



Cost of healthcare services in patients with chronic rhinosinusitis from the public hospital perspective: a retrospective prevalence-based costing approach

[El costo de los servicios de salud en pacientes con rinosinusitis crónica desde la perspectiva de un hospital público: un enfoque retrospectivo basado en la prevalencia de costos]

Trung Quang Vo^{1,*}

Department of Economic and Administrative Pharmacy (EAP), Faculty of Pharmacy, Pham Ngoc Thach University of Medicine, Ho Chi Minh City 700000, Vietnam.

*E-mail: trungvq@pnt.edu.vn; voquangtrungdk@gmail.com

Abstract

Context: Chronic rhinosinusitis (CRS) is a high-incidence health concern and therefore cause a high economic burden.

Aims: To evaluate the direct medical cost in CRS treatment. The findings of this research promised as a real evidence on decision-making.

Methods: This study was designed as a cost analysis study based on prevalent rate. The electronic database of a public hospital was used to find out the demographic characteristics and costs associated with CRS from healthcare provider (hospital), patient and third-party (health insurance) perspective. Data on 4,894 individuals with CRS treated at the Ear-Nose-Throat Hospital collected from 2015 to 2017 were analyzed.

Results: The age of majority was between 33 and 55 years, and the number of patients with insurance increased annually. About 35% of participants came from Ho Chi Minh City, and the median length of stay was 6 days. The direct medical costs per year per episode were 700.13 USD with health insurance and 1066.26 USD without health insurance. Treatment costs were found to be significantly different among years. The factors that directly influenced medical costs were gender, health insurance, and type of CRS.

Conclusions: This analysis states for the first time the specific costs for CRS, which would provide public health professionals with estimated the economic burden of CRS. The study provides a baseline treatment cost of CRS that can be used by future studies for comparison.

Keywords: cost of illness; direct medical cost; hospital; illness burden; public; Vietnam.

Resumen

Contexto: La rinosinusitis crónica (SRC) es un problema grave de salud pública y una de las principales causas de carga económica.

Objetivos: Evaluar el costo médico directo en el tratamiento de SRC. Los hallazgos en esta investigación servirán como evidencia real para la toma de decisiones.

Métodos: En este estudio retrospectivo, basado en la prevalencia, se utilizó una base de datos electrónica del hospital para examinar las características demográficas y los costos asociados con el SRC desde la perspectiva de un proveedor de atención médica (hospital), paciente y de terceros (seguro de salud). Se analizaron los datos de 4.894 individuos con CRS tratados en el Hospital de Garganta, Nariz y Oído desde el año 2015 al 2017.

Resultados: La mayoría de edad estuvo entre 33 y 55 años, y el número de pacientes con seguro aumentó anualmente. Alrededor del 35% de los participantes procedía de la ciudad de Ho Chi Minh, y el número promedio de días para la duración de la estadia fue de 6. Los costos médicos directos por año y episodio fueron de 700,13 USD con seguro de salud y 1066,26 USD sin seguro de salud. Los costos del tratamiento se encontraron estadísticamente significativamente diferentes entre los años. Los factores que influyeron directamente en los costos médicos fueron el género, el seguro de salud y el tipo de SRC.

Conclusiones: Este análisis establece por primera vez los costos específicos para CRS, que proporcionará a los profesionales de la salud pública del estado estimaciones de la carga económica de CRS. El estudio proporciona una estimación de referencia del costo de CRS que puede ser utilizada por estudios futuros para comparación.

Palabras Clave: carga de la enfermedad; costo de la enfermedad, costo médico directo, hospital, público, Vietnam.

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INTRODUCTION

Chronic rhinosinusitis (CRS) is a common condition in which the cavities around nasal passage become inflamed and swollen for at least three months despite treatment attempts. This condition and is associated with large healthcare expenditures including the need for lifelong medical and surgical resources and detrimental effects on patient quality of life and productivity (Rudmik and Soler, 2015). CRS affected both children and adults, although it is typically diagnosed in young or middle-aged adults. Previous studies estimated the mean age of CRS diagnosis is approximately 39 years old (Shashy et al., 2004; Lusk, 2007; Pilan et al., 2012).

Factors that should be considered in each patient with CRS included allergic rhinitis, asthma, aspirin-exacerbated respiratory disease, smoking, irritants and pollutants, immunodeficiency, defects in mucociliary clearance, viral infections, systemic diseases, dental infections, anatomic abnormalities, and indoor dampness and mold exposure. Potential treatments for CRS include lifestyle modifications, daily nasal washing, oral and nasal glucocorticoids, antibiotics, leukotriene modifiers and surgery (reopening the sinus route and removing trapped mucus or polyps). CRS is widely thought to be a widespread disease, and one study cited a prevalence of 10–15% (DeConde et al., 2016). Due to the enormous influence of CRS on economic and social development as well as the physical and mental well-being of patients, there is a need to accurately define prevalence and medical costs of CRS to evaluate the value of care provided to patients.

Numerous studies have focused on chronic sinusitis. The first European international multicenter prevalence study of CRS obtained information from 57,128 respondents living in 19 centers in 12 countries; the overall prevalence of CRS by the European Position Paper on Rhinosinusitis and Nasal Polyps as 10.9% (range: 6.9–27.1%) (Hastan et al., 2011). A study in China which included a total of 10,636 respondents from seven cities reported the overall prevalence of CRS as 8.0% and

stated that it influenced approximately 107 million people in mainland China (Shi et al., 2015). This disease is also one of the high-frequently occurred chronic inflammation in North America, with an prevalence estimated from 5% to 16%; the total direct cost associated with CRS in the United State (U.S.) in 2011 was estimated to be between 60.2 and 64.5 billion USD, and the incremental annual expenditures were in the range of 3.9 billion to 12.5 billion USD (Chen et al., 2003; Anand, 2004; Caulley et al., 2015);).

In 2011, a study conducted by Bhattacharyya using US-based Medical Expenditure Panel Survey database. Its main findings were the estimated the direct medical cost of CRS at about 8.6 billion USD per year in 2008, with a substantial incremental increase in health care utilization and expenditures due to increases in office-based and prescription costs. Based on the evidence, the direct medical cost of endoscopic sinus surgery (ESS) in the US ranges from 8200 to 10,500 USD, whereas the cost of ESS in the Canadian, Taiwanese, and Indian health care systems was 3500 USD, 1800 USD and 1000 USD in 2018, respectively (Au and Rudmik, 2013; Chatterjee and Laxminarayan, 2013; Smith et al., 2015). In 2014, Rudmik et al. calculated the indirect costs to equal 10,077 USD per patient per year (13 billion USD in 2014) in the US (Rudmik et al., 2014).

Although many studies have been conducted worldwide regarding the costs of CRS, only a few studies in Vietnam have been able to analyze and report the costs of this disease due to the difficulty of collecting data. The objective of this research was to retrospectively identify and analyze the direct costs for treating CRS in a public hospital in southern Vietnam from 2015 to 2017.

MATERIAL AND METHODS

Study design and site

A retrospective study was conducted in the Ear Nose Throat Hospital (ENTH) of Ho Chi Minh City (HCMC). Data were assembled from the medical records from January 2015 to December 2017.

The study took place at a 10-bed primary care specialty hospital in southern Vietnam, which has more than 30 years of history and development. It serves patients from HCMC and neighboring provinces.

Study population

Using the International Classification of Diseases 10th edition (ICD-10), information for all patients was pinpointed and retrieved using codes J32.x, where x = 0, 1, 2, 3, 4, 8, and 9 (chronic sinusitis), from the ENTH financial and medical electronic database. Patients diagnosed with more than one type of chronic sinusitis were coded as J32. The search included the records for all inpatients treated at the Nose-Sinus Department. The database contained information on patient demographics (age, gender, address and healthcare insurance) and healthcare utilization (medical services, medications and charges).

This study extracted data from January 2015 to December 2017 (a period of 3 years). Patients were ineligible for this study if they had been discharged from or transferred to the hospital or if the medical records needed for the research were not available.

Ethical considerations

The study methods were reviewed and approved by the President Council at the University of Medicine and Pharmacy as well as the ENTH. The information of all patients to guarantee the anonymity and scientific purpose.

Costing perspective and cost components

The direct medical cost of treatment for CRS patients was analyzed from the perspective of the healthcare provider (hospital), patients and a third-party (health insurance; HI), where the cost of the provider was equal to the aggregated amount of patient and third-party expenses. In particular, a bottom-up and micro-costing methodology was used to search the hospital records. All costs related to medical services used by a group of inpatients was included for analysis step. For this purpose, inpatients were broken down

into two groups: patients with and without HI. In addition, the cost components consisted of hospitalization, pharmaceuticals, laboratory tests, diagnosis (i.e., X-ray and endoscopy), operation (surgery) and other services such as high-technology services, physician consultation and medical supplies (e.g., syringes, bandages, etc.).

All costs in this study were converted into 2018 and are performed in USD with the exchange rate of 1 USD = 22,467 VND. These costs were adjusted according to the consumer price index (CPI) given by the General Statistics Office of Vietnam (General Statistics Office of Vietnam, 2018; The State Bank of Vietnam, 2018).

$$\text{Cost; 2018} = \frac{\text{Cost; x} \times \text{CPI; x}}{100} \quad | \quad \text{x} = 2015; 2016; 2017$$

Data management and analysis

Data were filtered and cleaned from the hospital database using Microsoft Office Excel 365 (Microsoft, Washington, USA) for verification and further analyses. SPSS® Statistics version 22 (IBM, New York, USA) was used for statistical analysis. Descriptive statistics were utilized to summarize the study variables. Model checks included normal distribution and influential observations.

Demographic characteristics are demonstrated by sex, age, HI reimbursement, location, ICD-10 code and length of stay (LOS). Categorical variables are written with numbers and percentages, whereas continuous variables are written as the mean, standard deviation (SD), median and interquartile range.

Costs for 3 years were compared using the non-parametric test namely Kruskal-Wallis H test due to skewed data. Differences between any 2 years were compared by a post-hoc pairwise comparison adjusted for multiplicity.

RESULTS

Table 1 provides the sociodemographic characteristics and endoscopic sinus surgery status of CRS patients from 2015 to 2017. In total, the study included 4894 respondents, among which there

Table 1. Demographic characteristics of hospitalized CRS cases by endoscopic sinus surgery status 2015–2017.

Variable	2015 (n=1,705)	2016 (n =1,608)	2017 (n = 1,581)	2015-2017 (N= 4,894)
Sex [n (%)]				
Male	818 (48.0)	795 (49.4)	753 (47.6)	2366 (48.3)
Female	887 (52.0)	813 (50.6)	828 (52.4)	2528 (51.7)
Age (Years)				
Mean (SD)	42.8 (15.4)	44.3 (14.5)	45.8 (14.3)	44.3 (14.8)
Median [Q1-Q3]	32 [42-54]	44 [33-55]	45 [35-56]	44 [33-55]
HI owner [n (%)]				
No	730 (42.8)	521 (32.4)	348 (22.0)	1599 (32.7)
Yes	975 (57.2)	1087 (67.6)	1233 (78.0)	3295 (67.3)
Location [n (%)]				
Ho Chi Minh City	622 (36.5)	549 (34.1)	537 (34.0)	1708 (34.9)
Other provinces**	1083 (63.5)	1059 (65.9)	1044 (66.0)	3186 (65.1)
ICD-10 code [n (%)]				
J32.0	243 (14.3)	285 (17.7)	180 (11.4)	708 (14.5)
J32.1	17 (1.0)	25 (1.6)	15 (0.9)	57 (1.2)
J32.2	12 (0.7)	12 (0.7)	18 (1.1)	42 (0.9)
J32.3	61 (3.6)	52 (3.2)	38 (2.4)	151 (3.1)
J32.4	883 (51.8)	692 (43.0)	433 (27.4)	2008 (41.0)
J32.8	24 (1.4)	26 (1.6)	30 (1.9)	80 (1.6)
J32.9	6 (0.4)	5 (0.3)	31 (2.0)	42 (0.9)
J32	459 (26.9)	511 (31.80)	836 (52.9)	1806 (36.9)
LOS (Days)				
Mean (SD)	5.8 (2.6)	6.3 (3.5)	6.3 (3.3)	6.1 (3.1)
Median [Q1 - Q3]	5 [5 - 6]	6 [5 - 6]	6 [5 - 6]	6 [5 - 6]
Endoscopic Sinus Surgery [n (%)]				
With NP	617 (36.2)	578 (35.9)	583 (36.9)	1778 (36.3)
Without NP	1088 (63.8)	1030 (64.1)	998 (63.1)	3116 (63.7)

SD: Standard Deviation, HI: Health insurance, ICD: International Classification Disease, LOS: Length of Stay, Q1 = 25th percentile, Q3 = 75th percentile, NP: Nasal polyposis. J32.0: Chronic maxillary sinusitis, J32.1: Chronic frontal sinusitis, J32.2: Chronic ethmoidal sinusitis, J32.3: Chronic sphenoidal sinusitis, J32.4: Chronic pansinusitis, J32.8: Other chronic sinusitis, J32.9: Chronic sinusitis, unspecified, J32: Combination of many kind of chronic sinusitis.

were 1705 cases in 2015, 1608 cases in 2016, and 1581 cases in 2017.

Table 2 shows the total annual direct medical costs of CRS classified by insurance service category.

Table 3 presents the direct medical costs attributed to CRS per episode-year and compares these costs between the 3 years.

Table 4 illustrates a summary of direct medical costs and LOS of CRS patients at ENTH from 2015 to 2017 according to different characteristic variables

DISCUSSION

Vietnam is a region with a high incidence of CRS. Its tropical monsoon climate, high humidity, polluted air, high-density residential areas and undeveloped healthcare system are the main factors responsible for respiratory illnesses such as sinusitis, especially in children, elderly people, those with immunodeficiency or those who regularly work in a dusty environment. Presently, many hospitals advocate for independent finance; the financial balance between having sufficient resources for development and not overburdening the cost of treatment has become a complex problem. This study seeks to provide information on the cost of CRS treatment at ENTH - one of the specialized hospitals for treating CRS disease.

The total number of study participants was 4894, and this amount decreased year by year, with 1705 patients in 2015, 1608 in 2016, and 1581 patients in 2017. The variation in the male to female ratio was negligible. The mean age in this study was 44.3 years (SD: 14.8) compared to 51.7 in a Canadian study (Yip et al., 2017), 44.8 (SD: 10.6) in a US study (Purcell et al., 2015), and 42.5 (SD: 18.6) in a German study (Park et al., 2018). It is interesting to note that the percentage of patients with insurance increased from 57.2% in 2015 to 78.0% in 2017, which an average coverage of 67.3%. The reason for this growth may be because of the compulsory insurance policy promulgated at the end of 2014. Patients treated at ENTH,

which is located in HCMC, were mainly from provinces outside of the city (about 65%). This may be explained by the shortage of specialized hospitals in those provinces. Of the types of CRS treated, J32.4 (chronic pansinusitis) and J32 (combination of many kinds of chronic sinusitis) were noticeably higher than others, with averages of 41.0% and 36.9%, respectively, over the 3 years. Nonetheless, there was a shift in the most commonly seen type of CRS, with the number of patients with J32 increasing (2015: 26.9%; 2017: 52.9%), and the number of patients with J32.4 decreasing (2015: 51.8%; 2017: 27.4%). In terms of endoscopic sinus surgery, nearly 36% of the patients were diagnosed with nasal polyposis over the 3 years. This ratio was similar to that of a US study in 2011 by Chandra et al., in which CRS with nasal polyposis accounted for up to 33% of cases, and a study in 2015 by Purcell et al., in which the proportion was 30.1%.

For our best review, this study was the first CRS study that evaluated the direct medical costs of CRS in a specialized hospital. Due to the yearly increase of cost trend, understanding the factors that affected to treatment cost would be an important consideration for decision-making in allocating medical resources. The economic burden of CRS has increased over the years, reaching nearly 1.9 million USD by the end of 2017. However, there was no statistical difference in financial burden between 2016 and 2017 ($p > 0.05$), which means the disease was handled and gradually controlled. This finding is very different from studies conducted in the US, where the burden of CRS was from 7.36 to 25.17 billion USD (Ray et al., 1999; Murphy et al., 2002; Bhattacharyya et al., 2011; Reschovsky et al., 2014). This can be explained by the discrepancies in the population, per capita income, and development of healthcare systems. Comparing these data with previously published evidence, the cost estimate for CRS in 2017 in Vietnam (1176.18 USD) was higher than in Canada, where the direct cost was 381.40 USD (Yip et al., 2017), and similar to a study in the US, which reported the cost at 939.91 USD (DeConde et al., 2016).

Table 2. Total annual direct medical cost of CRS divided into patients without HI(A) and with HI(B).

Cost category	2015			2016			2017		
	A	B	Subtotal	A	B	Subtotal	A	B	Subtotal
No. of patients	730	975	1705	521	1087	1608	348	1233	1581
Hospitalization	54,996.35	69,223.96	124,220.31	40,812.21	147,537.33	188,349.54	36,657.71	181,306.48	217,964.19
Pharmaceuticals	43,966.34	79,475.35	123,441.69	28,426.01	64,236.63	92,662.64	19,358.39	87,949.36	107,307.75
Labor tests	1,209.11	27,812.21	29,021.32	1,665.16	41,227.50	42,892.66	1,073.16	50,620.85	51,694.01
X-ray, Endoscopy	2,778.84	5,076.25	7,855.09	2,581.54	9,867.35	12,448.89	3,501.28	18,032.47	21,533.75
Operation	564,985.51	490,106.14	1,055,091.65	447,742.99	1,040,383.17	1,488,126.16	304,987.09	1,130,431.90	1,435,418.99
Others*	68,129.28	96,721.60	164,850.88	9,575.54	20,191.98	29,767.52	10,374.43	15,245.38	25,619.81
Economic burden	736,065.49	768,417.05	1,504,482.54	530,802.15	1,323,445.93	1,854,248.08	375,952.08	1,483,590.61	1,859,542.69
Total cost per episode	1,008.31	788.12	882.39	1,018.81	1,217.52	1,153.14	1,080.32	1,203.24	1,176.18
OOP payment	736,065.49	511,794.95	1,247,860.44	530,802.15	613,388.32	1,144,190.47	375,952.08	658,422.64	1,034,374.72
OOP payment per episode	1,008.31	524.92	731.88	1,018.81	564.29	711.56	1,080.32	534.00	654.25
Insurance payment	-	256,621.98	256,621.98	-	710,057.78	710,057.78	-	825,167.89	825,167.89
Insurance payment per episode	-	263.20	150.51	-	653.23	441.58	-	669.24	521.93

HI: Health insurance, OOP: Out-of-pocket. *Others: High-technology services, physician consultation, medical supplies (syringe, bandage, among others).

Table 3. Direct medical costs attributed to CRS per episode-year.

Cost category	2015	2016	2017	2015 - 2017	P-value**	χ ²	Multiplicity adjusted p-value		
							15 vs 16	16 vs 17	15 vs 17
Hospitalization	72.86	117.13	137.86	108.40	< 0.001	1438.62	< 0.001	< 0.001	< 0.001
Pharmaceuticals	72.40	57.63	67.87	66.08	< 0.001	418.84	< 0.001	< 0.001	< 0.001
Labor tests	17.02	26.67	32.70	25.26	< 0.001	359.59	< 0.001	< 0.001	< 0.001
X-ray, Endoscopy	4.61	7.74	13.62	8.55	< 0.001	401.27	< 0.001	< 0.001	< 0.001
Operation	618.82	925.45	907.92	812.96	< 0.001	494.08	< 0.001	0.277	< 0.001
Others*	96.69	18.51	16.20	45.00	< 0.001	841.79	< 0.001	< 0.001	< 0.001
Total	882.39	1,153.14	1,176.18	1066.26	< 0.001	436.03	< 0.001	0.103	< 0.001
OOP payment	731.88	711.56	654.25	700.13	< 0.001	21.28	0.518	< 0.001	< 0.001
Insurance payment	150.51	441.58	521.93	366.13	< 0.001	763.44	< 0.001	< 0.001	< 0.001

OOP: Out-of-pocket. *Others: High-technology services, physician consultation, medical supplies (syringe, bandage, among others). **3-year comparison.

Table 4. Descriptive statistics of total direct medical cost, and length of stay of all CRS patients in the Ear Nose Throat Hospital during 2015-2017.

Characteristic	Total direct medical cost per episode			Length of Stay (LOS)		
	Mean (95%CI)	P-value ^a	Median [Q1-Q3]	Mean (95%CI)	P-value	Median [Q1-Q3]
Year						
2015	882.39 (861.80 - 902.99)	< 0.001	810.75 [610.94-1,130.74]	5.77 (5.64 - 5.89)	< 0.001 ^a	5 [5-6]
2016	1,153.14 (1,128.76 - 1,177.52)		1,143.16 [859.05-1,516.92]	6.26 (6.09 - 6.42)		6 [5-6]
2017	1,176.18 (1,151.29 - 1,201.07)		1,179.93 [876.03-1,550.84]	6.29 (6.13 - 6.45)		6 [5-6]
Gender						
Male	1,100.38 (1,079.00 - 1,121.75)	< 0.001	1,086.29 [750.35-1,512.00]	6.08 (5.96 - 6.20)	0.727 ^b	6 [5-6]
Female	1,034.33 (1,016.29 - 1,052.37)		978.22 [719.34-1,326.43]	6.11 (5.99 - 6.24)		6 [5-6]
HI owner						
No	1,027.40 (1,005.18 - 1,049.63)	0.001	1,010.60 [748.52-1,319.71]	5.60 (5.45 - 5.75)	< 0.001 ^b	5 [5-6]
Yes	1,085.11 (1,067.47 - 1,102.76)		1,024.08 [719.80-1,501.66]	6.34 (6.23 - 6.45)		6 [5-6]
Location						
Ho Chi Minh City	1,066.77 (1,042.57 - 1,090.97)	0.766	1,003.80 [731.56-1,441.35]	6.04 (5.90 - 6.18)	0.329 ^b	6 [5-6]
Other provinces	1,065.99 (1,048.94 - 1,083.03)		1,024.81 [737.70-1,430.08]	6.13 (6.02 - 6.24)		6 [5-6]
ICD-10 code						
J32.0	927.37 (900.62 - 954.12)	< 0.001	909.32 [728.37-1,119.81]	5.72 (5.51 - 5.92)	< 0.001 ^a	5 [5-6]
J32.1	872.72 (757.32 - 988.11)		838.22 [637.15-1,047.05]	6.44 (5.23 - 7.65)		6 [5-7]
J32.2	974.21 (811.59 - 1,136.82)		931.98 [592.71-1,344.36]	5.48 (4.85 - 6.10)		6 [5-6]
J32.3	876.18 (819.67 - 932.69)		896.66 [611.49-1,101.16]	6.12 (5.54 - 6.69)		5 [5-6]
J32.4	1,152.44 (1,129.13 - 1,175.75)		1,184.77 [776.70-1,547.82]	6.08 (5.95 - 6.21)		6 [5-6]
J32.8	1,062.64 (959.60 - 1,165.68)		1,014.04 [736.45-1,470.15]	6.43 (6.05 - 8.28)		6 [6-7]
J32.9	991.94 (847.05 - 1,136.84)		1,015.59 [694.23-1,292.63]	6.12 (5.46 - 6.78)		6 [6-6]
J32	1,050.92 (1,028.00 - 1,073.84)		1,006.94 [716.47-1,422.77]	6.22 (6.07 - 6.37)		6 [5-6]

CI: Confidence interval, HI: Health insurance, ICD: International Classification Disease, Q1 = 25th percentile, Q3 = 75th percentile. ^a. Kruskal-Wallis or Mann-Whitney tests. ^b. One-Way ANOVA test or Independent-Samples t-test.

This study is valuable because it included a large number of inpatients; however, it also had certain limitations. First, the retrospective design may have led to data loss, which could have influenced the definitive conclusion. This study analyzed the retrospective data from a public hospital database, and therefore, the results may not be similar to other settings, such as private hospitals. Furthermore, this result reflected CRS-related costs in Vietnam, which complicates the generalization of these data to other countries.

CONCLUSIONS

This research stated the specific costs of CRS for the first time, which will provide to health professionals with estimates of the economic burden of CRS and illustrate the direct medical cost savings for nations via the implementation of programs to prevent the expansion of CRS (e.g., polluted air, poor hygiene). Generally speaking, the expense for CRS treatment has been increasing; however, OOP payment was paradoxical. The economic burden of CRS was 1.9 million USD by the end of 2017. The direct medical cost of treatment in 2017 was 1176.18 USD per patient and 654.25 USD with insurance coverage. Furthermore, the factors that directly influenced the medical costs were gender, healthcare insurance, and CRS category. The study provides a baseline treatment cost of CRS that can be used by future studies for comparison.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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Contribution	Vo TQ
Concepts or ideas	x
Design	x
Definition of intellectual content	x
Literature search	x
Experimental studies	x
Data acquisition	x
Data analysis	x
Statistical analysis	x
Manuscript preparation	x
Manuscript editing	x
Manuscript review	x

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