

HIV care need not hamper maternity care: a descriptive analysis of integration of services in rural Malawi

T van den Akker,^{a,b,c} M Bemelmans,^{b,d} N Ford,^{e,f} M Jemu,^a E Diggle,^b S Scheffer,^b I Zulu,^b A Akesson,^b J Shea^c

^a Thyolo District Health Office, Ministry of Health, Thyolo, Malawi ^b Médecins Sans Frontières, Thyolo Project, Thyolo, Malawi ^c Child Health Unit, University of Cape Town, Cape Town, South Africa ^d Médecins Sans Frontières Operational Centre Brussels, Brussels, Belgium ^e Médecins Sans Frontières, Geneva, Switzerland ^f Centre for Infectious Disease Epidemiology and Research, University of Cape Town, Cape Town, South Africa

Correspondence: Dr T van den Akker, Médecins Sans Frontières Belgium, Dupréstraat 94, 1090 Brussel, Belgium.
Email thomas_vd_akker@hotmail.com

Accepted 22 October 2011. Published Online 18 January 2012.

Objective To evaluate the use of reproductive health care and incidence of paediatric HIV infection during the expansion of antiretroviral therapy and services for the prevention of mother-to-child transmission in rural Malawi, and the influence of integration of these HIV-related services into general health services.

Design Descriptive analysis.

Setting Thyolo District, with a population of 600 000, an HIV prevalence of 21% and a total fertility rate of 5.7 in 2004.

Population Women attending reproductive health services care in 2005 and 2010.

Methods Review of facility records and databases for routine monitoring.

Main outcome measures Use of antenatal, intrapartum, postpartum, family planning and sexually transmitted infection services; incidence of HIV infection in infants born to mothers who received prevention of mother-to-child transmission care.

Results There was a marked increase in the uptake of perinatal care: pregnant women in 2010 were 50% more likely to attend at

least one antenatal visit (RR 1.50, 95% CI 1.48–1.51); were twice as likely to deliver at a healthcare facility (RR 2.05, 95% CI 2.01–2.08); and were more than four times as likely to present for postpartum care (RR 4.40, 95% CI 4.25–4.55). Family planning consultations increased by 40% and the number of women receiving treatment for sexually transmitted infections doubled. Between 2007 and 2010, the number of HIV-exposed infants who underwent testing for HIV went up from 421 to 1599/year, and the proportion testing positive decreased from 13.3 to 5.0%; infants were 62% less likely to test HIV positive (RR 0.38, 95% CI 0.27–0.52).

Conclusions During the expansion and integration of HIV care, the use of reproductive health services increased and the outcomes of infants born to HIV-infected mothers improved. HIV care may be successfully integrated into broader reproductive health services.

Keywords Antiretroviral therapy, health systems, HIV, prevention of mother-to-child transmission, reproductive health services, uptake.

Please cite this paper as: van den Akker T, Bemelmans M, Ford N, Jemu M, Diggle E, Scheffer S, Zulu I, Akesson A, Shea J. HIV care need not hamper maternity care: a descriptive analysis of integration of services in rural Malawi. BJOG 2012;119:431–438.

Introduction

In sub-Saharan Africa, the burden of HIV/AIDS has impacted on the health system in different ways. General healthcare services have struggled to provide care to increasing numbers of patients with AIDS-related opportunistic infections.^{1–3} At the same time as HIV increased the

demand for health care, it also reduced the number of healthcare workers, both directly through increased morbidity and mortality, and indirectly through increased workload and burnout.^{4,5} In some settings, these effects have been associated with a reduction in the quality of general health care,^{4,6} and this has been suggested to have contributed to an increase in maternal and infant mortality.^{4,7}

Nevertheless, despite early concerns that health systems in Africa would not be able to cope with demands to provide life-saving antiretroviral therapy (ART),⁸ today over 6.5 million people are alive and on treatment in low- and middle-income countries, the majority of whom would probably have died if access to ART had not increased.^{9,10}

Antiretroviral therapy, both for treatment and for the prevention of mother-to-child transmission (PMTCT), has the potential to dramatically reduce HIV-related mortality, including maternal mortality and paediatric HIV infection.^{11–13} However, concerns about implementing large-scale treatment programmes in low-income countries meant that the provision of ART in settings with a high HIV burden did not receive full support from national governments and international donors until late 2003.¹¹ Initially, the provision of ART and PMTCT services often occurred through specific 'vertical programmes', focusing on HIV only and operating independently from the general 'horizontal' primary healthcare system.

More recently, concerns have been raised about the potential negative effects of vertical HIV programmes on the use and outcomes of reproductive health services.^{1,14–17} Potential negative effects include: the diversion of funding away from reproductive health and the general health system towards HIV-specific services,^{1,4} the hypothesis that opt-out antenatal HIV testing could reduce the use of pregnancy care because women would not want to carry the burden of HIV-related stigma,^{18,19} and increased demands on an insufficient health workforce.^{20,21}

The actual impact of these potentially negative effects on reproductive health, particularly in well-integrated ART/PMTCT programmes, has not been comprehensively studied or documented.^{14,22,23} In the absence of evidence confirming or refuting these concerns, scepticism about the benefits of large-scale HIV programmes has contributed to decreased political and financial support for ART and PMTCT, ultimately putting hard-won public health gains at risk.²⁴

Malawi is one of the countries most heavily affected by the HIV pandemic. The HIV prevalence rate among adults of 15–49 years of age was 12% in 2007,²⁵ with young women disproportionately affected.²⁶ Despite a severe lack of financial and human resources in the country's health sector, Malawi managed to increase the provision of ART with marked success. By the end of 2010, 250 987 people were alive on ART. This represented 63% of the estimated need.²⁷

The provision of PMTCT in Malawi was slow compared with that of ART.²⁷ Suggested reasons for the delay include: low uptake of antenatal testing for HIV out of fear;^{18,19} inadequate referral systems between general maternal and child health services and PMTCT programmes;²⁸ high drop-out rates of women entering into PMTCT programmes

because of stigma or financial and logistical constraints,^{29,30} and a low number of health workers available to provide reproductive health and PMTCT care.³¹

This study describes the increase in use of reproductive health care during the scaling up and integration of ART and PMTCT services in Thyolo District, Malawi, and the impact of these services on paediatric HIV infection rates.

Methods

Design

We conducted a retrospective district-wide analysis of the uptake of reproductive services and of paediatric HIV infections between 1 January 2005 and 31 December 2010.

Setting

Thyolo is a rural district in southern Malawi, with around 600 000 inhabitants.³² More than two-thirds of the people live in extreme poverty.³³ Although health care in government facilities and maternal care in most mission facilities are free of charge, poor road conditions and lack of money for transport are some of the barriers for women accessing care.^{34–36} Other barriers include a lack of decision-making power among women, and fear of stigma and discrimination.^{33,35}

Despite the fact that the Malawian government encouraged women to attend health centres or hospitals for their delivery care, still around half of the women in the district delivered at home in 2004, often with the assistance of a traditional birth attendant.³³ The health system in Thyolo comprises one district hospital, one mission hospital, 13 government health centres, seven mission health centres and five private centres (tea estates), with a total of 21 973 institutional deliveries in 2010. As a result of the scarcity of registered nurse-midwives and medical doctors, nurse-midwife technicians (staff working as nurses and/or midwives, but with little professional training) and non-physician clinicians perform many of the nursing and clinical tasks at district level (task shifting).^{33,37}

Intervention/programme approach

This article describes the impact of the integration of HIV/PMTCT services into general health services. Since 2003, Médecins Sans Frontières (MSF) and the Ministry of Health (MoH) entered into a collaborative partnership to increase access to ART in Thyolo. MSF provided logistical support and technical guidance, whereas the MoH provided most of the human resources and health facilities, as well as the antiretroviral drugs obtained through the Global Fund to Fight AIDS, Tuberculosis and Malaria. ART and PMTCT care are mostly provided by government clinicians and nurses. In line with the national programme, the expansion of ART in Thyolo made use of a public health

approach based on decentralisation to peripheral clinics and task shifting, as mentioned above. Between 2007 and 2010, ART and PMTCT activities were increasingly integrated into general health services, meaning that ART and PMTCT care were provided wherever possible at the same clinics, during the same hours and by the same staff who provided general (peripartum) care (Box 1). The timeline of the expansion and integration of ART care has been described previously.³⁷

HIV services were initially delivered in a largely vertical fashion, but once district-wide provision of ART services and a substantial increase in the uptake of PMTCT services in 2007 were achieved, HIV care was integrated within general health services.⁴⁰ Increasingly, measures to improve uptake and outcomes of reproductive health services were implemented, including the provision of postpartum, non-monetary incentives, such as soap, a baby blanket and a traditional wrap, that could encourage women to attend a health facility for delivery.⁴¹ At the same time, contraception became more widely available and was promoted in all outpatient departments in Thyolo District, both for HIV-positive and HIV-negative people. By late 2008, most ART and PMTCT care was provided in an integrated manner, although elements of service integration continued beyond that time (Box 2).

Since 2003, women eligible for ART for their own health have been started on a combined regimen consisting of stavudine (d4T)/3TC/NVP. ART among pregnant women in Malawi is established by clinical and immunological evaluation, with patients in WHO clinical stages 3 and 4, and patients in stages 1 and 2 but with a CD4 count below 350 cells/mm³, eligible for ART (revised from 250 cells/

mm³ in late 2009).^{39,43} The newest WHO guidelines, which promote more robust and safer ART regimens, are expected to be adopted in Malawi in the near future.^{44,45}

HIV-related changes in reproductive health resources and infrastructure

Several improvements in reproductive health services were supported by the increased budget for HIV care. The financial support for the delivery incentive came from MSF, using money from the ART/PMTCT programme at a cost of \$7 per woman, which was considered affordable in this setting.⁴¹ Four maternity waiting homes were built at peripheral health centres throughout the district in 2007 and 2008, and four maternal and child health units of health centres were renovated in 2008. These constructions and renovations were all supported with funds from MSF's HIV/AIDS programme budget. Five facilities were upgraded to provide full basic emergency obstetric care services, including the possibility to perform vacuum extraction, administer magnesium sulphate and intravenous antibiotics, and perform manual vacuum aspirations. This involved upgrading the existing buildings and equipment, as well as training health staff. The upgrading was financed by the MoH and MSF, using both general and HIV-related funds.

Effective drug procurement and supply chain management for drugs to reach clinics and pharmacies are major challenges in Malawi.⁴⁶ At the district level, the supply systems of MSF and the MoH have been integrated into one general procurement and supply system. The availability of essential medications within the health system improved, thanks to investments in second- and third-line antibiotic

Box 1. PMTCT protocols used in Thyolo

- In 2002 the delivery of PMTCT services at the district hospital began. Initially, single-dose nevirapine (sd-NVP) was prescribed according to the WHO recommendation at that time³⁸
- In 2007, following a change in WHO recommendation, the regimen changed to: zidovudine (AZT) from 28 weeks of gestation, combined with sd-NVP and AZT/lamivudine (3TC) at the onset of labour, and a 7-day 'tailing off' of AZT/3TC to prevent resistance against NVP; sd-NVP and 1 week of AZT prophylaxis were provided to the child³⁹
- At the end of 2010 expanded prophylaxis was provided at all facilities with antenatal services

Box 2. Protocol for HIV testing of infants in Thyolo

- Testing of HIV-exposed infants using DNA PCR at 6 weeks of age (or as soon as possible thereafter) was introduced in August 2007 at the district hospital, and gradually expanded to include ten PMTCT sites by end 2010
- PCR-negative infants were retested with a rapid diagnostic test at 9 months. If breastfeeding continued beyond that time, tests were repeated every 3 months until the mother had stopped breastfeeding for at least 6 weeks
- In a child below 18 months of age testing positive by rapid test, the diagnosis would be confirmed with a DNA PCR test
- Treatment with ART for all children <1 year of age diagnosed as HIV positive, regardless of clinical and immunological status, was introduced in July 2008, in line with the latest evidence.⁴² DNA PCR diagnostic services were made available through a reference laboratory in Blantyre (nearest large town), and was funded through a consortium of several partners

regimens supported by funding from the HIV/AIDS programme. For instance, a wider range of antibiotics became available for the treatment of sexually transmitted infections (STIs), including third-generation cephalosporines.

Outcomes

We assessed uptake indicators for antenatal care (number of consultations, percentage of women tested for HIV, PMTCT uptake), institutional deliveries, postpartum care, treatment for STIs and family planning visits (as a proxy for uptake of contraceptives) during the period under observation (1 January 2005–31 December 2010). We also assessed polymerase chain reaction (PCR) HIV test outcomes among children born to mothers undergoing PMTCT for the period during which data were available (1 August 2007–31 December 2010).

Data collection and analysis

Data were collected from facility records, the Health Management Information System (HMIS) database and the MSF database (PMTCT uptake), which are maintained for routine programme monitoring. Facility records include information on the uptake of STI care and family planning services. Data were collected by a dedicated MSF staff member with experience in data collection, and by the family planning and STI coordinators from the district health office (DHO), and were cross-checked by senior MSF and DHO clinical staff. Quality control was regularly

performed on both databases by verifying information contained in databases with facility records. All relevant data were entered into a separate, password-protected Microsoft EXCEL sheet. In order to assess the relative change in uptake of services, we calculated relative risks and 95% confidence intervals comparing the data from 2005 (or the earliest available date) and 2010. All analyses were performed using SPSS 15[®] and STATA 11 (IBM, New York, NY, USA). For all analyses, $P < 0.05$ was considered to be statistically significant.

Results

In 2007, Thyolo achieved district-wide access to ART for 80% of those estimated to be in urgent need of treatment.³⁷ During the process of service integration in 2007 and 2008, the number of women initiating ART remained stable, and the number of women receiving PMTCT care further increased. At the end of December 2010, there were 18 753 people alive on ART in Thyolo.

Uptake of reproductive health services

The number of women attending antenatal services has increased significantly, as shown in Table 1. Women were 50% more likely to attend one antenatal care visit in 2010 compared with 2005, and were 18% more likely to attend four antenatal visits (as recommended by the WHO) in 2010 compared with 2008 (data not available prior to that

Table 1. Comparison of the uptake of reproductive health services in Thyolo, Malawi, between 2005 and 2010

	2005	2010	Relative risk
Estimated number of pregnant women*	25 050	28 280	–
Number of women attending at least one ANC visit	15 655	26 579	1.50 95% CI 1.48–1.51, $P < 0.001$
Number of women attending at least four ANC visits	3391 (2008)	4531	1.18 95% CI 1.14–1.23, $P < 0.001$
Number of HIV tests performed among pregnant women attending ANC**	4133	25 222	3.59 95% CI 3.50–3.69, $P < 0.001$
Estimated number of HIV-positive pregnant women (HIV prevalence 21%)	5260	5938	–
Number of HIV-positive women receiving PMTCT (any)	936	2873	2.72 95% CI 2.55–2.90, $P < 0.001$
Number of deliveries	9515	21 973	2.05 95% CI 2.01–2.08, $P < 0.001$
Number presenting for postnatal visit 1 week after delivery	3253	16 156	4.40 95% CI 4.25–4.55, $P < 0.001$
Number of infants tested by PCR	421 (2007)	1599	
Number of infants testing positive	56	80	
Proportion of infants testing positive	13.3%	5.0%	0.38 95% CI 0.27–0.52, $P < 0.001$

*Calculated with the projected population from the 1998 population and housing census, with a birth rate of 4.5%.

**Some women may have been tested more than once.

time). Among women attending at least one antenatal care visit, the likelihood of being tested for HIV was more than three times higher in 2010 compared with 2005.

Access to quality PMTCT care increased significantly between 2005 and 2010. In 2005, 936 HIV-positive women received single-dose nevirapine (NVP) for PMTCT. In 2010, 2873 women received PMTCT care: 1560 pregnant women received zidovudine (AZT) prophylaxis from 28 weeks of gestation; 794 women received full ART, as they were established to be eligible on maternal indication only; and 519 were on ART already at the first antenatal visit. The likelihood for an HIV-positive woman to receive PMTCT was 2.7 times greater in 2010 compared with 2005.

We previously reported that in the 2-year period between late 2007 and late 2009, the number of deliveries in health facilities throughout the district increased by 78%.⁴¹ Women were twice as likely to deliver at a health facility in 2010 compared with 2005, and were more than four times as likely to undertake a postnatal visit.

Figure 1 shows the increase in uptake for antenatal, intrapartum and postpartum care between 2005 and 2010, calculated as the percentages of the total number of pregnant women receiving these types of care. Despite this increase in patient burden, the maternal pregnancy outcomes at the facility level improved during the same period, probably as a result of obstetric audit and feedback to improve the quality of care.^{47,48}

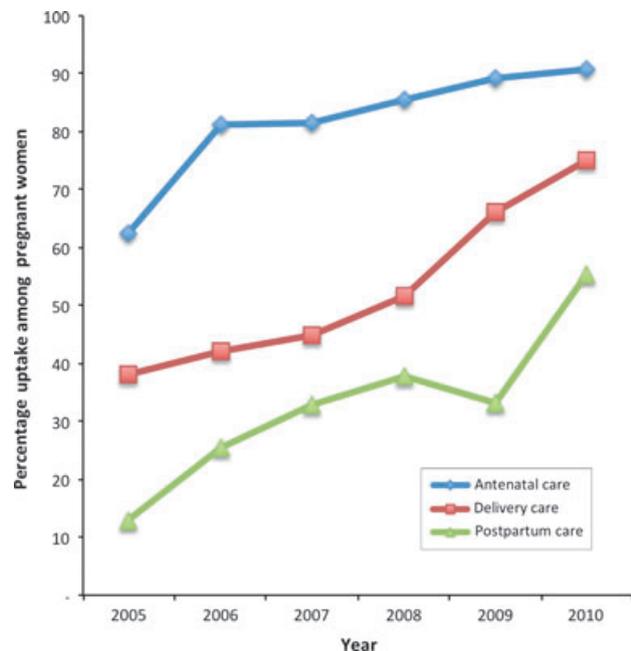


Figure 1. Increase in uptake of peripartum care between 2005 and 2010.

Health promotion efforts also increased. All women attending STI care are actively encouraged to test for HIV, and all women attending HIV care are asked whether they have STI-related complaints, and are treated if this is the case; women attending HIV care are generally encouraged to use condoms; family planning is promoted, in particular to HIV-positive women, and women attending STI treatment and HIV care are encouraged to bring their partners to the clinic during subsequent visits for assessment and treatment. As a result of these activities, between 2005 and 2010, the number of women receiving treatment for STIs increased from 5345 to 11 236 (in populations of 140 000 and 150 000 women of reproductive age, respectively), which represents a doubling in the likelihood of receiving STI treatment (RR 1.96, 95% CI 1.90–2.03).

The number of family planning consultations at medical facilities in Thyolo district increased from 73 625 in 2005 to 103 480 in 2010, an increase of 41%. This includes consultations in the public as well as the private sectors. It is not known how many of these consultations were repeat consultations, nor for how many women.

PMTCT outcomes

Since 2007, the number of infants receiving a PCR HIV test at 6 weeks of age increased substantially, whereas the HIV prevalence rate among infants whose mothers had received PMTCT showed a steady reduction, indicating that the outcome of the PMTCT programme improved markedly over the period in which services were scaled up and integrated. Infants that had been exposed to HIV were 62% less likely to test HIV positive in 2010 compared with 2007 (RR 0.38, 95% CI 0.27–0.52).

Discussion

We can tentatively conclude that the availability of HIV funding has broadly benefited the overall health system and contributed to the improved use of reproductive healthcare services. At the very least these findings show that scaling up PMTCT and ART need not hinder improvements in other health priorities. The national demographic health surveys (DHSs) of 2004 and 2010 indicate that Thyolo was the district with the second highest increase in the percentage of all deliveries occurring at a health facility (from 51.4 to 75.1%).^{33,49} The figures for peripartum care use are comparable between these demographic health surveys and our study, except for the antenatal care use in 2005 that was found to be lower in our study compared with the DHS (~60 versus ~90%).³³ This discrepancy may be caused by different methods of data collection.

Our report shows that the integration of opt-out HIV testing and counselling and PMTCT care within the general peripartum services did not limit women's uptake of

general and reproductive health care, as some had feared.^{18,19} Moreover, despite the fact that considerable human and material resources were needed to facilitate the increased provision of ART and PMTCT, the healthcare system was still able to accommodate an increasing number of patients attending general reproductive health care.

This type of study can be classified as 'operational research', meaning that it is based on routinely collected programme data. The main strength of such a study is that the data are all derived from a real programme/field setting, and as such may provide a more credible picture for programme planners compared with findings from a controlled study environment.⁵⁰ The limitations of this type of research are its retrospective nature and the fact that some degree of under-reporting may occur, as proper recording and storing of data may be a challenge in under-resourced settings, and is usually not given high priority.⁵¹ However, we consider the data used in this analysis for the period 2005–2010 to be reliable for two main reasons. Firstly, quality control was performed for data reported at HMIS and MSF. Secondly, data on ANC, delivery care, postpartum care, family planning and STI treatment all showed very clear trends, without any major 'outliers'.

Another important limitation of the study design is that no causal relationships can be ascribed. We have shown that several initiatives were implemented with money allocated to HIV, but that there may be other explanations for the observed increase in uptake of services. The significant increase in the uptake of ANC may have been the result of increased health promotion efforts to all women, including perception in the community of improved antenatal care or health services in general, increased availability of ART, PMTCT and HIV testing and counselling, and increased availability of health staff as a result of reduced HIV/AIDS-related mortality among staff.⁵ The increase in women coming for at least four antenatal visits may have resulted from an increase in the number of women coming for PMTCT care who are urged to come every month for their ART or AZT refills. Among women coming for a fourth visit the clinic records do not differentiate between those who receive PMTCT and those who do not. Increased health promotion and improvements in quality of care are also likely contributors to the increased uptake of postpartum care, family planning services and STI treatment.

The PMTCT and ART services in Thyolo were delivered in an integrated manner, through the public health system, by health staff in the same clinics used for general health care. This means that HIV testing and counselling, PMTCT services and ART care could be received by patients at the same place and time that they received their general peripartum care. The fact that PMTCT and ART are readily available is likely to positively influence the decision of women to accept to be tested and seek care. Also, as

PMTCT and ART were provided at the general clinic, this forced both MoH and MSF health managers to take into consideration the (limited) resources of these clinics while planning the provision of ART and PMTCT.

It is understandable that those concerned with the general health of women and children have grown apprehensive of the substantial budget that has been made available for HIV care. However, it is likely that the financial situation of the local public health sector would be in an even more deplorable state without the influx of HIV money. Our findings indicate that investments in district health services that take into account both HIV-related and reproductive health needs may produce significant improvements. Maternal mortality and HIV should be tackled together by the same services. ART reduces HIV transmission from mother to child, promotes women's health and survival, and in this way can also improve the health outcomes of their children. For this reason, the provision of ART should be promoted as an essential element of primary maternal and child care, and pregnant women should be considered a priority group to access ART.

Under the current circumstances, given the fragile situation of most public health systems in sub-Saharan African nations, and the overwhelming burden of the HIV/AIDS epidemic, integrated HIV/reproductive health programmes such as the one described in this paper are difficult to sustain without significant external support. The withdrawal of donor funding based on several reasons, including unjustified scepticism about the effects of external investments, will endanger the lives of many HIV-positive and -negative people.

Disclosure of interests

None of the authors have any conflicts of interest to declare.

Contribution to authorship

None of the authors have any con Tvda and MB conceptualised the study, which was designed by Tvda, MB, NF and JS. IZ, SS and ED were responsible for data collection, AA and MJ were responsible for checking the data, and analysis was carried out by Tvda, NF, SS and ED. MB and MJ were responsible for the project. Tvda wrote a first draft of the article, which was then edited by all other authors. All authors contributed significantly to the intellectual content. flicts of interest to declare.

Details of ethics approval

Permission was obtained from the Faculty of Health Sciences Human Research Ethics Committee of the University of Cape Town, South Africa. All patient information was entered into a database using coded identification numbers, and no information that could reveal patient

identity was collected. In addition, this study has met the MSF Ethics Review Board-approved criteria for analysis of routinely collected programme data.

Funding

This study was entirely self-funded by the Thyolo District Health Office and MSF, which supports the Thyolo District HIV/AIDS programme.

Acknowledgements

We thank Mrs Makombe, district STI coordinator, and Mrs Gamechi, district family planning coordinator, for their tremendous assistance with the data collection. ■

References

- 1 Chopra M, Lawn JE, Sanders D, Barron P, Abdool Karim SS, Bradshaw D, et al. Achieving the health Millennium Development Goals for South Africa: challenges and priorities. *Lancet* 2009;374:1023–31.
- 2 Lawn SD, Harries AD, Anglaret X, Myer L, Wood R. Early mortality among adults accessing antiretroviral treatment programmes in sub-Saharan Africa. *AIDS* 2008;22:1897–908.
- 3 UNAIDS, WHO. AIDS epidemic update. Geneva: joint United Nations Programme on HIV/AIDS (UNAIDS), 2005.
- 4 Yu D, Souteyrand Y, Banda MA, Kaufman J, Perriens JH. Investment in HIV/AIDS programs: does it help strengthen health systems in developing countries? *Global Health* 2008;4:8.
- 5 Bemelmans M, van den Akker T, Pasulani O, Tayub NS, Hermann K, Mwangomba B, et al. Keeping health staff healthy: evaluation of a workplace initiative to reduce morbidity and mortality from HIV/AIDS in Malawi. *J Int AIDS Soc* 2011;14:1.
- 6 Samb B, Desai N, Nishtar S, Mendis S, Bekedam H, Wright A, et al. Prevention and management of chronic disease: a litmus test for health-systems strengthening in low-income and middle-income countries. *Lancet* 2010;376:1785–97.
- 7 Buve A, Kalibala S, McIntyre J. Stronger health systems for more effective HIV/AIDS prevention and care. *Int J Health Plann Manage* 2003;18:S41–51.
- 8 McCoy D, Chopra M, Loewenson R, Aitken JM, Ngulube T, Muula A, et al. Expanding access to antiretroviral therapy in sub-Saharan Africa: avoiding the pitfalls and dangers, capitalizing on the opportunities. *Am J Public Health* 2005;95:18–22.
- 9 French N, Mujugira A, Nakiyingi J, Mulder D, Janoff EN, Gilks CF. Immunologic and clinical stages in HIV-1-infected Ugandan adults are comparable and provide no evidence of rapid progression but poor survival with advanced disease. *J Acquir Immune Defic Syndr* 1999;22:509–16.
- 10 Schim van der Loeff MF, Jaffar S, Aveika AA, Sabally S, Corrah T, Harding E, et al. Mortality of HIV-1, HIV-2 and HIV-1/HIV-2 dually infected patients in a clinic-based cohort in The Gambia. *AIDS* 2002;16:1775–83.
- 11 Kim JY, Gilks C. Scaling up treatment—why we can't wait. *N Engl J Med* 2005;353:2392–4.
- 12 Blower SM, Gershengorn HB, Grant RM. A tale of two futures: HIV and antiretroviral therapy in San Francisco. *Science* 2000;287:650–4.
- 13 Peckham C, Gibb D. Mother-to-child transmission of the human immunodeficiency virus. *N Engl J Med* 1995;333:298–302.
- 14 Both JM, van Roosmalen J. The impact of Prevention of Mother to Child Transmission (PMTCT) programmes on maternal health care in resource-poor settings: looking beyond the PMTCT programme—a systematic review. *BJOG* 2010;117:1444–50.
- 15 Hanefeld J, Musheke M. What impact do Global Health Initiatives have on human resources for antiretroviral treatment roll-out? A qualitative policy analysis of implementation processes in Zambia *Hum Resour Health* 2009;7:8.
- 16 Hanefeld J. The impact of Global Health Initiatives at national and sub-national level - a policy analysis of their role in implementation processes of antiretroviral treatment (ART) roll-out in Zambia and South Africa. *AIDS Care* 2010;22(Suppl 1):93–102.
- 17 Magoma M, Requejo J, Campbell OM, Cousens S, Filippi V. High ANC coverage and low skilled attendance in a rural Tanzanian district: a case for implementing a birth plan intervention. *BMC Pregnancy Childbirth* 2010;10:13.
- 18 Simba D, Kamwela J, Mpembeni R, Msamanga G. The impact of scaling-up prevention of mother-to-child transmission (PMTCT) of HIV infection on the human resource requirement: the need to go beyond numbers. *Int J Health Plann Manage* 2010;25:17–29.
- 19 Turan JM, Miller S, Bukusi EA, Sande J, Cohen CR. HIV/AIDS and maternity care in Kenya: how fears of stigma and discrimination affect uptake and provision of labor and delivery services. *AIDS Care* 2008;20:938–45.
- 20 Banteyerga H, Kidanu A, Stillman K. *The Systemwide Effects of the Global Fund in Ethiopia: Final Study Report*. USAID, Partners for HealthReformplus, 2006.
- 21 Nuwagaba-Biribonwoha H, Mayon-White RT, Okong P, Carpenter LM. Challenges faced by health workers in implementing the prevention of mother-to-child HIV transmission (PMTCT) programme in Uganda. *J Public Health (Oxf)* 2007;29:269–74.
- 22 Brugha R, Simbaya J, Walsh A, Dicker P, Ndubani P. How HIV/AIDS scale-up has impacted on non- HIV priority services in Zambia. *BMC Public Health* 2010;10:540.
- 23 Kennedy CE, Spaulding AB, Brickley DB, Almers L, Mirjahangir J, Packer L, et al. Linking sexual and reproductive health and HIV interventions: a systematic review. *J Int AIDS Soc* 2010;13:26.
- 24 Nattrass N, Gonsalves G. AIDS funds: undervalued. *Science* 2010;330:174–5.
- 25 UNAIDS. AIDS Epidemic update 2009. 2009.
- 26 USAID. Malawi HIV/AIDS health profile. 2010. Date accessed: 28-1-2011.
- 27 Ministry of Health, HIV department. *Quarterly Report Malawi Antiretroviral Treatment Programme in Malawi with Results up to 31st December 2010*. Lilongwe, Malawi: Ministry of Health, HIV department, 2011.
- 28 Horwood C, Haskins L, Vermaak K, Phakathi S, Subbaye R, Doherty T. Prevention of mother to child transmission of HIV (PMTCT) programme in KwaZulu-Natal, South Africa: an evaluation of PMTCT implementation and integration into routine maternal, child and women's health services. *Trop Med Int Health* 2010; DOI: 10.1111/j.1365-3156.2010.02576.x (Epub ahead of print).
- 29 Manzi M, Zachariah R, Teck R, Buhendwa L, Kazima J, Bakali E, 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;10:1242–50.
- 30 Bwirire LD, Fitzgerald M, Zachariah R, Chikafa V, Massaquoi M, Moens M, et al. Reasons for loss to follow-up among mothers registered in a prevention-of-mother-to-child transmission program in rural Malawi. *Trans R Soc Trop Med Hyg* 2008;102:1195–200.
- 31 Nakakeeto ON, Umaranayake L. The global strategy to eliminate HIV infection in infants and young children: a seven-country assessment of costs and feasibility. *AIDS* 2009;23:987–95.

- 32 National Statistical Office. 2008 Population and Housing Census. 2008.
- 33 National Statistical Office. Malawi Demographic and Health Survey 2004. 2005.
- 34 Blencowe H, Kerac M, Molyneux E. Safety, effectiveness and barriers to follow-up using an 'early discharge' Kangaroo Care policy in a resource poor setting. *J Trop Pediatr* 2009;55:244–8.
- 35 O'Gorman DA, Nyirenda LJ, Theobald SJ. Prevention of mother-to-child transmission of HIV infection: views and perceptions about swallowing nevirapine in rural Lilongwe, Malawi. *BMC Public Health* 2010;10:354.
- 36 Zachariah R, Harries AD, Manzi M, Gomani P, Teck R, Phillips M, et al. Acceptance of anti-retroviral therapy among patients infected with HIV and tuberculosis in rural Malawi is low and associated with cost of transport. *PLoS ONE* 2006;1:e121.
- 37 Bemelmans M, van den Akker T, Ford N, Philips M, Zachariah R, Harries A, et al. Providing universal access to antiretroviral therapy in Thyolo, Malawi through task shifting and decentralization of HIV/AIDS care. *Trop Med Int Health* 2010;15:1413–20.
- 38 WHO. *Strategic Approaches to the Prevention of HIV-Infection in Infants*. Geneva: WHO, 2003.
- 39 WHO. *Antiretroviral Drugs for Treating Pregnant Women and Preventing HIV-Infection in Infants. Recommendations for a Public Health Approach. 2006 version*. Geneva: WHO, 2006.
- 40 Beltman JJ, Fitzgerald M, Buhendwa L, Moens M, Massaquoi M, Kazima J, et al. Accelerated HIV testing for PMTCT in maternity and labour wards is vital to capture mothers at a critical point in the programme at district level in Malawi. *AIDS Care* 2010;22:1367–72.
- 41 van den Akker T, Radge G, Mateyu A, Mwangombwa B, Bemelmans M, Reid T. Can non-monetary incentives increase health facility deliveries?—The experience in Thyolo District, Malawi. *International Health* 2011;3:66–8.
- 42 Violari A, Cotton MF, Gibb DM, Babiker AG, Steyn J, Madhi SA, et al. Early antiretroviral therapy and mortality among HIV-infected infants. *N Engl J Med* 2008;359:2233–44.
- 43 Ministry of Health. *Guidelines for the use of antiretroviral therapy in Malawi*, 3rd edn. Lilongwe, Malawi: Ministry of Health, 2008.
- 44 WHO. *Antiretroviral Drugs for Treating Pregnant Women and Preventing HIV-Infection in Infants. Recommendations for a public health approach. 2010 version*. Geneva: WHO, 2010.
- 45 WHO. *Antiretroviral Therapy for HIV-Infection in Adults and Adolescents. Recommendations for a Public Health Approach*. Geneva: WHO, 2010.
- 46 Nyasa Times. Global Fund rejects Malawi's funding proposal again. 2011. Date accessed: 1-2-2011.
- 47 van den Akker T, Van Rhenen J, Mwangombwa B, Lommerse K, Vinkhumbo S, van Roosmalen J. Reduction of maternal mortality and severe maternal morbidity in Thyolo District, Malawi: the impact of obstetric audit. *PLoS One* 2011;6:e20776 (Epub ahead of print).
- 48 van den Akker T, Mwangombwa B, Irlam J, van Roosmalen J. Using audits to reduce the incidence of uterine rupture in a Malawian district hospital. *Int J Gynaecol Obstet* 2009;107:289–94.
- 49 National Statistical Office. Malawi Demographic and Health Survey 2010. Preliminary report, 2011.
- 50 Zachariah R, Harries AD, Ishikawa N, Rieder HL, Bissell K, Laserson K, et al. Operational research in low-income countries: what, why, and how? *Lancet Infect Dis* 2009;9:711–7.
- 51 Wagaarachchi PT, Graham WJ, Penney GC, Caw-Binns A, Yeboah AK, Hall MH. Holding up a mirror: changing obstetric practice through criterion-based clinical audit in developing countries. *Int J Gynaecol Obstet* 2001;74:119–30.