

A Decline in Community Viral Load in Cape Town and Johannesburg, South Africa between 2004 to 2011

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ABSTRACT

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Background The total number of people living with HIV in South Africa in 2011 is estimated at approximately 5.4 million, with a prevalence of 16.6% in the adult antenatal population: ranging from 6.2% in the Western Cape to 16.6% in Gauteng provinces, respectively. Antiretroviral therapy (ART) became accessible in 2004, with an estimated 1.4 million on treatment by December 2011. Prior work has suggested that a community viral load (CVL) can be used as a tool for monitoring the success of ARV therapy. This pilot study measured the population based CVL in the cities of Cape Town (CT) and Johannesburg (JHB) and in a large urban clinic from 2004 and 2011.

Methods Retrospective analyses of HIV viral load (VL) tests performed over the 8-year period on patients from CT, JHB and an urban clinic were undertaken on data extracted from the central data warehouse of the National Health Laboratory Service and the clinic database. For each calendar year the CVL was represented as a mean (log) VL, and as a proportion of patients with suppressed VL. Each patient contributed only one VL per calendar year. Lower than detectable limit (LDL) results were assigned a theoretical minimum detectable level of the assay and values >3.0 million cp/mL were truncated at that value.

Results We analyzed 848,325 VL tests matched to 550,527 patients. Patients were linked with a median of 2 tests in CT, 1 test in JHB, and 4 tests at the urban clinic. Total follow-up time after the first VL test ranged from no follow-up in the city communities to 24 months in the urban clinic. The proportion of LDL VL's increased in the community and clinic sites between 2004 to 2009 and declined again in 2010 (Table 1). The proportion of subjects with VL <1000 cp/ml rose to approximately 84% in CT, 79% in JHB, and 88% in the urban clinic. CT demonstrates a higher proportion of subjects with suppressed viral loads than JHB, but the urban clinic shows the highest levels of suppression.

Conclusions The dramatic decline in CVL from 2004 to 2011 in two major cities in South Africa suggests successes in the ARV treatment program. The proportion suppressed at the urban clinic generally exceed what was being observed at the community level. Our next step is apply this monitoring tool to district level and to evaluate outcomes of HIV control programmes for corrective action and appropriate direction of resources.

BACKGROUND AND OBJECTIVES

Community Viral Load (CVL) is an indicator of amount of viral burden circulating in the population. A high CVL is associated with high rates of infection, infected patients initiating care with advanced stages of disease and/or a lack of compliance with therapy

We used HIV viral load monitoring data from the National Health Laboratory Service (NHLS) to compare the change in CVL in the two largest metropolitan areas in South Africa: Cape Town and Johannesburg. Additionally, we included a large urban clinic with a comprehensive clinical care database in the comparison of CVL (gold standard). The objective of this analysis is to demonstrate the use of a comprehensive laboratory database to evaluate the success of the CCMT program in South Africa and demonstrate the value of this type of data beyond this specific indication.

METHODS

Data Sources

- National Health Laboratory Service HIV viral load results (N=1,042,244) from March 2004 through December 2011 for the Cape Town and Johannesburg metropolitan areas.
 - Individual HIV viral load results were matched to individuals (N=531,316) by an exact match of first name, last name, date of birth, sex, and the first address line.
- HIV viral load results (N=52,767) from March 2004 through December 2011 for a large urban clinic in Johannesburg (18,489 patients).

Study Population

All HIV viral load test results in the databases from patients in the Johannesburg and Cape Town metropolitan areas and the urban Johannesburg clinic from March 2004 through December 2011.

Calculation of Community Viral Load

Each subject could only contribute a single viral load result to the time period (calendar year) under analysis. In cases where a subject had more than one viral load result in a calendar year, we used the last viral load taken during that year.

We calculated mean viral load, geometric mean viral load, and the proportions of tests less than detectable (<LDL), <400 cp/ml, and <1,000 cp/ml by calendar year.

In both databases, from March 2004 to December 2011, viral load testing was performed using a variety of different assays with different sensitivities. Test sensitivity increased over time lowering the limit of less than detectable results and increasing the maximum limit.

As a result of this increase in test sensitivity, we recoded test results from November 2009 onwards to have a maximum limit of 3,000,000 cp/ml and any results less than 25 cp/ml to be less than detectable and given a value of 12.5 cp/ml for the purposes of calculating the mean viral load.

We did not perform any statistical testing of differences in the results from the different sites. We chose not to conduct statistical testing because the large number of samples would provide enormous statistical power that would result in statistically significant results for minor differences in CVL.

RESULTS

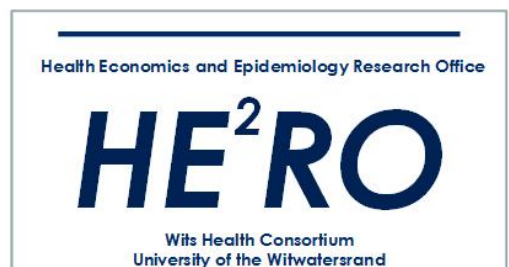
Table 1-Number of subjects, number of VL tests, months observed, mean and geometric viral load, proportions less than detectable, less than 400 cp/ml and less than 1,000 cp/ml.

	Site		
Parameter	Urban Clinic	Cape Town	Johannesburg
Number of Subjects	18,489 ¹	163,214 ¹	368,102 ¹
Median Number of VL Tests (IQR)	4 (2 to 8)	2 (1 to 3)	1 (1 to 2)
Median months observed (IQR)	24 (6 to 49)	0 (0 to 13)	0 (0 to 6)
Proportion Single VL Measurement Only	18.2% (3,374/18,489)	51.0% (83,374/163,385)	67.4% (248,568/368,653)
Mean Viral Load (SE)			
Year 2004	25,047 (12,400)	274,296 (10,437)	257,874 (7,317)
Year 2005	12,575 (1,711)	160,267 (4,628)	195,972 (3,887)
Year 2006	18,563 (2,418)	73,224 (3,303)	181,500 (2,677)
Year 2007	12,246 (1,520)	52,553 (1,879)	192,231 (2,333)
Year 2008	5,450 (1,000)	26,876 (1,034)	75,746 (1,102)
Year 2009	11,008 (3,649)	27,440 (1,060)	75,574 (1,130)
Year 2010	8,378 (2,193)	59,625 (2,194)	120,219 (2,172)
Year 2011	11,093 (1,442)	32,382 (1,145)	82,061 (1,743)
Geometric Mean Viral Load (SE)			
Year 2004	129 (1.10)	5012 (1.07)	7943 (1.05)
Year 2005	123 (1.05)	1259 (1.05)	1995 (1.02)
Year 2006	85 (1.02)	158 (1.02)	1259 (1.02)
Year 2007	76 (1.02)	100 (1.02)	794 (1.02)
Year 2008	63 (1.02)	100 (1.02)	501 (1.02)
Year 2009	72 (1.02)	79 (1.00)	251 (1.00)
Year 2010	66 (1.02)	100 (1.02)	158 (1.00)
Year 2011	91 (1.02)	316 (1.00)	398 (1.00)
Proportion Viral Load Less than Detectable			
Year 2004	61.4% (1,290/472)	30.2% (1,042/3,456)	20.7% (1,287/6,208)
Year 2005	68.5% (1,755/2,563)	43.6% (4,444/10,188)	29.9% (5,424/18,158)
Year 2006	73.4% (3,258/4,441)	68.5% (7,742/11,304)	37.2% (14,148/37,994)
Year 2007	70.6% (4,459/6,312)	73.1% (19,904/27,234)	48.4% (27,236/56,324)
Year 2008	72.7% (5,434/7,472)	65.8% (25,652/38,992)	50.5% (39,954/79,145)
Year 2009	75.0% (6,803/9,068)	74.0% (40,496/54,735)	56.5% (64,137/113,564)
Year 2010	72.7% (7,749/10,663)	53.1% (28,513/53,734)	43.5% (44,312/101,752)
Year 2011	23.4% (2,756/11,776)	18.0% (12,772/70,777)	16.6% (18,234/109,983)
Proportion Viral Load <100 cp/ml			
Year 2004	85.4% (1,403/472)	35.6% (1,229/3,456)	31.7% (1,970/6,208)
Year 2005	85.8% (2,198/2,563)	50.0% (5,089/10,188)	46.2% (8,396/18,158)
Year 2006	89.7% (3,983/4,441)	76.8% (8,677/11,304)	53.2% (20,226/37,994)
Year 2007	91.6% (5,779/6,312)	82.0% (22,330/27,234)	57.6% (32,427/56,324)
Year 2008	93.4% (6,977/7,472)	82.9% (32,308/38,992)	59.5% (47,083/79,145)
Year 2009	92.7% (8,409/9,068)	83.3% (45,602/54,735)	67.5% (76,690/113,564)
Year 2010	93.9% (10,013/10,663)	81.2% (43,622/53,734)	74.7% (76,039/101,752)
Year 2011	79.0% (9,302/11,776)	82.5% (58,380/70,777)	74.6% (82,086/109,983)
Proportion Viral Load <1,000 cp/ml			
Year 2004	89.8% (1,424/472)	37.4% (1,291/3,456)	34.7% (2,154/6,208)
Year 2005	91.3% (2,339/2,563)	51.8% (5,275/10,188)	48.9% (8,882/18,158)
Year 2006	91.2% (4,051/4,441)	78.5% (8,870/11,304)	55.5% (21,070/37,994)
Year 2007	92.8% (5,860/6,312)	83.6% (22,777/27,234)	59.5% (33,524/56,324)
Year 2008	94.8% (7,084/7,472)	84.9% (33,114/38,992)	61.7% (48,843/79,145)
Year 2009	94.3% (8,551/9,068)	85.7% (46,891/54,735)	69.9% (79,372/113,564)
Year 2010	95.2% (10,155/10,663)	83.4% (44,800/53,734)	77.4% (78,728/101,752)
Year 2011	88.5% (10,416/11,776)	84.4% (59,738/70,777)	79.4% (87,287/109,983)

CONCLUSIONS

The large decline in CVL from 2004 to 2011 in two major cities in South Africa provides evidence of a successful treatment program. Depending on the geographic location, the proportion of tests greater than 1,000 copies/ml is between 15% to 20% in 2011. Due to the incomplete matching of the data, we are unable to determine precisely where these people are in their course of treatment (baseline or early versus late failure), but this large proportion does suggest the need to monitor treatment compliance and the development of drug resistance in these populations.

Our next steps are to apply a probabilistic matching algorithm to this data to improve the matching and be able to apply cohort, as well as, cross-sectional monitoring and evaluation indicators to this data. We intend to use this monitoring tool at the district, sub-district and facility level and to evaluate outcomes of HIV control programmes for corrective action and appropriate direction of resources. The long-term success of this program could be improved by wide-scale implementation of unique patient identifiers linked to clinical records.



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