

Universal voluntary HIV testing and immediate antiretroviral therapy

In Reuben Granich and colleagues' mathematical model on the benefits of antiretroviral therapy for HIV prevention (Jan 3, p 48),¹ everyone is tested and everyone with HIV is treated immediately (irrespective of CD4+ cell count). However, the relation of this theoretical model to reality rests entirely on the veracity of the assumptions employed.

First, the hypothesis that suppressive antiretroviral therapy can reduce HIV transmission within a sexual partnership is plausible, but unproven. Several studies have shown that antiretroviral therapy suppresses HIV in genital secretions, and two observational studies^{2,3} have reported greatly reduced HIV transmission in couples when the infected person received antiretroviral therapy. However, neither the magnitude nor the durability of this benefit is known. Accordingly, the US National Institutes of Health has launched a randomised trial (clinicaltrials.gov identifier NCT00074581) designed to answer these questions.

Second, although detection of all HIV-infected people through wide-spread testing is a desirable goal, no evidence exists that this can be accomplished even in wealthy countries highly committed to HIV prevention.

Third, the decision to treat everyone irrespective of CD4+ cell count should not be taken lightly. Little doubt exists that suppressing HIV benefits the HIV-infected person. However, much of the immune damage to the host occurs during acute HIV infection⁴—a phase of the disease not detected by most current strategies. These "invisible" patients with acute HIV infection might contribute disproportionately to the spread of HIV.⁵ They have not been factored into most mass treatment models because they cannot be readily detected.

Additionally, we do not know the long-term toxic effects of many of the best antiretroviral therapy regimens; cardiovascular complications are of no small importance.

The WHO model¹ challenges us to marry treatment and prevention. The time has arrived for the drug discovery and treatment communities to fully embrace the public health benefits of antiretroviral therapy. Using drug combinations that will render patients durably less contagious can only be viewed as a salutary benefit of required therapy. Perhaps, in the coming years, it will turn out that we can provide enough antiretroviral therapy to enough people to curb the epidemic. The job now is to be realistic in our expectations and to generate the essential data to lay the tracks so the treatment-for-prevention train can leave the station.

We declare that we have no conflict of interest.

*Myron S Cohen, Timothy D Mastro, Willard Cates Jr
myron_cohen@med.unc.edu

University of North Carolina at Chapel Hill, Chapel Hill, NC 27599, USA (MSC); and Family Health International, Research Triangle Park, NC, USA (TDM, WC)

- 1 Granich RM, Gilks CF, Dye C, De Cock KM, Williams BG. Universal voluntary HIV testing with immediate antiretroviral therapy as a strategy for elimination of HIV transmission: a mathematical model. *Lancet* 2009; **373**: 48–57.
- 2 Bunnell R, Ekwaru JP, Solberg P, et al. Changes in sexual behavior and risk of HIV transmission after antiretroviral therapy and prevention interventions in rural Uganda. *AIDS* 2006; **20**: 85–92.
- 3 Kayitenkore K, Bekan B, Rufagari J, et al. The impact of ART on HIV transmission among HIV serodiscordant couples. XVI International AIDS Conference, Toronto, Canada, August 2006.
- 4 Brechley JM, Schacker TW, Ruff LE, et al. CD4+ T cell depletion during all stages of HIV disease occurs predominantly in the gastrointestinal tract. *J Exp Med* 2004; **200**: 749–59.
- 5 Hollingsworth TD, Anderson RM, Fraser C. HIV-1 transmission, by stage of infection. *J Infect Dis* 2008; **198**: 687–93.

Contrary to Reuben Granich and colleagues' interpretation, the results of their model-based analysis¹ actually suggest that, even under optimum conditions, early and sustained universal treatment cannot eradicate HIV.

Their assumptions about the effect of this strategy are highly optimistic: they assume that HIV-infected people would reduce risk behaviour by an average of 40%; that second-line therapy is immediately available on failure of first-line; and that antiretroviral therapy reduces infectiousness by 99%. This level of reduction is unlikely.²

Granich and colleagues calculate that an eradication phase would only be possible if HIV-infected individuals start antiretroviral therapy at a CD4+ T-cell threshold of about 1150 cells per μ L. But this would be impossible since the average CD4+ count immediately after seroconversion is about 884 cells per μ L in Africa.³ Even if the average testing frequency is once per year it would be difficult to catch early seroconversions since diagnoses will occur an average of 6 months after seroconversion.

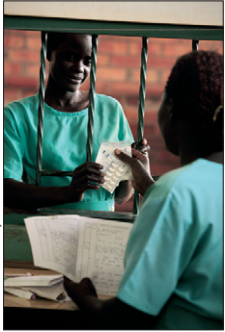
Various theoretical studies have indicated that increasing treatment coverage can substantially reduce incidence if supplemented with behaviour change,⁴ but the epidemiological impact is likely to be moderate unless testing rates increase substantially. Even in resource-rich settings there is a large proportion of people at high risk who are never tested for HIV.⁵

Therefore, although universal treatment should be strived towards, the notion that universal testing and treatment at high CD4+ concentrations can be attained in the foreseeable future seems unrealistic. The important message from the study is that large increases in testing and early treatment can have a substantial preventive effect at the population level. The paper should be a call to promote serious international discussion between public-health officials, clinicians, and other researchers about the viability of this intervention strategy, the ethics of individualism versus utilitarianism, and the possibility of using prevention funds to further increase treatment access.

The printed journal includes an image merely for illustration

Still Pictures

Submissions should be made via our electronic submission system at <http://ees.elsevier.com/thelancet/>



Science Photo Library

I declare that I have no conflict of interest.

David P Wilson
 dwilson@nchecr.unsw.edu.au

National Centre in HIV Epidemiology and Clinical Research, University of New South Wales, Sydney, NSW 2052, Australia

- 1 Granich RM, Gilks CF, Dye C, De Cock KM, Williams BG. Universal voluntary HIV testing with immediate antiretroviral therapy as a strategy for elimination of HIV transmission: a mathematical model. *Lancet* 2009; **373**: 48–57.
- 2 Wilson DP, Law MG, Grulich AE, Cooper DA, Kaldor JM. Relation between HIV viral load and infectiousness: a model-based analysis. *Lancet* 2008; **372**: 314–20.
- 3 Williams BG, Korenromp EL, Gouws E, Schmid GP, Auvert B, Dye C. HIV infection, antiretroviral therapy, and CD4+ cell count distributions in African populations. *J Infect Dis* 2006; **194**: 1450–58.
- 4 Montaner JS, Hogg R, Wood E, et al. The case for expanding access to highly active antiretroviral therapy to curb the growth of the HIV epidemic. *Lancet* 2006; **368**: 531–36.
- 5 Prestage G, Jin F, Zablotska IB, Imrie J, Grulich AE, Pitts M. Trends in HIV testing among homosexual and bisexual men in eastern Australian states. *Sex Health* 2008; **5**: 119–23.

We commend the creativity of Reuben Granich and colleagues¹ in proposing universal voluntary HIV testing and immediate treatment to reduce HIV incidence to less than 0.1% in a generalised epidemic such as South Africa's. However, in addition to programmatic, clinical, social, behavioural, financial, and ethical obstacles, we are concerned that their model underestimates the role of acute transmission. The proposed yearly testing would miss most acute infections (which cannot be detected by standard antibody tests), and thus would fail to stop potential rapid chains of early transmissions during peak (acute) infectivity.

Granich and colleagues assume acute infection to be ten times as infectious as chronic infection, partly on the basis of the Rakai, Uganda, cohort, which provides the best direct evidence (although it was not designed to assess acute infectivity). However, modelling based on Rakai data has indicated relative acute infectivity of 26-fold² to 43-fold.³

Additionally, Granich and colleagues' assumption of eight partners per year is strikingly at variance with survey

data (even if such data probably significantly under-report multiple partnerships), such as a 2005 South African survey that found only 16.3% of men and 2.6% of women reported two or more partners in the past year.⁴ Nor does an epidemic doubling time of 1.2 years approximate the current epidemic in South Africa.

Finally, the model's estimated effect is based on optimistic assumptions, including a "full package" of standard interventions reducing transmission by 40% (something rarely, if ever, achieved⁵). According to the model, the other 60% reduction in transmission would be achieved by universal testing and treatment (in a near-perfect scenario), but it would be very sensitive to rates of drop-out, infectivity while on antiretroviral therapy, and especially coverage of testing, making practical concerns about implementation all the more daunting.

We declare that we have no conflict of interest.

*Allison Ruark, James D Shelton,
 Daniel T Halperin, Maria J Wawer,
 Ronald H Gray
 allisonruark@gmail.com

Harvard Center for Population and Development Studies, Cambridge, MA 02138, USA (AR); Bureau for Global Health, US Agency for International Development, Washington, DC, USA (JDS); Harvard School of Public Health, Boston, MA, USA (DTH); and Johns Hopkins University, Baltimore, MD, USA (MJW, RHG)

- 1 Granich RM, Gilks CF, Dye C, De Cock KM, Williams BG. Universal voluntary HIV testing with immediate antiretroviral therapy as a strategy for elimination of HIV transmission: a mathematical model. *Lancet* 2009; **373**: 48–57.
- 2 Hollingsworth TD, Anderson RM, Fraser C. HIV-1 transmission, by stage of infection. *J Infect Dis* 2008; **198**: 687–93.
- 3 Pinkerton SD. Probability of HIV transmission during acute infection in Rakai, Uganda. *AIDS Behav* 2008; **12**: 677–84.
- 4 Shisana O. South African national HIV prevalence, HIV incidence, behaviour and communication survey, 2005. Cape Town: Human Sciences Research Council, 2005.
- 5 Potts M, Halperin DT, Kirby D, et al. Reassessing HIV prevention. *Science* 2008; **320**: 749–50.

Reuben Granich and colleagues explore a policy of universal voluntary HIV testing with immediate antiretroviral therapy as a strategy for elimination of HIV transmission.¹ I wonder how relevant their findings are, given that

the models used do not account for concurrency—ie, overlapping, long-term partnerships—which are likely to account for a substantial amount of HIV transmission in South Africa.²

Granich and colleagues do state that their model "allows for a high level of concurrency and for a much higher infectiousness during the acute phase than during the chronic phase." However, the reference they use to support this statement³ does not model concurrency, but uses a basic risk-category, deterministic model combined with a factor for changes in viral load. This is not the same thing as modelling concurrency, which is a network effect enhanced by, but independent of, viral load fluctuations.

For deterministic models to approximate the observed prevalence of HIV, they must make unreasonable assumptions about African sexual behaviour. The authors of the cited paper,³ and presumably Granich and colleagues, assume that 1% of people have on average 77 partners per year. Behavioural surveys from Africa have never found such high levels of "promiscuity".⁴ The authors' assumption is derived not from behavioural data, but from the demands of the model itself. The model would not predict actual prevalence otherwise.

Network models⁵ do not require unrealistic assumptions, and are much better able to derive prevalence estimates on the basis of actual behavioural data. Thus, it would seem worth modelling the effect of testing and antiretroviral therapy with a network model that includes concurrent partnerships.

At the very least, factoring in concurrency would increase the relative amount of transmission attributable to the "acute" phase—ie, when infection is not even detectable on an HIV test—beyond that calculated by Abu-Raddad and Longini⁴ (and presumably Granich and colleagues). That would reduce the effect of testing and early treatment significantly, I suspect.

I declare that I have no conflict of interest.

Helen Epstein

helenepstein@yahoo.com

424 West 144th Street, New York, NY 10031, USA

- 1 Granich RM, Gilks CF, Dye C, De Cock KM, Williams BG. Universal voluntary HIV testing with immediate antiretroviral therapy as a strategy for elimination of HIV transmission: a mathematical model. *Lancet* 2009; **373**: 48–57.
- 2 Mah TL, Halperin DT. Concurrent sexual partnerships and the HIV epidemics in Africa: evidence to move forward. *AIDS Behav* 2008; published online July 22. DOI: 10.1007/s10461-008-9433-x.
- 3 Abu-Raddad LJ, Longini IM Jr. No HIV stage is dominant in driving the HIV epidemic in sub-Saharan Africa. *AIDS* 2008; **22**: 1055–61.
- 4 Wellings K, Collumbien M, Slaymaker E, et al. Sexual behaviour in context: a global perspective. *Lancet* 2006; **368**: 1706–28.
- 5 Morris M, Goodreau S, Moody J. Sexual networks, concurrency, and STD/HIV. In: Holmes KK, Sparling PF, Stamm WE, et al, eds. Sexually transmitted diseases, 4th edn. New York: McGraw-Hill, 2007.

The theoretical model by Reuben Granich and colleagues¹ concludes that a massive scale-up of HIV testing with immediate initiation of antiretroviral therapy could nearly stop HIV transmission. Writing on behalf of a group of advisers to UNAIDS on HIV and human rights,² we welcome a model that proposes the attainment of universal access to HIV treatment and HIV testing, and confirms the link between HIV prevention and treatment; these are essential components of the right to health which must be pursued with much greater efforts.

Granich and colleagues acknowledge many barriers to implementation, but neglect a crucial issue: whether universal annual testing and immediate treatment can be applied safely and acceptably in the face of widespread HIV-related stigma, discrimination, and human rights abuses.

There is abundant evidence that the uptake of HIV prevention and treatment programmes is undermined by gender inequality and violence against women, stigma and discrimination against people living with HIV, and the criminalisation or denial of the existence by some governments of populations at high risk of HIV—eg, men who have sex with men, people who use drugs, and sex workers.

The model would have been stronger had it costed concrete programmes to reduce these barriers and support people's ability to access services. Without attention to such programmes, the model would not achieve the posited uptake necessary to achieve its goals. If efforts to determine the model's potential are deemed worthy of study, it is imperative that not only HIV testing and treatment be scaled up, but also programmes to protect and promote human rights of people living with and vulnerable to HIV.³ Additionally, people living with and affected by HIV should be involved.

We declare that we have no conflict of interest.

*Ralf Jürgens, Jonathan Cohen,
Daniel Tarantola, Mark Heywood,
Robert Carr
rjurgens@sympatico.ca

97, rue de Koninck, Mille-Isles, Quebec J0R 1A0, Canada (RJ); Public Health Program, Open Society Institute, New York, NY, USA (JC); School of Public Health and Community Medicine, Faculty of Medicine, University of New South Wales, Sydney, NSW, Australia (DT); South Africa National AIDS Council, Pretoria, South Africa (MH); and Caribbean Vulnerable Communities Coalition, Kingston, Jamaica (RC)

- 1 Granich RM, Gilks CF, Dye C, De Cock KM, Williams BG. Universal voluntary HIV testing with immediate antiretroviral therapy as a strategy for elimination of HIV transmission: a mathematical model. *Lancet* 2009; **373**: 48–57.
- 2 UNAIDS Reference Group on HIV and Human Rights. Time for action towards universal access to prevention, treatment, care and support: beyond theory towards practice and protection. Geneva: UNAIDS, 2008.
- 3 Open Society Institute. Human rights and HIV/AIDS: now more than ever. New York: Open Society Institute, 2008. http://www.soros.org/initiatives/health/focus/law/articles_publications/publications/human_20071017 (accessed March 10, 2009).

Reuben Granich and colleagues¹ suggest universal HIV testing and immediate treatment of those found positive, which is indeed “a bold move away”² from the current approach of treatment on the basis of clinical need and prevention through behavioural education.

Granich and colleagues' modelling results depend heavily on the validity of assumptions about future or unrealised events. For example,

they assume that, with treatment, infectiousness fell to only 1% of untreated infectiousness. They also assume a yearly dropout rate of 1.5%, which would seem overly optimistic for a long-term “universal” programme. A sensitivity analysis with these model parameters would have allowed us to see how different values might affect the results qualitatively. Scientifically, their results merely indicate some possible future scenarios—if antiretroviral therapy strikingly lowers the infectivity of treated patients, if long-term compliance is sufficiently high, and if this programme does not lead to significantly more risky behaviour by the population owing to a false sense of security.

Furthermore, to remedy the inadequacies of implementing a universal testing programme, one could consider the experience of Cuba, where extensive random testing accompanied by contact tracing of infected individuals has resulted in a high HIV detection rate, estimated by two different methods at around 77%³ and 80%,⁴ respectively. This has resulted in Cuba having a significantly lower HIV prevalence than its neighbours in the Caribbean Basin.⁵ Moreover, contact tracing is less costly than universal testing, and hence is an ideal complement to large-scale intervention programmes in developing countries.

We declare that we have no conflict of interest.

*Ying-Hen Hsieh, Hector de Arazoza
hsieh@amail.cmu.edu.tw

Department of Public Health and Institute of Biostatistics, China Medical University, Taichung, Taiwan (YHH); and Department of Mathematics, University of La Habana, Havana, Cuba (HdA)

- 1 Granich RM, Gilks CF, Dye C, De Cock KM, Williams BG. Universal voluntary HIV testing with immediate antiretroviral therapy as a strategy for elimination of HIV transmission: a mathematical model. *Lancet* 2009; **373**: 48–57.
- 2 Garnett GP, Baggaley RF. Treating our way out of the HIV pandemic: could we, would we, should we? *Lancet* 2009; **373**: 9–11.
- 3 Hsieh YH, Wang HC, de Arazoza H, Lounes R, Twu SJ, Hsu HM. Ascertaining HIV underreporting in low HIV prevalence settings. *J Biol Systems* 2005; **13**: 441–54.

- 4 de Arazoza H, Joanes J, Lounes R, et al. The HIV/AIDS epidemic in Cuba: description and tentative explanation of its low HIV prevalence. *BMC Infect Dis* 2007; **7**: 130.
- 5 UNAIDS. 2008 report on the global AIDS epidemic. Geneva: UNAIDS, 2008. http://www.unaids.org/en/KnowledgeCentre/HIVData/GlobalReport/2008/2008_Global_report.asp (accessed Jan 5, 2009).
- 1 Granich RM, Gilks CF, Dye C, De Cock KM, Williams BG. Universal voluntary HIV testing with immediate antiretroviral therapy as a strategy for elimination of HIV transmission: a mathematical model. *Lancet* 2009; **373**: 48–57.
- 2 Garnett GP, Baggaley RF. Treating our way out of the HIV pandemic: could we, would we, should we? *Lancet* 2009; **373**: 9–11.
- 3 World Medical Association. World Medical Association international code of medical ethics. <http://www.wma.net/e/policy/c8.htm> (accessed Dec 9, 2008).

In their important and provocative article,¹ Reuben Granich and colleagues argue that universal voluntary HIV testing and immediate antiretroviral therapy, irrespective of the degree of immune suppression, could eliminate HIV from countries where the infection is highly prevalent. However, we agree with Geoffrey Garnett and Rebecca Baggaley² that this approach could strongly shift the benefits of treatment from the individual to the population.

Although current HIV treatment guidelines favour earlier treatment, the risks and benefits of treatment for people with CD4+ cell counts above 350 per μL are unknown. Trials of therapy for patients with higher counts are yet to begin.

Within the field of communicable diseases, we are aware of little precedent for the approach of “treating for the common good”. Treatment of diseases such as tuberculosis might have the effect of decreasing transmission, but the primary goal is to decrease morbidity and mortality for the affected person. A better analogy might be found in immunisation programmes—eg, rubella vaccination of infants and children aims to reduce exposure among pregnant women. However, there is still a clear benefit and minimal risk for the individual vaccinee.

The World Medical Association international code of medical ethics states that “A physician shall act in the patient’s best interest when providing medical care.”³ If we are to deviate from this basic principle, we will need a robust ethical model for balancing individual and societal benefits.

We declare that we have no conflict of interest.

*Harold Jaffe, Adrian Smith, Tony Hope
harold.jaffe@dphpc.ox.ac.uk

Department of Public Health, University of Oxford, Old Road Campus, Headington, Oxford OX3 7LF, UK

Reuben Granich and colleagues¹ use mathematical models to show that annual screening of most adults for HIV, with immediate commencement of antiretroviral therapy for all infected, would strikingly reduce HIV incidence. The findings are very interesting. We would like to share our lessons from Ethiopia.

Ethiopia had a millennium AIDS campaign with the objective of increasing the number of people tested for HIV through universal voluntary counselling and testing and providing antiretroviral treatment for eligible patients. We were able to increase the number of people tested in 1 year from 560 000 in 2005/06 to 4.6 million in 2007/08. The number of patients started on antiretroviral therapy per month increased from 3500 to more than 5700.²

Even though we accomplished a lot in terms of HIV testing and antiretroviral therapy provision, we had challenges during the rapid scale-up of these services. We learnt that mass testing is very resource-intensive and needs a strong health system, including adequate human resources and a continuous supply of commodities. As a result, our current guiding principle is “high yield” and “high impact” through targeted testing of most-at-risk populations: patients with tuberculosis or sexually transmitted diseases, and pregnant women.

Universal voluntary HIV testing and antiretroviral therapy provision might be effective in reducing HIV transmission, but with the current health system constraints in many sub-Saharan African countries such as Ethiopia, it is really not feasible to

practise it. We recommend “high yield” and “high impact” HIV testing with early initiation of antiretroviral therapy, and improved adherence and retention of patients in care and treatment.

We declare that we have no conflict of interest.

*Yibeltal Assefa, Meskele Lera
yibeltalassefa@yahoo.com

National HIV/AIDS Prevention and Control Office, Addis Ababa, Ethiopia

- 1 Granich RM, Gilks CF, Dye C, De Cock KM, Williams BG. Universal voluntary HIV testing with immediate antiretroviral therapy as a strategy for elimination of HIV transmission: a mathematical model. *Lancet* 2009; **373**: 48–57.
- 2 MOH. Ethiopian monthly antiretroviral treatment report, September 2008. Addis Ababa: Ministry of Health, 2008.

Authors’ reply

We thank the many colleagues around the world who have commented on our theoretical paper, and are encouraged by the ongoing discussion about how best to use antiretroviral therapy for HIV prevention. These comments signal that more research is needed.

The hypothetical approach that was modelled need not be interpreted as putting public health in competition with individual health. There is increasing evidence of individual benefit from earlier initiation of antiretroviral therapy, and the optimum time to start therapy remains uncertain. Only research can determine conclusively whether the modelled approach would benefit individuals by reducing HIV transmission and HIV disease, or whether drug toxicity and other considerations would outweigh advantages.

We agree that operational challenges in high burden, resource-constrained settings are formidable. The paper was a hypothetical exercise and further research is required to assess whether the studied approach has merit. We also agree that ethical and human rights issues need to be addressed, along with technical and financial considerations, as the concept of antiretroviral therapy for HIV prevention is further developed. We stress that other prevention modalities would continue to have a role, including ethical partner notification, as appropriate.

Technical issues raised by the correspondents include the importance of acute infection and its associated high infectivity, epidemic trends in southern Africa, the role of sexual concurrency, the degree of protection against HIV from other preventive interventions, and the postulated rates of adherence to therapy. The assumptions that went into the model were supported by the results of published studies, including available information on the relative importance of the acute infection period. However, we welcome further specialist discussion of the model.

WHO will hold a meeting later this year which will allow discussion of many of the issues raised in the letters responding to our paper. Anticipated outcomes include review and discussion of relevant research questions and methods, ethical and human rights concerns, and operational challenges, including costing.

Finally, we carefully avoided the term “eradication” in our paper. “Elimination” refers to reduction in incidence of a public health challenge to levels below some arbitrarily defined threshold. Paediatric HIV disease has been virtually eliminated in the industrialised world by use of universal voluntary testing of pregnant women together with antiretroviral prophylaxis and other appropriate interventions. Irrespective of terminology, the model showed that it is theoretically possible to substantially reduce HIV transmission through regular, universal voluntary testing and immediate antiretroviral therapy. We agree with the comment from Ethiopia that efforts to scale up services should start where need is greatest.

We declare that we have no conflict of interest.

**Reuben M Granich, Charles F Gilks, Christopher Dye, Kevin M De Cock, Brian G Williams*
granichr@who.int

Antiretroviral Treatment and HIV Care Unit,
Department of HIV/AIDS, WHO, Avenue Appia 20,
1211 Geneva 27, Switzerland (RMG, CFG, KMDC);
and Stop TB Department, WHO, Geneva,
Switzerland (CD, BGW)

Better measures of affordability required

A Cameron and colleagues (Jan 17, p 240)¹ address the important topic of affordability of medicines in low-income and middle-income countries. The magnitude of the affordability problem depends on medicine prices and on the income level and distribution in a country.

Regarding income level, a convenient yet uncommon metric is used by Cameron and colleagues—ie, the salary of the lowest-paid unskilled government worker (LPGW). Use of this unusual measure hampers the interpretation of results and might overestimate the affordability of medicines. As they acknowledge, often “a substantial proportion of the population” earns less than the LPGW.

In collaboration with WHO and Health Action International, we investigated this situation in 17 of the countries in the Cameron study.² It turned out that, in 13 of these countries, half or more of the population was actually able to spend (much) less than the LPGW. The LPGW therefore is relatively well-off in most countries and at least half of the population in the 13 countries need to work more days than the LPGW to pay for necessary medicines.

Using household expenditure data and income distributions, we applied more common measures of affordability of medicines, based on impoverishment (ie, earning less than US\$1 or \$2 per day) and catastrophic spending on medicines (ie, more than a certain proportion of total spending).^{3,4} Our results highlight that the already compelling results shown by Cameron and colleagues are, in fact, substantial overestimates of the affordability of medicines. Unfortunately, therefore, even more people lack financial access to necessary medicine, stressing the need for intervention.

We declare that we have no conflict of interest.

**L M Niëns, W B F Brouwer*
niens@bmg.eur.nl

Erasmus University University Medical Center/
Erasmus University Rotterdam, PO Box 1738,
3000 DR Rotterdam, Netherlands

- 1 Cameron A, Ewen M, Ross-Degnan D, Ball D, Laing R. Medicine prices, availability, and affordability in 36 developing and middle-income countries: a secondary analysis. *Lancet* 2009; **373**: 240–49.
- 2 Niëns LM, Brouwer WBF, Cameron A, Ewen M, Laing R. The affordability of medicines—a cross-national study. Rotterdam: Erasmus University, 2009.
- 3 Hancock KE. Can pay? Won't pay? or economic principles of 'affordability'. *Urban Studies* 1993; **30**: 127–45.
- 4 Wagstaff A, Van Doorslaer E. Catastrophe and impoverishment in paying for health care: with applications to Vietnam 1993–98. *Health Econ* 2003; **12**: 921–34.

Authors' reply

Comparison of treatment costs with the salary of the lowest-paid government worker (LPGW) is recommended by WHO and Health Action International as a means of estimating medicine affordability^{1,2} and has been reported in various publications.^{3,4} This measure uses local medicine prices collected with a standard survey to determine the number of days' wages the LPGW would need to purchase a course of treatment. Although it provides a simple method of illustrating the effect of medicine prices on the average consumer, and has the advantage of being a metric available in all countries, the LPGW measure is not without limitations.³

Even if a treatment is affordable for the LPGW, it might not be affordable for the often substantial proportion of the population earning less than this salary in low-income and middle-income countries. Further, it does not account for the need for other non-discretionary expenditures (eg, food), seasonal fluctuations in income, the number of dependants living on this wage, and other treatment costs such as consultations and diagnostics. Finally, it does not address individual preferences in coping with the financial demands of medicine purchases. Despite these limitations, it remains a useful, relatively simple and easy to comprehend indication of affordability which can assist in assessing the accessibility of treatment and interpreting



Science Photo Library