Economic Impact of Reduction in Surgical Eligibility Among Newly Diagnosed Patients With Chronic Rhinosinusitis (CRS)—A Managed Care Cost-Offset Model

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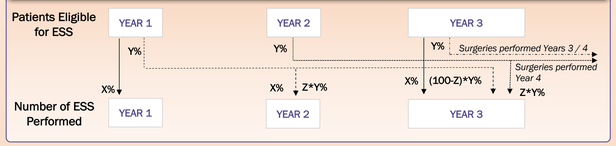
BACKGROUND

- CRS is a serious chronic inflammatory disease with high prevalence (~15% in the United States) that produces significant morbidity. It is characterized by chronic mucosal inflammation in the nose and sinuses.[1,2]
- Estimates of the direct costs of CRS range between $10 and $60 billion[3,4]; it is estimated that the indirect costs of the condition amount to $20 billion per year in the United States.[4]
- Though usually effective for allergic rhinitis, conventional nasal steroid sprays frequently produce unsatisfactory efficacy in the treatment of CRS.[2] This is due to their inability to deliver steroid high/deep in the nasal cavity (above the inferior turbinate, behind the uncinate process) to key anatomical regions (eg, the ostiomeatal complex) where sinus ostia ventilate and drain.[5]
- Evidence suggests that current medical (nonsurgical) treatment is associated with high rates of failure and low treatment satisfaction, and that approximately one-third of patients progress to endoscopic sinus surgery (ESS) within 6 months of diagnosis.[6] Although some patients treated with ESS experience significant improvement in their symptoms, post-ESS recurrence to baseline CRS is reported to occur in about half of patients after 18 months,[7,8] and the procedure carries a 1% risk of serious post-ESS complications, such as cerebrospinal fluid leak, major vascular injury, orbital injury, vision loss, and nasal atrophy.[9]
- Optimal medical therapy is recommended prior to ESS, and new medical treatments are being developed that may reduce progression to ESS as well as related costs.[1]
- The objective of this study was to quantify the potential cost offsets associated with a reduction in ESS among patients with CRS, from the perspective of US payers.

METHODS

- A 3 year, decision-analysis model was developed in Microsoft® Excel (**Figure 1**).

Figure 1. Cost-Offset Model



- The model incorporating CRS-related parameters was derived from the medical literature. Costs were adjusted to 2017 dollars using the medical care component of the consumer price index. A probabilistic sensitivity analysis was conducted.

Data sources

- CRS incidence rate, ESS rate, ESS revisions, and pre- and post-ESS health care costs were obtained from Bhattacharyya et al[6]; post-ESS complication rate and cost were obtained from Rudmik.[9]

Table 1. Epidemiological Inputs

Population	1,000,000		
CRS incidence	0.745%		
ESS progression rate over 3 y	46.2%		
ESS progression rate in first 6 mo	34.3%		
Cost Inputs			
ESS (2011 USD)	$7,726		
Revision ESS (2011 USD)	$7,726		
Cost of complicated ESS (2011 USD)	$16,877		
ESS-Related Costs	**Baseline**	**Y1 Post-ESS**	**Y2 Post-ESS**
Medication costs	$398	$493	$498
Office visit costs	$579	$487	$287
Endoscopy-related costs	$382	$118	$72
Radiology-related costs	$75	$72	$53

Analytical Methods

- Inputs listed in **Table 1** were used to simulate the baseline and post-ESS costs of newly diagnosed CRS patients.
- To evaluate the possible economic benefit of medical treatments that reduce progression to ESS, a reduction in the rate of ESS by 10% was modeled to assess the impact on costs from a per-member-per-month (PMPM) and per-patient-per-month (PPPM) perspective.
- The 10% rate was chosen to facilitate extrapolation of the results of this analysis to a range of benefits that may be achieved with real-world medical interventions in increments of 10%.
- Patients who avoided ESS were assumed to continue to incur baseline CRS treatment costs over the duration of the simulation.
- A probabilistic sensitivity analysis using 1000 simulations was performed by varying key model inputs, including CRS incidence rates, surgical progression and complication rates, and pre- and postsurgical health care costs. Inputs were varied using 95% confidence interval ranges reported in source publications.
- The distributions used for each parameter were:
  - Incidence: triangle
  - Progress rates: beta
  - Costs: gamma

RESULTS

Base-Case ESS cases and costs

- In a 1,000,000-member plan, approximately 7451 new CRS patients would be identified every year. This translates to 22,352 over 3 years, 8996 of whom would eventually be treated with ESS **(Table 2)**.
  - ESS, revisions, and complications would account for 69% of overall CRS treatment costs.

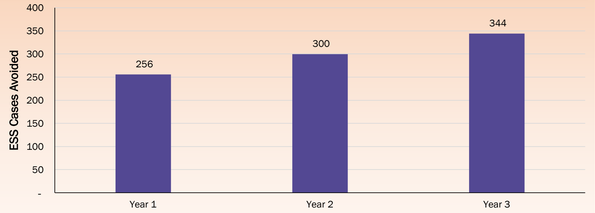
Impact of 10% reduction on ESS cases

- Each 10% reduction in the ESS rate through improvement in appropriate medical therapy would avoid 900 ESS procedures, 78 revisions, and 9 serious complications **(Table 2, Figure 2)**.

Table 2. Number of Surgeries: Current Care Versus 10% Reduction In ESS

	Year 1	Year 2	Year 3	Total	Complicated Surgeries	Revision Surgeries
No. of ESS procedures with current care	2556	2999	3442	8996	90	783
No. of ESS procedures with 10% reduction in ESS rate	2300	2699	3098	8097	81	704
Surgeries avoided in a 1,000,000-member plan with a 10% reduction	256	300	344	900	9	78

Figure 2. ESS Cases Avoided Over Time



Impact of 10% reduction on ESS-related costs

- A total of $11.6 million in ESS-associated costs could be avoided, including $9.2 million in surgical costs, $1.08 ± 0.01 million in office visits, $0.7 ± 0.02 million in radiology and endoscopy costs, and $0.6 ± 0.02 million in medications **(Table 3)**.
- Overall, the projected cost offset for each 10% reduction would be $0.32 PMPM, or $14.42 PPPM, respectively.

Table 3. 3-Year Cost Comparison (2017 USD): Current Care Versus 10% Reduction in ESS

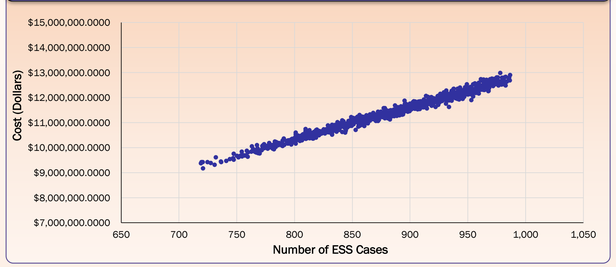
	Standard of Care	10% Reduction in ESS Rate	Total Savings (All Patients)	PMPM Savings	PPPY Savings
ESS Costs	$85,951,415	$77,586,138	$8,365,278	$0.23	$124.75
Complicated ESS Costs	$1,896,524	$1,706,872	$189,652	$0.01	$2.83
Revision ESS Costs	$6,047,099	$5,442,389	$604,710	$0.02	$9.02
Total ESS Costs	$93,895,039	$84,735,399	$9,159,640	$0.25	$136.60
Office visit Costs	$13,910,821	$12,892,589	$1,018,232	$0.03	$15.19
Medical Costs	$16,087,136	$15,336,754	$750,382	$0.02	$11.19
Radiology Costs	$2,083,287	$1,972,055	$111,232	$0.00	$1.66
Endoscopy Costs	$5,809,907	$5,244,452	$565,455	$0.02	$8.43
Total Costs over 3 y	$131,786,190	$120,181,249	$11,604,942	$0.32	$173.07

PPPY, per patient per year.

Probabilistic sensitivity analysis (PSA)

- Results of the PSA indicate that as few as 719 and as many as 986 ESS cases could be avoided with each 10% reduction in the rate of ESS for every 1 million members. The corresponding cost savings projected varied between $9 and $13 million per year.
- The model was most sensitive to changes in the cost of ESS, as well as the rates of ESS over 3 years and during the first 6 months **(Figure 3)**.

Figure 3. Reduction in ESS Cases Versus Total Costs Avoided



LIMITATIONS / DISCUSSION

- The ESS cost inputs are at the lower end of the range described in the literature. However, it is the same cost input used in a recent economic evaluation of ESS.[9] Results in this model were adjusted to 2017 dollars, which brings the cost of ESS within the recently published range of $8,500 to $11,000.[4]
- Treatment patterns and costs may vary over time. The use of real-world data will be useful in assessing how these changes, if any, alter the results of this model.
- ESS rates and costs may have changed since the publication of the studies referenced for this population simulation. However, the prevalence of CRS is high, and the ongoing unmet need of the condition makes it likely that the cost contribution of ESS will remain high.

CONCLUSION

- In this cost-offset model, each 10% reduction in rate of progression to surgery results in 900 fewer ESS cases and a cost reduction of $11.6 million over 3 years, or $0.32 PMPM. This suggests that medical interventions for CRS that reduce the need for surgery have potential to meaningfully reduce the high cost of care for CRS patients.

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Presented at the Academy of Managed Care Pharmacy Nexus Meeting; October 16-19, 2017; Dallas, TX.