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Lessons from Game Theory about Healthcare System Price Inflation: Evidence from a Community-Level Case Study

by

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Abstract

Background: Game theory is useful for identifying conditions under which individual stakeholders in a collective action problem interact in ways that are more cooperative and in the best interest of the collective. The literature applying game theory to healthcare markets predicts that when providers set prices for services autonomously and in a noncooperative fashion, the market will be susceptible to ongoing price inflation.

Objectives: We compare the traditional fee-for-service pricing framework to an alternative framework involving modified doctor, hospital, and insurer pricing and incentive strategies. While the fee-for-service framework generally allows providers to set prices autonomously, the alternative framework constrains providers to interact more cooperatively.

Methods: We use community-level provider and insurer data to compare provider and insurer costs and patient wellness under the traditional and modified pricing frameworks. The alternative pricing framework assumes: (1) providers agree to manage all outpatient claims; (2) the insurer agrees to manage all inpatient clams; and (3) insurance premiums are tied to patients' healthy behaviors.

Results and Conclusions: Consistent with game theory predictions, the more cooperative alternative pricing framework benefits all parties by producing substantially lower administrative costs along with higher profit margins for the providers and the insurer. With insurance premiums tied to consumers' risk reducing behaviors, the cost of insurance likewise decreases for both the consumer and the insurer.

Key points for decision makers

- Providers, employers, and patients could improve the efficiency and effectiveness of healthcare delivery if providers and employer groups could contract a per-period fixed fee for all outpatient services with no insurer involvement.

- Health insurers and hospitals could lower costs and increase profits if insurers limit their coverage of hospitals' claims to inpatient-only services.

- If health insurance premiums are tied to employee and workplace wellness programs, insurer costs as well as employer and employee healthcare costs could decrease.

Background

Cost containment in the U.S. healthcare system has been a difficult challenge in the past twenty years due to the complexity of the interacting parts.[1] The system has been built around the Adam Smith notion of free-markets that is governed by autonomous optimizing behaviors and the laws of supply and demand.[2] This design works well for widgets, but has significant implications when applied to a vertical market consisting of providers and patients/consumers who are linked via the use of health insurance. The pharmaceutical industry is another entity involved in the system but is outside the scope of this study. Under supply and demand economics, these three entities compete for the same dollars to achieve profitability. Insurance companies strive to minimize costs by limiting payments to providers and/or by raising patient (or employer) premiums or implementing copayment systems.[3] In turn, providers set their prices for patient services to maximize their profits; prices are determined by the procedure and diagnosis codes established by the insurance companies, which are pre-negotiated between providers and insurers.[4] Patients can, in some cases, lessen their out-of-pocket insurance and healthcare costs by limiting their utilization of provider services and/or by purchasing less insurance.[5, 6]

The issue of how to structure healthcare markets to promote both quality and cost effectiveness is highly relevant for policymakers as well as healthcare administrators and providers.[7] Understanding the strategic interdependencies between the insurance industry, providers, and patients is critical to cost containment in addition to optimizing patients' health outcomes.[8] Game theory provides a framework to understanding these interdependencies and can shed light on how improvements to the joint healthcare system may be accomplished by altering the "autonomous behaviors" of individual parties within the system.[9] Game theory

assumes that individuals are rational decision makers who are motivated to maximize their utilities.[10] Utility is often contextually defined as, for example, the personal welfares of consumers, or the total revenues or profits of business entities. When combining the decision-making processes of two or more parties whose autonomous motivations affect the nature and/or quality of the group outcome, game theory predicts that group outcomes could be suboptimal due to the non-cooperative nature of the parties' independent, yet interdependent, actions. Thus, game theory is useful for indentifying conditions under which individual stakeholders in a joint system (such as the healthcare system) can interact in ways that are more cooperative and in the best interest of the system.

The literature applying game theory to analysis of healthcare markets demonstrates that when the supply of healthcare is fixed, widespread health insurance coverage could lead to healthcare price inflation, which in turn undermines the value of insurance.[11, 12] These results stem largely from the fact that health insurance gives rise to price setting interactions between doctors and hospitals such that prices chosen by doctors influence the demand experienced by hospitals, and vice versa.[13, 14] According to this literature, when doctors and hospitals make pricing decisions autonomously in the manner of a Nash equilibrium, that is, neither party takes into account the effect their pricing decisions have on the cost or profits of the other party (including the insurer), then providers will collectively drive up healthcare prices and, at the same time, reduce their individual profits.[15] Tirole [16] refers to this price-profit distortion caused by noncooperative price setting behaviors as a vertical externality. One way of easing a vertical externality is to establish contractual price arrangements between parties. In effect, these price arrangements impose intraparty cooperation such that neither party can affect any other's price/profit by its choice of final price.

This analysis uses a community-level case study approach to compare traditional fee-for-service pricing of healthcare services to an alternative pricing framework involving modified doctor, hospital, and insurer pricing and incentive strategies. Our analysis assumes that under the status quo fee-for-service framework, doctors and hospitals have relatively wide discretion to autonomously set their prices for patient services. We use 2010 data from Altoona, Pennsylvania to compare status quo costs and profits for a community-level health system (a doctor group, patient group, insurer, and hospital) to simulated costs and profits assuming a modified pricing framework. The modified framework assumes: (1) providers agree to manage all outpatient claims; (2) the insurer agrees to manage all inpatient clams; and (3) insurance premiums are tied to patients' healthy behaviors. Calculated cost and profit comparisons for the status quo and modified frameworks are reported using payoff tables for the hospital and insurer, doctor group and patient group, and patients and insurer. Effects and implications of the modified framework are then discussed for individual providers, patients, insurer, and the healthcare system as a whole.

Methods

Data. Our primary data come from the 2010 end-of-year financial reports of Mainline Medical Associates, and Altoona Regional Health System (Altoona Regional) in Altoona, Pennsylvania.[17] Mainline Medical Associates is a 12-physician group that provides services to approximately 19,232 patients in Blair and Cambria counties. Mainline Medical's 2010 gross revenues from office visits and lab work was $5,477,898. Mainline Medical's operating cost was $4,039,190, yielding a net profit of $1,438,700 (profit margin of 26.2%) which was distributed to the Mainline physicians (V. Mignogia, unpublished data). Altoona Regional is the primary not-for-profit hospital serving the Altoona area communities with a capacity of 419

beds. Altoona Regional had a 2010 operating budget of $350 million with an end-of-year profit margin reported at -1.0 %. As reported by the CFO, Altoona Regional's 2010 administrative cost associated with billing insurance was 2.0% of its total cost, or approximately $7 million. Approximately 54% of this $7 million, or $3.78 million, was related solely to handling and billing insurance claims for outpatient services (C. Zorger, personal communication).

To supplement these data, we also obtained the 2010 end-of-year financial report of Highmark Blue Cross of Pennsylvania, and collected general health insurance premium data from Kaiser Foundation and from the Wellness Council of America (WELCOA).[18-20] Highmark Blue Cross of Pennsylvania is the largest insurer in the Central Pennsylvania region with reported 2010 gross revenues of $14.6 billion. Highmark reported a 2010 net profit of $462.5 million (a profit margin of 3.2%). Of Highmark's 2010 net profit, $242.5 million was from investment income, $165 million was from vision, dental, and reinsurance operations, and $55 million was from health insurance. Thus, Highmark's health insurance sector yielded the lowest 2010 profit margin of 0.4 %. According to Highmark, administrative costs specific to health insurance provision accounted for approximately 9.0% of its 2010 total operating costs.

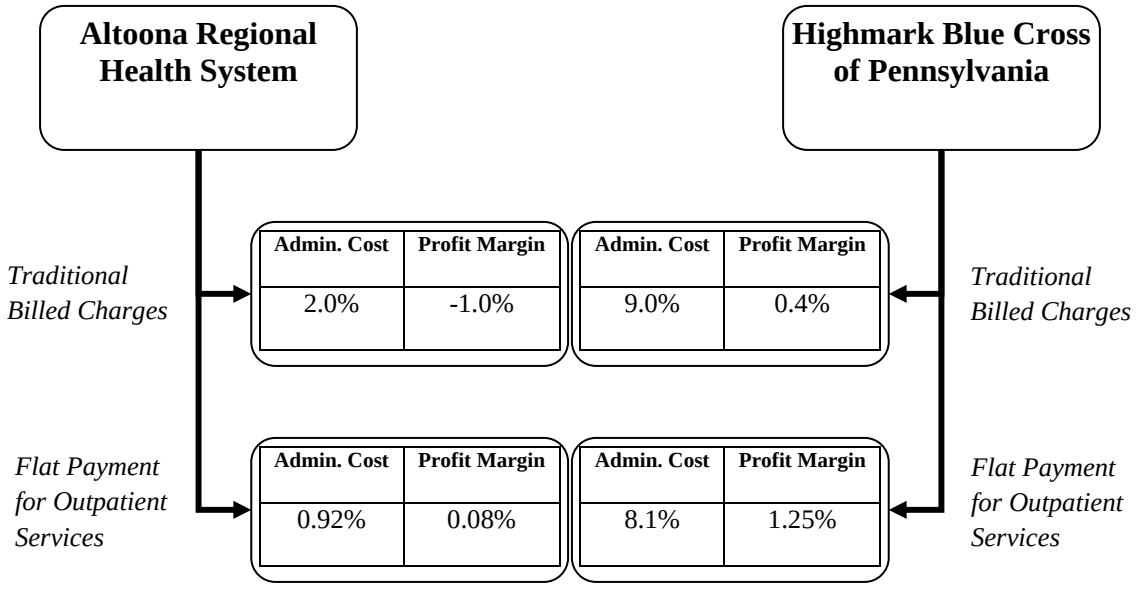
We use data from Kaiser and WELCOA to approximate the 2010 average annual health insurance premium paid by Pennsylvania employer groups, the amount of this premium allocated toward primary care physicians' services, and the growth rate of this premium and would-be impact on employer/consumer healthcare costs caused by the adoption of an employee wellness program. As reported by Kaiser (2010), the average annual premium paid by Pennsylvania employers was $7995 per individual. A nation-wide study by PricewaterhouseCoopers [21] found that, on average, approximately 33% of an individual's 2010 premium goes toward "physician services." Other nation-wide studies found that approximately 31.4% of this amount is allocated

toward primary care physicians' outpatient services, including lab work.[22-24] Combining these figures, we postulate that \$7995 × 33.0% × 31.4% = \$828.44 approximates the annual per-patient insurance premium expense paid by Central Pennsylvania employer groups for primary care physicians' outpatient services (or about \$69 per month). Kaiser reported a 9.9% average increase in Pennsylvania employer group premiums between 2010 and 2011. According to WELCOA,[20] an effective means of mitigating nominal premium costs, along with annual premium inflation rates, is to implement employee and worksite wellness programs. WELCOA's review of 42 published studies on corporate wellness programs found that businesses with some form of self-health promotion program realized, on average, a 24% reduction in annual company medical costs coupled with a 15% reduction in the annual inflation rate of employee premiums.

Results

Case 1 considers interaction between Altoona Regional and Highmark Blue Cross. In Figure 1, we display calculations of profit margins and administrative costs for the two parties assuming two separate behaviors: (1) the status quo framework in which all outpatient charges are managed by the traditional medical billing and coding formula currently used by Highmark Blue Cross; and (2) a modified framework that assumes all outpatient charges are managed by the hospital and are paid with a lump sum from either an employer group or the government without the involvement of Highmark Blue Cross.

Figure 1. Administrative costs and profit margins: Altoona Regional and Highmark



The upper left-hand box in Figure 1 represents the status quo scenario in which all of Altoona Regional's outpatient charges are managed by the traditional medical billing and coding method. The percentages listed from left to right in this box are the hospital's 2010 2.0% administrative cost (i.e., the fraction of total costs attributed to billing insurance) and -1.0% profit margin as discussed earlier. Similarly, the upper right-hand box in Figure 1 displays Highmark's 2010 9.0% administrative cost and 0.4% profit margin as per the status quo billing and coding system.

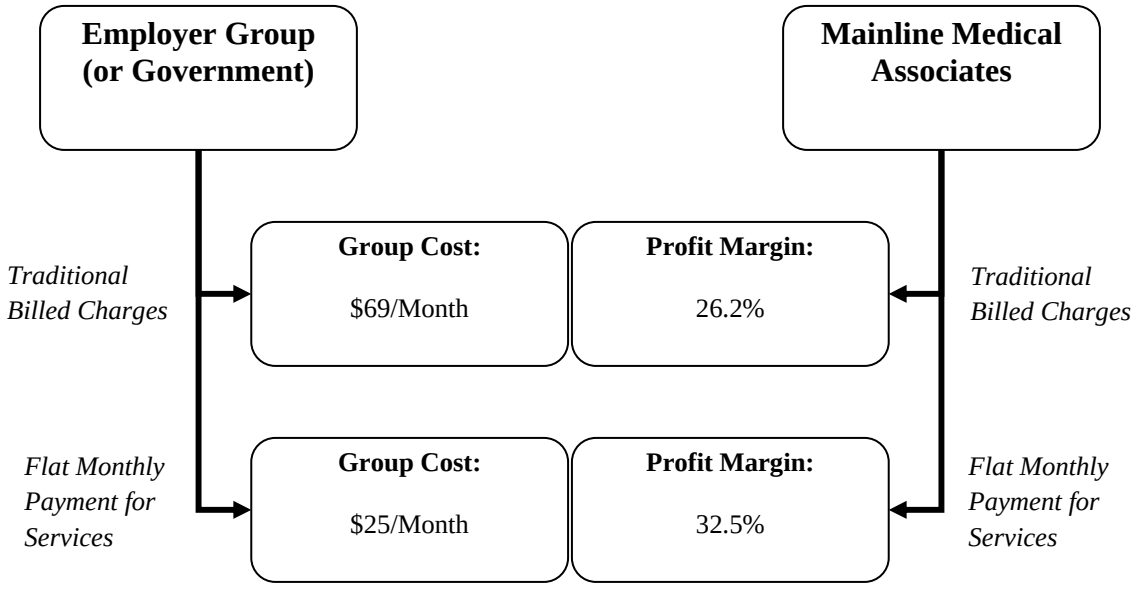
The lower left- and right-hand boxes in Figure 1 consider the scenario in which Altoona Regional and Highmark Blue Cross mutually agree to operate with Highmark covering only hospital inpatient claims, thus leaving all outpatient claims to be handled by the consumer (i.e., government or employer group). When Highmark covers only hospital inpatient claims, Altoona Regional will save approximately $3.78 million, the portion of its 2010 operating costs directed specifically toward handling insurance claims for outpatient services. Assuming Altoona

Regional's annual revenues and other costs remain roughly constant, this $3.78 million savings will increase its profit margin from -1.0% to a sustainable 0.08%. Furthermore, if all hospital outpatient services claims are handled henceforth by the consumer, Highmark's claims operations and administrative costs specific to health insurance provision will decrease by approximately 35% and 30% respectively (P. Reilly, personal communication). These cost savings will more than offset Highmark's reduction in revenues from hospital outpatient services by a conservative estimate of 10%. Assuming Highmark's other revenues and costs remain roughly constant at 2010 levels, Highmark's profit margin on health insurance would increase from 0.4% to 1.25%. These latter estimates suggest that, consistent with game theory predictions, economic gains are achievable for both Altoona Regional and Highmark Blue Cross if the hospital could agree to make only inpatient claims, thus allowing the insurer to focus exclusively on risk compensation. Eliminating the hospital's management of outpatient charges based on traditional billing and coding removes one of Altoona Regional's self-directed pricing objectives for maximizing profits: to optimize its billed charges on outpatient services—many of which are fixed cost items such as cholesterol screenings, mammograms, and PSA tests. In turn, the insurance company devotes significantly fewer resources to controlling costs in the form of claim validations and reimbursements. Both the hospital and insurance company reduce total resources devoted to evaluating and billing charges, and reviewing and paying claims.

In case 2, we compare Mainline Medical physician group's profit margin against a Central Pennsylvania employer group's monthly per-patient insurance premium expense for outpatient primary care and basic laboratory services. This comparison is illustrated in Figure 2. As in Case 1, the upper left- and right-hand boxes depict the status quo scenario in which both the physician and employer groups operate under the traditional fee-for-service framework, i.e.,

all physicians' fees are processed and billed to the employer group's insurance company. The lower left- and right-hand boxes assume a modified pricing framework in which physicians and the employer group agree to a capitated fee payable periodically (e.g., monthly) from the employer group to the physicians.

Figure 2. Employer group cost/month and physician group profit margin



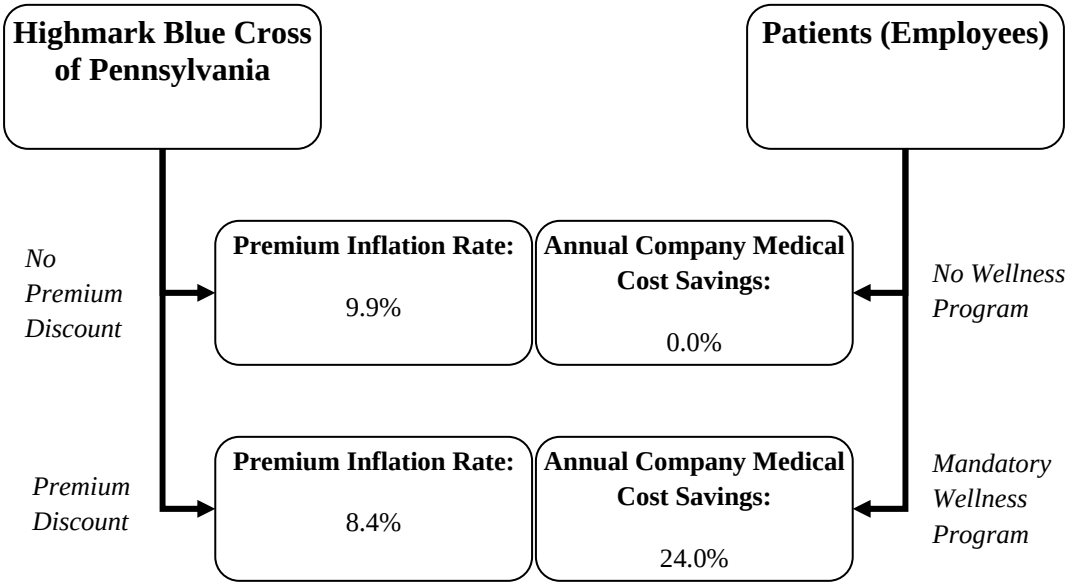
Under the status quo fee-for-service framework, Mainline Medical's profit margin will be 26.2%, and the employer group's monthly cost per employee will be $69, as outlined earlier in our data description. Conversely, suppose we assume that Mainline Medical and the employer group negotiate a flat monthly payment of $25 per employee for all outpatient services. Under this scenario, each enrolled patient makes his/her claims for outpatient services against the fixed resources of the provider (the value of the capitation). However, unlike pure capitation in which the physician group must absorb all unknown future costs of patients' illnesses regardless of severity,[25, 26] we assume that the portion of Mainline's financial risk associated with patients' severe illnesses, i.e., all inpatient services needs, will be handled by insurance. Given this $25

flat rate, the employer group's cost per employee decreases by almost 64% (from $69 to $25). In addition, Mainline Medical's profit margin will increase from 26.2% to 32.5%. This increase in profits emerges in two ways. First, assuming Mainline's annual patient numbers are roughly constant at 19,232, the $25/month/patient fee will raise Mainline's annual gross revenues from office visits and lab services from $5,477,898 to $5,769,600. Second, based on information provided by Mainline Medical's CEO, the physician group's annual operating costs will fall by approximately $150,000 due to the elimination of three staff positions whose sole purpose is to process outpatient insurance claims.

Similar to case 1, removing the physician group's independent management of fee-for-service charges eliminates the group's incentive to optimize price based on billed charges. Also, unlike fee-for-service where physicians have no incentive to consider cost, physicians will have the incentive to consider the costs of treatments and to avoid more costly and possibly less effective treatment options.[27] Physicians will have a financial incentive to focus on patients' preventive healthcare, because it is more profitable to keep patients from becoming ill than to treat them once they become ill.

Finally, we consider the interaction between patients in a Central Pennsylvania employer group and Highmark Blue Cross of Pennsylvania. The upper left- and right-hand boxes in Figure 3 depict the status quo scenario in which the insurance company and the employer group operate autonomously; that is, the insurance company offers employers no cost-saving incentives for employees' healthy behaviors, and the employer initiates no workplace health promotion (wellness) program. The lower left- and right-hand boxes in Figure 3 alternatively assume that the employer group agrees to implement a mandatory employee wellness program in exchange for Highmark agreeing to offer a discount in the employer group's annual premium.

Figure 3. Annual cost savings and average premium increase



With no premium discount and no workplace wellness program, the patients and employer derive no medical cost savings and the annual premium inflation rate equals the Pennsylvania state average of 9.9% as reported earlier in our data description. Alternatively, if the insurer rewards mandatory employee wellness with a premium discount, the patients and employer experience a 24% average annual savings in medical costs. In addition, with reduced use of employee healthcare benefits (i.e., lower actuarial payouts), Highmark is able to reduce the annual premium inflation rate by 15% to 8.4%.

System-Wide Benefits. While the abovementioned cases bring to light potential benefits from more cooperative interactions between providers, patients, and insurer, we recognize that the system-wide benefits from cooperation are likely to be higher since the gains from any single interparty agreement plausibly generate spillover benefits accruing to other system participants.

To give some examples, the hospital-insurer agreement in case 1 lowers both parties' administrative costs and raises their profits, but this agreement also plausibly lowers administrative costs for the physician group given that all insurance-related barriers to hospital-physician group interactions are eliminated by removal of prior authorizations for outpatient services. Second, while the hospital-insurer contract does not imply a capitated fee agreement will emerge between the physician and employer groups, once established this agreement will plausibly benefit the insurer further by reducing administration costs of servicing claims for outpatient physicians' care (P. Reilly, personal communication; see also Jensen and Mendonca[28]). Third, providers in a capitated system as well as insurer will benefit from workplace wellness programs as healthier employees reduce their healthcare utilization and subsequent treatment costs.

Discussion

Game theory predicts that if hospitals, doctors, and insurers optimize their own strategies autonomously at the expense of each other, they create a vertical externality problem that systematically drives up healthcare prices while lowering individual profits. Game theory reveals two key leverage points for enhancing cooperation between providers and insurers: (1) improve communication so that all stakeholders are aware of each other's motivations; and (2) create price contracts so that neither party affects the other by its choice of final price.

Three community-level case studies were examined using 2010 provider, insurer, and patient data from the Altoona, Pennsylvania bi-county area. Consistent with game theory predictions, our results suggest that if Altoona Regional and Highmark Blue Cross could agree that Highmark covers only hospital inpatient claims, hospital and insurer profits could rise as the result of lower total resources committed to processing and paying claims. Second, if Mainline

Medical physician group could agree to accept a periodic flat rate for all outpatient services, the group's annual profit margin could increase. Furthermore, the periodic cost to Mainline's patients could fall well below the 2010 Pennsylvania average. Third, if Highmark Blue Cross could agree to offer employers who adopt workplace wellness programs a discount on premiums, both Highmark, the employer, and patients could experience lower costs as well as a reduction in the 9-10% cost inflation that has become the standard over the past 5 to 10 years.

Nearly all of our comparisons in Figures 1 and 2 use 2010 financial data obtained from the providers and insurer. One exception is the annual per-patient insurance premium expense paid by Central Pennsylvania employer groups ($69/month in Figure 2), which was unobtainable. While not ideal, we use 2010 national averages to construct an approximation. The studies used for this approximation do not report sample sizes or standard deviations necessary for us to construct confidence intervals. Nevertheless, the $69 - $25 difference is quite large; thus, even with significant variance in the national averages used to construct our $69 number, it is conceivable that employers and employees could mutually benefit from a physician-employer group fixed fee arrangement. Lastly, our Figure 3 numbers, while not specific to Central Pennsylvania, reflect a large and growing literature consensus that workplace wellness programs coupled with premium discounts for healthy behaviors could reduce patient, employer, and insurer costs. WELCOA's 42-article review on corporate wellness programs provides a current and reasonably comprehensive summary of this literature.

The interrelatedness of doctors and hospitals by way of insurance suggests that health insurance is not well designed to handle fixed cost items (outpatient services). Indeed, it is very difficult for any insurance company to maintain appropriate operating margins when at least 70% of patients regularly utilize their insurance; by comparison, property and casualty insurance

companies operate with customer usage rates of 12% or less. Thus health insurance companies, rather than abdicating risk, attempt to manage it, collecting and investing premiums as a means to achieve profitability. The foregoing case studies offer an example where the health insurer's profit is derived solely from inpatient insurance coverage; the result of this example is higher profits for the insurer and the hospital. When Altoona Regional receives a lump sum for all outpatient services, the hospital is better able to minimize its costs and to sustain itself financially. This idea holds true even though Altoona Regional, as with most hospitals, supplies some services that are either uncompensated or under-compensated (e.g., through Medicaid or Medicare).

Physicians' offices without the burden of insurance operate in the better interest of patients, employer groups, and insurers. In the 1990's, capitation performed poorly in most parts of the country because incentives were largely misaligned.[29] Patients' potential savings from the fixed payments were grossly overshadowed by the costs insurance companies were incurring to administrate the capitation, subsequently passing these costs onto the employer groups and providers. Development of a direct relationship between employer and physician groups, sans insurer involvement, reduces costs for all groups. Finally, workplace wellness programs coupled with premium discounts for healthy behaviors reduce patient, employer, and insurer costs. For many companies, medical costs can consume half of corporate profits or more.[20] Today, more than 81% of U.S. businesses with 50 or more employees have some form of health promotion program. With tangible benefits such as reduced absenteeism, higher productivity, reduced use of health care benefits and increased morale and loyalty,[30] it is not surprising more and more employers are choosing to implement workplace wellness programs within their companies.

Conclusions

Community-level provider and health insurer data indicates that if: (1) providers agree to manage all outpatient claims; (2) the insurer agrees to manage all inpatient clams; and (3) all health insurance premiums are tied to patients' healthy behaviors, then providers and the insurer could realize lower (higher) administrative costs (profits) and patients could realize lower health insurance costs. Traditional fee-for-service pricing of healthcare services yields comparatively higher administrative costs, lower profit margins, and higher health insurance costs.

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