Health Economic Impact of a Multicenter Quality-of-Care Initiative for Reducing Unplanned Healthcare Utilization Among Patients With Inflammatory Bowel Disease

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INTRODUCTION: **A multicenter adult inflammatory bowel disease learning health system (IBD Qorus) implemented clinical care process changes for reducing unplanned emergency department visits and hospitalizations using a Breakthrough Series Collaborative approach.**

METHODS: **Using Markov decision models, we determined the health economic impact of participating in the Collaborative from the third-party payer perspective.**

RESULTS: **Across all 23 sites, participation in the Collaborative was associated with lower annual costs by an average of $2,528 ± $233 per patient when compared with the baseline period.**

DISCUSSION: **Implementing clinical care process changes using a Collaborative approach was associated with overall cost savings. Future work should examine which specific interventions are most effective and whether such cost savings are sustainable.**

SUPPLEMENTARY MATERIAL accompanies this paper at http://links.lww.com/AJG/C267, http://links.lww.com/AJG/C268, http://links.lww.com/AJG/C269, http://links.lww.com/AJG/C270

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INTRODUCTION

US healthcare expenditures associated with inflammatory bowel diseases (IBDs) are considerable at up to $25 billion/year (1–4), 60% of which is attributable to IBD-related emergency department (ED) visits and hospitalizations (4,5). To improve IBD outcomes and decrease costs, IBD Qorus—a multicenter adult IBD learning health system (6)—used a breakthrough series (BTS) Collaborative approach to quality improvement for reducing unplanned healthcare utilization (7). Sites tested and implemented various interventions and demonstrated statistically significant reductions in hospitalizations (7). In this study, we estimated the health economic impact of participation in the Collaborative for IBD Qorus, as a whole, and for each individual site.

METHODS

We used decision analysis software (TreeAge Pro 2021; TreeAge Software, Williamstown, MA) to model the economic impact of participation in the IBD Qorus BTS Collaborative. This economic analysis was exempt from review by the Cedars-Sinai Institutional Review Board because only site-level, deidentified data were used. We fully describe the IBD Qorus BTS Collaborative elsewhere (7), but in brief, sites proposed, developed, and implemented various clinical care process changes for reducing unplanned healthcare utilization (Table 1). Given the pragmatic nature of the Collaborative, each site chose and implemented process of care changes from a toolkit of interventions that best fit their practice's needs and existing infrastructure and personnel (7).

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Table 1. Clinical care process changes implemented by each IBD Qorus site

Site	Academic/ community	High-risk patient list	Weekly team huddle	Proactive nurse phone calls to high-risk patients	Patient education materials on when and how to seek urgent care	Reserved clinic slots for urgent care	High-risk patients had follow-up within 90 d	Phone calls to patients the morning after an ED visit	IBD rapid access clinic	Urgent care hotline	4-hr return call policy	Standing nursing orders for urgent care calls	Monthly IBD Qorus BTS collaborative webinar attendance	IHI site assessment score
Sites where interventions led to cost savings in >75% of Monte Carlo simulations														
1	Academic	X	X	X	X	X		X			X		100%	2.5
2	Academic	X	X	X	X	X			X	X			93%	3.0
3	Academic	X			X	X				X			93%	2.5
4	Community	X	X	X	X	X	X		X				100%	2.5
5	Academic	X	X	X	X								67%	3.0
6	Community	X	X	X	X	X		X					80%	2.5
7	Academic	X	X	X	X	X							80%	3.0
8	Community	X	X	X	X	X	X				X		100%	3.0
9	Academic	X	X	X		X	X		X				93%	3.0
10	Academic	X	X	X	X	X	X						100%	3.0
11	Community	X	X	X	X			X					100%	3.0
12	Academic	X			X	X							60%	2.0
Sites where interventions led to cost savings in 25%–75% of Monte Carlo simulations														
13	Academic	X	X	X	X	X		X					100%	3.0
14	Academic	X	X	X	X	X						X	80%	2.5
15	Community	X	X	X	X								93%	3.0
16	Community	X	X	X	X	X		X	X				93%	3.0
17	Community	X	X		X	X							73%	2.0
18	Community	X	X	X		X							73%	2.5
Sites where interventions led to cost savings in <25% of Monte Carlo simulations														
19	Academic	X	X	X	X	X	X						93%	2.5
20	Academic	X		X			X						87%	2.0
21	Community	X	X			X	X						100%	2.5
22	Academic	X	X										33%	2.0
23	Community	X	X	X	X								40%	2.5

Note: Sites in the IBD Qorus BTS collaborative voted to have practice names anonymized to allow for more risk-free communication and transfer of data.
BTS, Breakthrough Series; IBD, inflammatory bowel disease; IHI, Institute of Healthcare Improvement.

During the Collaborative, data on IBD-related ED visits and hospitalizations within the past 6 months were collected using patient surveys at clinic visits (7); both outcomes are in the Standard Set of measures for IBD developed by an international working group (8). Notably, van Deen and colleagues found that IBD Qorus patients' self-reported survey data were highly accurate for both ED visits (92% agreement) and hospitalizations (96% agreement) after reviewing their electronic health records (9). Twenty-three of 27 IBD Qorus centers had data to support clinical probability estimates (clinical remission, ED visit only, or ED visit and hospitalization) for the baseline and intervention periods (Table 2). See Supplementary Figure 1 (http://links.lww.com/AJG/C267) for the Markov state transition diagram. The baseline period rates were determined by the first 5 months of data collection during the Collaborative (February 2018 to June 2018), whereas the final 5 months (December 2018 to April 2019) were considered to reflect the impact of the interventions. The data for both periods were extrapolated over a hypothetical 1-year time horizon (12 one-month cycles).

The primary outcome for this economic analysis was incremental costs between the intervention and baseline periods. Costs were considered using the third-party payer perspective and are shown in Supplementary Table 1 (see http://links.lww.com/AJG/C270). To determine the incremental costs between periods, we conducted Monte Carlo probabilistic sensitivity analyses with clinical probabilities following triangular distributions (Table 2). We also performed budget impact analyses to calculate the incremental per-member per-month (PMPM) cost of the intervention versus baseline periods in a hypothetically managed care organization with 1 million members. Detailed descriptions of both approaches are detailed in Supplementary File 1 (see http://links.lww.com/AJG/C269).

RESULTS

Overall, 23 (13 academics and 10 communities) of 27 sites provided data to support clinical probability estimates for the

Table 2. Monthly clinical probability estimates used in the Markov models

Site	Baseline period: ED visit and hospitalization	Intervention period: ED visit and hospitalization	Baseline period: ED visit only	Intervention period: ED visit only
All sites	13.2% (12.0%–14.0%)	11.4% (11.0%–12.0%)	3.8% (3.0%–4.0%)	3.2% (3.0%–4.0%)
1	19.4% (8.0%–28.0%)	8.8% (4.0%–13.0%)	0.8% (0.0%–5.0%)	2.0% (0.0%–4.0%)
2	15.0% (9.0%–25.0%)	6.8% (4.0%–11.0%)	0.8% (0.0%–5.0%)	1.6% (0.0%–4.0%)
3	16.4% (13.0%–23.0%)	11.8% (8.0%–13.0%)	3.0% (0.0%–6.0%)	6.3% (0.0%–12.0%)
4	11.0% (7.0%–20.0%)	7.2% (5.0%–10.0%)	5.0% (1.0%–8.0%)	3.6% (1.0%–7.0%)
5	13.4% (4.0%–20.0%)	7.7% (7.0%–9.0%)	1.4% (0.0%–4.0%)	3.3% (0.0%–6.0%)
6	21.0% (13.0%–26.0%)	14.0% (7.0%–29.0%)	3.6% (0.0%–11.0%)	0.0% (0.0%–8.0%)
7	15.3% (10.0%–20.0%)	9.3% (4.0%–19.0%)	0.5% (0.0%–6.0%)	11.2% (7.0%–20.0%)
8	12.7% (12.0%–14.0%)	9.8% (9.0%–12.0%)	3.0% (1.0%–7.0%)	5.4% (3.0%–11.0%)
9	19.0% (16.0%–21.0%)	15.0% (12.0%–22.0%)	1.5% (0.0%–7.0%)	1.6% (0.0%–5.0%)
10	15.0% (12.0%–19.0%)	11.6% (6.0%–22.0%)	4.3% (0.0%–8.0%)	3.4% (0.0%–7.0%)
11	6.8% (5.0%–9.0%)	6.2% (3.0%–9.0%)	6.0% (3.0%–14.0%)	2.2% (0.0%–6.0%)
12	10.8% (6.0%–14.0%)	9.5% (5.0%–13.0%)	2.0% (0.0%–7.0%)	6.0% (0.0%–13.0%)
13	12.6% (8.0%–20.0%)	13.8% (11.0%–15.0%)	5.6% (2.0%–9.0%)	1.8% (0.0%–5.0%)
14	11.6% (8.0%–14.0%)	10.5% (6.0%–15.0%)	4.4% (1.0%–7.0%)	4.8% (3.0%–9.0%)
15	8.5% (5.0%–14.0%)	9.0% (4.0%–13.0%)	3.5% (0.0%–10.0%)	3.5% (0.0%–10.0%)
16	11.8% (8.0%–15.0%)	11.3% (4.0%–19.0%)	2.8% (0.0%–15.0%)	2.0% (0.0%–6.0%)
17	13.8% (8.0%–25.0%)	15.8% (8.0%–27.0%)	12.8% (5.0%–25.0%)	0.0% (0.0%–0.0%)
18	15.0% (9.0%–20.0%)	15.8% (9.0%–21.0%)	6.6% (0.0%–12.0%)	3.5% (0.0%–7.0%)
19	13.3% (11.0%–16.0%)	14.0% (8.0%–20.0%)	0.0% (0.0%–3.0%)	2.8% (0.0%–6.0%)
20	16.2% (13.0%–21.0%)	18.6% (7.0%–33.0%)	3.6% (0.0%–10.0%)	4.6% (0.0%–13.0%)
21	13.0% (11.0%–15.0%)	16.6% (13.0%–20.0%)	2.5% (2.0%–3.0%)	5.2% (1.0%–8.0%)
22	15.5% (9.0%–22.0%)	20.0% (15.0%–25.0%)	10.5% (8.0%–13.0%)	3.2% (0.0%–9.0%)
23	13.3% (10.0%–18.0%)	16.0% (9.0%–29.0%)	5.5% (0.0%–14.0%)	2.8% (0.0%–12.0%)

Data are presented as base case estimate (range tested in Monte Carlo analysis), which correspond to the mean, minimum, and maximum values during each period. ED, emergency department.

baseline and intervention periods. Characteristics of the patients and their outcomes during the Collaborative are presented elsewhere (7). Table 1 presents the process of care changes that each site implemented for reducing unplanned healthcare utilization; the median number of interventions per center was 5 (range: 2–7). The most common interventions were creation of a high-risk patient list (sites included patients they believed were likely to go to the ED for IBD care within the next 6 months and others at their discretion [e.g., patients actively flaring, newly started on steroids or biologics]) (n = 23; 100%) and weekly team huddles (n = 20; 87%).

Figure 1 depicts the results from the probabilistic sensitivity analyses for IBD Qorus, as a whole, and for each individual site. Over the 1,000 simulations, across all sites, the mean difference in annual costs between the intervention and baseline periods was –$2,528 (SD: $233) per patient. Moreover, 100% of the simulations showed that the interventions were cost saving versus the baseline period when considering all sites collectively.

Among the 23 individual IBD Qorus centers, incremental costs between the periods ranged from –$17,234 (SD: $2,284) to +$7,761 (SD: $2,369) per year per patient. Clinical care process changes at 12 (52%) sites led to cost savings in >75% of simulations. Six (26%) and 5 (22%) centers had interventions that led to savings in 25%–75% and < 25% of simulations, respectively. Supplementary Table 2, http://links.lww.com/AJG/C270, presents comparisons among the 3 groups for clinic setting, number of implemented interventions, and Collaborative engagement scores; no statistically significant differences for these parameters were seen among groups.

In the budget impact analysis, across all sites, the incremental PMPM cost of the intervention versus baseline periods was –$2.74 (SD: $0.25). The incremental PMPM costs by site; estimates ranged from –$18.67 (SD: $2.47) to +$8.41 (SD: $2.57) are shown in Supplementary Table 3 (see http://links.lww.com/AJG/C270).

DISCUSSION

We performed a comprehensive decision analysis assessing the economic impact of interventions implemented in a multicenter adult IBD learning health system for reducing unplanned healthcare utilization. Our analysis has 3 key findings. First, we found that participating in the Collaborative and implementing simple process of care changes leveraging existing clinic personnel and infrastructure were associated with $2,500/year in cost savings per patient. Because upward of $25 billion is spent on IBD

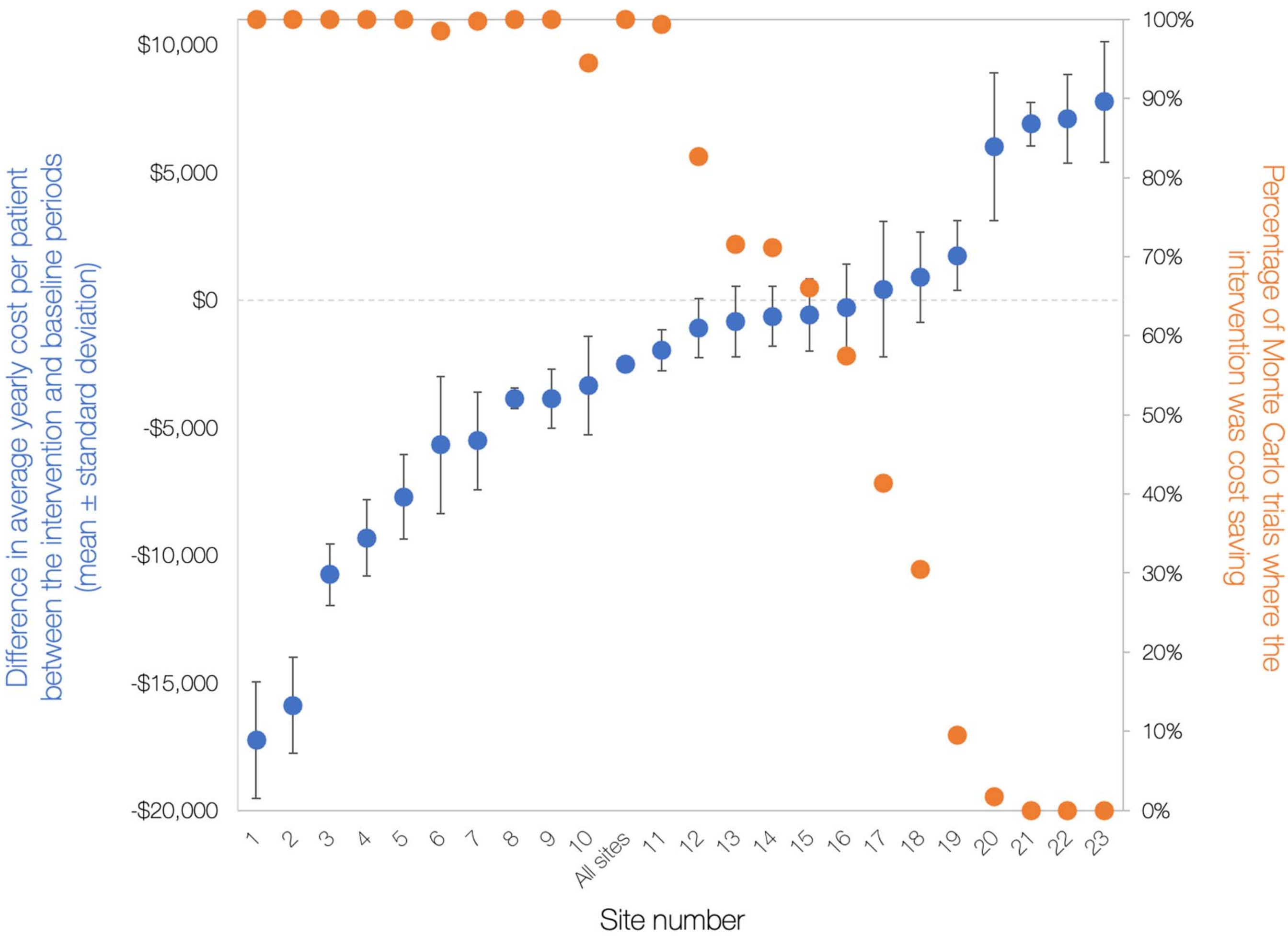

Figure 1. Difference in average yearly cost per patient between the intervention and baseline periods (left axis) and percentage of the 1,000 Monte Carlo simulations where the intervention was cost saving (right axis), stratified by IBD Qorus site.

each year in the United States (1–4), every effort to address mutable factors such as avoidable ED visits and hospitalizations through process changes is warranted.

Second, although the types and number of implemented interventions varied by site, a high-risk patient list and weekly team huddles were most commonly used. For these and the other interventions, each center customized their approach to meet the needs of their practice and patient population. Through interviews with sites, we also learned that their process of care changes largely used existing infrastructure without hiring additional staff or incurring other capital costs as seen in other efforts (10–12). Thus, these interventions can be implemented, scaled, and sustained in diverse practice settings and potentially lead to cost savings.

Third, we observed considerable variation in incremental costs among centers. In probabilistic sensitivity analyses, cost savings were seen in approximately half of the participating sites. Although there was a trend toward more implemented interventions and higher Collaborative engagement scores at centers with cost savings, these associations were not statistically significant. Rather, differences among sites in outcomes may reflect differential implementation and acceptance of the interventions among the centers' clinicians, office staff, and patients.

There are limitations to our analysis. First, there was no data collection before the Collaborative because both development of the interventions and prospective patient data collection on ED and hospitalization rates occurred at the outset. Interviews with sites, although, revealed that most took several months to develop and implement their process changes and hence our decision to have data from the first 5 months to inform the baseline. Nonetheless, this biases toward the null because there might have been partial integration of interventions during the baseline period and our findings may underestimate the true cost savings associated with the interventions. Second, the model used prepost data without a control group; we cannot establish causation. However, the reduction in hospitalizations—the main driver of costs in the model—seen during the Collaborative was due to special cause variation rather than chance (7). Third, because sites implemented multiple process changes at the same time, we could not determine which interventions were more effective than others. Because this was a function of the pragmatic nature of the Collaborative, future controlled studies are needed to determine which interventions, either solo or in combination, lead to improved outcomes and cost savings. Fourth, our model focused solely on third-party payer expenditures and did not consider personnel costs in implementing and maintaining the interventions. Although sites did not hire new personnel and process of care changes were largely incorporated in routine workflows, personnel opportunity costs were not prospectively tracked in detail during the Collaborative, which precluded their inclusion in the model. Future studies should quantify and include these costs so that the economic impact of quality improvement programs can be assessed from the healthcare sector perspective.

In conclusion, process of care changes implemented in a multicenter adult IBD learning health system can promote cost savings by reducing unplanned healthcare utilization. Successfully implementing such process changes on a wide scale can lead to improved outcomes and substantial reductions in healthcare costs. Additional work is needed to determine whether such improvements in outcomes and cost savings are sustainable in the long term.

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CONFLICTS OF INTEREST

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