

HIV-associated morbidity, mortality and diagnostic testing opportunities among inpatients at a referral hospital in northern Tanzania

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Hospitalized patients with HIV infection are among the most likely to benefit from the expanding availability of anti-retroviral therapy in sub-Saharan Africa. Between 1990 and 2000, 3667 people known to be HIV-infected were admitted to Kilimanjaro Christian Medical Centre (KCMC) in Moshi, northern Tanzania. The level of inpatient mortality among these patients varied from 15%–21%, and the proportion of the HIV-infected patients admitted who were female increased significantly, from 45% at the start of the study period to 52% at the end ($P < 0.001$). When the medical records for 1683 of the HIV-infected patients who had been admitted between 1996 and 2001 were reviewed, the most prevalent diagnoses on admission were found to be pulmonary tuberculosis (21%), malaria (14%) and gastro-enteritis/diarrhoea (12%) among the adults, and non-tubercular pulmonary infection (21%), pulmonary tuberculosis (19%) and gastro-enteritis/diarrhoea (12%) among the children. The crude odds ratios (OR) for inpatient death were greatest for adults presenting with meningitis [OR = 3.7; 95% confidence interval (CI) = 2.1–6.7], septicaemia (OR = 2.9; CI = 1.2–7.3) or renal disease (OR = 2.6; CI = 1.2–5.7), and mortality was higher for men than for women (OR = 1.4; CI = 1.1–1.8). A single-day, point-prevalence survey in September 2001, among the KCMC's inpatients, identified HIV infection in 21% of those surveyed, many (44%) of the patients found positive being previously unaware of their infection. HIV infection remains a major cause of hospitalization and mortality in Moshi. A policy of routine testing would increase the number of HIV infections detected, allowing improvements in case management and in the prevention of infection.

Of the 42 million people living with HIV/AIDS at the end of 2002, over 70% resided in sub-Saharan Africa, making it easily the most affected region of the world (Anon., 2002). In Tanzania, by the end of 2001, approximately 2.2 million individuals aged ≥ 15 years were living with HIV/AIDS — a 3% increase from the previous year. In the Kilimanjaro region, the prevalence of HIV

infection among women attending some antenatal clinics has nearly tripled since 1992, with estimates for 1997–2000 ranging from 17% to 20% (Anon., 2003). Between 1992 and 1998, across 51 villages surveyed in the Hai district of this region, HIV/AIDS accounted for 57% of all deaths, reflecting the dramatic impact HIV has made among young, sexually active adults (Setel *et al.*, 2000). Unfortunately, in Tanzania, as in other countries in sub-Saharan Africa, many of those infected with HIV are unaware of their serostatus. This not only hampers

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efforts to prevent transmission of the virus but also limits the efficacy of the treatment and care services. The problem of the late recognition of many cases of HIV infection is beginning to be addressed by the development of a growing number of sites for voluntary counselling and testing (VCT). Many opportunities to detect seropositive individuals are still missed, however, because many hospitalized individuals are not routinely offered HIV tests.

As increased international attention and resources are focused on the AIDS crisis in sub-Saharan Africa and plans for more intensive and effective therapeutic interventions are developed, it has become increasingly important to describe the clinical manifestations of HIV infection among hospitalized patients. Such patients are particularly likely to have advanced HIV-attributable disease and most of them could derive immediate benefit from anti-retroviral medications. Although there have been some hospital-based surveys of HIV-associated morbidity and mortality in sub-Saharan Africa (Tembo *et al.*, 1994; Arthur *et al.*, 2000; Lewis *et al.*, 2003), including other regions of Tanzania (Kwesigabo *et al.*, 1999), there has been none in northern Tanzania. Recently, a policy of offering VCT to everyone admitted to hospitals in sub-Saharan Africa has been advocated (De Cock *et al.*, 2002). However, the number of additional HIV infections that might be detected if this strategy were implemented has not been estimated.

In the present study, the clinical characteristics of HIV infection and HIV seroprevalence, among patients admitted to the major referral hospital in northern Tanzania, were determined. For this, the medical records of patients found to be HIV-positive over an 11-year period were reviewed, and a cross-sectional seroprevalence survey was conducted among the hospital's inpatients. To estimate the proportion of HIV infections missed by a testing policy based on clinical and behavioral criteria, the data obtained routinely, following this policy, were compared with those of the cross-sectional survey.

PATIENTS AND METHODS

Study Site

Kilimanjaro Christian Medical Centre (KCMC) is located in the Moshi municipality in the Kilimanjaro region of northern Tanzania. As one of four national referral centres, the 450-bed hospital serves those (>10 million) living in the Northern and Central zones of Tanzania. In addition, the KCMC hosts a medical school and 15 other schools of allied health sciences. In 2001, 17,812 admissions and 1121 inpatient deaths were recorded in the KCMC, and bed occupancy was nearly 100%.

Hospital-inpatient Series

Between 1990 and 2001, all patients suspected by clinicians at the KCMC to be at relatively high risk of HIV infection were offered HIV testing; such testing was not offered routinely to all inpatients. In following the relevant guidelines of the World Health Organization (WHO, 1997), each patient who consented to HIV testing was checked for anti-HIV antibodies using two rapid tests, commonly the Capillus[®] HIV-1/HIV-2 rapid test (Trinity Biotech, Bray, Ireland) and the Vironostika[®] HIV Uni-Form II Ag/Ab microwell enzyme immunoassay (bioMérieux, Marcy l'Etoile, France). Demographic information and the status of the patient at discharge were extracted from the KCMC's discharge and HIV-testing logs. An additional set of data, based on a retrospective review of medical records, was generated for patients admitted between 1997 and 2001, using a standardized form. These data included patient age, gender, status at discharge, and admission diagnoses. The recorded admission diagnoses reflected the opinions of the senior consultant physicians who reviewed each case on the day of his or her admission; if further investigation resulted in an alternate, definitive diagnosis, this was recorded as the admitting diagnosis. For analysis, composite diagnostic categories were formulated, by combining aetiologically

or syndromically related diagnoses, to shorten the long list of diagnoses observed in the medical records. Any patient aged > 13 years was considered an adult.

Cross-sectional Seroprevalence Survey

To assess the seroprevalence of HIV among some of the KCMC's inpatients and, specifically, to help determine what percentage of HIV infections was being routinely detected, a point-prevalence survey was performed on 18 September 2001. The protocol for this survey was approved by the Research Ethics Committee at KCMC, and patients were enrolled only after their informed consent (or that of a parent/guardian, if the patient was a child) had been obtained. All patients on the general medical and paediatric wards at the KCMC were invited to participate in the study. Patients who were younger than 6 months of age, those in the intensive care unit and those receiving private medical care were excluded from the study.

Prior to the survey, clinical information, including recorded HIV serostatus (if known), was abstracted from the routine medical records for the subjects. The subjects were asked about their medical histories and given physical examinations to see if, according to the World Health Organization's case definition (WHO, 1994), they had AIDS. Four drops of blood from each subject, collected from a fingerprick, were transferred to filter paper, allowed to air dry, and sealed in plastic for transfer to Duke University's Medical Center (in Durham, NC). A waiver for the anonymised testing of the dry blood spots, for anti-HIV antibody, was granted by Duke University's Institutional Review Board. The dried blood was eluted from the filter paper so that it could be tested in the Vironostika® HIV-1 micro-ELISA (Organon Teknika, Durham, NC) according to the manufacturer's instructions. Every sample found positive was tested again, using the same kit, and only samples found positive twice were

considered to have come from seropositive patients.

Statistics

All of the statistical computations and comparisons were made using version 4.04 of the JMP software package (SAS Institute, Cary, NC) and Epi Info 2002 (Centers for Disease Control and Prevention, Atlanta, GA).

RESULTS

Hospital-inpatient Series

The number of patients known to be seropositive for HIV increased approximately 2-fold from the first half of the study period to the second (see Figure), and the male:female ratio for the known seropositives gradually decreased so that, from 1998, there was a preponderance of females (χ^2 test for trend; $P < 0.001$). The proportion of identified seropositives who were female was consistently < 50% between 1990 and 1996 (with a low of 38% in 1994) and consistently > 50% from 1998. The inpatient mortality for the known seropositives generally increased over the study period, varying from 14.6% to 21.2% for each calendar year.

Between 1997 and 2001, 1553 adults — 814 (52%) women and 739 (48%) men — known to be seropositive for HIV were inpatients at the KCMC. The median age and (range) of these 1553 adults was 35 (13–92) years. Among the known seropositive patients, the females were significantly younger (median = 33 years; range = 13–92 years) than the males (median age = 38 years; range = 14–80 years; $P < 0.001$). Data on in-hospital mortality were available for 1549 of the patients; the median age and (range) of the 386 patients known to have died while hospitalized was 36 (13–77) years, the known seropositives who were male being more likely to die in hospital than their female counterparts [28% *v.* 22%; odds ratio (OR) = 1.4; 95% confidence interval (CI) = 1.1–1.8; $P = 0.004$].

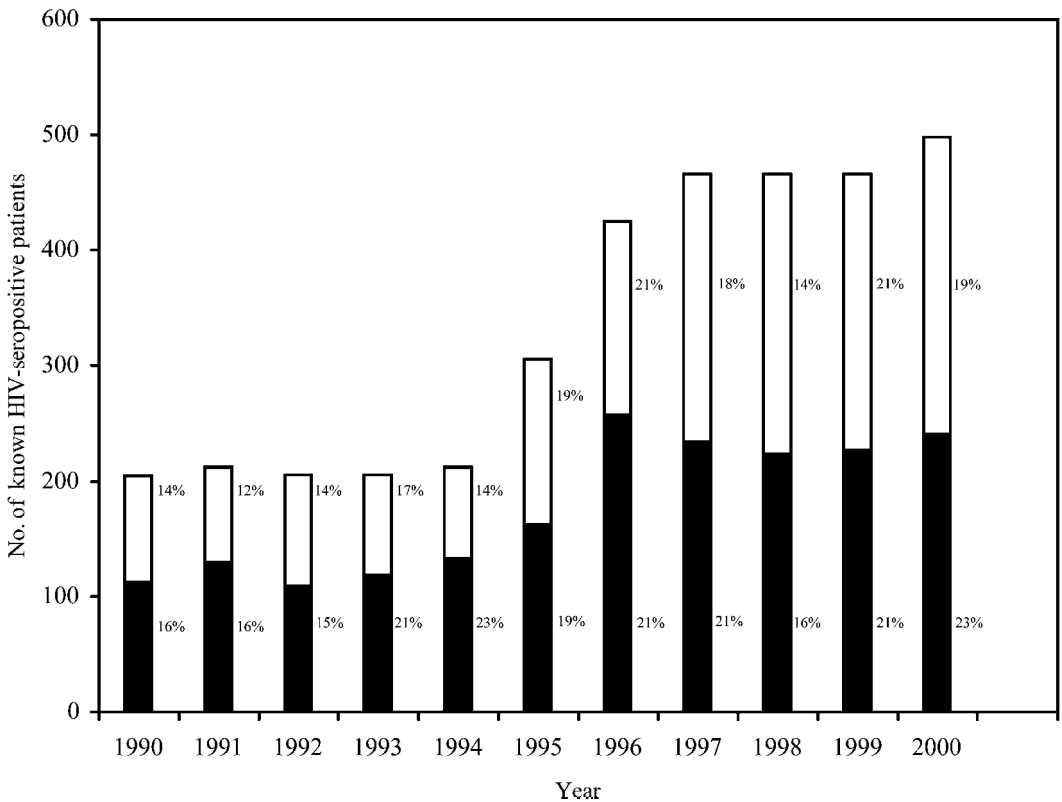


FIG. The annual numbers of male (■) and female (□) inpatients at the Kilimanjaro Christian Medical Centre who were known to be infected with HIV. The percentages shown next to the bars indicate the corresponding levels of inpatient mortality.

Table 1 lists the diagnostic categories assigned to 1242 HIV-infected adult patients between 1997 and 2001 and the level of inpatient mortality among those with each of these diagnoses. The most common diagnosis, for the adults known to be HIV-positive, was pulmonary tuberculosis (21%), followed by malaria (13.6%), gastro-enteritis/diarrhoea (12.2%) and non-tubercular pulmonary infection (10.1%). Taken together, pulmonary infections accounted for nearly one-third of all admissions. Central-nervous-system disease was more frequently recorded in the women than in the men (47 cases *v.* 26; OR = 1.7; $P=0.034$) but the women were less likely to have Kaposi's sarcoma (15 *v.* 30; OR = 0.4; $P=0.009$) and renal disease (nine *v.* 18; OR = 0.5; $P=0.04$) than the men. No significant gender differences

were seen among the other diagnoses. With the exception of intra-abdominal infections, which tended to occur in the older patients (median age = 42 years; range = 24–57 years), there was little variation in the median patient age across the diagnostic categories. The frequencies of in-hospital death were relatively high for those presenting with meningitis (OR = 3.7; CI = 2.1–6.7), septicaemia (OR = 2.9; CI = 1.2–7.3), renal disease (OR = 2.6; CI = 1.2–5.7) or non-tubercular pulmonary infection (OR = 1.9; CI = 1.3–2.8).

Table 2 shows the diagnoses assigned to 130 paediatric patients (aged 1.5–12 years) who were known to be positive for anti-HIV-1 antibody. High prevalences of chest disease, particularly of non-tubercular pulmonary infection, were noted in this population.

TABLE 1. Diagnoses assigned to 1242 HIV-infected adult inpatients at the Kilimanjaro Christian Medical Centre between 1997 and 2001

Diagnostic category*	N	Prevalence (%)	Female:male ratio	Median age (years)	No. of inpatient deaths	Mortality (%)	Crude odds ratio and (95% confidence interval) for inpatient mortality†
Pulmonary tuberculosis	262	21	1.0	37	62	24	1.0 (0.7–1.4)
Malaria	169	14	1.1	34	52	31	1.5 (1.1–2.2)
Gastro-enteritis/diarrhoea	152	12	1.1	34	31	20	0.8 (0.5–1.2)
Non-tubercular pulmonary infection	126	10	0.9	36	45	36	1.9 (1.3–2.8)
Oral candidiasis	114	9	1.4	35	22	19	0.7 (0.5–1.2)
Anaemia	73	6	1.1	36	25	34	1.7 (1.0–2.9)
Central-nervous-system disease	73	6	1.8	37	20	27	1.2 (0.7–2.1)
Dermatitis	48	4	1.1	37	1	2	0.1 (0.01–0.4)
Meningitis	46	4	1.0	34	24	52	3.7 (2.1–6.7)
Kaposi's sarcoma	45	4	0.5	33	6	13	0.5 (0.2–1.1)
Extrapulmonary tuberculosis	43	4	1.2	35	9	21	0.8 (0.4–1.8)
Cardiac disease	34	3	1.1	35	10	29	1.3 (0.6–2.8)
Renal disease	27	2	0.5	35	12	44	2.6 (1.2–5.7)
Malignancy‡	27	2	2.0	37	5	19	0.7 (0.3–1.9)
Urinary-tract infection	24	2	1.7	34	4	17	0.6 (0.2–1.9)
Lymphoma	23	2	0.6	38	5	22	0.9 (0.3–2.4)
Septicaemia	19	2	1.4	33	9	47	2.9 (1.2–7.3)
Skin/soft-tissue infection	18	1	0.6	35	1	6	0.2 (0.02–1.4)
Sexually transmitted disease	18	1	2.6	36	5	28	1.2 (0.4–3.5)
Intra-abdominal infection	16	1	1.3	42	0	0	–
Cryptococcosis	13	1	1.2	35	3	23	1.0 (0.3–3.5)
Otitis media	8	1	1.7	36	3	38	1.9 (0.5–8.1)
Other, unclassified diagnoses	142	11	1.2	35	18	13	0.6 (0.4–1.0)

* Multiple diagnoses per patient were possible; the mean number of diagnoses/patient was 1.2 (with a range of one to three).

† Calculated with death as the dependent variable and diagnostic category as the independent variable.

‡ Other than Kaposi's sarcoma or lymphoma.

TABLE 2. Diagnoses assigned to 130 HIV-infected paediatric inpatients (aged 1.5–12 years) at the Kilimanjaro Christian Medical Centre between 1997 and 2001

Diagnostic category*	N	Prevalence (%)	Median age and (range) (years)	No. of inpatient deaths	Crude odds ratio and (95% confidence interval) for inpatient mortality†
Non-tubercular pulmonary infection	27	21	4 (1.5–10)	8	2.3 (0.8–6.1)
Pulmonary tuberculosis	25	19	4 (2–12)	3	0.5 (0.1–2.0)
Gastro-enteritis/diarrhoea	16	12	3 (1.5–10)	6	3.2 (1.0–9.9)
Malnutrition	15	11	3 (2–9)	6	3.6 (1.1–11.3)
Malaria	14	11	3.5 (2–11)	3	1.2 (0.3–4.8)
Otitis media	6	5	4 (2–12)	0	–
Anaemia	7	5	4 (2–9)	2	1.8 (0.3–10.1)
Extrapulmonary tuberculosis	10	8	9 (2–10)	0	2.0 (0.5–8.5)
Septicaemia	7	5	3 (2–9)	1	3.6 (0.8–17.4)
Kaposi's sarcoma	6	5	3.5 (2–8)	1	0.9 (0.1–7.8)
Other	16	19	4 (1.5–12)	1	0.3 (0.03–2.1)

*Multiple diagnoses per patient were possible.

†Calculated with death as the dependent variable and diagnostic category as the independent variable.

Whereas the median age for most of the diagnostic categories was quite young, that for extrapulmonary tuberculosis was relatively high, at 9 years (range = 2–10 years).

Cross-sectional Seroprevalence Survey

Of the 61 adults on the general wards and 29 children on the paediatric wards offered testing on 18 September 2001, consent was provided by 58 of the adults (median age = 45 years; range = 20–94 years) and by the guardians of 25 children (median age = 1.9 years; range = 0.7–14 years). Only the 16 children who were aged >18 months and for whom consent had been obtained were tested. Twelve (21%) of the 58 adults tested and four (25%) of the 16 children were seropositive for HIV. Four (33%) of the seropositive adults were not known to be HIV seropositive when tested. One of the four seropositive children was previously thought to be seronegative and two others had unknown serostatus when tested in the survey. No significant differences in sex or age were found between those testing positive for anti-HIV antibodies and those who tested negative. Of those tested, 15% of the 26 women and 25% of the 32 men were found seropositive ($P = 0.3686$). The adult seropositives were generally younger than

the adult seronegatives, with mean ages of 44 and 52 years, respectively ($P = 0.2415$). For the adult inpatients, the sensitivity of the World Health Organization's case definition for AIDS surveillance was 0.58 (CI = 0.31–0.74). In terms of specific symptoms and signs, the sensitivity was 0.75 (CI = 0.47–0.91) for weight loss, 0.33 (CI = 0.47–0.91) for chronic diarrhoea, 0.50 (CI = 0.25–0.75) for prolonged fever, 0.58 (CI = 0.32–0.81) for cough, and 0.25 (CI = 0.09–0.53) for thrush.

DISCUSSION

This article describes the diagnoses and mortality associated with HIV infection in a large referral hospital for the Northern zone of Tanzania, based on retrospective but systematic review of medical records. The present findings are consistent with those of other researchers in sub-Saharan Africa, in highlighting the considerable morbidity and mortality of HIV/AIDS seen in a relatively young and potentially economically-productive population and the large number of missed cases. It is clear that a more aggressive testing strategy would markedly increase the numbers of HIV infections being identified.

Significant gender differences in case age and mortality were noted. The longitudinal data reveal a decreasing male:female ratio for those hospitalized with known HIV infection, and the women known to be seropositive were, in general, approximately 5 years younger than the men. Similar age differences have been noted in hospital-based studies in Kenya, Uganda and Malawi (Tembo *et al.*, 1994; Arthur *et al.*, 2000; Lewis *et al.*, 2003). It remains unclear why the hospitalized seropositive women are generally younger than the men but this may reflect gender differences in age at acquisition of HIV (Fylkesnes *et al.*, 1998), health-seeking behaviour, and/or in the rate of disease progression. In the present study, the women with (known) HIV infections were less likely to die in hospital than the men (22% *v.* 28%; $P = 0.004$). Others have noticed more striking differences in gender-associated mortality in sub-Saharan Africa, speculating that cultural reasons may account for such variation. Compared with very sick men, for example, very sick women may be less likely to be taken to hospital (Arthur *et al.*, 2000).

The most prevalent diagnoses on admission recorded in the adults known to be seropositive were pulmonary tuberculosis, malaria, gastro-enteritis/diarrhoea and non-tubercular pulmonary infection. With the exception of malaria, these diagnoses are similar to those reported among seropositives from other regions of sub-Saharan Africa (Tembo *et al.*, 1994; Floyd *et al.*, 1999; Arthur *et al.*, 2000; Colvin *et al.*, 2001). Among the patients at the KCMC who were known to be HIV-positive, those considered to have meningitis, septicaemia, renal disease or non-tubercular pulmonary infection on admission were quite likely to die while hospitalized, with in-hospital mortality levels of 52%, 47%, 44% and 36%, respectively. Although relatively high mortality levels are expected with meningitis, septicaemia and renal disease, even among seronegative patients in resource-poor set-

tings, the relatively high mortality seen, in the present study, among the seropositive patients with non-tubercular pneumonia is surprising. It highlights the need for more intensive investigations of chest disease in seropositive patients at the KCMC. The true case fatality 'rates' for several of the diagnoses recorded on admission (e.g. cryptococcal meningitis) are probably higher than the inpatient levels reported here, as many of the seropositive patients, though critically ill, were probably discharged so that they could die at home.

The present, single-day, point-prevalence survey documented HIV seroprevalence of 21% on the general adult wards and 25% on the paediatric. Even within the small sample investigated, almost half (44%) of those found seropositive had not previously been so identified. Although a prevalence study conducted over a period of a few weeks and with many more subjects may give a more precise picture of the prevalence of HIV seropositivity and clinical symptomatology at the KCMC, it seems clear that the use of a testing policy directed by clinical suspicion leads to a considerable number of HIV infections going undiagnosed. De Cock *et al.* (2002) argued for the routine testing of all those admitted to general medical wards. This policy, of offering HIV testing to all patients admitted, irrespective of perceived risk, would allow many more patients living with HIV/AIDS to be detected and therefore provide additional prevention and treatment opportunities.

Although the point-prevalence survey revealed several HIV infections that had not been recognized previously, the seroprevalence of HIV infection at the KCMC appeared to be relatively low compared with that seen in similar studies in sub-Saharan Africa (Miller *et al.*, 1995; Kwesigabo *et al.*, 1999; Arthur *et al.*, 2000; Colvin *et al.*, 2001; Lewis *et al.*, 2003). There may therefore be marked regional differences in overall seroprevalence. An alternative explanation is that, in northern Tanzania, a relatively high

proportion of those infected with HIV either never become hospital inpatients or are only admitted relatively late, when in the advanced stages of AIDS. In this region, much of the burden of chronic HIV/AIDS care is carried by the communities in which the cases live, often with the support of a programme of home-based care run by *Kikundi cha Wanawake Kilimanjaro Kupambana na UKIMWI* (Women Against AIDS in Kilimanjaro). This organization currently cares for between 700 and 1000 patients in Kilimanjaro region (L. Kaale, unpubl. obs.). At Kenyatta National Hospital in Nairobi, curiously, despite predictions of overwhelming numbers of AIDS cases, a decrease in clinical AIDS presentations was noted between 1992 and 1997 (Arthur *et al.*, 2000).

Although HIV seroprevalence is not as high in the Kilimanjaro region as in many other parts of sub-Saharan Africa, it remains a significant contributor to admissions and mortality at the KCMC. It appears that HIV infection is increasingly affecting local women, and disproportionately affects an otherwise economically productive segment of the population. The results of the present, relatively small, point-prevalence survey indicate that >40% of patients in the KCMC who were HIV-infected had not been identified as HIV-positives by the centre's routine procedures. A more liberal testing strategy would probably lead to the identification of many more HIV-positives, who could then be offered access to the expanding HIV-care options (including anti-retroviral therapy) and be targeted for health education to help prevent further transmission.

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REFERENCES

- Anon. (2002). *AIDS Epidemic Update: December 2002*. Geneva: Joint United Nations Programme on HIV/AIDS (UNAIDS).
- Anon. (2003). *National AIDS Control Programme HIV/AIDS/STI Surveillance Report: January–December 2001*. Dar es Salaam: Ministry of Health.
- Arthur, G., Bhatt, S. M., Muhindi, D., Achiya, G. A., Kariuki, S. M. & Gilks, C. F. (2000). The changing impact of HIV/AIDS on Kenyatta National Hospital, Nairobi from 1988/89 through 1992 to 1997. *AIDS*, **14**, 1625–1631.
- Colvin, M., Dawood, S., Kleinschmidt, I., Mullick, S. & Lallo, U. (2001). Prevalence of HIV and HIV-related diseases in the adult medical wards of a tertiary hospital in Durban, South Africa. *International Journal of STD and AIDS*, **12**, 386–389.
- De Cock, K. M., Mbori-Ngacha, D. & Marum, E. (2002). Shadow on the continent: public health and HIV/AIDS in Africa in the 21st century. *Lancet*, **360**, 67–72.
- Floyd, K., Reid, R. A., Wilkinson, D. & Gilks, C. F. (1999). Admission trends in a rural South African hospital during the early years of the HIV epidemic. *Journal of the American Medical Association*, **282**, 1087–1091.
- Fylkesnes, K., Ndhlovu, Z., Kasumba, K., Mubanga Musonda, R. & Sichone, M. (1998). Studying dynamics of the HIV epidemic: population-based data compared with sentinel surveillance in Zambia. *AIDS*, **12**, 1227–1234.
- Kwesigabo, G., Killewo, J. Z., Sandstrom, A., Winani, S., Mhalu, F. S., Biberfeld, G. & Wall, S. (1999). Prevalence of HIV infection among hospital patients in north west Tanzania. *AIDS Care*, **11**, 87–93.
- Lewis, D. K., Callaghan, M., Phiri, K., Chipwete, J., Kublin, J. G., Borgstein, E. & Zijlstra, E. E. (2003). Prevalence and indicators of HIV and AIDS among adults admitted to medical and surgical wards in Blantyre, Malawi. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, **97**, 91–96.

- Miller, W. C., Thielman, N. M., Swai, N., Cegielski, J. P., Shao, J., Manyenga, D., Mlalasi, J. & Lallinger, G. J. (1995). Diagnosis and screening of HIV/AIDS using clinical criteria in Tanzanian adults. *Journal of Acquired Immune Deficiency Syndromes and Human Retrovirology*, **9**, 408–414.
- Setel, P., Unwin, N., Alberti, K. & Hemed, Y. (2000). Cause-specific adult mortality: evidence from community-based surveillance — selected sites, Tanzania, 1992–1998. *Morbidity and Mortality Weekly Report*, **49**, 416–419.
- Tembo, G., Friesan, H., Asimwe-Okiror, G., Moser, R., Naamara, W., Bakyaite, N. & Musinguzi, J. (1994). Bed occupancy due to HIV/AIDS in an urban hospital medical ward in Uganda. *AIDS*, **8**, 1169–1171.
- World Health Organization (1994). WHO case definitions for AIDS surveillance in adults and adolescents. *Weekly Epidemiological Record*, **69**, 273–275.
- World Health Organization (1997). Revised recommendations for the selection and use of HIV antibody tests. *Weekly Epidemiological Record*, **72**, 81–88.

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