METHODS

Modeling Financial Outcomes and Quantifying Risk in Episode-Based Payment Models

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ABSTRACT

OBJECTIVES: Health systems and provider groups currently lack a systematic mechanism to evaluate the financial implications of value-based alternative payments. We sought to develop a method to prospectively quantify the financial implications, including risk and uncertainty of (1) transitioning from a fee-for-service to an episode-based payment model and (2) modifying episode-specific clinical cost drivers. Finally, we highlight practical applications for the model to help facilitate stakeholder engagement in the transition to value-based payment models.

STUDY DESIGN: We created a financial simulation from empirical data to demonstrate the feasibility and potential use cases within the context of a hypothetical episode-based payment model for prostate cancer surgery (prostatectomy).

METHODS: We used Monte Carlo simulation methods to predict financial outcomes under various clinical and payment model scenarios for our pilot prostatectomy episode use case. We input patient-level empirical cost, reimbursement, and clinical data for a cohort of 157 patients at our institution into our model to quantify expected financial outcomes (payments, financial margins) and financial risk for stakeholders (payer, hospital, providers) under an episode-based payment model.

RESULTS: Compared with the status quo, there is a range of expected financial outcomes for various stakeholders depending on the financial parameters (episode price, shared savings, downside risk, stop-loss) in an episode-based payment model. Modifying clinical cost drivers has a profound impact on these outcomes. Uncertainty is high due to the small number of episodes.

CONCLUSIONS: The simulation demonstrates that both financial parameters and clinical cost drivers significantly affect the expected financial outcomes for stakeholders in value-based payment models.

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Fee-for-service (FFS) reimbursement incentivizes maximal use of services without accountability for quality, outcomes, or appropriateness, and it contributes to low-value care in the United States.[1] Ever-growing concerns about affordability and quality have led to widespread efforts to deploy alternative payment models (APMs), including episode-based payments (EBPs), that reward high-quality, low-cost care.[2,3] In an EBP, often referred to as a "bundled" payment, an accountable care entity receives a lump sum for relevant medical services within a defined time period or clinical care cycle. In contrast to other population-based APMs, like accountable care organizations or capitation, EBP models are particularly relevant for specialty care providers and surgeons.[4-6]

However, there is trepidation around this transition to value-based reimbursement. Health systems and provider groups lack structured, systematic mechanisms to assess the potential impact on institutional and provider finances.[7,8] Current strategies estimate health system reimbursement under an alternative model relative to FFS. This method conceptualizes "cost" as payer reimbursement to the health system, rather than true service-delivery costs. Because internal production costs are neither well understood nor systematically tied to reimbursement, such analyses provide an incomplete picture of the true financial implications of transitioning to value-based payments.[9] Health care organizations must understand the impact of adopting alternative payments in the context of true costs to deliver care.[10] Thus far, uncertain financial implications have stymied stakeholder enthusiasm around EBP models.[11]

We propose a health system–driven framework to systematically evaluate the impact of adopting EBPs for discrete episodes of care. We illustrate the approach through a case study of a prostate cancer surgery episode at a tertiary institution. The objectives are to develop a mechanism to (1) quantify the impact on stakeholder finances of adopting an EBP and (2) inform value-based care redesign efforts by quantifying the impact of clinical cost drivers. Herein, we discuss our process for collecting and analyzing episode-specific clinical and financial data, describe our simulation model for predicting financial outcomes, and illustrate uses of the methodology to gain prospective insights on the financial implications of a hypothetical EBP for prostate cancer surgery.

TAKEAWAY POINTS

Value-based payment model adoption is hampered by unknown financial impact, particularly regarding downside risk, and poor provider engagement. We describe our method for prospectively quantifying the expected financial impact and risk (upside and downside) of transitioning from a fee-for-service to an episode-based payment model using empirical financial and clinical data. We provide use cases for the simulation's output that:

- quantify how the value-based payment arrangement parameters affect each stakeholder's financial outcome, including risk exposure; and
- identify the highest-impact modifiable targets of value-based care redesign for engaging clinicians in the transition to value.

METHODS

Episode Design and Cohort Identification

Select the episode. An episode of care may span an inpatient hospitalization, surgical procedure, or medical condition. Broader episode definitions present greater opportunity to address variation and low-value care, but they introduce complexity in payer reimbursement.[12]

Radical prostatectomy is the surgical standard of care for localized prostate cancer. This episode satisfies the Health Care Payment Learning & Action Network's criteria for prioritization for value-based APMs and is a likely focus for future EBPs (**eAppendix A** [eAppendices available at **ajmc.com**]).[13,14]

Define episode period. The closest urology visit prior to surgery initiates the episode, which continues 90 days postoperatively (**eAppendix B**). Although many medical and surgical EBP models begin at the index hospitalization,[12] we capture variation in preoperative care to identify opportunities for value improvement during this phase. In the preoperative period, we include only services rendered for prostate cancer or preoperative care (*International Classification of Diseases, Ninth Revision* [*ICD-9*] code 185.0 and *International Classification of Diseases, Tenth Revision* [*ICD-10*] code C61, and *ICD-9* codes V72.81-V72.84 and *ICD-10* codes Z01.810-Z01.818, respectively). We include all medical services during the index admission and 90-day postoperative period (**eAppendix C**).[15]

Identify patient cohort. After obtaining institutional review board approval, we identified patients undergoing robot-assisted laparoscopic radical prostatectomy in 2016 at our primary teaching facility. We utilized the hospital's hybrid analytics and information technology group to extract cases using *ICD-9* or *ICD-10* codes for prostate cancer (185.0 or C61, respectively) and Common Procedural Terminology (CPT) code for laparoscopic radical prostatectomy (55866). This group provides reporting, analysis, monitoring, and actionable business intelligence by combining data across different hospital systems. We cross-referenced the cohort with operative schedules to assure the veracity of our search. We identified 157 cases performed by 5 urologic oncology faculty members.

Obtain Model Input Data

Demographic and clinical. Our bioinformatics team extracted demographic and clinical data, including patient age, body mass index, comorbidities, education, income, tobacco use, tumor grade, and cancer stage. We abstracted clinical data from the inpatient admission, including length of stay, operating room time, escalation

TABLE 1. Clinical and Demographic Data of Empirical Cohort (N = 157)

Data	Mean (SD) or n (%)
Patient	
Age in years	64.6 (6.8)
Prostatectomy pathology: Gleason score	
N/A[a]	13 (8.3%)
3 + 3	15 (9.6%)
3 + 4	82 (52.2%)
4 + 3	37 (23.6%)
≥ 4 + 4	10 (6.4%)
Prostatectomy pathology: T stage	
ypT0[b]	3 (2%)
pT2	96 (61%)
pT3	58 (37%)
Prostatectomy pathology: N stage	
N0	109 (69%)
N1	13 (8%)
Nx	35 (22%)
Number of lymph nodes (n = 122)	17.1 (9.4)
ASA physical status classification	2.3 (0.5)
Body mass index	27.3 (4.2)
Smoking status	
Never	92 (61.3%)
Former	48 (32.0%)
Current	10 (6.7%)
Income level[c]	
< $50,000	5 (5.4%)
$50,000-$100,000	32 (32.8%)
$100,000-$200,000	37 (40.2%)
> $200,000	19 (20.7%)
Education[d] (% chance of holding a bachelor's degree based on Census tract)	
< 30%	18 (19.1%)
30%-60%	44 (46.8%)
> 60%	32 (34.0%)

(continued)

TABLE 1. *(Continued)* Clinical and Demographic Data of Empirical Cohort (N = 157)

Data	Mean (SD) or n (%)
Preoperative	
Prostate MRI at treating institution	56 (35.7%)
Preoperative cardiac testing at treating institution	
Electrocardiogram	38 (24.2%)
Chest radiograph	22 (14.0%)
Echocardiogram	9 (5.7%)
Stress test[e]	5 (3.2%)
Preoperative functional recovery counseling visits	60 (38.0%)
Perioperative	
Anesthesia operative time in minutes	258.6 (49.3)
Postoperative	
Length of stay in days	1.78 (1.51)
MS-DRG	
707: complicated	24 (15.3%)
708: uncomplicated	131 (84.7%)
Required escalation of care during index hospitalization	0 (0.0%)
Discharged home	157 (100.0%)
Readmitted	4 (2.5%)
Emergency department visits	13 visits by 9 (5.7%) patients
Postoperative functional recovery counseling visits	45 (28.5%)

ASA, American Society of Anesthesiologists; MS-DRG, Medicare Severity Diagnosis Related Group; N/A, not applicable.

[a]Gleason score is undefined because of morphologic changes due to neoadjuvant androgen deprivation clinical trial.

[b]Complete pathologic response to neoadjuvant androgen deprivation clinical trial.

[c]Missing n = 64 (40.8%).

[d]Missing n = 63 (40.1%).

[e]Myocardial perfusion imaging or stress echocardiogram.

of care, and postdischarge events, including discharge disposition, readmissions, and emergency department visits (**Table 1**).

Financial. We then obtained granular cost and reimbursement data for each patient. **Table 2**[16] reports aggregate financial input data and detail on cost-accounting methods and reimbursement data sources. Despite a mix of payers, we calculated reimbursement according to Medicare fee schedules to simulate a Medicare-specific EBP model. The confidential nature of commercial contracts preclude inclusion in this report, but we previously verified the assumption that internal costs are independent of payer.[17]

Costs. We separated costs by phase (preoperative, inpatient, postoperative). We further divided inpatient costs into 2 phases: surgery/perioperative and inpatient ward (personnel and hospital). We utilize previously reported institution-specific time-driven activity-based costing estimates for outpatient (all costs) and inpatient (personnel costs only) for robotic radical prostatectomy.[18] For all other operating room/perioperative and inpatient ward costs, we used our hospital's activity-based costing data.

Reimbursement. We also separated reimbursement by phase (preoperative, inpatient, postoperative) and type (professional, nonprofessional). Nonprofessional reimbursement included the Inpatient Prospective Payment System's reimbursement for laparoscopic radical prostatectomy (CPT 55866), with or without pelvic lymph node dissection (CPT 38571), and technical component reimbursement for outpatient services such as radiology and laboratory testing. We searched the Medicare Physician Fee Schedule for patient-level professional reimbursement for all physician services, excluding anesthesia, which we estimated using data from the department of anesthesiology's finance office.[16]

Episode Payment Model Design

The 5 urologic oncologists collaborated to define a consensus high-value clinical care pathway to inform the inclusion of clinical services in the payment model (**eAppendix D**). We developed an EBP model by defining modifiable financial and clinical parameters according to the specifics of the clinical episode and model participants.[7,12,19-22] **Table 3** reports the key model components.

Financial Simulation Model

We constructed a simulation to gain confidence in the computation of stakeholders' payments under the EBP. This entails sampling patient cohorts consistent with individual patient-level empirical cost and clinical data from our cohort to compute payment distributions under an EBP and the extant FFS arrangement. We built the simulation model using the following steps:

- Step 1: Collect empirical patient-level clinical and granular financial data inputs (Table 2 [A]) for the original patient cohort.
- Step 2: Generate simulated patient data by independently fitting distributions for each empirical input, considering correlations among input variables. We assume patients are independent of each other and use the Cholesky matrix decomposition technique to add desired correlation to independently drawn data. For simplicity, we account for primary correlations and ignore cascading effects (**eAppendix E**).
- Step 3: Validate simulated data by graphically comparing empirical and simulated distributions for independent input variables (**eAppendix F**).
- Step 4: Calculate relevant financial outcome for each stakeholder using the simulated patient cohort data according to the defined EBP model. Although the 2 required stakeholders are the payer and the accountable entity (usually a health system or provider group), we additionally split the accountable entity into the hospital and participating physicians for this exercise. The relevant financial outcome differs by stakeholder (payer and physician: per-episode payment; accountable entity [hospital plus physician] and hospital: per-episode financial margin [payment minus internal costs]). We also compute corresponding hypothetical outcomes under FFS using the sampled reimbursement data for each patient. By simulating

TABLE 2. Episode Payment Model Input Variables: Empirical Cohort Data[16]

Input variable	Mean	SD	Data source and description
Phase 1: preoperative			
Cost preoperative (excluding imaging) ($)	449	344	TDABC; true internal costs to provide preoperative clinic visits[a] and routine preoperative testing
Cost MRI ($)	670	–	TDABC; true internal costs to deliver a multiparametric MRI for preoperative staging purposes
Probability of receiving MRI	35.7%	–	
Cost CXR ($)	20	–	TDABC; true internal costs to deliver a CXR for preoperative clearance
Probability of receiving CXR	14.0%	–	
Cost EKG ($)	20	–	TDABC; true internal costs to deliver an EKG for preoperative clearance
Probability of receiving EKG	24.2%	–	
Reimbursement preoperative ($)	1380	1087	MFS; reimbursement for all services, including professional and nonprofessional (technical) payments for all relevant CPT codes[b]
Phase 2: inpatient			
% DRG 707 (708)	15.3% (84.7%)	–	Empirical data from 2016 cohort
Cost of surgery and perioperative care ($)	3979	592	Hospital ABC; direct and indirect costs of supplies and services rendered in the operating room (cost of surgery) and the preoperative holding area/postacute care unit (perioperative care), including personnel costs
Personnel costs in ward ($)	1554	1006	TDABC; true internal costs of physician, resident, advanced care provider, nursing staff, and nursing administration staff involvement in inpatient care, including direct (salary and benefits) and indirect costs
Cost of inpatient hospitalization ($)	13,546	4007	Hospital ABC; direct and indirect costs of medical services rendered on the inpatient ward. Individual cost centers include room and board, pharmacy, laboratory, radiology, and pathology.
Reimbursement hospital ($)	16,773	1803	MS-DRG; Inpatient Prospective Payment System reimbursement for DRG 707 or 708 with facility-specific adjustments[c]
Reimbursement professional ($)	2344	506	MFS; reimbursement for all inpatient physician services[b,d]
Reimbursement anesthesia ($)	545	81	Anesthesia finance department[e]
Total length of stay, nonoutliers (days)	1.56	0.60	Empirical data from 2016 cohort
Total length of stay, outliers[f] (days)	5.68	1.42	Empirical data from 2016 cohort
Operating room time (minutes)	259	49	Empirical data from 2016 cohort
Phase 3: postoperative			
Cost postoperative care ($)	147	137	TDABC; true internal costs to provide postoperative clinic visits, including surgical follow-up, urology men's health visits for functional recovery counseling, and nurse visits
Cost postacute care[g] ($)	234	1416	Hospital ABC; direct and indirect cost of medical services rendered during ED visits and readmissions[h]
Reimbursement postacute care[g] ($)	313	1857	Hospital ABC; encounter-specific reimbursement for ED visits and readmissions[i]

ABC, activity-based accounting; CXR, chest x-ray; ED, emergency department; EKG, electrocardiogram; MFS, Medicare Fee Schedule; MS-DRG, Medicare Severity Diagnosis Related Group; TDABC, time-driven activity-based costing.

[a]Includes urologic oncologist, urologic men's health specialist, primary care/anesthesia preoperative clearance, cardiologist, and radiation oncologist; excludes multiparametric MRI.

[b]See the MFS.[16]

[c]Standard adjustments include wage index, cost of living, disproportionate share hospital, indirect medical education, and outlier payments.

[d]Excludes anesthesia professional fees.

[e]Estimated Medicare reimbursement.

[f]Length-of-stay outliers defined as greater than 2 SDs above the mean length of stay.

[g]All patients were discharged home. There were 9 patients with 9 ED visits and 4 readmissions. In our financial model, we elected not to include postacute encounters as an input variable and instead modeled cost outliers based on length of stay. Because of how infrequently postacute care occurred, no other variable correlated with postacute costs/reimbursements and was therefore not useful for the model. This also explains the very large SDs.

[h]Because TDABC estimates for professional (physician) services rendered during ED visits and readmissions are unavailable, they can only be estimated by professional reimbursement using MFS. Although this is a standard method for estimating costs when more granular cost-accounting methods are unavailable, using reimbursement amounts to estimate costs does not contribute to an understanding of true financial margins. Therefore, professional costs and reimbursement for these unplanned encounters were excluded from the model.

[i]The 90-day global period negates any reimbursement for outpatient physician services rendered in the postoperative time frame.

TABLE 3. Episode Payment Model: Simulation Inputs

Financial parameters	Elements of the financial model	Baseline model value
Episode payment	Target or "bundle" price reimbursed per episode by the payer (Medicare rates)	$20,600
	Adjustment based on negotiated discount factors and patient risk profiles	0%
Allocation of risk: payer and accountable entity	Shared savings: upper limit of any financial savings awarded to accountable entity (payer retains any additional savings)	20%
	Risk-bearing: upper limit of any financial losses borne by the accountable entity (payer bears any additional losses)	8%
	Stop-loss threshold: upper limit of costs for an individual episode above which the payer assumes financial responsibility	3 SD above the mean
Allocation of risk: parties within accountable entity (hospital and physicians)	Shared savings: upper limit of any financial savings awarded to physicians (hospital retains any remaining savings)	50%
	Risk-bearing: upper limit of any financial losses borne by the physicians (hospital bears any additional losses)	50%
Physician payment	Mean Medicare fee-for-service physician reimbursement from original cohort	$2615
Advanced APM provider bonus	Medicare bonus payment for participating in a qualifying (risk-bearing) advanced APM	5%
Quality threshold	Annual probability of the accountable entity reaching a predetermined, episode-specific, minimum quality threshold • Ensures that reduced costs do not come at the expense of care quality • Accountable entity is rewarded shared savings only if this quality threshold is met	100%
Clinical parameters	**Modifiable clinical cost drivers**	**Default input**
Case volume	Number of episodes per year	160
Efficiency	Reflects current clinical care processes and pathways • Operating room time • Hospital length of stay	Empirical baseline
Resource utilization	Reflects how intensely medical services and supplies are utilized	
	• Pre- and postoperative cost variability	0.67, 0.60 SD of log cost
	• Preoperative advanced imaging (prostate MRI)	35.7%
	• Operating room costs, per minute (reflects supplies used)	$12.07
	• Inpatient ward costs, per minute (reflects intensity of inpatient care)	$0.73
Outcomes	Reflects clinical outcomes that deviate from optimal care pathway • Prolonged length of stay[a]	3.2%

APM, alternative payment model.

[a]For this episode of care, very few clinical outcomes deviated from the optimal care pathway, including no escalations of care to a higher acuity inpatient unit, no discharges to an institutional postacute care facility, 13 emergency department visits (8.3%), and 4 readmissions (2.5%). No preoperative variables predicted these deviations, so we therefore collapsed all these potential sources of outlier costs into a single parameter (prolonged length of stay) for modeling purposes.

many patient cohorts (200), we generate the distribution of outcomes for each stakeholder under both payment models. Based on these distributions, we report dollar change and risk metrics in the EBP with respect to the current state of FFS.

Risk Evaluation

We additionally consider financial outcomes in terms of the level of risk assumed by each stakeholder. Standard deviation is an aggregate volatility measure and is inadequate to quantify risk in digestible terms for clinicians. Therefore, we consider 2 additional financial risk metrics, inspired by value at risk and conditional value at risk, to communicate pertinent financial risk of the EBP in terms of best- and worst-case scenarios compared with the status quo. We compute the probability that a stakeholder is better off under an EBP (value at risk) and the mean gains (or losses) given that the stakeholder performs better (or worse) in the EBP (conditional value at risk). The latter essentially illustrates the episode's "risk corridor" (**eAppendix G**).

RESULTS

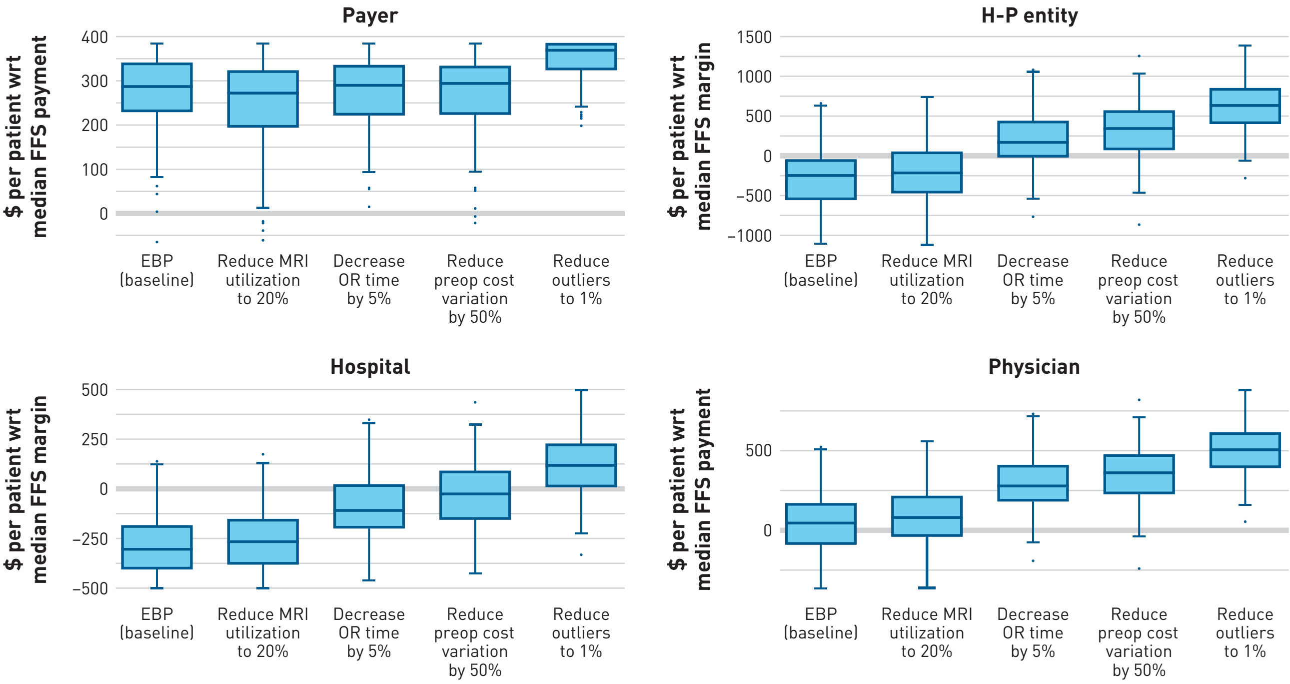
We created an interactive, web-based interface that allows stakeholders to dynamically evaluate financial outcomes under a range of payment model parameters and clinical scenarios. The following case studies illustrate 2 potential applications.

Case Study 1: Financial Implications of Transitioning From FFS to EBP (Figure 1)

For this application, we maintain clinical parameters at their baseline levels (Table 2[16]). We report the financial outcomes under EBP for a simulated cohort as the median per-episode change in dollar amount with respect to the FFS payment or financial margin for each stakeholder. Positive (or negative) change compared with FFS reflects a more (or less) favorable outcome for that stakeholder.

For our baseline EBP scenario (Table 3), we set the episode price at the historical mean payment. Federal bundled payment programs frequently mandate a downward adjustment (often around 3%) to ensure payer savings, but

FIGURE 2. Expected Change in Payment (payer, physician) or Margin (H-P entity, hospital) Under an EBP Model With Changes in Clinical Cost Drivers



Median (SD) per-episode $ change in the EBP relative to median FFS					
	Baseline clinical state	Reduce MRI utilization from 35.5% to 20%	Decrease OR time by 5%	Decrease variability in preoperative cost by 50%	Decrease high-cost outliers from 3.5% to 1%
Payer	286.13 (82.6)	271.88 (96.38)	287.77 (75.22)	293.69 (78.71)	369.4 (43.64)
Accountable (hospital-physician) entity	−294.73 (337.69)	−220.27 (346.64)	167.73 (328.17)	335.69 (339.09)	624.06 (310.63)
Hospital	−341.15 (168.84)	−303.92 (173.32)	−109.92 (164.08)	−25.94 (169.55)	118.24 (155.31)
Physician	44.24 (168.84)	81.47 (173.32)	275.47 (164.08)	359.45 (169.55)	503.64 (155.31)

EBP, episode-based payment; FFS, fee-for-service; H-P entity, hospital-physician entity; OR, operating room; wrt, with regard to.

driven by a decrease in the hospital's margin. The hospital has only a 3% chance of faring better in the EBP, with an expected decrease in per-episode financial margin of $341.15 compared with status quo FFS.

Acknowledging there is no prescriptive "correct" level for any of the financial payment model parameters selected here, our model allows stakeholders to explore a spectrum of options, potentially in the context of EBP contract negotiations. To illustrate this, we adjust the EBP parameters to shift more downside risk onto the payer by reducing the accountable entity's maximum aggregate loss from 8% to 5% and lowering individual patient outlier threshold from 3 to 2 SDs above the mean. The financial outcomes become somewhat less unfavorable for the accountable entity as compared with the baseline EBP scenario (Figure 1: third box plot vs second box plot; second stakeholder column in the corresponding table).

Case Study 2: Impact of Modifying Individual Clinical Cost Drivers on Financial Outcomes (Figure 2)

Here we assume the baseline EBP financial parameters are locked in. We can now explore how changes in clinical cost drivers affect financial outcomes for each stakeholder. This application helps inform value-based care redesign efforts by prospectively evaluating the financial impact of changes in resource utilization, efficiency, and outcomes that drive EBP performance. This process also illustrates the business case for aligning stakeholders around value.

Figure 2 quantifies the financial outcomes of achieving value-based care redesign goals and the opportunity for all parties to benefit within a value-based APM. For this case study, we evaluated the impact of reducing preoperative MRI utilization from 35.7% (current state) to 20%, reducing operating room time by 5%, reducing preoperative cost variation by 50%, and reducing high-cost outliers from 3.2% (current state) to 1% within the EBP. For the accountable entity, achieving these clinical care delivery goals changes the financial outcome of shifting from FFS to this EBP from an unfavorable situation ($294.73 reduction) to a favorable ($624.06 increase) in per-episode margin compared with FFS. Meanwhile, physician payments rise drastically, from $44.24 higher than FFS in the current clinical state to $503.64 higher. Demonstrating the financial alignment among the stakeholders in this type of arrangement, the payer's outcome simultaneously becomes more favorable with these care delivery changes: Median per-episode payment goes from $286.13 lower to $369.40 lower than what the payer would expect to pay in FFS. Full outcomes for all stakeholders under all clinical scenarios are shown in **eAppendix H**.

DISCUSSION

We describe our method for systematically analyzing financial outcomes of a discrete episode of care under different payment arrangements. Our financial simulation is based on patient-level empirical cost, reimbursement, and clinical data that capture real-world variability in patient care. Through our prostatectomy case study, we reveal insights into (1) the financial impact of transitioning from FFS to EBP models and (2) the financial impact of value-based care redesign targets. Health systems currently lack such systematic, prospective modeling to anticipate the financial implications of value-based payment reform, make decisions on adopting alternative payments, and maximize the value of care delivery.

Our framework offers a solution to several knowledge gaps and could address strategic hurdles that are impeding adoption of EBP models. First, we present a novel mechanism to quantify and provide transparency around the financial risk of transitioning from FFS to EBP, the uncertainty around which hinders adoption of value-based payment models.[11] Our model provides the flexibility to evaluate an array of clinical circumstances and payment model structures. The output is both a method of analysis and a tool for communicating uncertainty and opportunity.

Second, our granular, internal cost accounting methods disentangle the arbitrary relationship between reimbursement and actual costs of delivering a service.[10] Due to inherent cost accounting challenges, episode "costs" are traditionally viewed from the payer perspective in the form of price-standardized Medicare reimbursement. By comparing historical Medicare spending against prospective financial targets, health systems estimate short-term reimbursement in an APM relative to the status quo. However, this strategy lacks the specificity to inform care redesign that maximizes value. We demonstrate how analyzing internal service-line costs relative to reimbursement provides a more nuanced understanding of the financial implications of transitioning away from FFS. This model may also help health systems succeed in EBP models by identifying the most efficient targets for value-based care redesign.[10]

Finally, our user interface facilitates stakeholder engagement. Clinical stakeholders can tailor relevant clinical cost drivers for specific episodes. Stakeholders may more effectively participate in payment model design and contract negotiation by better understanding the importance of specific financial model parameters. Extrapolated over a time for an expected case volume, payers can project the global change in service-line spending, risk-bearing entities can project the global change in financial margin, and providers can prospectively estimate reimbursement. Delivery systems can also use this model to calculate expected return on investment of value improvement initiatives.

Limitations

We note several limitations. First, although quality measures are an essential component of value, this model focuses primarily on financial outcomes. It remains challenging to define feasible, specific quality metrics that occur within the episode time frame, are adequately risk-adjusted, and are under the control of those at risk.[23,24] However, to acknowledge the importance of quality, we created a modifiable parameter representing the likelihood that the accountable entity meets a generic minimum quality standard, making them eligible for gain-sharing.[19] Specific quality metrics, methods of data collection, and minimum quality thresholds may vary across service lines and institutions, and they must be clearly delineated for each episode.

Second, the insights generated by our prototype are valid only internally, due to the institution-specific nature of the internal production costs and reimbursement structure.[25] Replication of these methods for independent provider groups, in which the accountable entity is not split between a facility and providers, may yield variable results but would be simpler to model. This represents a learning use case through which we developed a replicable, scalable framework to help facilitate the transformation from volume to value.

Third, we modified only a limited number of financial model parameters (maximum aggregate loss and stop-loss threshold) to illustrate a potential use of the model. However, we could have explored countless modifications to the financial parameters to evaluate their impact on overall financial outcomes.

Fourth, this financial model addresses only variable or marginal costs. Many experts view cost savings attributed to reduced utilization at the margin as a "savings illusion" due to massive fixed costs.[26] However, others argue that within the appropriate time frame and with adequate managerial attention, up to 95% of health care costs become variable.[10] This emphasizes the need for systemwide scaling of this methodology in conjunction with an active, institutional commitment to systematically redesign care delivery.

Finally, this tool is not a stand-alone solution to value transformation. Rather, it provides insights and actionable information to support value-based care initiatives, clinician engagement, and

EBP design that align payers, hospitals, and physicians around high-value care.[27]

CONCLUSIONS

The transformation to value-based care in the United States faces profound challenges. Although societal, political, economic, and psychological barriers continue to impede the transition, health systems and payers are forging ahead with APM design and implementation. We present a systematic framework for prospectively generating institution-specific financial insights into the value of care delivery for defined episodes. Importantly, this model allows stakeholders to better understand the financial risk of adopting APMs. Health systems must replicate, validate, operationalize, and scale this process to effectively drive systematic delivery system redesign. ■

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REFERENCES

1. Porter ME, Kaplan RS. How to pay for health care. *Harv Bus Rev*. 2016;94(7-8):88-98,100,134.
2. Burwell SM. Setting value-based payment goals—HHS efforts to improve U.S. health care. *N Engl J Med*. 2015;372(10):897-899. doi:10.1056/NEJMp1500445
3. Murray A, Jha AK, Lee TH. Surgical care value—beyond bundled payments. *NEJM Catalyst*. October 30, 2018. Accessed November 12, 2020. https://catalyst.nejm.org/doi/full/10.1056/CAT.18.0062
4. Tsai TC, Miller DC. Bundling payments for episodes of surgical care. *JAMA Surg*. 2015;150(9):905-906. doi:10.1001/jamasurg.2015.1236
5. Alphs Jackson H, Walsh B, Abecassis M. A surgeon's guide to bundled payment models for episodes of care. *JAMA Surg*. 2016;151(1):3-4. doi:10.1001/jamasurg.2015.2779
6. Nathan H, Dimick JB. Medicare's shift to mandatory alternative payment models: why surgeons should care. *JAMA Surg*. 2017;152(2):125-126. doi:10.1001/jamasurg.2016.4005
7. Delbanco SF, Anderson KM, Major CE, Kiser MB, Toner BW. Promising payment reform: risk-sharing with accountable care organizations. The Commonwealth Fund. July 25, 2011. Accessed November 18, 2020. https://www.commonwealthfund.org/publications/fund-reports/2011/jul/promising-payment-reform-risk-sharing-accountable-care
8. Feeley TW, Mohta NS. Transitioning payment models: fee-for-service to value-based care. Optum. November 2018. Accessed December 1, 2020. https://www.optum.com/content/dam/optum3/optum/en/resources/publications/NEJM_Optum_Transitioning_Payment_Models_2018.pdf
9. Reinhardt UE. The pricing of U.S. hospital services: chaos behind a veil of secrecy. *Health Aff (Millwood)*. 2006;25(1):57-69. doi:10.1377/hlthaff.25.1.57
10. Kaplan R, Porter M. The big idea: how to solve the cost crisis in health care. *Harvard Business Review*. September 2011. Accessed November 28, 2020. https://hbr.org/2011/09/how-to-solve-the-cost-crisis-in-health-care
11. Ridgely MS, de Vries D, Bozic KJ, Hussey PH. Bundled payment fails to gain a foothold in California: the experience of the IHA bundled payment demonstration. *Health Aff (Millwood)*. 2014;33(8):1345-1352. doi:10.1377/hlthaff.2014.0114
12. Bundled Payments for Care Improvement Advanced: target price specifications – model years 1 and 2. CMS Center for Medicare & Medicaid Innovation. February 2018. Accessed October 19, 2020. https://innovation.cms.gov/files/x/bpciadvanced-targetprice-my1-2.pdf
13. Accelerating and aligning clinical episode payment models. Health Care Payment Learning & Action Network. August 1, 2016. Accessed August 4, 2020. https://hcp-lan.org/clinical-episode-payment/
14. Kaye DR, Miller DC, Ellimoottil C. Alternative payment models and urology. *Curr Opin Urol*. 2017;27(4):360-365. doi:10.1097/MOU.0000000000000403
15. Ellimoottil C, Ryan AM, Hou H, Dupree JM, Hallstrom B, Miller DC. Implications of the definition of an episode of care used in the Comprehensive Care for Joint Replacement Model. *JAMA Surg*. 2017;152(1):49-54. doi:10.1001/jamasurg.2016.3098
16. Search the Physician Fee Schedule. CMS. Accessed January 15, 2018. https://www.cms.gov/medicare/physician-fee-schedule/search
17. Johnson DC, Kwok E, Ahn C, et al. Financial margins for prostate cancer surgery: quantifying the impact of modifiable cost inputs in an episode based reimbursement model. *J Urol*. 2019;202(3):539-545. doi:10.1097/JU.0000000000000283
18. Laviana AA, Ilg AM, Veruttipong D, et al. Utilizing time-driven activity-based costing to understand the short- and long-term costs of treating localized, low-risk prostate cancer. *Cancer*. 2016;122(3):447-455. doi:10.1002/cncr.29743
19. Witkowski M, Higgins L, Warner J, Sherman M, Kaplan RS. How to design a bundled payment around value. *Harvard Business Review*. October 3, 2013. Accessed December 5, 2017. https://hbr.org/2013/10/how-to-design-a-bundled-payment-around-value
20. Contracting for bundled payment. MITRE Corporation. December 16, 2011. Accessed August 11, 2018. https://www.mitre.org/sites/default/files/pdf/Contracting_Bundled_Payment.pdf
21. American College of Surgeons. Proposal for a physician-focused payment model: ACS-Brandeis Advanced Alternative Payment Model. Office of the Assistant Secretary for Planning and Evaluation. December 13, 2016. Accessed October 8, 2017. https://aspe.hhs.gov/sites/default/files/private/pdf/253406/TheACSBrandeisAdvancedAPM-ACS.pdf
22. OCM performance-based payment methodology. CMS. December 17, 2018. Accessed January 24, 2019. https://innovation.cms.gov/files/x/ocm-cancercodelists.pdf
23. Hussey PS, Friedberg MW, Anhang Price R, Lovejoy SL, Damberg CL. Episode-based approaches to measuring health care quality. *Med Care Res Rev*. 2017;74(2):127-147. doi:10.1177/1077558716630173
24. Pronovost PJ, Miller J, Newman-Toker DE, Ishii L, Wu AW. We should measure what matters in bundled payment programs. *Ann Intern Med*. 2018;168(10):735-736. doi:10.7326/M17-2815
25. Lee VS, Kawamoto K, Hess R, et al. Implementation of a value-driven outcomes program to identify high variability in clinical costs and outcomes and association with reduced cost and improved quality. *JAMA*. 2016;316(10):1061-1072. doi:10.1001/jama.2016.12226
26. Rauh SS, Wadsworth EB, Weeks WB, Weinstein JN. The savings illusion—why clinical quality improvement fails to deliver bottom-line results. *N Engl J Med*. 2011;365(26):e48. doi:10.1056/NEJMp1111662
27. Sandy LG, Pham HH, Levine S. Building trust between physicians, hospitals, and payers: a renewed opportunity for transforming US health care. *JAMA*. 2019;321(10):933-934. doi:10.1001/jama.2018.19357

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