

Risk Theory, Reinsurance, and Capitation

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Risk theoretic analysis of capitation contracts suggests that capitation contracts are closely aligned to reinsurance contracts between insurance companies. Similarities and differences between these two forms of contractual instruments are reviewed, and several implications are discussed. Viewing capitation contracts as reinsurance contracts has implications that are incompatible with the overall purpose of these agreements as financing mechanisms for health care service provision. Legal, ethical, financial, and operational implications are reviewed, and the suggestion is made that these contracts are against the public interest and that litigation by providers and consumers may be appropriate under extant contract law.

In today's rapidly changing medical marketplace, managed care plans are not the only entities assuming risk for the care of enrollees through capitation. Increasingly, managed care plans are transferring this risk to their primary care and specialty physicians by paying them on a fully or partially capitated basis. Although capitation provides a strong incentive for physicians to provide cost-effective care, there are concerns that capitation may place some physicians at considerable financial risk.

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Capitation contracts became a common feature in providing health care services during the past several decades (Bodenheimer & Sullivan, 1998). It is understood that there is an element of risk and reward that accrues to capitation contractees. However, viewing these contracts as mere business agreements, albeit with incidental risk, is a mistake (Ginzberg, 1984). There is a compelling alternative way to view these contracts and all other average-cost based (ACB) reimbursement practices such as Diagnosis Related Groups (DRGs). Viewing these contracts as primarily, rather than incidentally, risk transfer devices between people with unequal understandings, rather than as equals, necessarily opens a Pandora's box of ethical, legal, professional, and business concerns.

Capitated health care providers accept portfolios (collections of clients) and agree to provide health care services required by that portfolio in return for fixed payments from third parties. The expected revenue streams are often aug-

mented by patient copayments. Similarly, service costs might be subject to deductibles that limit the costs of health providers and hence provide some measure of risk reduction. In general, health providers do not, and will not, know in advance the actual costs that will be generated by the portfolios they accept at the time they sign these contracts.

Several different types of risk are involved in capitation contracts. Some forms of risk are more predictable, whereas some other forms of risk are less predictable. The most predictable risks reflect variations in health costs related to factors such as age, gender, or chronic illness status that suggest different levels of demand for health care services. Health care providers, especially smaller providers, are not necessarily experts at evaluating these risks when accepting a portfolio, but there is a clear understanding that the risks exist and some people are expert at analyzing them.

Other, less well understood and therefore less predictable risks have to do with issues of self-selection bias, financial risks related to the need to borrow money to meet current expenses before income is received, risks related to deferred and uncertain payments to be made in the future, and risks related to staff and resource adequacy in provider organizations. These risks are even more difficult for smaller provider groups to evaluate, predict, and manage. In addition, the major source of risk is not clearly understood; nor has it been discussed in the literature. This form of risk supersedes all others.

This risk is due to the fact that the variability in experience for a small subset of any portfolio exceeds the variability in experience for the full portfolio. This seemingly trivial consequence of statistical sampling theory has far-reaching implications. This also has great power in explaining what has happened in the health care sector during the past two decades. This understanding plays a critically important role in guiding necessary corrective actions.

There are a number of weighty issues regarding ACB reimbursement contracts that could be focused on in this article. These include, but are not limited to,

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1. profitability issues related to capitation and managerial competence,
2. contract law issues,
3. ethical issues,
4. probability distributions appropriate to this line of inquiry,
5. Semantics—when is an agreement a 'risk transfer device' because all contracts have some element of risk,
6. their effects on relationships between providers and insurers,
7. their effects on relationships between providers and consumers,
8. their effects on relationships between consumers and insurers,
9. ethical issues attached in profit-seeking behavior by providers,
10. historical evolution of these contracts,
11. legal issues regarding potential litigation over these agreements,
12. analysis of the impact of increased expenses on financial viability,
13. first in versus last out pricing models,
14. utility theory implications regarding profitability versus bankruptcy risks, and
15. ethical and legal issues related to denial of services.

This article will not cover most of these issues. The effort will be to make a strong case that there is a significant assumption of risk involved in an ACB agreement that is insufficiently understood by some contractees. Insurance company actuaries and government regulators might have understood that this risk transfer mechanism was biased and inherently unfair if they had viewed the contracts as reinsurance contracts rather than purchase of service agreements. It is possible to analyze the consequences of aspects of these agreements in a very conservative manner and still grasp the enormity of the impact these contracts must have on provider group viability and on service delivery quality.

PROBABILITY ISSUES

If a capitation contract is viewed as a reinsurance agreement, we uncover a fundamental flaw. All insurance, reinsurance being a subclass, is based on the premise that the entity providing the insurance is more capable of handling the risk than the entity purchasing the insurance. The usual premise is that the entity providing the insurance is more financially capable, benefits from increased volumes of business or from greater geographic spread of its risk portfolio, or spreads its risks over different types of insurance contracts. In particu-

lar, the law of large numbers is the guiding principle in insurance operations. In essence, the basis of insurance is that insurers can more accurately predict their cost of providing insurance because they write a large number of similar policies, and the accuracy of their average cost predictions increases with the volume of business that they write.

The form that this benefit takes is the same as the effect of taking ever-larger samples from a probability distribution. As the size of samples increases, the variability in average values of the sampled items decreases. In short, increasing the number of units observed substantially reduces the range of likely error in estimating the average cost. In terms of portfolios of clients, this means that small practices that contract for providing services to small numbers of clients may not only benefit from the contract but actually will have a predictably greater variability in their financial experience than the larger entities from which their portfolios are derived. These more variable outcomes increase the probability of both very good and very adverse financial outcomes.

THE NORMAL DISTRIBUTION

The normal distribution is frequently used to explain issues of probability and statistics (Robbins & Van Ryzin, 1975). In many lines of insurance the lognormal is used. However, the lognormal is unnecessary to clarify and simplify issues regarding variability. As well, the very large number of policies involved in the health insurance business makes the use of the normal distribution, in this article, defensible. The issue to be addressed is how likely is it that events distant from the expected (mean) value of a normal distribution will occur in the provider group as compared with the probability of equally distant, from average, experience for an insurer or HMO? The next step is to consider the relative probabilities of adverse outcomes for the provider group as compared with the probabilities of adverse outcomes for the insurer.

To be sure, there is a problem with this approach that will be addressed shortly. This article examines the different spread around the average loss that occurs due to the difference in variability for the smaller cohort of patients compared to the larger cohort represented by the insurer/HMO client pool.

FORMULATION OF THE MODEL

Assume that the statistical distribution of loss ratios (losses divided by premium income) for our large insurer is $N(0.85, 0.05)$ (normal distribution with a mean loss ratio of 0.85 and a standard error of 0.05), profit margin of 0.05 and the expense ratio [(non-health care administrative costs + taxes)

divided by premiums] is 0.10. Under these conditions, the probability that the insurer's losses in any year will exceed 0.90 is 0.1587. At that level, the insurer will fail to make some profit on its portfolio less than 16% of the time. Approximately 84% of the time, its business transactions will be profitable. Now assume that a provider group accepts the average loss amount as payments in a capitation contract. What is the probability that its loss ratio will exceed 90%?

If the provider accepts 10% of the insurer's portfolio, the standard deviation for it is $0.05 \cdot (10 \cdot .5)$ or 0.158. The probability that the provider group's loss ratio will exceed 90% is 0.376. The relative risk of a loss's exceeding 90% is 2.37 times that for the insurer. If the same provider assumes only 5% of an insurer's portfolio, the relative risk of a loss greater than or equal to 90% is 2.59 times that of the insurer. That is, under the normal operation of such a contract there is 2.59 times as high a risk of such an adverse experience in the smaller entity (assuming that 1/20th of the insurer's portfolio is transferred to the individual provider group) than for the larger entity that transfers the risk. Worse is that the smaller entity has very limited ability to withstand such losses. This contrasts with the insurer, which is generally required to follow regulatory requirements to maintain sufficient assets to meet unexpectedly high losses. As well, the insurer has knowledgeable employees to analyze risk, and rating organizations issue reports on the insurer's financial viability at regular intervals. This means that the insurer is capable of handling unusual losses where the provider is generally not able to withstand such adverse experiences.

This increased vulnerability to high losses is, of course, offset by a greater probability of achieving a lower loss than the insurer. The same approach applies to losses below 0.85 except that, there, the increased probability is toward profitability, which is part of the lure of these contracts. However, due to other dissimilarities between providers and insurers, the risk of going bankrupt is the trade-off for a small probability of increased profitability. Most providers would not be willing to risk bankruptcy for an equal chance of greater profitability. Greater concern, from a consumer standpoint, is that a provider might elect to control its risk of bankruptcy by arbitrarily limiting a consumer's access to care. Delayed appointments, long waits in the office, missed or delayed diagnoses, delayed treatments, and denied treatments are the most efficient mechanisms available to providers to control their risk of adverse financial outcomes and bankruptcy. Unfortunately, it may take consumers a long period of time to determine that their provider has used this approach. Still worse, their health and even their lives may have been compromised in the process.

Many capitation contracts are written for a year at a time. A subsequent provider group may diagnose a client who is

not diagnosed by the original provider group a year later. The client may not realize that the delay was intentionally imposed. The new provider group also faces a greater potential of loss if it is assuming the responsibility for care of a large cohort of patients whose diagnoses have been intentionally deferred. In short, faced with higher probabilities of loss, the provider groups are placed in an unenviable position where their economic interests are clearly in conflict with their clients' well-being. This conflict is exacerbated by the fact that half of the contractees are likely to have better than average experience, whereas the other half of the contractees are likely to have worse than average experience merely because their cohorts are drawn from the same, finite population.

INSURER-PROVIDER FINANCIAL STRENGTH DIFFERENTIALS

These contracts are clearly biased in favor of the well-being of the larger organization. State and federal law requires insurers to maintain their financial capacity to withstand risk. Typically, insurers have considerable war chests for years in which they suffer unusually high losses. In fact, insurers are required by law and monitored through special GAAP (Generally Accepted Accounting Principles) and FASB (Financial Accounting Standards Board) accounting standards to maintain a comfortable liquidity position that allows them to weather the vicissitudes of the insurance business (American Association of Health Plans, 1998). Smaller providers, on the other hand, have no such requirements and, in fact, rarely have this capability.

In truth, many providers enter into these contracts because they are financially vulnerable rather than financially strong. A small provider that is not meeting its business costs, or operating at lower profit margins than possible, may be tempted to enter such a contract, believing that will make its operations profitable. This increased vulnerability to higher losses than expected is taken on without a real appreciation of the fact that the increased risk of loss may mean the difference between a business failure and a marginally profitable and continuing business. That the smaller providers are subject to this higher dispersion of risk is clear. It is difficult to understand how these risk differentials have been ignored up to the present time.

RELATIVE RISK OF ADVERSE EXPERIENCE FOR PROVIDERS VERSUS INSURERS

Table 1 details the probabilities of losses greater than or equal to a given loss ratio for the insurer and the provider as

well as the relative risk for the provider compared to the insurer. The table is based on an expected loss ratio of 0.85, a standard error of 0.05 for the insurer and the assumption that the provider group accepts 5% of the insurer's clients. At an actual loss ratio of 0.85 there is no risk differential. However, as the actual loss ratio increases—the fact that the standard error is lower for the insurer—the relative risk becomes greater as the experience moves away from 0.85. The table clearly demonstrates that the provider groups have far greater probabilities of extreme losses than is true for the insurer. This is not all that comes into play, however. The provider groups are also weaker financially. Whereas an insurer may be able to withstand several years of extremely high losses, many small providers move from month to month in a precarious financial balance. Outstanding loans, obligations to workers and patients, immediate payroll demands, delayed revenues, denials of or delays in payments by noncapitated insurers and first-party payers, and inadequate liquid capital resources may push a small provider to the brink, if not over the edge, of bankruptcy in the early stages of such a contract. A single month of far greater than expected losses may literally make the provider group unable to continue in business. Even before that point, providers become vulnerable to financial manipulation by others, including the very insurers that created their financial risk.

FIRST UNIT VERSUS LAST UNIT PRICING

There is a significant question about how to price capitation payments. In fact, there are at least two distinctly different agenda regarding pricing. This discussion will be a brief explanation of the differences between two extremes. On one hand, there is the argument that pricing for the last client served should be the approximate form of pricing for these contracts. The point taken in such a position is that start-up costs and routine costs apply long before the extra clients in a capitated agreement enter the picture. Marginal costs for the last unit produced are often lower than the average costs and far lower than average start-up costs encountered for producing a unit of service from scratch.

However, if we compare health care with acquisition pricing for new technology, the pricing for new technological innovations (computer chips) often reflects development costs and a need to recoup those costs relatively quickly. Here, the initial pricing reflects a value that is far closer to start-up costs.

Exactly how this issue should be played out is far from clear. What is very clear is that the "last unit produced" approach would prove to be untenable over time, as the proportion of capitated patients increases in any practice envi-

TABLE 1

<i>Loss Ratio</i>	<i>Insurer Risk</i>	<i>Provider Risk</i>	<i>Relative Risk</i>
0.85	0.5000	0.5000	1.0000
0.86	0.4207	0.4822	1.1460
0.87	0.3446	0.4644	1.3480
0.88	0.2743	0.4466	1.6290
0.89	0.2119	0.4290	2.0250
0.90	0.1587	0.4115	2.5940
0.91	0.1151	0.3942	3.4260
0.92	0.0808	0.3771	4.6700
0.93	0.0548	0.3603	6.5740
0.94	0.0359	0.3437	9.5650
0.95	0.0228	0.3274	14.3890
0.96	0.0139	0.3114	22.3960
0.97	0.0082	0.2958	36.0780
0.98	0.0047	0.2805	60.1760
0.99	0.0026	0.2656	103.9550
1.00	0.0013	0.2512	186.0540

ronment. This happens because the marginal costs are only adequate if there is a funding base for the total costs. If a practice were to move from 100% fee-for-service clients to 100% capitated, marginal cost revenue clients, no professional group would be viable. In fact, this revenue shift has been the general trend over the past decade as capitation contracts have become more common (Jensen, Morissey, Gaffney, & Liston, 1997).

This issue further exacerbates the major theme of this article. Over time, the impact of last unit pricing inevitably leads to increased vulnerability to extreme losses on the part of providers and to reductions in loss experience and hence inadequate pricing by capitation-based insurers. This is true because capitated providers either default on their obligations to provide service, provide service at lower cost than the revenue they have received, or bear the costs of providing unremunerated losses. Insurance is, above all else, a highly competitive enterprise. If an insurer experiences reduced costs in any period, competitive pressures compels it to reflect those lower costs in future pricing. This is a matter of insurance regulation as well as good business practice. Any insurer that fails to reflect reduced costs in future pricing will soon be faced with eager competitors in the marketplace.

The critical problem is that if providers default on their obligations, patients do not get the services they need when they are needed. That this is not beneficial for consumers is clear. Unfortunately, unmet or delayed service needs are ultimately reflected in reduced operating costs to the insurer. If the providers have a healthy cohort that demands less service, the insurer's costs are reduced as well. In effect, the insurer's loss experience can be less than the loss costs assumed in its premium income but should not exceed the losses assumed in its premium by the provisions in the capitation agreement unless the enterprise fails completely. In

short, insurers abdicated their role as risk assumers and risk managers and instead thrust providers into the insurance business.

There are two consequences of this departure from the insurance role by the insurer. First, of course, some of the providers will suffer adversity as their costs exceed the amounts of the payments they receive. This is necessary because approximately one half of all the possible portfolios to be transferred will have actual loss ratios that exceed those on which the insurer's projections are based. The second, and more formidable consequence is that the providers are far less capable of withstanding the vicissitudes of financial uncertainty. Whereas providers can make or lose money on these contracts, the benefit of the extra dollars they may make is small compared to the dire consequences of equally large losses. Utility theory suggests that most people are risk averse. Risk-averse people do not accept the risk of an equal amount of gain for an equal amount of loss when the cost of the loss is very dear.

CAN SMALLER PROVIDERS MANAGE THEIR RISK ASSUMPTION?

It may be argued that smaller providers are not dependent on single insurers in the marketplace. This may or may not be true. In many areas, one or two large insurers may hold monopoly positions. Whereas insurers generally have wide geographic spreads in the risks they assume, providers generally operate in a small geographic region (Enthoven, 1993). This poses three serious problems. First, they are in fact more limited in terms of their ability to negotiate fair contracts. Large insurers hold the power to determine whether these small providers have access to the requisite numbers of the insured to make their enterprises financially viable. Second, these insurers have great leverage when it comes to determining the amount of the capitation payment, when the payments are to be made, and under what conditions they will be made. Third, whereas the experience of the large insurer is spread over different areas, the small geographic spread for the providers entails a far greater risk that local conditions will result in conflagration losses. If a flu epidemic, a large fire, a major industrial accident, or severe weather conditions result in localized injury or illness, the small provider group may be overwhelmed by the consequences of that event. Not so the larger insurer, which may have unusually smaller losses in other areas of its operations.

The consequence of this is that on the basis of their loss experience potential alone, the small local providers face higher risks of financial adversity than do the larger insurers. However, there is yet another dissimilarity between insurers and providers that works against risk assumption by provider

groups. Insurers benefit by reducing their expenses when handling a large number of relatively similar policies. For an insurer, writing 10 times as many policies introduces only marginal increases in its operating costs. Providers' expense costs, on the other hand, increase dramatically when they deal with dissimilar insurance coverages (Hurley, 1998). A provider that accepts multiple portfolios from different insurers or even portfolios of different types from the same insurer actually increases the complexity and inefficiency of its operations. One set of patients may have coverage for laboratory testing, whereas another set of patients may not. If lab tests are ordered, the provider may have to cover the costs out of pocket. In any event, a higher order of complexity and inefficiency is introduced into the normal mode of operation of the provider by increases in volume rather than less complexity and greater efficiency.

There is only one way for a capitated provider to effectively manage its potential for adverse financial experience. The provider must target its average costs to an amount that is sufficiently lower than the loss component in its reimbursement plan to make it highly unlikely that it will suffer financial ruin. As suggested above, there is a variety of unobtrusive means to do this: delayed scheduling of appointments; use of lower cost, less sensitive diagnostic tests that will delay the use of more expensive and conclusive tests; delays on correctly diagnosing and advising consumers about potentially costly illnesses; and denial of treatment for recognized illnesses. Whereas most providers will not willingly travel these paths, poor planning for and poor implementation of these contracts can quickly place a provider group in financial jeopardy necessitating precisely such measures. Other features of these contracts, such as bonuses for limiting the use of expensive diagnostic and treatment protocols, place providers in an ethical and legal bind where it is difficult if not impossible to act in the best interest of the patient, their group, and the balance of their patients.

CONCLUSION

Average cost-based reimbursement schemes such as capitation contracts and DRG financing are very similar to reinsurance contracts. Provider contractees are smaller, more financially vulnerable, and harmed by the greater probability of excessive losses they assume under these contracts. Using a normal distribution as an approximation to the experience under a capitation contract, a comparison of risk susceptibility between providers and insurers has been reviewed. Capitated health care providers face higher probabilities of financial loss, and this can only be moderated by the delivery of a lower level of service than incorporated in the agreement. Over time, one would expect these contracts to result

in necessary reductions in both the quantity and quality of health care services. These contracts would also be expected to result in financial ruin, takeovers, and consolidation of health providers and reductions in available services in future contract periods. All of these effects have been observed in the past two decades.

As a matter of public policy, capitation agreements should be treated as reinsurance agreements. If providers do not have the financial capacity to effectively manage their risk under these contracts, these contracts should not be permitted. Neither capitation agreements nor DRG reimbursements are appropriate mechanisms for cost control (Berwick, 1996), and public policy should reflect this fact. Any form of prospective substitution of average costs for variable costs should be restricted under law for the public good. Whereas these agreements have reduced the costs of health care services, they have done so at an unacceptable cost of reduced quality and quantity of care (Miller & Luft, 1996 **1994?**). Other, less biased methods to control health care costs must be pursued (Fries, Koop, Sokolov, Beadle, & Wright, 1998).

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