%)	27 (42.2%)	37 (57.8%)
At least some Secondary	29 (67.4%)	14 (32.6%)	21 (58.3%)	15 (42.7%)
Admission diagnosis:				
Respiratory	31 (72.1%)	12 (27.9%)	15 (55.6%)	12 (44.4%)
Gastrointestinal	11 (64.7%)	6 (35.3%)	15 (62.5%)	9 (37.5%)
Other	22 (52.4%)	20 (47.6%)	18 (37.5%)	30 (62.5%)
Unknown/missing	0	0	0	1

*p=0.02 by Chi square with Yates' correction, comparing the proportion of persons ≥40 years of age who were seropositive in 2003 with 2006.

DISCUSSION

We found inpatient prevalence to be exceedingly high in a general medical ward of the University Teaching Hospital in Lusaka, Zambia, 62.8% in 2003 (all with prior unknown status) and 73.1% in 2006 (or 48% among persons of unknown status). Thus, while HIV contributes to the inpatient burden in the University Teaching Hospital medical wards

more than ever, expanded outpatient care and ART were reaching a substantial pool of persons such that many more patients already knew their HIV status in 2006 compared to 2003. HIV/AIDS services in Zambia, largely provided by government clinics and supported by the President's Emergency Plan for AIDS Relief (PEPFAR; www.pepfar.gov), have enabled many Zambians to become aware of their status, bridging them to care as needed [26]. That so many known HIV-infected persons who are on ART nonetheless became in-patients in 2006 suggests just how sick many out-patients with HIV are in Zambia, as well as on-going challenges in community-based out-patient programs.

It was notable that all inpatients who know that they were HIV-infected in 2006 were already on ART. It may be that persons in HIV outpatient care were more likely to get inpatient hospital care when they needed it, and/or that persons with higher CD4+ T-cell counts who are not on ART are unlikely to be admitted. Tanzanian hospital data suggest that HIV infection is highest among patients with an infective condition [5]; this may be why the Ugandan medical ward patients had the highest HIV prevalence rates [32]. We only surveyed medical ward patients and therefore cannot comment on comparisons between patients on different hospital wards.

Nearly all inpatients agreed to VCT when it was offered, both in 2003 and 2006, unlike the Zambian experience in outpatient antenatal care settings that has seen lower-than-ideal uptake in VCT [27-30]. In Tanzania, HIV testing was agreed to by 67.2% of surgical in-patients in a December 2001-February 2002 survey, but this predated widespread availability of ART, an incentive to get tested [31]. From November 2004 to February 2006, universal and "opt-out" routine screening in a Ugandan hospital demonstrated a 98% uptake among inpatients and outpatients with the highest HIV seroprevalence among medical inpatients [32]. In this study, fewer than half of the seropositive inpatients received their test results before they were discharged in 2003, but nearly all received their post-test counseling and their HIV test results in the 2006 survey. This substantial improvement results, we think, from the 2006 strategy to provide VCT on the wards rather than relying on the hospital VCT center, as was done in 2003. Given that only one patient in each of the two years who received post-test counseling refused to collect the HIV result, we believe that our study, along with the experience throughout Africa [2, 4-22, 31-33], suggests the hospital to be a superb venue for routine HIV testing and counseling.

Studies done in Zambia on the implementation of same-day VCT in antenatal clinics have shown reasonably high uptake among outpatients as well [27-30]. VCT for pregnant women in Lusaka includes same-day rapid tests and on-site post-test counseling as an entry point for provision of family-centered ART [28]. We do not think it is surprising that sick inpatients were even more willing to be tested than were women in antenatal care, given that benefits of diagnosis (i.e., use of ART) for the sick patient are more intuitive than for the asymptomatic pregnant woman for prevention of transmission of HIV to the fetus.

The first documented hospital-based HIV prevalence survey in Zambia was done in 1985, also at UTH . Even in the early and mid-1980s, HIV rates were rising steeply in Zambia [24,25]. In men, the seroprevalence was highest (32.9%) in 30-35 year olds and in women it peaked (24.4%) in 20-25 year olds [3]. Seropositivity rates were higher in patients with an infectious problem (23.4%) than in those without (11.4%) [3]. These early data suggest that it would have been desirable to institute inpatient screening for HIV at UTH >20 years ago.

ART was limited in 2003 to those who could pay. ART was initiated in selected clinics under a Government of Zambia initiative during late 2003, and was expanded markedly in 2004-2005 to all Lusaka clinics with PEPFAR support. As of November 5, 2005, just 6 months before our 2006 survey, 21,755 adults had been enrolled into HIV care and 16,198 (75%) of them had started ART within the PEPFAR program, the dominant contributor to HIV care in Lusaka at that time [26]. Our data suggest success in widely expanding HIV testing in out-patient venues, but also may suggest that treatment failure (as measured by an HIV-infected person on ART being hospitalized) is prevalent.

Our sample is not likely to be biased since we selected randomly from general medical ward admissions from a ward of mixed social class. There were no evident shifts in admissions criteria from 2003 to 2006 (NGK, ISZ, and DC, personal

observations). A limitation of our study is that we cannot generalize to the rest of the hospital (e.g., surgery, obstetrics and gynecology, and pediatrics) as we did not survey those wards. While Western blot confirmation was unaffordable in our setting, we believe that misclassification is unlikely with our dual rapid test [34].

Our experience suggests strongly that HIV testing is feasible and well-accepted in a large Zambian hospital. Ward-based counseling and testing is superior to sending patients for VCT off the ward since both rapid testing and post-test counseling can occur before the patient is discharged from hospital. Based, in part, on the results of these two surveys, the U.S. Centers for Disease Control and Prevention Zambia office began fiscal support in 2007 of a ward-based, routine counseling and testing service in the UTH medical admissions ward as part of the PEPFAR initiative with the Zambian Ministry of Health. Just in the first two months of operation in 2007, >600 patients were tested with subsequent expansion of the service hospital-wide. The program has been sustained and expanded through the present (September 2010). Hospital HIV testing services can serve as valuable surveillance sites to assess the impact of expanded outpatient HIV services. The Lusaka-wide expansion of care and ART has led to a huge increase in the number of inpatients who knew they were HIV-infected, but had not yet resulted in a decline in the proportion of inpatients who were HIV-infected. Hospital-based HIV testing services are of vital clinical and public health importance [35-39]. These data are a tool for epidemiologic and operations research to help set priorities for HIV-related investments and to help evaluate the community impact of outpatient AIDS services [40, 41].

List of abbreviations used: antiretroviral therapy (ART), human immunodeficiency virus (HIV), acquired immunodeficiency syndrome (AIDS), University Teaching Hospital (UTH), voluntary HIV counseling and testing (VCT), President's Emergency Plan for AIDS Relief (PEPFAR)
Competing interests: The authors declare no competing interests.

Authors' contributions: NGK, AKJ, and ISZ conducted the surveys and gathered the data. NGK, ISZ, and SHV conceptualized the research. DC was responsible for the laboratory work. NGK and AKJ analyzed the data. NGK, AKJ, and SHV developed the tables and abstracted the data from the overall study results. All five authors contributed to the writing of the manuscript and approved the final product submitted to MJZ.

Authors' information: NGK, ISZ, and DC were physicians at the University Teaching Hospital. AKJ was a medical student doing a clinical research project. SHV was the professor supervising NGK and AKJ.

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