Comparison of cost effectiveness of directly observed treatment (DOT) and conventionally delivered treatment for tuberculosis: experience from rural South Africa

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Abstract

Objective: To conduct an economic evaluation of directly observed treatment (DOT) and conventionally delivered treatment for the management of new cases of tuberculosis in adults.

Design: Community based directly observed treatment, which has been implemented in the Hlabisa district of South Africa since 1991, was compared with a conventional approach to tuberculosis treatment widely used in Africa. Each was assessed in terms of cost, cost effectiveness, and feasibility of implementation within existing resource constraints.

Setting: Hlabisa Health District, South Africa.

Subjects: Adult patients with new cases of tuberculosis on smear testing; the number of cases increased from 20 per month to over 100 from 1991 to 1996.

Main outcome measures: Cost of case management in 1996, cost effectiveness in terms of the cost per case cured, and bed requirements in comparison with bed availability for the 1990, 1993, and 1996 caseload. Costs are expressed in US dollars at values for 1996.

Results: Directly observed treatment was 2.8 times cheaper overall than conventional treatment (\$740.90 compared with \$2047.70) to deliver. Directly observed treatment worked out 2.4-4.2 times more cost effective, costing \$890.50 per patient cured compared with either \$2095.60 (best case) or \$3700.40 (worst case) for conventional treatment. The 1996 caseload of tuberculosis required 47 beds to be dedicated to tuberculosis to implement directly observed treatment, whereas conventionally delivered treatment would have required 160 beds; the current number of beds for tuberculosis treatment in Hlabisa is fixed at 56.

Conclusions: Because of the reduced stay in hospital, directly observed treatment is cheaper, more cost effective, and more feasible than conventional treatment in managing tuberculosis in Hlabisa, given the existing hospital bed capacity and the escalating caseload due to the HIV/AIDS epidemic. Such results may hold elsewhere, and wherever conventional tuberculosis management is practised a switch to directly observed treatment will increase hospital capacity to cope with a growing caseload.

Introduction

Tuberculosis is a problem of global importance,¹ and population growth, increasing poverty, and the AIDS epidemic mean that the number of reported cases continues to grow.²⁻³ Coping with this rising caseload is difficult: delivery of treatment is not straightforward, and successful programmes in Africa have typically relied on lengthy admissions to ensure patient compli-

ance.⁴ Given that already constrained resources preclude either the construction of new wards or the hiring of additional staff and that hospitals are already operating at or beyond capacity,⁵⁻⁶ this approach seems to be increasingly unviable. Other approaches to case management are urgently needed that can achieve high patient compliance while being cheaper per patient and less dependent on hospital care.

Community based directly observed treatment (DOT) is currently the standard approach to care in the United States. Though expensive,⁷ it is probably less costly than admission, and high cure rates have been achieved. To evaluate whether directly observed treatment could be an attractive economic option in a resource poor setting, we studied such a programme in Hlabisa district, South Africa—one of the few sites in a developing country where it has been implemented. We have previously reported the costs, cost effectiveness, and feasibility of implementing several strategies within existing resource constraints.⁸ In this paper we compared directly observed treatment with the conventional approach that has been widely used elsewhere in Africa.

Subjects and methods

Hlabisa is a rural district where the tuberculosis caseload has increased from 25 to over 100 per month during 1991-6, largely because of the emergence of the HIV epidemic. In 1993, 35% of adult patients with tuberculosis tested positive for HIV infection⁹; in 1997 the figure was 70% (unpublished data). There are seven clinics and a district hospital, and the yearly income per head is \$1730 (£1081).¹⁰

Strategies

The two strategies were compared after diagnosis of new cases of tuberculosis in patients with positive results on smear testing. Before diagnosis the strategies were similar.

Directly observed treatment has been described in detail elsewhere.¹¹⁻¹² After diagnosis, the time patients spend in hospital is determined by their clinical condition and the time taken to arrange community care. In 1996 the average length of stay was 17.5 days. While in hospital, patients receive daily treatment with four drugs (isoniazid, rifampicin, pyrazinamide, and ethambutol) and, with the help of field workers, identify someone who can supervise treatment after discharge. The emphasis is on choosing a supervisor who makes accessing directly observed treatment convenient for the patient. In 1995, 56% of patients were supervised by unpaid non-health workers, most of whom were storekeepers; 21% were supervised by health clinic staff; 21% by community health workers; and 2% by staff in tuberculosis wards. On discharge, field workers transport patients to their supervision point in a hospi-

See p 1403 and editorial by Squire and Wilkinson

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tal vehicle. Supervisors are given the prepacked drugs required for completion of the six month treatment course. The drugs used after discharge are the same as those given in hospital, except that they are given at higher dose and are taken on an intermittent basis twice weekly. Patients therefore visit their supervisor twice a week to take their drugs under direct observation, visiting on average 48 times. Field workers visit supervisors monthly to check compliance, collect patient outcome data, and trace absconders. A hospital doctor manages the programme.

Conventional approach—Patients stay in hospital for the first two months of treatment under the conventional management strategy for tuberculosis. This lengthy stay is designed to ensure compliance with treatment during the intensive phase (at least), when patients are most infectious, and with some drug regimens is necessitated by the use of streptomycin. At discharge, patients are given a one month supply of drugs, and they subsequently collect their drugs once a month from their nearest clinic. Drug regimens vary, but we assumed that the six month course recommended by the World Health Organisation would be used. This consists of two months of isoniazid, ethambutol, pyrazinamide, and rifampicin, followed by four months of rifampicin and isoniazid, with exact dosages dependent on body weight. Two sputum smears are examined at 2, 4, and 6 months.

Costing

We assessed both average and marginal costs.¹³ We report average costs because they are a better reflection of true variable costs and therefore of greater use for planners and policymakers concerned with national policy for a large number of facilities, such as a country's tuberculosis control strategy.¹⁴ Costs were assessed from a societal perspective in United States dollars at values for 1996.

Health system costs

For each strategy component except drugs, total annual recurrent health system costs for the financial year 1995-6 were calculated using one or more of the following: expenditure files which provided a breakdown for inpatient, outpatient, and health clinic care; the hospital payroll; the rate paid by the ministry of health for vehicle usage; vehicle logbooks; and interviews with staff. Gross salaries were used to calculate staff costs. Average drug costs per patient were established by combining a costing of each regimen by weight category (using the hospital pharmacy price list) with data from the tuberculosis register on the weight of patients.

Total annual capital costs were calculated using quoted 1996 purchase prices, reasonable assumptions concerning expected useful life (5 years for a vehicle, 10 years for equipment, and 30 years for buildings), and a discount rate of 8% (the difference between the interest rate paid on government treasury bonds and the inflation rate).

For hospital costs, 92.5% of the costs of administrative and support staff and of capital costs were allocated to inpatient care and 7.5% to outpatient care, since staff involved in direct outpatient care accounted for 7.5% of the total costs of staff involved in direct patient care. We allocated 4.1% of laboratory costs

(staff and equipment not used solely for tuberculosis work) to sputum smear testing since smears comprised 4.1% of the total number of laboratory tests in 1995.

Annual output data were for 1995—that is, the number of days in hospital; the number of visits to outpatient departments, health clinics, and community health workers; the number of patients receiving directly observed treatment for tuberculosis; the total number of patients with tuberculosis; and the number of laboratory tests done. Sources included hospital admission records, the medical superintendent, programme reports, and the regional laboratory manager.

For average cost calculations we assumed that visits to outpatient departments, health clinics, and community health workers by a patient with tuberculosis would cost the same as visits for other health problems. For spending a day as an inpatient we assumed that all costs (except those associated with staff allocated to the tuberculosis ward, drugs, laboratory investigations, and x ray examinations) would be the same for a patient with tuberculosis as for any other inpatient. The cost of a visit for directly observed treatment was calculated by combining the cost per visit with the pattern of supervision in 1995 as costs vary according to the site chosen for supervision of treatment.

Patient costs

A questionnaire was administered to all patients eligible for treatment under the directly observed treatment programme at the outset of the study (48 in total). The time and travel costs associated with visits to hospital and health clinics were recorded. When different sites were chosen for directly observed treatment, the time and travel costs incurred to visit them were also noted. Time costs were translated into monetary costs using monthly incomes reported in a second questionnaire (designed one week into the study and administered to the 35 original respondents in the tuberculosis ward at this time). Calculations assumed patients would work 25 days a month and 8 hours a day. Travel and time costs were then summed and average costs associated with visits to hospital and health clinics and for directly observed treatment by specific type of supervisory site calculated. The average costs of directly observed treatment by supervisory site in 1995 were combined to calculate the average cost incurred by a patient per directly observed treatment visit.

Community costs

Time constraints meant that the only data collected on community costs were those incurred when patients were accompanied on hospital visits. These were comparatively small and were included in the patient cost per hospital visit. Costs incurred by non-health worker supervisors were considered to be nil because the time commitment was negligible and supervision creates no additional costs for supervisors (unpublished data).

Effectiveness measure

We chose cure as the measure of effectiveness—the WHO's criterion for measuring a programme's success.¹⁵ To estimate a best and worst case scenario for the likely effectiveness of the conventional strategy, we analysed data on the outcomes of a six month cohort of patients with positive results on smear testing in Tanzania in 1990¹⁶ and annual reports with detailed

Table 1 Average health system, patient, and total costs in 1996 \$ (percentages of total) for curing one patient of tuberculosis according to management strategy

Cost item	Health system costs		Patient costs		Total costs	
	Directly observed treatment	Conventionally delivered treatment	Directly observed treatment	Conventionally delivered treatment	Directly observed treatment	Conventionally delivered treatment
Hospital stay	486.50 (75)	1668 (94)	70 (76)	240 (88)	556.50 (75)	1908 (93)
Visits for directly observed treatment	81.60 (12.5)	NA	21.60 (24)	NA	103.20 (14)	NA
Outpatient visits for sputum collection	NA	33.40 (2)	NA	19.40 (7)	NA	52.80 (3)
Health clinic visits for collection of pills	NA	19.20 (1)	NA	7.80 (3)	NA	27 (1)
Arrangements for supervision and supervision of supervisors	38.90 (6)	NA	NA	NA	38.90 (5)	NA
Drugs	36.60 (5.5)	40.40 (2)	NA	NA	36.60 (5)	40.40 (2)
Sputum examinations	NA	9 (0.5)	NA	NA	NA	9 (0.4)
Management and audit	5.70 (1)	5.70 (0.3)	NA	NA	5.70 (1)	5.70 (0.3)
Return home at hospital discharge	NA	NA	NA	4.80 (2)	NA	4.80 (0.2)
Total	649.30	1775.70	91.60	272	740.90	2047.70

NA = not applicable.

outcome data from Malawi 1989-93³ because these programmes used a similar case management approach. For directly observed treatment we used data from the 1991-4 audits of the Hlabisa programme.¹² Cure is not routinely assessed bacteriologically in Hlabisa, but a retrospective analysis of 109 patients found that 95% were cured.¹⁷ In this analysis, the rate of completion of treatment was therefore multiplied by 95% to give an estimated cure rate. For consistency, the same assumption was applied to the data from Malawi and Tanzania for the small number of patients who completed treatment but for whom cure was not confirmed.

Patients who died or left the district during treatment were excluded from the analysis. Differences in the death rate may reflect the varying impact of the AIDS epidemic. The proportion of patients leaving the district during treatment is related to population transience. Neither of these is a direct function of the tuberculosis programme itself, so omitting these categories prevented unnecessary distortion of the analysis.

Calculation of cost effectiveness

Cost effectiveness was calculated in three steps. First, the proportion of patients who completed treatment was multiplied by the cost of managing a patient up to the completion of treatment. Second, the cost of a patient not completing treatment (calculated by assuming that default would occur at hospital discharge) was multiplied by the proportion of patients not completing treatment. Third, the resulting two costs were summed and divided by the cure rate.

Results

Directly observed treatment was considerably cheaper than the conventional strategy (table 1). It was 2.7 times cheaper for the health system, 3 times cheaper for the patient, and 2.8 times cheaper overall. In both cases, health system costs accounted for 87% of total costs. Admission to hospital was the most costly item. For directly observed treatment it accounted for 75% of health system costs, 76% of patient costs, and 75% of costs overall; for the conventional approach it accounted for 94% of health system costs, 88% of patient costs, and 93% of costs overall. The only other important cost items were visits for directly observed

Table 2 Average health system costs (in 1996 \$)

Cost item	Average cost
Day in hospital (excluding drugs, laboratory tests, and x ray films)	27.80
Outpatient visit (excluding drugs, laboratory tests, and x ray films)	16.70
Health clinic visit (excluding drugs, laboratory tests, and x ray films)	6.40
Visit to community health worker	1.60
Visit for directly observed treatment*	1.70
Course of drug treatment:	
Directly observed treatment	36.60
Conventionally delivered treatment	40.40
Arrangements for supervision and supervision of supervisors	38.90
Management and audit	5.70
Sputum smear testing	1.50

*Assumes that 56.3% of patients were supervised by non-health workers, 21.4% at health clinics, 20.6% by community health workers, and 1.7% in tuberculosis wards, as in 1995. Visit to tuberculosis ward was estimated to cost nothing because additional workload is trivial.

treatment (14% of the total cost of the directly observed treatment strategy) and organisation of supervision and supervision of supervisors (5% of the total cost of the directly observed treatment strategy). No other item—including drugs—accounted for more than 5% of total costs.

The data for individual strategy components (tables 2 and 3) showed that a day in hospital was costly (\$27.80 per day for the health system and \$4 for the patient), as was an outpatient visit (\$16.70 for the health system and \$9.70 for the patient). In terms of time, a hospital visit cost a patient five hours. Visits to health clinics and community health workers cost less. The different drug regimens cost about the same, and sputum smear examination was a minor cost.

The organisation of supervision and the supervision of supervisors were less expensive than expected, at \$38.90 per patient. Visits for directly observed treatment were also notable for their low cost. Visits to non-health workers were cheapest, costing the health system nothing and the patient just 35 minutes, estimated to equate to \$0.30. On average, each visit for directly observed treatment cost the health system \$1.70 and the patient \$0.45. Overall, the input of non-health workers reduced the total cost of directly observed treatment by 26% from the health system's perspective, by 53% from the patient's perspective, and by 31% overall in comparison with what costs would be if health clinics alone were used for supervision.

Directly observed treatment based in the community was therefore inexpensive. In combination, arrangements for supervision, supervision of supervi-

Table 3 Average patient costs (in 1996 \$)

Cost item	Travel cost	Time cost (equivalent in minutes)	Total cost
Day in hospital	0	4.0 (402)*	4.00
Hospital visit	6.90	2.8 (300)	9.70
Health clinic visit	1.40	1.2 (127.5)	2.60
Visit for directly observed treatment:			
When health clinic chosen for supervision	0.10	0.6 (60)	0.70
When tuberculosis ward chosen for supervision	0.50	0.45 (47.5)	0.95
When community health worker chosen as supervisor	0	0.5 (50)	0.50
When non-health worker chosen as supervisor	0	0.3 (3.5)	0.30
Average†	0.03	0.4 (44)	0.45

*Assuming that 25 out of 30 days (83.3%) are worked. Average day in hospital is thus equivalent to 6.7 working hours, or 402 minutes. Mean monthly income of 35 inpatients with tuberculosis was \$121.

†Assumes that 56.3% of patients are supervised by non-health workers, 21.4% at health clinics, 20.6% by community health workers, and 1.7% in tuberculosis wards, as in 1995.

sors, and 48 visits cost the health system \$120.50 per patient (equivalent to 4.3 days spent in hospital receiving treatment for tuberculosis) and the patient \$21.60 (equivalent to five days in hospital).

Directly observed treatment also seemed to use resources efficiently (table 4). At \$890.50 per patient cured, it was between 2.4 and 4.2 times more cost effective than the conventional approach. Moreover, directly observed treatment was feasible within existing resource constraints (table 5). Both strategies were possible in 1990, but in 1996 the increased caseload meant that directly observed treatment was the only strategy that could be implemented without displacing patients from other wards, reducing the quality of care provided, and needing extra investments in infrastructure (and, probably, staff).

Discussion

Directly observed treatment is an attractive economical option in Hlabisa. It is cheap, cost effective, and implementable within existing resource constraints.

This strategy is cheap because treatment based in the community that is supervised by field workers is

cheaper than lengthy hospital supervision of care (all other cost items were insignificant in terms of impact on total costs). This is also likely to be true elsewhere in South Africa because the costs of the major inputs—staff, vehicles, and fuel—do not vary much; population densities in most districts are unlikely to fall to the point where the costs of vehicles and fuel would become inordinately expensive; and non-health worker input is considered acceptable by the Department of Health.¹⁸

Even in very poor African countries, the cost of hospital care is unlikely to fall enough to make directly observed treatment comparatively expensive. In Malawi in 1995, a day in hospital cost \$2.09⁷ (13.3 times less than in Hlabisa), so 60 days in hospital would cost the health system \$125.40. On the assumption that health clinic and community health worker visits and field worker and driver costs would also be 13.3 times less but that vehicle and fuel costs would be the same as those in Hlabisa, 17.5 days in hospital, 48 visits for directly observed treatment, and field worker supervision would cost \$64.30 (36.60 + 6.10 + 21.60). Since the population density is higher in Malawi than Hlabisa (93 *v* 67 per square kilometre),¹⁹ the cost of field worker supervision might be cheaper still. Furthermore, the low cost of visits for directly observed treatment suggests that if input by non-health workers were unacceptable and the costs of directly observed treatment more than doubled, this strategy would still be cheap from the perspective of the health system.

For the patient, in contrast, the acceptability of non-health worker input is critical. When this is feasible, 48 visits for directly observed treatment will always be cheaper than 42.5 days in hospital because the patient can choose a supervisor who makes access to treatment convenient. Moreover, recent observation in Hlabisa indicates that the increased caseload secondary to the HIV epidemic may be best absorbed through supervision by volunteers.²⁰ When using non-health workers is not acceptable and access to health facilities is limited, however, 48 visits for directly

Table 4 Cost effectiveness of different case management strategies

Management strategy	Cost for a cured patient (\$) (% patients in this category)	Cost for a patient who completes treatment but for whom cure is not confirmed (\$) (% patients in this category)	Cost for a patient who does not complete treatment (\$) (% patients in this category)	Cure rate (%)*	Cost per patient cured
Directly observed treatment†	740.90 (81)	740.90 (4.3)	607.50 (14.7)	81	890.50
Conventionally delivered treatment:					
Best case‡	2047.70 (97.6)	2047.70 (0)	1749 (2.4)	97.60	2095.60
Worst case§	2047.70 (50.6)	2047.70 (3.8+3.8)	1947 (41.8)	54.20	3700.40

*Cure is established in patients who have completed treatment and have negative results on sputum smear testing at or near the end of treatment.¹⁵ Of those who completed treatment but were not bacteriologically assessed, 95% were assumed to have been cured.¹⁷ In calculating cure rates patients who died or who left the district during treatment were excluded (see Subjects and methods). A patient who did not complete treatment was considered to have defaulted at the time of hospital discharge.

†Hlabisa 1991-4 (derived from Wilkinson et al).¹²

‡Malawi 1989 (derived from Harries et al).³

§Malawi 1991 (derived from Harries et al).³

Table 5 Numbers of beds available and required to manage patients with tuberculosis in Hlabisa hospital according to management strategy

Management strategy	No of beds available	No of beds required, given:		
		1990 caseload (25 patients/month)	1993 caseload (65 patients/month)	1996 caseload (80 patients/month)
Directly observed treatment (average length of stay 17.5 days)	56	15	38	47
Conventionally delivered treatment (average length of stay 60 days)	56	50	130	160

observed treatment will incur large costs and treatment in hospital could be preferable.

The likely effectiveness of directly observed treatment elsewhere is harder to assess. Nevertheless, a nearby district has found early success in implementing a similar programme (G Dean, personal communication); and the programme in Hlabisa has continued to prove highly effective even after management was no longer the responsibility of the programme innovator. Evidence also suggests that contacts of patients with tuberculosis treated in the community are not at increased risk of infection compared with those managed in hospital.²¹⁻²³

Wherever the conventional approach is currently relied on, a switch to directly observed treatment will help to decongest hospitals and increase the capacity to cope with a growing tuberculosis caseload and a more widespread increase in demand for hospital care. Indeed, with the HIV related tuberculosis epidemic across Africa and limited extra resources for tuberculosis control programmes, it may become programme managers' only option.

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- 1 Kochi A. The global tuberculosis situation and the new control strategy of the World Health Organisation. *Tubercle* 1991;72:1-6.
- 2 Harries AD. The association between HIV and tuberculosis in the developing world. In: Davies PDO, ed. *Clinical tuberculosis*. London: Chapman and Hall, 1994:241-64.
- 3 Harries AD, Mbewe LN, Salaniponi FM, Nyangulu D, Veen J, Ringdal T, et al. Tuberculosis programme changes and treatment outcomes in patients with smear-positive tuberculosis in Blantyre, Malawi. *Lancet* 1996;347:807-9.
- 4 Murray CJL, DeJonghe E, Chum HJ, Nyangulu DS, Salomao A, Styblo K. Cost-effectiveness of chemotherapy for pulmonary tuberculosis in three sub-Saharan African countries. *Lancet* 1991;338:1305-8.
- 5 Hassig SE, Perriens J, Baende E, Kahotwa M, Bishagara K, Kinkela N, et al. An analysis of the economic impact of HIV infection among patients at Mama Yemo Hospital, Kinshasa, Zaire. *AIDS* 1990;4:883-7.
- 6 Sawert H. *Cost analysis and cost containment in tuberculosis control programmes: the case of Malawi*. Geneva: WHO Task Force on Health Economics, 1996.
- 7 Frieden TR, Fujiwara PI, Washko RM, Hamburg MA. Tuberculosis in New York City—turning the tide. *N Engl J Med* 1995;333:229-33.
- 8 Wilkinson D, Floyd K, Gilks CF. Costs and cost-effectiveness of alternative tuberculosis management strategies in South Africa: implications for policy. *SA Med J* 1997;87:451-5.

Key messages

- Tuberculosis is a problem of global importance, and the number of cases is rising as a consequence of population growth, worsening poverty, and the HIV/AIDS epidemic
- Conventional approaches to management are increasingly difficult to implement, especially when caseloads are rapidly increasing
- This study found that community based directly observed treatment, a novel approach to treating tuberculosis, was considerably cheaper and more cost effective than a conventional approach entailing prolonged admission to hospital
- Because directly observed treatment considerably reduces hospital stay, its implementation will increase the capacity of hospitals to cope with a rising tuberculosis caseload wherever the conventional approach is currently used
- This South African model of directly observed treatment for tuberculosis is worthy of serious consideration by policymakers and programme managers elsewhere

- 9 Wilkinson D, Moore DAJ. HIV-related tuberculosis in South Africa: clinical features and outcome. *SA Med J* 1996;86:64-7.
- 10 Whiteside A, Wilkins N, Mason B, Wood G. *The impact of HIV/AIDS on planning issues in KwaZulu/Natal*. Pietermaritzburg: Town and Regional Planning Commission, 1995.
- 11 Wilkinson D. High compliance tuberculosis treatment programme in a rural community. *Lancet* 1994;343:647-8.
- 12 Wilkinson D, Davies G, Connolly C. Directly observed therapy for tuberculosis in rural South Africa, 1991 through 1994. *Am J Public Health* 1996;86:1094-7.
- 13 Floyd K, Wilkinson D, Gilks CF. *Community-based, directly observed therapy for tuberculosis: an economic analysis*. Cape Town: Corporate Communications Division, South African Medical Research Council, 1997.
- 14 Drummond MF, Jefferson TO. Guidelines for authors and peer reviewers of economic submissions to the BMJ. *BMJ* 1996;313:275-83.
- 15 World Health Organisation. *Treatment of tuberculosis: guidelines for national programmes*. Geneva: WHO, 1993.
- 16 Graf P. Tuberculosis control in high-prevalence countries. In: Davies PDO, ed. *Clinical tuberculosis*. London: Chapman and Hall, 1994:325-40.
- 17 Wilkinson D, Anderson E, Davies GR, Sturm AW, McAdam KPWJ. Efficacy of twice-weekly treatment for tuberculosis given under direct observation in Africa. *Trans R Soc Trop Med Hyg* 1997;91:87-9.
- 18 World Bank. *World development report 1993: investing in health*. Oxford: Oxford University Press, 1993.
- 19 Wilkinson D, Davies GR. Coping with Africa's increasing tuberculosis burden: are community supervisors an essential component of the DOT strategy? *Trop Med Int Health* 1997;2:700-4.
- 20 South African Department of Health. *South African tuberculosis control programme practical guidelines*. Pretoria: Department of Health, 1996.
- 21 Tuberculosis Chemotherapy Centre, Madras. A concurrent comparison of home and sanatorium treatment of pulmonary tuberculosis in South India. *Bull WHO* 1959;21:51-144.
- 22 Klausner JD, Ryder RW, Baende E, Lelo U, Williams J, Ngamboli K, et al. Mycobacterium tuberculosis in household contacts of human immunodeficiency virus type 1-seropositive patients with active pulmonary tuberculosis in Kinshasa, Zaire. *J Infect Dis* 1993;168:106-11.
- 23 Nunn P, Mungai M, Nyamwaya J, Gicheha C, Brindle RJ, Dunn DT, et al. The effect of human immunodeficiency virus type-1 on the infectiousness of tuberculosis. *Tubercle Lung Dis* 1994;75:25-32.

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A memorable patient

Effective analgesia

I was a house officer, and our medical unit was on take. The senior oncologist admitted a 15 year old boy with terminal Hodgkin's disease. I was told that nothing more could be done and I was simply to "keep him comfortable." This was in 1971, just before effective treatment for Hodgkin's disease became available.

As is common among junior doctors, I did not want to overprescribe narcotics, and as a result the patient asked for his intramuscular analgesia more frequently. The nursing staff thought that he really did not need such frequent analgesia and that he was demanding medication when the next dose was

available and not when it was needed. I decided to initiate a trial of placebo treatment.

Ten minutes after the injection of 5 cc of normal saline the patient asked to see me. He was so debilitated and drowsy that I had to sit down by his bedside to get close enough to hear his request. "Doc," he said, "please give me another shot—the last one was like water."

His analgesia was continued at a higher dose. I have never again used placebo medication.

David S H Bell, *professor of medicine, Birmingham, Alabama*