

Promoting rational prescribing: an international perspective

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Irrational prescribing is a global problem. Rational prescribing cannot be defined without a method of measurement and a reference standard. The former is now available but the latter needs further development. Proven effective interventions to promote rational prescribing in developed countries are treatment protocols based on wide consultation and consensus, properly introduced and with a possibility of feedback; face-to-face education focussed on a particular prescribing problem in selected individuals; structured order forms; and focussed educational campaigns. Essential drugs lists are probably effective when based on consensus and used within a comprehensive educational programme. Printed materials alone are not effective. In most cases the usefulness of such strategies in developing countries has not been proven and should be studied. Medical education in clinical pharmacology and pharmacotherapy should be based on the practical needs of future prescribers, should include the principles of rational therapeutics and problem solving, and should immunize the students against the influences they are likely to encounter in their professional life, such as patient pressure, drug promotion and irrational prescribing by peers. Within the scope of a national formulary, specialist departments in teaching hospitals should define prescribing policies as the basis for prescribing, teaching, examinations and medical audit.

Keywords essential drugs developing countries prescribing pattern drug utilization medical education

The problem of irrational prescribing

Irrational prescribing is a global problem. Numerous studies, both from developed and developing countries, describe a pattern that includes polypharmacy [1-7], the use of drugs that are not related to the diagnosis [8-12] or unnecessarily expensive [13-18], the inappropriate use of antibiotics [19-26] and irrational selfmedication [27-31] with drugs frequently taken in underdose [32, 33]. The problem is worsened by a global shift from public to private sector spending, which, in many developing countries without adequate regulation and inspection, usually results in a large proportion of drugs being purchased without any prescription at all.

Measuring drug use

Rational drug use cannot be defined without a method of measurement and a reference standard. These same tools are even more necessary to measure the impact of an intervention, to make comparisons between

facilities, districts or regions, and for supervisory purposes. Knowledge of the prescriber has sometimes been used as an output measure of interventions [34]. However, adequate *knowledge* on rational drug use does not always result in rational prescribing *behaviour*. Actual behaviour is therefore preferred as a measurement. Over the past few years the International Network for Rational Use of Drugs (INRUD) and the WHO Action Programme on Essential Drugs have closely collaborated in developing and testing a set of 12 quantitative indicators to measure some key aspects of prescribing and the quality of care [35]. These indicators, which are now also recommended by UNICEF, are listed in Table 1. A detailed manual on their use is available from WHO [36].

The second important requirement in studying rational drug use is a standard. What is rational? How much deviation from an agreed standard can be accepted? In practice this implies that the prescription should be compared with an agreed treatment protocol or with a list of therapeutic alternatives. This is also a core principle of medical audit, which is

Table 1 Drug use indicators [36]*Prescribing indicators*

- 1 Average number of drugs per encounter
- 2 Percentage of drugs prescribed by generic name
- 3 Percentage of encounters with an antibiotic prescribed
- 4 Percentage of encounters with an injection prescribed
- 5 Percentage of drugs prescribed from essential drugs list or formulary

Patient care indicators

- 6 Average consultation time
- 7 Average dispensing time
- 8 Percentage of drugs actually dispensed
- 9 Percentage of drugs adequately labelled
- 10 Patient knowledge of correct dosage

Facility indicators

- 11 Availability of copy of essential drugs list or formulary
- 12 Availability of key drugs

becoming more and more important in developed countries like the United Kingdom [37].

Audit needs a standard, and a standard needs consensus. Treatment protocols and prescribing policies should be agreed by the prescribers themselves in their own environment at the hospital or clinical department. In a national perspective one would then distinguish between three levels: the total range of drugs approved for sale and use in the country, usually defined by the regulatory authorities; within this range, the national formulary or national list of essential drugs, preferably sub-divided by level of care (health centre, general hospital, specialist department) and developed by a national formulary committee; and within that, a hospital formulary or departmental prescribing policy specific for one hospital, a clinical department or a group of practitioners.

Strategies to promote rational prescribing and their possible impact

The various interventions to promote rational prescribing are best classified as educational, managerial and regulatory [38]. Educational strategies include printed materials, seminars, bulletins and face-to-face interventions. Managerial methods refer to various restrictions on prescribing, e.g. restrictive lists, a maximum number of drugs per prescription, budgetary or cost restrictions, endorsement by higher qualified consultants, patient co-payment strategies, price measures, structured prescription forms or a maximum duration for inpatient prescriptions (automatic stop-orders). Regulatory measures include procedures to critically evaluate drugs and product information (e.g. data sheet, patient information leaflet) before market approval is granted, scheduling drugs for different sales levels (over the counter, pharmacy only, prescription only) and specifying for each drug a minimum level of prescriber or health facility (for example, no injectable antibiotics at health centres).

Several studies have critically reviewed the available evidence to identify the most effective interventions [39–41], and the following provisional conclusions may be drawn. An important observation is that printed materials alone hardly influence prescriber behaviour [42], and that any such influence is usually of short duration [43,44]. Most of these interventions assume that the main reason for incorrect prescribing is a lack of knowledge and that if prescribers had the correct information, their prescribing would automatically improve. This is not always the case in view of the many other factors influencing prescribing, like drug promotion [45], patient demand, intentional use of placebo drugs and prescriber preference based on personal experience rather than peer reviewed standards [46]. Technical information on cost and side effects of the drugs is of much less influence, as shown in the Netherlands [47] and further illustrated by the total lack of impact of a series of warnings in the FDA bulletin as recorded by Soumerai [48]. Another aspect of the problem is that prescribers with irrational prescribing behaviour are the very ones that are less likely to read the educational material mailed to them.

Proven cost-effective interventions are face-to-face education focussed on a particular prescribing problem in selected individuals [48–54], structured prescription forms [55], and focussed educational campaigns together with widely discussed and frequently revised treatment guidelines. An example of the latter is the success of the Australian antibiotic guidelines [56]. Most recently, a review of 59 published evaluations of the effect of clinical guidelines concluded that all but four of these studies detected significant improvements in the process of care after the introduction of guidelines, and all but two of the 11 studies that assessed the outcome of care, reported significant improvements. However, the size of the improvements in performance varied considerably [57]. Essential drugs lists together with an educational programme and follow-up are probably effective as well.

As mentioned above, most evidence suggests that printed materials alone are ineffective [42–44, 47, 48]. It is likely that this also applies to essential drugs lists and treatment guidelines if these are just distributed to prescribers without an introduction campaign and without intensive follow-up, and especially if the prescribers had not been involved in the development process.

A general problem is that many interventions have only been tested in developed countries and that the results can therefore not automatically be extrapolated to developing countries where conditions are so different. In the absence of well conducted studies Laing has attempted to give provisional advice to developing countries with regard to possible effective interventions [58]. He suggests that basic and post-basic medical education should include specific training in rational prescribing; that essential drugs lists and therapeutic guidelines should be developed through wide consultation and feed-back and be disseminated by means of intensive educational pro-

grammes as recorded from Yemen [59], Uganda [60] and Zimbabwe [61]; that general limitations on prescribers (maximum number of drugs per prescriptions, maximum quantities, maximum costs etc) may have unexpected effects which should be avoided through careful studies before such measures are taken; that face-to-face education may be effective but expensive; and that printed materials, including treatment guidelines, are ineffective without educational programmes and follow-up activities.

The overall impact of drug bulletins is not clear. Experience from developed countries is not encouraging, but this may be due to the fact that prescribers receive so many promotional and other materials that some of them did not even recognize a carefully designed set of academic detailing material as different from commercial material [62]. However, in most developing countries the lack of information, promotional or other, is so serious that any unbiased material sent out to prescribers might be studied with more care. Bulletins, especially when geared to actual day-to-day prescribing problems, may therefore have more impact in developing countries than elsewhere. This hypothesis is worth examining.

The role of medical schools and teaching hospitals

The impact of medical education on subsequent prescribing behaviour is difficult to evaluate, as most studies have measured knowledge rather than actual performance. Moreover, immediately after leaving medical school the young doctors are exposed to many other factors influencing their prescribing. It is now increasingly being recognized that the traditional medical education concentrates too much on an accumulating quantity of facts, including the drugs of the day, rather than teaching the student techniques of problem solving and making a rational choice between drug treatment alternatives, which includes

the skill to evaluate critically any new drugs of the future [63].

With regard to rational prescribing this implies that the objectives of clinical pharmacology training need to be defined better, with more emphasis on the practical needs of the future prescriber. This has shown to result in better therapeutic knowledge and skills of the students [64–66]. An undergraduate course in clinical pharmacology and therapeutics should stress the principles of rational evaluation of therapeutic alternatives and help the students to develop their own personal formulary on the basis of a rational comparison of therapeutic alternatives. Such a course could also 'immunize' the students against the disturbing influences they are likely to encounter in their professional life, such as patient pressure, drug promotion and irrational prescribing by peers. A WHO student manual on this subject is now available [66].

The introduction of such a revised course in clinical pharmacology alone will not be enough. In many teaching hospitals bedside training emphasizes the need to make a correct diagnosis, with much less time spent on choosing the correct treatment. And even if treatment guidelines exist, students are usually told to follow them rather than being taught on what grounds the guidelines had been developed, and how they should choose their own treatment in the future. Under these circumstances students entering the wards can do little more than copy the behaviour of residents and consultants.

Unfortunately the prescribing practice in teaching hospitals, that inevitably serves as a role model for the students, is often irrational and inconsistent, as has frequently been described from developed and developing countries. For example, numerous studies report on the inappropriate use of antibiotics in teaching hospitals (Table 2). In all these studies performance was measured against an agreed standard. Overall, as many as 41–91% of all antibiotic prescriptions in teaching hospitals were considered inappropriate; a slightly better picture emerged from

Table 2 Inappropriate use of antibiotics in teaching hospitals

<i>Country</i>	<i>Inappropriate use (%)</i>	<i>Type/department</i>
Canada, 1977 [19]	42%	Surgical ward, parenteral antibiotics
	50%	Gynaecology ward (id)
	12%	Medical ward (id)
USA, 1978 [11]	41%	All inpatients
Australia, 1979 [73]	86–91%	Prophylaxis
Canada, 1980 [74]	30%	Paediatric medical cases
	63%	Paediatric surgical cases
Australia, 1983 [23]	48%	All departments
Kuwait, 1988 [75]	39%	Paediatric inpatients
Australia, 1990 [76]	64%	Patients treated with vancomycin
Thailand, 1990 [24]	91%	All departments
South Africa, 1991 [25]	54%	Gynaecology inpatients
	22–100%	Unrestricted antibiotics
Thailand, 1991 [77]	41%	All departments
	79.7%	Surgical prophylaxis
	40.2%	Documented infection

medical and paediatric wards but the situation in surgical and gynaecological wards was usually worse. Unnecessary treatment was by far the most common reason for irrational prescribing, followed by wrong duration, misguided prophylaxis and poor selection of the drug.

Not only antibiotics are misused in teaching hospitals. Polypharmacy was considered a serious problem in the medical and surgical wards of Singapore general hospital [67] and vitamins were heavily overprescribed in the Kenyatta Teaching Hospital [8]. In the teaching hospital in Aden (Yemen) 68% of all patients with hypertension were prescribed diazepam, and 54% received frusemide [34]; 80% of patients with osteoarthritis received vitamins. In the teaching hospital in Benin city (Nigeria) 74.3% of all paediatric prescriptions were considered inappropriate, mostly because of polypharmacy, the use of unnecessary drugs and sub-optimal dosage schedules [12]. In Ilorin teaching hospital in Nigeria 33.1% of patients admitted to the surgical and medical wards received psychotropic drugs, 91.4% being tranquillizers [68]. In a teaching hospital in the Netherlands it was observed that most drug-associated problems occurred with new drugs, and that semi-innovative drugs were used too often and for indications for which their use was not warranted [69]. In the teaching hospital in Kathmadu (Nepal) only 56.3% of all prescribed drugs figured on the national list of essential drugs [70].

The potential long term impact of such a lack of structured therapeutic training in the wards should not be underestimated. Teaching hospitals have a special responsibility towards society to promote rational prescribing by their staff and, through these, by future generations of doctors. The best approach

seems that each clinical department in the teaching hospital should develop a departmental prescribing policy through a process of consultation and consensus building, in which clinical pharmacologists are involved. Such prescribing policies can later be integrated into a hospital formulary and should be used, and enforced, as the basis for prescribing, teaching, examinations and medical audit. This is already the case in several medical schools in the United Kingdom [71] and elsewhere; amongst developing countries Zimbabwe is a good example [72].

Ideally, medical students would then be trained in the principles of rational prescribing before they enter the wards; and these concepts would be reinforced during the clinical training with bedside teaching, examinations and actual prescribing by senior staff all based on the same principles.

Research priorities

Several of the interventions mentioned above have not been tested in developing countries. Especially the effect of the development and introduction of treatment guidelines, the use of drugs and therapeutic bulletins and some of the hospital-based interventions as structured order forms and face-to-face education should now be subjected to well structured intervention studies in developing countries, using objective measurements and a control group. The newly developed drug use indicators can be used to identify the most important problems and the results of such studies could open the eyes of prescribers and teaching staff that something has to change.

References

- 1 Barnett A, Creese AL, Ayivor ECK. The economics of pharmaceutical policies in Ghana. *Int J Health Serv* 1980; **10**: 479-499.
- 2 Victora CG, Facchini LA, Grassi Filho M. Drug usage in Southern Brazilian hospitals. *Trop Doctor* 1982; **12** (4 pt 2): 231-235.
- 3 Hogerzeil HV. The use of essential drugs in rural Ghana. *Int J Health Serv* 1986; **16**: 425-439.
- 4 Isenalumhe AE, Oviawe O. Polypharmacy: its cost burden and barrier to medical care in a drug-oriented health care system. *Int J Health Serv* 1988; **18**: 335-342.
- 5 Angunawela II, Tomson GB. Drug prescribing patterns: a study of four institutions in Sri Lanka. *Int J Clin Pharmac Ther Tox* 1988; **26** (2): 69-74.
- 6 Goodburn E, Mattosinho S, Monge P, Waterston T. Cost-benefit of self prescribing. *Lancet* 1989; **ii**: 281.
- 7 Weedle PB, Poston JW, Parish PA. Drug prescribing in residential homes for elderly people in the United Kingdom. *DICP Ann Pharmacother* 1990; **24**: 533-536.
- 8 Maitai CK, Watkins WM. A survey of outpatient prescriptions prescribed in Kenyatta National Hospital. *East Afr med J* 1980; **58**: 641-645.
- 9 Chennabuthni CS, Brown DJ. Prescribing patterns in Seychelles. *Trop Doctor* 1982; **12** (4 pt 2): 228-230.
- 10 Palombo FB, Knapp DA, Brandon BM, Knapp DE, Solomon DK, Klein LS, Shah RK. Detecting prescribing problems through drug usage review: a case study. *Am J Hosp Pharm* 1977; **34**: 152.
- 11 Maki DG, Schuna AA. A study of antimicrobial misuse in a university hospital. *Am J Med Soc* 1978; **275**: 271-282.
- 12 Oviawe O, Okonokhua L, Isenalumhe A. Prescriber performance in a paediatric general practice clinic of a university teaching hospital. *W Afr J Med* 1989; **8** (2): 130-134.
- 13 Parkinson R, Wait C, Welland C, Vost DA. Cost analysis of minor ailments in rural Swaziland. *Trop Doctor* 1983; **13**: 38-40.
- 14 Speight ANP. Cost-effectiveness and drug therapy. *Trop Doctor* 1975; **5**: 89-92.
- 15 Yudkin JS. The economics of pharmaceutical supply in Tanzania. *Int J Health Serv* 1980; **10**: 455-477.
- 16 Glucksberg H, Singer J. The multinational drug companies in Zaire: their adverse effect on cost and availability of essential drugs. *Int J Health Serv* 1982; **12**: 381-387.
- 17 Nyazema NZ. Control of drug supply and drug monitoring. *C Afr J Med* 1983; **29**: 109-111.
- 18 Leighton Read J, Epstein AM. Aspirin and its expen-

- sive substitutes: prescribing patterns and cost implications. *J Comm Health* 1984; **9** (3): 216–221.
- 19 Achong MR, Hauser BA, Krusky JL. Rational and irrational use of antibiotics in a Canadian teaching hospital. *J Can med Ass* 1977; **116**: 256–259.
 - 20 Vass K. Misuse of antibiotics in the third world. *The Listener* 1985 (Sep); 11–12.
 - 21 Kunin CM, *et al.* Social, behavioral and practical factors affecting antibiotic use worldwide: Report of Taskforce 4. *Rev Inf Dis* 1987; **9** (suppl. 3): S270–285.
 - 22 Where does the tetracycline go? *Health center prescribing and child survival in Indonesia*. Boston, Management Sciences for Health, 1988: 10–12.
 - 23 Harvey K. Antibiotic use in Australia. *Australian Prescriber* 1988; **11** (4): 74–77.
 - 24 Aswapokee N, Vaithayapichet S, Heller RF. Pattern of antibiotic use in medical wards of a university hospital, Bangkok, Thailand. *Rev inf Dis* 1990; **12**: 136–141.
 - 25 Till B, Williams L, Oliver SP, Pillans PI. A survey of inpatient antibiotic use in a teaching hospital. *S Afr med J* 1991; **80**: 7–10.
 - 26 Guerrero-Munoz F, Guerrero ML. Fixed combinations of antibiotic drugs used in Central America. *PAHO Bulletin* 1987; **21**: 106–110.
 - 27 Sekhar C, Raina RK, Pillai GK. Some aspects of drug use in Ethiopia. *Trop Doctor* 1981; **11**: 116–118.
 - 28 Krishnaswamy K, Kumar BD, Radhaiah G. A drug survey – precepts and practices. *Eur J clin Pharmac* 1985; **29**: 363–370.
 - 29 Tomson G, Sterky G. Self-prescribing by way of pharmacies in three Asian developing countries. *Lancet* 1986; **ii**: 620–622.
 - 30 Hardon AP. The use of modern pharmaceuticals in a Filipino village: doctors' prescription and self medication. *Soc Sci Med* 1987; **25**: 277–292.
 - 31 Fabricant S, Hirschhorn N. Deranged distribution, perverse prescription, unprotected use: the irrationality of pharmaceuticals in the developing world. *Health Pol Plan* 1987; **2**: 204–213.
 - 32 Moshaddeque Hossaine M, Glass RI, Khan MR. Antibiotic use in a rural community in Bangladesh. *Int J Epidem* 1982; **11**: 402–405.
 - 33 Price LJ. In the shadow of biomedicine: self medication in two Ecuadorian pharmacies. *Soc Sci Med* 1989; **28**: 905–915.
 - 34 Walker GJA, Hogerzeil HV, Sallami AO, Alwan AAS, Fernando G, Kassem FA. Evaluation of rational drug prescribing in Democratic Yemen. *Soc Sci Med* 1990; **31**: 823–828.
 - 35 Hogerzeil HV, Bimo, Ross-Degnan D, *et al.* Field tests for rational drug use in twelve developing countries. *Lancet* 1993; **342**: 1408–1410.
 - 36 How to investigate drug use in health facilities: selected drug use indicators. *Geneva, World Health Organization*, 1993. WHO/DAP/93.1.
 - 37 *Medical audit in the hospital and community health services*. London, Department of Health, 1991. HC(91)2.
 - 38 Soumerai S, Quick J, Avorn J, Tawfik Y. Changing the unchangeable: principles and experiences in improving prescribing accuracy. *World Paediatrics and Child Care* 1987; **3**: 287–291.
 - 39 Soumerai S, Avorn J. Efficacy and cost-containment in hospital pharmacotherapy: state of the art and future directions. *Milbank Memorial Fund Quarterly/Health and Society* 1984; **62**: 447–474.
 - 40 Soumerai S. Factors influencing prescribing. *Aust J Hosp Pharm* 1988; **18** (suppl): 9–16.
 - 41 Mugford M, Banfield P, O'Hanlon M. Effects of feedback of information on clinical practice: a review. *Br med J* 1990; **303**: 398–402.
 - 42 Avorn J, Soumerai SB. Improving drug-therapy decision through educational outreach. *New Engl J Med* 1983; **308**: 1457–1463.
 - 43 Schaffner W, Ray WA, Federspiel CF, Miller WO. Improving antibiotic prescribing in office practice. *J Am med Ass* 1983; **250**: 1728–1732.
 - 44 Berbatis CG, Maher MJ, Plumbridge RJ, Stoelwinder JU, Zubrick SR. Impact of a drug bulletin on prescribing oral analgesics in a teaching hospital. *Am J Hosp Pharm* 1982; **38**: 98–100.
 - 45 Lexchin J. Doctors and detailers: therapeutic education or pharmaceutical promotion? *Int J Health Serv* 1989; **19**: 663–679.
 - 46 Schwartz RK, Soumerai SB, Avorn J. Physician motivations of nonscientific drug prescribing. *Soc Sci Med* 1989; **28**: 577–582.
 - 47 Denig P, Haaijer-Ruskamp FM, Zijsling DH. How physicians choose drugs. *Soc Sci Med* 1988; **27**: 1381–1386.
 - 48 Soumerai SB, Avorn J, Gortmaker S, Hawley S. Effect of government and commercial warnings on reducing prescription misuses: the case of propoxyphene. *Am J Pub Health* 1987; **77**: 1518–1523.
 - 49 Klein LE, Charache P, Johannes RS. Effect of physician tutorials on prescribing patterns of graduate physicians. *J med Educ* 1981; **56**: 504–511.
 - 50 Johnson WJ, Mitch WE, Heller AH, Spector R. The impact of an educational program on gentamycin use in a teaching hospital. *Am J Med* 1982; **73**: 9–14.
 - 51 Avorn J, Soumerai SB. Improving drug-therapy decision through educational outreach. *New Engl J Med* 1983; **308**: 1457–1463.
 - 52 Ray WA, Schaffner W, Federspiel CF. Persistence of improvement in antibiotic prescribing in office practice. *J Am med Ass* 1985; **253**: 1774–1776.
 - 53 Soumerai SB, Avorn J. Economic and policy analysis of university-based drug 'detailing'. *Medical Care* 1986; **24**: 313–331.
 - 54 McGavock H. Improving the rationality and economy of family doctor drug prescribing by means of feedback interviews: the 13-year N-Ireland experience. *Geneva, World Health Organization*, 1989. DAP/89.
 - 55 Avorn J, Soumerai SB, Taylor W, Wessels MR, Janousek J, Weiner M. Reduction of incorrect antibiotic dosing through a structured educational order form. *Arch int Med* 1988; **148**: 1720–1724.
 - 56 Victoria Medical Postgraduate Foundations. Antibiotic Project Committee Report, 1985.
 - 57 Grimshaw J, Russell IT. Effect of clinical guidelines on medical practice: a systematic review of rigorous evaluations. *Lancet* 1993; **ii**: 1317–1322.
 - 58 Laing RO. Rational drug use: an unsolved problem. *Trop Doctor* 1990; **20**: 101–103.
 - 59 Hogerzeil HV, Walker GJA, Sallami AO, Fernando G. Impact of an essential drugs programme on availability and rational use of drugs. *Lancet* 1989; **i**: 141–142.
 - 60 Christensen RF. *A strategy for the improvement of prescribing and drug use in rural health facilities in Uganda*. Entebbe, Uganda Essential Drugs Management Programme, 1990.
 - 61 Laing RO, Ruredzo R. The essential drugs programme in Zimbabwe: new approaches to training. *Health Pol Plan* 1989; **4**: 229–234.
 - 62 Soumerai SB. Personal communication.
 - 63 Nierenberg DW. Clinical pharmacology instruction for all medical students. *Clin Pharmac Ther* 1986; **40**: 483–487.

- 64 Nierenberg DW, Stukel TA. The effects of a required fourth-year clinical pharmacology course on student attitudes and subsequent performance. *Clin Pharmac Ther* 1986; **40**: 488–493.
- 65 Vries de TPGM. Presenting clinical pharmacology and therapeutics: evaluation of a problem based approach for choosing drug treatments. *Br J clin Pharmac* 1993; **36**: 591–597.
- 66 Guide to Good Prescribing – a practical manual. Geneva: World Health Organization, 1994. WHO/DAP/94. 11.
- 67 Tan SF, Teoh PC. Major drug prescribing patterns in Singapore General Hospital. *Singapore med J* 1978; **19**: 25–30.
- 68 Abiodun OA, Ogunremi OO. Psychotropic drug use in medical and surgical wards of a teaching hospital in Northern Nigeria. *Br J Psychiatry* 1991; **159**: 570–572.
- 69 Denig P, Haaijer-Ruskamp FM, Versluis A, Wesseling H. Prescribing pattern in a Dutch university hospital. *J clin Pharm Ther* 1991; **16**: 423–433.
- 70 Joshi MP. Prescribing trends at in-patient departments of the TU Teaching Hospital, Kathmadu. *J Nep med Ass* 1992; **30**: 85–88.
- 71 Interview with Prof J.C. Petrie. Geneva: World Health Organization, 1993. Essential Drugs Monitor, **15**: p. 16.
- 72 EDLIZ 1994. *The Essential Drugs List for Zimbabwe, including guidelines for treatment of medical conditions common in Zimbabwe*. Harare: Ministry of Health and Welfare, 1994.
- 73 Mashford ML, Robertson MB. Surveying antibiotic use in a general teaching hospital. *Med J Austr* 1979; **2**: 515–518.
- 74 Schollenberg E, Albritton WL. Antibiotic misuse in a paediatric teaching hospital. *Can med Ass J* 1980; **122**: 49–52.
- 75 Najdi AN, Khuffash FA, R'Said WA, Ateeqi WA. Antibiotic misuse in a paediatric teaching department in Kuwait. *Ann Trop Paediatr* 1988.
- 76 Misan GM, Martin ED, Smith ER, Somogyi AA, Bartholomeusz RC, Bochner F. Drug utilization review in a teaching hospital: experience with vancomycin. *Eur J clin Pharmac* 1990; **39**: 457–461.
- 77 Udomthavornasuk B, Tatsanavivat P, Patjanasontorn B, Khomthong R, Bhuripanyo K, Saengnipanthkul S, Lumbiganon P, Wiengnond S, Boonma P, Vongsangnak V, et al. Intervention of inappropriate antibiotic use at a university teaching hospital. *J med Ass Thai* 1991; **74**: 429–436.

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