

# Estimating Diagnostic Costs Associated with a Second-Generation Blood Test For Anti-Vinculin and Anti-Cytolethal Distending Toxin B (CdtB) Biomarkers in Comparison to the Standard Exclusionary Approach For Irritable Bowel Syndrome with a Diarrheal Component (IBS-D/M)

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## OBJECTIVES

- Due to a lack of obvious pathophysiological markers of disease, IBS has historically been a diagnosis of exclusion centered on patient-reported GI-related symptoms in the absence of demonstrable organic disease.<sup>1,2</sup>
- The process of exclusion leading to a diagnosis of IBS, which frequently includes a range of laboratory tests and diagnostic procedures, can be time-consuming and costly.<sup>3-5</sup>
- A novel, second-generation blood test has been developed to quantify levels of anti-vinculin and anti-cytolethal distending toxin (anti-CdtB) antibodies, facilitating a rapid “rule-in” diagnosis of IBS-D/M (Table 1).<sup>6</sup>
- The objective of this study was to estimate the economic impact associated with a second-generation blood test compared to the standard exclusionary approach for diagnosing IBS-D/M.

## METHODS

- A cost-minimization decision tree was constructed in TreeAge Pro 2019 (Figure 1).
- For the second-generation blood test arm, sensitivity, specificity, and likelihood ratios determined how patients advanced to treatment. Patients positive for either anti-CdtB or anti-vinculin, or both, were assigned a likelihood of having IBS-D/M. Patients negative for the second-generation blood test subsequently moved down the standard exclusionary arm.
- For the exclusionary arm, six gastroenterology providers were surveyed to understand the typical diagnostic framework for IBS-D/M, including utilization probabilities of tests and procedures (Table 2) and the probability of treatment as a function of test results.
- Input costs (Table 2) were drawn from the 2019 MDsave weighted national average.
- Probabilistic sensitivity analysis (PSA) was performed to determine 95% confidence intervals for costs. Component costs were assigned normal distributions, while probabilities were assigned beta distributions.
- Decision tree results informed a budget impact model with 1M covered lives.

Figure 1. Cost-minimization decision tree model

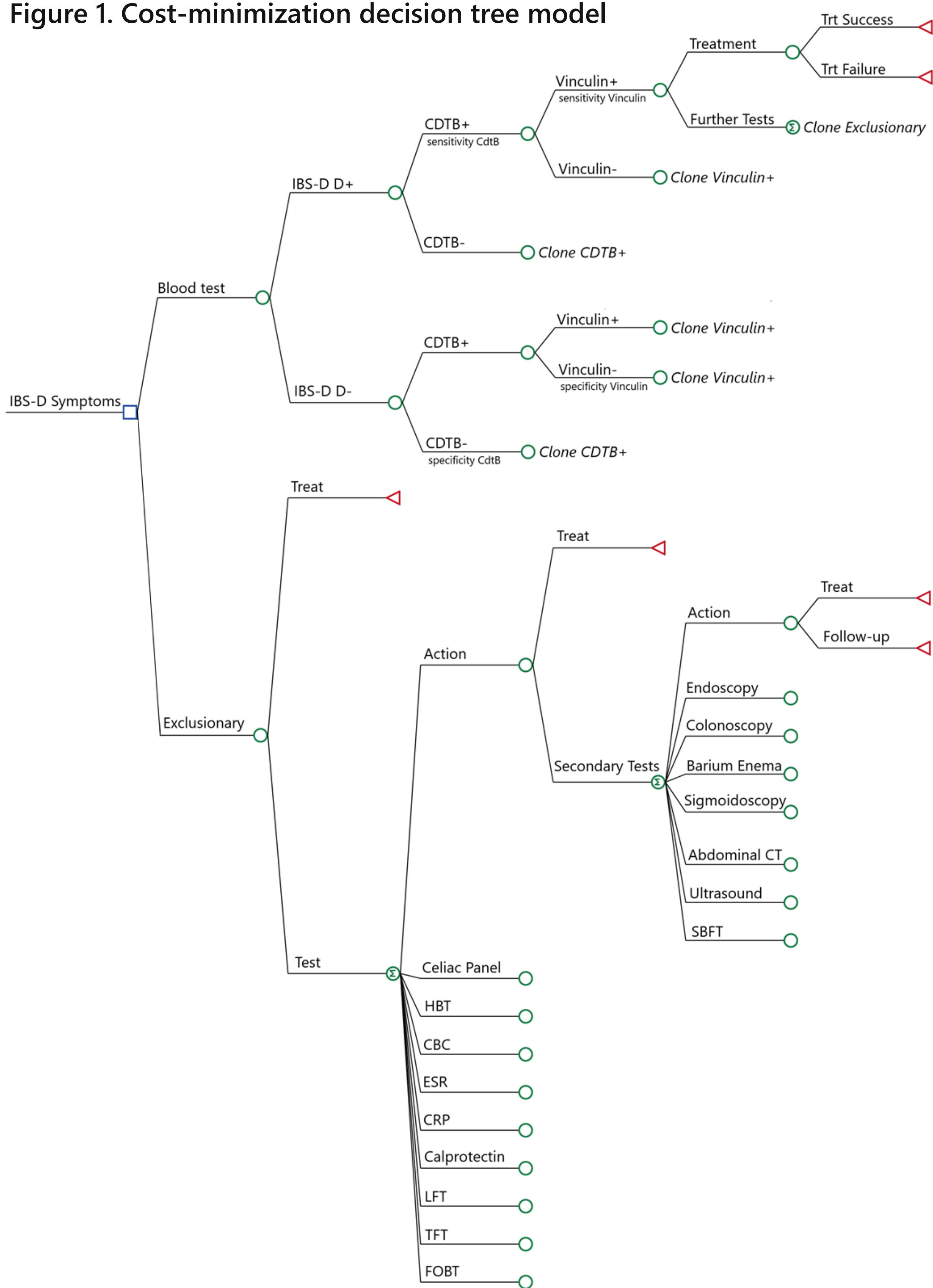


Table 2. Diagnostic probability and cost of tests and procedures

Test/Procedure	Diagnostic Probability	Cost	Test/Procedure	Diagnostic Probability	Cost
Celiac Panel	0.567	\$233	Upper endoscopy	0.067	\$2950
Hydrogen Breath Test	0.117	\$157	Colonoscopy	0.467	\$3277
Complete Blood Count	0.950	\$36	Barium Enema	0.008	\$541
ESR	0.475	\$26	Sigmoidoscopy	0.092	\$2177
C-Reactive Protein	0.783	\$39	Abdominal CT	0.125	\$1027
Fecal Calprotectin	0.567	\$160	Ultrasound	0.092	\$327
Liver Function Test	0.750	\$82	Small Bowel Follow Through	0.000	\$302
Thyroid Function Test	0.475	\$68	FOBT	0.108	\$79

Table 1. Performance of second-generation blood test for diagnosing IBS-D/M.

Biomarker Test	Sensitivity	Specificity	LR+	LR-
Anti-CdtB (OD>1.56)	43.0	93.5	6.7	0.61
Anti-vinculin (OD>1.60)	52.0	90.9	5.7	0.60

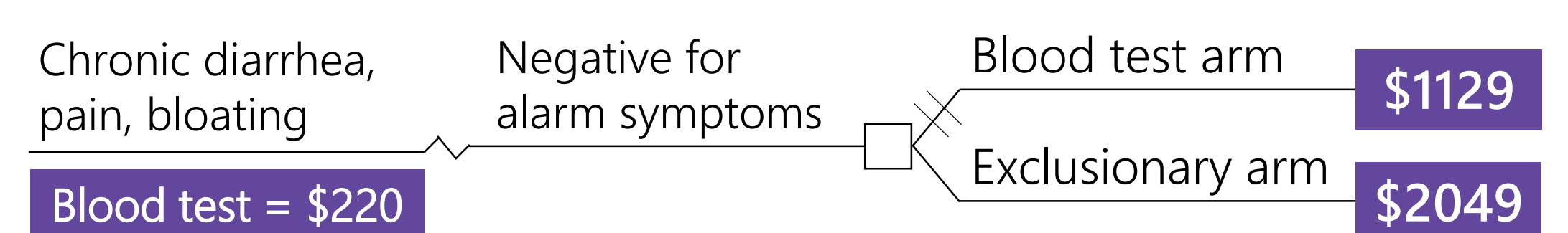
OD: optical density; LR+: positive likelihood ratio; LR-: negative likelihood ratio

## RESULTS

### Cost-Minimization Model

- The base case showed average expected cost of \$1129 for the blood test arm compared to \$2049 for the exclusionary arm, resulting in average savings of \$920 in favor of the blood test arm that “rules in” IBS-D/M (Figure 2).
- Savings in the blood test arm were due to reduced potential for expensive procedures like colonoscopy or sigmoidoscopy, imaging, as well as unnecessary lab tests.

Figure 2. Base case results for blood test “rule in” arm vs. exclusionary arm for diagnosis of IBS-D/M



### Probabilistic Sensitivity Analysis

- PSA results (Figure 3) for the blood test arm show a 95% CI of \$997 - \$1275 and median of \$1125; for the exclusionary arm, 95% CI of \$1528 - \$2443 and median of \$2068.
- The Blood test arm was the less expensive choice in 99.91% of trials.

Figure 3. Probabilistic Sensitivity Analysis results

Boxes show 2.5 - 50 - 97.5 percentiles; whiskers show minimum and maximum



### Budget Impact Model

- Cost savings in favor of the blood test were possible regardless of the proportion of IBS-D/M patients seeking care and increased with increases in the proportion of IBS-D/M patients seeking care.
- Cost savings of \$0.26 - \$0.52 PMPM were possible with 50% - 100% of patients seeking care and assuming half were diagnosed with the blood test (Table 3).
- These PMPM savings result in aggregate annual plan savings of \$3.1M - 6.2M.

Table 3. Budget impact model

Proportion Seeking Care	Number of Individuals Seeking Care	100% Exclusionary Path		50% diagnosed with blood test, 50% with exclusionary path		100% diagnosed with blood test		
		Net Cost	Net Cost	Cost (Savings)	Cost (Savings) PMPM	Net Cost	Cost (Savings)	Cost (Savings) PMPM
10%	1357	\$2,780,493	\$2,156,273	(\$624,220)	(\$0.05)	\$1,532,053	(\$1,248,440)	(\$0.10)
20%	2714	\$5,560,986	\$4,312,546	(\$1,248,440)	(\$0.10)	\$3,064,106	(\$2,496,880)	(\$0.21)
30%	4071	\$8,341,479	\$6,468,819	(\$1,872,660)	(\$0.16)	\$4,596,159	(\$3,745,320)	(\$0.31)
40%	5428	\$11,121,972	\$8,625,092	(\$2,496,880)	(\$0.21)	\$6,128,212	(\$4,993,760)	(\$0.42)
50%	6785	\$13,902,465	\$10,781,365	(\$3,121,100)	(\$0.26)	\$7,660,265	(\$6,242,200)	(\$0.52)
60%	8142	\$16,682,958	\$12,937,638	(\$3,745,320)	(\$0.31)	\$9,192,318	(\$7,490,640)	(\$0.62)
70%	9499	\$19,463,451	\$15,093,911	(\$4,369,540)	(\$0.36)	\$10,724,371	(\$8,739,080)	(\$0.73)
80%	10856	\$22,243,944	\$17,250,184	(\$4,993,760)	(\$0.42)	\$12,256,424	(\$9,987,520)	(\$0.83)
90%	12213	\$25,024,437	\$19,406,457	(\$5,617,980)	(\$0.47)	\$13,788,477	(\$11,235,960)	(\$0.94)
100%	13570	\$27,804,930	\$21,562,730	(\$6,242,200)	(\$0.52)	\$15,320,530	(\$12,484,400)	(\$1.04)

PMPM – per member per month

## CONCLUSIONS

- Utilizing a second-generation diagnostic blood test to “rule-in” IBS-D/M can reduce health plan costs compared to a purely exclusionary diagnostic framework.
- For a health plan with 1M covered lives, aggregate annual savings of up to \$6.2M may be possible when 50% of IBS-D/M patients seek care.
- Reduced costs are due to a fewer expensive diagnostic procedures (e.g., colonoscopy) and unnecessary lab tests.

## REFERENCES

- 1) Cash BD, Chey WD. Aliment Pharmacol Ther. 2004 Jun 15;19(12):1235-45.
- 2) Longstreth GF, et al. Gastroenterology. 2006 Apr;130(5):1480-91.
- 3) Hookway C, et al. BMJ. 2015;350:h701.
- 4) Cash BD. Am J Manag Care. 2005;11 suppl: S7-S16.
- 5) Inadomi JM et al. Aliment Pharmacol Ther. 2003;18:671-682.
- 6) Morales W, et al. Dig Dis Sci. 2019 Nov;64(11):3115-3121.

## DISCLOSURES

MP is an employee of Cedars-Sinai and stockholder of Gemelli Biotech.

