

Antiretroviral treatment roll-out in a resource-constrained setting: capitalizing on nursing resources in Botswana

K Miles,^a DJ Clutterbuck,^b O Seitio,^c M Sebege^d & A Riley^e

Problem As programmes to deliver antiretroviral therapy (ART) are implemented in resource-constrained settings, the problem becomes not how these programmes are going to be financed but who will be responsible for delivering and sustaining them.

Approach Physician-led models of HIV treatment and care that have evolved in industrialized countries are not replicable in settings with a high prevalence of HIV infection and limited access to medical staff. Therefore, models of care need to make better use of available human resources.

Local setting Using Botswana as an example, we discuss how nurses are underutilized in long-term clinical management of patients requiring ART.

Relevant changes We argue that for ART-delivery programmes to be sustainable, nurses will need to provide a level of clinical care for patients receiving this therapy, including prescribing ART and managing common adverse effects.

Lessons learned Practicalities involved in scaling up nurse-led models of ART delivery include overcoming political and professional barriers, identifying educational requirements, agreeing on the limitations of nursing practice, developing clear referral pathways between medical and nursing personnel, and developing mechanisms to monitor and supervise practice. Operational research is required to demonstrate that such models are safe, effective and sustainable.

Bulletin of the World Health Organization 2007;85:555–560.

Une traduction en français de ce résumé figure à la fin de l'article. Al final del artículo se facilita una traducción al español. الترجمة العربية لهذه الخلاصة في نهاية النص الكامل لهذه المقالة.

Introduction

Expanding access to antiretroviral therapy (ART) to treat HIV in low-resource settings has demonstrated benefits in terms of health and survival^{1–7} and, contrary to earlier claims, high levels of treatment adherence have been reached.^{8–13} As antiretroviral drug prices have fallen, the key constraint to delivering treatment has become human resources.^{14,15} Human-resource capacity is generally weak in resource-constrained settings, particularly in sub-Saharan Africa, and some evidence suggests that ART delivery scale-up could fail on these grounds alone.¹⁶

Several needs, assessments have shown only limited capacity to scale up service models oriented towards doctors, particularly in settings with low ratios of physicians to population and high rates of attrition among medical staff (K Gilbert et al., unpublished data, 2005; B Damascene et al., unpublished

data, 2005).¹⁷ Scaling up ART delivery will require tens of thousands of health-care workers with the experience and training needed to treat people with HIV, a complex health problem.¹⁸ There is, therefore, an urgent need to develop simple and sustainable models of delivering ART and its associated care that maximize the potential of existing human resources in less-developed health-care delivery systems. Physician-based models of care adapted from industrialized countries will not suffice to treat the majority of patients in resource-constrained settings, so the use of non-medical staff should be considered.¹⁹

In this paper we focus on developing nursing resources in Botswana, where the roll-out of ART has been under way since 2002. We begin by outlining the policy context and the need to make better use of non-medical staff to deliver ART. By using Botswana as an example, we argue that for ART programmes to be sustainable nurses

will need to provide a level of clinical care for patients receiving this therapy, including prescribing ART and managing common adverse effects.

Policy background

WHO's strategic framework for the emergency scale up of ART involves training a range of community-based health-care staff to support the delivery and monitoring of HIV/AIDS treatment.²⁰ This is a significant shift from the centralized, physician-led model of HIV care that prevails in high-income nations. WHO recognizes that a public health approach to HIV/AIDS treatment should include strategies to reduce dependence on highly trained physicians, thus enabling a larger number of people to have access to ART.^{21,22} According to WHO's guidelines on delivering ART in low-resource settings,²³ the initiation of first-line treatment for HIV/AIDS and management of

^a Camden Primary Care Trust, Centre for Sexual Health and HIV Research, Royal Free and University College Medical School, Mortimer Market Centre, London WC1E 6JB, England. Correspondence to K Miles (e-mail: kevin.miles@camdenpct.nhs.uk).

^b Department of Genitourinary Medicine, Lothian University Hospitals, Edinburgh, Scotland.

^c Institute of Health Science, Gaborone, Botswana.

^d Department of Nursing Education, University of Botswana, Gaborone, Botswana.

^e African Comprehensive HIV/AIDS Partnerships, Gaborone, Botswana.

doi: 10.2471/BLT.06.033076

(Submitted: 3 July 2006 – Final revised version received: 4 January 2007 – Accepted: 14 January 2007)

follow-up can be considered relatively straightforward for a significant proportion of individuals. If there are objective criteria to assess eligible candidates (for example, CD4 count, physical illness) and clear guidance for follow-up, it seems reasonable that it may not always be essential that a medically trained person initiates treatment and manages follow-up consultations.

WHO's 3 by 5 treatment guidelines on the Integrated Management of Adolescent and Adult Illness have been translated into guidelines that can be used by non-medical health-care workers.²⁴ Under district medical officers' supervision, health workers at first-level facilities or health workers or lay staff at the district clinic level can be trained to initiate first-line ART regimens in patients who do not have complicating conditions. They can also be trained to provide clinical monitoring, respond to new signs and symptoms, dispense medications and arrange follow-up. These staff can refer patients to medical clinicians at the district level when treatment does not seem to control the disease or when there is severe toxicity and illness.

There is a distinct paucity of empirical evidence for the effectiveness of such models of care. This is a general issue in terms of operational research for more generic nurse-delivered programmes in low-resource settings, particularly those involving nurse prescribing.²⁵ However, evidence from North America, where HIV care has been provided by nurse practitioners since the early 1990s, suggests that in comparisons between nurse-led and physician-led HIV outpatient care, the quality of care and patients' satisfaction are equivalent.²⁶⁻²⁸

Nonetheless, the impetus to utilize non-medical personnel has now begun to develop beyond small, isolated and often NGO-funded initiatives. For example, a South African township model used nurses for follow-up care delivered according to standardized protocols.²⁹ The national ART programme in Uganda has acknowledged that, in the long term, tasks customarily performed by physicians will have to be shared and involve other health-care providers such as clinical officers and nurses, of whom there are greater numbers. Physicians will play the lead role in assessing people living with HIV/AIDS, initiating or switching therapy, managing serious conditions and supervising staff. Clinical officers, nurses and counsellors will routinely fol-

low up ART, providing counselling and initially diagnosing and treating common opportunistic infections.³⁰ Nigeria, with an estimated 1 million people with HIV/AIDS who will require ART by 2009, has developed a dynamic plan for scale up that involves training non-medical personnel to deliver therapy (P Mpele et al., unpublished data, 2005). Malawi, which has a plan to decentralize care in rural districts, has trained medical assistants and nurses to follow-up patients stabilized on ART (R Nalikungwi et al., unpublished data, 2005).

Botswana's ART programme

According to estimates from 2004, about 17.1% of Botswana's 1.7 million people are HIV-positive, with an HIV prevalence in women attending antenatal care remaining above 30%.³¹ In 2000, the Government of Botswana declared a state of emergency and initiated the first state-funded ART programme in Africa as part of its response to the epidemic. Launched in 2002, the programme aims to deliver care with a high level of clinical monitoring and a low tolerance of adverse events, as is the norm in high-resource settings. Robust public-private partnerships providing drugs, laboratory services, help with guideline development and training as well as the establishment of a strong centralized support infrastructure have been central to the programme's success. Useful lessons have been learned in terms of providing designated services, staffing and training.³²

To support phased roll-out across the country, the public-private African Comprehensive HIV/AIDS Partnerships – has facilitated a clinical preceptorship programme that places senior HIV clinicians from leading international institutions in Botswana's urban and rural hospitals and clinics for an average of 3–6 months. The programme builds skills and confidence in dealing with a range of situations through practical training and mentoring. At the end of 2004, the preceptorship programme had reached 151 medical doctors, 1701 nurses and counsellors, 27 pharmacists and 59 pharmacy technicians. Since the programme began, 22 preceptors have been involved.³³

In September 2006, 74 000 people in the country were on ART. The overall goal of the ART programme is to increase treatment services to reach a target of

80% of eligible HIV-infected citizens by 2009.³⁴ Several capacity challenges must be overcome to achieve this goal. At present, ART delivery is limited to urban areas and large villages, leaving many patients to travel long distances to seek treatment. In regions where ART programmes have been launched, waiting lists to start therapy sometimes exceed 3 months, primarily because of the shortage of doctors. Once people start therapy, they again have to endure long travelling distances for follow-up visits and medication refills, which may have serious implications for adherence to treatment. It thus seems unrealistic to assess all patients eligible for ART in a timely manner and manage long-term follow-up for the large number of people requiring therapy, without encouraging the wider engagement of local nursing personnel in initiating ART and providing follow-up care for selected groups of patients.

Botswana's economy is regarded as one of the strongest and best-managed in the developing world, with a per-capita gross domestic product of US\$ 9945.³⁵ It has a highly developed health-care system that is free at the point of delivery. Care is provided through an extensive system of "mobile stops", health posts, clinics, primary hospitals, and district and referral hospitals. As a result of a shortage of doctors (40 per 100 000 people), the majority of rural clinics and health posts are staffed by trained nurses and family welfare educators. Nurses are the largest professional group of care providers in Botswana (235 per 100 000 people); they are, therefore, ideally placed to start patients on ART and monitor them.

Nurses have acted as the first contact with the health-care system at primary care facilities since the mid-1960s.³⁶ During undergraduate training in nursing they learn consultation skills, including how to assess patients, make a diagnosis and prescribe medication. In addition to general nursing training, Botswana has established postgraduate education centres to develop family nurse practitioners. The role of family nurse practitioners was established in the 1980s in response to a perceived shortage of primary care medical practitioners and an increased demand for services. As of 2007, more than 250 family nurse practitioners have been trained. They are equipped with advanced skills in the areas of assessing and managing patients with various health-care problems, including

K. Miles et al.

HIV/AIDS. They are able to order and interpret diagnostic tests, establish medical and nursing diagnoses and institute treatment with prescribing authority for a broad range of medications and hospital admission privileges. In remote rural settings, they are trained to practice both independently of, and collaboratively with, district medical officers.

ART management by nurses

The idea of nurses in Botswana taking on an expanded role in managing patients requiring ART arose when it became clear that the predicted long-term demand for ART services at rural primary hospitals was clearly going to exceed the availability of medical personnel. After the medico-legal aspect was considered and local stakeholders were consulted, pilot work began in two centres in 2004. Nurses were trained to manage clinically stable patients who were being seen for follow-up. Criteria for these patients to be managed by a trained ART nurse, as opposed to a doctor, were agreed upon locally with medical and nursing directors. Clinical mentorship by ART preceptors ensured that national standards were met, that the nurses were clear about the limitations of their practice and that they knew when and how to refer patients to a doctor. This model worked well and was communicated to interested stakeholders.

It was soon realized that an expanded utilization of nursing skills could substantially contribute to reducing waiting lists for ART across the country and sustain the lifetime of monitoring and follow-up care that is required for those on therapy. With the need for nurses to take on a broader role in ART management recognized, several remaining issues are receiving needed attention in Botswana. These issues have relevance for other countries considering models of nurse-led care. As in Botswana, they should be addressed in partnership with any national nurses' association and related nursing education institutions to develop a sense of involvement and ownership among nurses and to overcome any potential opposition from them.

Overcoming political and professional barriers

Potential threats or concerns – at the political, professional and public levels – need to be addressed and overcome. Doctors and pharmacists may object

to nurses managing ART since physicians have traditionally managed the care of patients with HIV. Policy-makers and the public may perceive that HIV care delivered by nurses is second-rate. Nurses may feel threatened and feel they are taking on doctors' roles on nurses' wages. But where resources are limited in high-prevalence countries like Botswana, HIV can no longer be treated as a speciality: it must be considered a long-term condition and be managed as such. In securing political support and persuading professional leaders and the public that this is a way forward, comparisons can be made with the success of other HIV programmes, such as those aimed at preventing mother-to-child transmission. In this context, for example, nurses and midwives have already proved themselves by delivering zidovudine and nevirapine regimens.

Clarifying the medico-legal position

Ideally, the medico-legal position of nurses who assume this enhanced role, and in particular nurses prescribing ART, should be formally recognized and clarified at the national level.

"Nurse prescribing" is a term that has been used to describe more than one type of practice in different countries.³⁷ Nurse prescribing may involve a limited range or broad range of drugs; several drugs are available for nurses to prescribe in some countries but not in others. Certain countries may allow nurses to prescribe medicines from specific drug classes, classifications or schedules, whereas others allow nurses only to prescribe for specific conditions. Some countries allow nurses to prescribe according to the level of practice at which they are employed or according to their speciality or place of work. As a result of the various approaches applied to the term nurse prescribing, the International Council of Nurses has defined four models describing how nurses may be involved in prescribing.³⁷ The different types of nurse prescribing seen across the globe are likely to have arisen from the differing needs of health-care services, which vary greatly between countries and are largely dependent on the disease burden, income status and governing infrastructure of individual countries. Practice will also differ within a country, between urban and rural settings, and between private and public health-service delivery.²⁵

Enhanced roles for nurses may therefore require that legislation, policy or guidance, or all three, are reviewed and modified. When these changes occur, nurses will be able to practice knowing that their professional identity is protected. In Botswana, the Drug and Related Substances Regulations of 1993 state that nurses may be granted the power to prescribe only those drugs specific to their speciality or training and, where applicable, those which are specified in Botswana's national drug formulary.³⁸ Given that the last national drug formulary was written in 1992 and the majority of antiretroviral medications were not in existence then, it seems reasonable that the formulary should be updated to reflect the current use of antiretrovirals. However, the principle of addressing the medico-legal issues at national level may not always be feasible or achievable, particularly in settings where there is a distinct lack of clear structures for governance. Timescales for addressing such issues may also present a barrier, particularly with the urgency of scaling up ART, so other solutions may need to be developed.

Educational requirements

There is a need to define which nurses could take on extended roles in delivering ART as well as clear criteria as to what the minimum educational and experiential prerequisites should be. For example, prescribers could be registered nurses with accredited ART training who receive clinical mentorship from an experienced HIV practitioner until they are deemed competent. Clinical supervision could be instituted to ensure that ongoing practice meets care and prescribing standards. Botswana is in a fortunate position in terms of its national preceptor programme. To further develop the role of nurses in ART, experienced preceptors may provide direct training for those nurses suitable for taking on more advanced levels of ART care. As the ART programme matures, a core of experienced practitioners will be able to become active trainers, reducing the country's dependence on preceptors over time.

Addressing the scope of nursing practice

In terms of practical application, integrated care pathways need to be developed that clearly state which patients

may be managed by nurses and which should be seen by a doctor. The limitations of nursing practice should be clearly defined and referral pathways between nursing and medical practitioners streamlined. For example, nurses could see asymptomatic patients, and doctors see those with AIDS-defining illnesses. Patients with stable or increasing CD4 counts and suppressed viral load could continue to be followed up by nurses, and those presenting with adverse effects or treatment failure by doctors. These elements could be determined nationally or regionally, according to local staffing capacity, capability and infrastructure.

Monitoring and evaluation

Finally, the development of expanded clinical roles for nurses crosses traditional boundaries of routine ART care. Therefore, mechanisms for monitoring nursing care should be in place. At this embryonic stage of the development of new roles, consideration should be given to implementing operational research to determine the safety, cost-effectiveness, acceptability and sustainability of such programmes. In England, for example, legal standards require that a nurse who takes on a role or task previously performed by a doctor should be able to perform that role or task to the same standard as a doctor.³⁹ In the ideal research situation, trials to assess the equivalence or quality of care could verify whether outcomes of patients managed by nurses are no worse than those managed by doctors. Outcomes assessed could include

the correct initiation of ART according to national standards, the correct and timely management of side effects, biological outcomes (CD4 count, viral load) and mortality. Evaluating the process of care using qualitative approaches such as non-participant observation, process modelling and stakeholder interviews alongside economic evaluations should be central to any research studies.

Conclusion

WHO's initiative to scale up the delivery of ART offers pragmatic approaches to address difficult questions about the wider roll-out of HIV therapy in resource-limited settings. These approaches include advocating for strategies that do not rely on highly trained physicians. Although some progress has been made in widening the tasks performed by nurses,⁴⁰ models of ART delivery that fully capitalize on nursing resources remain relatively limited and none has been rigorously evaluated.

This concept paper draws on experiences from the Botswana ART programme. This programme has shown that better utilization of nurses has the potential to increase access to ART, reduce congestion at centralized ART centres, reduce unnecessary travel by patients and allow for localized provision of support for adherence and education. This paper's limitations include a lack of operational outcomes demonstrating that in this context nurses could perform as safe, accountable and acceptable practitioners. Nurses in Botswana are well-educated, have good access to

ongoing continual professional development, work within a strong framework of clinical governance and remain the country's largest group of health-care providers. This is not the case for many other low-resource settings, where it may be unrealistic to expect a similar programme to proceed. Therefore, before being scaled up, each ART programme warrants a thorough situational analysis and adaptation of the programme.

While there will always be wide variance across ART programmes in different parts of the world, lessons from the Botswana programme may help shape strategic directions in other settings. To increase nursing capacity, the development of nursing capability needs to be considered in terms of legislation and policy, the limitations of nursing practice, initial and ongoing training, the development of clear referral pathways between medical and nursing personnel, and mechanisms for monitoring and supervision. It is necessary to explore the feasibility of nurse-led strategies through formative research; controlled trials are needed to provide empirical data on the benefits and risks of this strategy compared with traditional models of ART delivery. Planning and investing for the better use of human resources is not optional: ART scale-up initiatives can succeed only with the full and extensive involvement of nurses and other non-medical personnel. ■

Competing interests: None declared.

Résumé

Lancement d'un traitement antirétroviral dans un pays à ressources limitées : comment tirer le meilleur parti des ressources en personnel infirmier du Botswana

Problématique Avec la mise en œuvre dans des pays à ressources limitées de programmes de délivrance de traitements antirétroviraux (ART), le problème n'est plus de savoir comment ces programmes seront financés, mais de déterminer qui se chargera de leur mise en œuvre et de leur maintien.

Démarche Les systèmes de délivrance du traitement et de prestation des soins liés au VIH/sida gérés par des médecins qui ont été mis en place dans les pays industrialisés ne peuvent être reproduits dans les pays où le VIH/sida est fortement prévalent et l'accès au personnel médical très restreint. Il faut donc que les systèmes de soins exploitent mieux les ressources humaines disponibles.

Contexte local A partir de l'exemple du Botswana, nous étudions la sous-utilisation du personnel infirmier dans la prise en charge à long terme des patients ayant besoin d'un traitement antirétroviral.

Modifications pertinentes Pour que les programmes de délivrance de traitements ART soient durables, il faut, à notre avis, que le personnel infirmier assure des soins cliniques d'un certain niveau auprès des patients recevant ce type de traitement, et notamment la prescription des ART et la prise en charge des effets indésirables courants.

Enseignements tirés Parmi les considérations pratiques intervenant dans l'extension des systèmes de délivrance des

traitements ART gérés par du personnel infirmier, figurent l'élimination des barrières politiques et professionnelles, l'identification des besoins en matière de formation, la concertation sur les limites à fixer aux pratiques infirmières, l'élaboration de procédures claires pour l'orientation vers du personnel médical

ou infirmier et la mise au point de mécanismes pour surveiller et superviser ces pratiques. Des études relevant de la recherche opérationnelle sont nécessaires pour démontrer la sécurité, l'efficacité et la durabilité de tels systèmes.

Resumen

Aplicación del tratamiento antirretroviral en un entorno con recursos limitados: aprovechar el personal de enfermería en Botswana

Problema A medida que se aplican los programas destinados a suministrar tratamiento antirretroviral (TAR) en entornos con recursos limitados, el problema no es tanto encontrar la manera de financiar esos programas como determinar quién se responsabilizará de su implementación y mantenimiento.

Métodos Los modelos de tratamiento y atención de la infección por VIH dirigidos por el médico que han surgido en los países industrializados no son reproducibles en los entornos con alta prevalencia de esa infección y acceso limitado a personal médico. Es preciso, por tanto, que los modelos de atención aprovechen mejor los recursos humanos disponibles.

Contexto local Tomando Botswana como ejemplo, analizamos la infrautilización que se hace del personal de enfermería en el manejo clínico a largo plazo de los pacientes que requieren TAR.

Cambios destacables Argumentamos que, para que los programas de TAR sean sostenibles, las enfermeras tendrán que asumir parte de la atención clínica de los pacientes que reciban esa terapia, incluidos la prescripción de TAR y el manejo de efectos adversos comunes.

Enseñanzas extraídas Entre los aspectos prácticos que plantea la expansión de los modelos de suministro de TAR dirigidos por personal de enfermería cabe citar la necesidad de superar barreras políticas y profesionales, la identificación de las necesidades educacionales, el establecimiento de vías de derivación claras entre los médicos y el personal de enfermería, y la formulación de mecanismos de vigilancia y supervisión de las prácticas. Es necesario emprender investigaciones operacionales para comprobar si esos modelos son seguros, eficaces y sostenibles.

ملخص

تعميم المعالجة بمضادات الفيروسات القهقرية في موقع محدود الموارد: الاستفادة من الموارد التمريضية في بتسوانا

الموقع المحلي: ونرى أنه لضمان استمرار برامج إيتاء هذه الرعاية، ينبغي للممرضات أن يقدمن مستوى معيناً من الرعاية السريرية للمرضى الذين يتلقون هذا العلاج، يشمل وصف الأدوية المضادة للفيروسات القهقرية ومواجهة التأثيرات الضائرة الشائعة.

الدروس المستفادة: وتشمل عوامل النهوض بالبرامج التي تقودها الممرضات في إيتاء المعالجة بمضادات الفيروسات القهقرية، التغلب على العوائق السياسية والمهنية، وتحديد المتطلبات التعليمية، وتحديد أوجه قصور الممارسة التمريضية، وإنشاء قنوات واضحة للإحالة بين العاملين الطبيين والتمريضيين، ووضع آليات لرصد الممارسة والإشراف عليها. ويستلزم الأمر إجراء بحوث عملية لبيان أن هذه النماذج مأمونة وفعالة ومضمونة الاستمرار.

المشكلة: بعد بدء تنفيذ برامج إيتاء المعالجة بمضادات الفيروسات القهقرية في المواقع المحدودة الموارد، لم تُعد المشكلة تتمثل في كيفية تمويل هذه البرامج وإنما في من سيضطلع بمسؤولية تقديم هذه البرامج وضمان استمرارها. **الأسلوب:** فالنماذج التي يقودها الأطباء لمعالجة ورعاية المصابين بفيروس الإيدز، والتي نشأت في البلدان الصناعية، لا يمكن تطبيقها في الأماكن التي تعاني من ارتفاع معدل انتشار العدوى بالفيروس ومن صعوبة الوصول إلى العاملين الطبيين. لذلك ينبغي لنماذج الرعاية أن تحسن استفادتها من الموارد البشرية المتاحة.

الموقع المحلي: وبأخذ بتسوانا كمثال، فإننا ناقش في هذه الدراسة مظاهر نقص الاستفادة من الممرضات في المعالجة السريرية الطويلة الأجل للمرضى المحتاجين إلى مضادات الفيروسات القهقرية.

References

- Ivers LC, Kendrick D, Doucette K. Efficacy of antiretroviral therapy programs in resource-poor settings: a meta-analysis of the published literature. *Clin Infect Dis* 2005;41:217-24.
- Djomand G, Roels T, Ellerbrock T, Hanson D, Diomande F, Monga B, et al. Virologic and immunologic outcomes and programmatic challenges of an antiretroviral treatment pilot project in Abidjan, Cote d'Ivoire. *AIDS* 2003;17 Suppl 3:S5-15.
- Kumarasamy N, Solomon S, Chaguturu SK, Mahajan AP, Flanigan TP, Balakrishnan P, et al. The safety, tolerability and effectiveness of generic antiretroviral drug regimens for HIV-infected patients in south India. *AIDS* 2003;17:2267-9.
- Landman R, Schiemann R, Thiam S, Vray M, Canestri A, Mboup S, et al. Once-a-day highly active antiretroviral therapy in treatment-naive HIV-1-infected adults in Senegal. *AIDS* 2003;17:1017-22.
- Laurent C, Diakhate N, Gueye NF, Toure MA, Sow PS, Faye MA, et al. The Senegalese government's highly active antiretroviral therapy initiative: an 18-month follow-up study. *AIDS* 2002;16:1363-70.
- Laurent C, Kouanfack C, Koulla-Shiro S, Nkoue N, Bourgeois A, Calmy A, et al. Effectiveness and safety of a generic fixed-dose combination of nevirapine, stavudine, and lamivudine in HIV-1-infected adults in Cameroon: open-label multicentre trial. *Lancet* 2004;364:29-34.
- Weidle PJ, Malamba S, Mwebaze R, Sozi C, Rukundo G, Downing R, et al. Assessment of a pilot antiretroviral drug therapy programme in Uganda: patients' response, survival, and drug resistance. *Lancet* 2002;360:34-40.
- Coetzee D, Boule A, Hildebrand K, Asselman V, Van Cutsem G, Goemaere E. Promoting adherence to antiretroviral therapy: the experience from a primary care setting in Khayelitsha, South Africa. *AIDS* 2004;18:S27-31.
- Eley B, Nuttall J, Davies MA, Smith L, Cowburn C, Buys H, et al. Initial experience of a public sector antiretroviral treatment programme for HIV-infected children and their infected parents. *S Afr Med J* 2004;94:643-6.
- Koenig SP, Leandre F, Farmer PE. Scaling-up HIV treatment programmes in resource-limited settings: the rural Haiti experience. *AIDS* 2004;18:S21-5.

11. Laniece I, Ciss M, Desclaux A, Diop K, Mbodj F, Ndiaye B, et al. Adherence to HAART and its principal determinants in a cohort of Senegalese adults. *AIDS* 2003;17 Suppl 3:S103-8.
12. Nemes MIB, Carvalho HB, Souza MFM. Antiretroviral therapy adherence in Brazil. *AIDS* 2004;18:S15-20.
13. Orrell C, Bangsberg DR, Badri M, Wood R. Adherence is not a barrier to successful antiretroviral therapy in South Africa. *AIDS* 2003;17:1369-75.
14. Mbewu AD. Changing history: closing the gap in AIDS treatment and prevention. *Bull World Health Organ* 2004;82:400-1.
15. Marchal B, De Brouwere V, Kegels G. HIV/AIDS and the health workforce crisis: what are the next steps? *Trop Med Int Health* 2005;10:300-4.
16. Kober K, Van Damme W. Scaling up access to antiretroviral treatment in southern Africa: who will do the job? *Lancet* 2004;364:103-7.
17. Dhaliwal M, Ellman T. *Improving access to anti-retroviral treatment in Cambodia*. Brighton: International HIV/AIDS Alliance; 2003.
18. Curran J, Debas H, Arya M, Kelley P, Knobler S, Pray L, eds. *Scaling up treatment for the global AIDS pandemic: challenges and opportunities*. Washington: National Academies Press; 2005.
19. Jaffar S, Govender T, Garrib A, Welz T, Grosskurth H, Smith PG, et al. Antiretroviral treatment in resource-poor settings: public health research priorities. *Trop Med Int Health* 2005;10:295-9.
20. *Treating 3 million by 2005: making it happen: the WHO strategy*. Geneva: WHO; 2003.
21. *A public health approach for scaling up antiretroviral (ARV) treatment: a toolkit for programme managers*. Geneva: WHO; 2003.
22. *A public health approach to antiretroviral treatment: overcoming constraints*. Geneva: WHO; 2003.
23. *Scaling up antiretroviral therapy in resource-limited settings: treatment guidelines for a public health approach (2003 revision)*. Geneva: WHO; 2004.
24. *Chronic HIV care with ARV therapy: integrated management of adolescent and adult illness. Interim guidelines for first-line facility health workers*. Geneva: WHO; 2003.
25. Miles K, Seito O, McGilvray M. Nurse prescribing in low-resource settings: professional considerations. *Int Nurs Rev* 2006;53:290-6.
26. Aiken L, Lake E, Semaan S, Lehman H, O'Hare P, Cole S, et al. Nurse practitioner managed care for persons with HIV infection. *Image J Nurs Sch* 1993;25:172-7.
27. Langer SR, Hutelmyer C. Patient satisfaction with outpatient human immunodeficiency virus care as delivered by nurse practitioners and physicians. *Holist Nurs Pract* 1995;10:54-60.
28. Wilson IB, Landon BE, Hirschhorn LR, McInnes K, Ding L, Marsden PV, et al. Quality of HIV care provided by nurse practitioners, physician assistants, and physicians. *Ann Intern Med* 2005;143:729-36.
29. Coetzee D, Hildebrand K, Boule A, Maartens G, Louis F, Labatala V, et al. Outcomes after two years of providing antiretroviral treatment in Khayelitsha, South Africa. *AIDS* 2004;18:887-95.
30. Okero F, Aceng E, Namagala E, Serutoke J. *Scaling up antiretroviral therapy: experience in Uganda. perspectives and practice in ARV treatment*. Geneva: WHO; 2005.
31. *2005 progress report of the national response to the UNGASS Declaration of Commitment on HIV/AIDS*. Gaborone: National AIDS Coordinating Agency (NACA), Botswana; 2005.
32. Wester CW, Bussmann H, Avalos A, Ndwapi N, Gaolathe T, Cardiello P, et al. Establishment of a public antiretroviral treatment clinic for adults in urban Botswana: lessons learned. *Clin Infect Dis* 2005;40:1041-4.
33. *ACHAP review 2004*. Gaborone: African HIV/AIDS Partnerships (ACHAP); 2004.
34. *ACHAP review 2005*. Gaborone: African HIV/AIDS Partnerships (ACHAP); 2005.
35. *Human Development Report 2006. Beyond scarcity: power, poverty and the global water crisis*. New York: United Nations Development Programme; 2006.
36. Boonstra E, Lindbaek M, Khulumani P, Ngome E, Fugelli P. Adherence to treatment guidelines in primary health care facilities in Botswana. *Trop Med Int Health* 2002;7:178-86.
37. International Council of Nurses. *Implementing nurse prescribing*. Geneva: ICN; 2004.
38. Ministry of Health, Botswana. *Drug and related substances regulations*. Gaborone: Government Printer; 1993.
39. *Developing key roles for nurses and midwives: a guide for managers*. London: Department of Health, United Kingdom; 2002.
40. Hirschhorn LR, Oguda L, Fullem A, Dreesch N, Wilson P. Estimating health workforce needs for antiretroviral therapy in resource-limited settings. *Hum Resour Health* 2006;4:1.