Re-Examining Arrow in the Age of Managed Care and Capitation

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January 9, 2019

Kenneth Arrow published “Welfare Economics of Medical Care" in 1963. Since that time, the paper has been used to justify a wide variety of public policies that have had, as their intent, improving or increasing access to medical care for populations under-served by free market health insurance and free market health systems.

Among the derivative innovations are a variety of health care finance mechanisms that might be referred to, collectively, as "capitation like"(2). Progressives have embraced Arrow, because they believe that the extension of care, especially minimal standards of care, to the under-served, would provide a greater social benefit for the greatest number of people, in line with Arrow's earlier paper "The possibility of a universal social welfare function"(3).

However, there are several problems with Arrow's paper, the consequences of which ought to be a concern for all of us who wish to see efficient and effective health care (finance) care systems.

1 Arrow's Description of Free Market Distortions in Health Care

Arrow focuses in on five areas in which he believed that health care deviated from norms in free markets.

Unpredictability: Arrow noted that people's needs for health care were unpredictable, unlike other basic necessities like food, shelter and clothing. But while we can briefly skip these necessities, our needs for health care may be far more urgent.

Barriers to entry: Arrow noted that nobody can just practice medicine anywhere and anytime they want. Practitioners must have licenses to be physicians, and that requires years of expensive schooling and training. These barriers to practice are a constraint on the supply of medical care even in the face of high demand.

The importance of trust: Arrow, assumed that "trust" is a key component of the physician-patient relationship. Arrow suggests that if a physician makes a serious mistake, the patient may die or suffer disability. Patients must trust that their physicians, including general practitioners and specialists, know what they are doing and will act for the best outcome for them. No patient gets to take their physician for a test drive, kick the physician's tires, or check the physician's mileage before agreeing to be cared for by a specific physician.

Asymmetrical information: Physicians generally know more about medicine than their patients. As a result, buyers/patients are at a serious disadvantage relative to the sellers/treaters. Patients are inherently vulnerable to exploitation because of this imbalance of knowledge. In addition, Arrow assumes that third-party payors, such as insurers or the government, are too far from the locus of care, to be able to adequately supervise physician practice.

Idiosyncratic payment: Unlike most other commodities purchased freely in the market place, patients almost always pay for health care, if at all, after being treated. This is especially true of the most expensive care. Patients rarely know all the costs until after consuming health care services. Additionally, patients cannot return the care they receive, after the services have been rendered. Patients rarely have information about the price of the care they use, or the cost to produce it. Neither patients, nor third party payers, can shop around for medical care based on price and value. Worse still, few patients pay for their care directly creating a lack of connection and concern for the amount paid.

According to Arrow, and expressed most recently by him and four dozen of his colleagues, in one of his last publications[2], capitation is an excellent vehicle for encouraging physicians to become more efficient providers of health care services. I believe that this is simply incorrect and I will show why below.

2 Arrow's Embrace of Structural-Functional Sociology

One area in which progressives would be wise to question the applicability of Arrow's world view is his citation of Talcott Parsons[28] when describing the importance of "trust" in patient-physician re-

lationships. To be sure, I am not suggesting that patients should not have the right to assume that physicians ought to behave in concert with the patients' well-being. Instead, I suggest that the assumption of trust-worthiness was nowhere supported by empirical evidence at the time Arrow's paper was published [2]. This is not an issue restricted to the sphere of physician-patient relationships. Structural-Functionalists made a lot of mistakes, particularly in the area of their studies of criminality.

2.1 Can Professionals Be Trusted? The Case of Social Services

Here, I am guided by the work of another eminent sociologist, Edwin Sutherland. Sutherland first captured my attention in the 1970s when I was trying to understand a phenomena I witnessed first hand in which "presumed trust" clearly did not apply. As a caseworker in a social service agency I witnessed, first hand, a phenomenon that is central to this article. Clients of the welfare agency were routinely denied services they were entitled to receive.

These services: food and rent allowances, eligibility for surplus food distributions, and very meager cash benefits, entailed little to no personal loss on the part of my fellow caseworkers, our supervisors, or the Director of Social Services. But these personnel collaborated in the wholesale denial of these services to dozens, perhaps hundreds, of eligible clients every day.

On the face of it, clients should have been able to trust their caseworkers to advise them of their eligibility for these services. In fact, caseworkers routinely engaged in what clearly appeared, to would be clients, to be "eligibility interviews". But despite the appearance of fairness, considerable caseworker and supervisor expertise, and clear cut eligibility standards, clients were routinely told that they were not eligible for services they were entitled to, or their applications were simply put aside and ignored unless they returned and demanded attention.

In the early 1970s, having discovered Sutherland's work on White Collar Crime129, 30, 31], I wrote a class paper, which I presented, and published, two years later: "Denial of Services In Public Agencies: A White Collar Crime [20].

In that paper I followed the approach Sutherland used, relying on non-criminal censure, the results of "Fair Hearings," a quasi-judicial review of such denials, as the standard for attributing criminality to the actions of workers, and the Department of Social Services. Clients denied benefits could petition for review and redress by initiating a "Fair Hearing" request. Once the client did this, an arbitrator would schedule a formal hearing. The client, and the agency, would present their versions of the facts and relevant regulations, and the arbitrator would render a decision. Arbitrators would either agree that the client had been denied services, or conclude that the denial was legitimate.

This system overwhelmingly favored the agency. Clients denied benefits lacked food and shelter while the Fair Hearing process unfolded. As well, the agency, which could stall for months, would often offer to provide the challenged benefit denial moments before, or even during the "Fair Hearing". Clients in such a position had to decide whether to pursue the Fair Hearing to make a point, or agree to drop their action. If clients dropped their action, evidence of wrongdoing on the part of the Agency ceased to exist.

If clients pursued their Fair Hearings it would be weeks, sometimes months, before the actual decision would be rendered, and benefits provided. During that period clients would continue to lack the benefits they were entitled to receive. In most cases, when an Arbitrator knew they would absolutely rule against the Agency, or the client, they would "hint" at their likely decision and suggest that the parties take a few minutes to work out an agreeable solution, usually resulting in an agreement, and withdrawal of the Fair Hearing action.

I know of this process because after I worked at the Agency, I became a community organizer with the local welfare rights group. One of my principal duties was providing quasi-legal representation for clients in "Fair Hearings".

2.2 Can Professionals Be Trusted? The Case of Physicians

A few years later, during 1974, I served as the Project Director for a health care feasibility study [25]. During that time I undertook a limited study of comparative health care (finance) systems. When I first started learning about health maintenance organizations I was

very receptive. But, at a critical moment I remembered my experiences at the Department of Social Services. I asked myself one of the most defining questions of my life: "Could physicians really be relied on to care for their patients?" This concern became even more critical, over the last four decades, as I realized that physicians were assuming considerable financial risk in their relationships with managed care and health maintenance organizations.

My peers, and our supervisors, at the Department of Social Services routinely failed to provide benefits to eligible clients in the absence of any personal financial loss. I asked myself the most obvious question, one that any sociologist, or economist should have asked: "Could physicians be relied on to furnish services when their own financial interests would be negatively impacted by their behavior?"

Structural-functionalists, like Parsons [28], rarely asked such questions, and neither, apparently, did Arrow. Instead, Arrow seems to have relied on Talcott Parson's characterization of the importance of trust in physician-patient relationships as a given. Talcott Parsons believed that physicians were ethical exemplars. But this was not because he had evidence to support that view. In fact, there was good reason to be skeptical of the virtuosity of physicians as detailed in two major reviews of medical education' [1, 21]. Just a few decades earlier, the Flexner Report on medical education in the United States arrived at a far different assessment about physicians, calling for sweeping reforms in medical education and practice.

Parsons saw social systems as supporting social cohesion, so he apparently chose to "believe" that physicians "should" act that way to maintain social system coherence. For readers not used to perusing the sociological literature, Talcott Parsons also believed that the "nuclear family" was the American family norm, that sex-role stereotyping was a positive binding force for the fabric of American society, and that socialization was about the process of learning, based on race, class, gender, where you fit into an already ideal society. Parsons fell into considerable disfavour in the 1960s and 1970s as a result.

Few progressives would find Parsons' descriptions of American society, families, and sex-role differentiation palatable today. Yet, through Arrow, they may uncritically endorse many erroneous and overly

simplistic characterizations of how American society and our health care (finance) systems work. In essence, Parsons and Arrow assumed that physicians approached their business activities with a higher level of ethical behavior than other business people. In particular, Arrow suggests that the physician is constrained from approaching "his" activities as a "profit maximizer," in any situation in which doing so would conflict with "his" patients' well-being. But this is actually routinely the case in medicine today, and capitation like health care finance mechanisms exacerbate financial conflicts beyond the level in fee for service payment systems for reasons that I will shortly explain.

Quite the contrary, I suggest that physicians accepting insurance risk transfers, through capitation like health care finance mechanisms, cannot be trusted to put their patients' well-being ahead of their own for two primary reasons. First, and most important, because capitated physicians are paid too little to be able to realistically honour such an obligation. Second, because capitated physicians must balance the care they provide to each patient against the care they will be able to provide to all their other patients. Under fee for service such a trade-off rarely exists.

The first problem arises because of the increased variability of average medical costs in small portfolios of patients and the fact that capitation mechanisms cannot adequately compensate physicians for the significant financial risks they assume. The second problem arises because capitation like health care finance mechanisms sets an arbitrary ceiling on the maximum amount of care a provider can furnish, that does not exist in fee for service finance systems. All capitated physicians have ceilings, under capitation, despite the fact that there is a very high probability that at least some capitated physicians' patients will generate costs that exceed those ceilings each year.

As a last comment, I also want to suggest that Arrow's assumptions include the notion that "free markets" and "competition" are virtuous, as are other core principles of capitalism. In Arrow's perspective, the failure of free markets to generate society's demands for affordable health care is a rare, but critical departure from the virtues of free markets. Arrow believes that this rare failing, and the severity of the consequences of not being able to get our health care needs met, justify non-

market interventions such as government sponsored Medicare and Medicaid programs that followed two years after this article was published.

3 Bernoulli's Expected Value Principle

Arrow, on Page 959, following a principle first suggested by Bernoulli in 1738 [5], and employed by Borch [6] states that:

"It follows from the assumption of risk aversion that if an individual is given a choice between a probability distribution of income with a given mean value *m*, and the certainty of the income *m*, he would prefer the latter."

This assumption has been widely interpreted to suggest that if a physician is given a choice between a certain capitation payment, and the uncertainties of fee for service payments, the physician will prefer the certainty of the capitation payment.

This same principle is invoked to describe the conditions under which an insurer will be willing to issue, and consumers will be willing to purchase, insurance policies. I will suggest that this principle is, at best, being invoked inappropriately and without critical examination of its relevance to the current situation in modern health care economics.

I will show that far from resulting in a more certain net revenue stream, "capitation like health care payment mechanisms" introduce far greater uncertainty in the final wealth function of capitated physicians than "fee for service health care payment mechanisms". I will also show that despite Arrow's desire to produce "optimal solutions", his rejection of a monopoly health insurer belies the fact that the optimal size for an insurer is always the largest insurer size possible in any population.

4 The Impact of Size on Insurer Risk

Arrow cites Borch's [6] paper, "The safety loading of reinsurance premiums" to describe the components of an insurance premium. Borch mentions three such components in his paper, stating: "The only problem which may be troublesome is to determine the three components of the gross premium, i.e. net premium, safety loading and loading for expenses." In essence, Arrow is looking for a way to extend health insurance coverage to millions of Americans who were unable to afford free market, private sector, health insurance. He is specifically advocating

for a non-market, governmental solution to the problem of funding health care services.

Arrow's objective, and why he was asked, by the Ford Foundation, to prepare the article, was to justify increased access to health insurance, and governmental intervention into the health insurance marketplace'

One problem with Borch's approach, and with the actuarial literature of that time, and continuing to the present, was the focus on calculating the appropriate premium for an individual policyholder. As such, the relative advantage of insurer size was almost systematically ignored. American actuaries, to this day, continue to deny that the largest insurers face little, if any risk, while small insurers face enormous risks. I have published several articles addressing these issues' [11, 13, 14, 15, 17, 18] and my nursing dissertation explored the impact of insurance risk transferring health care finance mechanisms on hospital nurses [12].

Because American actuaries assume that competition between insurers is a good thing, they fail to adequately account for the diminishing risk insurers face as their portfolio sizes approach infinity. To be sure, Arrow does mention this, but he swiftly rejects it as of little practical importance. As I will show, the increasing efficiency of risk management with increases in portfolio size are critical to the proper assessment of the impact of all insurance risk transferring health care finance schemes.

'The reader should recall at this point that Arrow's paper was published just two years before Lyndon B. Johnson signed into law the bill that led to the creation of the American Medicare and Medicaid systems on July 30, 1965.

4.1 The Paradigm Insurer (PI)

I will, at this juncture assume sufficient knowledge of insurance and statistics to understand the mean, the standard deviation, the standard error, and some elementary financial mathematics(9, 22, 23, 24). I cover all of this, in detail, in my book (191) and several papers (11, 12, 13, 14, 16]

I assume the existence of an "efficient enough" insurer *PI. PI* issues 1,000,000 policies per year to randomly selected policyholders from

population *P*. This allows us to assume a fair degree of normality in *PI's* loss ratio distribution. In the United States we would need 325 health insurers the size of *PI* to insure the entire population of 325,000,000 Americans. In fact, we have hundreds more health insurers. My point here being that if more competition between health insurers was going to produce lower premiums and higher benefits, we would already have them.

I assume that *PI's* expected loss ratio is 0.7500 (incurred claims costs divided by premium revenues). I also assume that *PI's* loss ratio varies, historically, between 0.6500 and 0.8500, about 95 years out of 100. To adequately compensate its investors, *PI's* premiums include a 5% profit margin and a 5% risk premium. I also assume that all insurers spend about 15% of their premium revenues on administrative expenses. The analyses below are quite robust to perturbations in these assumptions.

As a consequence of these assumptions, invoking normality, and assuming a standard deviation of 0.0500, we can see that *PI* will earn profits greater than 10% of revenues in roughly half of all years. *PI* will earn profits greater than 5%, about 84 years in 100, and *PI* will break even in roughly 98 years out of 100, as it sequentially devotes 75%, 80%, and 85% of its revenues to medical care for its policyholders.

We can therefore specify *PI's* cumulative loss ratio distribution function(7, 8, 241, the probability that *PI's* loss ratio will be less than an arbitrary amount x, as Formula 1:

(1) $\Phi_{PI}(0.7500, 0.0500)(x)$

In short, because it draws so many policyholders, at random, from Population *P*, there is no reason to think that the *PI's* loss ratio distribution function is not normally distributed. Moreover, in efficient insurance markets, where there are many sellers, and many buyers, the same exact policy would have to have the same premium. Any insurer charging significantly more, for identical insurance, would find it difficult to attract policyholders.

Back at the time Arrow published his paper, this was largely the case. Even relatively large insurers, such as those I worked at, in the 1980s, had to compete with the market dominant insurers:

State Farm and Allstate for private passenger auto and homeowners, and Liberty Mutual, where I also worked, for workers compensation.

But, as do Arrow and Borch, actuaries of that era assumed that insurers were trading risk management services for revenue and that they had a reasonable expectation that their results would be "close" to the population loss ratio, *PLR,* in some sense. I never saw anyone do the analysis I am doing while I was working in insurance. In fact, because I had a masters degree in statistics, I was frequently cautioned that "traditional statistical methods" did not apply to actuarial work.

The assumption was that both large and small insurers would be willing to issue policies, at a market viable premium, independent of their portfolio size. After all, invoking Bernoulli, each insurer randomly issuing policies to policyholders from Population *P* was expecting average profits, at year end, of 10% of premium revenues and they were getting premiums slightly higher than their expected losses. As I will discuss later, insolvency is an acceptable, though not desirable, outcome in insurance.

PI's loss ratio standard deviation (0.0500), in Formula 1 has another name of course. It is the **standard error,** for the sampling distribution, of the sample mean, for portfolio size 1,000,000. In essence, *PI's* year to year loss ratio variability, is based on the inherent variability in the health experiences of members of Population *P.* Phrased differently, if there are many *PIs* operating the same year, the variation in their end of year loss ratios will be described by Formula 1.

This naturally leads us to ask: "What is the standard error for the sampling distribution for the sample mean for portfolio sizes other than 1,000,000?, and how might this impact the end of year financial results for insurers of different sizes?"

4.2 The Impact of Portfolio Size On Insurer Performance

To simplify our inquiry let us look at just two other portfolio sizes. First, there is a single payer, National Health Insurer (NHI), for the United States. *NHI* insures 325,000,000 policyholders. Second, we have a much smaller "mom and pop" health insurer *(MP). MP* in-

sures just 50,000 policyholders. We assume that the expense ratios are the same, at 15%, but when we look at their cumulative loss ratio distribution functions, we will soon realize that they are very, very different, despite the fact that their expected loss ratios are all the same.

Of course this will have implications for capitation and for disaggregation of risk in all situations. Currently in the United States there are a wide variety of insurance risk transferring health care finance mechanisms in play: Contractual capitation, the Medicare/Medicaid Prospective Payment Systems for physicians, hospitals, nursing homes and home health agencies, the Diagnosis Related Groups systems, and a wide variety of other risk-sharing mechanisms between providers and third party payers.

Additionally, insurance risk transfers appear to occur in the National Health Service, through fixed, prospective allocations to Community Trusts and throughout the world based on various forms of prospective, bundled payment, or episode based systems.

The cumulative loss ratio distribution functions, for insurers *NHI* and *MP* are similar to *PI's* cumulative loss ratio distribution function, except that their standard errors vary with their portfolio sizes as suggested in the Central Limit Theorem (23).

As a review, we are assuming the health care (finance) systems are efficient, and that *PI's* loss ratio in any given year reflects the inherent variability for health care services in Population *P.* Providers are furnishing all the services they can, with current resources. Insurers are operating as efficiently as possible, and paying for as much medical care as possible for their randomly selected policyholders. The variability in health experiences for members of Population *P* cannot be affected, over the next policy year, by any feasible change in the behavior of physicians or insurers.

Because the next step is a little tricky, I will go into considerable detail about the **standard deviation,** the **standard errors,** and the **variance** and the three loss ratio distributions involved.

I will assume, though I will make little use of it, that each policyholder pays $4,000 in premiums to their insurer, and, on average, incurs $3,000 in covered costs. With these assumptions, the population loss

ratio *(PLR)* for Population *P* is 0.7500. In return, the insurer agrees to pay some portion of each policyholder's health care costs. We can assume 100% to keep things simple.

Citizen/Policyholder (i) has a Population Loss Ratio Estimate, $PLRE_i$, where policyholder i's paid health care costs divided by policyholder i's annual premium (See Formula 2):

$$(2) \quad PLRE_i = \frac{\text{Policyholder i's Claims Costs}}{\text{Policyholder i's Premium Payments}}$$

If policyholder i has no health care claims, $PLRE_i = 0.0000$; if her health care claims are $40,000, her loss ratio would be 10; and if her health care claims are $400,000, her loss ratio would be 100. Obviously, there is a lot of variation in individual policyholder loss ratios.

The **variance** for an individual, randomly selected policyholder's loss ratio, in a population with *p* members, is therefore:

$$(3) \quad \sigma^2 = \frac{\sum_{i=1}^{i=p} (PLREi - PLR)^2}{p}$$

and the standard deviation is

$$(4) \quad \sigma_{PLREi} = \sqrt{\left(\sum_{i=1}^{i=p} (PLREi - PLR)^2 \Big/ p\right)}$$

Of course, the variance is next to useless, s2φo we always deal with **standard deviations.** Now what happens when we draw many,

many random samples of size "n" from population *P* and calculate their sample averages "m"? We get a distribution of estimates for the Population Loss Ratio *PLR.* In true insurance systems this is exactly what insurers are supposed to be doing. What is the **standard error** of the sampling distribution for such a process? Formula 5 is what we need:

$$(5) \quad \sigma_e = \sqrt{(\sigma^2 / n)}$$

where n is the sample size.

Since I already assumed a plausible value *(u* = 0.0500) for the standard error for an insurer with 1,000,000 policyholders, it is just a matter of a little alge-

bra to calculate the standard errors for *NHI* and *MP,* using the following formulas which are merely adjusting for the changes in portfolio sizes that we would use in Formula 5:

(6) $б e_{NHI} = б e_{PI} * \sqrt{(Size_{PI})/(Size_{NHI})}$

$=0.0500*\sqrt{(1{,}000{,}000/325{,}000{,}000)}$

$= 0.00277$

and

(7) $б e_{MP} = б e_{PI} * \sqrt{(Size_{PI})/(Size_{MP})}$

$= 0.0500 * \sqrt{(1{,}000{,}000/50{,}000)}$

$= 0.22361$

and, assuming normality continues to apply, in loss ratio estimate distributions produced by randomly selected portfolio sizes of 325,000,000 and 50,000, leads to cumulative loss ratio distribution functions of:

(8) $\varphi_{NHI\ (0.7500,\ 0.00277)}(x)$ for *NHI,* and

(9) $\varphi_{MP}\ (0.7500,\ 0.22361)(x)$ for *MP.*

All three insurers have the same probability (0.5000) of earning profits at least as high as the expected level of 10% at insurer loss ratios below 0.7500. So, one might argue, agreeing with Arrow, that insurers would be willing to issue policies to members of Population *P.* The market based premium for *PI* covers each insurer's expected losses, policy issuance expenses, includes a profit contingency of 5% to reward investors, and includes a 5% risk-premium to protect the insurers, and investors, chances of earning their target profit.

4.3 Insurer Profitability - A Closer Look

If we stop right here, everything looks fine. But, on closer examination, *NHI* earns profits of 8.89% ($\varphi_{NHI}(0.7500,\ 0.00277)(0.7611) = 0.99997$) most years. *MP* will earn profits at least this high in fewer than 52 out of every 100 years ($\varphi_{MP}(0.7500,\ 0.22361)(0.7611) = 0.51980$), and "efficient enough" insurer *PI,* only earns such profits about 6 out of ten years ($\varphi_{PI/}(0.7500,\ 0.0500)(0.7611) = 0.58784$).

Of more concern, while *NHI* earns profits between 8.89% and 11.11% of revenues almost every year (Probability = 0.99994), except in situations likely to drive all insurers to financial ruin, the same is not true for the smaller insurers. *PI* only earns profits between 8.89% and 11.11% of revenues with probability 0.17568, while *MP's* probability is just 0.03960. While *NHI* is guaranteed high, and stable, levels of profits year after year, the smaller insurers have far more variable outcomes.

4.4 Insurer Operating Loss Probabilities

We can also turn our attention to an even greater problem than low probabilities of profits. As we have shown, *NHI* has no reasonable expectation of incurring operating losses. Of course this is never really true. The geographic region *NHI* covers could experience a terrorist attack, resulting in hundreds of thousands of ill and injured policyholders. Such conflagration risks are always possible, lurking, like ogres, under the beds of insurance executives. But conflagration is highly unlikely and there is no plausible way to protect against it. Insurers fail all the time and in a severe terrorist attack it is likely that all exposed insurers would fail.

The destruction of the World Trade Center buildings was the worst attack on American soil in US history, but few people were injured and the replacement cost of the buildings, and the medical care for victims, was measured in billions, not trillions, of dollars. If the buildings had not fallen and killed most of the victims, there may have been thousands of severely injured people and hundreds of millions of dollars in unanticipated health care costs.

I want to explain why insurer failure is so interesting to me. In the late 1980s I worked for Reliance Insurance Group. Reliance was one of the oldest insurers in America. Years earlier it had been purchased by a reckless and predatory investor. The venerable traditions of high surplus reserves, careful underwriting, and rock solid investments were systematically violated. While I was there the company became less and less viable by the day.

Shortly before I left, I was asked to do a study and come up with a recommendation on selling earthquake insurance and reinsurance in California. Being an atypical actuarial analyst, I looked at both

seismological studies and claims data. I concluded that a major earthquake was imminent, and recommended against entering that market. I have no doubt that my report was quickly filed in a wastebasket by my supervisor and I left the company shortly thereafter.

A few months later, while watching the 1989 baseball World Series, The Loma Prieta earthquake occurred in Northern California. Not only had my recommendations been ignored, but Reliance had become a major player in the California earthquake reinsurance market. Through a lot of questionable contracting practices, where Reliance bought and sold the same reinsurance covers, Reliance was on the hook for a lion's share of the losses. Before the earthquake, Reliance's objective was to grab as much premium as possible to bolster its dwindling cash flows, a typical practice in failing insurers, and an insurance industry example of a "Ponzi scheme".

Reliance didn't have the assets needed to cover its losses. All the good assets had been sold off, including real estate and government bonds. Secure, liquid assets had been replaced with junk bonds, or not replaced at all. Reliance was the largest insurer insolvency in history, an embarrassment it ceded two decades later to American International Group, and for virtually the same reasons. When Reliance failed, it took a lot of other companies with it. Those failed insurers thought they had obtained solid reinsurance contracts from Reliance.

Insurers fail all the time, but usually they are small, inconsequential insurers, and the largest, guaranteed profitable, insurers will, for the sake of public image, take over their policyholders, cover claims, or return premiums. Failed insurers are usually small. Their failures serve a very useful function, reinforcing, in the minds of the public, that insurance itself is a risky business. Nothing could be further from the truth. Small insurance companies are engaged in a risky business. Large insurers have to be driven to failure by incompetent, or malicious, management.

While unpredictable disasters can and do happen, the normal variability in health experiences in smaller portfolios is another matter entirely. While *NHI* is guaranteed high profits every year, *MP* should expect to incur operating losses, at loss ratios greater than 0.8500, more than 3

years in 10 ($1-\varphi_{MP}(0.7500, 0.22361)(0.8500)$ = 1.00000 - 0.67264 = 0.32736. *MP* should also expect losses greater than 10% of its revenues, almost once every five years ($1 - \varphi_{MP}(0.7500, 0.22361)(0.9500)$ = 1.00000 - 0.81445 = 0.18555) at loss ratios in excess of 0.9500, and should also be prepared for catastrophic losses, equal to 25% of its premium revenues, about 6 years per century ($1 - \varphi_{MP}(0.7500,0.22361)(1.1000)$ = 1.00000 - 0.94123 = 0.05987) at loss ratios in excess of 1.1000.

To be sure, these loss probabilities are offset, for small insurers, by higher probabilities of earning large profits. But an insurer with catastrophic losses will not survive to benefit from higher profits next year. Average industry profitability does not translate to average individual insurer profitability.

4.5 The Impact of Portfolio Size on MP's Policyholder Benefits

This section is a little more involved, and I am not going to try to explain it in detail. I do so in my book (19). I am also very clearly not suggesting that insurance executives actually do such analyses, though I personally believe that they should, as I think health care providers should approach their work this way.

Clearly, smaller insurers have poor prospects compared to *PI* and *NHI.* Though they have much higher probabilities of earning profits greater than 15% of revenues than *NHI* or *PI,* that would be little solace to *MP's* CEO when she has to report that *MP* is insolvent because their policyholders are randomly sicker than anticipated.

Is there anything *MP's* CEO could possibly do to sleep better at night during the year? Indeed there is. *MP's* CEO could alter *MP's* claims settlement policies and procedures. Again here, I want to stress that I do not believe this is actually happening as deliberately as I think it should, but it routinely happens in an *ad hoc* fashion. *MP's* CEO could direct the VP for Claims to slow down claims settlements. She could also direct the VP for Legal Affairs to begin defending *MP* from claims more strenuously.

With a little judicious algebraic twisting we can come up with an easy to implement strategy. Suppose the CEO of *MP* wants to match *PI's* probability of earning profits greater than 5% of revenues? By

how much would *MP* have to alter its current claims settlement policies and procedures so that its revised target average loss ratio would produce a probability of incurring a loss ratio, no higher than 0.8000 with *PI's* probability (0.8413)?

Here, for the sake of brevity, I will assume that rather than cutting benefits for its sickest and most seriously injured policyholders, *MP* is going to spread the pain across all its policyholders, in equal measure. As a result, it will shift its loss ratio distribution mean, but leave its standard error unchanged.

PI's probability of earning profits greater than 5% is 0.8413 because 0.8000 is exactly one *PI* standard error unit ($бе_{PI}$ = 0.0500) above *PI's* target average of 0.7500. If *MP's* CEO wants to sleep better at night, she could direct the head of Claims to start slowing down payments, and settling claims for lower amounts, so that *MP's* new target loss ratio would shift from 0.7500 to one *MP* standard error unit below 0.8000, or (0.8000 - 0.22361 = 0.57639). Of course, this will be noticed by policyholders and eventually such a strategy will lead to fewer policyholders. But insurers can get away with lower levels of deception rather easily.

This will increase *MP's* probability of earning profits greater than 5% of revenues (φ'_{MP}(0.57639, 0.22361)(0.8000)), from 0.58847 to 0.8413. But it will also do something else. If *MP's* CEO acts in her own rational self-interest, to match *PI's* probability of earning profits greater than 5%, she will also increase *MP's* break-even probability, at loss ratios less than 0.8500, from 0.67264, to 0.92608 (φ'_{MP} (0.57639, 0.22361)(0.8500)).

It turns out that withholding policyholders/patients' benefits has massive advantages for dodgy health insurers and insurance risk assuming heath care providers. If done slyly, affecting all policyholders equally, but in small degrees, it may continue for years, or even decades. More importantly, fee for service payment systems leave a distinct, verifiable, paper trail of inappropriate diagnosis and treatment, that documents the provider's fraudulent activity.

Denial of services, under capitation, leaves virtually no paper trail for denied care. Unscrupulous physicians would have to first document their patients' needs for care, and then fail to provide appropriate

care, before they could be caught. The absence of any documentation of patient need, in a medical record, is a viable defense against legal action because the doctor can simply claim they did not know the patient had early signs and symptoms of heart disease or cancer.

5 The Impact of Portfolio Size On NHI's Policyholder Benefits

Here is something almost no actuary wants the public to understand. What happens if *NHI* decides it is going to alter its claims settlement policies in exactly the same way? Suppose *NHI is* willing to operate so that its probability of earning profits at least as high as 5% of its revenues, matches *PI's* probability of 0.8413? *NHI's* CEO can make the same phone call, but directing the VP for Claims to speed up claims settlements, settle claims for higher amounts, or perhaps add additional benefits. Why? Because if *NHI* sets its target loss ratio one standard error below 0.8000, its target loss ratio will be 0.79723, a 6.3% increase in benefits compared to the level it was offering previously.

Clearly, these analyses show that increased competition between more, small, health insurers cannot lead to higher benefits and lower premiums. But a single payer, national health insurer, can offer much higher benefits, and/or equal benefits, for lower premiums, than any collection of two or more health insurers.

But, it could be even better. *NHI*, particularly if it is government operated, could choose another strategy: Matching *PI's* probability of breaking even, at loss ratios below 0.8500. *PI's* break even probability is 0.97725. This occurs because *PI's* claims policies and procedures produce, on average, a loss ratio of 0.7500, two *PI* standard error units below 0.8500. If *NHI* increases policyholder benefits to a point two *NHI* standard errors below 0.8500, at a target loss ratio level of 0.84446, it will, at worst, break-even with *PI's* probability, 0.97725 (Φ_{NHI} /(0.84446, 0.00277)(0.8500)), while increasing benefits by 12.6%. No set of two, or more, insurers can ever match this performance.

6 The Impact of Portfolio Size on Insurer Surplus Requirements

We can also look at another measure of insurer performance. Every insurer should be protected from losses that exceed the portion of their premium revenues available to pay losses. *PI* can protect itself from losses in a tier between two and three of *PI's* standard errors above its expected loss ratio (0.8500 - 0.9000) by establishing a highly liquid, surplus account with $200,000,000 ($4,000 * 1,000,000,000 * 0.0500). If *PI* does this, its probability of insolvency will be less than 0.00135 (1 - 0.99865). Most insurance executives would rest easy with such a safety blanket.

6.1 MP's Surplus Requirements

But, what if *MP* wants to meet the same standard? *MP* has to set aside far more because we already know it has a high probability of exceeding the portion of its premiums available for paying claims (0.8500). To be as well protected from loss as *PI, MP* must also be able to cover claims costs three *MP* standard errors above its expected loss ratio, or (0.7500 + 3 * 0.22361 = 1.42083). To be prepared to pay all claims with the same probability as *PI, MP* would have to set aside (4,000 * 50,000 * (1.42083 - 0.8500)) or $114,166,000 in highly liquid, surplus reserves. This is more than half the amount *MP* will earn in premiums during the entire year. Astute investors will not invest in insurers the size of *MP.*

6.2 NHI's Surplus Requirements

On the other hand, *NHI,* which is virtually guaranteed to earn high profits every year, would not have to set aside any funds to meet this standard. *NHI* can easily cover loss ratios three *NHI* standard errors above its expected loss ratio (0.7500 + 3 * 0.00277 = 0.75831) from current premium revenues.

One *NHI* can insure every American, with no idled surplus at all. 325 *PI's* would require sidelining an aggregate surplus of $65,000,000,000 (325 * $200,000,000) to insure every American, and 6,500 insurers the size of *MP,* would have to set aside $742,079,000,000 in idled surplus reserves to insure every American and have each *MP* match *PI's* probability of remaining solvent at year end.

7 Summary and Conclusions

I have shown above, that increased competition between many, small insurers, leads to inefficient risk management, missed profit goals, and high probabilities of operating losses and insolvency. Increased competition also leads to excessive surplus requirements, lower policyholder benefits, and ultimately higher premiums to compensate inefficient insurers for the risks in small portfolios.

But the situation is much worse if we transfer insurance risks to health care providers, using capitation as suggested by Arrow(2). In a truly efficient health care system, all health care providers devote all their assets to providing health care services. If, instead of considering *MP* to be a health insurer, we say that *MP* is a mom and pop health care provider, assuming responsibility for the health care needs of the same 50,000 patients, and *MP* is paid, through capitation, the capitation payment sets an absolute ceiling on how much care each *MP* can provide.

I won't go through a detailed analysis in this paper. But the reader should consider the implications of what happens if very generous insurer *PI,* or *NHI,* passes 85% of its insurance premiums, for 50,000 patients, to a health care provider, as a capitation payment. If the provider is efficient, its profit margin should be small. I suspect a profit margin of 5% of revenues is not unreasonable, in an efficient health care system.

But let's assume, for the sake of argument, that the provider is earning a very generous, and inefficient profit margin of 10% of fee for service revenues. These revenues, of course, are claims costs for insurers.

When insurers pass 85% of their premium to providers, the insurers earn no profits at all. So no insurer should do this. *NHI* should never be willing to pass more that 76.11% of its premiums to providers because that is the highest level of loss *NHI* is likely to sustain when retaining its insurance risks.

Capitated provider *MP* can furnish services, at worst breaking even, up to an insurer loss ratio of 0.944444 (0.8500/0.9000). But the probability (1 - (Omp(0.7500, 0.22361)(0.944444) = 1 - 0.80773)) of an insurer loss ratio this high, or higher, in portfolios of size 50,000, is

0.19227. One in five capitated providers, with 50,000 randomly assigned patients, would, on average, fail to honor their obligations because their patients need more care than they can provide.

When these small, inefficient insurers are insurance risk assuming health care providers, perhaps groups of physicians, small accountable care organizations, or some form of local community health agency, these results speak to a deeply dark and uncomfortable truth: The loss in insurance risk management efficiency, due to capitation-induced risk dis-aggregation, creates serious systemic inefficiencies. Either Arrow failed to anticipate this effect, ignored it, or knowingly used it to compel health care providers to cut costs. What is clear, is that introducing capitation, in otherwise efficient health care (finance) systems, leads to inefficiency and decreased social benefit.

But here, we have to take pause. Could a Nobel Prize winning economist, such as Arrow, truly fail to notice this incredibly obvious flaw? At this point, having explored this for several decades, I have arrived at a far less charitable conclusion. I think Arrow performed similar analyses and intentionally misinterpreted the fact that small insurers, and small insurance risk assuming health care providers, must cut necessary and appropriate benefits to avoid financial ruin.

I now believe that Arrow used capitation as an axe to compel health care providers to make cuts to care they had resisted for decades. The bitter truth is that capitation and efficiency are quite clearly mathematically incompatible and a brilliant economist, like Arrow, must certainly have known.

Echoing my earlier comments on the denial of services, it seems clear that patients should be able to trust their physicians to advise them of their eligibility for medical care. I agree with Arrow that patients lack the medical skills needed to diagnose, or treat themselves, so patients have to rely on their physicians to interpret signs and symptoms of ill-health. But for the physician, as for a claims agent in an insurance company, acknowledging that a claim is valid comes with costs.

Physicians routinely engage in what clearly appear, to patients, to be "eligibility interviews". These "eligibility interviews" are generally

known as "physical examinations" and they take place in physicians' offices, hospitals, and nursing homes. But despite the appearance, to patients, of fairness, trust, and reasonable expectation of physician expertise and indifference to the financial consequences, and seemingly clear cut eligibility, manifest in the form of signs and symptoms of ill-health, each year, our results suggest that some eligible patients will have their legitimate claims for care denied.

Each year this will happen, likely to different patients, and different providers, because each insurance risk assuming health care provider has a high probability of greater demand for care than their resources will allow them to furnish. None of them will know, at the start of the year, that it is their turn, but it is inevitable.

In capitated payment systems this happens because there is an artificially low ceiling on the maximum amount of care any provider can furnish. This ceiling exists solely due to the existence of the capitation mechanism. Astute providers should approach this situation by employing a strategy of cutting care early, as should the CEO of *MP,* lest they run out of service capacity weeks, or months, before they complete their contractual obligations.

But even the astute provider, who correctly concludes that they must cut benefits, and who seeks a path to minimize the effects on their patients, still faces a professional abyss. Denying care to any eligible patient may be a violation of the law, it violates the patient's trust, it is an ethical failing, and it is a source of professional angst and conflict [12, 15]. Despite this, providers are clearly seeking ways to rationalize their denials of care [27].

While my experience is primarily within the United States, it seems obvious to me that within the purview of the NHS, and wherever capitation is employed, the benefits of the meritorious liberal and progressive objective of shifting control of resource capacity, and priorities, to local communities, to create more responsive health systems, would likely be dwarfed by the negative impact of risk disaggregation (26] and pay for performance programs (10].

I suggest that rather than leading to more efficient, and locally responsive health care systems, insurance risk disaggregation decreases the degree to which physicians, hospitals, nursing homes, home

health agencies, accountable care organizations, or local control can succeed, because the net benefit for each entity decreases as the risk moves closer to it, and the individual patient.

Fee for service may be an inefficient payment mechanism, rewarding over-treatment and permitting fraud, but it does not compel honest and efficient providers to cut patient care to remain financially viable.

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