Advancing Return on Investment Analysis for Electronic Health Record Investment

Impacts of Payment Mechanisms and Public Returns

By Susan Xu

ABSTRACT

This paper reviews a sample of studies reporting evidence on the implementation of electronic health record systems and identifies connections between reported benefits and hospitals’ internal returns as well as public returns to external stakeholders, such as patients, the government and insurers. The study indicates that payment mechanisms play an important role in whether and to what extent reported benefits can be translated into a healthcare provider’s financial profits. Under fee-for-service, reported benefits, such as reducing duplicate tests or improving preventive practice, will have a negative effect on a provider’s financial performance. However, providers can realize those benefits financially under capitation. EHRs can improve clinician’s compliance with pay-for-performance guidelines and promote the collection and report of quality data. But P4P’s financial impact on EHR adoption is not clear. The study also suggests that returns from adopting EHRs can flow from the internal improvements in a healthcare entity resulting in returns to external stakeholders.

KEYWORDS

Electronic health record, return on investment, fee for service, prospective payment system, capitation, pay-for-performance.

IN 2004, President Bush outlined a 10-year plan to establish a national electronic health record system, with the belief that, “By computerizing health records, we can avoid dangerous medical mistakes, reduce costs and improve care.”

According to a RAND analysis, potential savings enabled by widespread adoption of EHRs could average $42 billion yearly and overweigh the projected costs, a mean yearly spending of $7.2 billion. The Office of the National Coordinator for Health Information Technology estimates that widely adopted EHRs would annually contribute 7.5 percent to 30 percent savings to national health expenditures.

Although the benefits are clear in theory, and policymakers, healthcare experts and payors strongly advise adoption of EHRs, progress toward widespread use of electronic systems remains slow. On average, healthcare organizations spend less than 3 percent to 4 percent of their budgeted capital on IT, much less than other information-intensive industries. Failure to demonstrate a positive return on investment is the most commonly cited barrier. The price tag for EHRs is high, while the benefits, such as reductions in medical errors, have yet to be linked to financial rewards.

A better understanding of the distribution of returns of EHR investment among healthcare providers and external stakeholders will help to answer the question of why there is a gap between positive macro benefits and costs analysis, and negative micro ROI. In turn, it will enable policy makers to seek EHR investment.
incentive mechanisms that are aligned with benefits that stimulate widespread EMR adoption.

**STAKEHOLDERS AND EHR INVESTMENT**

Payors of healthcare services discussed here include government and employers, who finance healthcare expenditure, and insurers, who directly disburse payments to healthcare providers. The driving force behind payors’ initiatives in advocating EHR adoption is cost containment.

The federal government is by far the nation’s largest healthcare payer through supporting two major public healthcare programs, Medicare and Medicaid (including SCHIP), which account for 33.2 percent of national health expenditures in 2005. Medicare is a large part of federal outlay, accounting for 12 percent of all federal spending in 2005. Moreover, it has been projected that in 30 years, as a majority of the baby boomers enter retirement, entitlement spending for Medicare and Medicaid will consume correspondingly larger shares of federal and state budgets, and will threaten to crowd out other spending.

The majority of working Americans have private health insurance, generally through their jobs. Aside from the federal government, which is the nation’s largest employer, private employers are the financial foundation of private health insurance in the U.S. The escalation of health expenditures, which was represented by years of faster increases in the medical prices index than the consumer price index, forces employers to pay more for healthcare and places them at a competitive disadvantage in the international market.

Taking the automobile industry as an example, as pointed out by Lee Iacocca, the retired chairman of Chrysler, more money per car is expended on healthcare than on steel.

Insurance companies generate profits from the difference between the total insurance fund collected and the total health expenditures they have to pay. As both government and private employers already cannot bear the burden of healthcare costs any longer, more effort on cost containment is a reasonable choice for insurance companies to maintain business.

EHRs are believed to be able to assist costs containment in several ways. First, EHRs can save money by improving the efficiency of the healthcare delivery system. Efficiency savings come from the ability to perform the same task with fewer resources. For example, sharing EHRs among healthcare providers can reduce the number of duplicate tests and thus save money. Secondly, EHRs have the potential to improve clinician compliance with established evidence-based guidelines, which leads to higher healthcare quality, and higher quality care is believed to save money. Thirdly, EHRs can make the care delivery process more transparent to the public, enabling payers to exert stricter review and weed out provider fraud, and improving market competition by giving consumers more information they can use to choose their providers.

So far, 35 states have either an executive order or a legislative mandate to stimulate the use of healthcare information technology. Most states are providing grant funds to support regional and local efforts, as well as state-level planning. Payors in the private sector also have made great efforts and offered substantial grants, loans and other financial incentives to stimulate healthcare providers to implement IT.

**PROVIDER RESPONSE**

Providers represent any entity that delivers healthcare services, such as physicians, hospitals, community health centers. By far, providers are the main investors in EHR systems. Providers welcome returns promised by EHRs, such as reduced malpractices and improved healthcare quality, which also could improve providers’ reputation in professional circles as well as with customers.

Several other considerations also influence providers’ decisions. Transparency enabled by EHRs is a two-edged sword because it can highlight clinical performance, whether it is good or bad. In contrast to payors’ efforts to control, physicians want to have a minimum of interference with the way they practice medicine. Physicians are concerned whether EHRs will impair their practice independence or authority. As the users of EHR systems, providers also want them to be user-friendly, easy to learn and secure.

No matter the mission (for-profit or not-for-profit) or size of an organization, making a reasonable profit is an important issue for healthcare providers. For this reason, healthcare providers want to know whether an EHR investment will bring positive returns. Many decision makers view EHRs as an opportunity cost rather than as a strategic investment. More often than not, an investment in an EHR is given a lower priority than other projects that could earn immediate medical benefits.

**PATIENTS AND VENDORS**

In a Kaiser Family Foundation’s survey, patients showed strong interest in EHRs even though most have had limited experience with such systems. Survey results from the Markle Foundation reveal that Americans want access to their personal health records electronically because they believe that such access is likely to increase their quality of care as well as improve healthcare efficiency by reducing unnecessary and repeated tests and procedures. Another Kaiser Family Foundation’s Survey in 2006 showed that patients were dissatisfied with the cost of the healthcare over all other categories. In general, Americans support a variety of government efforts to reform healthcare. However, support appears relatively fragile when rising costs or taxes will be involved. Therefore, it is still a long way to get consumers to vote for financing healthcare IT through tax money or patients’ payments.

Investments in EHR systems used to be very risky because of immature products, high entry and exit rates by vendors, lack of proven approaches and for other reasons. “One of the main
reasons for the unnecessarily high costs and lack of flexibility of today's IT systems is that previous investments have been in systems that either do not comply with interoperable standards or use closed or proprietary turn-key solutions. A new study from Kalorama Information forecasts that the market for EHRs in the U.S. will grow at a 13.5 percent rate during the next four years, and by 2015, it will total $4.85 billion.

The growing market volume is a signal that the EHR industry will evolve into a shakeout stage, which, according to industry life cycle models, occurs after a dominant model emerges in what had been a fragmented industry; in the shakeout, unaligned firms are forced to exit. According to this model, the EHR industry is nearing the end of its two-decade fragmentation phase.

The market transition is reflected in the United efforts on and progress in developing and adopting interoperable standards. In May 2006, the Certification Commission for Health Information Technology finalized the first national certification standard for ambulatory EHR products and initiated the process of certification. Although it just got started, CCHIT data suggest that there is at least anecdotal evidence to suggest that certification is becoming the differentiator in the marketplace. In general, certification will have a positive effect on EHR adoption by reducing providers’ investment risk, lowering product prices and driving the industry on the right track.

**EVIDENCE REPORT OF EHR**

An evidence report of the Agency for Healthcare Research and Quality systematically reviewed studies on the effect of health information technology from 1995 to January 2004. References of this report, case reports from winners of the Nicholas E. Davies Awards of Excellence and a literature search of PubMed for published reports on EHR from 2004 to March 2007 are the main resources to sum up the effects of EHR implementations in this study.

Reported benefits of EHR implementations, as listed in Table 1, support the assertion that EHRs can improve the efficiency of the healthcare delivery system. EHRs can facilitate or automate revenue cycle management. For example, the order entry function of EHRs is reported to contribute to the completeness of medical documentation and improve coding and charge capture. EHRs show a great potential in rationalizing the utilization of medical resources. Especially in the area of controlling overuse of drugs, lab tests and radiology, EHRs have demonstrated the ability to make a difference. RAND estimates that annual national savings in these areas can reach $12.6 billion, nearly one third of total annual savings possible by widely adopting EHRs.

The readily available, comprehensive and integrated clinical information provided by EHRs also enables physicians to replace some office visits with more efficient communication channels, such as telephone contacts.

**PAYMENT MECHANISMS AND ROI**

To realize the financial gain on these reported savings, a healthcare provider must be able to translate those benefits either into revenue growth or cost savings, or both. That is, returns on an EHR's impact on revenue is negative, which is the case for some “benefits” under certain payment mechanisms, the difference between cost savings and the revenue decrease — also described as the contribution margin — needs to be examined.

### Table 1. Main functions of EHR and reported benefits.

| 1. Health Information and Data | **Core functions** | Key data, including problem list, procedures, diagnoses, medication list, allergies, demographic, diagnostic test results, health maintenance, advance directives, diagnosis, level of service. **Minimum dataset for testing bases.** |
| 2. Results Management | **Core functions** | Results reporting, including laboratory, microbiology, pathology, radiology reports and consults. Results notification. Multiple views of data presentation. Multimedia support, including images, workflows, scanned documents, pictures and sounds. |
| 3. Order Entry | **Core functions** | Computerized provider order entry, including electronic prescribing, laboratory, microbiology, pathology, X-ray/histology, nursing, supplies and supplies. |
| 4. Patient Support | **Core functions** | Access to knowledge sources. Drug efficacy, such as drug dose details, drug-dose checking, allergy checking, drug interaction checking, drug checking, drug-dose checking, drug checking, drug interaction checking, drug-dose checking, drug checking, drug interaction checking. Other tab-based alerts in e.g. significant lab results, lab test results, because of drug. Preventive service reminders. Clinical guidelines and pathways. Chronic disease management. Clinician work list. Incorporation of patient and family preferences. Diagnostic decision support. Use of epidemiologic data. Automated real-time surveillance to detect adverse events and near misses, detect disease outbreaks, detect transitions in care. |
| 5. Electronic Communication & Connectivity | **Core functions** | Provider-provider. Peer-to-peer. Patient-provider (e-mail, secure Web messaging). Medical devices. Telephoning (external) such as videophony in care, laboratory, radiology. Integrated medical record (with matching, cross-coding, cross-entering). |
| 6. Administrative Processes | **Core functions** | Scheduling management (appointments, admissions, surgery procedure schedule). Eligibility determination (insurance eligibility, clinical trial enrollment, drug recall, chronic disease management). |
| 7. Reporting and Population Health Management | **Core functions** | Patient safety and quality reporting (clinical demographics, external accountability, ad hoc reporting). Public health reporting (reportable diseases, immunization). De-identifying data. Disease registries. |
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To maintain profits, providers need to keep the variable cost of DRG rates (R) of Q patient visits, that is $TR=Q \times R$. In short, $TR=Q \times R$.

Payment, a provider's total revenue is the accumulation of the amount of resources necessary for treatment. Under prospective payment, a group of patients that is homogeneous in terms of the diagnosis-related group. A DRG represents a fee schedule listing individual fees for each type of service provided, and ai is the amount consumed. Variable costs of each patient visit are equal to $V_j$, the accumulation of amount multiple price per item, or cost per service. For each patient visit, $V_j$ represents the type and intensity of utilization consumed. TVC is the summation of expenses of Q patient visits. Simply put, $TVC=V \times Q \times P$.

**Fee for service.** Under fee for service, insurers usually determine a fee schedule listing individual fees for each type of service in advance. The fee schedule is generally based on community or statewide surveys of what providers are charging. Total revenue (TR) for healthcare providers under FFS can be formulated as $TR=N \times P \times M$. For the jth patient visit, $pi$ represents the price of each item used or the cost of each service provided, and ai is the amount consumed. Variable costs of each patient visit are equal to $V_j$, the accumulation of amount multiple price per item, or cost per service. For each patient visit, $V_j$ represents the type and intensity of utilization consumed. TVC is the summation of expenses of Q patient visits. Simply put, $TVC=V \times Q \times P$.

Table 2: EHR functions, potential benefits and returns

<table>
<thead>
<tr>
<th>EHR Function</th>
<th>Potential Benefits</th>
<th>Returns</th>
<th>%FFS</th>
<th>%PPS</th>
<th>%Cap</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPOE</td>
<td>Improve coding and charge capture</td>
<td>$\bigcirc$</td>
<td>$\bigcirc$</td>
<td>$\bigcirc$</td>
<td></td>
<td></td>
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<tr>
<td>Lab test Alert</td>
<td>Reduce lab tests</td>
<td>$\bigcirc$</td>
<td>$\bigcirc$</td>
<td>$\bigcirc$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Telecommunication</td>
<td>Reduce office visit</td>
<td>$\bigcirc$</td>
<td>$\bigcirc$</td>
<td>$\bigcirc$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Returns</td>
<td></td>
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</table>

Note: $\bigcirc$ suggests positive returns; $\bigcirc$ suggests negative returns; $\bigcirc$ suggests no financial effects.

For healthcare providers, total variable cost is a function of volume (V), price (P) and quantity (Q), i.e., $TV=V \times Q \times P$. For the jth patient’s visit, $pi$ represents the price of each item used or the cost of each service provided, and ai is the amount consumed. Variable costs of each patient visit are equal to $\sum a$, the accumulation of amount multiple price per item, or cost per service. For each patient visit, $V_j$ represents the type and intensity of utilization consumed. TVC is the summation of expenses of Q patient visits. Simply put, $TVC=V \times Q \times P$.

**Fee for service.** Under fee for service, insurers usually determine a fee schedule listing individual fees for each type of service in advance. The fee schedule is generally based on community or statewide surveys of what providers are charging. Total revenue (TR) for healthcare providers under FFS can be formulated as $TR=V \times Q \times P$.

**Prospective payment system.** Since 1983, Medicare has been using a prospective payment system to reimburse hospitals for inpatient acute care services to control healthcare expenditures. Instead of paying for each service provided, PPS pay a pre-determined flat rate for each diagnosis-related group. A DRG represents a group of patients that is homogeneous in terms of the amount of resources necessary for treatment. Under prospective payment, a provider’s total revenue is the accumulation of the DRG rates (R) of Q patient visits, that is $TR=Q \times R$. In short, $TR=Q \times R$.

To maintain profits, providers need to keep the variable cost of each patient visit $V_j$ below $R_j$, or $V_j \times P < R_j$, which provides an incentive for providers to control both V and P.

A prospective payment system puts V and P under control but still leaves Q untouched. As such, EHRs’ ability to control V, such as reducing duplicate tests, will increase providers’ income, while reported benefits that can reduce Q, such as reducing office visits, still have a negative impact on a provider’s financial results.

**Capitation.** Managed care organizations grew in response to uncontrolled escalations in the cost of providing healthcare in the 1990s. A mechanism used by these organizations for reimbursing providers is capitation. A provider is paid a fixed monthly fee per enrollee, regardless of whether an enrollee sees the provider or not and regardless of how often an enrollee sees the provider. Under capitation, a provider’s total revenue is the product of the number (N) of enrollees and the per member per month rate (PMPMR), TR=N×PMPMR. Providers can increase their income if they can enlarge the number of enrollees they serve and, at the same time, control the quantity of patient visits Q and per-visit variable cost (V×P).

Capitation provides an incentive for providers to control Q, V and P all together. As pointed by Wang et al., returns on EHRs under capitated reimbursement primarily come from averted costs as a result of decreased utilization. Under capitation, providers can realize the most reported financial benefits by adopting EHRs. Wang et al’s research suggests that the higher the portion of capitated patients, the greater returns providers can reap from investment in an EHR.

To get a more accurate estimate, the ratios of patients that are reimbursed by different payment methods should be taken into consideration in quantifying returns on an EHR. Table 2 gives an example of how to do the calculation. If the EHR system will integrate or has integrated multiple practice settings, such as outpatient and inpatient, it is better to further break down returns according to different settings, as the ratios %FFS, %PPS and %Cap, because the benefit structure for EHR implementation might be different in different sectors.

**PUBLIC RETURNS AND THE GAP IN ROI ANALYSIS**

Thus, under certain payment mechanisms, some reported benefits can’t be realized by providers, or they may even suffer a financial loss in adopting EHRs. However, benefits that cannot be realized by providers are not lost; they are just transferred from...
the internal returns to a provider to the public value and thus to external stakeholders.

Table 3 provides a sample of the distribution of benefits between payors and providers under different payment mechanisms. Taking reductions in office visits as an example, if providers cannot realize the benefits, payors can as long as the quality of care does not decrease, and patients can save time and money as well.

A public ROI value proposition was developed and presented in Figure 1 to further explain the liquidity of benefits. Returns from an EHR investment can flow from the internal improvements in a healthcare entity, resulting in returns to external stakeholders, such as patients, insurers and employers. Other returns can flow to the economic environment and contribute to the improvement of the public-at-large benefit.

Benefits estimated at the national level usually include internal returns to providers, external returns to patients and payors, as well as part of public-at-large benefits. For example, in RAND’s national cost-benefit analysis,2 efficient savings are identified from 10 different sources, such as transcription improvement, utilization reduction in drug, lab test and radiology. By contrast, micro ROI analysis usually focuses on providers’ internal returns but bears the full cost of EHR; as a result, the net ROI of an EHR project may be relatively modest or even negative.

That can help explain why there is a gap between micro negative ROI and macro positive benefits/costs analysis. As long as providers cannot reap all the benefits of their investment in an EHR system—in other words, if external returns exist in such an investment—the underadopted status of EHRs might not change fundamentally. Furthermore, as the objective of EHR investment focuses more on patient-centered quality of care improvements rather than revenue cycle management, more of the returns of EHR investment will be generated and transferred to patients and other external stakeholders. The ROI problem might be even aggravated, which does not bode well for further expansion of EHRs.

Exceptions may occur in large systems, particularly those that are operated by healthcare insurers or employers themselves, such as Kaiser Permanente and the VA, because the ROI analysis of such systems usually includes public values enclosed in the dashed circle of Figure 1. The Veterans Health Information Systems and Technology Architecture (VistA) won the 2006 Innovations in American Government Award. The innovation fact sheet pointed out that “the cost of maintaining VistA is $87 per patient per year, only slightly more than the cost of one unnecessarily repeated lab test.” In the VA’s case, the logic is perfectly right, as both the cost of maintaining VistA and the cost of lab tests are financed by the government—what the left pocket invested, the right pocket gained back. However, for most healthcare providers, the cost of maintaining an EHR system will be recorded as a fixed cost, and the cost of a lab test is also a cost but might be reimbursed as revenue.

**PAY FOR PERFORMANCE**

There are now at least 115 private programs tying physician payment to performance, and some Medicare reimbursements are now being linked to quality performance. Highlighting the public effort is the CMS’ Premier Hospital Quality Incentive demonstration (HQID). The project will provide significant leverage in the healthcare market because of CMS’ buying power and its influence on private pay for performance programs.

More than 260 hospitals participated in the voluntary HQID program, and performance data in five clinical areas—acute myocardial infarction, heart failure, coronary artery bypass graft, pneumonia and hip and knee replacement, were tracked and reported. The top 10 percent of performers in 33 specific catego-

### Table 3: Distribution of benefits between payors and providers

<table>
<thead>
<tr>
<th>Reported Benefits</th>
<th>Payers</th>
<th>Providers</th>
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<tr>
<td></td>
<td>FFS</td>
<td>PPS</td>
</tr>
<tr>
<td>Reduce medical errors</td>
<td>🌟</td>
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<tr>
<td>Improve preventive practices</td>
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<td>🌟</td>
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<tr>
<td>Reduce duplicate tests</td>
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<td>🌟</td>
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<tr>
<td>Reduce office visits</td>
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Note: 🌟 suggests positive financial effects; 🌟 suggests negative financial effects; 🌟 suggests no financial effects or hard to estimate.

To realize the financial gain on these reported savings, a healthcare provider must be able to translate those benefits either into revenue growth or cost savings, or both.
ries received a 2 percent increase in reimbursement on their Medicare DRG payments. Hospitals in the second 10 percent received a 1 percent bonus.

Medicare has paid $8.85 million in first-year incentive payments and $8.69 million in the second year. If the demonstration program expands from the 260 participants to all 5,600 hospitals in the United States, the bonus cost will be substantial and might receive little support from lawmakers because Medicare is already very costly and program expenditures are growing rapidly. The Institute of Medicine suggests the use of a budget-neutral existing-funds model to support pay for performance programs. “This model reduces payments to all or selected types of providers for redistribution to those exhibiting higher quality in examined areas.” In other words, the “fine,” or reduced payment, paid to low-quality performers will fund the reward pool. Actually, in year three of HQID, CMS will begin to penalize hospitals that do not achieve performance improvements above the demonstration baseline by lowering DRG payments by 1 percent or 2 percent.

In the demonstration program, the performance bonus is a percentage increase in the DRG payment. Pay for performance does not replace the prospective payment system, but rather is an extra payment mechanism established on top of it. To get the quality reward, participants need to pay for the extra processes that collect, measure and report clinical data. From a financial perspective, the decision of whether to participate in the pay for performance program is based on marginal benefits—that is, whether the performance bonus will be enough to cover the expenses of data reporting.

The clinical decision support capabilities of some EHR systems can facilitate higher quality care, as shown in Table 1, and EHR’s data mining and reporting modules can improve the efficiency, completeness and accuracy of collecting and reporting data for pay for performance programs. For providers that already have advanced EHR systems, the performance bonus will come as an extra reward. For those that already have been equipped with basic EHRs but have limited functionality to support decision making or data mining, pay for performance will provide a strong incentive for them to catch up, because the bonus will be relatively easy to obtain.

Pay for performance will give an impetus to providers that have already considered adopting EHRs. However, for those that have neither an EHR system nor an interest in implementing one, pay for performance approaches may make no difference; that is because the marginal cost is high; even worse, potential cuts in payments may leave them with insufficient resources to maintain their current quality of care. In light of the low adoption rate of EHRs so far, providers standing in this camp may not be in the minority, making it hard to estimate the overall impact of pay for performance on EHR adoption. To achieve the best incentive effects of P4P on EHR adoption, more exchanges of evidence-based experiences and some form of startup funds are necessary.

CONCLUSIONS AND LIMITATIONS

Reported benefits support the assertion that EHRs can improve the efficiency of the healthcare delivery system by reducing overuse and misuse of healthcare resources. EHRs also enable and
support new communication channels that are efficient and inexpensive between healthcare providers and patients.

Payment mechanisms play an important role in whether and to what extent reported benefits can be translated into financial returns for healthcare providers. For example, under fee for service, most reported benefits, such as reductions in duplicate tests or office visits, will have a negative effect on a provider’s financial performance; under capitation, providers can reap those profits.

Returns from adopting an EHR can flow from the internal improvements in a healthcare entity, resulting in returns to external stakeholders. Existing ROI analysis typically focuses on providers’ internal ROI, and therefore the net ROI of an EHR project may be relatively modest or even negative. As long as providers cannot reap all the benefits of their investment in an EHR system—in other words, if external returns exist in such investments—the under-adopted status of EHRs might not fundamentally change.

EHRs can improve clinician’s compliance with P4P guidelines and promote the collection and reporting of quality data. But the true impact of the financial incentives offered under P4P related to EHR adoption is not clear. This study assumes that within the relevant period, the fee schedule, capitation rate or DRG rate is fixed and not affected by the adoption of an EHR. If the wide adoption of an EHR enables providers to deliver the same level of care for less cost, payors may reduce the payment rate, which will change the benefits distribution.

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