

# Effects of financial incentives on medical practice: results from a systematic review of the literature and methodological issues

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## Abstract

**Objective.** To identify all financial incentives that had been proposed, described, or used regardless of their initial objective and, when possible, to assess the results of these incentives on costs, process or outcomes of care.

**Material and methods.** Systematic review of the literature. Databases searched were: Medline, Embase, Health Planning and Administration, Pascal, International Pharmaceutical Abstracts and the Cochrane Library. Search terms were: health professionals and type of practice, type of incentive, methodology, languages English or French, January 1993 to May 1999.

**Results.** Financial incentives concerned the modalities of physician payment and financing of the health care system. Confounding factors included: age of the doctor, training, speciality, place and type of medical practice, previous sanctions for over-prescribing, type and severity of disease, type of insurance. Risks of financial incentives were: limited access to certain types of care, lack of continuity of care, conflict of interests between the physician and the patient. Any form of fund-holding or capitation decreased the total volume of prescriptions by 0–24%, and hospital days by up to 80% compared with fee-for-service. Annual cap on doctors' incomes resulted in referrals to colleagues when target income is reached.

**Discussion.** Financial incentives can be used to reduce the use of health care resources, improve compliance with practice guidelines or achieve a general health target. It may be effective to use incentives in combination depending on the target set for a given health care programme.

**Keywords:** capitation, DRG, economics, fee-for-service, financial incentives, managed care, physician behavior, physician incentive plans, physician practice patterns, salary

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Financial incentives are used in addition to other measures such as education, or organizational changes which aim at: (i) reducing utilization of health care resources; (ii) transforming clinical practice; and (iii) improving quality of care or reach a general health target [1,2]. One difficulty in interpreting the effects of a financial incentive is that all three objectives can be set, resulting in a variety of incentives and end-points.

We attempted to identify all financial incentives that had been proposed, described, or used regardless of their initial objective and, when possible, to assess the results of these incentives on costs, process or outcomes of care. The analysis of financial incentives cannot be separated from the general context of the health care financing system.

The possibility of using financial incentives, and the type of incentives used is directly dependent on the structure and financing mechanisms of a health care system – the socioeconomic and cultural context. Thus, both the experiments made with financial incentives in one country and the results obtained may not be reproduced straightforwardly in another country unless major structure reforms are undertaken [3]. It must also be kept in mind that other non-financial measures, such as continuing education sessions or mandatory practice guidelines, affect physicians behaviour and possibly revenue. The causal relationship between financial and non-financial incentives is therefore not straightforward.

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## Material and methods

We performed a systematic review of the literature. Medline, Embase, Health Planning and Administration, Pascal, International Pharmaceutical Abstracts and the Cochrane Library were searched for articles published in English or French from January 1993 to May 1999.

Search terms characterized health professionals and type of practice (physicians practice patterns, physician behaviour, physician attitude, physician and clinical practice, medical care, patient care, health care, health care delivery, health care utilization, laboratory tests, prescriptions, decision making), type of incentive (physician incentive plans, economics, information systems, health planning, organization and administration, quality assurance, health care, guidelines, feedback, drug industry, leadership, education, reminders), and methodology (randomized controlled trials, controlled clinical trials, clinical trials, prospective studies, retrospective studies, longitudinal studies, evaluation studies, programme evaluation, health services research, intervention studies, pilot projects, comparative studies). From citations and abstracts two reviewers independently selected articles to be retrieved and reviewed further, with nomination by any one reviewer leading to retrieval of the full-text article. Additional articles were retrieved from bibliographies of articles selected. Every full-text article was reviewed by two persons together. Disagreements were resolved by discussion. The articles selected were analysed according to three criteria: the type of incentives, results of the incentive on selected end-points and quality of the methodology, according to the criteria described by the Cochrane collaboration EPOC group (Cochrane Library Update Software Ltd, Summertown Pavilion, Middle Way, Summertown, Oxford OX2 7LG UK).

## Results

From a total of 130 articles retrieved, 89 met the criteria described above and were kept for final analysis. Of these, eight reported results from randomized controlled trials. Other articles that did not describe actual studies but addressed methodological issues were kept for the discussion.

We report in sequence: (i) the exhaustive list of financial incentives described in the literature, regardless of their results, the quality of their assessments, and whether or not they were legal; (ii) the confounding factors; (iii) the risks that were described as a possible outcome of financial incentives, whether or not they were actually proven; (iv) the effects of financial incentives on the use of health care services, process and outcome; (v) methodological issues.

### Typology of financial incentives

Characteristics of financial incentives are described in Table 1. Concerning capitated payment and fund-holding, a difference must be made between capitation by physician and capitation by patient. Capitation by physician means that the office-based physician is given a historically-based sum of money

to provide ambulatory care for his/her patient population. Patient-based capitation means that the physician is given a sum adjusted to the number and type of patients who register in his/her office. This latter case requires a gate-keeping referral system which the former does not. Adjustments can be made to the simple capitation per patient in order to include physician performance on costs, patient satisfaction or quality of care, or to limit the financial risk to the physician or the group practice [4–19]. Payment by salary results in an incentive when the salary is adjusted to performance criteria either collectively or individually. Other types of financial incentives relate to the regulatory possibility of substitution between health care professionals (primary care physicians/nurses, general practitioners (GP)/deputies, GP-based care/secondary care) [20–23], and the possibility for pharmacists to substitute a generic drug (generic and therapeutic interchange bonuses [24]). Bilateral agreements between physicians and the pharmaceutical industry were excluded.

### Confounding factors

Different results for the same incentive were found, depending on the type of health professional, institution, or patient treated [25]. With regard to the type of patients treated in their practice, physicians reacted to incentives differently depending on: number and type of diseases, whether they are acute or chronic, whether diagnostic or therapeutic procedures are performed, patient sex and ability to pay [26]. Other factors affecting physicians responses to incentives were demographic and organizational: age, sex, experience, qualification; individual versus group practice, size of the hospital department or of the group practice, number of different institutions where the physicians practiced, level of local competition, volume of activity [27–32]. Factors promoting acceptance of financial incentives included trust, accuracy of data, appropriate stimulus for change and supportive medical leadership. A special mention should be made for managed care in the USA, and the number of non-financial incentives used within its environment. These incentives differ from one plan to another and include: utilization review, peer pressure and educational activities [33].

With regard to negative incentives, physicians who had previously been penalized tended to comply more readily [34], physicians who were informed on the threshold (volume of prescriptions for example) that trigger sanctions and on the actual financial risk to themselves were more likely to respond [3,35,36].

Out-of-pocket payment for patients (insurance coverage) affected the way physicians reacted to patients' demand for health care. One objective of financial incentives directed towards patients had been to make it easier for physicians to achieve cost containment goals, and these incentives thus constitute a confounding factor.

### Risks related to the use of financial incentives

M. Rodwin described the risk to the quality of care of establishing a direct link between the revenue of physicians and their ability to deny care [19]. When financial incentives

**Table 1** Characteristics of financial incentives for health care professionals

Current denomination	Description
Fee-for-service; Salary; Fund-holders; Capitation Prospective payment system by DRG Independent Practice Association Preferred Provider Organizations 'Drugs formularies'	Global payment per patient per year  Patients benefit from fee reduction when they visit physicians from the group practice Limited list of drugs that can be prescribed, with or without preliminary authorization
Dichotomy	The referring physician receives payment from the colleague to whom patients are referred
Shareholding in diagnostic facilities Kickbacks in exchange for preferential drugs prescriptions or use of medical supplies Additional payment made to physicians to ensure self-referrals, hospital purchase of physicians' medical practice self-referrals	The physician refers patients to the facilities owned by his employer Dispensing drugs, selling medical products, performing ancillary medical services
Ceiling for annual patient revenue Sanctions/bonuses according to the amount of generic substitution (for pharmacists) Incentives to early retirement	Physicians in private practice are offered a lump sum of money to retire
Sanctions/bonuses according to productivity, quality of care Sanctions/bonuses according to the total volume of prescriptions	May be based on the individual provider's performance or on a pool of providers, depending on the type of plan The sanctions/bonuses in managed care organizations are often related to both the overall performance of the institution and the individual's performance
Risk of medical malpractice suits	

limit the therapeutic choices available, the following risks have been suggested [37]:

- limited continuity of care, in particular for patients suffering from chronic illnesses [6,7,38,39];
- reduced range of services offered to patients, particularly in the case of prevention and psychological support;
- underuse or improper use of emergency services resulting in delayed treatment and related medical complications;
- reduced confidence of the patients;
- risk of ethical conflicts;
- reduced time for teaching and research [37];
- multiplicity of guidelines from different plans recommending different courses of action for the same conditions [39–41].
- the major risk identified remains that of conflict of interest between the physicians and the patient [19,42, 43], across all populations, including both low-risk and

high-risk patients [7]. Proposed remedies include the current removal of the 'gag rule' in certain American states, and the use of collective, not individual incentives.

### Effects of financial incentives on use of health care services, process and outcome of care

The effects of financial incentives have usually been described from observational studies: simple data collection, time series, opinion polls, prospective studies, intervention studies without a control group, models, literature reviews, but seldom from randomized controlled trials [35,44–50] (Table 2).

Most financial incentives described in US studies operated within a managed care environment [33], which was not the case in Europe. Thus, we described them separately and used the classification by Hellinger [33]: randomized studies, same physician studies, same patient studies, same disease studies, other.

### Fund-holding

The effects of fund-holding (capitated payment for each patient registered) have been studied from retrospective data

**Table 2** Characteristics of randomized trials on the effects of financial incentives on resources use, process of care and patient outcome

Population	Intervention	Results	Reference
Physicians <i>n</i> = 1182	Insurance coverage, reduced co-payment	<ul style="list-style-type: none"> <li>● Moral hazard ex post</li> </ul>	Mort [45]
Physicians <i>n</i> = 18	\$2 Per patient visit or \$20 per month per patient	Fee-for-service versus salary <ul style="list-style-type: none"> <li>● More visits per patients (0.86)</li> <li>● More frequently (0.49 visit more)</li> <li>● Physicians saw themselves a higher percentage of patients</li> <li>● Fewer emergency room visits (0,1)</li> </ul>	Hickson [50]
Insurance carriers <i>n</i> = 24	Reveal the threshold that triggers financial sanctions against providers for six procedures	<ul style="list-style-type: none"> <li>● When the threshold is known, physicians tend to reduce their prescriptions</li> </ul>	Nyman [35]
Patients <i>n</i> = 800	Prepaid versus fee-for-service groups	Prepaid groups <ul style="list-style-type: none"> <li>● Use of services was lower in the prepaid group</li> <li>● No difference in access to or satisfaction with care</li> <li>● Patients in prepaid group reported a trend toward better general health rating score (<math>P=0.06</math>) and well-being scores (<math>P=0.07</math>)</li> </ul>	Lurie [44]
Patients <i>n</i> = 7445	Second opinion for 20 procedures	<ul style="list-style-type: none"> <li>● Reduction in the number of procedures performed (<math>P=0.02</math>)</li> </ul>	Rosenberg [46]
Physicians <i>n</i> = 54	Effect of performance-based financial incentives [\$0.80–1.60 per immunization shot]	<ul style="list-style-type: none"> <li>● 7% increase in immunization rate among the ambulatory elderly</li> </ul>	Kouides [48]
Physicians <i>n</i> = 52	Written feedback and a financial bonus	<ul style="list-style-type: none"> <li>● Failure to demonstrate the effectiveness of a combination of financial and non-financial incentives (feedback on performance)</li> </ul>	Hillman [49]
Physicians <i>n</i> = 140	Assign to one of the two payment groups (prepaid or paid fee-for-service)	<ul style="list-style-type: none"> <li>● More primary visits in fee-for-service per year (0.77 versus 0.92, <math>P &lt; 0.1</math>)</li> <li>● Fewer visits per year to a non-primary care office-based specialist for capitation group children (0.24 versus 0.25, <math>P &lt; 0.1</math>)</li> <li>● Emergency department visits were significantly lower for the capitation group</li> </ul>	Davidson [47]

or prospective same-physician (GP) studies. Negative results reported are the absence of effect on the workload of GPs (no transfer to either specialists or hospitals) [51]. Positive results include a 0–24% reduction in prescription costs (the null hypothesis is not excluded) [5] and in total number of drugs per prescription [52–56]. Shifting from fee-for-service to fund-holding reduced the number of referrals for elective

surgery and to private clinics. The differences observed between fund-holders and non-fund-holders in the UK were attributed in part to the confounding factors described above [53]. Of interest is the same-physician study conducted among those who did not participate in the fund-holding experiments. When given a financial incentive close to that of their fund-holding colleagues, non-fund-holders reduced prescriptions

by 1–3% and shifted to generic drugs [15]. The major limitations of these studies were the poor level of evidence and the short duration of follow-up.

### Fee for service

A same-physician study looked at the effect of increasing the fee for night visits. The result was a 33% increase in the number of visits by GPs and a 19% decrease in visits made by deputies [20]. Fee-for-service with a tariff freeze was tried in a number of countries, and a same-physician study assessed the results in Quebec [57]. The potential savings from the tariff freeze were outweighed by an average 6% increase in the quantity of services produced. Implementing a ceiling on the annual revenue of physicians resulted in a modest redistribution of patients from more to lesser active physicians, and a reduction of total medical revenues. The conclusions of the Quebec experiment were that physicians had the capacity to influence the demand from their patients both in terms of quantity and in terms of type of services provided [11,57]. The burden of the ceiling fell mostly on high revenue physicians.

A same-disease study on gynecological patients concluded that fee-for-service seemed to encourage, whereas capitation seemed to discourage, gynecologists from performing elective procedures. Shifting from fee-for-service to capitated contract reimbursement seemed to affect physician decision making for only the most elective of procedures, whereas similar practice patterns were maintained for severe conditions [58].

### Salary

Salary and fee-for-service were compared in same-physician studies. Salaried physicians referred their patients less frequently and had a lower level of activities: fee-for-service doctors chose home visits more often than salaried doctors, but this was statistically significant for ‘scheduled’ visits only [59], and saw patients during working hours. When forced to go on salary, physicians traded revenue for leisure [57,59].

### Managed care (USA)

#### Use of health care resources

The positive effects of managed care reported from same-patient, same-physician studies were a reduction in patients costs, mostly due to reduction in length of stay. Converging results indicated that an overall 25% reduction in costs could be expected, with as much as 80% in hospital length of stay and ambulatory costs for certain case-types [60,61]. Same-patient studies reviewed by Miller and Luft [10] found that enrolment in a managed care plan compared with a no-network fee-for-service insurance resulted in lower hospital admission rates and length of stay. The magnitude of the effect varied from 70 to 0%, two of the 15 studies reviewed even reported a 10% increase in hospitalizations. The explanation for these results may be that the managed care plans presented wide differences among themselves. A randomized study of fee-for-service versus capitation for the children’s Medicaid programme found similar results: capitation significantly decreased the number of physicians’ visits and

hospitalizations, whereas provision of services increased when the fee was increased [47]. A randomized prospective 9-month study of physicians compared the impact of salary versus fee-for-service reimbursement on physicians’ behaviour [50]. Fee-for-service physicians scheduled more visits per patient than did salaried physicians (0.86 more) and saw their patients more often (0.49 visit more). Fee-for service physicians also provided better continuity of care by attending a larger percentage of all visits made by their patients (8.3% more) and by encouraging fewer emergency visits per enrolled (0.1 fewer than salaried physicians).

A randomized physician trial studied insurance-related differences in physicians’ practice [45]. Physicians were assigned randomly to eight scenarios (of discretionary, non-discretionary, preventive and diagnostic/therapeutic services) in which patients were either insured or uninsured. For insured patients, physicians recommended the same services to 72% of patients versus 67% for uninsured patients ( $P < 0.001$ ), they recommended both discretionary (50% versus 42%,  $P < 0.001$ ) and non-discretionary services (93% versus 91%,  $P < 0.05$ ) more often for insured than for non-insured patients.

The general effect of prospective payment on hospital care is a reduction in utilization of services (both length of stay and admissions); the magnitude of the effect appeared to be related to the disease category. From the Veteran’s Administration interrupted time-series data, it appeared that the greatest reductions concern psychiatric disorders [62]. Managed care has been found to reduce the cost per admission by on average 20%, with greater reductions found in those hospitals that promote sharing of resource use with physicians and dissemination of guidelines on the processes of care [63].

In the ‘Health Stop’ same-physician experiment, physicians’ revenues increased with the number of procedures and prescriptions. The implementation of a bonus system, whereby doctors who prescribed more X-rays and tests had higher revenues showed that physicians could increase by 12 to 23% the total volume of their prescriptions [64]. A randomized trial was performed to determine whether revealing the threshold that triggers financial sanctions affects physicians’ practice patterns for six different procedures [35]. When the threshold was known, physicians reduced their prescriptions. There was no evidence of an income-maximizing response to revelation of the screen parameters or any suggestion that providers scheduled procedures to avoid review when they know the parameters.

### Process of care

The impact on financial incentives on diagnostic strategies, and the likelihood of missing a diagnosis have been explored in two same-physician studies. Both found that physicians tended to reduce costs by limiting the number of diagnostic procedures and providing higher quality clinical decision-making [65,66]. A randomized patient trial conducted in New York [46] assessed the effect of utilization review (second opinion) on patterns of health care for 20 elective procedures. Requiring second opinion reduced the number of procedures performed in all cases ( $P = 0.02$ ).



Three same-disease studies assessed the effects of financial incentives on physicians' compliance with practice guidelines. One study concerned patients with congestive heart failure and compared fee-for-service and Medicare enrollees in a variety of managed care plans [67] with regards to both financial and process of care outcomes. The authors found no differences in the hospital management of patients, and an improved compliance with practice guidelines during the follow-up. Similar results were found in the study on influenza immunization, a randomized study that compared the rate of immunization in a population of elderly patients. Physicians were randomized to either no financial incentive or a performance-based incentive. The rate of immunization was found to be significantly higher (7% higher) in the population treated by doctors who were given the incentive (\$.80 per shot or \$1.60 per shot if an immunization rate of 70% or 85%, respectively, was attained) [48]. A third study compared physician behaviour before and after enrolment in a managed care plan: the end-points were rates of immunization, screening for cholesterol levels and charting adequacy. The plan did not only provide financial incentives, but also a variety of non-financial incentives. Compliance rate with guidelines improved significantly across practices by an average of 25–100% [68]. In a same-disease survey on dental care, authors found that the actual amount and quality of treatment proposed did not differ between fee-for-service and managed care patients [69]. Such favourable effects of financial incentives were not confirmed by the randomized physician trial by Hillman *et al.* on breast, colorectal and cervical cancer screening. Feedback on performance and financial bonuses failed to increase the compliance rate with guidelines in a Medicaid health management organization (HMO) [49].

Conflicting results were found by a review of same-disease studies on cardiovascular care in HMO versus fee-for-service patients. It appears that compliance with guidelines for the management of hypertension or hypercholesterolemia was either greater or identical in HMO than fee-for-service. When acute events were considered, HMO patients tended to have better processes of care than fee-for-service patients, and when final outcomes were considered, no conclusion could be reached on which payment system gave better results [70]. Another study, however, indicated that physicians treating HMO and non-HMO patients reduce the care given to HMO patients while increasing it for non-HMO patients [71]. This did not concern acute patients such as the cardiac patients in the Seidman study [70] or patients treated in intensive care units. In a same-disease study, Angus *et al.* found no difference in practice patterns for HMO and non-HMO patients admitted to the intensive care unit. Incidentally, the authors also found a modest beneficial effect of HMO enrolment on mortality [72]. A controlled before and after study assessed hypertension screening in primary care [73]. The programme (physician education and incentives) was found to be effective in improving hypertension screening practices (odd ratio: 3.67).

### Outcomes of care

The Medical Outcomes (same-disease) Study compared the

outcomes of 1574 HMO and fee-for-service patients over a 4-year period. While there was no difference in physical and mental health when total population in each group were compared, subgroup analyses showed differences. Poor or elderly patients treated in fee-for-service practice had better outcomes than those treated in HMOs [74].

The one randomized (Medicaid elderly) trial reported data on health and functional status outcomes and quality of care in prepaid versus fee-for-service HMO patients. The authors did not find a significant difference in the primary outcomes measures: number of deaths, proportion of patients in fair or poor health, physical functioning, activities of daily living, visual acuity, blood pressure or diabetic control. The access to or quality of care and patient satisfaction did not differ between prepaid and fee-for-service physicians groups [44]. There was a trend toward better general health rating scores ( $P=0.06$ ) and well-being scores ( $P=0.07$ ) in the prepaid group compared with the fee-for-service group.

### Methodological issues

Unlike other studies, those on financial incentives are hardly amenable to structured systematic review or meta-analysis of their results. This is due to the small number of randomized trials, and to the lack of comparability of both interventions and study populations (physicians or patients). We identified a number of items that should be present in an assessment of financial incentives [75]:

- data origin (population of physicians and patients);
- percentage of patients enrolled in a given plan;
- expected effect of the incentive: on resource use, practice patterns or patients outcome;
- type of feed-back to physician and doctors;
- type of study (times series, opinion polls, trial), same-patients, same-physician;
- type of incentive given to physician;
- existence of a stop-loss protection and its threshold;
- general environment: peer review, educational activities, guidelines, types of payments for doctors other than that studied;
- patient disclosure, regulations, legal environment, stakeholder;
- purchaser-provider relationships.

### Discussion

Of the many studies published on the impact of financial incentives on physicians and patients behaviour, few met the basic criteria proposed by the Cochrane group on professional practice. Furthermore, the results presented were often preliminary over a short follow-up period. Few studies used the same methodology to assess the impact of the same incentive,

which limited the external validity of their conclusions. When looking at the effects of incentives within managed care environment and without (European countries and Quebec), the general results appeared to be similar: salary and capitation/fund-holding reduced the use of services, whereas fee-for-service increased it. Such results were also found by Gosden *et al.* in their review of the effects of salary payment for doctors [76]. From the results of the studies currently available, it is not obvious that the effects of an incentive were magnified by the managed care environment, in part because physicians adapted their prescriptions to the level of reimbursement to the patient and cross-subsidized patients with poor medical coverage [45]. The very small number of studies from health care systems that do not operate in a managed care environment renders comparisons difficult, which is a shame because it would be interesting to know how much managed care is necessary to contain costs and improve quality of care.

A few lessons and recommendations could be drawn from this preliminary review. Financial incentives represent a non-voluntary strategy to implement change in medical practice, and therefore do not result from the motivation of health care professionals. Thus, financial incentives alone cannot be an effective tool for public health policies. In general, financial incentives directed towards physicians must not create a conflict of interest between their revenue and the quality of care given to the patients [43]. This implies that financial incentives should be adjusted for quality, productivity and severity of patients treated [19,77]. These adjustments can be particularly difficult where prevention and health promotion activities are concerned, and have been shown to result in increased inequities between patients [78,79]. Disclosure of incentives to the public is necessary in order to maintain trust in the physicians and in the payer, be it private or public [33,80,81]. This is true for both ambulatory and hospital practice, where physicians tend to provide most cost-effective care in response to financial incentives if they receive regular information on the use of resources and are provided explicit processes of care for patients [82].

A recommendation when implementing financial incentives in the health care system could be to make them simple, transparent and direct: there should be a binary relationship between the incentive and the desired behaviour from doctors or patients. Hillman has noted that the complexity of a multiple-tier payment system for bonuses can be puzzling not only for physicians but also for policy makers [83]. Similarly, when physicians have to deal with a variety of different plans in their practice, the incentives provided by one plan for one category of patients may be diluted [49]. Even in a less complex environment with a single payer, the shift from one system to another creates tensions and reveals the conflicting interests between groups of health care professionals [84].

The results of financial incentives on physicians behaviour depend on trust, legitimacy, and quality of the data that will be used to decide bonuses/sanctions [85,86]. Incentives should support the goals of the physicians, which usually

combine both improving health in the population and maintaining their revenues [87]. Some physicians try to maximize their revenue, other use a more complex indicator of revenue, quality of care and patient satisfaction [88].

The availability of a number of financial tools (i.e. payment methods) should induce reflections on the possible use of different tools in conjunction. Different types of physician payment could be used depending on the programme considered. In areas when more services need be provided, fee-for-service could be appropriate, whereas capitation or fund-holding may be used to reduce spending for an over-served population. Financial incentives in the hands of 'good' managers and doctors may result in better quality of care, providing that the evidence exists to show which care and how much care is enough [89].

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## References

1. Anderson G. Implementing practice guidelines. *Can Med Assoc J* 1993; **148**: 753–755.
2. Burt RS. Social contagion and innovation: cohesion versus structural equivalence. *AJS* 1987; **92**: 1287–1333.
3. Giuffrida A, Torgeson DJ. Should we pay the patient? Review of financial incentives to enhance patient compliance. *Br Med J* 1997; **315**: 703–707.
4. Bodenheimer TS, Grumbach K. Capitation or decapitation: keeping your head in changing times. *J Am Med Assoc* 1996; **276**: 1025–1031.
5. Dowell JS, Snadden D, Dunbar JA. Changing to generic formulary: how fundholding practice reduced prescribing costs. *Br Med J* 1995; **310**: 505–508.
6. Greenfield S, Nelson E, Zubkoff M, Manning W. Variation in resource utilization among medical specialties and systems of care. Results from medical outcome studies. *J Am Med Assoc* 1992; **267**: 1624–1630.
7. Hillman AL. The impact of physician financial incentives on high-risk populations in managed care. *J AIDS* 1995; **8** (suppl 1): S23–S30.
8. Hillman AL, Pauly MV, Kerstein JJ. How do financial incentives affect physicians' clinical decisions and the financial performance of health maintenance organizations? *N Engl J Med* 1989; **321**: 86–92.
9. Lundberg GD. United States health care system reform: an era of shared sacrifice and responsibility begins [editorial]. *J Am Med Assoc* 1994; **271**: 1530–1533.
10. Miller RH, Luft HS. Managed care plan performance since

1980. A literature analysis. *J Am Med Assoc* 1994; **271**: 1512–1519.
11. Commissariat général du plan. Santé 2010. *Equity and efficiency in the healthcare system* (French). Paris: La Documentation Française, 1993: pp.355–385.
12. Smalley WE, Griffin MR, Fought RL et al. Effect of a prior-authorization requirement on the use of nonsteroidal anti-inflammatory drugs by Medicaid patients. *N Engl J Med* 1995; **332**: 1612–1617.
13. Stewart-Brown S, Surender R, Bradlow J et al. The effect of fundholding in general practice on prescribing habits three years after introduction of the scheme. *Br Med J* 1995; **311**: 1543–1547.
14. Whynes DK, Baines DL, Tolley KH. GP fundholding and the costs of prescribing. *J Public Health Med* 1995; **17**: 323–329.
15. Bateman DN, Campbell M, Donaldson LJ et al. Prescribing incentive scheme for non-fundholding general practices: on observational study. *Br Med J* 1996; **313**: 535–538.
16. Bloor K, Freemantle N. Lessons from international experience in controlling pharmaceutical expenditure II: influencing doctors. *Br Med J* 1996; **312**: 1525–1527.
17. Eccles MP, Soutter J, Bateman DN, Smith JM. Influence on prescribing in non-fundholding general practices. *Br J Gen Pract* 1996; **46**: 287–290.
18. Katz PM. Establishing a physician incentive system. *Top Health Care Financ* 1993; **20**: 53–64.
19. Rodwin MA. *Medicine, Money and Morals: Physicians' conflicts of interest*. Oxford: Oxford University Press, 1993: pp. 97–175.
20. Baker D, Klein R, Carter R. Impact of the 1990 contract for general practitioners on night visiting. *Br J Gen Pract* 1994; **44**: 68–71.
21. Friedman E. Changing the system, implications for the physicians. *J Am Med Assoc* 1993; **269**: 2437–2438.
22. Scott A. Primary or secondary care? What can economics contribute to evaluation at the interface? *J Public Health Med* 1996; **18**: 19–26.
23. Surender R, Bradlow J, Coulter A et al. Prospective study of trends in referral patterns in fundholding practices in the Oxford region, 1990–4. *Br Med J* 1995; **311**: 1205–1208.
24. Carroll NV. Impact of generic and therapeutic interchange incentives on community pharmacy. *Am Pharmacy* 1995; **NS35**: 27–34.
25. Krasnik A, Gottschau A. Doctor and patient characteristics as modifiers of the effect of a changing remuneration system in general practice. *Dan Med Bull* 1993; **40**: 380–382.
26. Godwin M, Chapman J, Mowat D et al. Delisting of drugs in Ontario. How attitudes and prescribing strategies of family physicians in the Kingston area changed. *Can Fam Physician* 1996; **42**: 1309–1316.
27. Miller ME, Welch WP, Welch HG. The impact of practicing in multiple hospitals on physician profiles. *Med Care* 1996; **34**: 455–462.
28. Burns LR, Chilingerian JA, Wholey DR. The effect of physician practice organization on efficient utilization of hospital resources. *Health Serv Res* 1994; **29**: 583–603.
29. Hughes RG, Baker LC. Tracking the changes in physician practice settings. *Arch Fam Med* 1995; **4**: 759–765.
30. Sicotte C, Pineault R, Lambert J. Medical team interdependence determinant of use of clinical resources. *Health Serv Res* 1993; **28**: 599–621.
31. DeMaria AN, Lee TH, Leon DF et al. Effect of managed care on cardiovascular specialists: involvement, attitudes and practice adaptations. *J Am Coll Cardiol* 1996; **28**: 1884–1895.
32. Clarke A. Why are we trying to reduce length of stay. *Qual Health Care* 1996; **5**: 172–179.
33. Hellinger FJ. The impact of financial incentives on physician behavior in managed care plans: a review of the evidence. *Med Care Res Rev* 1996; **53**: 294–314.
34. Hoopmann M, Schwartz FW, Weber J. Effects of the German 1993 health reform law upon primary care practitioners' individual performance: results from an empirical study in sentinel practices. *J Epidemiol Commun Health* 1995; **49** (suppl): S33–S6.
35. Nyman JA, Akhtar MR, Feldman R. Does publishing the parameters that trigger review of medicare claims change provider behavior? Results of the parameter release study. *Med Care* 1995; **33**: 1022–1034.
36. Ziskind AA, Portelli J, Rodriguez S et al. Successful use of education and cost-based feedback strategies to reduce physician utilization of low-osmolality contrast agents in the cardiac catheterization laboratory. *Am J Cardiol* 1994; **73**: 1219–1221.
37. Simon SR, Pan RJD, Sullivan AM et al. Views of managed care. *N Engl J Med* 1999; **340**: 928–936.
38. Robinson JC. Decline in hospital utilization and cost inflation under managed care in California. *J Am Med Assoc* 1996; **276**: 1060–1064.
39. Kravitz RL, Greenfield S. Variations in resources utilization among medical specialties and systems of care. *An Rev Public Health* 1995; **16**: 431–445.
40. Rodwin V. Managed care US: physicians and patients react (in French). Filières et réseaux: *Lettre du Disease Management à la Française* 1997; **1**: 2.
41. Van Horn L, Burns L, Wholey D. The impact of physician involvement in managed care on efficient use of hospital resources. *Med Care* 1997; **35**: 873–889.
42. Allen JC. Economics and the health care system: changing physicians' practices. *Trans Am Clin Climatolog Assoc* 1993; **105**: 1–18.
43. Thirlby RC, Quigley TM, Anderson RP. The shift toward a managed care environment in multispecialty group practice model. Looking for reciprocal benefits. *Arch Surg* 1996; **131**: 1027–1031.
44. Lurie N, Christianson J, Finch M, Moscovice I. The effects of capitation on health and functional status of medicaid elderly. A randomized trial. *Ann Int Med* 1994; **120**: 506–511.
45. Mort EA, Edwards JN, Emmons DW et al. Physician response to patient insurance status in ambulatory care clinical decision-making. Implications for quality of care. *Med Care* 1996; **34**: 783–797.
46. Rosenberg SN, Allen DR, Handle JS, Jackson TC, Leto L,



- Rodstein BM *et al.* Effect of utilization review in a fee-for-service health insurance plan. *N Engl J Med* 1995; **33**: 1326–1330.
47. Davidson SM, Manheim LM, Werner SM *et al.* Prepayment with office-based physicians in publicly funded programs: results from the children's Medicaid program. *Pediatrics* 1992; **89**: 761–767.
  48. Kouides RW, Bennett NM, Lewis B *et al.* Performance-based physician reimbursement and influenza immunization rates in the elderly. *Am J Prev Med* 1998; **14**: 89–95.
  49. Hillman AL, Ripley K, Goldfarb N *et al.* Physician financial incentives and feedback: failure to increase cancer screening in Medicaid managed care. *Am J Public Health* 1998; **88**: 1699–1701.
  50. Hickson GB, Altemeier WA, Perrin JM. Physician reimbursement by salary or fee-for-service: effect on physician practice behavior in a randomized prospective study. *Pediatrics* 1987; **80**: 344–350.
  51. Coulter A, Bradlow J. Effect of NHS reforms on general practitioners' referral patterns. *Br Med J* 1993; **306**: 433–437.
  52. Himmel W, Kron M, Thies-Zajonc S, Kochen M. Changes in drug prescribing under the Public Health Reform Law – a survey of general practitioners' attitudes in East and West Germany. *Intl J Clin Pharmacol Therapeutics* 1997; **35**: 164–168.
  53. Wilson RPH, Hatcher J, Barton S, Walley T. Influence of practice characteristics on prescribing in fundholding and non-fundholding general practices: an observational study. *Br Med J* 1996; **313**: 595–599.
  54. Maxwell M, Heaney D, Howie JGR, Noble S. General practice fundholding: observations on prescribing patterns and costs using the daily dose method. *Br Med J* 1993; **307**: 1190–1194.
  55. Bradlow J, Coulter A. Effect of fundholding and indicative prescribing schemes on general practitioners' prescribing costs. *Br Med J* 1993; **307**: 1186–1189.
  56. Whynes DK, Baines DL, Tolley KH. GP fundholding and the costs of prescribing. *J Public Health Med* 1995; **17**: 323–329.
  57. Rochaix L. Financial incentives for physicians: The Quebec experience. *Health Econ* 1993; **2**: 163–176.
  58. Ransom SB, McNeeley SG, Kruger L *et al.* The effect of capitated and fee-for-service remuneration on physician decision making in gynecology. *Obstet Gynecol* 1996; **87**: 707–710.
  59. Kristiansen IS, Holtedahl K. Effect of the remuneration system on the general practitioner's choice between surgery consultations and home visits. *J Epidemiol Commun Health* 1993; **47**: 481–484.
  60. Roland M. Pay more, get more? The influence of pay on doctors' behaviour. *J Epidemiol Commun Health* 1993; **47**: 431.
  61. Cave DG. Profiling physician practice patterns using diagnostic episode clusters. *Med Care* 1995; **33**: 463–486.
  62. Menke TJ, Ashton CM, Petersen NJ, Wolinsky FD. Impact of an all-inclusive diagnosis-related group payment system on inpatient utilization. *Med Care* 1998; **36**: 1126–1137.
  63. Conrad D, Wickizer T, Maynard C *et al.* Managing care, incentives and information: an exploratory look inside the black box of hospital efficiency. *Health Serv Rev* 1996; **31**: 235–257.
  64. Hemenway D, Killen A, Cashman S *et al.* Physicians' responses to financial incentives. Evidence from a for-profit ambulatory care center. *N Engl J Med* 1990; **322**: 1059–1063.
  65. Lescoe-Long MA, Long MJ, Amidon RL *et al.* The relationship between resources constraints and physician problem solving. *Med Care* 1996; **34**: 931–953.
  66. Clancy CM, Hillner BE. Physicians as gatekeepers. The impact of financial incentives. *Arch Int Med* 1989; **149**: 917–920.
  67. Retchin SM, Brown B. Elderly patients with congestive heart failure under prepaid care. *Am J Med* 1991; **90**: 236–242.
  68. Morrow RW, Gooding AD, Clark C. Improving preventive health care behavior through peer review and financial incentives. *Arch Fam Med* 1995; **4**: 165–169.
  69. Hazelkorn HH, Jovanovic BD, Macek MD, Ghouni J. New assumptions concerning IPA and cost of dental care. *J Public Health Dent* 1996; **56**: 347–351.
  70. Seidman JJ, Bass EP, Rubin HR. Review of studies that compare the quality of cardiovascular care in HMO versus non-HMO settings. *Med Care* 1998; **36**: 1607–1625.
  71. Kerr EA, Hays RD, Mittman BS *et al.* Primary care physicians' satisfaction with quality of care in California capitated medical groups. *J Am Med Assoc* 1997; **278**: 308–312.
  72. Angus DC, Linde-Swirble WWT, Sirio CA *et al.* The effect of managed care on ICU length of stay. *J Am Med Assoc* 1996; **276**: 1075–1082.
  73. Aubin M, Vezina L, Fortin JP, Bernard PM. Effectiveness of a program to improve hypertension screening in primary care. *Can Med Assoc J* 1994; **150**: 509–515.
  74. Ware JE, Bayliss MS, Rogers WH *et al.* Differences in 4-year outcomes for elderly and poor chronically ill patients treated in HMO and fee-for-service systems. *J Am Med Assoc* 1996; **276**: 1039–1047.
  75. Latham SR. Regulation of managed care incentive payments to physicians. *Am J Law Med* 1996; **22**: 399–432.
  76. Gosden T, Pedersen L, Torgeson D. How should we pay doctors? A systematic review of salary payments and their effect on doctor behavior. *Qim-Monthly J Ass Phys* 1999; **92**: 47–55.
  77. Grumbach K, Osmond D, Vrazinian K *et al.* Primary care physicians' experience of financial incentives in managed care patients. *N Engl J Med* 1998; **339**: 1516–1521.
  78. Langham S, Gillam S, Thorogood M. The carrot, the stick and the general practitioner: how have changes in financial incentives affected health promotion activity in general practice? *Br J Gen Practice* 1995; **45**: 665–668.
  79. Newhouse JP. Risk adjustment: where are we now? *Inquiry* 1998; **35**: 122–131.
  80. Miller TE, Sage WM. Disclosing physician financial incentives. *J Am Med Assoc* 1999; **281**: 1424–1430.
  81. Gallagher TH, Alpers A, Lo B. Health care financing administration's new regulations for financial incentives in Medicaid and Medicare managed care: one step forward? *Am J Med* 1998; **105**: 409–415.
  82. Conrad D, Wickizer T, Maynard C *et al.* Managing care, incentives

- and information: an exploratory look inside the black box of hospital efficiency. *Health Serv Rev* 1996; **31**: 235–257.
83. Hillman AL, Welch WP, Pauly MW. Contractual arrangements between HMOs and primary care physicians: three-tiered HMOs and risk pools. *Med Care* 1992; **30**: 136–148.
  84. Hurley J, Card R. Global physician budgets as common-property resources. *Can Med Assoc J* 1996; **154**: 1161–1168.
  85. Monrad A. Incentives and financial methods. *Health Policy* 1995; **34**: 205–220.
  86. Rochaix L. Comparative analysis of health care providers' financing system: implications for the French healthcare systems (in French). *Revue Française d'Economie* (in press).
  87. Shah J, Higgins T, Friedman R. Performance incentives and means: how regulatory focus influences goal attainment. *J Personality Social Psychol* 1998; **74**: 285–293.
  88. Hurley J, Labelle R. Relative fees and the utilization of physicians' services in Canada. *Health Econ* 1995; **4**: 419–438.
  89. Williams SV. The impact of DRG-based prospective payment on clinical decision making. *Med Decis Making* 1985; **5**: 23–29.

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