HIV/AIDS in Ethiopia: where is the epidemic heading?

W Hladik, I Shabbir, A Jelaludin, A Woldu, M Tsehaynesh, W Tadesse

Sex Transm Infect 2006;**82**(Suppl I):i32–i35. doi: 10.1136/sti.2005.016592

See end of article for authors' affiliations

Correspondence to: Dr W Hladik, wfh3@cdc.gov

Objectives: A possible decline in prevalence of HIV in some sub-Saharan African countries has been reported recently. The present study aimed to evaluate the prevalence and incidence of HIV and behavioural data to investigate trends in HIV/AIDS in Ethiopia.

Methods: A review was conducted of published reports and literature, raw and modelled (using Epidemic Projection Package and Spectrum software) surveillance data and estimates from antenatal clinics (ANCs) and data from voluntary counselling and testing centres. Observations were restricted to the adult population.

Results: Between 2001 and 2003, more ANC sites showed a decline than a rise in HIV prevalence, but most lacked statistical significance. Modelled data suggested a rise in prevalence of HIV in rural areas (2003: 2.6%) and in all Ethiopia (2003: 4.4%), but a stable or declining prevalence in Addis Ababa (2003: 14.6%) and other urban areas (2003: 11.8%). Modelled HIV incidence, inferred from prevalence changes, showed a slowly rising trend in Addis Ababa (2003: 2.0%), other urban areas (2003: 1.7%), and rural Ethiopia (2003: 0.46%). The total burden of HIV/AIDS is expected also to rise substantially due to population growth. In Addis Ababa, crude data on HIV prevalence from ANCs too suggested a falling trend. Voluntary counselling and testing data from 2002 to 2004 supported this trend but indicated a mixed trend pattern for high risk behaviour. No other serial behavioural trend data were available.

Conclusions: Lack of quality data on behavioural trends impedes the interpretation of prevalence and incidence data in Ethiopia. Modelled data suggest an expanding HIV epidemic in rural and all Ethiopia, but a possible decline in some urban areas. Crude site prevalence values may be more sensitive to acute changes, possibly indicating a slowing/reversal of the epidemic's expansion.

Since the reporting of Ethiopia's first HIV (1984) and AIDS cases (1986),[1] its HIV epidemic has evolved into a generalised epidemic, and AIDS is now the leading cause of morbidity and mortality among adults in Ethiopia.[1] Although among the largest countries in Africa, few published data are available that describe Ethiopia's epidemic on a national scale. The main source for HIV surveillance trend data in Ethiopia is the antenatal clinic (ANC) based HIV sentinel surveillance system, which was established in 1989. It relies on unlinked anonymous testing of left-over blood in selected (sentinel) ANC sites, following World Health Organization (WHO)/Joint United Nations Programme on AIDS (UNAIDS) guidelines.[2] Other sources of surveillance data include case reporting (AIDS, sexually transmitted diseases), and infrequent surveys of the general population or high risk groups. We present here trend data on selected HIV/AIDS indicators and consider the current and possible future course of the HIV epidemic in Ethiopia.

METHODS

We reviewed various sources of data on trends in HIV prevalence and incidence, HIV related risk behaviour, and mortality, including published reports, literature, and routine programme data. All reported data refer to estimates for the adult population.

ANC site data

We used ANC site prevalence data from 1989 to 2003. Individual data were available only for the years 2001 (not for regions Dire Dawa and the Southern Nations Nationalities and Peoples Region (SNNPR)), 2002, and 2003. The number of ANC sites per year expanded from 4 in 1989 to 64 in 2003. Sites serving police and military staff were excluded from this analysis. In 2003, the sample size at each sentinel site varied mostly between 250 and 600 with a total of 23 713 specimens tested. The most reliable and consistent HIV surveillance data are from the capital, Addis Ababa, with an average of 4 (range 1–5) ANC sites per year. We evaluated sentinel sites which were included in at least two of the last three surveillance rounds and assessed whether they showed an increasing or decreasing prevalence. For sites with data for 2001, 2002, and 2003, χ^2 for trend and the corresponding p values were computed using Epi Info 6.04d (Centers for Disease Control, Atlanta, GA).

Modelled HIV/AIDS estimates

Modelled HIV prevalence and incidence estimates were obtained from the Ministry of Health's (MOH's) most recent surveillance reports or generated in the preparation of these reports.[1 3] Briefly, to model, estimate, and project HIV prevalence trends, the Epidemic Projection Package (EPP)[4] software was used. In EPP, the modelled prevalence curve is based on site HIV prevalence values, a start year of the epidemic (urban 1982, rural 1984), the force of infection (the speed at which the infection spreads in the susceptible population), proportion of population at risk, and *phi*, a behavioural variable accounting for changes in risk behaviour during the epidemic's course.[4] For HIV incidence, as well as AIDS incidence and AIDS mortality, we used the Spectrum software.[5] Spectrum applies formulas to compute the various estimates using assumptions such as life expectancy in HIV positives (median 9 years), time from HIV infection to AIDS, and survival after AIDS onset.[5] These default values were accepted, while for others (population size by age group, fertility, overall mortality, proportion urban, and migration)

Abbreviations: AIDS, acquired immune deficiency syndrome; ANC, antenatal clinic; HIV, human immunodeficiency virus; MOH, Ministry of Health; STI, sexually transmitted infection; VCT, voluntary counselling and testing

Ethiopian census data from 1994 were used and projected to the year of interest. For the time period reported here, antiretroviral treatment and prevention of mother to child transmission programmes were still in their infancy and their impact on HIV/AIDS parameters were not considered. The EPP and Spectrum based estimates for Ethiopia were weighted for regional urban and rural population sizes. A passive surveillance system exists for facility based reporting of AIDS cases and STIs, but this was not used due to substantial underreporting.

Behavioural and mortality estimates

Serial voluntary counselling and testing (VCT) programme data were available from two VCT centres in Addis Ababa for the years 2002–04; the ''Organization of Social Services for AIDS'' (OSSA, hospital based) and Zewditu (free standing). Data from the two centres were merged and trends in the frequencies of selected behavioural variables obtained. Mortality data from Addis Ababa cemeteries for the years 1988–2000 were recently analysed by Sanders *et al*[6] and are cited here.

RESULTS

Site specific HIV prevalence

In 2003 the median prevalence at ANC sites was 7.8% (urban: 11.2%, rural: 2.8%), with a range of 0.5–24.0%. Of 64 sites in 2003, 40 (31 urban, 9 rural) sites also had been sampled in 2002 or 2001. Compared with the 2002 surveillance round (2001 for sites not included in 2002), 14 (35%) of the 40 sites showed an increase in prevalence (urban: 11/31 (36%), rural: 3/9 (33%)); 25 sites (62.5%) showed a decline in prevalence (urban: 19/31 (61%), rural: 6/9 (67%)); 1 site (urban) showed no change. Restricting sites to Addis Ababa, the median site specific HIV prevalence in ANC attendees rose steadily to 18.2% until 1997, then declined significantly to 16.0% (2000) and 11.8% (2003; $p<0.001$). Of sites with data for all three years ($n = 26$), 5 (26%) experienced significant declines in HIV prevalence, whereas 1 (4%) showed a significant rise (table 1). Restricting ANC client age to 15–24 years at the same sites (age data were available for 39 sites), urban HIV prevalence decreased at more sites (69%) than increased (31%). Rural site HIV prevalence also declined more often (78%) than increased (22%). Of 19 sites with age and trend data, only 6 (32%) showed significant prevalence trends, all of them declining (table 1).

Table 1 HIV prevalence (%) for ANC sites with data from 2001 to 2003

		15–49 year olds			15–24 year olds		
Setting	Name of site	2001	2002	2003	2001	2002	2003
Addis Ababa	Gulele	15.8	12.3	12.4	12.9	10.8	10.1
Addis Ababa	Higher 23	12.3	10.2	11.8	15.7	4.9	13
Addis Ababa	*Kazanchis**	*17.7*	*15.1*	*11.6*	*16.1*	*12.7*	*8.0*
Addis Ababa	Teklehymanot	16.6	15.1	15.1	16	16.3	16.4
Other urban	Awassa	10	11.1	8.8	–	–	–
Other urban	Bahir Dar (HC)	23.4	20.0	20.2	21.5	20.3	18.5
Other urban	*Bahir Dar (Hsp)**	19.9	21.0	16.9	*24.6*	*18.2*	*15.8*
Other urban	Dilla	9.8	11.5	12.1	–	–	–
Other urban	Diredawa (HC)	8.5	11.6	*7.7*	8.4	12.7	9.5
Other urban	Diredawa (Hsp)	15.2	12.1	14.4	–	–	–
Other urban	Estie	10.7	8.9	11.7	10.3	8.6	13.6
Other urban	Gambella	14.6	15.4	18.7	–	–	–
Other urban	Gonder HC	15.1	18.3	13.9	15.1	13.9	13.8
Other urban	Hiywot Fana	9.4	12.8	7.8	10.6	4.5	8.8
Other urban	*Hossana**	*5.9*	*6.0*	*12.4*	–	–	–
Other urban	*Jijiga**	*19*	*15.7*	*7.3*	*16.3*	*17.5*	*6*
Other urban	Jimma	8.6	16.9	10.2	*7.6*	16.9	9.8
Other urban	*Mekele**	*17.2*	*16.8*	*9.3*	*15.5*	*16.5*	*8.3*
Other urban	Mettu	10.5	11.6	10.8	7.4	11.1	9.0
Other urban	*Nazareth (Adama)**	*18.7*	*16.0*	*10.8*	*19.4*	*16.0*	*11.0*
Other urban	Nekemet	9.1	11.3	13.0	9.2	13.1	11.6
Other urban	Soddo	11.6	12.2	11.2	–	–	–
Rural	*Aira**	*2.6*	*2.0*	*0.5*	*7.3*	*2.2*	*0.6*
Rural	Attat	1.5	2.3	1.8	–	–	–
Rural	Borena Dadim	1.7	0.9	1.0	0.6	0.0	0.5
Rural	Borena Gosa (Bore)	1.7	0.5	2.5	1.6	1.4	2.9

*Site names and data with significant trends over time are in *italics*.
– Missing age data.
HC, health centre; hsp, hospital.

Modelled national estimates

A total of 181 site prevalence data points (urban: 126, rural: 55) from all surveillance rounds were available for modelling and projecting HIV related estimates for the years 1982–2008. The modelled adult HIV prevalence estimates for urban (Addis Ababa and other), rural, and all Ethiopia are shown in fig 1A.[1] For all Ethiopia, the modelled prevalence curve rises steadily, reaching 4.4% by 2003. The estimated trend in rural Ethiopia parallels that for all Ethiopia, increasing to 2.6% by 2003. Both trends appear to continue until the last projected year, 2008. In contrast, the estimated HIV prevalence for Addis Ababa and other urban areas peaked in 1996 at 15.6% and 12.7%, respectively, before declining slightly to 14.6% and 11.8% by 2003, respectively, suggesting a levelling-off for the following years. The modelled adult HIV incidence for all Ethiopia (fig 1B) shows a steady but slow growth to 0.68% in 2003 and stabilises for the years 2004–08. For rural Ethiopia the modelled HIV incidence suggests a steady increase over the years, reaching 0.46% in 2003, and it is projected to remain at this level in the following years. Mirroring the rapid rise in urban HIV prevalence during the late 1980s and early 1990s, the corresponding HIV incidence for Addis Ababa and other urban areas was estimated at a much higher

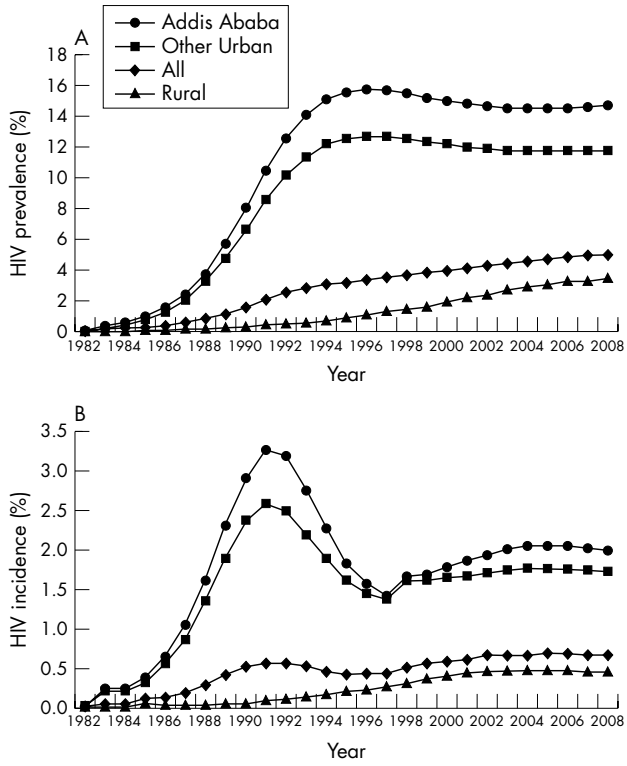

Figure 1 (A) Modelled HIV prevalence in adults aged 15–49 years, Ethiopia, 1982–2008. (B) Modelled HIV incidence in adults aged 15–49 years, Ethiopia, 1982–2008.

level during that period, peaking in 1991 at 3.3% and 2.6%, respectively, before declining to 1.4% in all urban areas until 1997, and rising again modestly to 2.0% and 1.7% by 2003 in Addis Ababa and other urban areas, respectively.

The estimated number of people living with HIV/AIDS rises rapidly in both urban and rural Ethiopia for every projected year between 1983 and 2008, driven by the increasing severity of the epidemic and/or population growth. By 2000, the number of people living with HIV/AIDS is estimated to have reached 660 000 and 490 000 in urban and rural areas, respectively, growing to 720 000 and 750 000, respectively, by 2003. The number of new, incident HIV infections shows a continued rise, plateauing only during the mid-1990s. In 2000, 80 000 and 106 000 new HIV infections are estimated to have occurred in urban and rural Ethiopia, respectively, rising to 95 000 and 137 000 in 2003.

Few data on HIV/AIDS related programmes exist that are suitable for data interpretation, and no trend data on AIDS mortality or behavioural indicators are available. Sales figures for condoms for all Ethiopia show a steady increase throughout the 1990s, reaching 49.9 million in 2000 and peaking at about 67 million in 2002 and 2003 (A Woldu, Addis Ababa, Disease Prevention and Control Department, Ministry of Health, Ethiopia, personal communication, 2005).

Behavioural and mortality data

Between 2002 and 2004, 19 531 clients visited OSSA VCT centre, and 15 534 clients visited Zewditu (age range 15–83 years), both located in Addis Ababa. At both VCT centres, the total number of clients per year rose sharply from 2002 to 2004 (data not shown). Client records were excluded from analysis if the recorded reason for VCT was illness (n = 1256; 3.6%), a repeat HIV test (n = 800; 2.3%), confirming a previous HIV positive result (n = 778; 2.2%), or antiretroviral treatment initiation (n = 12; <0.01%). Also excluded were clients stating that they had never had sex (n = 6815; 19.4%), clients aged ⩾50 years, and records without information regarding use of condoms. All trends reported here were similar for each of the two sites (data not shown). The median age of clients included in the analysis (n = 17 966, all years) was 26 years and 52.9% were men. HIV prevalence declined from 29.1% (2002) to 22.2% (2003) and 14.9% (2004) for adults aged 15–49 years ($p<0.001$), and from 22.0% to 15.9% and 9.0% (2002–04, $p<0.001$) for clients aged 15–24 years. The mean number of casual partners reported in the three months prior to testing declined among all clients over the three years from 1.0 to 0.6 (2002–04, $p<0.001$); a similar decline was seen among 15–24 year old clients alone, falling from 1.5 to 0.6 ($p<0.001$). However, among all adult clients and those aged 15–24 years alone, the proportion reporting never using condoms consistently exceeded 60%, while the proportion of clients reporting having used condoms at their last sexual intercourse never exceeded 35%. These values did not change significantly over time except for a rising trend among clients aged 25–49 years who reported never using condoms (data not shown).

Sanders *et al*[6] investigated retrospective burial data from three Addis Ababa cemeteries in the period 1987–2001 and prospectively from 70 additional cemeteries during 2001. The all-cause mortality ratios of 25–49 year olds versus 5–14 year olds increased by 8.5% ($p<0.05$) per calendar year. Mortality among 30–35 year olds was approximately five times higher in 2001 than it was in 1984. The authors attributed this excess mortality largely to the HIV epidemic.

DISCUSSION

We reviewed published, MOH, and non-government organisation owned trend data related to HIV/AIDS in an attempt to interpret the course of the epidemic in Ethiopia. ANC site HIV prevalence estimates from 2003 suggested a heterogeneous epidemic in the country, with the highest site prevalence being 48 times that of the lowest. Such heterogeneous spread had already been reported earlier for Addis Ababa alone[7] and among army recruits in the four largest regions.[8] Of note, both army recruit data on 72 000 rural and urban recruits (1999/2000) and the ANC surveillance system suggest that the highest HIV prevalence is in Amhara region (data not shown). Where serial ANC data for 2001–03 were available, more sites suggested a declining prevalence rather than an increasing one; this observation was even more pronounced among the younger ANC clients. For most sites significant trends were not observed or trend analysis was not feasible, but of those with significant changes, most showed a decline in prevalence. Of note, most rural sentinel surveillance sites operating in 2003 were new and did not contribute to trend observations. The modelled HIV prevalence estimates suggested a sustained rise for all Ethiopia and the rural areas (approximately 85% of Ethiopians live in rural areas) and a plateauing or declining trend for urban Ethiopia. A declining trend in urban HIV prevalence was also suggested for the capital Addis Ababa alone and was even more pronounced in unmodelled trend data and in VCT clients. Similar observations for Addis Ababa were made in the past by other investigators with a noted parallel decline in the prevalence of syphilis.[9] The MOH reported modelled HIV prevalence curves may be less sensitive to acute changes in prevalence than crude same-site observations imply, especially where the ''best fit'' curves were accepted, as was the case with most urban estimates in the MOH report. The contrast between the rather stable HIV incidence rates and the growing absolute number of people living with HIV/AIDS may largely be explained by Ethiopia's rapid population growth, estimated at an annual 2.6%,[10] and offsetting the modest decline in the modelled urban HIV prevalences. Although the HIV incidence estimates presented here are based on estimated annual changes in HIV prevalence and mortality assumptions, at least one estimate (Addis Ababa, 1994: 2.3%) is corroborated by a similar figure (2.1–2.4%) in the literature.[7] The linkage of modelled estimates with census data allowed the demonstration of the burden of HIV/AIDS disease shifting from urban to rural Ethiopia despite lower HIV prevalence estimates in rural Ethiopia. This is because of rural Ethiopia's larger population share and the faster pace at which the epidemic is expanding there.

Interpretation of trends in incidence and prevalence with behavioural data was limited to Addis Ababa as no behavioural trend data on a national level were available for analysis. Even in the capital, trend data were available from only two VCT centres. The falling HIV prevalence observed in ANC clients since the late 1990s was paralleled by an even steeper decline in prevalence from 2002 onwards

Key messages

- Ethiopia faces a generalised and expanding HIV/AIDS epidemic with a rising trend in (modelled) HIV prevalence and stable incidence.
- The epidemic appears to be intensifying in rural Ethiopia, whereas data suggest a slowing in urban Ethiopia, and a decline in the capital Addis Ababa.
- A paucity of data impedes a better understanding of the epidemic's dynamics, caused by a relative lack of data from population based HIV surveys, serial behavioural surveys, high risk group surveillance, and vital registration systems.

among VCT clients, and was more pronounced among younger VCT clients. The reported use of condoms among VCT clients was alarmingly low and did not improve over the three year observation period, and other behavioural indicators helped explain the fall in HIV prevalence. However, these data need to be interpreted with caution as they may be subject to participation bias due to changing proportions of high/low risk clients attending VCT centres over time. Sanders *et al*'s work on burial data confirms the rapid rise in mortality burden due to HIV/AIDS in the 1990s although they may have less value in interpreting the epidemic's current dynamic.

Although HIV/AIDS sero-surveillance activities have been ongoing since 1989, the HIV/AIDS related health information system remains limited in quantity and quality, as has already been observed previously.[11] Most national HIV/AIDS estimates are derived from modelling serial ANC based HIV prevalence data linked to census data. No behavioural trend data based on surveys are available. Repeat sero-behavioural surveys would greatly enhance the current poor understanding of the determinants and dynamics of Ethiopia's HIV epidemic, yet the last HIV sero-survey based on the general population dates back to the early 1990s. Similarly, no or few recent surveillance data on high risk groups, STIs, or vital events (AIDS mortality) exist or are readily available for public health planning. The lack of such data makes interpretation of the remaining trend data difficult and unreliable with the exception of trends in ANC based HIV prevalence. A concerted effort to supplement the existing ANC surveillance system with additional data sources is needed to increase the understanding of the epidemic and its determinants. The Demographic and Health Survey (DHS) currently underway in Ethiopia will improve data interpretation by comparing results with the DHS 2000. In summary, our modelled estimates suggest a continuing rise in HIV prevalence for rural and all Ethiopia from the 1980s to the last projected year, 2008, whereas the urban HIV epidemic appears to have peaked in the mid-1990s. A significant downward trend in HIV prevalence may be occurring at least in the capital Addis Ababa, as indicated by prevalence data from ANC and VCT sites.

AUTHORS' CONTRIBUTIONS

W Hladik reviewed available data and literature, analysed the data, and wrote the manuscript. I Shabbir analysed data and co-wrote the manuscript. J Ahmed analysed and generated HIV/AIDS estimates using ANC surveillance data and contributed to the manuscript writing. A Woldu provided data and took part in data analysis. T Messele and T Wuhib contributed to manuscript writing.

Authors' affiliations

W Hladik, Global AIDS Program, National Center for HIV, STD, and TB Prevention, Centers for Disease Control and Prevention, Entebbe, Uganda
I Shabbir, A Jelaludin, W Tadesse, Global AIDS Program, Centers for Disease Control and Prevention, Addis Ababa, Ethiopia
A Woldu, Disease Prevention and Control Department, Ministry of Health, Addis Ababa, Ethiopia
M Tsehaynesh, Ethiopian Health and Research Nutrition Institute, Addis Ababa, Ethiopia

Competing interests: none declared

The findings and conclusions in this report are those of the authors and do not necessarily represent the views of the centers for Disease Control and Prevention.

Address for reprints: S Ismail, CDC-Ethiopia, US Embassy, Entoto Road, PO Box 1014, Addis Ababa, Ethiopia; ismails@etcdc.com

REFERENCES

1 **Disease Prevention and Control Department**. *AIDS in Ethiopia, 5th edn*. Addis Ababa: Disease Prevention and Control Department, Ministry of Health 2005.
2 **UNAIDS/WHO Working Group on Global HIV/AIDS/STI Surveillance**. *Guidelines for conducting HIV sentinel serosurveys among pregnant women and other groups*. Geneva: UNAIDS/WHO Working Group on Global HIV/AIDS/STI Surveillance, 2003.
3 **Disease Prevention and Control Department**. *AIDS in Ethiopia, 5th edn*. Technical Document. Addis Ababa: Disease Prevention and Control Department, Ministry of Health, 2005.
4 **Ghys PD**, Brown T, Grassly NC, *et al*. The UNAIDS Estimation and Projection Package: a software package to estimate and project national HIV epidemics. *Sex Transm Infect* 2004;**80**(suppl 1):i5–i9.
5 **Stover J**. Projecting the demographic consequences of adult HIV prevalence trends: the Spectrum Projection Package. *Sex Transm Infect* 2004;**80**(suppl 1):i14–i18.
6 **Sanders EJ**, Araya T, Kebede D, *et al*. Mortality impact of AIDS in Addis Ababa, Ethiopia. *AIDS* 2003;**17**:1209–16.
7 **Fontanet AL**, Messele T, Dejene A, *et al*. Age- and sex-specific HIV-1 prevalence in the urban community setting of Addis Ababa, Ethiopia. *AIDS* 1998;**12**:315–22.
8 **Abebe Y**, Schaap A, Mamo G, *et al*. HIV prevalence in 72 000 urban and rural male army recruits, Ethiopia. *AIDS* 2003;**17**:1835–40.
9 **Tsegaye A**, Rinke De Wit TF, Mekonnen Y, *et al*. Decline in prevalence of HIV-1 infection and syphilis among young women attending antenatal care clinics in Addis Ababa, Ethiopia: results from sentinel surveillance, 1995–2001. *J Acquir Immune Defic Syndr* 2002;**30**:359–62.
10 **Office of Population and Housing Census Commission**. The 1994 Population and Housing Census of Ethiopia: Results at Country Level; Volume II Analytical Report. Addis Ababa: Federal Democratic Republic of Ethiopia; Office of Population and Housing Census Commission–Central Statistical Authority, 1999.
11 **Kebede D**, Aklilu M, Sanders E. The HIV epidemic and the state of its surveillance in Ethiopia. *Ethiopian Med J* 2000;**38**:283–302.