SUSTAINING THE MEDICAL HOME:
HOW PROMETHEUS PAYMENT® CAN REVITALIZE PRIMARY CARE

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PROMETHEUS PAYMENT INC™
Igniting Payment Reform

Robert Wood Johnson Foundation

EXECUTIVE SUMMARY

SUSTAINING THE MEDICAL HOME:

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As U.S. policymakers debate various approaches to reform the nation's ailing health care system, efforts to improve quality and reduce costs have never received more attention. One potential solution that is gaining support is to restructure primary care practices to incorporate essential principles of the "patient-centered medical home" clinical delivery model. Some early evidence shows that aggressive clinical care coordination, intense communication with patients, concentrated adherence to evidence-based measures and attention to avoiding hospitalization results in better-quality care being delivered at a lower overall cost. The PROMETHEUS Payment model is designed to encourage these better care patterns and can support the creation and sustainability of medical homes.

By avoiding the pitfalls of current and past incentive models, payment can be reformed, and primary care practices can return to the solid and central place they deserve in a better American health care system. At the core is recognition that existing fee-for-service (FFS) and capitation-based payment systems encourage *volume-driven* health care rather than *value-driven* health care. Providers are rewarded for "doing things" (either too many or not enough), rather than delivering quality services that are proven to keep people healthy, reduce errors and help avoid unnecessary care.

In analyzing a large body of national claims data, the PROMETHEUS Payment developers found that a significant percentage of total cost of care spent today on six chronic diseases is attributable to "Potentially Avoidable Complications" (PACs). On average, close to half of total costs for these conditions are attributable to PACs, and they present a powerful mechanism to sustainably fund the patient-centered medical home model of care delivery.

The PROMETHEUS Payment model presents a blueprint for physician payments based on packaging a comprehensive "episode" of medical care that covers all patient services related to a condition. The model uses an "Evidence-informed Case Rate®" (ECR), which creates a patient-specific, severity-adjusted prospective budget for a patient with a chronic condition. Each patient is assessed a budget based on his or her condition and its relative severity. These budgets can be added up across a specific patient population and represents a global budget for the physicians caring for these patients—irrespective of whether the physicians are incorporated in a "system."

Patients access care as they do now; physicians who care for the patients get paid under their current negotiated fee schedules; and all claims get accumulated against the prospective budget for each patient. At the end of the year, the actuals are compared to budgets, and any excess is the upside opportunity for the physicians. This report details how episode of care payment can be operationalized today, without any major disruption to payer or provider operations, or forced integration into "accountable care organizations," and yield significantly improved margins for physicians that deliver coordinated, patient-centered care.

The current national health reform dialogue provides an opportunity to correct the deficiencies in health care value and usher in meaningful changes in the way we pay for care. The PROMETHEUS Payment model may serve as a viable example to effectively power the medical home concept, resulting in better patient outcomes and greater affordability of care.

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Introduction

Health care services currently consume 17 percent of the U.S.

Gross Domestic Product. Observers expect that share to reach more than 20 percent of GDP within a decade. And yet, in a sector of the economy that, in dollar terms, is doubling every 10 years, primary care physicians are in financial crisis. Seven years ago, many of the specialties that deliver primary care services sounded the alarm.[i] Employers, health plans and policymakers are now ready to take action, realizing that (1) the total number of physicians practicing in internal medicine, family practice and general practice has fallen dramatically in recent years and is predicted to continue to fall over the next decade;[ii] and (2) the fee-for-service (FFS) payment system blindly rewards both volume of services (not quality or results), and procedures over cognition. The willingness to confront the primary care crisis has also been accelerated by several factors:

- The ongoing distortions in Medicare's Resource-Based Relative Value Scale (RBRVS) scale that compresses fees for cognitive services (what good patient management care is all about) in favor of procedural care and technological inputs;

- Increasing evidence of mediocre quality of care combined with escalating costs;

- The inexorable increase in chronic illness that demands far greater care coordination;

- The realization that the 15-minute primary care visit spawned by the FFS payment system cannot provide high-quality preventive, chronic and acute care.

As Congress prepares to address health reform, we offer a partial blueprint for a payment approach that, we believe, could guide, promote and support the sound, sustainable restructuring of primary care. It is focused around the principles of the "medical home" as a clinical care delivery model, based on over 40 years of theoretical work, and many years of analytical research and practical experimentation.

Criticism of FFS is hardly new. In the 1960s, Dr. Jerry Solon was one of the first to express that paying for care by unit of service and creating accountability for costs at that level was irrational for many reasons. First, paying for the unit of service had no relationship to the way physicians and other clinicians think about and carry out patient treatment. Instead, he suggested that using a comprehensive episode of medical care

as a unit of measurement of costs would better reflect the actual practice of medicine.[iii] Since then, others have expanded on this concept. Most recently the National Quality Forum issued a Measurement Framework for Evaluating Patient-Focused Episodes of Care.[iv] In addition, the Geisinger Health System has, through its ProvenCare program, implemented a model in which physicians and hospitals are paid a global fee for all patient services related to a condition or a procedure. Geisinger also offers a limited "warranty" to payers, insulating them from the cost of mistakes or other care defects.

In 2006, the PROMETHEUS Payment® model was launched to develop and implement an episode of care payment effort with the goal of replacing much of FFS payment. It developed and analyzed a new type of episode—an "Evidence-informed Case Rate®" (ECR)—that can be used for chronic conditions, procedures and acute events, in all provider delivery settings. In analyzing large national claims data, PROMETHEUS developers found that a significant percentage of the total costs of care spent today on six chronic diseases was attributable to Potentially Avoidable Complications (PACs). On average, 40 percent of total costs for these conditions are attributable to potentially avoidable complications, and 15 to 30 percent of total costs for acute events and procedures are also attributable to PACs. Extrapolating to the nation across all procedures, acute events and chronic conditions, over $500 billion of the $2.4 trillion spent on health care services in the U.S. are potentially avoidable costs, although the extent to which these costs can be reduced in the short- medium- and long-term is as yet undetermined. This finding does not mean that the PROMETHEUS Payment® design expects that all complications *will* be avoided, nor does it deny payment for necessary care where complications occur. Rather, the analysis offers very clear data regarding where providers can focus their attention in changing care delivery, with the expectation that those changes can prevent some of these defects and thereby save money while simultaneously improving quality.

These PAC findings confirm the effects of fragmentation, lack of care coordination, quality deficiencies and, to an extent, the demise of primary care. However, they also point to a potentially powerful mechanism to sustainably fund what has become known as the Patient-Centered Medical Homes model of care delivery: by harnessing the dollars spent on potentially avoidable complications as powerful incentives to manage patients more effectively. In essence, existing money can be distributed as new money to physicians without increasing the total dollars the system is spending. Consider a payment mechanism in which physicians, hospitals, home health care

agencies and other clinicians would keep a significant portion of that $500 billion, provided they reduced that amount over time.

For us, a Patient-Centered Medical Home is any practice in which the care of the patient is delivered well, in accordance with evidence and best practices, is coordinated with other clinicians and caregivers and fundamentally meets the needs of the patients. There is a fair amount of research that indicates that reengineered practices which incorporate the essential principles of the Medical Home—aggressive clinical coordination of care, intense communication with patients, concentrated adherence to evidence and attention to avoiding hospitalizations—do, in fact, deliver better quality at a lower overall cost than non-reengineered practices.[v] To promote desired reengineering like a Medical Home, though, requires a payment approach that establishes incentives that depend on and reward good results.

Unfortunately, none of the current payment methods alone, neither FFS nor capitation, will promote or sustain Medical Homes. We argue that simply developing a new, promising delivery system and hoping it eventually matches a payment method that will sustain it—is backward. Form should follow rather than lead the incentive structure.

We argue that simply developing a new, promising delivery system and hoping it eventually matches a payment method that will sustain it—is backward. Form should follow rather than lead the incentive structure.

In this report, we explore the financing model for these clinical practices, point out some important lessons learned from the past and illustrate in practical terms how to reform payments and return primary care to the solid place it deserves in a better American health care system. We show how a hybrid approach that includes some FFS, some thin capitation and a significant share of payment oriented around ECRs would promote and sustain the Medical Home structure, provided that the Medical Home can, in fact, improve care and reduce defects.

Section 1: Avoiding the Mistakes of the Past

One of the fundamental flaws in past and existing payment models within an insurance-based health care payment system has been the misallocation of risk between insurers, providers and consumers. With the advent of traditional managed care, theorists came to the correct conclusion that FFS leaves physicians in a riskless environment where they are shielded from the economic consequences of their decisions and indeed benefit from increasing costs to others. But the same theorists jumped to the wrong assumption for distributing the risk (discussed below). Because of that incorrect assumption, they formulated a concept of risk that alienated both consumers and physicians. Consumers were given limited choice in closed provider panels and through gatekeeping, while physicians found no clinical logic and the wrong risk in capitation. Given that lesson from managed care, when considering potential sustainable funding for Medical Homes, ideally one would find a reimbursement mechanism that delegates risk appropriately, while at the same time preserving patient choice.

Today, we find three major ways to pay for care. The table below lists them with their attendant incentives, organizational effects and effects on consumerism. They are:

1. Fee for Service

2. Capitation

3. Global Fees, Case Rates, for Episodes of Medical Care

Payment Mode	Core Incentive	Organizational Effect	Consumer Shopping Effect
Fee-for-Service	Increase volume	Favors fragmentation	Can only shop for individual services
Capitation	Decrease volume	Favors consolidation	Can only shop for "systems"
Episode	Decrease volume w/in episode, increase volume of episodes	Favors some consolidation… at the disease/ procedure level	Can shop for "care packages" – relevant price transparency

In exploring the specific effects of each payment method, it is important to understand that the nature and apportionment of risk in each is different. How different types of risk are distributed amongst the three main stakeholders—patients, providers, payers—has profound implications on their incentives and actions.[1] As the recent financial crisis has shown, misunderstanding risk and how to adequately price and manage it can wreak havoc. This insight about apportionment of risk should guide policymakers in their deliberations of payment reform and help mitigate the negative effects of any proposed incentive scheme.

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[1] For an in-depth discussion of risk, please see Appendix A – Discussion of Risk Bifurcation in Health Care, by Douglas Emery

Because many of the chronic conditions addressed in the ECRs are being addressed by others as well, finding measures to score physicians on those conditions was not so difficult.

The predictability of risk manifests itself through variation in the price of services and goods. The less predictable risk is, the greater the variation in prices, because those who have to bear that risk will demand adequate compensation. As study after study has shown, there is tremendous variation in the total price of care, not simply from region to region, but within regions throughout the country.[vi] However, that variation is neither one-dimensional nor homogenous.[viii]

Prior research reveals that it is possible to identify three types of risk that drive this underlying variation[viii]: the risk that any patient at any point in time will develop an illness, have an accident or generally require medical services; the risk that physicians, hospitals and other health care services providers will make the wrong decisions and follow the wrong treatment pathways in managing patients; and the risk that patients will make the wrong decisions in seeking care or deciding upon which treatment pathway to follow. While there are clearly some inter-dependencies between these three types of risks, we believe that the function of each stakeholder in the health care system suggests the following pattern for an appropriate distribution of risks:

Type of Risk	Payer	Patient	Provider
Risk that a medical event will occur	80%	10%	10%
Risk related to choices made by patients	10%	80%	10%
Risk related to choices made by providers	10%	10%	80%

While creating such an ideal balance is likely to take time and many experiments, it is important for payment reform proponents to understand how their models will impact the distribution of risks in the table above, and it is just as important to understand how current provider, payer and patients incentives impact the distribution.

The patient's portion of the risks will depend largely on their benefit design. For example, patients with high co-insurance will carry a significant portion of the risks that a medical event will occur, the risks related to the choices made by providers, and their own choices. Several experiments have shown that the choice of services is highly dependent on the price paid for the service—higher price leads to lower consumption.[ix] The risk created by patient choice is also manifest in what the Dartmouth University researchers have termed "preference-sensitive care."[x]

There are many provider actions that create variation in total cost of care and create incremental risk. We know from many studies that there are significant defects in the

production of care services.[xi] These defects range from the seemingly benign—the failure of providing a recommended preventive screening—to the headline-grabbing tragedy—the graft of an incompatible blood-typed organ in a transplant patient. Other research has shown that demand for a specific treatment can be induced by the physician's preference for a certain pathway, even when that pathway is not consistent with the patient's needs.[xii] A well-designed payment model should shift the majority of these risks to providers.

Finally, to a certain extent, the likelihood of a costly medical event can be influenced by the actions (or inactions) of payers and purchasers. For example, the lack of patient education and activation might lead to more plan members becoming ill or acquiring a chronic disease. Similarly, creating barriers to accessing preventive care services or medication for the management of a chronic illness can greatly increase the severity of an episode of medical care. Importantly, and more simply, the risk that a medical event will occur is a core function of insurance, and the reason why consumers are willing to pay premiums. As such, it is the core risk that should be borne by payers and should not be shifted to the delivery system. A well-designed payment model should shift this risk to payers.

There are many factors in today's health care marketplace that significantly increase these three risks, and therefore inflate the total price of care. One such example is in the incentives created by the benefit design of most health insurance programs (not least the Medicare program). For the most part, they continue to make the consumer almost completely insensitive to the actual price of care services, and distorts their choices.

Similarly, FFS places the cost of all health care utilization into the hands of the payer and distorts technical risk. And the combination of FFS and non-value-based benefit design is the reason why costs of care have continued to outpace inflation. Conversely, capitation places the cost of the variation caused by both probability and technical risks in the hands of providers. In addition, capitation creates an inherent conflict between providers and patients because traditional capitation requires providers to control for both probability and technical risk, while blocking the expression of choice by patients.[xiii]

No matter how well intended, the effort to capitate providers radically lowers the total choice sets for consumers. We argue that to the extent that Medical Home funding is based on capitation, simply relabeling those narrowed sets of consumer choice as Medical Homes won't help at all. Consumers will ultimately rebel. If past is prologue, attempts to channel patients towards optimal care pathways that do not permit their choice utilities to be taken into account will likely fail.

The patient has an important role in helping to hold the delivery system accountable for variation in costs. Unfortunately, the efforts to maximize the patient role will require more than simply using incentives to "steer" patients to reengineered Medical Homes.

Health care is the perfect example of what economists refer to as a co-produced good. Providers have only so much power to manage patients towards better care. If Medical Homes are to be sustainable, patient compliance must also be included in the incentive mix. This is especially true with regard to chronic conditions. Although we will not address benefits redesign in this paper, we do point out that understanding the reality of choice-utility risk is indispensable to making the system better.[xiv] At some point, Congress must come to grips with the reality that Medicare benefits must be redesigned to turn beneficiaries into active partners in their care, not simply demanders of any service at any price.

Section 2: Hybrid Payment and Reconstituting Primary Care

Economists have learned that, generally, organizations rapidly respond to fiscal stimuli and incentives. Organizations will often quickly form to deliver the goods and services that are valued by those who are willing to purchase them. The U.S. health care delivery system has acted in a similar fashion, consolidating when the primary incentive has been global capitation, and fragmenting when it has been FFS. If we want primary care to be patient-centered and focused on delivering high-value, effective and efficient care, then those paying for care must do so in ways that stimulate that value. And, as history has shown, the payment design will refashion the delivery system to maximize incentives within that payment method.

In the initial development of the PROMETHEUS Payment® model, our design team gathered input from large and small provider organizations on the critical elements necessary for a payment system that stimulates high-value care. Some of the themes that emerged are: encourage high-quality treatment of all patients irrespective of health status; avoid major, immediate economic disruption; and promote professionalism. These needs are also highly consistent with needs expressed by health plans and employers, although these stakeholders add two important needs: moderate the overall medical cost trend and minimize operational disruption. We believe that for a payment reform effort to succeed, it must find a way to meet the needs of both providers and payers, and it must also be respectful of the needs of consumers. Research on consumer attitudes towards health care has consistently shown that apart from wanting access to care at the lowest cost possible, the most important consumer need is the freedom to choose the physicians who they want to manage their care.[xv]

Our review of the literature[xvi], along with the input from expert provider, employer and plan representatives, leads us to hypothesize that a hybrid payment approach that includes some residual FFS payments as well as bundled, episode-based payments, and what we call "thin" capitation to support reengineering work, is probably necessary. This approach would have the highest likelihood of both successfully driving high-value, and

being implemented. Such a hybrid approach should create an environment in which (1) providers are shielded as much as possible from probability risk, but are held accountable for technical risk; (2) consumers are free to choose the physicians they need for their care; and (3) providers, payers and patients are sensitive to the overall cost of care.

Part One: Visit-Based FFS

Primary care physicians offer a variety of services focused on routine prevention, non-emergent and non-chronic sick care. We argue that these kinds of services can and should be paid for on an FFS basis. Maintaining individual charges for these services will continue to allow for price and delivery system competition, which should result in greater value for the consumer, and can also lead to differential co-pays at the point of care (which further sensitizes consumers to the actual cost of services). While some have argued that these services could be bundled in an actuarially based per member, per month fee, that form of capitation inherently forces a lock-in of patients to a practice (which is undesirable for consumers), and prevents unit price transparency and competition for the delivery of those services (which is inconsistent with value creation). The services that are best suited for FFS are either services with very low technical risk (e.g., treating the flu), or underused (e.g., immunizations), or used to treat conditions for which we can't avoid complications (e.g., Parkinson's disease). Noting that there continues to be a gap in the quantity of preventive services that should be delivered with what is currently delivered (despite the inducement for volume offered by FFS) a portion of these FFS payments should be tightly linked to quality scores. These scores should reflect not simply the adherence to recommended preventive care guidelines, but also ease of access to routine care services by patients – for example, the availability of after-hours care for a child's earache in order to avoid unnecessary visits to the emergency department.

Retaining this sort of FFS in primary care would also allow for a smoother glide path towards revitalizing it, and would assure physicians and their business managers that the motion towards a reengineered practice will not require overnight transformation. It would allow time for primary care practices to identify areas that require critical change, latitude for execution including the inevitable mistakes and some space for accommodating change. Furthermore, the FFS claims billing and payment systems can continue to be used to funnel information on the volume and type of services practices provide, both of which are essential to understand both technical risk and overall cost of care.

Part Two: PROMETHEUS Payment® ECR®s[2]

Beyond each of the services that are paid for discretely and separately, much of the care in ambulatory settings, and especially care that includes internal medicine, family and general practices, can be bundled into episodes. Well-designed episodes would include all the services informed by best practices, expert opinion and clinical guidelines to treat the patient optimally. In 2007 and 2008, PROMETHEUS Payment® Inc. developed

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[2] For a description of the methodology used to create an Evidence-informed Case Rate (ECR), see Appendix B – Chronic Care ECRs, by Dr. Amita Rastogi

a series of ECR®s for chronic conditions: (1) diabetes, (2) coronary artery disease, (3) hypertension, (4) asthma, (5) heart failure and (6) chronic obstructive pulmonary disease. In the PROMETHEUS Payment® model, the negative consequences of technical risk are defined as "potentially avoidable complications", or PACs. Examples of PACs in patients admitted to a hospital for an acute myocardial infarction might include medication error and phlebitis. For patients with chronic conditions, PACs include hospitalizations related to the condition. Typical care is care that is recommended by expert opinion or guidelines.

To create ECRs, PROMETHEUS Payment® Inc. assembled working groups to develop criteria for building ECRs in several clinical areas, including cancer care, chronic care, interventional cardiology and orthopedic care. The result of this effort was published in a report.[xvii] These groups modeled ECRs for episodes of care that include both inpatient and outpatient services.[xviii]

> **While some providers are concerned that PACs cannot be avoided, each provider—whether a single internist, a hospital or an integrated health system—is not expected to act alone.**

Here's how ECRs work.[xix] To care for a patient diagnosed with a specific condition, a risk-adjusted global budget is established. This budget covers all services recommended by well-accepted clinical guidelines or expert opinions.[xx] It includes all of the care required for treatment delivered by physicians, hospitals, laboratories, imaging centers, pharmacies, rehabilitation centers and other providers. For chronic conditions, the time window of the services is the same as the plan member's benefit year. As a result, this type of fully priced episode of care can give consumers a means for more effective comparative shopping.

We designed the ECRs to separate the quantity and types of services that are routine or typical and evidence-informed, from the quantity and type of services caused by PACs. The ECR includes an allowance for PACs, which is added in proportion to the severity-adjusted base price. For example, if the base ECR price for a congestive heart failure (CHF) ECR is $5,000, the PAC allowance might be $4,000. And if the base ECR price for a CHF ECR is $10,000, the PAC allowance might be $8,000. This creates a de facto warranty, because providers in the PROMETHEUS Payment® system essentially warrant that they will reduce the expected PAC costs. While some providers are concerned that PACs cannot be avoided, each provider—whether a single internist, a hospital or an integrated health system—is not expected to act alone. In fact, the model places a strong emphasis on care coordination, including clinical collaboration among providers. And it does so through financial incentives. 70 percent of any provider score turns on what he or it does, but 30 percent of the scores depend on what every other provider treating the patient for the same condition does.[xxi] Because the ECR always includes this PAC allowance, providers ultimately win or lose financially based on their actual performance in reducing the incidence of avoidable complications. Whether or not adding back half of the total PACs is reasonable or should be increased (e.g., adding back 75 percent) will be determined during the pilot implementations.

Importantly, the PROMETHEUS Payment® work shows that chronic care ECRs, while defined at the patient level (e.g., each ECR is adjusted for the patient for whom it has been triggered), can create the appearance of an overall global fee for a practice as illustrated in the table below:

	Total ECR	Typical Portion of the ECR	PAC Allowance
	A = B + C	B	C
COPD	$60,154	$39,701	$20,452
Diabetes	$387,637	$255,840	$131,797
CHF	$190,208	$125,537	$64,671
Asthma	$136,182	$89,880	$46,302
CAD	$271,298	$179,057	$92,241
HTN	$1,048,704	$838,963	$209,741
Overall	**$2,094,182**	**$1,528,979**	**$565,203**

In this example, the practice's overall chronic care patient budget is $2,094,182 including $565,203 as a combined allowance for PACs that could occur to any patient. The extent to which the practice can minimize technical risk will determine its profitability. However, the practice also has an opportunity to increase margins simply by more efficiently allocating internal resources—in other words, redesigning processes, redeploying personnel, using more effective communication with patients—so that the $1,528,979 allocated to typical and evidence-informed services yields the highest return. For example, if the practice were to use group visits, or focus the physician's attention on the patients at highest risk of hospitalizations, while having the other patients closely monitored by physician assistants and nurse practitioners, the actual cost for the practice of delivering optimal care to the patients might be significantly lower than the typical portion budgeted.

Paying primary care practices—Medical Homes—using ECRs is designed to achieve exactly this type of efficient resource allocation and accountability for technical risk.

Part Three: Per-member-per-month Fee—or an Advance Against the Future Reductions in PACs

Asking physicians in small practices to self-invest in care reengineering; based on faith that PAC rewards are coming, is a very difficult value proposition. There is a time-phased transformation gap that could leave them vulnerable to financial risk with no real assurance that payers will make good on realized PAC gains. Conversely, in a severe economic downturn, asking employers to fund capital investments in practices simply on the hope that savings will accrue is an equally difficult value proposition. Well-designed incentives should energize and catalyze provider motivation for change, while giving employers and plans the assurance that the investment will be tied to a measurable return.

Using some measures of per member per month (PMPM) payment as an allowance against the future reduction in PACs achieves the dual aim of defraying some of the practice's investment costs, while tying the fixed fee to quantifiable savings. Using the example above, a portion of the $565,203 in PAC allowance could be paid to the primary care practice as a fixed PMPM. And during the year-end reconciliation of all ECR payments, the fixed fee paid would be reduced from any net gain owed the practice. This schema would motivate payers and providers to work collaboratively to ensure that those gains are realized. Ultimately, as the transformation of the practice takes hold, the PMPM would disappear.

Ideally, the size of the PMPM fee should be based on an analysis of current practice cash flows, liabilities versus assets, fixed versus variable costs, amortized investments needed to realize the transformation, and workflow disruption and transformation costs.

Section 3: Analysis and Implications

While the medical literature has ample evidence of care defects, there is little information attaching a dollar value to those defects. And yet, it is the ability to quantify and monetize defects that will be critical if we are ever going to reduce them. There are two central questions to be answered in analyzing the potential effects of a new payment mix in Medical Homes: what are the levels at which the Medical Home might be financially *and* organizationally sustainable?

Some health care services researchers have argued that only large medical groups or integrated systems are organizationally adept enough to manage patients and become accountable for results.[xxii] Others have recently proposed that only organizations with a minimum number of Medicare beneficiaries (around 5,000) could be held accountable for the management of those patients.[xxiii] And yet economists have long argued that form is far less important than function in delivering value, and that incentives will shape organizations.

In our analyses of ECRs, we have focused on the functional approach, trying to understand how incentives can be created in a way that would encourage continuous reductions in care defects, and how those incentives could drive physicians to organize themselves to deliver better results in the management of patients. What we have found is that a practice with as few as 150 patients with chronic illnesses could, at the very least, break even if the practice was compensated for those patients according to the ECR formula.

To arrive at this conclusion, we ran the chronic care ECRs through several large claims databases. One database was national in scope and had over 4 million commercially insured plan members. Three others were from existing or nascent PROMETHEUS

Payment® pilot sites, and yet another was from a large employer. The results have been striking in their consistency. Despite the geographic diversity of the populations studied, the proportion of potentially avoidable complications as a percentage of total costs averages 40 percent for the six chronic care conditions studied.

There are, however, significant variations in that proportion from condition to condition, and there are also significant variations in the total average annual cost of care from condition to condition and between regions. However, the stability of the overall average proportion of PACs as a percentage of total costs provides us with the financial mechanism that we need to construct the right incentives for primary care practices. Indeed, the analysis suggests we have developed a sustainable way to encourage practices to become and stay Medical Homes.

The table below summarizes the findings from the national database. It shows the extent to which resources are consumed today in potentially avoidable costs, mostly coming from the lack of optimal management of patients. If anything, the table illustrates the critical importance of reforming the delivery of care and the significant potential that it has to control total costs of care. That is because the reduction in PACs both enhances patient outcomes and reduces costs.

Chronic Care ECR Summary Costs

	CHF	CAD	Diabetes	Hypertension	COPD	Asthma	Total
# Unique Patients	48,878	283,503	218,541	1,287,521	97,051	148,597	2,084,091
Total Costs	$1,332,774,251	$1,976,867,847	$1,327,961,414	$5,148,045,540	$323,850,300	$265,542,677	$10,375,042,030
Total Typical[a]	$409,503,974	$1,554,887,036	$515,155,654	$3,447,047,314	$205,372,583	$186,812,031	$6,318,778,592
Typical stays[c]		$121,387,679					$121,387,679
Typical Professional[d]	$199,648,710	$687,316,269	$107,958,209	$1,092,100,766	$82,441,046	$55,297,065	$2,224,762,066
Typical Pharmacy[e]	$209,855,264	$746,183,088	$407,197,445	$2,355,967,599	$122,931,536	$131,789,770	$3,973,924,702
Total PAC[b]	$923,270,277	$421,980,811	$812,805,760	$1,700,998,226	$105,450,034	$78,730,646	$4,043,235,754
PAC stays[c]	$810,313,802	$137,605,423	$333,447,513	$954,045,079	$65,919,822	$31,511,481	$2,332,843,120
PAC Professional[d]	$86,376,772	$252,800,887	$154,162,385	$624,850,878	$26,180,770	$34,521,219	$1,178,892,911
PAC Pharmacy[e]	$26,579,703	$31,574,501	$325,195,862	$122,102,269	$13,349,443	$12,697,946	$531,499,724
% Dollars in Typical[a]	30.73%	78.65%	38.79%	66.96%	63.42%	70.35%	60.90%
% Dollars in PAC[b]	69.27%	21.35%	61.21%	33.04%	32.56%	29.65%	38.97%

SOURCE: Authors' analysis of the ECR models from data published by PROMETHEUS Payment on www.PROMETHEUSpayment.org

[a]Typical services are services that are defined by PROMETHEUS Payment as being relevant and appropriate in the treatment of patients with the studied condition

[b]PAC services are services that are considered by PROMETHEUS Payment as related to a potentially avoidable complication

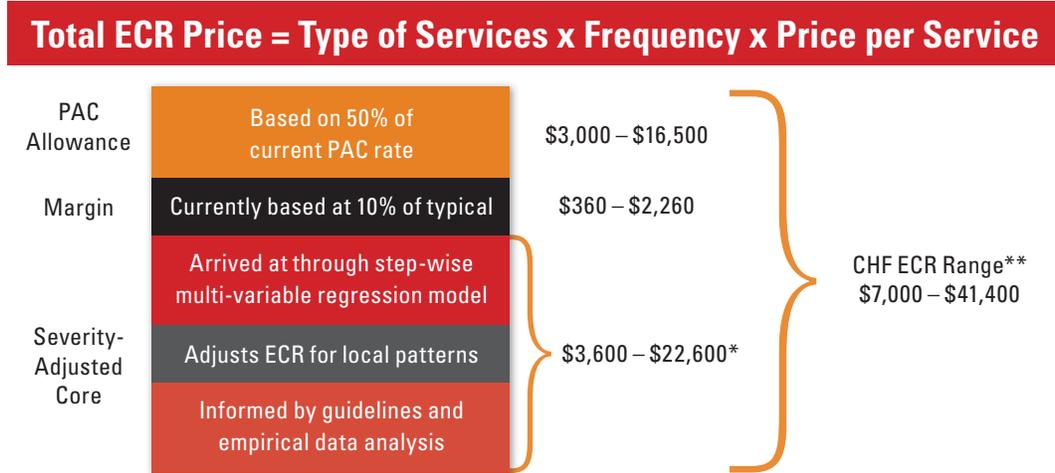[c]Stay costs only include the facility costs

[d]Professional services include services that are related to the stay as well as services not associated to a stay

[e]Pharmacy costs are all costs reported in the database and related to the purchase of prescription drugs through pharmacies

CHF is Congestive Heart Failure, CAD is Coronary Artery Disease, COPD is Chronic Obstructive Pulmonary Disease

The keys to the construction of ECRs are (1) right-sizing the core bundle of services that are needed to manage patients (as informed by expert opinion and guidelines); (2) severity-adjusting at the patient level so that patients with more comorbidities get a greater core bundle (e.g., more physician visits and lab tests); (3) adding a severity-adjusted allowance for PACs. The following illustration shows the range of ECR prices that can emerge from the analysis of CHF patients.

Total ECR Price = Type of Services x Frequency x Price per Service

PAC Allowance	Based on 50% of current PAC rate	$3,000 – $16,500
Margin	Currently based at 10% of typical	$360 – $2,260
Severity-Adjusted Core	Arrived at through step-wise multi-variable regression model	
	Adjusts ECR for local patterns	$3,600 – $22,600*
	Informed by guidelines and empirical data analysis	

CHF ECR Range**
$7,000 – $41,400

* $2,300 was added to the base set of claims-based/observed services to create a right-sized evidence-informed set of services.

** The upper range can be greater than the amount stated depending on the severity of the patient.

Importantly, the process of creating a core set of evidence-informed services in the ECR caused us to price a base set of services at $3,600. Our observations in the national database we initially used to create the ECRs indicated that the average core services paid for CHF averaged $1,300, or $2,300 in fewer services than what the evidence suggests should be delivered. This identified underuse, in and of itself, creates the opportunity for higher payments for physicians.

These numbers, however, mean little by themselves. In order for payment based on ECRs to be more favorable to a primary care practice than the current system, it should yield higher margins, not simply an appropriate allocation of services to care for the patient. These margins would compensate the practice for its investment in reengineering care processes, and create a far more attractive financial environment for physicians to practice general internal medicine and family practice.

In analyzing the national database, we estimated the average total typical cost for a year of CHF care at $4,100 per patient. The illustration of the CHF ECR above indicates that the base payment for a CHF patient would be $7,000. The average would, in fact, be about $12,000 (the actual amounts would depend on the actual severity of the CHF patients), or three times the current average.

There is, however, a catch. Included within the $12,000 is an allowance for potentially avoidable complications—the warranty we discussed previously. It is within this essential warranty that the potential reward—and the risk—of the PROMETHEUS Payment® model lies. If the practice can deliver good results, manage patients optimally and reduce avoidable complications, it can reap a sizable reward. If, on the other hand, it fails to improve its results, it can suffer a loss. So what is this risk of loss likely to be?

To answer that question, we constructed a series of simulations[3] that included building a risk profile of patients that mimicked the 4 million members in the national database and a randomization of those factors in a physician's patient panel; creating tables that contain the distributions of PACs by observed frequency and associated costs, and a randomization of those PACs by patients in a physician's panel. We also made certain assumptions relative to the ability of a physician to reduce PACs, and the investments—both fixed and variable—necessary to reengineer care. Finally, we modeled a distribution of patients within a practice that was consistent with the distribution of chronic conditions within the national database.

All these variables can be changed in the simulation model so that, ultimately, it can be used in any region and with any practice to more specifically analyze the impact of moving to an ECR payment mechanism. In the example below, we use a core patient panel of 1,500 patients, slightly over 50 percent of whom have chronic conditions:

	Patient Counts
COPD	40
Diabetes	80
CHF	16
Asthma	112
CAD	112
HTN	496
Overall	**856**

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[3] For a description of the simulation model, please see Appendix C – Chronic Care ECR Estimator, by Guy D'Andrea and colleagues at Discern Consulting.

Using the simulator, we then determined how much the practice would receive, both with ECRs and separately with FFS. The difference, labeled "bonus opportunity," includes both the allowance for right-sizing the core evidence-informed services for each ECR and the allowance for PACs. The table below summarizes the numbers:

	Average ECR Price	Average FFS Payments	Per Patient "Bonus" Opportunity	Total "Bonus" Opportunity	Total ECR Payments
COPD	$1,504	$550	$954	$38,143	$60,154
Diabetes	$4,845	$2,016	$2,829	$226,321	$387,637
CHF	$11,888	$5,117	$6,771	$108,340	$190,208
Asthma	$1,216	$817	$399	$22,364	$136,182
CAD	$2,422	$1,257	$1,166	$130,538	$271,298
HTN	$2,114	$1,462	$652	$323,604	$1,048,704
Overall	**$3,303**	**$1,606**		**$849,309**	**$2,094,182**

The next step in the simulation is to determine both a fixed (e.g., new staff) and variable investment (e.g., care coordination) the practice would have to make in the very first year of the implementation in order to improve care. While these assumptions can be changed at will, we used the best available information to estimate these costs.[xxiv] We also estimated the potential impact these investments would have on the practice's ability to reduce PACs. From those estimates, we created some fairly conservative projections of the practice's ability to reduce PACs in the short-term in the 16 - 17 percent range, although the existing literature does show that, on average, PACs for these chronic conditions can be reduced by about 36 percent. The table below summarizes the assumptions and their implications for the practice:

	Fixed Investment to Avoid PACs	Variable (per patient) Investment to Avoid PACs	Total Variable Investment to Avoid PACs	PAC Avoidance Effort	Predicted PAC Rate	PACs Incurred
COPD		$100	$4,000	19%	37%	$21,941
Diabetes		$200	$16,000	16%	53%	$176,837
CHF	$50,000	$1,000	$16,000	22%	51%	$97,389
Asthma		$50	$2,800	22%	26%	$4,619
CAD		$100	$11,200	18%	23%	$36,742
HTN		$50	$24,800	17%	27%	$71,094
Overall	**$50,000**		**$74,800**			**$408,621**

Bringing all these assumptions together completes the picture of the net benefit that could accrue to the practice and is summarized below:

	Total "Bonus" Opportunity	Fixed Investment to Avoid PACs	Variable Investment to Avoid PACs	PACs Incurred	Net (Compared to FFS)
	A	B	C	D	E = A - B - C - D
COPD	$38,143		$4,000	$21,941	$12,201
Diabetes	$226,321		$16,000	$176,837	$33,485
CHF	$108,340	$50,000	$16,000	$97,389	($5,049)
Asthma	$22,364		$2,800	$4,619	$14,944
CAD	$130,538		$11,200	$36,742	$82,596
HTN	$323,604		$24,800	$71,094	$227,710
Overall	**$849,309**	**$50,000**	**$74,800**	**$408,621**	**$315,888**

As such, even after an investment of close to $125,000, the practice still stands to achieve a significant net benefit from the more effective management of its patients—here a net benefit of $316,000 compared to FFS. And while this net benefit will increase or decrease based on the actual cost and frequency of PACs, it is clear that the benefits that accrue to the practice are closely—and mathematically—tied to the benefits that would also accrue to payers and to the patients. And while this might sound utopian, it can be a reality.

What is a minimum number of patients necessary to cover the fixed costs of practice transformation? That number appears to be around 150, significantly less than the 5,000 advanced by some health care services researchers[xxv], and a number that should be within reach of most primary care practices across the country.

Another concern about this approach would be that severity-adjustment cannot be done adequately when you only have two patients with CHF. That concern is valid if the severity adjustments were formulated on the basis of those patients, but they're not. The severity adjustments are performed on large cohorts of patients of a plan within a certain region and representative of the severity of that patient population. Then the actual ECR price for patients managed by any given physician is based on the profile of those patients.

If one combines normal FFS payments for all the services not covered by ECRs and ECR-based compensation for the six chronic conditions, most practices should be able to finance the development of their Medical Home. Given the enactment of the HITECH portion of

the American Recovery and Reinvestment Act, most primary care physicians should qualify for close to $50,000 in incentives from Medicare to purchase an EMR. However, many small practices might lack the human resources needed to improve care for patients and, importantly in a PROMETHEUS® model, start reducing PACs. It is to that end that we are also proposing a PMPM that would be based on an anticipated reduction of PACs. This monthly allowance would be negotiated between the payer and the practice and understood to be an advance payment of the net benefit calculated above. So in the example above, the payer could create a $10 PMPM—which comes out to $60,000 a year—which would come in reduction of the net benefit that accrues to the practice at the end of the y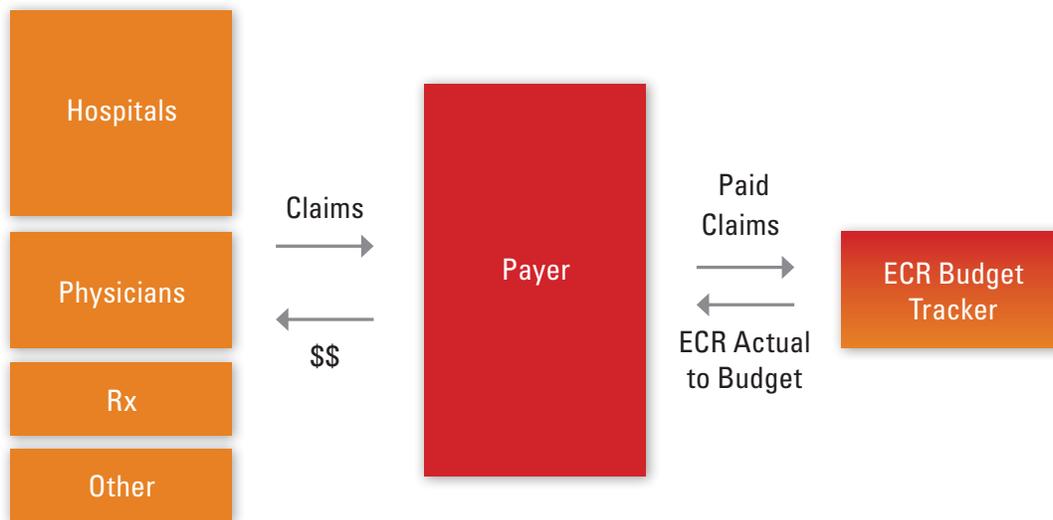ear. The payer would be taking a risk that the practice is unable to even minimally reduce PACs, but that payer could also mitigate that risk by actively collaborating with the practice to (a) accelerate the transformation, and (b) help improve care. In fact, in this hybrid model, payers and providers share a common interest in reducing PACs and improving the quality of care delivered to patients.

This model shows that probability and technical risk can be separated and "packaged" in a rational way that is manageable by the parties holding that risk. Payers manage probability risk by pricing premiums, and, ultimately, providers manage technical risk by pricing ECRs. However, between the FFS world we live in today and a future state in which physicians and hospitals can price their own ECRs and offer them to payers and patients, we need to find an operational mechanism that maintains the incentives while still being simple to manage. It is that mechanism we discuss in the next section.

Section 4: Operationalizing the Model

Simplicity and effectiveness in launching a new payment model is critical. First, health plans will not wholesale change their claims, contracting and benefit systems without the solid proof that the benefit of doing so will exceed its likely cost. Second, physicians and hospitals are as wedded to the current FFS claims systems as plans. All existing billing systems in physician offices are based on standard claims codes, and changing those processes will not only be disruptive, but could also lead to many unintended consequences. Further, as discussed in the first section, it is important in this evolution of a new payment model to maintain the flow of data that can help account for where and on what claims dollars are spent.

So how can we maintain the desired effect of an ECR-based compensation while continuing payment on FFS schedules? We have found we can do this by prospectively budgeting the ECRs, paying all claims FFS, and then doing a retrospective reconciliation. The illustration below shows how the claims and dollars would flow in a simplified process:

Picking up the example and tables in the prior section, the $2 million total across the 850 ECRs for the practice is prospectively budgeted based on data from the payer for the prior year. Then, during the course of the year, as claims are routinely filed by providers and paid by plans, they are then funneled to the ECR Budget Tracker. The Tracker then accumulates all the claims relevant to any patient-specific ECR. Any claim hitting an ECR would either fall into the Typical bucket or the PAC bucket, depending on the ECR algorithms. At the end of the year, all the dollars in each bucket, in each ECR and across ECRs are summed up and reconciled.

Let's assume that for the ECRs listed in the prior section, the actual dollars spent on typical care are as expected, but PACs are slightly higher than expected. Overall, there is still a net benefit as shown in the following table:

	Total ECR	Typical Claims Incurred	PACs Incurred	Net Benefit
	A	B	C	D = A - B - C
COPD	$60,154	$35,731	$21,941	$2,481
Diabetes	$387,637	$255,840	$176,837	($45,040)
CHF	$190,208	$125,537	$97,389	($32,718)
Asthma	$136,182	$89,880	$4,619	$41,682
CAD	$271,298	$179,057	$36,742	$55,500
HTN	$1,048,704	$838,963	$71,094	$138,647
Overall	**$2,094,182**	**$1,525,008**	**$408,621**	**$160,552**

So now comes the question that seems to baffle academics and practitioners alike: How do you divvy up the spoils if there isn't an integrated system or a formal group? What happens when the delivery system is fragmented, and patients are seen by different independent physicians? How can this possibly work if the patients aren't force-attributed to a specific practice or some sort of accountable entity?

The answer is simple—it works like it works today. In the FFS world, patients are not forced into an attribution, there are no gatekeepers and no complex financial arrangements among physicians practicing independently. The practical reality is that in an environment in which ECRs are *budgeted* prospectively (not paid prospectively) and reconciled retrospectively, the main issue is how to divvy up the net benefit to the extent there is one. We see two reasonable answers:

a. The physicians who commonly manage the patients together agree on a formula to split the upside, to the extent there is one. This is another potential aspect of collaboration. From the prior year's claims data, we have an understanding of which physicians cared for each patient, and can thus create a "one to many" attribution—essentially all the physicians touching the patient are jointly responsible for the outcome. The question of who "manages" the patient is moot and should not matter that much. After all, during the course of the year, a patient might need to be managed variously by, for example, the internist and the cardiologist. The incentives should not, in any way, create a conflict in providers deciding what is best for the patient. When compensation is ECR-based, physicians will always do better when they collaborate—integrating their clinical management of shared patients—which is not synonymous with formally integrating their actual practices. The formula that they agree on can be simply communicated to the plan.

b. The physicians who commonly manage the patients do not formally agree on a method to split the net benefit. In that instance, we recommend that the split be done as a function of the proportion of encounters observed in the typical portion of the dollars spent. The table below illustrates how that calculation would be done for the patients in our example:

	% of Total E&M claims	Share of Bonus
Dr. Machado – Internist	40%	$64,221
Dr. Rastogi – Cardiologist	30%	$48,166
Dr. Emery – Pulmonologist	15%	$24,083
Dr. Brown – Nephrologist	15%	$24,083

Whether option (a) or option (b) is in place—and physicians should choose their approach—the actual disbursement of funds would be similar to the table above. For any particular cohort of patients, the distribution of these dollars can change. And for any of the physicians listed above, their net benefit across all the ECRs they are co-managing would have a very different view. For example, in addition to the $64,221 listed above, the internist might get some additional net benefit from a cohort of patients for which he is mainly a consultant and not the principal physician (as could be the case for the patients in our current example). Similarly, the pulmonologist is likely to be the principal clinician for some COPD patients and would therefore receive the majority of the net benefit for those patients.

Ultimately, this approach will reward the physicians who collaborate with each other to actively reduce PACs for any patients they manage. If they don't explicitly collaborate, then the likelihood of reducing PACs will be much smaller, and they will not opti-mize either their own self-interest or the interests of the payers and the patients—all of which are aligned here. Furthermore, using the names in our prior example, if Dr. Rastogi systematically fails to communicate with Dr. Machado and, as a consequence, Dr. Machado's CAD and CHF patients are incurring PACs at a high rate, then Dr. Machado has strong incentives to start referring his patients to a cardiologist who will want to actively co-manage patients.

In that light, there is no clear incremental benefit to be gained by prematurely forcing or even, necessarily, either (1) promoting some sort of defined organizational or financial integration, or in (2) limiting participation in the payment model to integrated medical systems. As we've shown, here, forcing the shape of the delivery system ahead of the development of an incentive structure that rewards care coordination and high value is not necessary. In fact it could even have unintended, unfortunate side effects. For instance, if we force integration, physicians might waste valuable time attempting to organize into complicated entities instead of focusing on rapidly improving care for patients. As we've advocated elsewhere in this document, we should not let the shape of the delivery system dictate the terms of a payment model, but rather let the payment model shape the delivery system.

> ...We should not let the shape of the delivery system dictate the terms of a payment model, but rather let the payment model shape the delivery system.

Section 5: Disclaimers

This is not meant to be a position or white paper, but a potential guide for payers and providers to use for both payment and clinical practice transformation through the use of ECRs. However, this guide is about potential and therefore is untested, so it comes with some disclaimers.

First and foremost, we don't know if this hybrid payment approach will promote and sustain reengineered primary care. Designing new payment models in a highly complex system like health care is daunting at best, and no one can seriously pretend that a proposed formula is "The Formula."

Second, as in all new product or service designs, the most important part of the process is to minimize the potential failures and process breakdowns. We believe we have paid close attention to where this model will perform well. For example, we believe that continuing to leverage the current FFS system will avoid piling significant operational risks on payers and providers alike, and will provide us all with the time to closely analyze the impact of the new incentives. However, we might find that the behavior change might not be as profound as it would be if the financial risk were significantly higher—which it would be if we moved right away to prepaid episodes.

Third, our work suggests that some primary care practices might find it easier to improve care for patients with some of the six chronic conditions we've studied than for patients with others. For example, practices might find it much easier to improve hypertension care than diabetes care. Practices might, then, have an incentive to participate in some ECRs rather than others. To that end, we have recommended that practices not be allowed to select ECRs, rather, they must accept any ECR that applies to their patients.

Fourth, we are making a broad assumption that small practices will find the technical resources to help them reengineer. We believe that those resources are important. We also recognize that the development of those improvement resources is a significant challenge and not currently widely available. We do believe that payment models like PROMETHEUS Payment® ECRs highlight and intensify the urgent need for those kinds of improvement resources.

Designing new payment models in a highly complex system like health care is daunting at best, and no one can seriously pretend that a proposed formula is "The Formula."

Beyond these limitations, it is important to note that we have not addressed here how quality is measured in this payment model. There is, however, a companion report published by PROMETHEUS Payment®, Inc. (*"What's the Score?"*[xxvi]) that explains how the comprehensive scorecard based on the practice's medical record data will be constructed and used to manage the net benefit distributed to the practice. Ultimately, data from medical records should be used not simply for constructing the quality scorecard, but also to help better inform the severity adjustments of any ECR.

It is also important to note again that payers need to address plan member benefit design as a core complement to a payment model that includes ECRs. Benefit packages that complement value-based payment models will help mitigate the negative effects of choice-utility in the current benefit design environment. Patient compliance is critical in any payment environment where providers assume technical risk. Policy-makers need to understand that failure to address this patient role will lead to continued conflicts between payers and providers relative to which portions of PACs can be reasonably reduced without full patient engagement.

Section 6: Conclusion

We have a unique opportunity in the current national health reform discussion—along with the emerging consensus that any successful reform must correct the health care value equation. Further, many also understand that to correct the current value dysfunction, it will be necessary to launch meaningful changes in the way we pay for care.

For primary care, this is an emergency. The clinical promise of the Medical Home will be unachievable if the financial model supporting it does not drive toward both improved results for patients and dollars saved in the overall system. We believe the use of ECRs and PACs in the hybrid payment model we have described is uniquely positioned to sustain the Medical Home, revitalize primary care, create a business case for it and save money as well.

The PROMETHEUS Payment® pilot work supported by the Robert Wood Johnson Foundation is yielding evidence that may help payers learn how to package risk and create payment incentives that, in turn, could yield positive results for all stakeholders. Perhaps by using some of the basic payment principles outlined here, health care can indeed function like other industries where proper incentives, resources and information, promote rigorous and ongoing reduction in defects that actually does increase the value for all. For primary care, we think this is imperative.

[i] See The Future Of Family Medicine, at http://www.aafp.org/online/en/home/membership/initiatives/futurefamilymed.html

[ii] How Is a Shortage of Primary Care Physicians Affecting the Quality and Cost of Medical Care? Philadelphia: American College of Physicians; 2008: White Paper. http://www.acponline.org/advocacy/where_we_stand/policy/primary_shortage.pdf, accessed February 9 2009

[iii] Solon, JA, et al., Delineating Episodes of Medical Care, American Journal of Public Health 57(3) 1967:401-408

[iv] See http://www.qualityforum.org/projects/ongoing/episodes/index.asp

[v] Rosenthal, MB, de Brantes, F, AJMC 10/2008

[vi] ES Fisher, DE Wennberg, et al, "The implications of regional variations in Medicare spending" Annals of Internal Medicine, 2003

[vii] Emery, DW, Forging a New Paradigm, *Managed Healthcare*, November, 1999:20-26.

[viii] Emery DW, et al, The Political Economy of Capitated Managed Care, *American Journal of Managed Care* 1997; 3:397-416.

[ix] The RAND Health Insurance Experiment. See http://www.rand.org/pubs/research_briefs/RB9174/index1.html

[x] The Dartmouth Atlas of Health Care, Preference-sensitive Care. See http://www.dartmouthatlas.org/topics/preference_sensitive.pdf

[xi] Institute of Medicine Series on The Quality of Health Care in America: To Err is Human and Crossing the Quality Chasm

[xii] ES Fisher, JE Wennberg, "Health care quality, geographic variations, and the challenge of supply-sensitive care" Perspectives in biology and medicine, 2003

[xiii] Emery, DW, The Coming Transformation of Managed Care, *Managed Healthcare*, October 1999

[xiv] Global Fees for Episodes of Care: New Approaches to Healthcare Financing, Emery DW editor, McGraw Hill:1999.

[xv] JH Hibbard, "Engaging health care consumers to improve the quality of care" – *Medical Care*, 2003

[xvi] Allan H. Goroll, M.D., Robert A. Berenson, M.D, Stephen C. Schoenbaum, M.D., M.P.H. et al. "Fundamental Reform of Payment for Adult Primary Care: Comprehensive Payment for Comprehensive Care" The Commonwealth Fund, 2007. See http://www.commonwealthfund.org/Content/Publications/In-the-Literature/2007/Mar/Fundamental-Reform-of-Payment-for-Adult-Primary-Care-Comprehensive-Payment-for-Comprehensive-Care.aspx

[xvii] de Brantes, Camillus J, "Evidence-Informed Case Rates: A New Health Care Payment Model".

[xviii] Rastogi A, Jordan H, et al, "ECRs: Modeling inpatient and outpatient Evidence-informed Case Rates", in review.

[xix] For a full description of how ECRs are constructed, see Gosfield, "Making PROMETHEUS Payment® Rates Real: Ya' Gotta' Start Somewhere" *(June 2008) http://prometheuspayment.org/publications/pdf/MakingItReal-Final.pdf

[xx] Ibid.

[xxi] For a full description of the way scores affect payment, see Gosfield and de Brantes, "PROMETHEUS Payment®: What's the Score?"

[xxii] ES Fisher, et al. "Creating Accountable Care Organizations: The Extended Hospital Medical Staff", *Health Affairs* 2007, See http://content.healthaffairs.org/cgi/content/abstract/26/1/w44

[xxiii] ES Fisher, M McClellan, et al. "Fostering Accountable Health Care: Moving Forward In Medicare", *Health Affairs* 2009, See http://content.healthaffairs.org/cgi/content/full/28/2/w219

[xxiv] See Reports and Evaluation of the AAFP National Demonstration Project at http://www.transformed.com/index.cfm

[xxv] ibid

[xxvi] ibid

Discussion of Risk Bifurcation in Health Care

Doug Emery, M.S.

Probability risk is fundamentally different from technical risk. There are five reasons for this, which the bulk of this section will explain. First, it's priced in a radically different way. Since probability risk is about pricing uncertain future events, it's primarily a gross aggregated statistical artifact—what happens with large populations in the past is the best likely predictor of what will happen to the same populations in the future. This makes pricing probability risk the mathematical domain of actuaries. Technical risk, on the other hand, is about pricing clinically integrated episodes of care, which makes it the productive domain of physicians and other allied health care providers. The techniques necessary to pricing these two types of risk are radically different (as Section 2 explained). The problem with both FFS and capitation is that in addition to distorting risk, neither has anything to do with clinical reality. That being the case, any effort to harness FFS or capitation to quality outcomes analysis is like trying to square the circle; it is a forced fit requiring ambiguous proxies that disassociate actual patient experience from the natural flow of care.

Second, it's impossible to price technical risk through a probability mechanism like insurance. There are no modern instances of discrete goods and service being sold in other markets through insurance products. The attempt to integrate probability risk with technical risk sets up an unsolvable transfer pricing problem that shows capitation to be an inherently inefficient solution.[xxvi] As Jerry Solon, the inventor of the episode of care concept wrote in 1967:

> The summary statistical data used to describe the medical care received by a population usually take the form of (1) stating how many in the population have obtained medical services in a given period of time (the volume of users), and/or (2) expressing the volume of services in terms of the number of physician visits made, the days of inpatient care provided, the number of x-rays, lab tests, medications, physical therapy treatments, and so on. These culminations are valuable in so far as they represent, in an overall way, the sheer volume of service. But their very simplicity, their objectivity, and apparent precision are deceptively reassuring. *They create the illusion that that the essential facts of utilization are thus expressed.* There is much more to tell of medical care that these superficial counts reveal. [Emphasis added][xxvii]

Hopefully, most readers will recognize that the coarse statistical indices Solon criticized are precisely the indices upon which capitation rates are calculated. And just as these crude roll-ups give the illusion of understanding care utilization, basing payment on them gives the illusion that care is being managed. Rather than shedding light on care management, capitation only made the delivery system more opaque. And this was true from both sides of the aisle. Health plans could not see through the capitated entity, and providers could not accurately adjust utilization patterns to fit the cap rate.

Third, the business logic of health insurance is categorically different from the business logic of health care. The conflicting incentives mean that one must eventually predominate over the other. As the experiences of Humana, FHP, Sutter Health Systems, and Harvard Pilgrim Health Care in the 1990's demonstrated, a capitated house is a house divided.

As for primary care specifically, verification of this problem came to light during the summer of 1997 when Alta Bates Medical Group, in Emeryville, Calif., announced it would replace capitation with discounted FFS for its primary care providers.[xxviii] Alta Bates made the move because the proportional payments made to its PCPs under capitation did not accurately equate with the actual workload of productive individuals, and without differential rewards, it was extremely difficult to motivate productive activity toward certain quality benchmarks.[xxix] Moreover, the motivation to excel and innovate tends to get lost under such an arrangement. Because capitation is such an extraordinarily crude payment mechanism—determined not as a function of productive activities but as an actuarial artifact—revenue cannot be synergistically linked to processes of care. This is especially noteworthy because Alta Bates constructed itself in the early 1990's to thrive under what was then considered to be the inevitability of capitation and was absolutely couched in the arguments similar to the ones we hear today advocating Medical Homes; namely, that by capitalizing the payment of primary care through capitation to induce proactive care management, patients would be prevented from going better to worse, and kept away from expensive specialists and even more expensive hospital care. But it blew up before any gains could be shown, and this experience was repeated around the nation. By 2001, articles were announcing the end of capitated managed care and the return to FSS.[xxx] Why did this happen?

It is the severance of the production function of care, best described by episodes, and the derivation of capitation from probability functions that makes it nearly impossible to tell from the point of view of the bottom line whether a loss is due to an unanticipated actuarial blip or poor care productivity. Here is an example from a then popular trade journal specializing in capitation issues and dedicated to its success, *Capitation Management Report,* in an article titled, *"Fine Tune Your Strategies to Beat the Capitation Blues"* in 1997:

> So how does an organization stay the course when it's having trouble staying afloat under capitation? Organizations first need to determine if their costs are truly out of line and whether the short-fall is temporary—*due to seasonality or unpredicted actuarial (i.e., probability) risk*—or a more pervasive problem related to excessive administration or medical costs… Sometimes, the problem isn't cost… The provider may have accepted a rate that was too low or encountered poor risk selection. That's not something you can manage your way out of. [Emphasis added][xxxi]

Certainly not. But instead of recognizing the economic contradictions of capitation, the article offered an utterly dumbfounding solution, so common to the times: "If the problem is adverse selection, the provider should monitor the experience of the population and contrast the cost of care with age- and sex-adjusted normative data. Armed with these comparisons, the provider should meet with the health plan, acknowledge
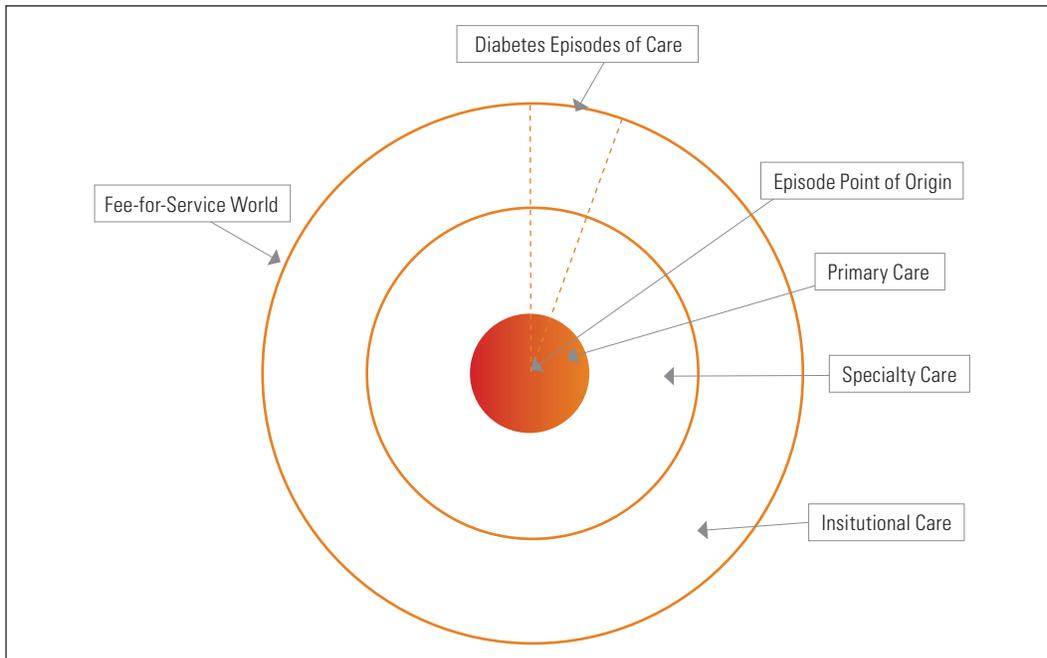
it underestimated risk and cite the need to prevent turnover and maintain patient satisfaction as grounds to increase the cap."

Passing strange! After confirming our hypothesis that capitation occludes tangible general ledger information for the primary care firm, we are asked to believe that physicians can capably do what even the best social scientists would probably shun; that is, "monitor the population," and then, using age-sex adjusters the best statisticians in the health services research business have concluded are practically useless[xxxii], perform an effective general ledger analysis. "Armed with these comparisons," the poor doctor is supposed to convince health plan executives to raise the capitation rate, not using the analysis *per se,* but by arguing that patient satisfaction and turnover may go south. Such non-sequiturs were the norm for the day.

In addition to the dark matter of trying to cull accurate cost and productivity data through the viscous medium of probability space, capitation tends to fragment intensive episodes of care requiring multiple providers, which brings us to our fourth reason why pricing probability risk is so different from pricing technical risk. Except in the case of global capitation for Integrated Delivery Systems (which, even in the heyday of capitation, was very rare, never rising above 6 percent of all IDS revenue)[xxxiii], capitating provider components separately such as PCPs, specialists, and hospitals was extremely difficult, and left the coordination of unintegrated episodes up in the air. Shared risk pools were often argued as the means for pulling coordination together and unifying interests, but it never worked out, and shared risk pools were dropped almost as quickly as they appeared. Without the agency of one managerial entity at technical risk for efficiently integrating the entire production function of an episode of care, the unified administrative machinery necessary to tightly align clinically homogenous care processes did not exist—by and large, they still do not. If we resurrect capitation for Medical Homes, lack of financial coordination across clinically homogenous care continua will abide. The following explains why this is so.

Imagine all of health care being divided into three concentric circles. The first is primary care, from which, most other care activities radiate. The second is specialist/tertiary care, and the third is facility/hospital and quaternary care. The totality of the circles is comprised of the total U.S. health care spend, which surpassed $2 trillion in 2006[xxxiv], and is dominated by FFS payment. This FFS world can be bisected by slices of care, proportional to the overall spend, which are comprised of all various disease states and injuries. Each of these slices is the full longitudinal pathway any given episode of care can take. In this case, we'll consider Diabetes Mellitus, an expensive disease and its possible comorbid conditions that gobbles up about 10 percent of the total medical spend (estimated at $174 billion in 2007 by the American Diabetes Association).[xxxv] As a proportional slice of the overall spend, its area is much larger than, say, Cystic Fibrosis or Tay-Sachs, but not much more than Congestive Heart Failure.
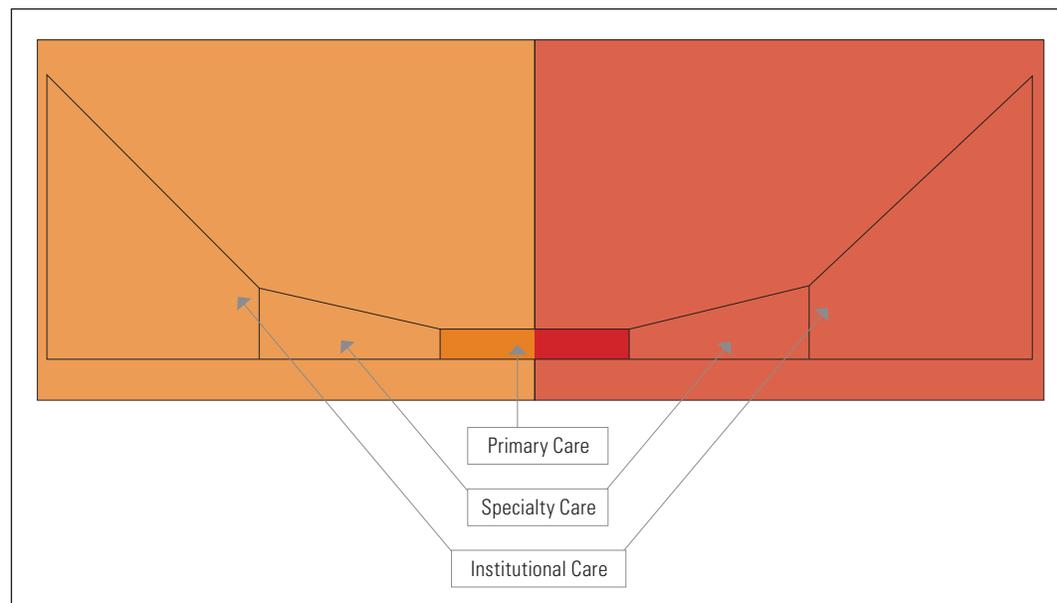
Total Dollar Continuity Over the Longitudinal Path of Care

The figure above gives us a bird's-eye view of episodes of care relative to one another in terms of the absolute medical spend. But if we flip the chart on its side, we can examine the distribution of dollars within any given episode and their relative rates of expenditure as determined by primary care, specialty care and institutional care boundaries. Now, it should be intuitively obvious that not all diabetics are contained within the boundary of primary care; in fact, as the PROMTHEUS ECR data analysis in Section 2 reveals, a great many patients are radiating out of primary care and into the far more expensive domains of specialty and facility care. This is exemplified by the relative altitudes of the three segments where, for instance, the costs associated with institutional care for diabetics far exceed the costs of primary care. As a result of RBRVS distortions, dollars have been pulled away from primary care into the more care-intensive domains, but exacerbating the problem even more is the fact that only 54.9 percent of patients receive recommended care[xxxvi], and care coordination between all domains is so poor.[xxxvii] Thus, the dollar altitudes of specialty care and facility care are much higher than primary care.

The guiding assumption informing the move to create Medical Homes—one which we accept—is that by reconstituting primary care through payment reform, primary care providers can invest in Electronic Health Records, care practice reengineering, and more effective care coordination with allied providers. By raising the dollar altitude of primary care, it is hoped that we can lower the altitudes of specialty and facility care, and not just because it's "cheaper" care, but because it represents patient populations who are healthier because their care is being better managed. We enlarge this argument

by stating that merely ramping up primary care dollars to achieve this will never be accepted by plans and payers; additional dollars will only be released when tied to proven care improvement, and that resurrecting capitation is not the optimal means for do so. Again, this requires further elaboration.

Primary Care

Specialty Care

Institutional Care

Along with the other arguments we have marshaled, primary care capitation leaves the full episode of care financially fragmented. Observe the bird's-eye figure once again. If a Medical Home is fully capitated, the financial incentive boundary ends at primary care, yet a good deal of the diabetic patients are still flowing into the other domains. Even if primary care for diabetics is greatly improved, there will still be many instances of patients requiring some form of specialty or facility care. By capitating the Medical Home, an artificial financial boundary—determined not by episode of care, but by coarse statistical abstracts drawn over the entire panel of patients—terminates the full pathway of clinically homogenous care at the primary care giver's doorway. The only way to tie financial incentives to the other care domains is to resurrect the risk pool proxies we observed in the 1990's or to tie bonuses to PCPs through reduced overall rates of inpatient admissions. But these are exactly the kind of crude indices that Jerry Solon and other health services researchers criticized so long ago, and proved unworkable in the 1990's. It makes little sense, therefore, to advance progress towards Medical Homes through retrogressive ideas.

By far, it is better to model the reimbursement dollars around the patient and his or her potential care pathway, than to force fit dollars around predetermined structural solutions and crude heterogeneous populations.[xxxviii] No matter how much "risk-adjustment" is fixed to population-based payments, it's still governed by probability risk, and places

physicians in the business of insurance, a business they are poorly suited to manage and to which their normative fiduciary roles come into profound conflict. As Krane and Emery have written on this subject:

> Probability risk is the risk assumed by one entity (the insurer) when it agrees, in exchange for payment (premium), to do something of value for another (the insured) upon the happening of a contingent, future event. Premiums for similar risks are pooled, and the premium charged is calculated to be sufficient to fund the performance obligation from the pooled premium. Therefore, probability risk is the risk that total premiums collected will be adequate to fund the total performance obligation due upon the occurrence of contingent, future events. Capitation is an example of probability or insurance risk because a healthcare provider (insurer) agrees, in exchange for a fixed, per member per month payment (premium), to assume the risk of providing potentially unlimited amounts of defined health benefits (something of value) to the HMO (insured) upon the happening of sickness or injury (a contingent, future event).[xxxix]

By this we observe that capitation is really a fee-for-indemnity concept that, ironically, puts providers in the very business the health plan is ostensibly in business for.[xl] Not only does it bring fiduciary roles into conflict, but it also makes patients—not medical services—the tradable commodity.[xli] In exchange for a certain amount of patients for a fixed price, providers agree to indemnify the plan's assets (e.g., premium reserves) from actuarial payout volatility. But the greatest conflict is yet to come.

The fifth reason that designing provider reimbursement around probability risk is so different from designing reimbursement around technical risk is that delegating risk through episodes of care preserves patient choice (more on this later). There is simply no way to capitate an open panel or a broad network of health care providers. The *sine quo non* of capitation is provider exclusivity. Of all the problems capitated managed care encountered, none even remotely exceeded the frenzy of consumer backlash that arose from restricting patient choice at the point of service. As Richard Wessland, Managing Director of BCD Advisors, noted in an interview in July, 1997: "We have a consumer and purchaser backlash regarding accountability, value, access to care, freedom of choice, and other elements," all of which he attributed to capitated systems.[xlii] In the same interview, Wessland correctly predicted that pay-for-performance programs would displace capitation. By 1997, the writing was on the wall, as J. Daniel Beckham explained the problem in the *Healthcare Forum Journal*:

> [H]undreds of healthcare organizations and thousands of physicians invested heavily, intellectually and financially, in the capitation/channeling presumption only to feel the earth shift under their feet as choice made its power felt. Too invested now to undertake the costs of switching to a new model, they are poised to have their ships wrecked on the rocks of market reality.[xliii]

Beckham turned out to be right. The market reality of consumers demanding choice at the point of service proved too powerful for capitated systems. Ultimately, it was the market violence of consumer choice that blew capitated managed care to pieces. As some of us predicted well before this all became glaringly apparent, Americans will not tolerate paternalistic health plans and systems telling them where to go for care and what to do with their physicians. Period. The will for choice produced what Jeff Goldsmith once called "selective disintegration" at a time when managed care theory predicted the triumph of large integrated systems operating under capitation.[xliv] They literally began to fall apart. In the dreary year of 1997 for capitated managed care, Goldsmith observed:

> Many nationally prominent integrated systems are performing terribly along every dimension of performance that you can think of—earnings, customer satisfaction, productivity, morale… Their theories about what would happen once they reached a certain mass or scale are not proving valid.[xlv]

Despite the fact that PPOs were once believed to be merely transitional products ferrying consumers from traditional indemnity plans to HMO nirvana, by the end of the 1990's, PPO growth had far outstripped HMO growth, by a factor of about 2 to 1. The reason is simple. For all the toxicities that FFS introduces into the health care delivery system, it has one strength that gives it a triumphant market advantage over capitation: it accommodates patient choice at the point of service. For this reason, discounted FFS dominates provider reimbursement to this day, accounting for well over 90 percent of all health care receipts. Even at the zenith of capitation's popularity in the 1990's, an AMA commissioned study showed that only 23 percent of physicians with HMO contracts reported having at least one capitated contract (5 percent for physicians contracting with preferred provider organizations);[xlvi] overall, capitation never exceeded 9 percent of physician reimbursement and 10 percent of hospital reimbursement.[xlvii] Given this truth, it is difficult to fathom why anyone would advocate a payment mechanism as inherently limited in its ability to capture marketshare as capitation—especially if it is to power up Medical Homes across the nation. We have every reason to believe patients, plans and providers will reject this arrangement.

xxvi Emery DW, et al, Global Theory and the Nature of Risk, in *Global Fees for Episodes of Care: New Approaches to Healthcare Financing*, Emery DW editor, McGraw Hill:1999.

xxvii Solon, JA, et al., Delineating Episodes of Medical Care, *American Journal of Public Health* 57(3) 1967:401-408.

xxviii Emery DW, et al, Global Theory and the Nature of Risk, in *Global Fees for Episodes of Care: New Approaches to Healthcare Financing*, Emery DW editor, McGraw Hill:1999.

xxix Emery, DW, The Coming Transformation of Managed Care, *Managed Healthcare*, October, 1999:18-29.

xxx Robinson JC, The End of Managed Care, *Journal of the American Medical Association*, 2001; 285:2622-2628.

xxxi Fine-Tune Your Strategies to Beat the Capitation Blues, *Capitation Management Report*, 5(2) 1998:17-21.

xxxii "Although it seems clear that adjusters [like age and sex] that can explain only 0.6% of the variance are scarcely better than no adjusters at all, it is less clear what percentage of variance would be satisfactory. Newhouse previously estimated that the maximum percentage that one should expect to explain is about 20%. McCall and Wai estimated the percentage to be 14%. The maximum is, in any event, much less than 100% because many health expenditures cannot be foreseen by either the individual or the HMO; that is, they are truly random." Newhouse JP, et al, Adjusting Capitation Rates Using Objective Health Measures and Prior Utilization, *Health Care Financing Review* (10) 1989:41-53.

xxxiii Health Care Advisory Board Company, *State of the Union* 1997, pp. 30-31.

xxxiv Ginsberg PB, High and Rising Health Care Costs: Demystifying U.S. Health Care Spending, *The Robert Wood Johnson Foundation*, Research Synthesis Report No. 16.

xxxv http://www.diabetes.org/diabetes-statistics/cost-of-diabetes-in-us.jsp

xxxvi McGlynn E, et al, The Quality of Health Care Delivered to Adults in the United States, *New England Journal of Medicine*, 2003; 348:2635-2645

xxxvii Paulus Ra, et al, Continuous Innovation in Health Care: Implications of the Geisinger Experience, *Health Affairs*, 27, no. 5 (2008):1235-1245.

xxxviii Engert EB, Emery DW, Integrated Delivery Systems: Non Fait Accompli, *Managed Care Quarterly* 1999; 7(1):29-38.

xxxix Krane D, Emery D, Episode of Care Approach Puts Risk Where It Belongs, Maximizes Outcomes*, BNA's Managed Care Reporter* 3(37) Sept 17, 1997:882-884.

xl Alper PR, Capitated Managed Care: An Exercise in Mediocrity, *Primary Care Weekly*, 2(7) 1996:27-40.

xli Robbins D, Emery D, Fiscal Arrogance: Questioning the Ethics of Capitation, in *Global Fees for Episodes of Care: New Approaches to Healthcare Financing*, Emery DW editor, McGraw Hill, 1999.

xlii Expansion of Pay-For-Performance Will Change the Way Payers Compensate Health Systems, *Medical Network Strategy Report* 6(7) 1997:1-3.

xliii Beckham JD, The Beginning of the End for HMOs, Part1: The Awakening Market, *Healthcare Forum Journal* (Nov-Dec) 1997:1-7

xliv Goldsmith JC, Goran MJ, Managed Care Mythologies: Supply-Side Dreams Die Hard, *Healthcare Forum Journal*, (36) 1996:42-47

xlv IDS Survival Strategies, *Medical Network Strategy Report* 6(7) 1997:3-8

xlvi Simon CJ, Emmons DW, Physician Earnings at Risk: An Examination of Capitated Contracts, *Health Affairs* 16, no. 3 (1997):29-35.

xlvii Wehrwien P, The March of Capitation: Reversed or Just Delayed?, *Managed Care,* Nov 1997:29-35.

Chronic Care ECRs

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METHODS:

For each ECR, three basic process steps were followed:

Step 1 involved creating the claims code definitions and triggers for each episode, time window for the episode, eligibility and exclusion criteria. Decisions were made about which codes to include as part of typical care and services, which services to consider as related to potentially avoidable complications instead of a normal progression of the condition, and what to consider as an irrelevant service to be excluded from the episode.

Step 2 involved using statistical modeling to identify factors that directly impact the quantity of services within a given ECR from those that can be attributed to patient variables (e.g., comorbidities) and the relative strength of each variable. The result is a severity-adjusted formula for the base price for typical care.

Step 3 involved the quantification of the allowance for potentially avoidable complications and the full construction of the ECR (excluding the regional adjustment) into a global price for an episode of medical care.

The methodology is available as open source and can be adopted by plans and providers to create their own case rates based on their own data and fee schedules.[xlviii]

Data Sources

We analyzed 2005-2006 claims data from a commercially insured population (CIP) of over 4.6 million members. The database contained inpatient and outpatient facility, inpatient and outpatient professional; laboratory; radiology; ancillary; and pharmacy claims. Diagnoses and procedures were coded using the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) codes, and the American Medical Association's Current Procedural Terminology (CPT®) codes. National Drug Codes (NDC) were used for pharmacy claims. Results of laboratory or radiology tests were not available. We used the Agency for Healthcare Research and Quality (AHRQ)'s Clinical Classification Software (CCS) as a means of grouping ICD-9-CM diagnosis and procedure codes, and the CCS for CPTs classification to group CPT codes into meaningful, clinically homogenous categories for further analysis. To estimate ECR price, we created a cost field called "allowed amount" that represented the reimbursable amount and was a sum of the paid amount plus the patient portion of the payment in the form of co-pay, deductibles and coinsurance amounts, as reported in the CIP database. Throughout this paper, cost refers to the "allowed amount" field.

Evidence-Informed Case Rates

Using the commercial database, we constructed Evidence-informed Case Rates (ECRs), which are condition-specific formulas for calculating a risk-adjusted global price to be used as a basis for paying providers.[xlix] Payments cover the cost of care recommended by well-accepted clinical guidelines or expert opinion, adjusted for type and intensity of services due to patient severity and comorbid factors ("typical" care). The formulas estimate the cost for an entire episode of care for a given condition treated for a defined period of time. In addition, an allowance is created for each episode, for 1) underuse adjustment/care coordination to account for minimum essential services required for each condition based on clinical guidelines, and 2) an additional allowance is created for payment for potentially avoidable complications, and is made available as part of the ECR price, irrespective of the fact that complications occur, but based on the severity of the episode. We created complete ECRs for six chronic medical conditions: congestive heart failure (CHF), coronary artery disease (CAD), diabetes, hypertension, chronic obstructive pulmonary disease (COPD), and asthma.

Episode Construction

The first step in ECR development was to construct an episode of care. Condition-specific trigger codes start an episode, and a predefined period determines the duration of the episode. For chronic medical conditions, this time period was one year from the trigger claim. Using CHF as an example, Table 1 displays condition-specific definitions (e.g., triggers, time period, exclusions). Similar criteria were defined for all the six chronic medical conditions. All claims for a member, including pharmacy claims, were identified using a unique member identifier, and aggregated together to create the complete set of services within the episode. The total costs for the entire episode were then calculated for each member.

Patients who did not meet the eligibility criteria, were not continuously enrolled for the entire episode duration, were missing gender, or had out of range or missing episode costs were excluded. Claims with medical diagnosis or procedural codes for services not directly related to care for the index condition were excluded, as were claims for "case-breaker" services, that is, major procedures which suggest that the index condition has advanced to a degree that services are now being provided for a different condition (e.g., coronary artery bypass graft in an episode of CHF or CAD). Pharmacy claims with NDC codes not relevant to the episode were also removed. The remaining claims were considered "relevant services"—this included claims related to (a) typical care or (b) potentially avoidable complications (PAC) for the index condition.
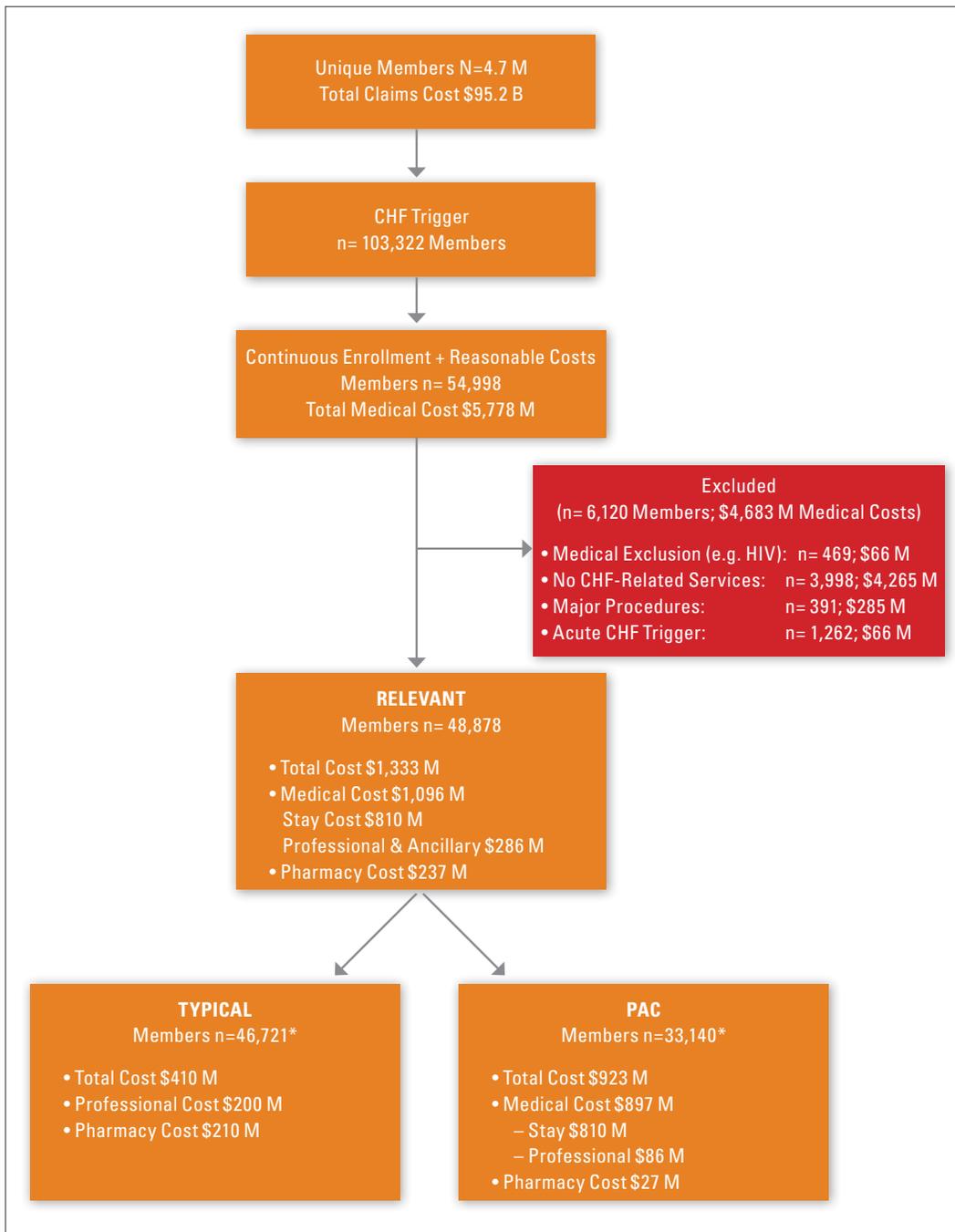
Table 1. **Condition-Specific Definitions for Episode Construction (Congestive Heart Failure)**

	Definition
Type of model(s) developed	Outpatient professional risk-adjustment model
Condition Trigger Codes*	The patient has a professional claim with one of these ICD-9-CM diagnosis codes in any position: 428 428.y, y=0,1,9 428.yz, y=2,3,4, z=0,2 or blank 402.y1, y=0,1,9 404.yz, y=0,1,9 z=1,3 398.91
Episode Period	One year starting from the date of service of the first trigger claim
Continuous enrollment requirement	9 months
Patient Exclusions	1. Remove episode if allowed amount (CHF and all other costs combined) are missing, < $20, or > $1,000,000. 2. Remove stay claim if stay claim costs are missing or < $50.
Medical exclusions	Exclude patients with HIV, suicide, pregnancy and newborn conditions
Procedural exclusions	Exclude claims with any major or irrelevant surgical procedure
Case Breaker Services*	Exclude claims with any major but relevant surgical procedure
Potentially Avoidable Complications (PACs)	Syncope, coma, hypotension, dizziness, stroke, CVA, septicemia, meningitis, adverse effect of drugs, overdose, complications of medical care, acute myocardial infarction, acute renal failure, urinary tract infections, pneumonia, lung complications, lung abscess, empyema, bronchiectasis, respiratory failure, tracheostomy, mechanical ventilation, decubitus ulcer, gangrene, phlebitis, deep vein thrombosis, pulmonary embolism, skin and woumd care, gastritis, stomach ulcers, gastrointestinal hemorrhage. Additionally, all hospitalizations and all emergency room visits are considered as PACs as well as professional services related to these hospitalizations.

* Case-breaker services refer to services that indicate the patient's condition has advanced to such a degree that the services are now for a different condition (i.e. other than CHF).

For each of the chronic medical conditions, claims were considered PAC claims if they were classified as, or associated with, an inpatient stay or an emergency room visit (except for CAD); carried a PAC code in any of the four diagnosis fields for all other claims (Table 1); or had a procedure code that was related to services provided for a complication. The remaining claims were considered typical claims. For CAD, some of the hospital stays and emergency room visits were considered as typical services since services for chest pain are part of management of CAD and could be in the emergency room or hospital setting. Using typical professional, outpatient facility, inpatient facility (in case of CAD) and pharmacy claims, we created risk-adjustment models for each of the six chronic medical conditions. Episodes with <$10 for remaining total typical costs were excluded from further modeling for the typical ECR. For each patient, we selected the first episode that met the eligibility criteria; therefore, each episode represented a unique person. Figure 1 details the data flow using CHF as an example.

Figure 1. **Flow Diagram**

Unique Members N=4.7 M
Total Claims Cost $95.2 B

CHF Trigger
n= 103,322 Members

Continuous Enrollment + Reasonable Costs
Members n= 54,998
Total Medical Cost $5,778 M

Excluded
(n= 6,120 Members; $4,683 M Medical Costs)

- Medical Exclusion (e.g. HIV): n= 469; $66 M
- No CHF-Related Services: n= 3,998; $4,265 M
- Major Procedures: n= 391; $285 M
- Acute CHF Trigger: n= 1,262; $66 M

RELEVANT
Members n= 48,878

- Total Cost $1,333 M
- Medical Cost $1,096 M
  Stay Cost $810 M
  Professional & Ancillary $286 M
- Pharmacy Cost $237 M

TYPICAL
Members n=46,721*

- Total Cost $410 M
- Professional Cost $200 M
- Pharmacy Cost $210 M

PAC
Members n=33,140*

- Total Cost $923 M
- Medical Cost $897 M
  – Stay $810 M
  – Professional $86 M
- Pharmacy Cost $27 M

Creating Severity-Adjustment Models

We used multiple linear regression modeling to identify factors that influence total costs—the dependent variable – for each chronic medical ECR. Since the distribution of total costs was right-skewed, we transformed it using natural logarithms to satisfy regression model assumptions. For the diabetes ECR, the log transformation was not strong enough to meet the constant error variance assumption, so the Box-Cox transformation was applied (formula: $(y^{0.25} - 1)/0.25$).[1] The independent variables considered consisted of demographics (age, gender), severity of index condition, comorbidities, pharmacy and procedure variables. To avoid overfitting (i.e., developing a model that predicts costs well using the analysis data, but does not have good predictive ability on new data), we validated the models. For diabetes and CHF, split-sampling methods were used.[3, li] The episodes in the analysis sample were randomly assigned to one of three datasets: model building (MB; 50 percent of episodes), validation (approximately 25 percent), and test (approximately 25 percent). The final models were based on the MB sample. Subsequent ECR model validation was performed using bootstrap techniques (see section below).

The methodology used to create the diabetes and CHF typical models is as follows. To select predictors for initial models, we conducted t-tests (or analysis of variance for age group) to measure the association between each independent variable and costs (univariate analysis). To improve the power to detect associations, we chose variables with at least 30 episodes per category and a univariate test p-value less than 0.25 to be candidate predictors for models. This p-value was chosen instead of 0.05 to increase our chances of detecting important variables.[lii] Variables with high clinical relevance were initially forced into the model (e.g., for diabetes: type I or II, controlled or uncontrolled diabetes). Multiple linear regression with the stepwise variable selection procedure was used to select predictors of costs among the candidate variables. The p-value to enter and exit the model was set at 0.20 to improve our ability to identify important predictors.[liii]

The stepwise model was reviewed and modified by the clinical expert, and subsequent models were fit without the stepwise procedure. The final predictors retained in the model were those with at least 30 episodes per category, a positive coefficient (since during the PROMETHEUS implementation, variables with negative coefficients would require a negative payment), a low variance inflation factor (VIF<3) to avoid collinearity, a high partial R-square to make the model parsimonious, performed consistently across the MB, validation and test samples, and those that were clinically plausible.

In October, 2008, we changed our statistical methodology so that the methodology would be easy for a wide variety of organizations to apply. This methodology was used for the COPD, asthma, hypertension and CAD typical models. We created a predictive model satisfying ordinary least-square (OLS) assumptions, using a natural log transformation of the dependent variable "cost." We performed all analyses on the full dataset, after trimming outliers (below the 1st percentile and above the 99th percentile). We used similar univariate techniques as described above for screening variables to be kept into the model. Age and age-squared were fed into the models if the relationship of age to costs was quadratic. Multiple linear regression with the stepwise variable selection procedure was used to select predictors of costs among the candidate variables. The p-value to enter and exit the model was set at 0.25. Variables occurring in less than 1 percent of the patients, those having a p-value greater than 0.25, those with high variance inflation factors (VIF > 3.0), and those with negative coefficients (except for age and gender) were eliminated.

The model was then validated using bootstrap techniques. The model was run using stepwise selection with SLE=.05 and SLS=.05 on 200 bootstrap samples, and a record was kept of how many times each variable was selected in the 200 model runs. A bootstrap sample was created by sampling with replacement, from the full dataset until a sample of the same size as the full dataset was drawn. Any variables that were forced into the model above were also forced in the 200 bootstrap models. Any variable that entered into less than 170 bootstrap models (85 percent of the models) was dropped. The initial model was modified based on the results of the validation techniques, and unstable variables were dropped. The final model was recalibrated on the full dataset.

Creating Illustrative Examples

To create illustrative examples, the final model was used to estimate the total "typical" severity-adjusted ECR price for hypothetical patients. The intercept from the model, plus an adjustment for age and gender (if included in the model), was used to calculate the base price, also called as the "actual" minimum (intercept) cost of care. For CHF, the base price was $1,488 for a hypothetical patient between 50 and 64 years of age with no comorbid conditions, no procedural services and no pharmacy costs. Patients with additional predictor variables / risk factors had additional costs determined by the respective regression coefficient from the model. All calculations for costs were performed on the transformed scale (CHF, CAD, hypertension, COPD and asthma: natural log; Diabetes: Box-Cox) and then the results were back-transformed to the original scale (dollars). Table 2 shows the final CHF model with the natural logarithmic coefficients and examples of three hypothetical patients and their ECR price for typical CHF care. Similar models were constructed for each of the six chronic medical conditions.

Table 2. **Construction of Severity-Adjusted Evidence-informed Case Rate (ECR) for Typical Care for Congestive Heart Failure (CHF) for Three Hypothetical Patients**

Predictor1	Number of Episodes with Variable	Percent Episodes (N=45,787)	Coefficient on Ln Scale2	Hypothetical Patient Scenarios		
				Patient 1	Patient 2	Patient 3
Intercept	45,787	100.0%	7.3049	1	1	1
Age: < 50 vs. 50-64	782	1.7%	-0.0687	0	0	0
Age: 65-79 vs. 50-64	15,813	34.5%	0.1330	0	0	0
Age: >= 80 vs. 50-64	23,411	51.1%	-0.0059	0	0	0
Heart valve disorders	4,506	9.8%	0.1463	0	1	1
Coronary atherosclerosis and other heart disease	19,652	42.9%	0.2072	0	1	1
Carditis, Cardiomyopathy	4,058	8.9%	0.1294	0	1	1
Conduction disorders	3,723	8.1%	0.2003	0	1	1
Eye, ENT, oral procedures	615	1.3%	0.4293	0	1	1
Diagnostic cardiac catheterization, coronary arteriography	882	1.9%	0.4524	0	1	1
DME, visual and hearing aids	9,104	19.9%	0.4552	0	0	0
Cardiac ablation, pacemaker or cardioverter/defibrillator	680	1.5%	0.6575	0	0	0
Statins and other anti-lipid agents	6,581	14.4%	0.2161	0	1	1
Bronchodilators and other antiasthmatics	15,574	34.0%	0.2345	0	0	1
Antiarrhythmic agents	6,100	13.3%	0.2274	0	0	1
Inhalers and respiratory agents	7,376	16.1%	0.2061	0	1	1
Antacids and drugs for other oral and GI problems	27,060	59.1%	0.2915	0	1	1
Diuretics	36,548	79.8%	0.2469	0	1	1
Other cardiovascular agents	13,975	30.5%	0.1697	0	0	1
Beta-Blockers	31,234	68.2%	0.2322	0	0	1
ACEI, ARB, anti-renin drugs	29,454	64.3%	0.1672	0	1	1
Calcium channel blocking agents	16,172	35.3%	0.1672	0	0	1
Antiplatelet agents, thrombin inhibitors	11,699	25.6%	0.2214	0	1	1
Antidepressants	16,569	36.2%	0.1940	0	0	1
Severity-adjusted Price of ECR3				**$1,488**	**$27,418**	**$93,341**

[1] Predictors of episode costs from a multiple linear regression model. Professional, outpatient facility and pharmacy costs were modeled on the natural log scale. The models included patient demographic, medical comorbid conditions, procedures performed, and pharmacy use.

[2] All coefficients were significantly different from 0 at the 0.05 level. The adjusted R-square was 41.9%

[3] To calculate the severity-adjusted price of the ECR by model, sum the estimates for the intercept and desired predictors (sumP) and compute e(sumP).

Pricing the Evidence-Based Services

A foundational element of PROMETHEUS is that the base set of services should include all the services that are recommended by Clinical Practice Guidelines or expert opinion as laid out by the Clinical Working Groups[liv] or published guidelines in the literature. Table 3 outlines the minimum evidence-based core services for each of the chronic medical conditions priced using our developmental database. For CHF, the evidence-informed core services priced at $3,597.

Table 3. **Evidence-informed Core Services and Prices**

Evidence-Based Services	CIP Database Unit price	CHF N	CHF Price	CAD N	CAD Price	Diabetes N	Diabetes Price	Hypertension N	Hypertension Price	COPD N	COPD Price	Asthma N	Asthma Price
Physicians													
PCP-new	$178	1	$178	1	$178	0	$0	0	$0	1	$178	0	$0
PCP-established	$104	5	$519	3	$312	4	$416	4	$416	2	$208	4	$416
Cardiology/ Pulmonologist	$242	3	$726	1	$234	0	$0	1	$121	1	$242	0	$0
Endocrinologist	$242	0	$0	0	$0	0.1	$24	0	$0	0	$0	0	$0
Ophthalmologist	$242	0	$0	0	$0	1	$242	0	$0	0	$0	0	$0
Ancillary													
Diabetes Educator	$104	0	$0	0	$0	1	$104	0	$0	0	$0	0	$0
Cardiac Rehab	$35	12	$422	0	$0	0	$0	0	$0	0	$0	0	$0
Emergency Room	$469	0	$0	0	$0	0.1	$47	0	$0	0	$0	0	$0
Diagnostics / Lab													
Echo transthoracic	$458	2	$917	1	$458	0	$0	0	$0	0	$0	0	$0
Electrocardiogram	$58	2	$116	1	$58	0	$0	1	$58	0	$0	0	$0
Chest x-ray	$90	2	$180	1	$90	0	$0	0	$0	1	$90	1	$90
Lung function test	$35	2	$70	0	$0	0	$0	0	$0	4	$141	1	$35
metabolic panel	$30	6	$177	1	$30	0	$0	1	$30	0	$0	1	$30
Lipid panel	$70	2	$139	1	$70	2	$139	1	$70	0	$0	0	$0
Liver Function Tests	$60	2	$121	1	$60	1	$60	0	$0	0	$0	0	$0
Microalbumin, quantitative	$16	2	$32	1	$16	0	$0	1	$16	0	$0	0	$0
HbA1c	$51	0	$0	0	$0	3	$154	0	$0	0	$0	0	$0
Potassium	$37	0	$0	0	$0	1	$19	0	$0	0	$0	0	$0
Creatinine	$75	0	$0	0	$0	2	$113	0	$0	0	$0	0	$0
Est. Evidence-Based Costs			$3,597		$1,505		$1,317		$710		$858		$570

[1] All specialists are computed at the same rate: cardiologist, pulmonologist, endocrinology, ophthalmologist.
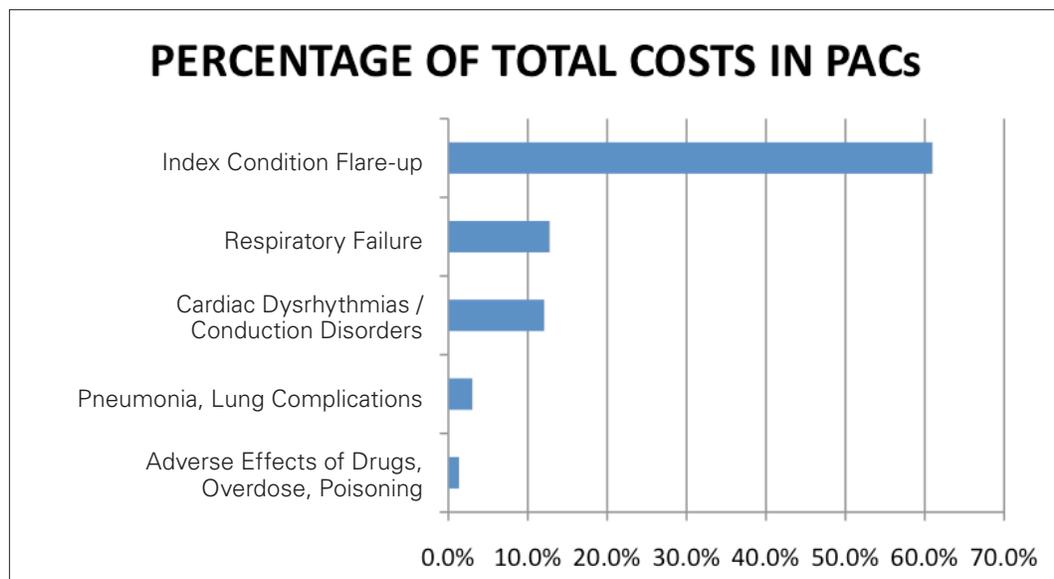
Determining the Underuse and Care-Coordination Allowance

If price of an individual episode fell below the minimum evidence-based costs, we classified it as underuse, and within PROMETHEUS, we provide an underuse and care-coordination allowance to these episodes. The allowance for care-coordination was calculated as the difference between the evidence-based recommended care and the actual minimum (intercept) costs of care from the regression models described above. The underuse amount represents the difference between what should have been the minimum costs based on care following evidence-informed guidelines, and what the patients in the database actually received for the core services provided. For CHF, the care coordination amount was calculated as $2,112 as the difference between evidence-informed cost of minimum core services ($3,597) and the actual minimum (intercept) costs ($1,488).

Potentially Avoidable Complications and the PAC Pool

Claims and services that were aggregated as potentially avoidable complications (PACs) were used to create the PAC pool. The PAC pool helped quantify the waste within the system and identify specifically where the potential for savings lies. The total amount of dollars in the PAC pool formed the basis of determining the PAC allowance that in turn is paid to providers irrespective of the occurrence of PACs, and serves as a warranty for care defects. The details of the PAC analysis and the distribution of costs were used to identify which complications were major cost drivers, and to make the data actionable for providers to focus their energies on. Figure 2 shows the distribution of the most expensive PACs within an episode of CHF. Similar PAC analyses were conducted to identify the top cost drivers of PACs for each chronic medical condition studied.

Figure 2. **Distribution of Most Expensive Potentially Avoidable Complications (PACs) in Congestive Heath Failure as a Percentage of Total PAC Costs**

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PAC Allowance

The total dollars associated with the treatment of PACs helped determine the PAC allowance that is given to providers towards payment for PACs irrespective of their occurrence, and is in part proportional to the severity and comorbidity factors present in the patients cared for within the ECR. By convention, PROMETHEUS reduces the total PAC allowance by the amount used to rebase the ECR for care coordination, and allocates 50 percent of the remaining PAC pool across each patient. A portion of this pool (25 percent) is given as a fixed amount to each episode, and the balance (75 percent) is allocated as a proportion of the risk-adjusted, rebased price for each patient. This is discussed in detail in another paper.lv Similar PAC allowances were developed for all the six chronic medical conditions.

Construction of the Complete ECR

Table 4 illustrates development of the complete ECR using CHF as an example. A complete ECR is derived as the sum of the typical evidence informed case rate using the severity adjusted regression models plus the underuse/care-coordination allowance plus the PAC allowance for each patient. As the example shows, for patient 1, the severity adjusted price for typical care is $1,488. This is adjusted for underuse/care coordination by $2,112 and by the PAC allowance of $3,165 to give a complete ECR price of $6,765. Similarly, hypothetical patient 2 has a "typical" ECR price of $27,418 based on the severity adjustment models for typical care and after the underuse/care coordination and PAC allowance adjustments, the complete ECR price is $51,308.

Table 4. **Distribution of most Expensive Potentially Avoidable Complications (PACs) in Congestive Heath Failure as a Percentage of Total PAC Costs**

PAC Allowance Calculations	Factors	Average Cost	Number of Episodes	Total Cost
Total relevant CHF episodes		$27,267	48,878	$1,332,774,251
Typical CHF episodes		$8,765	46,721	$409,503,974
PAC CHF episodes		$27,860	33,140	$923,270,276
Added Burden for PACs		$27,860		$923,270,276
Evidence-informed Adjustment (Adjustment for Underusea)		$2,112	48,878	$103,248,387
Allowable Cost of PACs	50%			$410,010,945
Flat Fee Portion (spread 25% of PAC costs over all episodes)	25%	$2,097		$102,502,736
Proportional Rate (75% of PAC costs as a rate over base costs)	75%			72%

ECR Construction	Hypothetical Patients			
	Factors	Patient 1	Patient 2	Patient 3
Severity-adjusted Base Price of ECR for typical CHF patientsb		$27,267	48,878	$1,332,774,251
Allowance for Underuse and Care Coordination ($3,597 - $1,488)	$2,112	$8,765	46,721	$409,503,974
Allowance for PACs		$27,860	33,140	$923,270,276
Flat Fee Allowance	$2,097	$27,860		$923,270,276
Proportional Allowance	72%	$2,112	48,878	$103,248,387
Total ECR per Patient (severity-adjusted + Underuse/Care Coordination + PAC Allowance)	50%			$410,010,945

a The adjustment for underuse/care coordination ($2,112) is the difference between (i) the evidence-informed core services price (table 3) and (ii) the intercept cost of the severity-adjusted base price for a patient with none of the comorbidites, procedures, etc. in the severity-adjusted regression model (Hypothetical patient 1 in table 2).

xlviii For a complete description of the PROMETHEUS Payment methodology, the codesets for each episode, the results of the modeling effort to date, and access to the SAS programs that help develop Evidence-informed Case Rates, see www.PROMETHEUSpayment.org/playbook/index.htm, accessed January 2009.

xlix F. de Brantes and A. Rastogi, "Evidence-Informed Case Rates: Paying for Safer, More Reliable Care," *The Commonwealth Fund* 40, publ. 1146 (2008): 1-14.

xlx Neter J, Wasserman W, and Kutner MH. Applied Linear Statistical Models, 3rd ed. Homewood, IL: IRWIN, 1990.

l Iezzoni LI, ed. *Risk Adjustment for Measuring Health Care Outcomes*, 3rd ed. Chicago, IL: Health Administration Press, 2003.

li Bendel RB and Afifi AA. "Comparison of stopping rules in forward regression", JASA no. 72 (1977): 46-53.

lii Bendel RB, ibid

liii For Clinical Working Group Guidelines, see Guidelines for each chronic medical condition, www.PROMETHEUSpayment.org/playbook/index.htm, accessed January 2009.

liv de Brantes et al, "Creating Warranties in an Episode of Care Payment System", under review.

Chronic Care ECR Estimator

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Guy D'Andrea, M.B.A.

PROMETHEUS Payment is designed to be a "win-win-win" for patients, physicians and health care purchasers. Patients benefit by avoiding PACs and achieving better health outcomes, and purchasers from lower health costs. Physicians who help patients stay healthy should benefit by retaining the portion of the episode case rate that normally would go to pay for the cost of avoidable PACs. To test the proposition that physicians will benefit under this new payment system, PROMETHEUS (with support from Discern Consulting) built a simulation of a primary care physician practice called the Chronic Care ECR Estimator.

The ECR Estimator is an Excel-based model used to simulate a population of chronically ill patients being treated in a primary care practice. Wherever possible, the data in the ECR Estimator are based on analysis of a large database for a commercially insured population. For example, the average fee-for-service (FFS) costs and the prevalence of chronic conditions and associated risk factors are all based on this database.

As a baseline, we assumed[4] a total population of 2,000 patients in the practice, or which 500 are chronically ill. Chronic conditions within this population are distributed as follows:

- Hypertension – 310 patients (62%)

- Coronary Artery Disease – 70 patients (14%)

- Diabetes – 50 patients (10%)

- Asthma – 35 Patients (7%)

- Chronic Obstructive Pulmonary Disease – 25 patients (5%)

- Congestive Heart Failure – 10 patients (2%)

Next, using randomization functions in Excel, we modeled each of the individual chronically ill patients in the physician practice. Parameters for each patient included age, gender and whether certain risk factors were present. (The risk factors included are those that were found to have a significant impact on total costs based on the analysis of the commercial insurance database.) While each patient was randomly generated, the probabilities for each parameter followed the probabilities observed in the commercially insured population. For example, each chronic disease has a certain age distribution, and each risk factor has a certain probability associated with the patient's age.

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[4] All of the assumptions in the Chronic Care ECR Estimator can be adjusted to: 1) test different parameters; 2) cover the details of a specific primary care practice or community; and/or 3) integrate new evidence as it becomes available.

Here is an example of a diabetes patient from the model:

- Age: 60

- Gender: Female

- Risk Factors Present

    ### Medical
    - Diabetes – IDDM, Uncontrolled
    - Thyroid Disorders
    - Ancillary, home health, transport
    - DME, visual, hearing aids

    ### Pharmacy
    - Insulin
    - Other anti-diabetics
    - Other cardiovascular agents
    - Statins and other anti-lipid agents

This process is replicated for each of the 500 patients, thus generating a patient population that a typical primary care physician might treat. For each patient, the ECR estimator then completes two calculations: 1) what the patient's costs would be under traditional FFS reimbursement and 2) the PROMETHEUS ECR payment for that patient. In general, the PROMETHEUS payment will be higher than the FFS reimbursement, because the PROMETHEUS payment includes allowances for care coordination and some PACs. The difference between the FFS and PROMETHEUS payment is the physician's "bonus potential" for that patient. By summing the bonus potential across all patients, we can calculate the physicians' total PROMETHEUS bonus potential for the population. In this example, running 1,000 iterations of the ECR Estimator, we find that the bonus potential is $541,339 with a standard deviation of $7,610 (the variation is due to random fluctuations in patients' risk profiles).

Of course, the crucial word here is "potential." In PROMETHEUS Payment, the physician is responsible for extra costs incurred when a patient experiences a PAC. If too many patients have PACs, the costs of treatment will exceed the extra payment, and the physician will lose money compared to FFS. It is therefore in the physician's interest to expend some resources to reduce the potential occurrence of PACs. However, it is still likely that some patients will experience PACs, and these costs must also be deducted from the bonus potential. Aggregating these concepts allows us to develop a model for "net bonus." Net bonus equals potential bonus minus PAC costs and minus dollars invested to reduce the PAC rate. For the ECR Estimator, we account for two types of investments to reduce PACs. Physicians may make a fixed-cost investment that impacts the care received by all patients (adding an electronic medical record system is an example of such an investment). Physicians may also make variable per patient investments, and the amounts of these investments may be different for each chronic condition. For

example, the physician might spend $1,000 per patient to reduce PACs in CHF patients, since PACs for these patients tend to be very expensive. The physician might spend less per hypertension patient, because related PACs cost relatively less.

The physician's goal will be to optimize the investment in reducing PACs. Invest too little, and the rate of PACs will not drop, and the physician may spend too much money treating those PACs. Invest too much, and much of the potential bonus will be eroded by the investment.

It is at this point that we leave the empirical aspects of the ECR Estimator and enter the theoretical. Specifically, we need to predict the physician's PAC rate for each of the chronic conditions, given the physician's investment to avoid PACs and the characteristics of the population. To make this prediction, we posit the following equation:

Predicted PAC Rate = Min PAC Rate + (Max PAC Rate - Min PAC Rate) * (1 - PAC Avoidance Effort)^Factor + Risk Adjustment
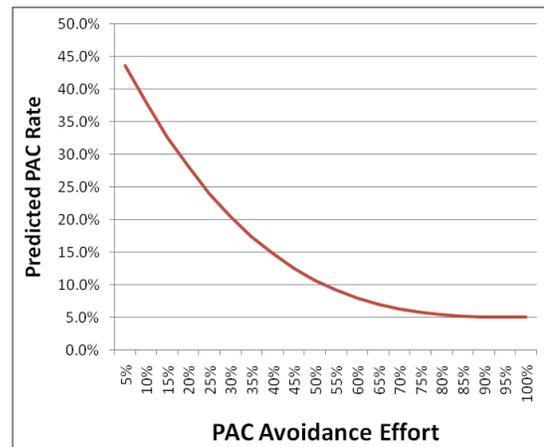
Where:

- Min PAC rate = the minimum possible PAC rate achievable for the chronic condition. This number should always be above 0 percent, because even with the physician's best efforts, some patients will still experience PACs. The current ECR Estimator assumes 5 percent for all chronic conditions.

- Max PAC rate = the maximum PAC rate for the chronic condition. The model assumes that the physician's maximum PAC rate is equal to the physician's current PAC rate. This assumption is based on the belief that, even if a physician gets no better at avoiding PACs under PROMETHEUS, he or she will get no worse. Current average PAC rates are observable in the commercial insurance database, as follows, and these are used for the Max PAC Rate in the model:

  › Hypertension – 29%

  › Coronary Artery Disease – 28%

  › Diabetes – 67%

  › Asthma – 31%

  › Chronic Obstructive Pulmonary Disease – 44%

  › Congestive Heart Failure – 67%

- PAC Avoidance Effort = the percentage of the potential bonus that the physician invests in reducing the PAC rate (including both fixed and variable investments). This is admittedly a difficult variable to quantify, and our method may not capture intangible efforts by the physician. However, real quality improvement will demand new systems and tools, and these require financial investment. The maximum PAC Avoidance Effort is 100 percent. However, physicians will not want to make this level of effort, as it would mean all of the potential bonus has been expended.

- Factor = a number that reflects the non-linearity of effort to reduce PACs. We believe that there will be diminishing returns on investment as the PAC rate approaches the minimum. In other words, some PACs may be easily avoidable, and these will yield to even modest investments. The next round of PAC avoidance will be harder to achieve and will require more investment and so on. For the model we have set the Factor value at 2, though future research may help to calculate a more precise value.

- Risk Adjustment = Any increase/decrease in the PAC rate due to riskier/less risky patients.[5]

The graph at right illustrates the PAC reduction curve as a function of PAC Avoidance Effort using the following values:

- Min PAC Rate = 5%

- Max PAC Rate = 50%

- Factor = 2

- Risk Adjustment = 0%

As stated earlier, we recognize that this is a theoretical model, and that reality may differ in terms of the parameters and values of the equation. In some ways, this equation addresses the great unknown of health care quality improvement: how do investments in systems of care translate into actual improvements in patient outcomes and cost reduction? While we cannot claim that our PAC rate equation answers this question definitively, we do assert that it has the correct *properties* that one would expect from any such equation. These properties are:

- The max PAC rate is the current PAC rate, since physicians won't get worse at avoiding PACs under a payment system that rewards them for reducing PACs.

- The minimum PAC rate is above zero –physicians cannot prevent every PAC.

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[5] In our model, the method of calculating PAC avoidance effort already adjust for risk, so we don't add any additional risk adjustment values (though we have constructed the model to accept such values as new evidence emerges). To see how PAC avoidance effort already includes risk adjustment, consider the following example: Two physicians are each treating a population of diabetics. Physician A has a bonus potential of $200,000. Physician B has a riskier population and a bonus potential of $250,000. Each physician invests $50,000 to prevent PACs. Physician A's PAC avoidance effort = 50,000/200,000 = 25%. Physician B's PAC avoidance effort = 50,000/250,000 = 20%. Feeding these values into the PAC prediction equation, we find that Physician A has a predicted PAC rate of 40%, while Physician B is expected to have a 45% PAC rate. The equation has accounted for the difference in risk.

- The predicted PAC rate is a function of how much the physician invests in avoiding PACs. This is a non-linear relationship, with diminishing returns as the PAC rate approaches the lower limit.

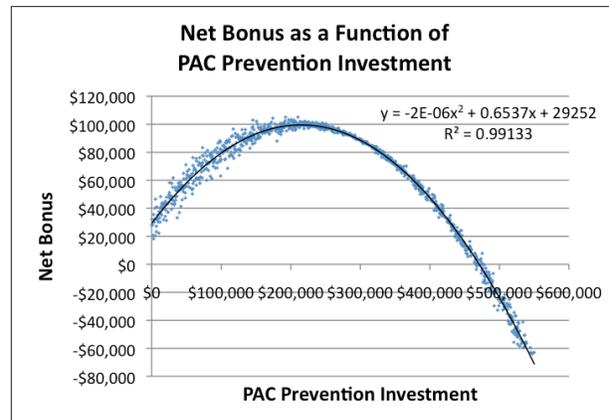- The PAC rate is adjusted based on the riskiness of the population.
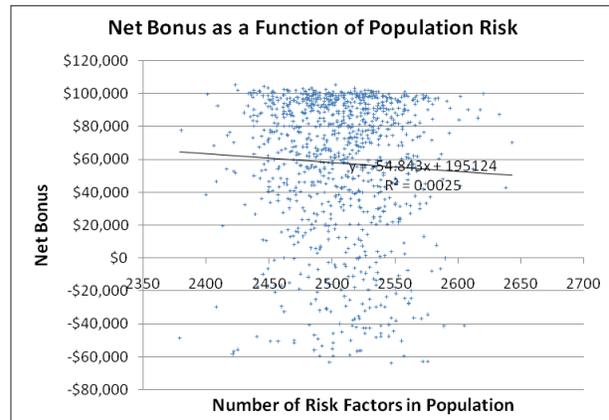
We now have all the components we need to operate the model:

- A population of 500 chronically ill patients

- A method to predict payment for each patient based on their risk profile:

    - FFS payment

    - PROMETHEUS ECR payment

    - The difference between FFS and ECR is the "potential bonus"

- A method to predict the PAC rate and costs within the population as a function of the physician's efforts to reduce the PAC rate.

We set up the model to run through 1,000 iterations. In each iteration, the physician's investment in avoiding PACs varied randomly between $0 and $500,000. Recall that the average total bonus potential was about $540,000. A physician investing $0 would be making no effort to reduce PACs, while a $500,000 investment would represent a very significant effort, as it would consume almost the entire potential bonus. Each iteration of the model also generated a new patient population; while the underlying probabilities remained the same, random variation meant that some patient populations had more risk factors present than others. While such riskier populations have higher bonus potentials than average populations (because PROMETHEUS ECRs are adjusted based on patient risk and complexity), they also have a higher probability of PACs and the higher costs associated with PACs.

For each iteration, the key output was the physician's net bonus. Recall that the potential bonus is the difference between the PROMETHEUS ECR payments for all the patients and what the physician would have received under FFS payment. The net bonus is the potential bonus minus any investments the physicians makes to prevent PACs and any costs for treating those PACs that do occur. Over 1,000 iterations, the average net bonus was about $57,500, with a standard deviation of $43,000. The maximum net bonus was $105,000, and the worst outcome was negative $64,000 (that is, in that iteration the physician was $64,000 worse off than under FFS.) These initial results suggest a high volatility, with the standard deviation being very large.

What is driving this volatility? First, one might look at population risk. Are physicians that have a riskier population losing money, while physicians lucky enough to get a healthy population making money? A glance at the scatter plot at right shows that this is not the case. In the graph, each point represents one of the 1,000 iterations of the model. The x-axis is a count of the total number of risk factors in the population; more risk factors means a riskier population with a higher probability of PACs. The y-axis is the physicians net bonus. Visual examination of the scatter plot suggests there is little if any relationship between the x and y variables (and this conclusion is confirmed by the very low r-square number). It appears that PROMETHEUS

Net Bonus as a Function of Population Risk

y = -54.843x + 195124
R² = 0.0025

Number of Risk Factors in Population

Net Bonus as a Function of PAC Prevention Investment

y = -2E-06x² + 0.6537x + 29252
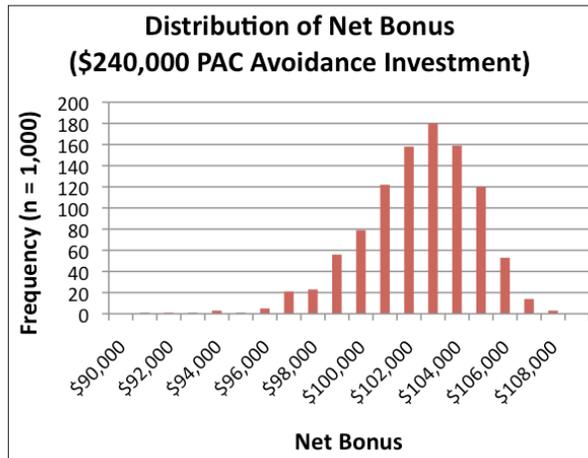R² = 0.99133

PAC Prevention Investment

Payment's adjustment for riskier patients is fulfilling its purpose, and physicians are not better or worse off with a less risky/riskier patient population.

If population risk is not driving the variation in net bonus, then what is? Next we look at the physician's efforts to prevent PACs. Here, a clear pattern emerges, as illustrated in the scatter plot on the following page. As before, each dot represents one of the 1,000 iterations of the model. In this graph, the x-axis is the physician's investment to reduce PACs (which is one of the inputs for our PAC prediction equation). The y-axis is the physician's net bonus. There is an obvious connection between these two variables, following a curve that peaks around $240,000 on the x-axis. Note that the upper and lower limits of the curve are the same as in the previous scatter plot. In fact, each dot in this scatter plot has a counterpart in the previous graph, since they are the results of the same iterations of the model. The difference is that using PAC Prevention Investment as the explanatory variable results in a clear pattern not present when we looked at risk factors.

What is producing this pattern? The answer is that at very low PAC prevention efforts, the PAC rate is not reduced significantly, and the physician ends up spending a lot of money treating PACs, which consumes most of the potential bonus. As the physician's PAC prevention efforts increase, the PAC rates and costs go down, so the net bonus increases. However, past a certain point, the physician is spending too much on reducing PACs. That is, the money spent preventing PACs is more than the money it would cost to treat the PACs themselves. It is past this point where the curve begins to slope downward (and crosses into negative numbers when the PAC prevention investment is very high). A physician operating under a PROMETHEUS-type payment system would seek to optimize his PAC prevention investment to balance the cost of PACs versus the cost of avoiding them. Given the parameters we have used for the model, the optimal PAC prevention investment for a physician treating a typical population of 500 chronically ill patients is about $240,000 (the peak of the curve).

Armed with this knowledge, we can then ask: what is the volatility of the physician's net bonus when the PAC prevention investment is optimized? The answer to this question, we ran another thousand iterations of the model, setting the PAC prevention investment to $240,000 (instead of allowing it to vary randomly). The results of this simulation are illustrated at right. The average net bonus was $102,000 (which is very close to the maximum net bonus we observed for the previous simulation). Perhaps more importantly, the standard deviation was $2,350, suggesting that physicians who optimize their PAC prevention efforts would have a high confidence of achieving the average net bonus +/- $6,000.

Distribution of Net Bonus ($240,000 PAC Avoidance Investment)

Overall, the results of the model support the idea that PROMETHEUS ECR payment can:

- Align payment so that physicians have an incentive to keep patients healthy and out of the hospital;

- Adjust for risk so that physicians do not have an incentive to avoid riskier patients;

- Increase physician payment while yielding net savings from fewer complications.