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Utilization Patterns of Topical Intranasal Steroid Therapy for Chronic Rhinosinusitis

A Canadian Population-Based Analysis

Luke Rudmik, MD, MSc; Yuan Xu, MD, MSc; Mingfu Liu, PhD; Ceris Bird, BSc; Edward Kukec, MBA; Hude Quan, MD, PhD

IMPORTANCE Practice guidelines have provided a strong recommendation for the daily use of topical intranasal steroid therapy for patients with chronic rhinosinusitis (CRS). Deficiencies in utilization of intranasal steroid therapy may represent a gap in quality of care.

OBJECTIVE To evaluate the utilization patterns of topical intranasal steroid therapy for CRS in the Canadian population.

DESIGN, SETTING, AND PARTICIPANTS Retrospective review of a Canadian population-based health care administrative database. A validated case definition for CRS was applied, and the utilization of topical intranasal steroid therapy within this cohort was quantified during the 2014-2015 fiscal year.

INTERVENTIONS Intranasal steroid spray for CRS.

MAIN OUTCOMES AND MEASURES Primary outcome was the rate (per 100 patients) and quantity (per patient) of intranasal steroid spray utilization in patients with CRS. Secondary outcome was the geographic variation in the rate and quantity of intranasal steroid spray utilization for CRS.

RESULTS A total of 19 057 adult patients with CRS were evaluated. The overall rate of intranasal steroid spray utilization was 20.1 per 100 patients with CRS (3821 of 19 057). In the 3821 patients with CRS who used an intranasal steroid spray during 2014 to 2015, the mean quantity of utilization was 2.4 U (1 U = 1 bottle per month) per patient (9314 U divided by 3821 patients with CRS). There was large geographic variation in both the rate and quantity of intranasal steroid spray utilization ($P < .001$ for both comparisons).

CONCLUSIONS AND RELEVANCE Topical intranasal steroid therapy continues to be underutilized for patients with CRS. Given the negative impact of low-quality medical care, outcomes from this study indicate a need to further evaluate factors leading to the underutilization of a recommended treatment in patients with CRS to improve overall health system performance.

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Author Affiliations: Division of Otolaryngology–Head and Neck Surgery, Department of Surgery, University of Calgary, Calgary, Alberta, Canada (Rudmik); Department of Community Health Sciences, University of Calgary, Calgary, Alberta, Canada (Rudmik, Xu, Quan); Data Integration, Measurement and Reporting (DIMR), Alberta Health Services, Calgary, Canada (Liu, Bird, Kukec).

Corresponding Author: Luke Rudmik, MD, MSc, Division of Otolaryngology–Head and Neck Surgery, Department of Surgery, University of Calgary, Richmond Road Diagnostic and Treatment Centre, 1820 Richmond Rd SW, Calgary, AB T2T 5C7, Canada (lukerudmik@gmail.com).

Health systems are focused on developing strategies to improve the quality and value of care.[1,2] However, before embarking on quality improvement, it is critical to first understand the current quality of health care delivery and identify key areas to focus on for change.[3,4] Performance measures to assess quality of care are important because they provide clinically meaningful metrics for health systems to monitor the adherence to specific management recommendations, appropriateness criteria, and expected outcomes.[5] Examples of quality performance measures within the field of otolaryngology include use of topical therapy for acute otitis externa and appropriate choice of oral antibiotic or acute sinusitis.[6]

Chronic rhinosinusitis (CRS) is a common and expensive-to-treat chronic inflammatory disease,[7] which is primarily managed with prolonged medical therapies.[8] Topical intranasal steroid (INS) therapy has been shown to be highly effective at improving CRS-specific symptoms and quality of life.[9,10] Given the strength of evidence along with a favorable safety profile, practice guidelines from the United States, Europe, and Canada have all provided a strong treatment recommendation for the daily use of topical INS during management of patients with CRS (hereinafter, CRS patients).[11-13] Therefore, given the absence of any medical contraindications, a high-quality treatment strategy for CRS patients should involve utilization of a daily topical INS to reduce sinonasal mucosal inflammation and improve clinical outcomes.

For CRS patients who present to a physician for care, following an accurate diagnosis, the use of topical INS therapy may represent an important process performance marker for the quality of CRS care. The primary objective of this study was to define the rate and quantity of topical INS therapy utilization for CRS within a Canadian population. The secondary objective was to evaluate for geographic variations in the utilization of topical INS therapy for CRS across a single Canadian province. Outcomes from this population-based study will provide insight into the current quality of care for CRS. Future studies may need to investigate for factors leading to current deficiencies of utilization and elucidate the clinical impacts of variable use of daily topical INS therapy for CRS.

Key Points

Question What are the rate and quantity of topical intranasal steroid therapy utilization in patients with chronic rhinosinusitis?

Findings In this Canadian population-based analysis of 19 057 patients with chronic rhinosinusitis, the rate of intranasal steroid utilization was 20 per 100 patients. When patients with chronic rhinosinusitis used topical intranasal steroid therapy, the mean quantity was 2 to 3 bottles per year.

Meaning Given that there is a strong recommendation for the use of topical intranasal steroid therapy for chronic rhinosinusitis, increasing utilization of this treatment may represent an opportunity to improve the quality of care. Future studies need to elucidate the factors leading to under use of topical intranasal steroid therapy.

Methods

Defining the CRS Cohort

The population-based Data Integration, Measurement, and Reporting (DIMR) administrative database[14] of the Alberta Health Services was used to identify the CRS patient cohort for this study. The DIMR database is a province-wide database that collects data on each health care encounter in Alberta, Canada. Given that all health care for CRS is funded under the provision of the Canadian government, without any private health care encounters, each CRS health care encounter will be recorded in the DIMR database.

The CRS cohort included all adult patients (ie, ≥18 years old) in Alberta who received a diagnosis of CRS between March 31, 2011, and March 31, 2014. Patients who received endoscopic sinus surgery (ESS), as defined by receiving a minimum of a maxillary antrostomy (physician claim 34.1A or 34.2A) or ethmoidectomy (physician claim 34.54A), were excluded because these patients often receive off-label, high-volume budesonide irrigations, which could not be differentiated from budesonide use for comorbid asthma. Therefore, this analysis focused on the utilization of traditional topical INS spray therapy as opposed to off-label topical steroid therapies, which are typically used after ESS.[10] This study applied the following validated case definition for CRS in DIMR claim data: at least 2 diagnosis claims with *International Classification of Diseases, Ninth Revision (ICD-9)*, code 471.x or 473.x within 2 years.[15] This case definition was developed by retrospectively reviewing 2167 medical records and selecting random sample of 100 patients with CRS and 100 patients without CRS. Seven different *ICD-9*-based coding algorithms were then evaluated to identify the most balanced validity. The case definition applied for this study provided a sensitivity of 77%, specificity of 79%, positive predictive value of 79%, and a negative predictive value of 78%. This study was approved by the University of Calgary Conjoint Health Research Ethics Board.

Geographic Regions

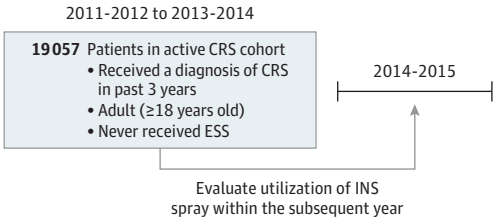
The geographic level used in this analysis are the province of Alberta 64 Health Status Areas (HSAs), which were developed to provide standard population health reporting, utilization rates, and health care outcomes. The boundaries for each HSA are based on community likeness, travel patterns, and shared public services, with a population goal of 25 000 to 55 000 people. Patients were categorized into each of the 64 geographic regions based on their household postal code.

Determining Rate and Quantity of INS Spray Utilization for CRS

As mentioned herein, the CRS cohort was composed of patients who received a diagnosis of CRS within the past 3 years (March 31, 2011, to March 31, 2014). The rate of quantity of INS spray utilization was then evaluated in the subsequent year of March 31, 2014, to March 31, 2015 (**Figure 1**).

The overall rate of INS spray utilization was calculated using number of CRS patients who utilized at least 1 U (1 U of

Figure 1. Analysis Scheme



CRS indicates chronic rhinosinusitis; INS, intranasal steroid.

Table 1. Rate of INS Spray Utilization for CRS in 2014 to 2015

Characteristic	No.
Overall CRS cohort[a]	19 057
CRS patients who used ≥1 U of steroid spray, No.[b]	3821
Crude rate of INS spray utilization (per 100 CRS patients)	20.1
Age- and sex- standardized rate of INS spray utilization (per 100 CRS patients)	25.1

Abbreviations: CRS, chronic rhinosinusitis; ESS, endoscopic sinus surgery; INS, intranasal steroid.

[a] Those older than18 years, new cases identified in the previous 3 years (2011-2012 to 2013-2014), and excluding patients who received ESS.

[b] 1 U = 1 bottle (1 bottle estimated to last 1 month).

INS spray is equivalent to 1 bottle of INS spray per month) of INS spray divided by the number of CRS patients in the overall cohort or small geographic region. The crude observed geographic rates of INS spray utilization for CRS were obtained and then appropriately age- and sex-standardized using the corresponding Alberta fiscal year population distribution.[16]

The quantity of INS spray utilization was calculated by summing the total number of units of INS spray used for each CRS patient within the overall cohort. When used as directed, 1 U (1 bottle) of INS spray is estimated to be equivalent to 1 month of daily use.

Small-Area Variation Analysis

Using the direct age- and sex-standardized rates for each geographic region, the extremal quotient (EQ) and weighted coefficient of variation (CV) were calculated.[17] The EQ describes the largest relative difference in rates by taking a ratio of the highest and the lowest rate of use. When the lowest rate of a geographic region was zero, the mean annual rate of outpatient physician visit for CRS was used for that year. The weighted CV is the standard deviation of the rates divided by the mean rate weighted by the population of each area multiplied by 100. The CV is used to compare the changes in variation over time.

The systematic component of variation (SCV),[18] the empirical Bayes (EB) variance component[19,20] as well as the χ^2 statistic[21] were calculated using actual counts of observed vs expected cases per age and sex per region. The expected rates of outpatient physician visits for CRS were calculated by determining the average utilization rate (number of visits divided by population) by age and sex for Alberta, which was then applied to the age and sex distribution of each of the individual geographies. The volume of outpatient physician visits for each age and sex category was then summed to obtain an overall expected number of outpatient physician visits for each individual geographic region.

The SCV is a robust method to quantify variation, and it is derived from a model that recognizes 2 sources of total variation in geographic area rates: (1) across areas (a difference in their rates, which is called systematic variation, and (2) within area (random variation of observed rates around each area's true rate). Thus, the SCV is an estimate of the "true" (ie, nonrandom) total variation and is considered a robust measure of variation.[18,22] Systematic component of variation values of 3.0 to 5.4, 5.5 to 10.0, and greater than 10.0 are felt to represent moderate, high, and very high variation, respectively.[23] Under the null hypothesis of homogeneity among rates (eg, same risk of outpatient physician visits across all geographic areas) the SCV would be zero.

The EB statistic improves on the SCV by increasing the resolution of outpatient physician visit events in small-population geographic regions where the annual number of events may be highly unstable and vary in frequency from year to year.[24,25] The χ^2 is used to determine if the rate of an area is statistically different from a standard reference area.[26]

Results

Rate and Quantity of INS Spray Utilization for CRS

Within the Canadian province of Alberta, there were 19 057 adult patients who received a diagnosis of CRS within the past 3 years (2011-2012 to 2013-2014) and did not receive ESS. Within this cohort, topical INS spray was utilized in only 1 of every 5 CRS patients (overall crude rate of utilization = 20.1 CRS patients used a topical INS spray per 100 CRS patients) (**Table 1**). This demonstrates that approximately 80% of patients with a recent diagnosis of CRS failed to use a single unit of topical INS spray during management of their CRS during the past 12 months (fiscal year 2014-2015).

When evaluating the quantity of INS spray utilized for management of CRS (1 U = 1 bottle of INS spray = 1 month of therapy), approximately 80% of CRS patients failed to use a single unit within the past year (2014-2015). The proportion of CRS patients who used 1 U and 2 U of INS spray within the past year was 10.7% and 3.9%, while there were even lower proportions using 3 U or more within the past year (**Table 2**).

There were 3821 CRS patients who utilized at least 1 U of INS spray within the past year (2014-2015). Within the subset of CRS patients who used at least 1 U of INS spray in the past 12 months, the crude and adjusted quantity of utilization was 2.4 and 3.1 U (ie, bottles) per CRS patient (**Table 3**). This suggests that on average, when a topical INS spray for CRS is prescribed, patients utilized the therapy for approximately 2 to 3 months.

Variation of Topical INS Spray Utilization for CRS

When evaluating the patterns of INS spray utilization for CRS across the 64 geographic regions within Alberta, there was large

Table 2. Proportion of Annual Quantities of INS Spray Utilization for CRS in a Total Cohort of 19 057 Patients

Quantity of INS Spray Utilization in 2014-2015, U[a]	Patients With CRS, No. (%)
0	15 236 (79.9)
1	2043 (10.7)
2	758 (3.9)
3	379 (2.0)
4	238 (1.3)
5	174 (0.9)
≥6	229 (1.2)

Abbreviations: CRS, chronic rhinosinusitis; INS, intranasal steroid.

[a] 1 U = 1 bottle (1 bottle estimated to last 1 month).

Table 3. Quantity of INS Spray Utilization for CRS in 2014 to 2015

Characteristic	No.
CRS cohort who used an INS spray[a]	3821
Total units of INS spray used in 2014-2015[b]	9314
Mean quantity of INS spray utilization[c]	2.4
Age- and sex- standardized quantity of INS spray utilization[c]	3.1

Abbreviations: CRS, chronic rhinosinusitis; ESS, endoscopic sinus surgery; INS, intranasal steroid.

[a] Those older than 18 years, new cases identified in the previous 3 years (2011-2012 to 2013-14), and those who used at least 1 U of INS spray in 2014 to 2015; patients who received ESS were excluded.

[b] 1 U = 1 bottle (1 bottle estimated to last 1 month).

[c] Per patient with CRS who used at least 1 U of INS spray.

variation for both the overall rate and quantity utilized. **Figure 2** demonstrates the variation in overall rate and quantity of INS spray utilization for CRS in 2014 to 2015. **Table 4** demonstrates the EQ, CV, SCV, EB, and χ^2 statistic for overall variation across the 64 geographic regions.

Discussion

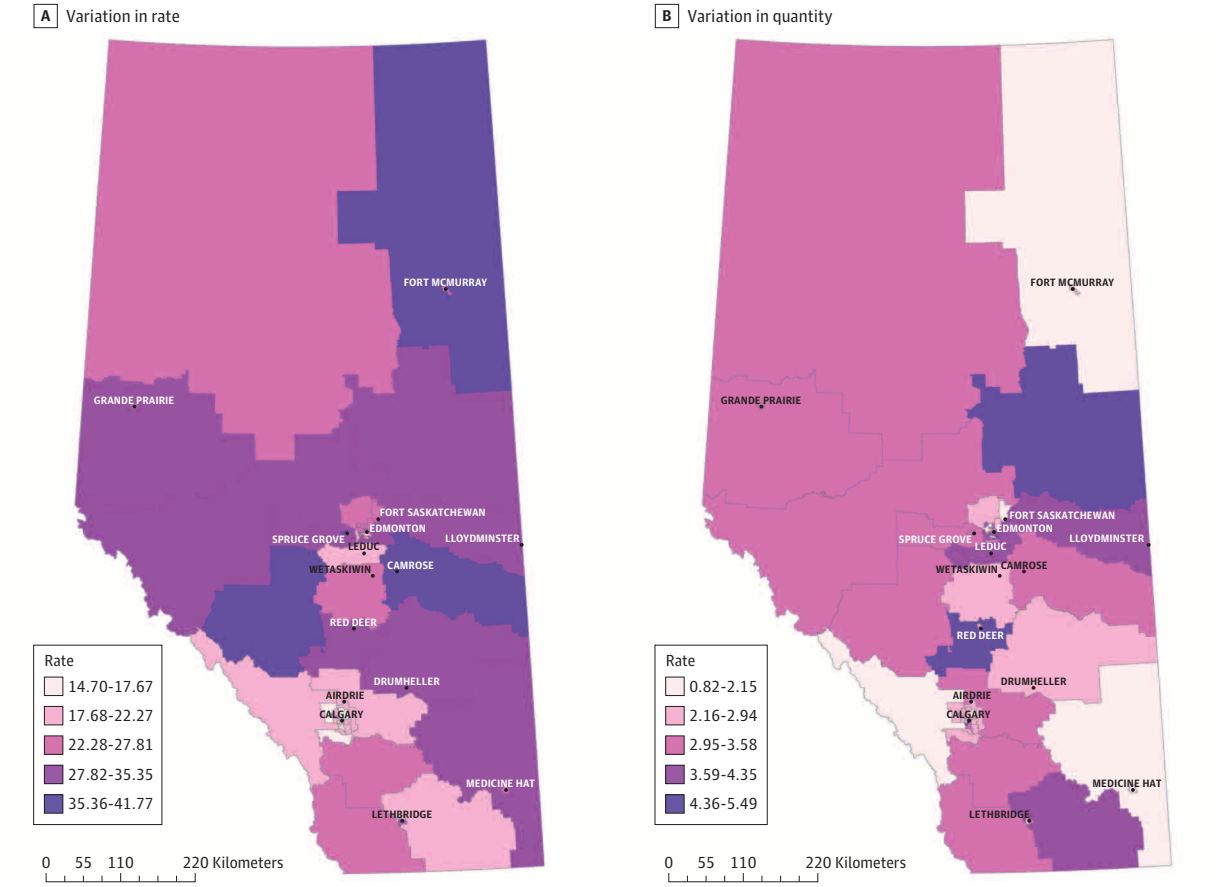
With the purpose to continue improving the quality of care for CRS, this study evaluated the utilization of topical INS therapy for CRS and quantified the degree of geographic variation across the province of Alberta, Canada. The results from this study have demonstrated that approximately 80% of patients with a recent diagnosis of CRS fail to utilize a single unit of topical INS spray within the most recent year (2014-2015). In CRS patients who used a topical INS spray within the past year, the mean quantity of utilization was 2 to 3 U (1 unit = 1 bottle = 1 month). Furthermore, there was large geographic variation for INS spray utilization, which suggests that certain regions are better at providing appropriate INS therapy for CRS. Overall, the outcomes demonstrate that there is a significant underuse of INS spray for CRS patients; however, factors driving the underuse are currently unknown. Given that CRS practice guidelines provide strong recommendations for daily use of topical INS therapy, improving utilization of this treatment strategy may represent an opportunity to improve the quality of care.

Steroids (ie, corticosteroids) have several beneficial effects in CRS patients, such as reducing sinonasal mucosal inflammation, decreasing vascular permeability (ie, reducing edema), and reducing glycoprotein release from submucosal glands (ie, thin mucus). Utilization of topical INS therapy can achieve local sinonasal steroid effects while minimizing the potential for adverse effects associated with systemic steroid therapy.[27] The benefit of INS therapy has the strongest level of evidence with 6 meta-analyses[28-33] quantifying the evidence from more than 40 RCTs. The strength of evidence combined with an excellent safety profile has led all 3 major practice guidelines to provide a strong recommendation for daily topical INS therapy for CRS patients.[11-13] Therefore, the utilization of topical INS therapy may represent an important performance metric to assess quality of care.

In 2009, Smith et al[34] evaluated the National Ambulatory Medical Care Survey (NAMCS) for 2003 to 2006 and demonstrated that there were significant variations in the volume of prescribing of medical therapies for CRS between 4 large geographic regions in the United States. In 2011, Lee and Bhattacharyya[35] evaluated the NAMCS between 2005 and 2006 and provided a more granular look into the prescribing patterns for CRS. They[35] reported that there was no variability in the overall utilization of topical INS spray between 4 broad US regions (South, West, Northeast, and Midwest); however, there was significant variation in the rate of topical INS spray being prescribed between primary care clinicians and otolaryngology. Furthermore, they demonstrated that only 10% of all outpatient visits resulted in a prescription of a topical INS spray. In 2013, Bhattacharyya and Kepnes[36] evaluated the NAMCS for 2004 to 2010 with the objective to quantify outpatient prescribing patterns for CRS with nasal polyps. They reported that less than half of all CRS visits (43%) resulted in a prescription for a topical INS agent. Although these were very important studies and provided early insight into the quality of medical therapy for CRS, there have been several updated practice guidelines and evidence-based recommendations since 2010, and it is important to evaluate if patterns of INS therapy have changed that may indicate an improvement in quality of care.

Unfortunately, the results from our study suggest that there has been minimal improvement in the utilization of INS therapy since 2010, and INS therapy continues to be underused in CRS patients. Our results demonstrated that only 20% of CRS patients utilized a topical INS spray that was only slightly better than the 10% utilization rate reported by Lee and Bhattacharyya.[35] Although the utilization of INS therapy was overall poor across all small geographic regions, there was large variation, which suggests that certain regions are providing more appropriate utilization rates and quantities compared with other regions. Another factor that may influence variation in quantity of INS spray utilization are climate differences between geographies. However, this analysis evaluated a CRS cohort within a single province with a uniform climate, and this minimizes this potential confounding risk of climate effects. Before strategies can be developed to improve the delivery of INS therapy for CRS, it will be important to first identify factors leading to the underuse of INS

Figure 2. Variations in the Rate and Quantity of Intranasal Steroid Utilization for Chronic Rhinosinusitis in Alberta, Canada



Source: Alberta Health Services geographic boundaries, 2010 (in public domain).

therapy and understand the impacts of variable INS use on clinical outcomes.

It is also important to highlight certain features of this analysis to appropriately interpret the findings. First, despite our analysis evaluating 3 years of an administrative database, the CRS case definition applied in this study required 2 CRS encounters over 2 years; therefore, each patient sought care within the previous 2 years (2012-2013 and 2013-2014). By evaluating a CRS cohort who sought medical care within the previous 2 years, it would increase the probability that the cohort has active disease. By excluding CRS patients who failed to seek care at least once prior to 2012, we were able to minimize the confounding effects of patients with clinically inactive disease. Second, the analysis could not discriminate between using budesonide respules for asthma or off-label sinus irrigations for CRS, therefore we excluded patients who received ESS since these patients may have been appropriately treated with topical INS therapy using budesonide irrigations. It is important to emphasize that excluding patients who received ESS will create a CRS cohort managed primarily at the primary care level as opposed to the specialist and/or otolaryngologist level. This will inherently select out a CRS cohort with a less severe phenotype and may not represent a CRS cohort treated by otolaryngologists. This suggests that despite our study demonstrating a large proportion of CRS patients who failed to receive a single unit of INS spray in 2014 to 2015, this may reflect that a large proportion of CRS patients treated by primary care physicians have a mild phenotype that did not need continual topical INS therapy to improve clinical outcomes. However, it is challenging to understand why 80% of CRS patients failed to use even a single unit of topical INS spray despite the likelihood the cohort represented a milder phenotype of the CRS. Future studies are under way to evaluate the topical INS spray "users" vs "nonusers" to elucidate factors leading to the underuse of daily treatment.

Despite several strengths of this study, such as using a population-based administrative database with high-quality data collection, use of a validated case definition for CRS, and robust small-area variation analysis using both the SCV and EB statistic to account for potential confounders in regional population size, the primary limitation is the accuracy and generalizability of outcomes. First, accurate pharmacoepidemiologic research using administrative databases for CRS relies on a case definition that will accurately identify patients with the disease within the database. Although we applied a case definition with a balanced validity (sensitivity, 80%; specificity,

Table 4. Variation in Rate and Quantity of INS Utilization for CRS

Measure of Geographic Variation	INS Utilization	
	Rate	Quantity
EQ	2.8	6.7
CV	26.3	27.9
SCV	4.5	6.7
EB	4.6	4.8
P value of χ^2	<.001	<.001

Abbreviations: CRS, chronic rhinosinusitis; CV, coefficient of variation; EB, empirical Bayes estimation; EQ, extremal quotient; INS, intranasal steroid; SCV, systematic component of variation.

77%; PPV, 78%; and NPV, 79%), as with all administrative database research, there will be an imperfect cohort with included patients who do not have the disease of interest. This is a limitation that must be recognized, and future studies will have to validate the findings from this analysis. Second, the cohort of CRS patients was derived from a single Canadian province, and, despite certain advantages, such as the increased homogeneity of the population (ie, similar access to care) and reduced risk of potential environmental confounding effects (ie, climate), the utilization patterns may not be completely generalizable to different regions within Canada or other countries, such as the United States. However, several of the outcomes from this study are similar to those of earlier published studies evaluating INS utilization, which suggests there may be similar practice patterns. Third, our study outcomes largely represent a mild cohort of CRS patients treated at the primary care level and likely fails to address management patterns at the specialist or otolaryngologist level. However, given the large volume of CRS cases managed at the primary care level, understanding delivery of care from this perspective is important to improve quality of care. Finally, this analysis did not investigate for factors leading to the underuse of topical INS therapy, and this will need to be the focus of subsequent studies.

Conclusions

In adult CRS patients who have not received ESS, topical INS therapy continues to be underutilized. Furthermore, there is large geographic variation in the overall rate and quantity of INS spray utilization, which suggests there may be deficiencies in the quality of care for this chronic disease. Given the negative impact of low-quality medical care, outcomes from this study indicate a need to further evaluate factors leading to the underutilization of a recommended treatment in CRS patients improve overall health system performance.

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Study concept and design: Xu, Quan.
Acquisition, analysis, or interpretation of data: All authors.
Drafting of the manuscript: Kukec.
Critical revision of the manuscript for important intellectual content: Rudmik, Xu, Liu, Bird, Quan.
Statistical analysis: Rudmik, Xu, Liu, Kukec, Quan.
Obtained funding: Quan.
Administrative, technical, or material support: Bird.
Study supervision: Rudmik.

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