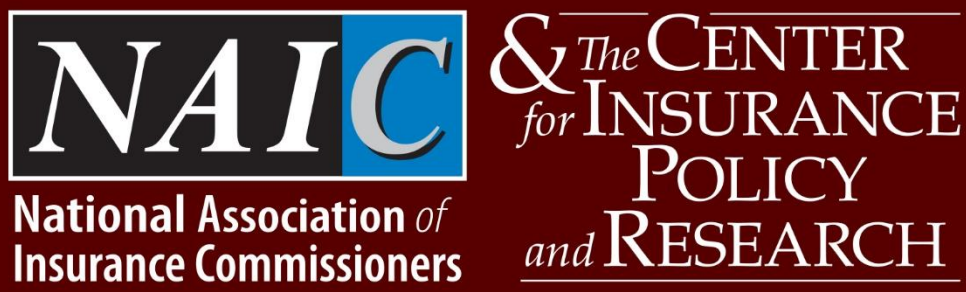

CIPR Research Study

Rising Health Care Costs: Drivers, Challenges and Solutions (Installment 3 of 3)

Healthcare Administrative Workflow: Costs and Savings Opportunities

By Kristine Burnaska, Ph.D., Director of Research and Measurement,
Council for Affordable Quality Healthcare

Cutting Wasteful Health Spending – Policy Options

By Daniel P. O'Neill, Robert Wood Johnson Foundation (RWJF) Health Policy Fellow,
National Academy of Science, and
David Scheinker, Clinical Associate Professor, Stanford University School of Medicine

Big Data Analytics and Health Care – Using Data Science to Reduce Health Care Costs

By John Frenzel, MD, Director, Division of The Learning Health System,
The University of Texas, Anderson Cancer Center

Adoption of Value-Based Payments Leveraging Fee-for-Service Lessons

By Erin Weber, Council for Affordable Quality Healthcare Committee on
Operating Rules for Information Exchange

AUGUST 2020

Rising Health Care Costs: Drivers, Challenges and Solutions

This National Association of Insurance Commissioners (NAIC) Center for Insurance Policy and Research (CIPR) study presents independent research the purpose of which is to inform and disseminate ideas to regulators, consumers, academics and financial services professionals. CIPR studies are available at no cost on the CIPR website: www.naic.org/ cipr_special_reports.htm

This study would not have been possible without the valuable contributions by members of the CIPR and the notable authors from the academic community and industry distinguished for their expertise in health care. All the contributors are listed on page ii.

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Rising Health Care Costs: Drivers, Challenges and Solutions

Foreword

This CIPR study brings together thought leaders, researchers and practitioners in the health care field to provide a wide spectrum of viewpoints on the rising cost of care. The study, by intention, is a compilation of individually authored papers designed to address various drivers of health care costs. The contributing authors also present recent government actions and advance possible solutions for state insurance regulators and other stakeholders to consider.

Following the release of the: i) executive summary and the first paper "Food is Medicine: Why Healthier Eating Should Be a Priority for Health Care Providers, Insurers and Government"(December 2018); and ii) the second installment containing the three papers of "Addressing High Health Care Cost Drivers—A Critical Role for Insurance Regulators"; "Regional Cost Variation and the Collaborative Path to Affordability"; and "Prescription Drug Cost Drivers" (August 2019); this is the third and final installment of the study.

This third installment contains four papers that continue to examine the underlying factors driving health care costs as well as offering up policy options to address them. The first paper ("Healthcare Administrative Workflow: Costs and Savings Opportunities") focuses on addressing administrative costs, highlighting saving opportunities to not only reduce health care spending, but also to ultimately direct more resources towards patient care. The second paper ("Cutting Wasteful Health Spending – Policy Options") examines how wasteful spending varies across different types of healthcare markets while highlighting market specific policy options to curb this wasteful spending to inform state and national policymakers. The third paper ("Big Data Analytics and Health Care – Using Data Science to Reduce Health Care Costs"), following from a technological historical understanding of the healthcare industry, provides an overview of some of the potential opportunities for the better use of big data analytics in health care today in order to improve the patient experience with corresponding avoided costs. And lastly the fourth paper ("Adoption of Value-Based Payments Leveraging Fee-for-Service Lessons") describes how value-based care as an alternative to the traditional fee-for-service payment system provides a potential opportunity to improve individual care and population health while changing the trajectory of national health expenditures.

We note that the views expressed in these papers are the opinions of the authors. They are not meant to represent the position or opinions of the NAIC/CIPR or its members. They are also not the official position of any staff members. The intent of these papers is to inform policymakers and further the conversation on effective health care cost solutions.

Healthcare Administrative Workflow: Costs and Savings Opportunities

By Kristine Burnaska, Ph.D., Director of Research and Measurement, CAQH

Introduction

Addressing administrative costs has the potential to not only reduce health care spending, but also to direct more resources towards patient care. While the health care industry has made significant progress to automate and reduce costs associated with administrative functions, the U.S. still spends more on health care and administrative services than any other developed nation.[1] As noted in the paper *Cutting Wasteful Health Spending – Policy Options for State Leaders* included in this series, administrative complexity accounts for a large slice of the total national health expenditures that could be eliminated without harming consumers or care quality.

Spending on health care administration costs an estimated $350 billion annually due to its complexity.[2] Data from the 2019 Council for Affordable Quality Healthcare (CAQH) Index, as shown in Figure 1 (on the next page), indicates that $40.6 billion, or 12% of the $350 billion spent on administrative complexity, is associated with conducting administrative transactions tracked by the CAQH Index. Of the $40.6 billion spent on these transactions, $13.3 billion, or 33% of existing annual spending on administrative transactions, could be saved by completing the transition from manual and partially electronic processing to fully electronic processing. The progress that the industry has already made to automate these administrative transactions has saved the industry more than $102 billion annually.

The 2019 CAQH Index estimates that the medical industry has avoided more than $96 billion in annual administrative costs through efforts to automate administrative transactions. By comparison, the dental industry has avoided more than $6 billion annually. For both industries, the largest annual savings has been achieved for eligibility and benefit verification at $68.8 billion for the medical industry and $3 billion for the dental industry. However, although the industry has already avoided significant administrative costs through automation, 33% of existing spending could be saved through further automation.

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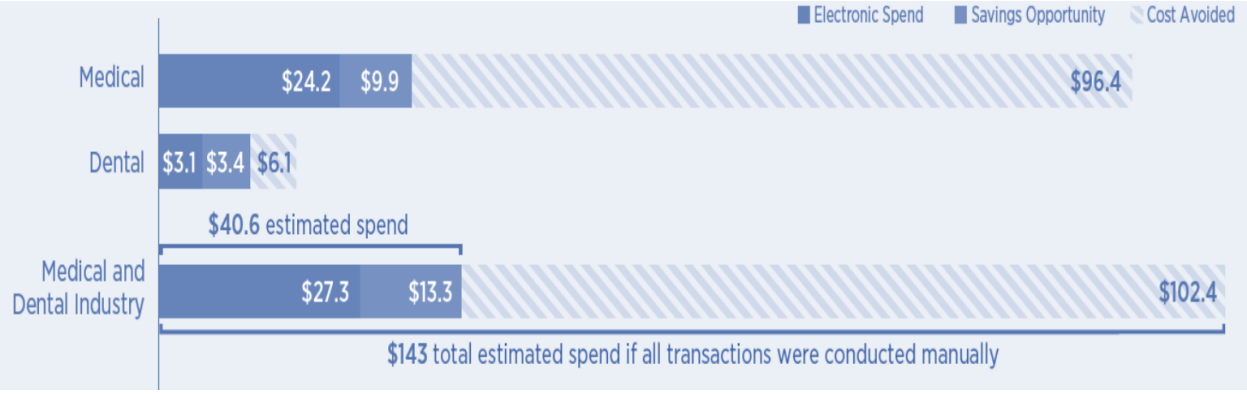
[1] Shrank, WH., TL Rogstad, and N. Parekh, 2019. "Waste in the US Health Care System: Estimated Costs and Potential for Savings," *Journal of the American Medical Association (JAMA)*, 322(15):1501–1509. Accessed at: *https://jamanetwork.com/journals/jama/article-abstract/2752664*.

[2] *www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/NationalHealthExpendData/NationalHealthAccountsHistorical.*

Figure 1: Estimated Medical and Dental Spend and Savings (in $Billions)

Source: CAQH



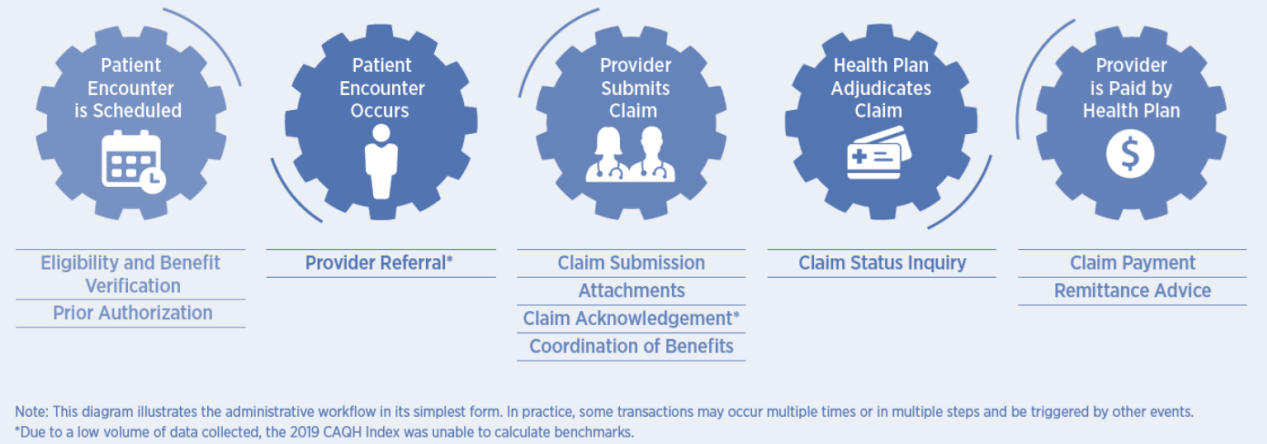
To continue to drive progress, harmonization is needed across all stakeholders to reduce administrative costs and burden. Aligning on a common understanding of the barriers to electronic adoption and the business needs of the future is imperative for plans, providers, vendors, standards development organizations, operating rule authoring entities and government to maintain and improve upon industry achievements to date.

Manual vs. Electronic Administrative Workflow Cost Comparison

The business of health care can be complex and includes various administrative transactions conducted routinely between health care providers before, during and after a patient-provider encounter. Understanding the workflow associated with administrative transactions (Figure 2), the level of spending and potential savings opportunities allow the health care industry to identify pain points and target areas for improvement.

Figure 2: Administrative Workflow Diagram

Source: CAQH



The Council for Affordable Quality Healthcare (CAQH), through its CAQH Index, tracks adoption of electronic administrative transactions between medical and dental health care providers and health plans. These transactions include verifying a patient's insurance coverage, obtaining authorization for care, submitting a claim and supplemental medical information, and sending and receiving payments. The CAQH Index also estimates the annual volume of these transactions, their cost and the time needed to complete them by mode (manually, partially electronic portal, or fully electronic (HIPAA standard).[3]

By benchmarking progress, industry and government can more easily identify barriers that may be preventing stakeholders from realizing the full benefit of electronic administrative transactions. These insights can prompt new initiatives to address and reduce barriers. Here we use the CAQH Index to compare manual vs. electronic costs in the administrative workflow and to then identify potential savings opportunities from transferring these activities to electronic transactions only.

Health care industry stakeholders made progress in 2019—in adoption of electronic transactions and the reductions in the volume of manual transactions. However, continued efforts are needed to significantly reduce the volume of expensive, time-consuming manual transactions and adapt to the changing administrative needs of the health care system.

Knowing the full cost associated with the administrative workflow can help organizations measure efficiency and productivity. Table 1 provides the average cost per transaction and the associated cost savings opportunity for health plans, health care providers and the medical industry overall to move from manual to electronic transactions. The medical industry could save as much as $42.45 (including $29.27 for providers and $13.18 for plans) for a single patient encounter requiring all eight of the transactions tracked by using a fully electronic workflow.

The greatest per transaction savings opportunities associated with moving from a manual to a fully electronic transaction for the medical industry include prior authorization ($12.31), claim status inquiry ($7.72), and eligibility and benefit verification ($7.55). Claim status inquiry ($10.23) and eligibility and benefit verification ($9.33) also had the greatest per transaction savings opportunities for the dental industry. Savings also exist for transactions that are conducted using partially electronic web portals versus the fully electronic federal Health Insurance Portability and Accountability Act (HIPAA) standards. For example, medical providers could save, on average, $2.11 per transaction by completing a prior authorization using the HIPAA-mandated standard as opposed to a web portal.

[3] The CAQH Index cost and saving estimates only account for the labor time required to conduct the transactions. They do not reflect the time and cost associated with gathering information for the transactions. Systems costs are also excluded from the cost and savings estimates.

Table 1: Average Cost per Transaction for Manual, Partial and Electronic Transactions and Savings Opportunity (2019 Index)

Source: CAQH

Transaction	Method	Plan Cost	Provider Cost	Industry Cost	Plan Savings Opportunity	Provider Savings Opportunity	Industry Savings Opportunity
Eligibility and Benefit Verification	Manual	$3 .47	$5 .30	$8 .77	$3 .43	$4 .12	$7 .55
	Partial	$0 .04	$2 .03	$2 .07	$0 .00	$0 .85	$0 .85
	Electronic	$0 .04	$1 .18	$1 .22			
Prior Authorization	Manual	$3 .32	$10 .92	$14 .24	$3 .27	$9 .04	$12 .31
	Partial	$0 .05	$3 .99	$4 .04	$0 .00	$2 .11	$2 .11
	Electronic	$0 .05	$1 .88	$1 .93			
Claim Submission	Manual	$0 .92	$3 .30	$4 .22	$0 .83	$2 .33	$3 .16
	Electronic	$0 .09	$0 .97	$1 .06			
Attachments	Manual	$0 .56	$4 .50	$5 .06	$0 .34	$2 .17	$2 .51
	Electronic	$0 .22	$2 .33	$2 .55			
Coordination of Benefits	Manual	$1 .05	N/A	$1 .05	$0 .87		$0 .87
	Partial	$0 .18	N/A	$0 .18	$0 .00		$0 .00
	Electronic	$0 .18	N/A	$0 .18			
Claim Status Inquiry	Manual	$3 .48	$6 .65	$10 .13	$3 .44	$4 .28	$7 .72
	Partial	$0 .04	$2 .25	$2 .29	$0 .00	($0 .12)	($0 .12)
	Electronic	$0 .04	$2 .37	$2 .41			
Claim Payment	Manual	$0 .67	$2 .51	$3 .18	$0 .59	$1 .00	$1 .59
	Electronic	$0 .08	$1 .51	$1 .59			
Remittance Advice	Manual	$0 .46	$3 .76	$4 .22	$0 .41	$2 .55	$2 .96
	Partial	$0 .05	$2 .15	$2 .20	$0 .00	$0 .94	$0 .94
	Electronic	$0 .05	$1 .21	$1 .26			

The volume of transactions is also important in identifying workflow pain points. As shown in Table 2, the highest-volume transaction is eligibility and benefit verification. In combination with the per-transaction cost savings opportunity, eligibility and benefit verification represents more than 43% of the total savings potential for the medical industry and offers the highest savings opportunities for both plans and providers.

Table 2: Estimated National Volume per Transaction and Savings Opportunity, Medical (2019 CAQH Index in $Millions)

Source: CAQH

Transaction	Method	Plan National Volume (in Millions)	Provider National Volume (in Millions)	Plan National Savings Opportunity (in $ Millions)	Provider National Savings Opportunity (in $ Millions)	Industry National Savings Opportunity (in $ Millions)
Eligibility and Benefit Verification	Manual	110	653	$378	$3,864	$4,242
	Partial	1,471	1,388			
	Electronic	8,093	7,633			
Prior Authorization	Manual	30	27	$99	$355	$454
	Partial	50	52			
	Electronic	12	13			
Claim Submission	Manual	155	217	$128	$507	$635
	Electronic	3486	3424			
Attachments	Manual	142	150			
	Electronic	35	27			
Coordination of Benefits	Manual	18	N/A	$16		$16
	Partial	*	N/A			
	Electronic	116	N/A			
Claim Status Inquiry	Manual	67	457	$231	$1,931	$2,162
	Partial	305	203			
	Electronic	858	571			
Claim Payment	Manual	146	49	$86	$49	$135
	Electronic	333	430			
Remittance Advice	Manual	71	167	$29	$1,822	$1,851
	Partial	1535	1489			
	Electronic	1689	1638			
Transaction Total	**Manual**	**739**	**1720**	**$1,015**	**$8,854**	**$9,589**
	Partial	**3361**	**3132**			
	Electronic	**14622**	**13736**			

Industry stakeholders can use the CAQH Index to identify and prioritize opportunities in their administrative workflow for improvement by considering both the cost of a transaction and the number of those transactions conducted annually. Below we go through each administrative workflow transaction and identify the potential savings opportunities using the combined cost index and volume data.

Eligibility and Benefit Verification

The eligibility and benefit verification transaction establishes a common understanding between the health plan, provider and patient about benefit status and financial roles and obligations at a specific point in time. The American Medical Association (AMA) encourages providers to verify patient eligibility one to two weeks prior to an appointment or at the time of scheduling.[4]

Eligibility and benefit verification continued to be the highest volume transaction measured in the medical industry, and its use continued to grow. Medical industry volume rose by 14% from the 2018 CAQH Index report. The number of transactions per member also increased from 26 annually to 30—still the highest number per member of all medical transactions measured. Provider spending accounted for 95% of the total spending. Providers have indicated that complicated benefits have resulted in additional points of contact with plans as providers check on a patient's eligibility and benefits multiple times throughout a patient encounter.

Potential Savings

Even though adoption of the electronic eligibility and benefit verification transaction is relatively strong for the industry, the high volume of this transaction magnifies the impact of the small proportion of manual transactions. An additional $5.2 billion can be saved annually across both the medical and dental industries by converting the remaining manual and partially electronic web portal transactions to fully electronic transactions. This is the largest single transaction savings opportunity identified by the 2019 CAQH Index.

While only 15% of medical transactions were conducted via a web portal as partially electronic, there is a sizable savings opportunity by moving to fully electronic transactions. The industry could save 85 cents per transaction by conducting eligibility and benefit verifications electronically using the HIPAA standard as opposed to a web portal. This switch would result in an annual savings opportunity of $1.2 billion

Prior Authorization

Prior authorization transactions involve engagement between a provider and a health plan to clarify, request and obtain approval for coverage of specific health care services for individual patients under specific circumstances.

Electronic prior authorization adoption by medical plans remained low relative to other

[4] McComas, H., 2018. "Revenue Cycle Management in Medical Practice," STEPS Forward, American Medical Association. Accessed at *https://www.stepsforward.org/Static/images/modules/20/downloadable/Revenue_cycle.pdf.*

administrative transactions, with only a one percentage point increase in electronic adoption compared to the 2018 CAQH Index report.

While spending on prior authorization constitutes only two percent of the overall medical industry transaction spend ($631 million), prior authorization is the costliest, time consuming administrative transaction for providers. On average, providers spent almost $11 per transaction to conduct a prior authorization manually and nearly $4 using a web portal.

Prior authorization has been the subject of intense debate and industry attention over the years, with stakeholders across the industry calling for action to simplify the process.[5,6,7,8] Although a national standard exists for prior authorization, adoption of this standard has trailed that of other transactions for which a standard is in place.

Potential Savings

The medical industry could save an additional $454 million annually by transitioning to fully electronic transactions. The opportunity for savings is greater for providers vs. plans, with a savings opportunity of $355 million for providers and $99 million for plans. This savings opportunity is on top of the $679 million in annual costs that the industry has already avoided spending, primarily through the use of web portals. However, moving from web portals to fully electronic transactions could reduce physician burden by $2.11 per transaction.

Claim Submission

Claim submission continues to have the highest electronic adoption rate among the transactions studied. The volume of medical claim submissions increased by 14%. Per member volume for the medical industry increased slightly from 10 transactions per member annually to 11 transactions per member annually. The number of transactions conducted per member annually remains the second highest of the transactions reported.

The medical industry spent a total of $4.5 billion on claim submissions, representing 13% of the total medical industry spend on administrative transactions reported.

Claims data has long been essential to health system and population health initiatives. It has been

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[5] *www.ama-assn.org/sites/default/files/media-browser/public/arc-public/prior-authorization-consensus-statement.pdf*.
[6] Luthi, S., 2018. "Senate panel eyes regulating insurance prior authorizations," *Modern Healthcare*, July 31, 2018. Accessed at *www.modernhealthcare.com/article/20180731/NEWS/180739979*.
[7] Frieden, J., 2018. "Healthcare Admin Costs Can Be Tamed, Senators Told," *MedPage Today*, July 31, 2018. Accessed at *www.medpagetoday.com/publichealthpolicy/healthpolicy/74340*.
[8] *www.hfma.org/Content.aspx?id=61486*.

mined for insights on the prevalence of common diseases and to estimate the number of individuals who remain undiagnosed.[9] Data from claims is also essential to risk adjustment, performance measurement and value-based payment.[10]

Potential Savings

Although electronic claim submission is the lowest cost transaction for providers in both industries, there is still a $635 million savings opportunity for the medical industry and $177 million for the dental industry by converting the remaining manual claim submissions to electronic transactions. Through automation, the medical and dental industries have avoided more than $12 billion in total costs annually by transmitting claims primarily through the HIPAA-mandated electronic transaction.

Claim Status Inquiry

Claim status inquiry was the second most expensive transaction to conduct manually ($10.13) and electronically ($2.41) for the medical industry. Combined, the medical and dental industries spent more than $6.2 billion in the past year on claim status inquiries. Of the total annual spending reported for administrative transactions, claim status inquiries accounted for 15% of total medical spend.

Electronic claim status inquiry has been a useful fee-for-service (FFS) revenue cycle tool. These transactions have helped providers and their vendors follow claims as they progress through adjudication and have given them an opportunity to intercede when issues arise that could delay or prevent approval of a claim.[11] This electronic transaction has also become widely accessible—79% of practice management systems offer solutions related to claim status inquiries.[12]

Potential Savings

The medical industry could save more than 42% of the existing spend on claim status inquiries, or $2.2 billion, by moving manual and partially electronic web portal inquiries to fully electronic transactions. The savings potential associated with claim status inquiry is the second highest

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[9] Dall, T., Y. Zhang, Y. Chen, W. Quick, W. Yang, and J. Fogli, J., 2010. "The Economic Burden of Diabetes," *Health Affairs*, 2010, 29(2), 297–303. Accessed at *https://doi.org/10.1377/hlthaff.2009.0155*.

[10] CAQH, 2018. "All Together Now: Applying the Lessons of Fee-for-Service to Streamline Adoption of Value-Based Payments." Accessed at *www.caqh.org/sites/default/files/core/value-based%20payments/core-value-based-payments-report.pdf*.

[11] LaPointe, J., 2018. "Hospitals Wait 16 More Days for Late Payments from Claim Denials," *RevCycleIntelligence,* May 7, 2018. Accessed at *https://revcycleintelligence.com/news/hospitals-wait-16-more-days-for-late-payments-from-claim-denials*.

[12] CAQH. 2018. "2017 CAQH Index: A Report of Healthcare Industry Adoption of Electronic Business Transactions and Cost Savings."

savings opportunity for the medical industry behind the eligibility and benefit verification transaction.

Most of this savings opportunity would occur for providers ($1.9 billion) who conduct more of these transactions manually. The $2.2 billion in total potential savings is on top of the $7.3 billion in annual costs that the medical industry has already avoided by transitioning most manual claim status inquiries to electronic transactions.

Claim Payment

Payment is one of the last steps in the administrative workflow. Electronic claim payment, or electronic funds transfer (EFT) via ACH27, moves money electronically from one account to another, taking the place of paper checks.

For medical plans, electronic claim payment adoption increased by seven percentage points, reaching 70%. Electronic adoption for claim payment showed the greatest increase from the 2018 report compared to the other reported transactions for the medical industry.

The volume of claim payments for the medical industry rose 18%. This increase in volume closely matches the increase reported for claim submission. However, medical claim submission volume is higher than claim payment volume given payments are often made in bulk where one payment is associated with multiple claims.

Potential Savings

The medical industry spent $896 million on claim payments in 2019, accounting for only 3% of spending on administrative transactions. By conducting claim payments electronically, the medical industry could save $135 million annually.

Remittance Advice

Electronic remittance advice (ERA) and electronic claim payment, also referred to as EFT, work in tandem to enable automated reconciliation and communication of reimbursement. An ERA is an electronic explanation of payments made to the provider by the health plan. It includes information about the patient, the service or procedure performed, the provider and any claims adjustments.

Health plans report that the combination of increased volume and portal use is the result of duplicate postings of remittance advice on a health plan portal and through the standard electronic transaction to ensure that a provider can access the information through multiple channels as needed.

After prior authorization and attachments, this transaction has the lowest electronic adoption at 51%. Partially electronic adoption increased four percentage points, while manual adoption dropped seven percentage points to a near negligible level of 2%. For the medical industry, overall volume increased by 31%, driven by the continued increase in duplicate use of ERA transactions and web portals. Nearly $6 billion was spent by the medical industry on remittance advice, corresponding to roughly 20% of the annual total spend on administrative transactions. Spending on remittance advice represented the second highest administrative transaction expense for the medical industry.

Potential Savings

For the second year in a row, the savings opportunity for the medical industry declined from $2.4 billion in the prior index report to $1.9 billion. The decline reported in the 2018 report was a result of a reduction in the manual cost of a transaction, while the decline this year was a result of lower manual volume. Despite this continued decline, remittance advice remains the third highest cost savings opportunity, with 76% of the savings opportunity associated with eliminating the mostly duplicative use of web portals.

Call to Action

As the industry evolves and the volume and complexity of administrative transactions rise, the need to streamline, automate and adapt business processes to changing business needs will continue to be a challenge. Despite these challenges, the industry should be encouraged by the annual costs that can be avoided through automation. Most of the health care industry savings correspond to transactions with higher electronic adoption levels, as shown for eligibility and benefit verification and claim submission. Efforts to automate administrative transactions can continue to deliver savings. However, standards, operating rules and technology must keep pace with the needs of the industry.

CAQH offers the following actions for the industry:

Focus Efforts to Reduce Provider Burden

Given that the majority of savings opportunities are attributed to medical and dental providers, the greatest opportunity to reduce administrative costs is to focus on transactions like eligibility and benefit verification, claim status, remittance advice, and prior authorization. For example, new findings from the 2019 CAQH Index suggest that provider burden could be reduced by switching from partially electronic web portals to fully electronic transactions. Providers could save, on average, nine minutes for a single patient encounter through the administrative workflow if all transactions were conducted using the fully electronic method instead of through web portals.

Accelerate Standards and Operating Rule Development

To maintain and foster ongoing adoption of fully electronic transactions, standards and operating rules must support changing business needs. In particular, standards and operating rules must adapt to the need for alignment between administrative and clinical data. The National Committee on Vital and Health Statistics (NCVHS), in a letter to the U.S. Department of Health and Human Services (HHS), provided recommendations to promote interoperability and reduce provider and regulatory burden

As the health care industry evolves, administrative processes need to adapt to address changing market needs to minimize the use of expensive, time-consuming manual processes. For example, value-based payment arrangements often have more complex data sharing requirements than was anticipated with existing standards and operating rules. As a result, these arrangements between health plans and providers frequently lead to manual processing or partially electronic portals to transact information.

Encourage Timely Vendor Adoption of Standards and Operating Rules

There is an opportunity for vendor systems to support the adoption of electronic transactions through more timely and comprehensive deployment of new and updated standards and operating rules. The vendor community can accelerate the adoption and support the ongoing use of electronic transactions by prioritizing the development of solutions to address the gaps and cost savings opportunities identified in this report.

Pursue a More Expansive Exploration of Administrative Operations

Numerous barriers—cost, resistance to change, lack of vendor support and others—have been suggested as possible contributors to challenges associated with adoption. However, in order to truly address the primary savings opportunities identified in this report, a more refined understanding of the barriers to electronic adoption of administrative transactions by health care providers is needed by all stakeholders.

Further, to identify and quantify cost-saving opportunities related to evolving market needs for electronic administrative transactions, more detailed research is needed to understand a broader range of functions and costs associated with the administrative workflow. Improving efficiency of the health care administrative workflow requires long-term commitment by all stakeholders. The strategies proposed here address the greatest opportunities and needs and identify areas for top performers to help peers overcome barriers to automation.

Cutting Wasteful Health Spending – Policy Options

By Daniel P. O'Neill,[13] David Scheinker[14]

Introduction

Wasteful spending—outlays for health services that could be eliminated without harming consumers or care quality[15]—deserves unflagging attention from researchers, clinicians and policymakers. The Institute of Medicine (IOM) estimated that waste consumed 30% of American health dollars in 2009.[16] Berwick and Hackbarth, working from a 2011 baseline, pegged the midpoint of reasonable waste estimates even higher, at 34%.[17]

A crude extrapolation of these figures, given the steady rise in overall health expenditures, implies that wasted spending now comfortably exceeds $1 trillion annually. (See Figure 1 on the next page.) This sum could fund the entire Medicaid program twice over.

There are significant benefits to basing policy on critiques that do not treat health care as if it were a single industry. At $3.3 trillion, the U.S. health care economy is larger than the entire economy of India. It is a mosaic of smaller markets for certain services or products, each further subdivided by the varying rules, pricing models and administrative mechanics of a specific provider-payer pair.

Figure 2 (see page 3) illustrates this segmentation by payer-provider pairs. For example, medical equipment manufacturers derive roughly three-quarters of their revenue from out-of-pocket payments, while pharmaceutical vendors (i.e., prescription drugs) rely on such payments for less than 15% of drug bills. This shapes each industry's sales and marketing strategy and is likely to affect patterns of spending and waste.

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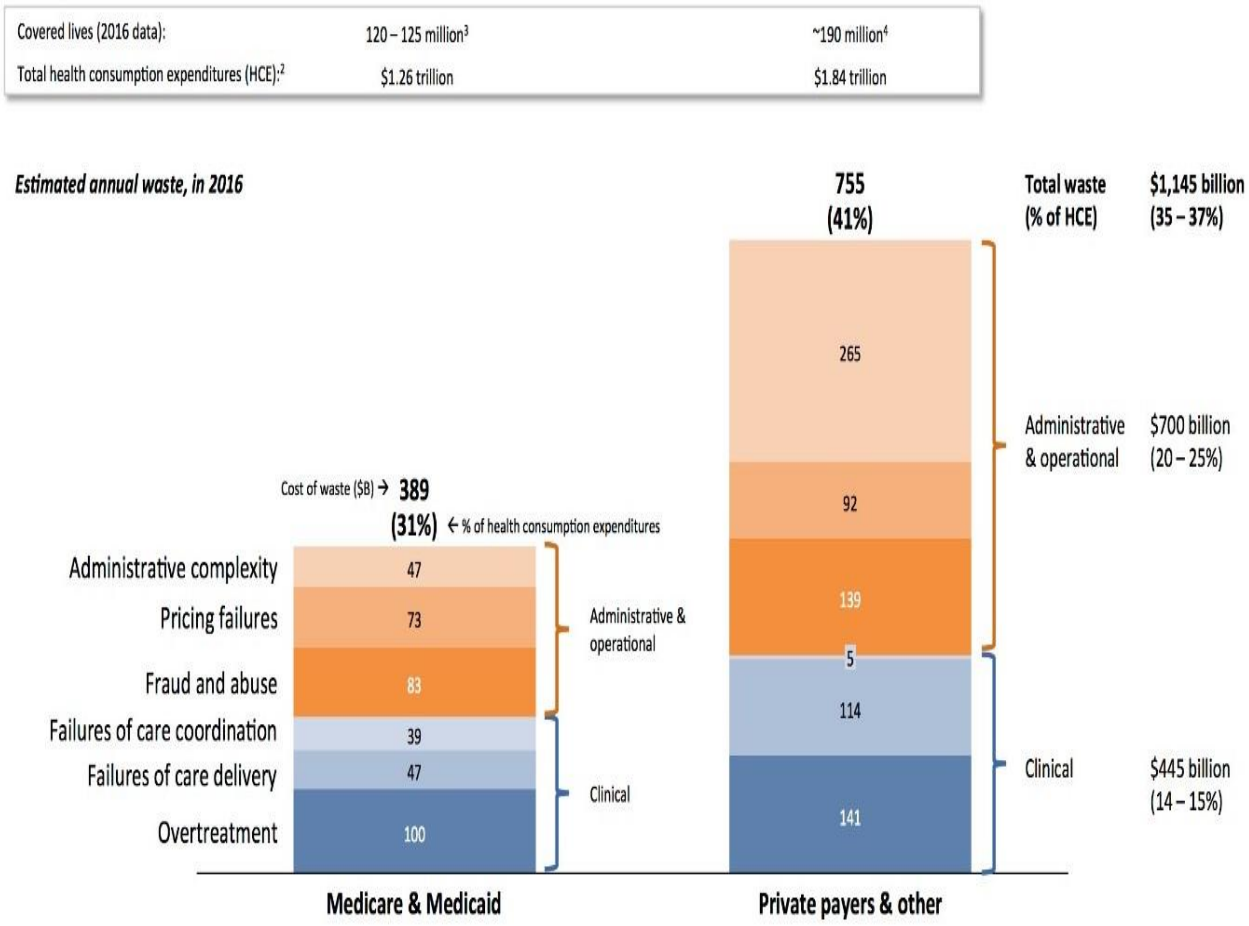
[13] Robert Wood Johnson Foundation (RWJF) Health Policy Fellow, National Academy of Science.
[14] Clinical Associate Professor, Stanford University School of Medicine.
[15] Commonwealth of Massachusetts, Health Policy Commission, 2013. "2013 Cost Trends Report," Annual Report. Accessed at: *www.mass.gov/files/documents/2016/07/rq/2013-cost-trends-report-final.pdf.*
[16] Institute of Medicine of the National Academies, 2012. "Best Care at Lower Cost, The Path to Continuously Learning Health Care in America," Report Brief, September 2012. Accessed at: *www.nationalacademies.org/hmd/~/media/Files/Report%20Files/2012/Best-Care/BestCareReportBrief.pdf.*
[17] Berwick, D.M., and A.D. Hackbarth, 2012. "Eliminating Waste in US Health Care," *Journal of the American Medical Association*, April 11, 2012; 307(14): 1513–1516.

Figure 1: Causes of Waste in the U.S. Health Care System

Sources: Authors' calculations based on work by Berwick and Hackbarth[18,19]



1) Waste categories and magnitudes based on work by Donald Berwick and Andrew Hackbarth, "Eliminating Waste in U.S. Healthcare," JAMA. 2012;307(14):1513-1516. Original estimates based on 2011 spending levels have been extrapolated to 2016 using NHE data.
2) Health consumption expenditures include all National Health Expenditures, less investment (research, structures and equipment) and public health outlays by federal and state governments.
3) Includes 55.8M Medicare enrollees, 71.2M Medicaid enrollees and 6.5M children covered by CHIP, per CMS data, less ~10M lives covered by both Medicare and Medicaid in 2016, per the American Community Survey.
4) Includes 173.1M lives covered by employer sponsored insurance in 2016, plus 17.5 million covered by a plan purchased directly, of which the majority bough plans on an ACA exchange. To avoid double counting, this figure excludes 7.3M individual Medigap plans.

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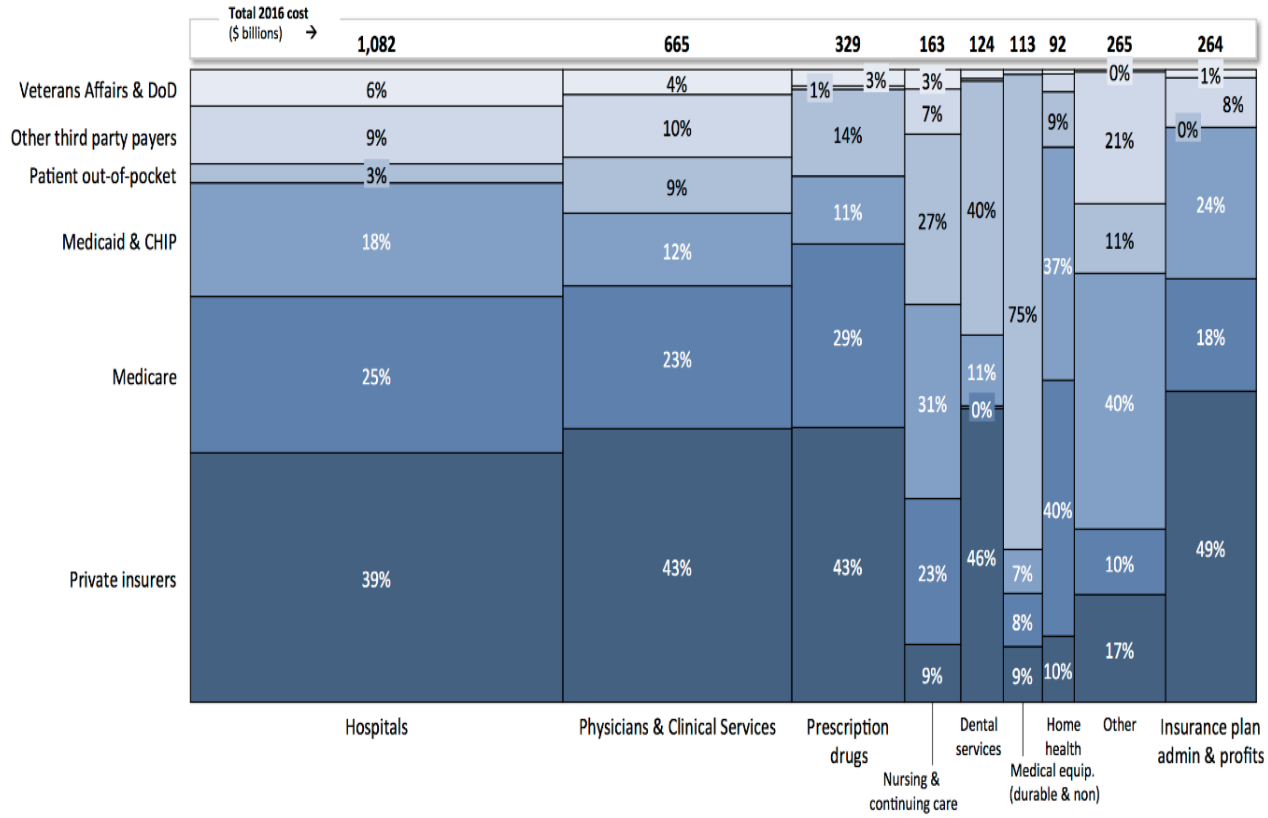
[18] Original estimates based on 2011 spending levels have been extrapolated to 2016 using National Health Expenditures (NHE) data. 1) Health consumption expenditures include all NHE, less investment (research, structures, and equipment) and public health outlays by federal and state governments. 2) Includes 55.4 million Medicare enrollees, 71.2 million Medicaid enrollees, and 6.5 million children covered by the Children's Health Insurance Program (CHIP) per the federal Centers for Medicare & Medicaid Services (CMS) data, less 10 million lives covered by both Medicare and Medicaid in 2016, per the American Community Survey. 3) Includes 173.1 million lives covered by employer-sponsored insurance in 2016, plus 17.5 million covered by a plan purchased directly, of which the majority bought plans on a federal Affordable Care Act (ACA) exchange. To avoid double counting, this figure excludes 7.3 million individual Medigap plans.

[19] Berwick, D.M., and A.D. Hackbarth, 2012. "Eliminating Waste in US Health Care," *Journal of the American Medical Association*, Apr 11, 2012; 307(14): 1513–1516.

Figure 2: Breakdown of 2016 Health Care Expenditures, by Source of Funds
(% of total cost in each category incurred by each payer type)
Source: National Health Expenditures, Centers for Medicare & Medicaid Services



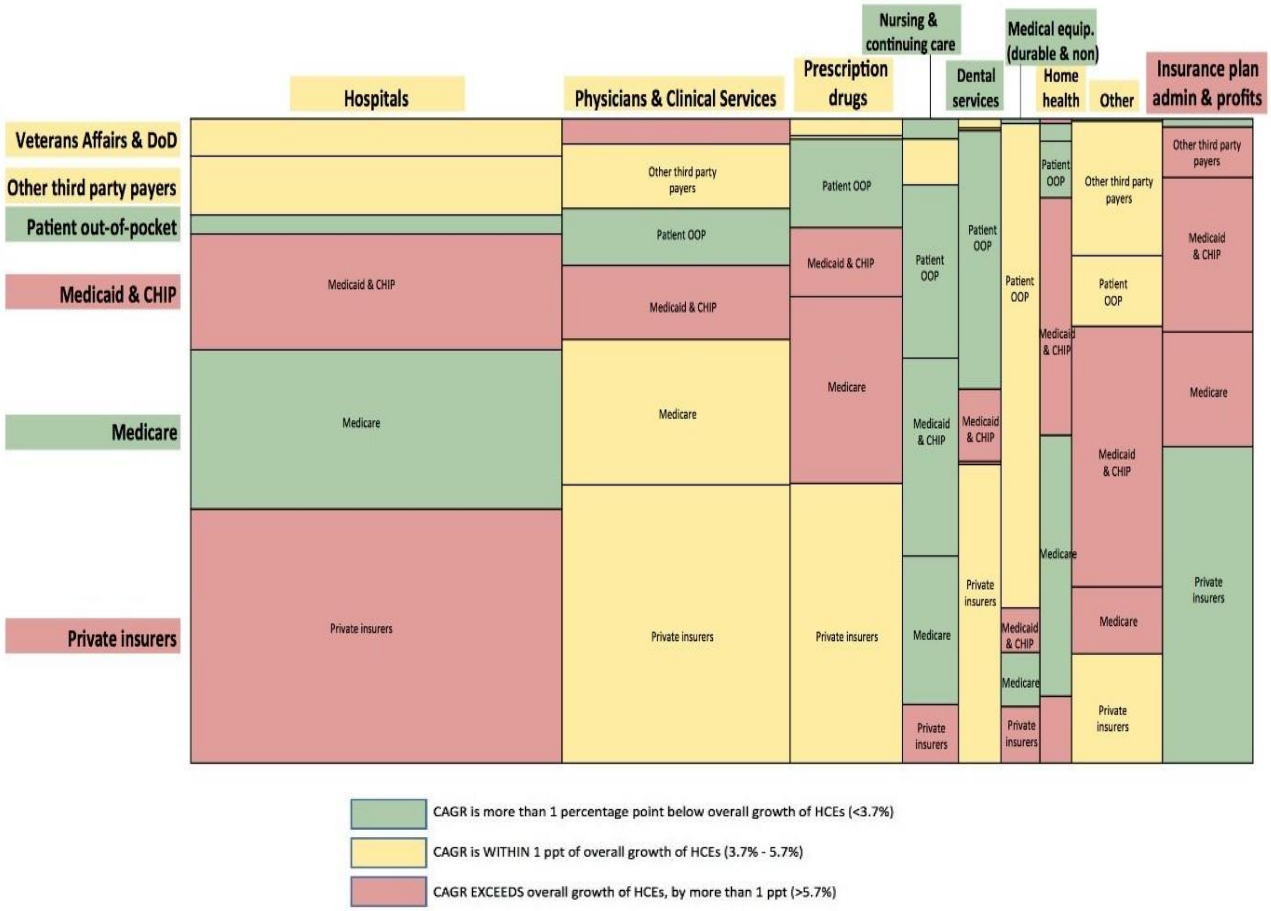
From another perspective, more than 90 million Americans carry coverage under a risk-adjusted, quality-rated plan funded by either Medicare Part C[20] or a state-run managed Medicaid program.[21] The economic incentives and administrative requirements in these coverage segments are distinct from the traditional fee-for-service model, and there is evidence that this structure can shape the choice of facilities[22] and use of preventative services.[23]

There is significant evidence that the dynamics of these sub-segments differ significantly. Figure 3 (next page) highlights variations in the relative growth of these sub-segments. Kenneth Thorpe has observed that the underlying drivers of spending growth differ sharply by the source of health insurance,24 with

[20] www.kff.org/medicare/state-indicator/ma-total-enrollment/.
[21] PwC, 2017. "The Complicated State of Medicaid in the United States, Stability Amidst Considerable Future Uncertainty," October 2017.
[22] Meyers, D.J., V. Mor, and M. Rahman, 2018. "Medicare Advantage Enrollees More Likely to Enter Lower-Quality Nursing Homes Compared to Fee-for-Service Enrollees," *Health Affairs,* Vol. 37, No. 1, January 2018.
[23] The Henry J. Kaiser Family Foundation, 2014. "What Do We Know About Health Care Access and Quality in Medicare Advantage Versus the Traditional Medicare Program," Report, November 2014.
[24] Thorpe, K.E., 2018. "Accounting for Health Spending Growth: Observations From The Past Several Years," *Health Affairs Blog*, March 26, 2018. Accessed at: www.healthaffairs.org/do/10.1377/hblog20180321.489080/full/.

enrollment and disease prevalence the major factors for Medicare and Medicaid, while the cost of individual cases is the primary culprit in the privately insured population. Detailed analysis of private claims confirms this latter point, finding relatively flat utilization of most health services from 2012 to 2016, with price hikes explaining most of the overall cost increase.[25]

Figure 3: Heat Map: 2011–2016 Growth in Health Consumption Expenditures
(Figures include all health consumption expenditures except public health activities)
Source: National Health Expenditures, Centers for Medicare & Medicaid Services



Given these market segments and likely impact on spending and waste, this chapter examines waste and spending together in market-specific contexts to generate new insights to inform state and national policymakers. We explore a few major themes of this market-specific approach to analyzing waste, including incentive structures, administrative complexity, and differences between private and public payers. We draw some preliminary conclusions about how waste may vary across these markets and highlight policy options to curb wasteful spending.

[25] HCCI, 2018. "2016 Health Care Cost and Utilization Report." Accessed at: *https://healthcostinstitute.org/annual-reports/2016-health-care-cost-and-utilization-report.*

What We Know About the Prevalence of Waste Across Markets

Despite much attention to the overall scale of waste, the allocation of that burden is not well-understood. Given the scale of the care delivery ecosystem, and limited availability of comparable claims and clinical data, the extant literature tends to provide highly aggregated system-level estimates[26] or a narrow look at a specific clinical service or care setting (e.g., health care-associated infections in the hospital setting[27]). Despite those limitations, we can draw three key insights into variations in waste and who bears the brunt of that unnecessary spending:

1. Private insurers—and ultimately employers and individuals who pay premiums—account for a disproportionate share of the waste attributable to administrative complexity and billing bureaucracy.

In 2012, Berwick and Hackbarth's meta-analysis estimated the relative incidence of waste within Medicare and Medicaid, and across the heath system as a whole.[28] (See Figure 3 on the previous page.) If we compare their reported figures to overall health consumption expenditures (HCEs) by certain payer types, the Berwick and Hackbarth assessment found waste on the order of 31% of HCEs within Medicare and Medicaid, but 41% across the rest of the system, which is predominantly funded through private insurers.[29] Waste rooted in administrative complexity—estimated at 14% of private payer outlays—accounts for the bulk of the difference.

Berwick and Hackbarth's conclusion is supported by other research. Using cross-country data, Himmelsten et al. find that administrative overhead consumes 25% of outlays on U.S. hospitals, which is far higher than in countries that do not rely on multiple private payers, with the difference due to "the complexity of the reimbursement system."[30] While the existence of many private payers imposes an administrative burden on provider organizations, private payers also account for a disproportionate share of the administrative overhead that occurs within coverage organizations. According to National Health Expenditure data, private insurers absorb

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[26] PricewaterhouseCoopers' Health Research Institute, 2008. "The Price of Excess, Identifying Waste in Healthcare Spending."

[27] Scott, R.D., 2009. "The Direct Medical Costs of Healthcare-Associated Infections in U.S. Hospitals and the Benefit of Prevention," Division of Healthcare Quality Promotion National Center for Preparedness, Detection, and Control of Infectious Diseases Coordinating Center for Infectious Diseases Centers for Disease Control and Prevention, March 2009.

[28] Berwick, D.M., and A.D. Hackbarth, 2012. "Eliminating Waste in US Health Care," *Journal of the American Medical Association*, April 11, 2012; 307(14): 1513–1516.

[29] Berwick, D.M., and A.D. Hackbarth, 2012. "Eliminating Waste in US Health Care," *Journal of the American Medical Association*, April 11; 307(14): 1513–1516.

[30] Himmelrstein, D.U., M. Jun, R. Busse, K. Chevreul, A. Geissler, P. Jeurissen, S. Thomson, M.A. Vilnet, and S. Woolanfer, 2014. "A Comparison of Hospital Administrative Costs In Eight Nations: US Costs Exceed All Others By Far," *Health Affairs,* Vol. 33, No. 9, Sept. 2014. Accessed at: *www.healthaffairs.org/doi/full/10.1377/hlthaff.2013.1327*.

administrative overhead (and profits) equivalent to $600 to $700 annually per member, as compared with about $200 for Medicare's traditional fee-for-service model, whose nationally consistent coverage and large scale approximate the performance of the less fragmented payer models in many other developed countries.[31] Indeed, private insurance companies account for ~83% of the total net cost of health insurance in the U.S.[32]

2. Patients and private insurers may be particularly exposed to the cost of unnecessary or low-value outpatient services, such as diagnostic imaging for uncomplicated headaches.

Macro waste estimates shed less light on the relative burden of waste arising from clinical practice, but increasing availability of claims data does permit some emerging conclusions. For example, Minnesota's all-payer claims database (APCD) suggests that patients paid about 17% of the cost for many low-value procedures out of pocket, as compared with the 12% of overall costs paid out-of-pocket in the state. These charges covered such services as prostate-specific antigen (PSA) screening in men over the age of 75, diagnostic imaging for uncomplicated headaches or low back pain, and unnecessary preoperative testing. Commercial insurers were also disproportionately affected, absorbing more than half of these unnecessary costs, well ahead of their 38% share of overall health expenses. Separate research has established that Medicare and (particularly) Medicaid pay lower rates for many clinical services than private payers and that Medicaid tends to deny or review the largest fraction of claims. Providers may, therefore, be more likely to promote low-value services to the buyers that pay higher prices and impose fewer reimbursement hurdles; this variance may also reflect the efficacy of prior authorization or payment rules under government programs.

3. Given its membership demographics, Medicare is heavily affected by the cost of failures of care coordination, in hospital and skilled nursing facilities (SNFs).

Berwick and Hackbarth judged Medicare and Medicaid programs much more exposed to failures of care coordination—the costs arising from "complications, hospital readmissions, declines in functional status, and increased dependency, especially for the chronically ill."33 Specifically, they found 3% of Medicare and Medicaid outlays to be wasted through care coordination failures, as compared with less than 0.5% of spend by other payers. This likely stems from Medicare's membership, which includes the elderly, disabled and those with end stage renal disease (ESRD) or amyotrophic lateral sclerosis (ALS), all groups that tend to have more complex needs and are more likely to suffer major declines in functional status if that care falls short. Detailed research has indeed found adverse events affecting Medicare patients in hospitals and SNFs to be both disturbingly common and very costly.

A study of hospital care in 2008, for example, found that 27% of admitted Medicare beneficiaries

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[31] *www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/NationalHealthExpendData/NationalHealthAccountsHistorical.*

[32] *www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/NationalHealthExpendData.*

[33] Berwick, D.M., and A.D. Hackbarth, 2012. "Eliminating Waste in US Health Care," *Journal of the American Medical Association*, April 11, 2012; 307(14): 1513–1516.

experienced an adverse event causing harm, costing Medicare approximately $4.4 billion a year.[34] Medicare patients admitted to SNFs (usually after hospital discharge) were even more likely to suffer an adverse event, with 39% experiencing temporary or lasting harm.[35] More than half of these events prolonged the SNF stay or necessitated hospitalization, and those resulting hospitalizations account for an additional two percentage points of Medicare's inpatient care costs. Assuming no change in adverse event frequency, the cost of these clinical breakdowns would have exceeded $15 billion in 2017, given the overall rise in Medicare outlays for hospital care. Some surveys have found a substantially lower overall incidence of adverse events when all patients are included, which would reinforce the conclusion that Medicare likely bears a disproportionate share of the waste caused by failures of care coordination.[36]

Are We Making Progress in Trimming Waste? It is Complicated

Differential growth across markets suggests that the waste attributable to administrative complexity is likely on the increase, consuming a larger slice of overall health expenditures (see Figure 4 on the next page). Privately-sponsored coverage—where this waste is most prevalent as discussed above—has increased only marginally over the past five years, as a share of total health consumption expenditures. However, the growth of Medicare Advantage[37] and Managed Medicaid programs[38] have inserted private insurance companies into the reimbursement cycle for a much larger fraction of patients and spending. For example, private insurers now manage 73% of Medicaid beneficiaries, up from 59% in 2013.[39] While private insurer participation in Medicare or Medicaid may have other virtues, their role does increase the net cost of administering coverage, though the impact on provider workflows and staffing is more ambiguous.[40]

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[34] U.S. Department of Health and Human Services, 2018. "Adverse Events in Long-Term-Care Hospitals: National Incidence Among Medicare Beneficiaries," Office of Inspector General, November 2018. Accessed at: *https://oig.hhs.gov/oei/reports/oei-06-14-00530.pdf*.

[35] U.S. Department of Health and Human Services, 2018. "Adverse Events in Long-Term-Care Hospitals: National Incidence Among Medicare Beneficiaries," Office of Inspector General, November 2018. Accessed at: *https://oig.hhs.gov/oei/reports/oei-06-14-00530.pdf*.

[36] Zeesnan, M.F., A.E. Demble, E. Seiber, and B. Lu, 2014. "Incidence of adverse events in an integrated US healthcare system: a retrospective observational study of 82,784 surgical hospitalizations," *Patient Safety in Surgery,* Vol. 8, No. 23, May 27, 2014. Accessed at: *www.ncbi.nlm.nih.gov/pmc/articles/PMC4055940/.*

[37] *www.kff.org/medicare/state-indicator/ma-total-enrollment/.*

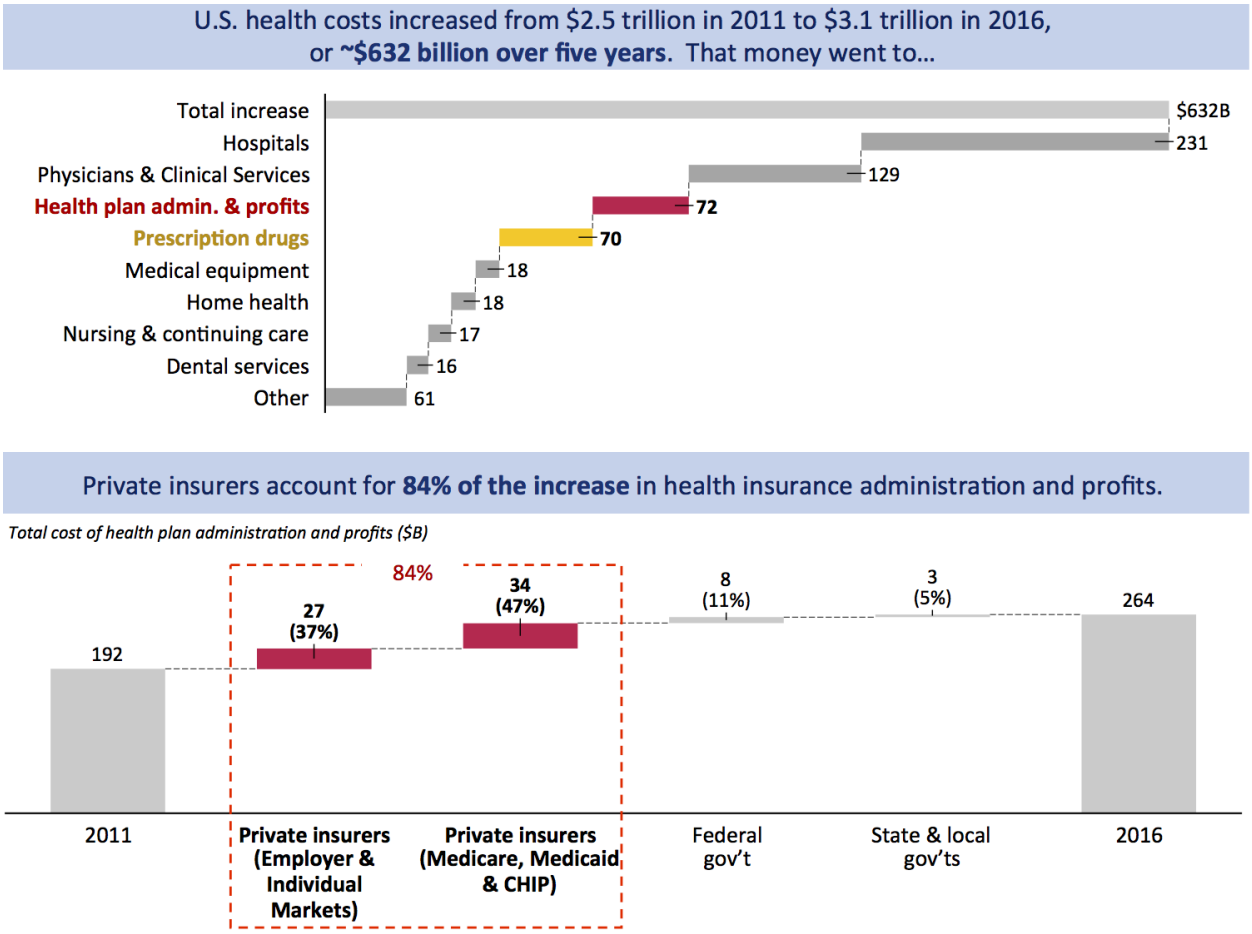
[38] Paradise, J., 2017. "Medicaid Managed Care Growth and Implications of the Medicaid Expansion," *Data Note,* The Henry J. Kaiser Family Foundation, April 2017. Accessed at: *http://files.kff.org/attachment/Data-Note-Medicaid-Managed-Care-Growth-and-Implications-of-the-Medicaid-Expansion*.

[39] PwC, 2017. "The Complicated State of Medicaid in the United States, Stability Amidst Considerable Future Uncertainty," October 2017.

[40] Gottlieb, J.D., A.H. Shapiro, and A. Dunn, 2018. "The Complexity of Billing and Paying for Physician Care," *Research Article, Health Affairs*, Vol.37, No.4, April 2018. Accessed at: *www.healthaffairs.org/doi/10.1377/hlthaff.2017.1325*.

Figure 4: Accounting for the Increase in U.S. Health Costs

Source: National Health Expenditures, Centers for Medicare & Medicaid Services



For waste rooted in unnecessary or low-value care—overtreatment, in Berwick and Hackbarth's framework[41]—the growth picture is mixed. Overall, patient out-of-pocket expenses have declined as a share of total health consumption expenditures, from 12.6% in 2011 to 11.4% in 2016 (per NHE data). However, both direct patient charges and private insurance payments have remained a consistent portion of the clinical services category, which encompasses many of these low-value diagnostics and procedures, while this cost category has grown at a 6.8% compound rate over the past five years. To the extent that low-value services are disproportionately charged to patients and commercial insurers, these growth trends suggest that the cost of overtreatment likely remains a relatively consistent portion of overall spending.

Finally, there is reason for guarded optimism on Medicare's costs from care coordination deficits. While overall hospital costs are growing faster than overall health expenditures, Medicare has

[41] Berwick, D.M., and A.D. Hackbarth, 2012. "Eliminating Waste in US Health Care," *Journal of the American Medical Association*, April 11, 2012; 307(14): 1513–1516.

successfully contained its own hospital costs (See Figure 3 on page 4). Further, recent research finds meaningful improvements in patient safety within hospitals,[42] suggesting fewer adverse events and less resulting cost.

Policy Considerations for Leaders at the State Level

Given this backdrop and the inherently local nature of many health care markets, there is substantial scope for regulators and legislators to cut health costs by tackling waste at the state level. The most promising policy options focus on: 1) administrative overhead rooted primarily in the complex private insurance segment; 2) rules and incentives to curb overtreatment; and 3) rate caps and antitrust actions to address pricing failures in opaque, concentrated health care markets. We provide detail on these three aspects in turn below:

1. Administrative Complexity (>$300 Billion of Waste, Nationally)
    a. Common payment platform

Reimbursement stems from the underlying structure of American care delivery and coverage, where each provider must bill multiple health plans, each with its own coding and authorization rules and payment methods, and the parallel cost to each health plan of interacting with thousands of hospitals and clinics. Just as Stripe43 has constructed a single platform to allow companies from Lyft to Target to transact seamlessly, a "common healthcare payment system (but not necessarily the same payment rates) could be … imposed through legislation."44

Such a platform could operate like the regional Medicare Administrative Contractors (MAC)45 but implement the same coding, authorization and payment rules for a given service, across all participating health plans.

    b. Simpler, site-neutral payments

Government and private payers often pay a different price for the same service depending on the facility type and allow for fine-grained price differences based on the complexity of the service. This introduces additional coding and documentation for physicians and hospitals (e.g., to identify a hospital outpatient department vs. an independent physician practice) and health plans to invest in software and staff to audit claims for fraud and overbilling.

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[42] Owens, P.L., R. Limcangco, M.L. Barret, K.C. Heslin, and B.J. Moore, 2018. "Patient Safety and Adverse Events, 2011 and 2014," Statistical Brief #237, Healthcare Cost and Utilization Project, Agency for Healthcare Research and Quality.

[43] *https://stripe.com/customers.*

[44] Anderson, G., and B. Herring, 2015. "The All-Payer Rate Setting Model for Pricing Medical Services and Drugs," *AMA Journal of Ethics,* 17(8): 770–775, August 2015. Accessed at: *https://journalofethics.ama-assn.org/article/all-payer-rate-setting-model-pricing-medical-services-and-drugs/2015-08*.

[45] *www.cms.gov/Medicare/Medicare-Contracting/Medicare-Administrative-Contractors/What-is-a-MAC*.

The federal Centers for Medicare and Medicaid Services (CMS) has already moved to pay the same rates for a given service,[46] regardless of facility type, and has proposed collapsing the codes for office visits into two or three categories[47] to simplify billing. States could follow suit through their own Medicaid programs and contractors, and mandate similar changes for private insurers.

c. All-payer rate schedule

Maryland has long operated an "all-payer" hospital rate schedule in which local hospitals are paid the same price regardless of whether the patient is insured by Medicare, Medicaid or a private plan. Such a comprehensive program could require federal waivers and significant bureaucratic capacity, but narrower versions for specific service lines—e.g., mandating that the Medicare fee schedule apply to all emergency services—could trim the complexity of multi-payer billing. Moreover, it would narrow the staff and systems costs of duplicative contract negotiations for every provider/payer pair.

2. Overtreatment (~$250 Billion)

a. Accelerate outcomes-based reimbursement, with multi-payer gain-sharing contracts

Many providers and insurers have embraced various forms of outcomes-based reimbursement, or value-based care, including bundled payments for surgical procedures, quality bonuses and capitation, and shared savings for primary care groups. Several of these models—particularly physician-led accountable care organizations (ACOs)[48] and bundled payments[49]—have cut costs with no loss of quality. And, because they dampen incentives for unnecessary testing and treatment, broader adoption of these reimbursement models should reduce overtreatment.

b. Mandate compliance with clinical guidelines

States can use licensing authority, Medicaid reimbursement and the federal Affordable Care Act (ACA) exchanges to eliminate procedures deemed "unscientific," "redundant" or "excessive,"

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[46] *www.cms.gov/newsroom/press-releases/cms-empowers-patients-and-ensures-site-neutral-payment-proposed-rule.*

[47] Morse, M., 2018. "CMS final rule delays coding reforms that affect physician payment," *HealthCare Finance,* Nov. 1, 2018. Accessed online at: *www.healthcarefinancenews.com/news/cms-final-rule-delays-coding-reforms-affect-physician-payment*.

[48] McWilliams, M.J., L.A. Hatfield, B.E. Landon, P. Hamed, and M.E. Chernew, 2018. "Medicare Spending after 3 Years of the Medicare Shared Savings Program," *The New England Journal of Medicine*, 379: 1139–1149, Sept. 20, 2018. Accessed at: *www.nejm.org/doi/full/10.1056/NEJMsa1803388*.

[49] Barnett, M.L., A. Wilcock, M. McWilliams, A.M. Epstein, K.E. Joynt Maddox, E.J. Orav, D.C. Grabowski, and A. Mehrotra, 2019. "Two-Year Evaluation of Mandatory Bundled Payments for Joint Replacement," *The New England Journal of Medicine*, 380: 252–262, Jan. 17, 2019. Accessed at: *www.nejm.org/doi/full/10.1056/NEJMsa1809010*.

using priorities established by authoritative national groups.[50] For example, Covered California—the state's ACA exchange—has moved to exclude hospitals that perform unnecessary cesarean sections (C-sections) or overuse opioids[51] or diagnostic imaging from the networks of all health plans on the exchange. Medicaid programs can exert similar pressure, while quality measures might become part of licensing rules.

c. Shift financial liability for unnecessary care to providers

In a similar vein, states could explicitly protect patients from financial liability for treatment or tests that are unnecessary under established guidelines. Today, health plans may deny payment for such care, but hospitals, physicians and diagnostic firms can still bill patients, creating a financial incentive for provider organizations to overtreat. Such a rule would not prevent patients from choosing to purchase services deemed unnecessary by a health plan but would create a stronger incentive for professionals with clinical expertise to choose wisely.[52]

d. Incentivize analytics-driven care

Clinicians are often forced to make decisions in situations for which no standard or care or evidenced-based best practice has been established. A variety of approaches have been proposed for standardizing clinical care, and as a result reducing unnecessary care, based on an analysis of historical data. These include using historical patient data to set care-targets,[53] to suggest medication choices[54] and to generate an informatics consult.[55] In order to expand the scope and impact of such projects, states could provide legislative incentives and funding.

3. Pricing Failures ($150 Billion)

a. Establish rate caps or mandatory arbitration for out-of-network charges

For service lines where it is unrealistic for patients to ensure they receive care only from in-network providers (e.g., emergency care, anesthesiology, neonatology, pathology, etc.), or in local

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[50] Lipitz-Snyderman, A., and P.B. Bach, 2013. "Overuse: when less is more … more or less," *JAMA Intern Medicine,* 173(14): 1277–1278, July 22, 2013. Accessed at: *www.ncbi.nlm.nih.gov/pmc/articles/PMC3805025/.*

[51] *www.npr.org/sections/health-shots/2018/05/23/611975420/californias-message-to-hospitals-shape-up-or-lose-in-network-status.*

[52] *www.choosingwisely.org/.*

[53] Algaze, C.M., A.Y. Shin, C. Nather, K.H. Elgin, C. Ramamoorthy, K. Kamra, A. Kipps, V. Yarlagadda, M. Mafla, T. Vashist, C. Krawczeski, P.J. Sharek, 2018. "Applying Lessons from an Inaugural Clinical Pathway to Establish a Clinical Effectiveness Program," *Pediatric Quality and Safety*, Vol. 3, Issue 6, p. 115, November–December 2018. Accessed online at: *https://journals.lww.com/pqs/Fulltext/2018/11000/Applying_Lessons_from_an_Inaugural_Clinical.1.aspx.*

[54] Bertsimas, D., N. Kallus, A.M. Weinstein, and Y.D. Zhuo, 2017. "Personalized Diabetes Management Using Electronic Medical Records," 40(2): 210–217, February 2017. Accessed at: *www.ncbi.nlm.nih.gov/pubmed/27920019.*

[55] *https://shahlab.stanford.edu/greenbutton.*

markets with limited competition, physician groups (and some hospitals) have used the option of remaining out of network to negotiate higher rates from insurers[56] or to balance bill patients at rates that are many times higher than what Medicare would pay for the same service. This can be financially devastating for patients, and—perhaps more perniciously—has been shown to cause price inflation for in-network rates in these specialties, raising overall health costs and, ultimately, insurance premiums.[57] Two established models warrant consideration in states looking to protect consumers and temper overall health cost inflation:

i. Medicare advantage-style rate caps on out-of-network care for privately insured patients

When a patient on a private Medicare Advantage (MA) plan visits an out-of-network facility, that provider may not bill more than the Medicare fee schedule. This shifts bargaining power, such that privately negotiated hospital and physician rates under MA plans hew closely to Medicare prices. In contrast, hospital prices for patients with employer-sponsored or individual insurance average almost 90% higher than Medicare prices.[58] Some states have already moved to protect consumers from surprise billing for some out-of-network services,[59] but these rules generally only cover certain services (e.g., emergency care) and may insulate the consumer but not constrain the overall charge. A simpler, clearer approach would borrow the rules in place for the dynamic, competitive MA market, and cap all out-of-network hospital and physician charges at a fixed percentage of the Medicare fee schedule (e.g., 150%), while permitting unfettered bargaining below that ceiling and for outcomes-based reimbursement contracts.

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[56] Cooper, Z., F. Scott Morton, and N. Shekita, 2018. "Surprise! Out-of-Network Billing for Emergency Care in the United States," Yale University, December 2018. Accessed at: *https://isps.yale.edu/sites/default/files/publication/2019/03/oon_doctors_dec2018.pdf.*

[57] Cooper, Z., F. Scott Morton, and N. Shekita, 2018. "Surprise! Out-of-Network Billing for Emergency Care in the United States," Yale University, December 2018. Accessed at: *https://isps.yale.edu/sites/default/files/publication/2019/03/oon_doctors_dec2018.pdf.*

[58] Fuglesten-Biniek, J., A. Bloschichak, and S. Rodriguez, 2019. "Comparing Post-Acute Care Use and First Site of Care Among Medicare Advantage Enrollees and Medicare Fee-for-Service Beneficiaries," Health Care Cost Institute, November 2019. Accessed at: *https://healthcostinstitute.org/hcci-research/comparing-post-acute-care-use-and-first-site-of-care-among-medicare-advantage-enrollees-and-medicare-fee-for-service-beneficiaries.*

[59] Lucia, K., J. Hoadley, and A. Williams, 2017. "Balance Billing by Health Care Providers: Assessing Consumer Protections Across States," The Commonwealth Fund, June 13, 2017. Accessed at: *www.commonwealthfund.org/publications/issue-briefs/2017/jun/balance-billing-health-care-providers-assessing-consumer.*

ii. Establish mandatory "baseball-style" arbitration for out-of-network charges

In 2015, New York state created mandatory arbitration to deal with out-of-network charges, and the approach has shown promising early results.[60] New York's state law bars any balance billing to the patient and uses baseball-style arbitration to mediate between the insurer and provider. In short, because an independent third party chooses one of the two proposals, both parties have an incentive to present reasonable offers. Disclosure of arbitration results can then inform contract negotiations among other providers and insurers, lessening the frequency of disputes over time.

b. Incentivize cost and price transparency

Short of regulatory intervention into price-setting or payer-provider bargaining, purchasers and patients could benefit from greater access from transparent pricing, at least for the minority of health care services that are potentially shoppable.[61] CMS rules now require hospitals to publish machine-readable "chargemaster" data, which may help researchers, akin to disclosure requirements which California implemented in 2006.[62] Prices listed on the chargemaster are not directly relevant to most patients, given the role of insurance contracts and complexity of the data, but expanded disclosure of this type could be useful for researchers and some purchasers (e.g., employers or health plans).[63]

a. Antitrust actions, including:

i. Interventions to block hospital mergers and physician practice acquisitions

Research has established that mergers of hospitals within five miles of each other tended to boost prices by 6%[64] and that hospital acquisitions of physician practices result in higher prices and a greater likelihood that primary care physicians will refer

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[60] Kliff, S., 2018. "There are actually some great policy ideas to prevent surprise ER bills," *Vox,* May 23, 2018. Accessed at: *www.vox.com/policy-and-politics/2018/5/23/17385866/voxcare-prevent-surprise-er-bills*.

[61] Desai, S., L.A. Hatfiel, and L.A. Hicks, 2016. "Association Between Availability of a Price Transparency Tool and Outpatient Spending," *Journal of the American Medical Association*, 315(17): 1874–1881, May 2, 2016. Accessed at: *https://jamanetwork.com/journals/jama/fullarticle/2518264*.

[62] Batty, M. and B. Ippolito, 2017. "Mystery of The Chargemaster: Examining the Role of Hospital List Prices in What Patients Actually Pay," *Health Affairs*, Vol. 36, No. 4. Accessed at: *www.healthaffairs.org/doi/10.1377/hlthaff.2016.0986*.

[63] Batty, M. and B. Ippolito, 2017. "Mystery of The Chargemaster: Examining The Role Of Hospital List Prices In What Patients Actually Pay," Health Affairs, Vol. 36, No. 4. Accessed at: *www.healthaffairs.org/doi/10.1377/hlthaff.2016.0986*.

[64] Cooper, Z., S.V. Craig, SV., M. Gaynor, and J. Van Reenen, 2018. "The Price Ain't Right? Hospital Prices and Health Spending on the Privately Insured," NBER Working Paper No. 21815. Accessed at: *www.nber.org/papers/w21815*.

patients to that (higher cost) hospital.[65] State attorneys general can move to block such mergers, as Washington state has done in a case involving CHI Franciscan, a large hospital chain, and two local physician groups.[66]

ii. Prohibition of anti-competitive terms in provider/insurer contracts

Providers and payers with local market power often impose contractual clauses with anti-competitive effects, such as anti-tiering or anti-steering provisions and most favored nation (MFN) clauses, which tend to raise the price of care.[67] Michigan[68] and Massachusetts[69] have both passed legislation to bar MFN clauses, and California has sued Sutter Health, a chain of 24 hospitals, for anti-competitive behavior, including gag clauses and anti-steering provisions.[70] Active antitrust efforts at the state level could temper the pricing failures, which result in approximately $90 billion of avoidable health costs for private insurers alone.

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[65] Baker, L.C., K. Bundorf, and D.P. Kessler, 2014. "Vertical Integration: Hospital Ownership of Physician Practices Is Associated With Higher Prices And Spending," *Health Affairs*, Vol. 33, No. 5, May 2014. Accessed at: *www.healthaffairs.org/doi/10.1377/hlthaff.2013.1279*.

[66] *www.atg.wa.gov/news/news-releases/ag-ferguson-sues-chi-franciscan-over-price-fixing-and-anticompetitive-kitsap*.

[67] Gaynor, M., F. Mostashari, and P.B. Ginsburg, 2017. "Making health care markets work: Competition policy for health care," Brookings, April 13, 2017. Accessed at: *https://www.brookings.edu/research/making-health-care-markets-work-competition-policy-for-health-care/.*

[68] *www.justice.gov/opa/pr/justice-department-files-motion-dismiss-antitrust-lawsuit-against-blue-cross-blue-shield*.

[69] Gaynor, M., F. Mostashari, and P.B. Ginsburg, 2017. "Making health care markets work: Competition policy for health care," Brookings, April 13, 2017. Accessed at: *www.brookings.edu/research/making-health-care-markets-work-competition-policy-for-health-care/.*

[70] *https://oag.ca.gov/news/press-releases/attorney-general-becerra-sues-sutter-health-anti-competitive-practices-increase*.

Big Data Analytics and Health Care – Using Data Science to Reduce Health Care Costs

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Introduction

Over the past four decades, since the widespread availability of commercially available computing power, the impact of digital technologies on the U.S. economy has been profound. The use of just-in-time inventory practices has improved manufacturing margins. Service industries have been revolutionized with the use of rapid communication enabled by email and the web.

However, health care remains fairly removed from these technological developments. While innovations in administrative and back office functions have been embraced, in the front lines of medicine, at the bedside or in the clinic, paper-based workflows and telephone communications are still present. While this has begun to change with the increasing adoption of electronic health records (EHRs), one of the key expected benefits of this technology has been remarkably absent—i.e., the analytic insight gained from the data to improve delivery of care and outcomes.

The broad economy has seen improvements coming from the competitive advantage derived from the use of data to drive operational effectiveness from analytics. Companies such as Walmart[71] and Federal Express,[72] as well as casinos like Harrah's,[73] consider analytics as a critical enabling component of their continued survival and success.

These companies can deliver a better customer experience at lower cost by harvesting the data collected within the business environment combined with external data sets to give consumers what they want at a price they are willing to pay. They create a competitive advantage and barriers to entry that grow market share and build a sustainable platform.

Health care has not taken this path. While awash in data, its use to improve the patient experience is relatively limited. While changing, medicine still lags behind other service industries in the

[71] Vizard, M., 2012. "FedEx CIO Sees Analytics Driving a World of Enterprise Change," *Dice,* Oct. 4, 2012. Accessed at: https://insights.dice.com/2012/10/04/fedex-cio-sees-analytics-driving-a-world-of-enterprise-change/.

[72] Marr, B., 2017. "Really Big Data At Walmart: Real-Time Insights From Their 40+ Petabyte Data Cloud," *Forbes,* Jan. 23, 2017. Accessed at: www.forbes.com/sites/bernardmarr/2017/01/23/really-big-data-at-walmart-real-time-insights-from-their-40-petabyte-data-cloud/#791a8cd56c10.

[73] Marr, B., 2015. "Big Data At Caesars Entertainment – A One Billion Dollar Asset?" *Forbes,* May 18, 2015. Accessed at: www.forbes.com/sites/bernardmarr/2015/05/18/when-big-data-becomes-your-most-valuable-asset/#77b10ae71eef.

innovation space.[74] Here we provide an overview of some of the potential opportunities for the better use of big data analytics in health care today, following from a historical understanding of how the industry came to this point from a technological perspective.

Economic forces are rapidly reshaping medicine, reducing the role of individual practices and creating large groups of providers. With this change comes the ability for organizations to engage in health care at a broader level and bring the vast amounts of data generated daily in the care of patients to help influence behavior and identify interventions earlier in the disease process. Using insights from relevant populations and affecting the appropriate individuals coupled with aligned financial goals, the health system can work to avoid expense rather than contain it.

Health Care IT Brief Historic Context

Information technology (IT) in health care has been organically integrated into various common functions found in hospital operations. Clinical computing first began as service-specific applications centered on laboratory medicine, pharmacy, and accounting or billing functions. These were relatively structured, transactional environments with minimal process variability and little exposure to clinical workflows.

Essentially closer to the back office, these were reasonably easy applications to install with easily recognized financial and clinical benefits. Running on a mainframe or the departmental minicomputer, the technology could be centrally managed. Updates, code fixes and feature enhancements were minimal as expectations of functionality were constrained.

Over time, these systems grew in sophistication and represented mature infrastructure supporting service lines. Computing technology continued to decline in cost and improve in capacity. With increasingly powerful and less expensive compute and storage, the user interface moved from green screen terminals to distributed personal computers. A powerful network enabled compute in the nurse's station or in the clinic enabled point and click functionality and rich graphical user interfaces (GUIs).

The 1990s was an inflection point in the health care IT application space. Inexpensive personal computers combined with growing network connectivity fostered an explosion of vendor offerings. Established companies were challenged by startups. New smaller companies were able to create a sustainable footprint or were absorbed or pushed out of the marketplace.[75]

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[74] Ginsburg, P.B., A. Loera-Brust, C. Brandt, and A. Durak, 2018. "The opportunities and challenges of data analytics in health care," *Bookings*, Nov. 1, 2018. Accessed at: *www.brookings.edu/research/the-opportunities-and-challenges-of-data-analytics-in-health-care.*

[75] Kohn, D., 2014. "The Evolution of EHRs," *For the Record,* 26(10): 10, October 2014. Accessed at: *www.fortherecordmag.com/archives/1014p10.shtml*.

Many vendors attempted to use their strength in a vertical to branch into adjacent spaces. Lab vendors added pathology, and pharmacy vendors added supply chain management. The Cerner Corp., a leading EHR vendor, started as an inpatient laboratory system. Over time, it acquired other companies and built out a complete suite of products stitched together using custom code and interfaces. The larger names began to create portfolios of offerings that attempted to span the needs of an entire hospital. Unintegrated applications continued to be isolated and were forced to serve smaller and smaller markets.

These vendors had acquired or built the breadth of infrastructure necessary to create a best of breed electronic architecture across the various siloed offerings. For health care providers and hospitals, creation of an electronic platform within an institution was difficult. No single vendor had really achieved a scope of applications to serve the entire workflow.

Institutions that looked to benefit from electronic systems had to select and combine vendor offerings resulting in a "best of breed" strategy. This required time, expertise, work and capital. Hospitals were forced to become their own IT application integration shop. This was a difficult role for chief information officers (CIOs) of the day. It was a risky endeavor often involving costly missteps.

In 2002, the Healthcare Information Management Systems Society (HIMSS) created and published a hierarchical maturity model that began to lay out a roadmap of critical functionality to support a fully electronic integrated workflow.[76] (See Figure 1 on the next page.) This model has become a standard for the industry and presaged the stunning consolidation that has occurred in the EHR space across health care in the U.S.

Over the past decade, the best of breed model has been largely supplanted with integrated software suites incorporating core clinical systems (physician and nursing documentation, scheduling and billing, radiology, lab, and ancillary services). Out of this transformation, a handful of large vendors have emerged to dominate the industry. They provide a platform that can deliver an integrated experience with data flowing between functionalities and a consistent user interface. From a health care executive's perspective, it represented a simplified business model with less IT risk and a commitment of development that would ensure compliance with government mandates and industry best practices.

[76] *www.himssanalytics.org/emram.*

Figure 1: EMR Adoption Model Cumulative Capabilities

Source: Himss Analytics

EMR Adoption Model℠	
Stage	Cumulative Capabilities
Stage 7	Medical record fully electronic; HCO able to contribute CCD as byproduct of EMR; Data warehousing in use
Stage 6	Physician documentation (structured templates), full CDSS (variance & compliance), full R-PACS
Stage 5	Closed loop medication administration
Stage 4	CPOE, CDSS (clinical protocols)
Stage 3	Clinical documentation (flow sheets), CDSS (error checking), PACS available outside Radiology
Stage 2	Clinical Data Repository, Controlled Medical Vocabulary, Clinical Decision Support System, may have Document Imaging
Stage 1	Ancillaries – Lab, Rad, Pharmacy - All Installed
Stage 0	All Three Ancillaries Not Installed

Data from HIMSS Analytics™ Database

While the maturity of application offerings enabled the health care delivery industry to move onto monolithic EHR platforms, continued improvement in the cost and performance of compute and storage enabled increased digitization of health information. Widespread adoption of digital radiology Picture Archiving and Communication System (PACS), as well as document imaging and archiving, brought enormous quantities of data into the digital environment. Moreover, it eliminated the manual handling of these artifacts with concomitant cost efficiencies, somewhat an echo of the original lab systems of decades before.

However, the complete benefit of this digitization has not been fully realized because the information these records contain are simply the digital representation of the physical media. In other words, benefits are derived only from reduction in physical storage, retrieval and handling. The full integration of the data into the EHR either from scanned documents or diagnostic insights from radiograph-based machine learning is the next step in harnessing advanced compute to reduce costs in medicine. A similar effort is currently underway in pathology, with digitization of slide images helping to facilitate faster workflow and slide review.

Moving to Data Integration for Big Data Analytics

I. Transactional System Consolidation and Impact on Data Aggregation and Reporting

Best of breed EHRs consisted of siloed applications each providing a single aspect of the information in a patient's medical record—a laboratory system, a scheduling system, a scanned documents system each working independent of the other. With these separate systems, some linkage had to be created to keep the enterprise in sync regarding critical information such as patient demographics, registration status and claims information. Behind the scenes interfaces carrying this data were created so that medical record number (MRN), date of birth (DOB) and gender were common across an enterprise. This reduced duplication of work caused by repeated data entry. But the silo effect due to essentially standalone systems was only masked and not eliminated. This became most evident when organizations attempted to use collected data in analytics. Most of these transactional applications supported just their own data reporting environment. Since the application was focused on a clinical service offering such as laboratory, the vendor integrated a warehouse or data mart to satisfy operational queries.

Over time these were enhanced with more comprehensive data collection, visualizations and reporting capabilities. The purpose of these archives was to enable data delivery to the department focused on their specific business needs. The gap occurred when the enterprise attempted to join data from separate departmental systems to gain a better understand a question spanning these silos.

Questions such as "How many patients on a diuretic for hypertension have a potassium below 3.3?" became nightmarishly difficult. To answer this question would require data from the lab system, pharmacy system and the patient's problem list of the ambulatory record. Although these data points are all clearly present in the source systems, to actually do this would require determining the MRN of the intersecting set of patients, finding and extracting those rows of information, and then joining them together in a new data structure to support the analysis. None of that work was within the capability of an end user and required substantial IT support. The work required to answer this query did not generalize to other queries and so did not support any type of scaling. Each question was a one-off, and analytics such as this represented an ongoing expense.

Data warehousing is a data management discipline that focuses on the integration of data to enable scalable analytics and sustainable analytic data delivery. The foundation of a warehouse is the data model. It incorporates the dimensions of data to be ingested such as DOB or gender

and their relations to and with one another. The data model constrains the data and the questions that can be asked of the data through the relationships between the various dimensions. Leading organizations designed or bought data models to form external reporting environments or warehouses. This attacked the root of the problem posed by the siloed nature of the transactional environments but at great cost and effort. Health care organizations were forced to become data integration organizations in the 2000s just as they had been forced to be application integrators in the previous decade.

Accelerated by the federal Affordable Care Act (ACA) and meaningful use, cross discipline reporting on patient encounters to support regulatory requirements has driven substantial maturity into the top tier of EHR offerings. For current best in class vendors, enterprise installations are packaged with data warehouses to conform data elements and the ability to explore that data using built-in visualization tools or third-party applications from Microsoft, SAP or Tableau. With the consolidation of separate systems into a monolithic offering, vendors began to aggregate and build a consolidated view of the data.

The EHR vendor commonly included an extensive data dictionary/library of common terminologies such as: Logical Observation Identifiers Names and Codes (LOINC), which is very focused on laboratory results); and Systematized Nomenclature of Medicine (SnoMed) and International Classification of Diseases, Tenth Revision (ICD-10, used for public health, claims analytics and billing) to which its data elements were mapped. During the design and installation process, these building blocks are used within the chart and workflow to capture and catalog data entered. In special situations, the organization could create custom data elements in order to capture workflow-specific information. These data are linked to and integrated with the reporting environment. With the integration of activities across the continuum of care within an enterprise, the span and depth of data available is remarkable. Continuous data collection from vital signs in the intensive care unit (ICU) to drug dispenses in the pharmacy, hospitals and clinics are awash in information. In comparison to the best of breed model, data is seamlessly available across the enterprise and commonly without the intervention of IT for simple reporting. This continues to be an evolutionary process, but one that is putting near real-time information deep into the health care organization near to and at the front line of patient care.

II. Current State of Clinical Data Warehousing

As competitive pressures increase and reimbursement rates decline, information systems are looked to for competitive advantage in advanced analytics. Health care continues to lag in the penetration of IT to drive efficiency gains as seen elsewhere across the economy. To realize these benefits, a self-reinforcing circle must be established linking individual provider performance at the patient bedside, effective team care for the delivery of services, integration of the downstream impacts of upstream choices and analytics to tease out where improvements can be

made. Clearly, most of this circle is not driven by IT. Effective use of personnel, business cost drivers and organizational structure are well within the realm of classical management expertise. It is data analytics, however, that can complete the circle.

Without continuous, sustainable data delivery, management and practice interventions become episodic at best and sporadic at worst. Fifty-five cents out of every dollar spent on health care goes to support labor costs.[77] Control of all aspects of health care costs is important. However, controlling labor costs requires either improved efficiency or reduced total wages. The major EHR vendors have created data warehouses to support pre-written analytics, as well as ad hoc queries. The market leaders by installed base[78] in medium to large hospitals and ambulatory care practices—Cerner, Epic and Allscripts—;support integrated data warehousing environments. While each vendor is substantially different from the other in data modeling or system architecture, they all share a common purpose to support more effective delivery of health care services.

Given the discussion above, one would assume the market for stand-alone data warehouses in health care is a diminishing market niche. Stand-alone warehouses became the clear answer for data integration during the best of breed era. They enabled organizations to bring data together and in doing so delivered insights that provided competitive advantage. They continue to have a place in health care. For larger organizations with more than one instance or type of EHR, they can be used to integrate these data sets. Stitching together a single enterprise view across separate clinical operations reprises their role during the best of breed era writ larger. Several vendors have begun to dominate this space. Commercial models from IBM, Oracle and Teradata are commonly seen. But installation and operation of a clinical data repository is technically complex requiring advanced skill sets for data modelling, data integration and analytic visualization. For innovative organizations, these skills are present, and the maturity of the organization engenders a lower risk.

These generalized clinical models contain the structures and relationships to support robust reporting and promote expansion where subject areas are not fully covered. For less technically adept organizations, a few vendor offerings have come to market to provide substantial analytic capabilities in a rapid time frame. Health Catalyst is the archetype of this model. Using a proprietary data model, information is mapped using specialized data extraction applications called Extract, Transform and Load (ETL) to transform data to conform to the base platform. From this, data marts enable the creation and display of prebuilt analytics focused on common queries

[77] *www.beckershospitalreview.com/finance/10-statistics-on-hospital-labor-costs-as-a-percentage-of-operating-revenue.html.*

[78] Installed base is the vendor's penetration into a target environment as a percentage of the overall size of that market.

and metrics. The benefit to this data application is rapid delivery of proven analytics. It is a low-risk project from an analytic standpoint as dashboards already exist and need not be subject to extensive development. The downside is twofold. First, the model and data marts only deliver what the product is designed to deliver. Any additional demands are subject to extra cost and possible only if the development roadmap would allow. Secondly, an enterprise is essentially outsourcing its analytic strategy to at third party.

III. Rise of Big Data and the Use of Non-Relational Datasets

With the advent of large concurrent distributed internet applications such as Facebook, eBay or Amazon, the necessity for responsive, large-scaling, fault-tolerant architectures became a widespread critical need. One of the recognized challenges was that of database design. Traditional databases can be thought of as tables organized by rows and columns linked to other tables through unique keys to form the data model or schema. The ability to write data into a row or read a data element from a table in this type structure was constrained due to concurrency.

Multiple clients attempting to read or write data to the same table as others were attempting to do the same resulted in corruption. To address this, table, row, column or cell locking was developed. The solution to one problem often causes others and in addressing this problem, scaling became a difficult issue. Many approaches including hardware, software and architectural were brought to bear. With increasingly sophisticated solutions, the relational databases continued to hold their ground, but the environment surrounding these applications was evolving rapidly. The data storage needs exploded with the ubiquitous access to cell phones, cameras and video.

The internet led this trend incorporating a wide variety of data. Rather than well-structured data elements, these applications were consuming text, video, image and sound. This was known as poorly or alternately structured data. Additionally, many of these applications did not need the determinism provided by relational architectures. In other words, they relaxed the constraints around read or write accuracy for greater speed and scalability. This was done by distributing the database across multiple processors and using algorithms to harmonize the resulting data as time allowed.

From this body of work came the development of No Structured Query Language (SQL) databases. Named for the fact that they did not use the SQL query language, this is used as a catchall term generally for nonrelational database offerings. SQL is the underlying language driving how data is written and returned from relational structures. First created in the 1970s, it is a mature and robust language. The NoSQL architectures step away from this construct and enable new approaches to data warehousing. Over the past decade, this field has rapidly matured. Mostly through the open source community, different vendors, including Facebook and Google, have

contributed large blocks of code that are the core of many foundational NoSQL projects. Numerous NoSQL offerings exist from vendors both commercial and open source. The explosion of work in this area is directly tied to and fueled by the rapid ascendancy of industrial scale big data.

The definition of big data is broad. It includes not just the size of the datasets (volume) but several other characteristics referred to as the four V's. These are volume, velocity, variety and veracity.

Volume is well understood, and these structures harness the inherent parallel processing of a database distributed across many nodes to create a highly scalable, fault-tolerant platform.

Variety was touched on above, with the hallmark being an ability to ingest data that has not been specifically created for reporting or analytic uses. Organizations ingest Twitter feeds that contain key words related to their business and using machine learning-based classifiers to derive sentiment analysis on marketing and branding initiatives. Clearly, data of this type is highly variable and heterogeneous.

Velocity is seen in the torrent of real-time, streaming data that is now available. As the use of internet technology has grown, more information is gathered from various smart devices. The internet of things (IoT) comprised of sensors, mobile endpoints and personal devices like the Fitbit constantly sends data on local conditions. Streaming data has unique challenges from a database load perspective. The NoSQL architecture can easily absorb this type of data source.

Finally, there is Veracity. As described above, this data is not like what is found in bank statements or lab values. Those are discrete and well-defined. IoT data—for example, streaming energy consumption from an electrical meter—may be subject to disconnects, data loss or even data corruption. In the big data space, veracity is expected to be questionable to some extent and understanding this, incorporated into subsequent analytics appropriately.

The power of NoSQL is evidenced in the flexibility it brings to problems of joining dissimilar data. As mentioned in the application of relational data platforms, joining data across environments required substantial preparation and data cleanup. In the NoSQL world, this overhead is much less. Data is aggregated on a case-by-case basis using small analytic programs commonly written in Java or Python. The NoSQL environment combines data storage and data preparation/processing into the same platform. Using the computational abilities of the underlying hardware to perform both the data management and the data manipulation (be it integration, transformation or other process) over a resource of many tens to hundreds of thousands of processors results in a deep scalable architecture capable of performing computationally complex manipulations of data. This new approach to how data can be used opened the door to scalable machine learning.

Actual and Potential Utilization of Big Data Analytics in Healthcare Today

I. Current Uses of Machine Learning

Machine learning, deep learning and Aartificial intelligence (AI) have become front page headlines. Machine learning at its core is the use of models, statistics and algorithms to produce reliable, repeatable decisions and results from historic relationships and trends in the data. Commonly the product of these efforts is an application that can be used to support a predictive analytic.

Deep learning is a machine learning method based on learning data representations rather than task-specific algorithms. Technologies supporting this sort of machine learning effort tend to be neural network-based and produce applications that are found in everyday life such as speech recognition, natural language processing and image processing. AI is more generic and encompasses machine learning and deep learning, as well as more esoteric pursuits such as knowledge representation, reasoning and perception. For this work, all these terms will be used interchangeably.

The impact of machine learning and deep learning are manifest today across society. In medicine, the most visible and common interaction providers have with this type of technology is machine learning driven speech to text. Companies such as Nuance Communications and M*Modal have created the infrastructure to ingest dictation at the point of care, perform voice to text translation and display the spoken word within the EHR in real time.[79] Physicians and other health care providers had relied for decades on human transcriptionists to transcribe recorded speech. The ability for health care organizations to deploy this technology without enormous training costs and end user adoption problems has only occurred recently. This technology enables physicians to continue to work as they are accustomed while deriving benefit of rapid turnaround and low training cost.

But voice to text only affects the user interface. The greater utility of the dictation exists when the concepts imbedded in the text can be codified and shared as independent discrete concepts. Talking about an episode of sepsis is useful to others only after the document is opened and read. Being able to extract the concept of sepsis using machine learning enables this discrete information to become actionable in many places without the need to search for, find, read and understand the base document. Automated concept extraction is a form of machine learning known as natural language processing (NLP).

NLP uses deep learning techniques to extract data and concepts from the written or spoken language. The utility of this capability is manifest within health care. While widespread EHR

[79] Warren, A., 2017. "3 Voice Recognition Platforms that Integrate with EHRs," Informaconnect, April 3, 2017. Accessed at: *https://knect365.com/pharmanext/article/32f56225-6c48-40cc-8f8e-cf710fe4aed0/3-voice-recognition-platforms-that-integrate-with-ehrs.*

implementation has reduced the number of paper forms and other documents within the care ecosystem, there exists a legacy of scanned as well as physical documents that are poorly indexed and essentially inaccessible.

In our mobile society, records such as these are transferred from provider to provider commonly as physical documents that become invisible within the scanned/outside documents tab of the destination EHR. Using NLP, these documents could be mined for concepts and organized for search. The impact of this on clinical care is substantial. The most expensive disease categories, chronic conditions, represent an overwhelming percentage of cost. The ability to understand the longitudinal course of a disease and therapies that have succeeded as well as failed would have an outsized impact.

NLP is an area of intense innovation and research. The machine-based understanding of language and its meaning is extraordinarily complex. In medicine, accuracy and reliability are critically important. Current technology continues to evolve and within constrained universes, accuracy is relatively good. The commercial product Nuance One is a relevant specific example. The Nuance One offering contains a component called Dragon Medical Advisor. Nuance One is a speech to text application with the capability for real-time medical concept extraction. Using the extracted concepts, Dragon Medical Advisor begins to create a profile of the patient.

A knowledge engine built specifically for diagnosis and billing criteria then evaluates the concepts presented with facts from the specific text and the applicable coding criteria. It notifies the physician on the HER screen of areas where additional language or finding specificity is needed. Within the context of billing codes and documentation completeness, the system is extremely accurate, unobtrusive and easy to use. It is essentially a just in time learning system around coding and documentation. The promise of machine learning to help find, correlate and display relevant information within the patient–physician interaction is appealing.

II. Neural Networks and Deep Learning

As opposed to machine learning, neural networks driving deep learning offer a technological approach for complex analysis of artifacts including images. Neural networks use layers of interconnected nodes that can analyze small sections of an image all working in parallel. These networks are trained with large sets of data containing the intended target. To create the final application, the neural network must undergo training. Training occurs where multiple samples such as images containing the desired feature (true positive) are ingested by the network.[80] This process causes the nodes to adjust their connections and create feedback loops. When presented

[80] Lakhani, P., and B. Sundaram, 2017. "Radiology – Deep Learning at Chest Radiography: Automated Classification of Pulmonary Tuberculosis by Using Convolutional Neural Networks," *Radiology,* Vol. 284, No. 2, April 24, 2017. Accessed at: *https://doi.org/10.1148/radiol.2017162326.*

with multiple images of chest x-rays known positive for tuberculosis (TB), the network begins to distinguish those features that are indicative for TB, similar to the method of training for residents in radiology.

The training process causes the features to be recognized implicitly within the network rather than explicitly programmed by a developer. In the example for TB, the application had a sensitivity (accurate identification of true positives) of 97% and a specificity (accurate identification of true negatives) of 100%. The impact of this technology on health care costs is evident. A deep learning application for automated image analysis has the potential to exceed the accuracy and reliability of human radiologists. Automated image analysis has several compelling economic and quality advantages. Given the low impact of imaging procedures to the patient, it is frequently used. For patients with chronic disease states, they accumulate numerous studies over time. While radiologists use previous images to compare and discern disease progression or discover new findings, there exists a functional limitation as to how far back and how many different modalities can be examined.

With a deep learning-based approach, this is only constrained by the available computing resources. Deep learning has the advantage of ingesting all the images within the PACS that are relevant to the analysis. Secondly, improvements to the application can occur continuously. Radiologists accumulate knowledge and insight over time. The resources for training and enabling a provider to become proficient are substantial. This creates a scaling problem leading to multiple tiers of access to this resource gated by location, practice environment and compensation. This results in variability of cost, quality and availability.

Finally, deep learning can feed forward information into the ordering cycle. Many organizations use a radiologist to protocol upcoming studies. This requires the radiologist to review the referring physician's order, review the chart and ensure that the study ordered is going to help answer the clinical question. Missing in this workflow is a comprehensive review of prior images. Coupled with natural language processing, this deep learning augmented activity could reduce inappropriate ordering and radiologist time, as well as improve diagnostic efficiency. This is similarly applicable to pathology, retinal photography and dermatology.

A common conception is that deep learning applications must be associated with a keyboard, screen and racks and racks of equipment behind the scenes. The level of integration available today enables powerful applications to be constructed to fit in the palm of one's hand. As an example of combining imbedded deep learning models, commercially available image sensor and commodity compute, DermaSensor has created a small handheld package that will image skin lesions (freckles, moles, etc.) and render a score of potential for malignancy. This type of technology could enable earlier detection of skin cancers for more people at a substantially lower cost. Current skin screenings are usually performed by dermatologists at a greater cost. With

devices such as these, lower skilled professionals would be able to deliver comparable results. This directly affects the economics of medicine through its impact on labor costs and potential curability of skin malignancies.[81]

III. Precision Medicine

Precision medicine is the use of targeted therapeutic interventions tailored to the results of extremely granular diagnostic testing. Due to the heterogeneity of diseases such as cancer, therapies guided by precision medicine would be envisioned to involve multitudes of extremely specific drugs aimed at unique metabolic defects found in the tumor cells. By contrast, current medical therapy is commonly guided via protocols or best practices based on disease diagnosis. Precision medicine relies on genetic testing as a cornerstone.

With the rapid decline in whole genome sequencing costs, currently at around $1,000 and expected to fall to under $100 in the next five years, the availability of this type of information will profoundly influence the practice of medicine. Integrating genomic testing data into clinical practice has already proven difficult. Unlike standard laboratory tests that yield discrete information bounded by a normal range, genetic tests are far more complex. The human genome has 3.2 billion base pairs encoding various enzymes, proteins and control mechanisms within the cell.

At the present, scientists are at the early stages of understanding cellular mechanics and do not have a good grasp of what the bulk of these sequences actually encode. That being said, there are numerous mutations identified associated with diverse conditions that could predispose an individual to ventricular fibrillation and sudden death, or impaired metabolism for Warfarin, an anticoagulant leading to potential bleeding of patients given the normal dose.[82,83] As the interactions between different cellular components become more complex and the ability for the treating physician to build a mental model becomes more difficult, the burden of the treatment model will necessarily shift more to insights derived from deep learning. For many, this will be a difficult shift. Deep learning is opaque. How the various inputs are brought together and how they are weighted or intertwined is unclear.

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[81] *www.dermasensor.com/.*

[82] Olfson, E., C.E. Cottrell, N.O. Davidson, C.A. Gurnett, J.W. Heusel, N.O. Stitziel, L.S. Chen, S. Hartz, R. Nagarajan, N.L. Saccone, and L.J.Bierut, 2015. "Identification of Medically Actionable Secondary Findings in the 1000 Genomes," *PLOS One,* Sept. 2, 2015. Accessed at: *http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0135193.*

[83] LaSala, A., B. Bower, A. Windemuth, M. White, M. Kocheral, R. Seip, J. Duconge, and G. Ruano, 2008. "Integrating Genomic Based Information into Clinical Warfarin (Coumadin) Management: An Illustrative Case Report," *Connecticut Medicine*, 72(7): 399–403, Aug. 7, 2008. Accessed at: *https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3696193/.*

In many respects, the deep learning application acts as a black box with data coming in one side and answers coming out from the other. There are currently no well-defined legal frameworks in medicine to handle the potential impacts of adverse outcomes. There is no way to put the key witness, the deep learning application, on the stand, and the developers who built it would not be able to adequately explain how it really worked following the training and tuning. This area is also clearly difficult from a patient consent and moral/ethical standpoint. All these factors will need to be addressed prior to widespread use of this type of analytic.

It is within the field of cancer that precision medicine is seen to hold the most promise. Cancer is fundamentally a disease of the genome. Environmental factors such as tobacco or radiation interacting with the DNA within the cell can cause breaks or changes in the encoded sequence. This can create unexpected effects in the production of proteins or cell receptors, leading to further changes in the behavior of the cell. A toxic feedback loop occurs and driven by the damaged DNA, the cellular machinery begins to go wild with uncontrolled replication of cells. Current chemotherapeutic approaches used are largely based on the tumor-originating tissue and morphologic findings on visual examination under the microscope. From this and some other testing, the cancer is classified and from that classification, a therapeutic regimen is built. The drugs used tend to have widespread effects both on the cancer as well as normal tissue, causing toxic side effects and secondary disease.

While this approach has shown success, it has enormous impact on the patient, with many therapies having no sustained impact. With the finer understanding of the genomic causes of cancer, less toxic, more finely targeted therapies have begun to emerge. Epithelial growth factor receptor (EGFR) mutation is commonly seen as the genetic defect in non-small cell lung cancer (NSCLC). A few drugs have been used successfully to block this receptor and stop the spread of disease. It is not uncommon for a subsequent mutation to occur called T790M that renders these drugs ineffective. A specific drug has been found that blocks the T790M receptor and again causes the spread to stop.[84] These are very expensive drugs, and administering them to patients without EGFR or T790M mutations is a waste. This specific genomic-driven type of therapy is the basis of precision medicine.

Medicine has worked for decades to reduce variability in how providers treat common diseases. The idea of first line and second line drugs for hypertension, along with the supporting treatment algorithms, is at the heart of this approach. However, the results have been mixed. Studies focused on physician guideline adoption for simple disease states such as hypertension show that even after demonstrating knowledge and familiarity with the specific guideline, physicians will

[84] Morgillo, F., C.M. Della Corte, M. Fasano, and F. Ciardello, 2016. "Mechanisms of resistance to EGFR-targeted drugs: lung cancer," *ESMO Open,* May 11, 2016. Accessed at: *www.ncbi.nlm.nih.gov/pmc/articles/PMC5070275/.*

still only follow the guideline recommendation 50% to 60% of the time.[85] How will physicians implement complex individualized tailored therapies when they are unable to widely adopt simple treatment guidelines? Clearly, this is a multifactorial issue. However, the inability to master these issues when addressing reasonably straightforward standard decision trees bodes poorly as the entire paradigm changes to highly variable personalized treatment plans driven by complex genetic findings.

IV. Shift to Population Health

Population health is defined as "the health outcomes of a group of individuals, including the distribution of such outcomes within the group."[86] Well understood within the medical literature is the fact that much of the morbidity seen in clinics and hospitals daily is a result of poor choices, habits or circumstance. The impact of these choices on our nation has been profound, contributing to the relentless compounding of health care cost currently toping 17% of gross domestic product (GDP).

Earlier treatment intervention, behavior changes or healthier lifestyles are all far less expensive than the use of cutting-edge treatments and therapies for conditions that, if addressed sooner, would have cost a fraction. Understanding this association is reasonably straightforward, but addressing it is extraordinarily difficult. The solution at its core requires behavior change. Many studies have examined behavior change and its impact on the progression of diseases. Studies in the medical literature assessing the sustainability of cardiac rehabilitation programs, for example, point to these issues.

Patients having suffered a serious heart attack are commonly directed to a program of diet, exercise, weight loss, smoking cessation and coexisting disease (hypertension, diabetes and cholesterol/lipid) control. Changing these habits and addressing these conditions is associated with better outcomes in the form of a longer and more functional life. Many studies have looked at the long-term efficacy of behavior change with interesting results. For some, the shock and stress of the heart attack and its implications on future life expectancy drives profound change. But for a sizable fraction of those enrolled in these programs, they quickly go back to their previous lifestyle; they stop exercising, stop taking their medications and gain weight. In other words, given the choice between behavior change and premature death, they overwhelmingly pick death.[87]

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[85] McGlynn, E.A., S.M. Asch, J. Adams, J. Keesey, J. Hicks, A. DeCristofaro, and E.A. Kerr, 2003. "The Quality of Health Care Delivered to Adults in the United States," *New England Journal of Medicine*, Vol. 348, No. 26, June 26, 2003.

[86] Kindig D., and G. Stoddart, 2003. "What is population health?" *American Journal of Public Health,* 93(3): 380–383. Accessed at: *doi:10.2105/ajph.93.3.380. PMC 1447747.*

[87] Effective secondary prevention through cardiac rehabilitation after coronary revascularization and predictors of poor adherence to lifestyle modification and medication. Results of the ICAROS Survey.

Previously discussed is the revolution in IT within the practice of medicine across the U.S. Adoption of EHRs is wide and deep. Paper-based processes are moving into the electronic realm and data artifacts from episodes of care widely captured. Our understanding of how health care is delivered with the health system is better than it has ever been. But the greatest determinates of health continue to reside outside that data. While we understand much better how to care for the afflicted, we recognize that the biggest impact may exist in the care of the well. The perspective of population health is also somewhat antagonistic to that of current fee-for-service model. Fee-for-service historically originates from that of an unintegrated industry where individual providers deliver services to individual patients. Lost is the context of the population where efficacy and outcome are measured in aggregate health improvement regardless of the mechanism or deliverer.

The practice of medicine has undergone a substantial change in economic organization and the relationships between and within providers. "The Physicians Foundation, which conducts surveys of America's doctors, found that 62% of physicians were independent in 2008. By 2014, that number had dropped to 35%—a precipitous decline in such a short time frame.[88] A 2012 survey by the Doctor Patient Medical Association found that 95% of physicians see corporate medicine supplanting the traditional private practice."[89] Medicine is beginning to be economically organized into larger groups. Using data to drive understanding of nonmedical factors such as social determinates of health, socioeconomic and ethnic influences is only possible when the scope of health care practices expands.

The use of statistics and large public datasets to understand populations has a long history in the realm of public health. This field has helped to shape our current health care delivery system, its focus and path. The data used in public health is different in two fundamental ways from that in population health. First, it is usually de-identified. Given the inherent risks of identifiable data for privacy and security, de-identified data sets are the bulk of how public health analytics are based. Second, the data is non-real time. Given the slow changing nature of large populations, aggregated data over years past is useful. Population health is focused on using insights derived from the population applied to the individual. Identified data is commonly part of a population health platform. With the close association of EHR data and the ability to interject useful findings into the care of a patient, the use of real-time or near real-time data is important.

Understanding the patient's daily environment is a critical factor in his or her well-being. Publicly

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[88] LaPointe, J., 2018. "Less Than a Third of Docs Owned Independent Practices in 2018," *Revcycle Intelligence,* Sept. 20, 2018. Accessed at: *https://revcycleintelligence.com/news/less-than-a-third-of-docs-owned-independent-practices-in-2018.*

[89] Wilson, R., 2016. "Why Private Practice Is Dying," *Forbes,* Sep. 7, 2016. Accessed at: *www.forbes.com/sites/realspin/2016/09/07/why-private-practice-is-dying/#f3b7bb027c8e.*

available datasets commonly derived from census data and other governmental sources begin to fill in some of the environmental aspects. Socioeconomic status, education level, crime rates, income and poverty measures are available. What separates population health from the more traditional public health analysis is the intersection of traditional EHR-derived heath information and publicly available datasets. Bringing these two environments together enables care providers and payers to focus on secondary factors. Patients using emergency medical services (EMS) for transport to the clinic appointment could be given access to an Uber account to provide transportation. Creating nutrition education in community centers for those with high prevalence of obesity would be a specific program.

The second is the use of comprehensive data across health records, institutions, encounters and providers to create a unified picture of the individual's health environment. Sharing data between providers and institutions begins to fill in the gaps and identify needs. Topically in the U.S., the opioid crisis is front page news. Sharing data of opioid prescriptions, providers, patients and dispensers can help target those who are abusing or enabling. Data taken organization by organization can hide patients that hopscotch across the quilt work of providers. Identifying and targeting these types of activities is extremely difficult in current systems enabling problems to expand into crises before action is taken.

Clearly, some of the population health work is focused programs outside the traditional role of health care providers attempting to influence individuals. Using health-related data to reduce risk factors more broadly has traditionally fallen outside the role of payers and providers. There is no entity that currently fills this important part of the ecosystem. Local governments through their public health department, schools, and the local school board or county resources have some effect on this area. Nationally, there are U.S. Department of Health and Human Services (HHS) programs that cover part of the space, but no single group has the data and financial incentives to actually do this work. It is yet to be seen whether the shifts in the organization of modern-day medicine in the U.S. will translate into a reassessment of how to prevent disease rather than treat it at much greater cost and morbidity.

Conclusion

The role of advanced analytics coupled with machine learning and comprehensive approaches to population health have the potential to radically change the practice of medicine. Moreover, the impact of deep learning, machine learning and the other technologies discussed should have a profound impact on increasing costs, as well as improved quality and availability of health care. The use cases cited above exist and are in clinical practice. Innovation using advanced algorithms will affect the ways we engage, treat and prevent disease. The use of machine learning and concept extraction from text is unlocking the written record. Health information buried in

documents and practically invisible to most providers will surface within the EHR. How providers interact with the EHR using voice commands coupled with the same concept extraction technology instead of the mouse and keyboard will begin to free providers from the current environment tied to a screen.

Precision medicine driven by deep learning will become the bridge between genetic testing and therapies of care. As we begin to untangle the delicate machinery driving the cellular processes, the ability to affect a single receptor protein or enzymatic pathway of a complex cascade becomes a powerful tool for managing cancer. Given a palette of potentially hundreds of these against a backdrop of each tumor having its own specific and rapidly changing weaknesses, it becomes difficult for the human mind to manage the endless possible combinations and permutations of therapy.

However, for successful application of these techniques, this change must address key issues that come along with it. Trusting machine learning and the associated algorithms is going to take a change in how we see ourselves in relation to our computational creation. Furthermore, population health as an example is a new territory for medicine. It will entail an intrusion into our daily lives asking us to change how we live. For some, it will be welcomed guidance, but for others, it will be seen as one more bit of evidence that our lives are being managed by others rather than lived by us. How will we balance the loss of privacy of personal health information with the potential gains with more precise and effective treatment? How will our personal information be safeguarded and algorithms developed in ways that protect consumers and limit biases?

Also, this sort of technology has the potential to cause extreme disruption in the structure of medicine. As in most other industries, technology has caused displacement and upheaval. The travel industry is a clear example with the role of the travel agent dramatically shifting. Uber and Lyft have completely disrupted the cab industry, resulting in wage compression and suicides.[90,91,92] Progress in deep learning as applied to images has the potential to disrupt fields of practice where image analysis is the cornerstone of skill. As machines become as accurate and specific as humans at a fraction of the cost, huge changes in the fabric of medicine will occur as experienced, trained, respected professionals are less necessary or cannot compete. Technology and innovation can be like a double-edged sword having an impact in medicine that should not be underestimated.

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[90] Morris, DZ., 2018. "6th New York City Cab Driver Takes His Life in Crisis Blamed on Uber," *Fortune,* June 16, 2018. Accessed at: *http://fortune.com/2018/06/16/new-york-cab-driver-suicide-uber.*

[91] *www.nbcnews.com/news/us-news/shadow-uber-s-rise-taxi-driver-suicides-leave-cabbies-shaken-n879281.*

[92] Stewart, N., and F. Ferre-Sadurani, 2018. "Another Taxi Driver in Debt Takes His Life. That's 5 in 5 Months," *The New York Times*, May 27, 2018. Accessed at: *www.nytimes.com/2018/05/27/nyregion/taxi-driver-suicide-nyc.html.*

Adoption of Value-Based Payments Leveraging Fee-for-Service Lessons

By Erin Weber, CAQH CORE

Introduction to Value-Based Reimbursement

The traditional and still leading fee-for-service payment system has long been considered as an important factor for rising health care costs. Whether or not fee-for-service is the main cause, spiraling costs along with the patchy quality of health care underscore the need for a better alternative.

The fee-for-service payment system, with its primary focus on the quantity of services, has overburdened health care providers and especially independent primary care practices—increasing administrative costs and making it hard to compete with larger, hospital-owned health systems. However, the consolidation of the health care marketplace has generally not resulted in lower health care costs as expected. This is mostly due to continued and generalized overuse of services and higher prices.

An increasingly popular alternative is value-based care, which is gaining traction among payers and providers of care. As opposed to fee-for-service where providers are compensated for the number and type of services they perform, a value-based reimbursement system is based on patients' health outcomes as determined by specific quality measures. Value-based care is data-driven, with providers reporting on the quality measures to show concrete improvements in patients' health. Under a value-based reimbursement system, providers are incentivized to use evidence-based medicine, fully engaging and empowering patients to manage their own health. The end result is that when patients receive more coordinated, appropriate, better quality and effective care, as evidenced by objective measures, providers are accordingly rewarded. Transitioning to a patient-centered value-based system could help produce better outcomes and would also cut costs as providers are held responsible for containing expenses and increasing quality.[93]

Since the passage of the federal Affordable Care Act (ACA), value-based reimbursement models have been introduced by the federal Centers for Medicare & Medicaid Services (CMS) tying payments to quality of care, improved patient outcomes and better use of resources.[94] Hundreds

[93] Karapiperis, D., 2018. "A Brief Exploration of Rising Health Care Costs," *CIPR Newsletter*, Vol. 25, pp. 2—-5, August 2018. Accessed at: *www.naic.org/cipr_newsletter_archive/vol25_health_costs.pdf*.
[94] Dreyfus, A. 2019. "Study shows that value-based care works," *Stat News*, July 24, 2019. Accessed at *www.statnews.com/2019/07/24/value-based-care-works/*.

of accountable care organizations (ACOs)[95] caring for millions of patients are participating in the CMS value-based system. In the private health insurance sector, the Alternative Quality Contract (AQC) for Blue Cross Blue Shield Association (BCBSA) members provides financial incentives to providers for delivering high-quality patient care and for controlling costs.[96] Recent research has shown that this value-based model can help solve the challenges plaguing the health care system.[97]

And in fact, value-based payment now drives a sizable—and growing—proportion of the U.S. health care system.[98,99,100,101] Health care providers and health plans are currently making significant monetary and resource investments, including in electronic health record (EHR), billing and other information technology (IT) systems, plus training and human resources, to better fulfill their new roles as collaborators. Because value focuses both on the quality of care and on its cost, many believe value-based payment has the power to improve individual care and population health while changing the trajectory of national health expenditures.[102]

Streamlining Value-Based Payment

Fee-for-service payment was initially plagued by process variations as the industry sought to automate billing and payment transactions in the early 2000s through the federal Health Insurance Portability and Accountability Act (HIPAA). While the HIPAA administrative transaction

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[95] ACOs are groups of doctors, hospitals and other health care providers who come together voluntarily to give coordinated, high-quality care to their Medicare patients.

[96] *https://aboutus.bluecrossma.com/affordability-quality/alternative-quality-contract-aqc.*

[97] Song, Z., Y. Ji, D. Safran, and M. Chernew, 2019. "Health Care Spending, Utilization, and Quality 8 Years into Global Payment," *The New England Journal of Medicine*, 381: 252–263, July 18, 2019. Accessed at *www.nejm.org/doi/full/10.1056/NEJMsa1813621.*

[98] Japsen, B., 2017. "UnitedHealth, Aetna, Anthem Near 50% Value-Based Care Spending," *Forbes.com*, Feb. 2, 2017. Accessed at: *www.forbes.com/sites/brucejapsen/2017/02/02/ unitedhealth-aetna-anthem-near-50-value-based-care-spending.*

[99] "Measuring Progress: Adoption of Alternative Payment Models in Commercial, Medicare Advantage, and State Medicaid Programs," Health Care Payment Learning & Action Network. Accessed at *https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=2ahUKEwjUvO-Um5_oAhUFQ60KHQmaDJ8QFjAAegQIBhAB&url=https%3A%2F%2Fhcp-lan.org%2Fworkproducts%2Fapm-measurement-final.pdf&usg=AOvVaw2H_SqPv0a_gSt0O_vJpJbX*
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[100] Gruessner, V., 2016. "58% of Payers, Providers Adapt Value-Based Care Reimbursement," *HealthPayer Intelligence*, Sept. 27, 2016. Accessed at *https://healthpayerintelligence.com/ news/58-of-payers-providers-adapt-value-based-care-reimbursement.*

[101] Dickson, V., 2017. "CMS Gives 800,000 Docs a Pass on MACRA Requirement," *Modern Healthcare*, May 11, 2017. Accessed at *https://www.modernhealthcare.com/article/20170511/NEWS/170519964/cms-gives-800-000-docs-a-pass-on-macra-requirement.*

[102] Marcotte, B.J., A. Guarisco Fildes, M. Thompson, and L. Binder, 2017. "U.S. Health Care Reform Can't Wait for Quality Measures to Be Perfect," *Harvard Business Review*, Oct. 4, 2017. Accessed at *https://hbr. org/2017/10/u-s-health-care-reform-cant-wait-for-quality-measures-to-be-perfect.*

standards for billing and claims processing were intended to make it easy for providers and health plans to conduct administrative transactions electronically, they lacked rules for smooth implementation. Without collaboration and business rules for operations, the variation in use of the standards made adoption of electronic systems and automation challenging for all stakeholders.

Beginning in 2005, the Council for Affordable Quality Healthcare (CAQH) Committee on Operating Rules for Information Exchange (CORE)[103] brought the industry together to develop common rules of the road to support electronic business transactions, increasing uniformity and automation. Because of this work, an increasing number of HIPAA-standardized electronic transactions between healthy plans and providers became more uniform, and use of phone, fax and mail to conduct transactions declined.[104]

As value-based payment innovation and experimentation is ongoing, numerous challenges may slow or prevent its ultimate progress, similar to the early challenges of automating fee-for-service transactions.[105,106,107] Without an efficient, uniform operational system, it will be difficult for stakeholders to achieve the fluid, reliable and trusted interactions and exchanges of data needed for long-term value-based payment success. Thus, these investments can deliver value to the entire health care industry if there are consistent expectations and rules of the road related to value-based payment.

However, many features of value-based payment do not align with the current fee-for-service operational system. Indeed, proprietary systems and processes for implementing value-based payment have already begun to introduce operational variations. Without collaboration to minimize variations, the current environment is ripe for repeating a scenario that cost

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[103] Industry-led, CAQH CORE is a nonprofit organization formed to drive the creation and adoption of health care operating rules that support standards, accelerate interoperability, and align administrative and clinical activities among providers, payers and consumers. CAQH CORE participating organizations represent more than 75% of insured Americans, including health plans, health care providers, vendors, government entities and standard setting organizations. Five phases of CAQH CORE Operating Rules and Certification Test Suites have been issued to date.

[104] *https://www.caqh.org/sites/default/files/explorations/index/report/2018-index-report.pdf*.

[105] Chee, T., A.M. Ryan, J.H. Wasfy, and W.B. Borden, 2016. "Current State of Value-Based Purchasing Programs," *Circulation* (133(22): 2197–2205, May 31, 2016. Accessed at *http://dx.doi.org/10.1161%2fcirculationaha.115.010268*.

[106] Damberg, C.L., M.E. Sorbero, S.J. Lovejoy, G. Martsolf, L. Raaen, and D. Mandel, 2014. "Measuring Success in Health Care Value-Based Purchasing Programs: Findings from an Environmental Scan, Literature Review, and Expert Panel Discussions," RAND Corporation. Accessed at *www.rand.org/content/dam/rand/pubs/research_reports/RR300/RR306/ RAND_RR306.pdf*.

[107] Lagasse, J., 2017. "Navigant execs identify trends to watch for in 2018," *Healthcare Finance News*, Dec. 21, 2017. Accessed at *https://www.healthcarefinancenews.com/news/ navigant-execs-identify-trends-watch-2018*.

stakeholders billions of dollars and slowed and complicated adoption of fee-for-service transactions.

By collaborating now, before proprietary systems and processes become entrenched in value-based payment operations, by reaching out to potential collaborators across the industry and by applying lessons learned through its success in the fee-for-service space, CAQH CORE hopes to energize an effort to ease value-based payment operational inefficiencies.

The success of value-based payment is fundamentally dependent upon smooth and reliable business interactions between all stakeholders, and especially between health care providers and health plans. The scope and scale of direct collaboration required for value-based payment stands in stark contrast to more limited stakeholder interactions in the fee-for-service market. Health care providers and health plans are currently making significant monetary and resource investments, including in EHR, billing and other IT systems, plus training and human resources that will help them fulfill new roles as collaborators. These investments can deliver value to the entire industry if there are consistent expectations and rules of the road related to value-based payment.

While stakeholders are eager to collaborate, extensive research from CAQH CORE[108] indicates they are concerned that non-uniformity is currently the norm in value-based payment implementation. They have called for more standardization across a wide range of operational areas specific to value-based payment, with strong consensus for a focus on five key elements introduced briefly here: 1) data quality and standardization; 2) interoperability; 3) patient risk stratification; 4) provider attribution; and 5) quality measurement.

In the absence of operational systems designed specifically to support value-based payment, innovators and early adopters invented new systems and adapted existing systems. In the context of value-based payment, for example, the most fundamental concepts and terms—"cost of care," "emergency department visit," "bundled care" and "primary care physician"—have dissimilar meanings among the various stakeholders. Value-based payment may require new data elements for which standardization does not yet exist and/or new uses for existing data elements for which adherence to standardization is inadequate.

Compounding the problem, no single system supports exchange of all the necessary data for value-based payment. The current claims system was designed to support reimbursement in a fee-for-service environment. EHR systems hold much of the clinical data needed for direct patient

[108] CAQH CORE, 2019. "All Together Now: Applying the Lessons of Fee-for-Service to Streamline Adoption of Value-Based Payments," CAQH CORE website. Accessed at *www.caqh.org/sites/default/files/core/value-based%20payments/core-value-based-payments-report.pdf?token=dxNjR8RY*.

care. While these systems have moved from electronic medical record to EHR,[109] they were not intended to integrate financial and clinical data or to serve as analytics tools. In addition, EHRs have been plagued by interoperability issues. To access analyses of clinical quality data in the EHR, providers are often forced to develop separate data warehouses and custom reports. Health plans also maintain siloed systems, in which there is no clean way to integrate clinical data from providers. These data retrieval and integration roadblocks cause delays in quality-of-care analytics and prevent real-time, actionable information from reaching the point of care.

Models for patient risk stratification and provider attribution also vary considerably across the industry. Providers have criticized the complexity and the lack of uniformity or transparency of these processes. In a single provider setting, for example, where multiple health plans use different methods for these functions, the variation can be especially pronounced.

Furthermore, as noted earlier, there is considerable burden placed on providers by the quality measurement programs. Though the measures are clinical, the burden to gather data and produce reports is operational. The measurement process for providers tends to be inefficient, duplicative and disconnected.

These operational challenges highlight an urgent need for improvement. Health care stakeholders must act quickly, decisively and collaboratively to prevent value-based payment from confronting the administrative roadblocks once encountered by the fee-for-service space. The success of value-based payment is fundamentally dependent upon the smooth and reliable business interaction among all stakeholders, and especially between health care providers and health plans.

The scope and scale of direct collaboration required for the success of value-based payment stands in stark contrast to the more limited interactions in the fee-for-service market. Below we provide more detail on the challenges of these five aspects, as well as recommendations and strategies to address them. The recommendations and strategies outlined in this report can hopefully help the industry learn what practices work best, reduce non-uniform processes and encourage dialog to prevent new operational barriers from slowing the progress of value-based payment.

I. Data Quality and Uniformity

Challenges

[109] Garrett, P., and J. Seidman, 2019. "EMR vs EHR—What is the Difference?," *Health IT Buzz*, Office of the National Coordinator of Health IT. Accessed at *www.healthit.gov/buzz-blog/electronic-health-and-medical-records/emr-vs-ehr-difference*.

Health plans and health care providers agree there is already an enormous amount of data, which represents an immense challenge. However, they have indicated that non-standardized data and data quality, or irregular data, pose far greater challenges to their value-based payment operations. Improving the accuracy, completeness and timeliness of data and enabling easier access to high-quality data are top priorities. Going forward, although providers and health plans recognize the need for some new data elements, they believe improving the standardization and quality of data should be the overriding priority, whenever feasible.[110]

There are many issues with data quality, or irregular data. Missing or inaccurate provider identification may cause inaccurate risk-based payments when a given provider's specialty and relationship to the patient are unclear. Inaccurate provider data may complicate specialist referrals. The higher cost of out-of-network providers can affect the overall amount of payment and significantly increase the patient's out-of-pocket costs. Provider data plays a major role in care accountability, and it can affect costs.

For example, if a provider moves and cannot be located for a prescription management function, an order may not be discontinued on a timely basis, and medication may be unnecessarily supplied. Patient cost may also be affected if, for example, a required medical code is not applied to a prescription and the patient must pay out-of-pocket when the prescribing provider cannot be located.

Another example is that standards may exist for the use of many, but not all, medical code sets. Inconsistent use of common terms not yet standardized can compromise the ability to measure timeliness of care and affect patients' financial obligations. Examples include terms used to describe the date and time of an event, such as "discharge from an emergency department" or the nature of an event, such as "admission for observation."

Finally, data embedded in narrative notes in the EHR and/or supplied in paper-based documents lacks the standardization imposed by structured data and is not interoperable. As a result, this data may be disregarded since time-consuming and costly methods must be applied to extract the data for processing.

Promotion and Enforcement of Data Standards

Our research has identified increased industry use of the standard National Provider Identifier (NPI) as an important opportunity to support accurate value-based payment data. Use of the NPI

[110] CAQH CORE, 2019. "All Together Now: Applying the Lessons of Fee-for-Service to Streamline Adoption of Value-Based Payments," CAQH CORE website. Accessed at *www.caqh.org/sites/default/files/core/value-based%20payments/core-value-based-payments-report.pdf?token=dxNjR8RY*.

has been required in all HIPAA-mandated transactions since 2007.[111] However, it has been observed that the NPI is not always used on claims.[112]

While it is clear universal use of the NPI on the HIPAA transactions, possibly backed by an enforcement effort, would help, the issue of provider identification is broader than this use alone. Every individual provider must be identifiable in regard to actions for which they are accountable. This requires not only a unique identifier for each individual provider, but also a database that must be continually maintained. Today, changes are easier to make by the provider but are not incorporated into the NPI database in real time.

Inconsistent and inaccurate provider identification data can compromise quality measurement. Uncertainty about the role of each provider in a care team can also result in inefficient care coordination. Finally, in a value-based payment environment, the role of the provider, whether acting as primary care physician or specialist, must be clear in order to accurately disperse shared savings or shared risk.

Adoption of Uniform Definitions and Data Elements

More consistent definitions of data elements and standardized use of certain code sets emerged in CAQH CORE research as needed improvements to facilitate value-based payment operations. Inconsistent use of standardized code sets causes specific problems for value-based payment. Misinterpretation of a medical code can skew or obscure information critical to value-based payment analytics. For example, when Logical Observation Identifiers Names and Codes (LOINC),[113] which encodes laboratory orders and results, are truncated or used in non-standard ways, it can be difficult to identify why charges vary for seemingly identical laboratory tests. An analysis of such tests may reveal that the orders were directed to laboratories that use preferred, and often different, laboratory instruments or modalities, carrying different usage costs. Also, quality outcomes measurement is affected when LOINC are truncated, as valid comparisons cannot be made across the different modalities for a specific test.

Additionally, existing standardized medical code sets may not be fully utilized. A set of codes reflecting all the patient's conditions and comorbidities may be entered on the claim by the provider but may be truncated by a claims processor. As a result, comorbidities requiring more time to manage and impact treatment options may not be recognized.

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[111] *www.cms.gov/Regulations-and-Guidance/Administrative-Simplification/NationalProvIdentStand/.*

[112] Among those interviewed by CAQH CORE.

[113] LOINC is the international standard (set of identifiers, names, and codes) for identifying health measurements, observations and documents. Reference labs, health care organizations, U.S. federal agencies, insurance companies, software vendors, *in vitro* diagnostic testing companies and more than 86,600 registered users from 176 countries use LOINC to move data seamlessly between systems.

Not all data frequently used today, and being added because of value-based payment models, are part of a standardized medical or non-medical code set (as described in the HIPAA Transactions and Code Sets regulations).[114] The term "admission" is a good example. Today, the term "admission" may be used as an acceptance into an "emergency department" (as opposed to placement in an "urgent care department" with the patient's consent), placement in an "observation bed" following an emergency department "admission" or "day surgery" "admission," or in the traditional meaning of placement in an "inpatient hospital bed." Since these admissions have different reimbursement structures, inconsistent use of unique terms and definitions to describe them can significantly affect payment.

Value-based payment models may also require new data elements, such as data characterizing social determinants of health (SDOH)—that is, the conditions in which people are born, grow, live, work and age.[115] Emphasis on SDOH is growing, as this data is useful in programs to reduce inequities, improve health and reduce health care costs. SDOH information directly affects providers' ability to conduct patient risk stratification in order to focus on those patients with high and emerging risks. SDOH also plays a role in health plan value-based payment contracting, as accounting for SDOH may affect premiums. Moreover, collection of SDOH data by providers, who have the closest relationship and most frequent contact with patients, is critical for monitoring factors that may change over time, such as socioeconomic position or insurance coverage.

Finally, value-based payment underscores and accelerates the need for a standardized, unique patient identifier or identification process. Research participants agreed strongly that patient identification can support interoperability of data across multiple providers, settings and plans. As care is increasingly delivered in outpatient and other settings, patient identification today may simply be based on the name a person presents with at the time of a health care encounter, resulting in the inability to accurately aggregate all data for a given patient.

Even when the practice is to query patients for additional information to improve the accuracy of their identity, providers may use different data elements for this purpose. Also, each provider may assign its own unique identification number to patients. Lack of accurate patient identification may lead to duplicate diagnostic testing, potential medication errors due to unknown contraindications and other consequences resulting from a lack of data about patient health status. In some cases, data from several patients can be merged when it appears that records belong to a single patient. The result may then appear to be duplicate testing, leading to denial of a claim, loss of revenue in a shared risk environment or lack of attention to an actual need, presumably addressed by another provider.

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[114] *www.hhs.gov/hipaa/for-professionals/index.html.*
[115] *www.cdc.gov/socialdeterminants/index.htm.*

More consistent adoption of medical and non-medical code sets, as well as more uniform use of agreed-upon definitions, will improve care delivery and care management capabilities, promote transparency in value-based payment and strengthen the ability to perform quality and cost analyses. Uniformity in how organizations are collecting, managing and analyzing data can make important cross-industry analysis possible.

II. Interoperability

Challenges

Interoperability challenges are a pressing problem in health care. For those working to implement value-based payment, they are greatly magnified. CAQH CORE research participants overwhelmingly called for improvements in interoperability, not only in semantic interoperability, but specifically technical and process interoperability.

Technical interoperability for data sharing relates to the ability to pass data from one information system to another while maintaining accuracy and validity. Process interoperability relates to having common expectations for workflows, connectivity processes, timeliness of data provision, response time to inquiries or requests, security requirements, consent/authorization management, and other practices that affect multiple stakeholders.

Data increasingly needs to be appropriately and securely shared across the continuum of care by providers, between providers and health plans and with patients. Such a cross-enterprise exchange requires different forms of standards and technologies. The complex and costly software products used by stakeholders today are based on existing standards, which fundamentally do not support cross-enterprise interoperability. Current standards in health care are largely grounded in electronic data interchange (EDI) supporting the fee-for-service business. In that environment, a limited set of predefined data flow between known trading partners. In value-based payment, however, data exchange needs to happen with full data privacy and security.

Many of the hallmark features of value-based payment require the support of new and complex processes, which to date have been implemented in nonuniform ways by industry participants. Value-based payment changes patient management approaches to improve quality and reduce cost. To achieve this, new types of information are needed at various points during care. Improved communication with patients by both providers and health plans are necessary to support patient engagement and shared decision-making. Process changes may also require new agreements, partners, contracts, workflows and data collection.

The Use of Existing and Emerging Standards and Technologies

Value-based payment requires clinical, financial and administrative data to be shared across disparate providers, between providers and health plans and with patients. While the vast majority of the data on patient care is tracked and managed today using an EHR, those systems still do not communicate or share data well. For example, stakeholders shared a vision for fully interoperable EHR systems capable of sharing longitudinal patient-level data. Such a system would support the development of better outcomes-based payment structures, dramatically improving the nation's health and advancing value-based payment.

The federal 21st Century Cures Act (Cures Act),[116] signed into law on Dec. 13, 2016, encourages EHR interoperability. The Cures Act uses substantial penalties to discourage information blocking, or an unreasonable constraint imposed on the exchange of patient data or electronic health information.[117]

Application (API) development is becoming extremely important for achieving health care interoperability. APIs developed for mobile devices, such as smartphones and tablets, often can be used on computers and medical devices. This characteristic makes these apps easier to use for providers and patients. A major goal of the Cures Act is to achieve nationwide interoperability.[118] To help realize this goal, the U.S. Department of Health and Human Services' (HHS') Office of the National Coordinator for Health Information Technology (ONC) and CMS published proposed rules to facilitate patient access to information through HL7 Fast Healthcare Interoperability Resources (FHIR) APIs, including administrative data such as claims data that has historically been shared between health plans and providers through different methods.[119,120] Common, uniform and consistent use of APIs could also support connecting clinical and administrative data to support value-based payments across stakeholder groups— including patients, providers, health plans and vendors—to achieve industry-wide interoperability.

Emerging technologies are also considered for use in health care. Blockchain has been suggested as a good fit for clinical data sharing, administrative and financial information, and patient and provider identity, among others. Proponents point to inherent features of the technology—a

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[116] *www.fda.gov/regulatory-information/selected-amendments-fdc-act/21st-century-cures-act.*

[117] *http://searchhealthit.techtarget.com/definition/ information-blocking*.

[118] "H.R.34 – 21st Century Cures Act," Congress.gov website. Accessed at: *www.congress.gov/bill/114th-congress/house-bill/34/text*.

[119] "21st Century Cures Act: Interoperability, Information Blocking, and the ONC Health IT Certification Program," regulations.gov. Accessed at: *www.regulations.gov/document?D=HHS-ONC-2019-0002-0001*.

[120] "Medicare and Medicaid Programs; Patient Protection and Affordable Care Act; Interoperability and Patient Access for Medicare Advantage Organization and Medicaid Managed Care Plans, State Medicaid Agencies, CHIP Agencies and CHIP Managed Care Entities, Issuers of Qualified Health Plans in the Federally-Facilitated Exchanges and Health Care Providers," federalregister.gov. Accessed at: *www.federalregister.gov/documents/2019/03/04/2019-02200/medicare-and-medicaid-programs-patient-protection-and-affordable-care-act-interoperability-and*.

distributed, consensus-managed, cryptographically secured database—as evidence it would untether data by eliminating interoperability limitations. However, even those who see tremendous potential with blockchain in health care acknowledge the technology has some inherent vulnerabilities that can make its use challenging.[121]

Improved technical interoperability would eliminate a significant barrier for value-based payment. Interoperable systems would support more fluid data interactions needed to fuel actionable and trustworthy analytics for care management, quality measurement, patient attribution, risk adjustment, payment and more.

In value-based payment, success also hinges on how information is exchanged and how actions are interpreted by other stakeholders. In its research, CAQH CORE identified a significant opportunity to support value-based payment operations by improving process interoperability. More carefully choreographed workflows, processes and policies would allow stakeholders to make more reliable comparisons and act on timelier insights, among other benefits.

Workflows are one area where value-based payment is prompting changes and creating new processes. One example is the capture and use of accurate and timely data. As claims may no longer be the source for reimbursement, equivalent data (i.e., claims data without an imputed charge) are still essential for risk adjustment, performance measurement and incentive programs.[122] While shared risk arrangements may not require claims per se, the encounter data held by the claim must be compiled with the same level of completeness and accuracy as claims data in order for there to be meaningful monitoring of quality and cost of health care services.[123]

Value-based payment processes should integrate clinical, financial and administrative data to improve health and reduce cost, a process in which timing is vital. For example, hospital admission, discharge and transfer (ADT) information can be used by providers to better coordinate care and by health plans to better understand what is happening with members. For these uses, ADT data is needed by all parties within at least one day of admission. In many cases, ADT data is currently received months after discharge. Unfortunately, CAQH CORE research indicates that this is the norm, not the exception. ADT data needed for patient care is often delivered too late to have an effect.

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[121] Gordon, W., A. Wright, and A. Landman, 2017. "Blockchain in Health Care: Decoding the Hype," *NEJM Catalyst,* Feb. 9, 2017. Accessed at *https://catalyst.nejm.org/decoding-blockchain-technology-health/.*

[122] "Encounter Data: The Achilles Heel of the Delegated Model?," presented June 18, 2016 at the CAPG Continuing Medical Education Joint Providership Conference, San Diego, CA, PowerPoint presentation. Accessed at *www.capg.org/modules/showdocument. aspx?documentid=2878.*

[123] "Encounter Data Project," presented by Carol Wanke, Sharp HealthCare, March 31, 2017, The 26th National HIPAA Summit, Washington, DC, PowerPoint presentation. Accessed at *www.ehcca.com/ presentations/HIPAA26/wanke_3.pdf.*

In value-based payment, CAQH CORE found that conflicting expectations are greatly hampering clinical and financial data exchange between providers and health plans. Participants acknowledged that while some of these challenges may be due to technical barriers, issues related to conflicting expectations for how data will be shared and used can be resolved with data-sharing agreements.

Connectivity, security practices and standards for data sharing that protect and assure the privacy and confidentiality, including minimum necessary use, of health information are top priorities for all stakeholders. As stakeholders interact more closely to leverage combined data for greater insight, the need for uniform security protocols arises.

III. Patient Risk Stratification

Challenges

Value-based payment initiatives have made risk assessment an essential process. It must be understood risk assessment is used for different purposes with different methodologies by health plans and health care providers. Health plans have long conducted risk assessment using proprietary, actuarial models to determine premiums. This form of risk assessment is most often referred to as member risk adjustment.

Today, health plans and providers both conduct another form of risk assessment using different models to characterize patients' risks as they age, as their financial circumstances change or as other factors affect their health over time. For example, individuals may be identified as high risk, emerging risk or low risk in order to focus care coordination on patients who need careful, proactive management.[124] This form of risk assessment, used more frequently for value-based payment, is referred to as patient risk stratification.

CAQH CORE found two dominant operational challenges posing barriers to successful patient risk stratification in value-based payment.

First, many health care providers are unclear about how health plans are using risk assessment—and whether member risk adjustment tools are being applied for patient risk stratification. This lack of clarity has eroded trust and may be influencing health plan-provider relationships.

Second, even when it is clear health plans are using a patient risk stratification methodology, each plan may use a different methodology. This additional layer of complexity may prevent providers

[124] Just, E., 2017. "Understanding Risk Stratification, Comorbidities, and the Future of Healthcare," *Health Catalyst Insights*, Jan. 3, 2017. Accessed at *www.healthcatalyst.com/understanding-risk-stratification-comorbidities/*.

from achieving the same results as payers when conducting patient risk stratification.

Each health plan a provider contracts with may apply a unique model that could potentially categorize patients differently from the provider's categorization. For example, model A from health plan A may include certain risk factors for individuals with emergent risk that are not addressed by provider B in its model B. Similar patients are stratified differently based only on specific artifacts of the risk stratification models being applied. The ability to accurately identify the methodology used, and to streamline the number of methodologies used, would reduce administrative burden and assure that providers are focusing resources on appropriate patient populations, reducing provider risk in a shared savings or shared risk payment environment.

Another factor challenging providers and health plans as they attempt to stratify patient risk is accurate and timely data. Even though many providers recognize the importance of patient risk stratification and factor it into their thinking, their EHRs typically do not support some of the data collection needed for a formal patient risk stratification process. These processes may require data elements, such as those characterizing the nature of the community in which patients live, their marital status and so forth. Some models use many data elements, while others rely on just a few. The result is a hit-or-miss situation that does not focus on reducing escalating risks. In addition, health plans generally do not have access to this evolving data, so they may be relying upon old or limited data as they attempt to perform patient risk stratification as means to assist in care coordination.

While it may not be possible for the industry to coalesce around a standard method of patient risk stratification, CAQH CORE research indicated strong interest in a more transparent and unified approach. An initiative to engage key stakeholders to identify how existing models are currently used and to begin the process of recommending models for different uses is a key first step to eventually achieving consensus on a standard suite of risk stratification models.

Data Inaccuracy, Unavailability and Methodology Variation

It is important for the industry to understand the unique and important role patient risk stratification plays in value-based payment. While it may not be appropriate to use a single framework for patient risk stratification, it is essential to understand the purpose of any variation and for providers to be measured against a known methodology. Given the industry-wide transition to value-based payment models is still evolving, this is a key opportunity for entities to build industry collaboration.

The total number of risk stratification models is unknown. There are approximately seven publicly available models most commonly used for risk stratification, with others emerging as use of value-

based payment accelerates.[125,126] All of these models are based, to some degree, on comorbidity. While several of the methods are similar, others are unique to a specific population.[127] There has been no known cost analysis or demonstration of the effectiveness of each model to guide the industry in best use.

Given the lack of transparency, the industry would benefit from more research on the efficacy of risk stratification approaches, a first step to creating a set of standard individual risk stratification methodologies that would benefit both providers and health plans.

IV. Provider Attribution

Challenges

In value-based payment models, providers take on responsibility for the care of specific patients in a population. A process called attribution matches individual patients in a population with providers. Attribution ultimately determines the patients for which a provider is responsible within a population.[128]

Subsequent analytics draw heavily on the attributed population's individual patient health data. For example, attribution forms the basis of analysis for metrics underpinning value-based payment, such as total costs of care, outcomes and distribution of shared savings/shared risk.[129]

Many providers participating in CAQH CORE research have noted they often are not informed about their attributed patients. As a result, providers feel an important and useful feature of value-based payment is not being fully utilized to help them proactively manage these patients' health.

Also, the large number of attribution methodologies is a source of provider frustration, as it can

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[125] Just, E., 2017. "Understanding Risk Stratification, Comorbidities, and the Future of Healthcare," article posted on Health Catalyst Insights, Jan. 3, 2017. Accessed at *www.healthcatalyst.com/understanding-risk-stratification-comorbidities/.*

[126] Haas, L.R., P.Y. Takahashi, N.D. Shah, R.J. Stroebel, M.E. Bernard, D.M. Finnie, and J.M. Naessens, 2013. "Risk-Stratification Methods for Identifying Patients for Care Coordination," *American Journal of Managed Care* Vol. 9, No. 9., Sept. 17, 2013.

[127] Hileman, G., and S. Steele, 2016. "Accuracy of Claims-Based Risk Scoring Models," research by the Society of Actuaries Health Section, Oct. 28, 2016. Accessed at *www.soa.org/Files/Research/ research-2016-accuracy-claims-based-risk-scoring-models. pdf.*

[128] Ryan, A., A. Linden, K. Maurer, R. Werner, and B. Nallamothu, 2016. "Attribution methods and implications for measuring performance in health care," a paper commissioned by National Quality Forum, July 2016. Accessed at *www.qualityforum.org/ WorkArea/linkit.aspx?LinkIdentifier=id&ItemID=82908.*

[129] LaPointe, J., 2017. "Value-Based Contracts Rely on Patient Attribution, Data Sharing," *Revcycle Intelligence,* Nov. 27, 2017. Accessed at: *https://revcycleintelligence.com/news/value-based-contracts-rely-on-patient-attribution-data-sharing.*

obscure providers' view of patients' true care coordination needs. For example, a health plan may attribute patients into a provider organization but then leave it up to the organization to attribute patients to specific physicians. In some models, patients may prospectively attribute themselves by choosing a provider. Currently, there is a trend towards prospective models, as providers are increasingly measured on quality-of-care metrics and timeliness of reports.[130] Prospective attribution assumes patients will continue to use the same provider. Prospective attribution can be patient-based (discrete medical services) or episode-based (grouping of medical services based on a disease or condition).[131] In other models, providers may prospectively identify patients for attribution or retrospectively identify them through prior-year claims data. If patients do not have a claims history, payers can use other criteria, such as geography, to attribute patients. Other models also exist that use factors such as type of provider and timing.[132,133,134] Without a full understanding of the methodology used, providers can make flawed assumptions, leading to wrong decisions about which patients need the most attention.

As with patient risk stratification, research suggests that it may not be feasible to reduce the number of provider attribution methodologies, especially at this stage of value-based payment implementation. However, there is the potential to improve attribution by promoting accountability for patient care through improved accuracy and clarity of attribution data and streamlining and improving transparency of attribution models to reduce variation.

Provider Awareness

Clearly defined and accurate data are needed to attribute patients to providers. Identifying providers at the individual level, their relationships to other providers (e.g., same group, same physical location, within network) and their specialty with respect to their patients (e.g., primary care provider [PCP], specialist by type) can improve the accuracy of patient attribution.

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[130] Pantely, S.E., 2011. "Whose Patient Is It? Patient Attribution in ACOs," Milliman Healthcare Reform Briefing Paper, January 2011. Accessed at *www.milliman.com/uploadedFiles/insight/healthreform/whose-patient-is-it.pdf*.

[131] Hussey, P.S., M.E. Sorbero, A. Mehrotra, H. Liu, and C.L. Damberg, 2009. "Episode-Based Performance Measurement and Payment: Making It a Reality," *Health Affairs,* 28(5): 587–595, September/October 2009. Accessed at *www.healthaffairs.org/doi/ abs/10.1377/hlthaff.28.5.1406*.

[132] Lewis, V.A., A.B. McClurg, J. Smith, E.S. Fisher, and J.P.W. Bynum, 2013. "Attributing Patients to Accountable Care Organizations: Performance Year Approach Aligns Stakeholders' Interests," *Health Affairs,* Vol. 32, No. 3, March 2013.

[133] "DRAFT Background About Shared Savings Program Design Features: Patient Attribution, Cost Target Calculation, and Payment Calculation and Distribution Excerpted from Draft Narratives Developed in the CT SIM Equity and Access Council March 2015." Accessed at *www.healthreform.ct.gov/ohri/.lib/ohri/work_groups/quality/2015-04-01/quality_ssp_contract_design_features.pdf*.

[134] "Assigning Accountability to Health Care Costs," HealthPartners, technical paper, updated Sept. 21, 2017. Accessed at *www.healthpartners.com/ucm/groups/public/@hp/@public/documents/documents/cntrb_031064.pdf*.

In addition to use—and potential expansion—of the standard NPI, as described earlier in this report, the industry needs clearly defined data to attribute providers to a service provided. This includes identifying provider relationships with individuals, the specialty a provider may be applying to specific services and relationships between providers for risk sharing. Some state health information exchanges and large health systems are addressing a portion of these issues at the state or system level.

The Need for Transparency

Extensive variation in attribution models and the frequent lack of transparency about the model make it difficult for providers to understand how their patients are attributed. This confusion can lead to gaps in managing the care of patients who are attributed to them.

Attribution methods must be fair and understandable to both patients and providers. Patients need to understand why they may be assigned to see a given PCP. If patients opt to choose a different PCP, there must be a process to change the attribution so that accurate cost and quality comparisons can be made in order to ensure a realistic picture of whether value-based payment is meeting its goals.

V. Quality Measurement

Challenges

Effective measurement of process performance and outcomes is foundational to value-based payment and to cost containment efforts. More revenue is at risk than ever before, with a host of financial incentives—rewards and penalties—tied to clinical performance and outcomes.

While quality measurement programs predominantly collect and analyze clinical data, the delivery of the data and reports needed for quality measurement can present an operational challenge. In many cases, redundant information is collected and communicated inconsistently, presenting opportunities to eliminate noise and free resources to fix the gaps.

CAQH CORE identified three specific operational challenges posed by quality measurement that provide opportunity for improvement.

First, providers reported an over-proliferation of quality measures in the industry and low consistency in the measures required across health plans and performance initiatives. A study by the National Quality Forum (NQF) found that in the second quarter of 2014 alone, 33 CMS programs—Medicare, Medicare Advantage, all of the Medicaid managed plans and all of the federal individual exchange market plans—collectively used more than 850 unique measures,

with only one-third of the measures used in more than two CMS programs.[135] Similarly, in the private market, different measures are often used by multiple private insurers in both employer-sponsored health plans and plans sold in the individual market.[136] In addition to reporting requirements for value-based payment programs, most providers are also required to supply measures to accreditation agencies, professional societies, registries and other organizations for multiple different purposes ranging from credentialing to medical research.[137]

Second, providers are also burdened by the process to generate quality data reports for value-based payment initiatives. A recent study of primary care and selected specialty members found that physicians and staff spent 15.1 hours per physician per week entering information into health records and on other activities for the sole purpose of reporting on quality measures from external entities.[138] Additionally, not all necessary quality measurement data are available in EHRs. Getting the data from the EHR into the quality measurement reporting format is not always streamlined.[139] Workflows also do not necessarily support consistency in data collection. For example, data for a measure looking at emergency department wait time may vary based on whether a patient is registered before or after being triaged.[140] The significance of the measures can sometimes be diluted due to the sheer amount of effort and tracking required.[141]

Finally, although there are different types of quality measures for different purposes, there is also a need for quality measure reporting to prioritize the use of provider resources, focusing on the collection of data that is useful to improving care and that can address consumer concerns.[142] As previously noted, quality measurement programs consume a considerable amount of provider

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[135] *www.qualityforum.org/WorkArea/linkit.aspx?LinkIdentifier=id&ItemID=78231.*

[136] J. Kenen, "Look at How Health Quality Measures Have Become a Jungle," Covering Health Blog, Association of Health Care Journalists, Aug. 26, 2015. Accessed at *http:// healthjournalism.org/blog/2015/08/look-at-how-health-quality-measures-have-become-a-jungle/.*

[137] "Quality Measurement: Focus on the Measures That Matter: New Report Calls for Reforming Healthcare Measurement to Improve Patient Care," Healthcare Association of New York State, press release issued April 20, 2016. Accessed at *www.hanys.org/communications/ pr/2016/2016-04-20_quality_measurements_focus_on_measures_that_matter.cfm.*

[138] Casalino, L.P., D. Gans, R. Weber, M. Cea, A. Tuchovsky, T.F. Bishop, Y. Miranda, B.A. Frankel, K.B. Ziehler, M.M. Wong, and T.B. Evenson, 2016. "US Physician Practices Spend More Than $15.4 Billion Annually to Report Quality Measures," *Health Affairs*, March 2016. Accessed at *https://www.healthaffairs.org/doi/full/10.1377/hlthaff.2015.1258.*

[139] White, J., 2016. "Why EHRs Have Trouble Reporting Quality Measures," *Healthcare Business & Technology*, June 22, 2016. Accessed at *www.healthcarebusinesstech.com/ehr-quality-measures/.*

[140] Dietzler, L., 2014. "The Unintended Consequences of Electronic Clinical Quality Measures," *HealthCatalyst.* Accessed at *www.slideshare.net/healthcatalyst1/the-unintended-consequences-of-electronic-clinical-quality-measures.*

[141] Center for Health Care Strategies (CHCS), 2015. "Aligning Quality Metrics Can Help Ease the Burden on ACO Providers." Accessed at *www.chcs.org/aligning-quality-metrics-can-help-ease-burden-aco-providers/.*

[142] "Measures that Matter: Moving from Measure Madness to Measures that Matter," HANYS Quality Institute, Healthcare Association of New York State, 2016. Accessed at *www.hanys.org/quality/clinical_operational_oversight/measures_that_matter/docs/mtm_report.pdf.*

and staff time, yet not all collected data is ultimately used by the entity collecting it. Also, providers question whether quality measures ultimately improve patient outcomes.[143] When quality measures are reported to consumers, the information is often confusing or not useful. For example, a study of four leading hospital report cards found that only 10% of the 844 hospitals evaluated achieved a "high performer" rating by more than one of the report cards.[144] Also, many of the measures reported to consumers address processes, such as timing of medication administration prior to surgery, that are not directly relevant to consumers.[145]

Harmonization

Many organizations noted that the number of quality measures, as well as their lack of focus, consistency and organization, presents a challenge.[146] A variety of state or regional efforts are focused on improving quality measurement and reporting. The Network for Regional Healthcare Improvement (NRHI) identifies more than 30 such collaboratives for improving data, providing transparency and sharing insights to speed innovation and accelerate progress toward reform.[147] There is currently a renewed effort to address the issue through various core measure projects. In 2014, America's Health Insurance Plans (AHIP) convened leaders from health plans, CMS, NQF and national physician organizations to form the Core Quality Measures Collaborative (CQMC).[148] In 2016, the collaborative released seven sets of core clinical quality measures to align public and private payers on quality measures to support new patient-centered payment and delivery system reforms.[149,150] Industry work to streamline quality measurement and promote harmonization

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[143] Blackwelder, R.B., 2017. "Accelerating Payment Reform Through Informed and Engaged Family Physicians," Health Care Payment Learning and Action Network Blog, June 2017. Accessed at *https://hcp-lan.org/2017/06/accelerating-payment-reform-through-informed-and-engaged-family-physicians/*.

[144] Austin, J.M., A.K. Jha, P.S. Romana, S.J. Singer, T.J. Vogus, R.M. Wachter, and P.J. Pronovost, 2015. "National Hospital Ratings Systems Share Few Common Scores and May Generate Confusion Instead of Clarity," *Health Affairs* 34(3): 423–30, March 2015. Accessed at *www.healthaffairs.org/doi/abs/10.1377/hlthaff.2014.0201.*

[145] Binder, L., 2015. "2 thoughts on "Look at how health quality measures have become a jungle," comments on "Look at How Health Quality Measures Have Become a Jungle," Covering Health Blog, Association of Health Care Journalists. Accessed at *http://healthjournalism.org/blog/2015/08/ look-at-how-health-quality-measures-have-become-a-jungle/*.

[146] Institute of Medicine Committee on Core Metrics for Better Health at Lower Cost, David Blumenthal, Elizabeth Malphrus and J. Michael McGinnis, editors, "Vital Signs: Core Metrics for Health and Health Care Progress," The National Academies Press, April 28, 2015. Accessed at *http://nationalacademies.org/HMD/reports/2015/ vital-signs-core-metrics.aspx*.

[147] *www.nrhi.org.*

[148] Conway, P.H., and the Core Quality Measures Collaborative Workgroup, 2015. "The Core Quality Measures Collaborative: A Rationale and Framework for Public-Private Quality Measure Alignment," *HealthAffairsBlog*, June 23, 2015. Accessed at *https://www.healthaffairs.org/do/10.1377/hblog20150623.048730/full/*.

[149] Morse, S., 2016. "Quality Measures Aligned by CMS, AHIP to Ease Reporting Headaches," *Healthcare IT News*, Feb. 17, 2016. Accessed at *https://www.healthcareitnews.com/news/quality-measures-aligned-cms-ahip-ease-reporting-headaches*.

[150] *www.cms.gov/Newsroom/MediaReleaseDatabase/Fact-sheets/2016-Fact-sheets-items/2016-02-16.html*.

should focus on contributing to these and other existing industry efforts.

Call to Action

The early signs of value-based payment variation documented in this paper constitute an opportunity to shape this emerging payment system.

Value-based payment—and the associated operational processes—are still relatively young. By comparison, when CAQH CORE began to address fee-for-service administrative complexity in 2005, the system was quite mature. And, stakeholders were growing increasingly frustrated by their lack of progress in the transition from manual fee-for-service transactions to electronic.

Contemporary best practices, technologies and lessons learned on behalf of fee-for service can be applied to strengthen the foundation of value-based payment. This includes the resources of CAQH CORE, with a proven track record as a leader of multi-stakeholder collaborations and author of operating rules that have moved the needle to automate fee-for-service administrative processes. In addition, numerous potential industry collaborators, many of which have worked alongside CAQH CORE to reduce the fee-for-service administrative burden, bring a wealth of experience and perspective to this effort.

Going forward, collaboration will become the currency of value-based payment. As implementation progresses, for example, health plans and provider organizations are expected to become data and analytics partners. By collaborating to leverage their respective data strengths, these stakeholders can illuminate blind spots in care management and reveal richer insights about practice variation.[151]

Operational enhancements, such as those proposed in this report, put more stakeholders on a good footing as potential data collaborators. By improving the reliability of data and interoperability, bringing clarity to patient risk stratification and provider attribution, and streamlining quality measurement, stakeholders will lay the foundation for improved communication.

Many industry and government initiatives already are working to improve value-based payment operations. CAQH CORE applauds ongoing efforts and calls on industry organizations, including those identified in this report and others that see a role for their organization, to take action.

[151] Flanigan, B., Lockwood, M., Chang, C., 2017. "Analytics to improve outcomes and reduce cost," Deloitte Center for Health Solutions, 2017. Accessed at *www2.deloitte.com/content/dam/Deloitte/us/Documents/ life-sciences-health-care/us-lshc-analytics-to-improve-outcomes-and-reduce-cost.pdf*.

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