

A Case Report of the Analytic Development of Bundled Payments for the Commercial Market

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ABSTRACT

In this manuscript, we provide a case report of a novel methodology for the analytic development of bundled payments designed to be implemented in the commercial market. In winter 2016, an integrated health system's senior leadership tasked the system with the development of episode-based bundled payment programs for its employer-sponsored self-insured health plan. A steering committee was formed to manage the effort, and 6 interdependent teams were organized to address each work stream. Analytic objectives included the development of a methodology for clinical opportunity identification, data analysis and communication, and bundle development. Two data sources were used to understand clinical opportunity: the health plan's administrative claims to understand practice patterns before, during, and after a bundled payment episode, and facility charge detail to understand utilization variation within and across providers in a bundle. Through statistical analysis, data visualization, clinical consultation, and feedback, 6 bundled payments were developed within 24 months.

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Episode-based bundled payment programs provide patients, employers, and third-party payers with a prescribed set of health care goods and services related to a medical procedure or condition at a fixed charge. Payments for the care are distributed on a contractual basis to each provider who contributes to patient care during the episode to the extent that quality goals are met; facilities utilized during the episode of care are reimbursed at prearranged rates. The bundled payment organizes care in such a way as to produce optimal patient outcomes efficiently, taking all aspects of care before and after the procedure or treatment into account. In a commercial market, contracts for episode-based bundled payment programs are negotiated between a provider organization and a third-party payer. The patient typically pays less than they would for the episode of care had the program not been available.^{1,2}

Research regarding the development of bundled payment programs in the private sector has focused on the establishment of a bundled payment program,^{1,2} a description of their clinical parameters,^{2,3} a description of their operational development,⁴ the administration of a bundled payment program,^{1,5,6} implementation issues,⁷ and financial results.^{2,6,8} This paper contributes to the literature by providing a case study of their analytic development.

In winter 2016, OhioHealth senior leadership advised the leader of population health analytics (G.I.S.) to prepare several episode-based bundled payment programs for the consideration of its employer-sponsored self-insured health plan (hereafter referred to as "health plan"). The intent behind the request was to work with the clinical service teams to improve the value of care provided across several high-volume procedures and conditions in order to support its go-to-market strategy. A steering committee was formed across service lines to identify goals, objectives, and milestones.

Six interdependent work streams were organized to address the foundational aspects of bundled payment program

development. This manuscript focuses on the efforts of the first work team, clinical opportunity development. Pursuant to its objectives, analysts from a variety of departments collaborated to develop the data architecture required to analyze spending and utilization across the episode. The analyses were conducted in 2 phases: the first using the claims of the integrated health system's health plan to develop baseline pricing given clinical opportunities to increase the efficiency of care delivery, and the second using charge detail from a financial decision support system to understand opportunities to reduce spending, resulting in an estimated target price.

Phase 1: Using Administrative Claims to Understand Procedural and Medical Episode Costs

In the first phase, the analytic team submitted an administrative claims file to its analytic business associate, Aver Inc, in December 2016. Aver applied bundle methodologies to the claims using the episode of care definitions developed by PROMETHEUS Analytics maintained by Altarum. The PROMETHEUS algorithm provided logic to group claims into episode phases such as preprocedure, procedure, and post procedure. PROMETHEUS' Episodes of Care Definition Summary Descriptions are only available to licensees and partners of PROMETHEUS Analytics, but their format is described generally in the literature.⁷ Using the methodology, Aver produced initial high-level results for 90 episodes in March 2017. In 1 case, the team chose to use the CMS bundle definition of an episode as opposed to the PROMETHEUS definition since the operations team was already participating in the same bundle for the Medicare fee-for-service population and did not want multiple definitions for the same episode. The analytic team validated the initial results in SAS 9.4 (SAS Institute), shared them with the integrated health system's clinical leaders to obtain feedback on the components of each bundle, and by April 2017 prioritized 29 episodes of care for bundled payment development consideration based upon existing volume and potential clinical variation.

Beyond clinical variation, several other prioritization criteria were employed in order to reduce the number of bundled payment candidates, including the ability to manage outcomes (where procedural bundles would be prioritized over chronic conditions, acute conditions, and system failures), physician and service line engagement, providing a level playing field for all providers in the integrated health system's clinically integrated network, interest from an employer's commercial populations, case volume, and synergies with existing system quality or process improvement activities. These criteria further reduced the list of candidate bundles from 29 to 10.

Across all 10 episodes of care, the total cost was determined by summing the reimbursement levels associated with codes for the pretrigger (episode) period, trigger professional payments, trigger facility payments, and posttrigger periods. In the aggregate, facility costs comprised approximately 79% of the total spend. Given this, the next goal was to identify actionable information about variation in physician practice patterns within the facility trigger period in order to reduce the cost of each episode, as facility costs would comprise the majority of baseline price for each bundled payment.

Phase 2: Using Financial Data to Understand Treatment Variability and Set Baseline Prices

In the second phase, the analytics team drilled down into each episode to understand the clinical variation associated with the facility charge component of each episode using the health plan's claims data and internal OhioHealth facility revenue and charge data from EPSi (Chesterfield, MO), a financial decision analytics platform. Thus, 2 related but independent analyses were occurring simultaneously to develop a comprehensive perspective for clinical leader input. Initial analyses of the 29 bundled candidates revealed the high variability of clinical costs within and across sites of service.

Charge data were indispensable in this effort because some health plans pay the facility portion of a claim as a percentage of total charges. Thus, all line items that were included as charges to the patient had to be reviewed. Utilization of financial decision support system data enabled review of line item detail for drugs, supplies, and services (claims detail is summarized at the revenue code level). Charge data provided a way to analyze physician practice patterns at a level that claims could not provide, but it came at the cost of low sample sizes, because the cases under analysis were limited to health plan patients. Low per-physician per-facility sample sizes created the need for analysts to review patient acuity and outliers carefully. As a proxy for patient acuity, physician variation was analyzed at a diagnosis-related group level, which helped to ensure that patient heterogeneity was dampened; cost outliers were defined using a heuristic from statistical process control theory.⁹

Even with these precautions, subsequent analyses demonstrated the need for larger sample sizes in order to have reliable and valid results at a physician level. One potential solution was to identify the extent to which patients from multiple payer populations could be combined with the health plan to analyze clinical variation within and across facilities. A hypothesis was developed and tested to identify if the charge distributions were similar in the health plan and other commercial payer populations. Satisfied that the

Figure 1. Commercial Bundle Phase 1 and Phase 2 Work Product



assumptions of the test were met, a Kruskal-Wallis H test was performed. In each case, no statistically significant differences were detected. Thus, the combined populations were used to analyze average charge per case at the individual line item level across all provider groups, providing analysts and clinical leaders a perspective on provider utilization variation. Because the goal was to determine a target price for each bundle, the average charge per case for all commercial payers was adjusted to the employer-sponsored health plan contract rate for all cases. This analysis provided the core definitions for each bundle: the pretrigger, trigger, and post-trigger time frames, and the baseline total cost of care. It also highlighted the need to drill into the trigger facility portion of the baseline spend. Enterprise charge data were used to augment the analysis and provided the detail necessary to understand the opportunities for cost reduction. **Figure 1** illustrates the relationship between the information gained in the 2 phases.

Presenting Phases 1 and 2 Data to Clinical Leaders

To identify clinical opportunities to increase the value of procedural and medical episodes of care that could be developed into bundled payments, analysts developed a presentation platform in Microsoft Excel for clinical leaders, consisting of detail and variance tabs. The variance tab described spending patterns at the revenue code level (spending categories describing items and services charged to a patient). The **Table** illustrates the information reviewed at a revenue code level to help focus analysis in areas that would provide the greatest impact. Because the goal was to determine a target price for each bundle, the average charge per case for all commercial payers was adjudicated to the health plan contract rate for all cases. This converted the average charge per case to an average baseline price per case for the facility component of the trigger event. The intent

was to inform leaders as to which spending category had not only high variation in dollars but also high utilization. The detail tab was subtotaled at 3 levels—individual line item, revenue code, and grand total—and displayed the unit charge amount for each item, the number of cases using that item, and the average charge per all cases. This information was displayed by physician or physician group, as appropriate for the episode, and provided a complete view of utilization, highlighted variation among providers, and was reviewed with clinical leaders who helped to identify clinical opportunities and provide the basis for making change recommendations. **Figure 2** is a visualization of information learned at the detail level.

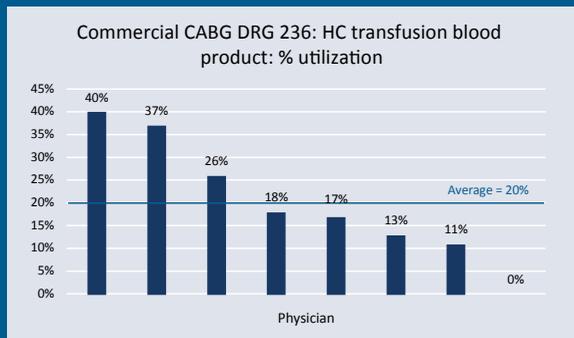
The clinical teams estimated the amount of variation that they could reduce for each episode. Knowing this information, the clinical impact was estimated and the baseline price per case for each clinical population was reduced by the estimated clinical impact per case to arrive at a proposed target price per case. Once the baseline estimates per bundle were derived, each was subjected to a bootstrap routine. Bootstrapping is a nonparametric resampling technique that is used to mimic random sampling from a source population. In it, multiple samples of the same size as the study sample are drawn with replacement. These models are then compared with the study sample so that alternative measures of accuracy can be applied to sample estimates. Given the small sample size of each of the potential bundled payment programs, this technique was employed to estimate the variance of the median and lower and upper bounds of the cost distributions and to place the appropriate CIs on the parameters of the distribution.¹⁰ In this case, bootstrapping was employed to generate 95% CIs for each bundle’s baseline price using the percentile method.

To provide a communication platform between the analytic and clinical teams, dashboards were built in Qlik. Participants from the executive and clinical teams were assigned to

Table. Elements of the Variance Tab

Revenue code category	Number of cases using this category	Minimum charge per case	Average charge per case used	Maximum charge per case	SD	Total charges	Cases	Average charge per all cases
Ambulatory surgical care	4							
Anesthesia	25							
Arteriography	9							
Blood administration	99							
Blood storage and processing	140							
Cardiac catheterization lab	177							
Cardiology	23							

Figure 2. Visualization of Variation Seen at the Detail Charge Level



CABG, coronary artery bypass graft; DRG, diagnosis-related group; HC, hospital charge.

executive, operational, and patient-facing teams to help design the dashboards to provide strategic, operational, and analytic views.¹¹ Key performance indicators and current-vs-baseline metrics for each area of focus were developed and built into data visualizations. The data were updated with electronic health records weekly and claims data monthly. The dashboards catered to the user roles; executive and operational stakeholders were given aggregate views and financial metrics, whereas the patient-facing stakeholders were given performance on the chosen metrics directly and in much greater detail. All dashboards were published on the health system’s intranet and available at all hours from anywhere on the system’s network via web address.

Executive and operational dashboards included vertical bar charts with bundles of participation on the x-axis and

current average charges per case on the y-axis displayed as percent distance from target. A table under each bar chart displayed number of cases per bundle, target, and total difference from the target in estimated dollar values. Drop-down menus on each dashboard allowed the user to select specific facilities, discharge dates, physician groups, and admission types, with the bar charts and tables updating dynamically based on the chosen criteria.

Patient-centered dashboards provided much more detail. Drop-down menus offered selection on facility, clinic, method used, primary modality, secondary modality, discharge date, payer, physician, and physician group. Data visualizations used included dynamic bar charts with target reference lines to show facility by default with the ability to drill down to physician group and physician. Dynamic tree maps were used to show density of facilities, physician groups, and physicians with the ability to drill into each level. Claims-based visualizations also included a drop-down menu for claim service begin-date selection. In all cases, stakeholders in each group provided continuous input on actionable measures, iteratively providing insights and suggestions to optimize metric calibration.

The development of pricing models for commercial bundled payment programs requires the development of a shared vision, operational plan, and well-articulated goals and objectives across management, analytic, clinical, and operational teams. Analysts contribute to this work by providing reliable and valid data that surface unwanted clinical variation and opportunities for improvement. By creating a common data analytic platform that provides actionable information, biomedical informatics professionals can help deliver value-based care for patients and providers.

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