

Quantitative sputum cell counts to monitor bronchitis: A qualitative study of physician and patient perspectives

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Many common diseases affecting the airways are characterized by airway inflammation. The measurement of this inflammation has a significant role in the management of these diseases. Quantitative sputum cell counts provide a measurement of the type and severity of inflammation present. Sputum cell counts are used in routine clinical practice in some centres but their use is not widespread. The present study used a standardized questionnaire to determine both patients' and physicians' attitudes toward the use of sputum cell counts. The use of sputum cell counts was well accepted by patients and physicians. Ninety per cent of patients were satisfied with the test. Sixty per cent of family physicians were satisfied with the test and 80% were in favour of it being funded by the government. The authors recommend more widespread use of sputum cell counts to guide the management of airway diseases.

Key Words: Asthma; Bronchitis; Patient satisfaction; Sputum cell counts; Willingness to pay

Airway inflammation is an important component of all diseases of the airways, including asthma, chronic obstructive airway disease, emphysema, bronchiectasis and chronic cough (1,2); however, the importance of inflammation in its treatment is generally not acknowledged in consensus documents (3,4). Methods of measuring airway inflammation, such as exhaled nitric oxide (5) and quantitative sputum cell counts (6-8), have reached clinical practice but are not widely used (9). In contrast to exhaled nitric oxide (10), the use of induced sputum cell counts has been shown to be successful in reducing exacerbations of disease (11,12) and health care costs (12). Despite this, its application has been established in clinical practice in only a few cities in Canada: Quebec City and Montreal (Quebec), Hamilton (Ontario) and Calgary (Alberta) (9). The use of sputum cell counts has received criticism in the literature with the suggestion that the procedure is time consuming and should only be reserved for a specific subset of patients being considered for treatment with antieosinophil therapies such as anti-interleukin-5 (13). Potential reasons for this include the perceived unpleasantness and difficulty of the procedure, and the skepticism related to patient and physician satisfaction. Therefore, we assessed patient satisfaction and strength of satisfaction based on patients' willingness to pay for sputum induction (14), and the acceptability and physician satisfaction with quantitative sputum cell counts and its impact on clinical practice in Canada. The use of patient-reported outcomes is becoming increasingly important – the United States Food and Drug Administration recently released guidelines on the use of patient-reported outcomes in medical product development, which has implications for the conduct of research (15).

La numération cellulaire quantitative dans les expectorations pour surveiller la bronchite : une étude qualitative du point de vue des médecins et des patients

De nombreuses maladies courantes des voies aériennes se caractérisent par une inflammation des voies aériennes. La mesure de cette inflammation joue un rôle important dans la prise en charge de ces maladies. La numération cellulaire dans les expectorations fournit une mesure du type et de la gravité de l'inflammation. Certains centres recourent à la numération cellulaire dans les expectorations en pratique clinique habituelle, mais son utilisation n'est pas généralisée. La présente étude faisait appel à un questionnaire standardisé pour déterminer les attitudes des patients et des médecins à l'égard de son utilisation. Son recours était bien accepté des patients et des médecins. Quarante pour cent des patients étaient satisfaits par le test. Soixante pour cent des médecins de famille l'étaient également, et 80 % étaient d'accord pour qu'il soit financé par le gouvernement. Les auteurs recommandent une utilisation plus généralisée de la numération cellulaire dans les expectorations pour orienter la prise en charge des maladies des voies aériennes.

Patient satisfaction is also now considered to be a quality of care indicator (16,17) and is associated with adherence to medical treatment plans (18). It has recently been recommended that more importance be placed on patient satisfaction in the management of another chronic condition – heart failure (19). Patient satisfaction is likely to receive more emphasis in the management of chronic disease in the future. In addition, if referring physicians consider the test to be useful in the management of their patients, usage will increase. We believe that the information presented in the present article is essential to have sputum cell differential counts widely accepted by both physicians and patients. Once this is achieved, it will increase the likelihood of routine use in clinical practice.

METHODS

Setting

The project was performed at the Firestone Institute for Respiratory Health, a tertiary respiratory centre located in Hamilton.

Assessment of patient satisfaction and willingness to pay for sputum induction

Survey instrument: Patient satisfaction was assessed using a standardized questionnaire. The questionnaire was developed after interviewing patients who had undergone sputum induction and respirologists who referred patients for sputum induction. Information based on a literature review was also included. The hospital research ethics board approved the questionnaire. A research fellow or a pulmonary function technologist administered the questionnaire to patients who

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visited the clinic for routine sputum induction. The purpose of the questionnaire was explained to the patient and written informed consent was obtained. The questionnaire was designed to collect information in three domains including sociodemographic status (eight questions), the convenience of attending the clinic for the sputum test (six questions) and experience with the procedure of sputum induction (eight questions). For most of the questions, the patient was required to circle the most relevant answer and usually completed the questionnaire within 20 min. Overall satisfaction was assessed using a 6-point Likert scale (1 to 6), with lower scores indicating greater satisfaction. The patients' 'willingness to pay' was assessed using a bidding algorithm, after presenting them with data from a previous two-year randomized controlled study (11) to explain the advantages of treating airway disease using induced sputum cell counts compared with current practice and was made clear that the valuation exercise was hypothetical. A sputum induction costs CAD\$250, which includes spirometry during induction, technologist's time, reagents required for processing the sputum sample, professional fee for supervision and interpretation of the report, and laboratory maintenance. Therefore, \$250 was chosen as the initial figure in the willingness-to-pay bidding algorithm. The bidding continued by either increasing or decreasing by 50% until two values that were 20 units apart were reached. The final figure corresponded to the average of the two values.

Study population and sample size: Male and female patients 18 to 82 years of age who had undergone at least one sputum induction participated in the present study. Based on sample size for proportions, to be 95% certain that the true population proportion estimated by the sample was between 40% and 60% (10% CI), 96 interviews would need to be conducted to meet these precision requirements. The 'willingness to pay' was assessed in a subset of patients who underwent at least two sputum inductions.

Assessment of physician satisfaction with quantitative sputum cell counts and the impact on their clinical practice

Survey instrument: The questionnaire was developed on the basis of a literature review and expert opinion. A review of the English literature was conducted using the PubMed database and the following index terms: "satisfaction", "provider satisfaction", "satisfaction questionnaires", "asthma" and "sputum cell counts". The team of respirologists at the Firestone Institute for Respiratory Health (Hamilton, Ontario) assessed the 21-item questionnaire for face validity. The response format, structure, relevance, appropriateness and clarity of each of the questions were evaluated on a scale of 0 (strongly disagree) to 6 (strongly agree). Based on feedback, the items were scaled and reduced to 18 items. The 18 items scoring 5 or 6 by at least 70% of the respondents were selected. Using a 7-point numerical scale, these items were divided into four categories (need for induced sputum, logistics, usefulness and impact) to form the questionnaire.

The questionnaire was mailed to 300 family physicians in the Hamilton-Wentworth (Ontario) region who received a copy of the sputum report from August 2004 to January 2006. With each questionnaire, a cover letter explaining the purpose of the study, ensuring anonymity of the responder and providing instructions on how to respond to the survey, and a stamped postage-paid return envelope was enclosed. Two additional mailings separated by four to five weeks were targeted to recipients who had not responded to the initial survey.

To obtain information from specialists in the field, feedback from specialists in respirology and allergy was also sought. Another questionnaire specific to this group of physicians was mailed to 300 specialists across Canada. A cover letter explaining the purpose of the survey was included. Two additional mailings were sent to individuals who had not responded to the initial survey.

Statistical analysis

Descriptive statistics were used to summarize the items in the questionnaire. Willingness to pay was reported as median (first quartile [Q1], third quartile [Q3]). Regression analysis using a stepwise model was used to examine the relationship between willingness to pay and

demographic variables such as age, marital status, health status, employment, annual income and satisfaction level with sputum induction; $P < 0.05$ was considered to be statistically significant. All statistical analyses were performed using SPSS version 13 (IBM Corporation, USA) for Windows (Microsoft Corporation, USA).

RESULTS

Patient questionnaire

Respondent demographics: A total of 101 patients completed the questionnaire. The mean age of the respondents was 57 years (range 18 to 82 years); 51% were men and 67% were married. The majority of patients had asthma (57%), while the remaining had chronic airflow limitation (27%), bronchiectasis (6%) or chronic cough (4%), and 6% had other diseases such as unexplained breathlessness on exertion, nonobstructive pulmonary disease and peripheral eosinophilia. A diagnosis was not available for two patients. Most of the patients had less than 12 years of formal education (41%), 39% were retired, 30% were in full time employment, 33% had an annual income of between \$20,001 and \$40,000, and 42% self-rated their health status as 'good', while 8% rated their health status as 'poor'.

Satisfaction rating of sputum induction: The majority (71%) of respondents found it convenient to attend the clinic for sputum induction (Table 1) and 90% were satisfied with the test (Table 2). Patients 51 to 82 years of age were significantly more satisfied compared with younger respondents. Sex and health status did not affect satisfaction with sputum cell counts.

Willingness to pay: The willingness to pay was assessed in 82 patients who underwent at least two sputum inductions. The total median (Q1, Q3) amount of money patients were willing to pay for the test was \$125 (\$52, \$300). The patients who were very satisfied (59%) were willing to pay a mean (\pm SD) of $\$217 \pm 200$ while most of the patients (46%) agreed to pay up to \$100 (Figure 1). Respondents with a higher annual income were willing to pay up to \$27 more for sputum induction (95% CI 3.66 to 50.23; $P = 0.024$) compared with individuals with lower annual incomes. Age, marital status, health status, employment and overall satisfaction level with sputum induction did not influence patients' willingness to pay for sputum induction.

Family physician questionnaire

Response rate: A total of 160 (53%) family physicians responded to the questionnaire, 52% after the first mailing, 32% after the second and 16% after the third. Of these, 52 were ineligible. The ineligible family physicians included five who retired from clinical practice; 12 returned the survey but refused to complete it without giving a reason; 13 did not directly refer patients for sputum induction; one was a pediatrician who believed that it was inappropriate to complete the questionnaire; 10 could not recall sending a patient for the test; two believed that the wait time to obtain an appointment was more than one week and, therefore, refused to complete the questionnaire; and nine could not be contacted due to a change in address. The remaining 108 family physicians formed the basis of the present report.

Satisfaction with quantitative sputum cell counts: Items inquiring about the safety and success of sputum induction, time to obtain an appointment for the test, and understanding and valuing the information from the report had mean scores of ≥ 4 in more than 60% of the respondents – an indication of provider satisfaction; however, approximately 50% of the physicians were not satisfied with the delay of more than seven days in receiving the report and would prefer to receive it within three days (Tables 3 and 4).

Impact on clinical practice: More than 60% of the respondents agreed that the test provided them with information that could not be obtained clinically; helped in deciding the best possible treatment for their patients; was a useful procedure in managing airway diseases, especially during exacerbations; and served as a guide to adjust corticosteroid treatment. Overall, family physicians believed that sputum cell counts achieved worthwhile results for their patients and that the procedure should be funded by the Ontario Health Insurance Plan

TABLE 1
Factors related to convenience of reporting for sputum induction

Sputum tests performed per patient*	4 (1 to 100)
Cost of travel to and from the centre*, \$	0 (0 to 45)
Parking charge per visit*, \$	0 (0 to 12)
Convenience of attending the clinic for the sputum test, %	
Convenient to come for the test	71
Previous home arrangement had to be made before coming for the test	28
Timing was unsuitable	1
Loss of income when you report for the test, %	
Always	6
None	86
Occasionally	7
Not in paid employment	1
Timing of the sputum test, %	
Arranged before clinic visit	29
Arranged at the same time of clinic visit	52
Arranged after clinic visit	8
Arranged at the same time or after clinic visit	1
Arranged at the same time or before clinic visit	6
Arranged before or after clinic visit	2
Arranged before, same time or after clinic visit	3

*Data presented as median (minimum to maximum) unless otherwise indicated

(OHIP), a government-run health insurance plan for the residents of Ontario (Tables 3 and 4).

Questionnaire for specialists

Thirty-three specialists (94% respirologists, 3% respirologist and otolaryngologists, and 3% pediatricians) in practice for a mean of 18 ± 9.6 years caring for patients with airway disease ($60 \pm 22\%$) and chronic cough ($28 \pm 26\%$) completed the questionnaire (10% response rate). Of these, 70% and 24% were in hospital and community practice, respectively, while the remaining were practicing in a hospital and in the community. Although 55% of the specialists were aware of the availability of quantitative sputum cell counts, 19% used the service less than once per week, 6% once or twice per week, 3% three to five times per week and 6% more than five times per week.

DISCUSSION

The survey used in the present study demonstrated that the use of quantitative sputum cell counts to guide the management of airway diseases was well accepted by patients and clinicians. Ninety per cent of the patients were satisfied and were willing to pay a total estimated median amount of \$125 for sputum induction. More than 60% of the family physicians were satisfied with the test and more than 80% were in favour of the test being funded by OHIP.

The data were collected from more than 100 patients, 70% of whom had undergone up to 10 sputum inductions, 14% up to 20 and the remaining up to 100 over the past few years. We assessed the willingness to pay in patients who had undergone at least two sputum inductions. By this, we were certain that patients understood the value of the test.

One of the limitations of the present study was the low response rate to the physicians' survey questionnaire. This occurred despite several measures taken to explain the purpose of the study, ensure anonymity and facilitate response to the mailed questionnaire. Other contributing factors could be lack of financial or nonfinancial incentives (20), no telephone call reminders, excessive mailing interfering with busy practice (21), or the mere lack of interest because the patient was referred by the respirologist and not the family physician. We expected a reply from 150 physicians who had received sputum reports for at least two or more patients; therefore, responses from 108 of 150 yielded a high response rate of 71%.

TABLE 2
Experiences of patients undergoing sputum induction

Behaviour of medical staff	
Always courteous	96
Usually courteous	3
Occasionally courteous	1
Explanation of the procedure by the medical staff	
Always explain the procedure	87
Usually explain the procedure	10
Occasionally explain the procedure	3
Symptoms caused by sputum induction	
No increased symptoms	58
Chest tightness	4
Cough	19
Wheeze	3
Shortness of breath	7
Shortness of breath and chest tightness	3
Cough and wheeze	1
Cough and chest tightness	1
Increase in all symptoms	2
Necessity of the procedure	
No (the patient could cough up sputum on his/her own)	15
Yes (the patient could not cough up sputum on his/her own)	85
Taste of hypertonic saline	
Unacceptable	14
Acceptable	86
Test duration	
<45 min	75
1 h	22
>1 h	3
Total time spent in the laboratory	
Unduly long	6
Not unduly long	94
Overall satisfaction on the 6-point Likert scale	
Very satisfied	64
Moderately satisfied	26
Slightly satisfied	10

Data presented as %

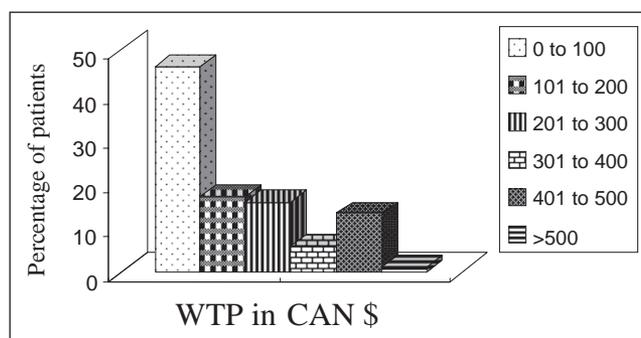


Figure 1 The frequency distribution of the willingness to pay (WTP) for sputum induction. The bars indicate the percentage of patients willing to pay for sputum induction. The values on the x axis are expressed in different ranges. There was only one patient who agreed to pay \$1,000

Other studies have examined physicians' beliefs and prescribing habits, patients' experiences with asthma, doctor-patient communication, satisfaction with asthma medications and interest in new-onset asthma (22), cost effectiveness in occupational asthma (23), perceptions of chronic obstructive pulmonary disease (COPD) severity, quality of life, attitudes about COPD, health insurance barriers to COPD care, sources of information and knowledge about COPD diagnosis and treatment (24). To our knowledge, the present questionnaire-based

TABLE 3
Descriptive statistics of items in the physician satisfaction questionnaire

	Respondents, n	Score		
		Mean ± SD	Minimum	Maximum
Sputum induction is a non invasive usually successful and safe method to assess the type of airway inflammation	108	4.4±1.1	1	6
I am satisfied with the time required to get an appointment for sputum induction	105	3.8±1.4	0	6
I feel my patient understands the need to have a sputum test to assess the type of airway inflammation than not to have one	102	3.6±1.3	0	6
I usually receive the sputum report within 3 to 7 days after the procedure is done	104	3.6±1.5	0	6
I would like to receive the sputum report within a time frame of 3 days	103	3.7±1.7	0	6
I understand the information that I get from this report	107	4.2±1.3	0	6
I value the information that I get from this report	104	4.5±1.2	0	6
The different types of airway inflammation are clear to me after reviewing the sputum reports	107	3.8±1.4	0	6
Sputum induction provides me with information that I am unable to obtain clinically	107	4.1±1.3	0	6
I feel I am achieving worthwhile results through my referral for sputum induction	106	4.1±1.3	0	6
The sputum report usually assists in arriving at the best possible treatment for my patient	106	4.2±1.2	0	6
I can use the results to help establish the minimum dose of corticosteroid required	107	3.8±1.4	0	6
I recognize that the procedure is useful in managing Asthma, COPD and chronic cough	106	4.5±1.1	1	6
I think it is especially useful when the patient is uncontrolled or exacerbated	106	4.6±1.2	1	6
Monitoring of airway inflammation to guide corticosteroid treatment reduces exacerbations and hospitalizations	106	4.5±1.1	1	6
Sputum induction should be a part of routine management for patients with airway disease	105	4±1.4	0	6
This procedure should be funded by the Ontario Health Insurance Plan	102	4.8±1.3	0	6
Percentage of patients with airway disease referred for quantitative sputum cell counts	86	3±1.7	0*	10*

*Values indicate the minimum and maximum percentage of patients referred. COPD Chronic obstructive pulmonary disease

TABLE 4
Frequency distribution of item scores in the questionnaire

	Score						
	0	1	2	3	4	5	6
Sputum induction is a noninvasive usually successful and safe method to assess the type of airway inflammation	0.0	0.9	2.8	15.7	30.6	32.4	17.6
I am satisfied with the time required to get an appointment for sputum induction	4.8	2.9	1.9	25.7	33.3	23.8	7.6
I feel my patient understands the need to have a sputum test to assess the type of airway inflammation than not to have one	3.9	2.9	6.9	26.5	35.3	20.6	3.9
I usually receive the sputum report within 3 to 7 days after the procedure is done.	4.8	2.9	10.6	27.9	20.2	26	7.7
I would like to receive the sputum report within a time frame of 3 days	2.9	9.7	10.7	28.2	9.7	21.4	17.5
I understand the information that I get from this report	1.9	0.9	5.6	15	30.8	32.7	13.1
I value the information that I get from this report	1.0	1.9	3.8	11.5	26.0	35.6	20.2
The different types of airway inflammation are clear to me after reviewing the sputum reports	1.9	3.7	11.2	23.4	29.9	20.6	9.3
Sputum induction provides me with information that I am unable to obtain clinically	1.9	2.8	6.5	16.8	27.1	34.6	10.3
I feel I am achieving worthwhile results through my referral for sputum induction	3.8	0.9	2.8	14.2	36.8	31.1	10.4
The sputum report usually assists in arriving at the best possible treatment for my patient	1.9	0.0	6.6	13.2	37.7	31.1	9.4
I can use the results to help establish the minimum dose of corticosteroid required	0.9	6.5	9.3	21.5	30.8	20.6	10.3
I recognize that the procedure is useful in managing asthma, COPD and chronic cough	0.0	0.9	4.7	10.4	35.8	27.4	20.8
I think it is especially useful when the patient is uncontrolled or exacerbated	0.0	1.9	2.8	12.3	24.5	31.1	27.4
Monitoring of airway inflammation to guide corticosteroid treatment reduces exacerbations and hospitalizations	0.0	0.9	1.9	12.3	34	31.1	19.8
Sputum induction should be a part of routine management for patients with airway disease	1.0	3.8	7.6	26.7	23.8	21	16.2
This procedure should be funded by the Ontario Health Insurance Plan	2.0	0.0	2	11.8	17.6	26.5	40.2

The table reports the percentage of physicians achieving scores of 0 to 6. COPD Chronic obstructive pulmonary disease

survey was the first to assesses patient and physician satisfaction with quantitative sputum cell counts.

The OHIP covers \$79.35 (technical component \$49, professional component \$30.35) for sputum induction, while the remaining is from hospital laboratory funds (\$20.80) and research funds. However, the Ontario Medical Association (OMA) recommends that OHIP pay \$150 for sputum induction. Given that 90% of the respondents were willing to pay \$125, the OMA is justified in the latter recommendation. The OMA tariff committee is awaiting approval by the Ministry of Health and Long-Term Care. British Columbia has a billing code. Quebec and

Alberta do not have a provincial billing code, but there is a local funding plan for the University of Laval (Quebec City, Quebec) and the University of Calgary (Calgary, Alberta). Eleven respondents were not willing to pay for sputum induction, although 46% were very satisfied with the test. The reasoning behind this requires further prospective evaluation. It may partly be due to limitations of the 'willingness to pay' tool. Although it is well validated (25), questions may be misunderstood and responses may be modified according to financial status.

The results from the family physician survey questionnaire revealed an overall sense of satisfaction with sputum induction and enabled the

identification of certain areas of dissatisfaction. While the referring respirologist received the result within 24 h, family physicians were dissatisfied with the delay of more than seven days to receive the report by mail. Because the family physician does not refer the patient directly for sputum cell counts, this delay does not affect the treatment of the patient; however, we are working on improving the efficiency of the program toward simplifying and automating the test so that a physician outside of our hospital can also receive the report within 24 h, which is crucial to adjust treatment, especially during an exacerbation. The other issues can be addressed by ensuring that clear clinical advice based on the sputum cell count is included in the report sent to the physicians.

Although the cell counts provide an accurate assessment of cellular bronchitis, it is not available as a point-of-contact test that enables physicians to make adjustments to treatments at the time of a patient's clinic visit. Although this is not a major limitation, it is widely perceived as a drawback. A more reasonable limitation is the difficulty in establishing a laboratory that is capable of performing this test. Although cell counts can be performed in a any core laboratory that is staffed by medical laboratory technologists trained in cellular morphology, similar to any other laboratory procedure, this requires regular quality control and training. Another major reason that the test is not widely used, at least in Canada, is the lack of a fee reimbursement system to compensate for the provision of a clinical service.

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The use of quantitative sputum cell counts to guide treatment in airway disease is more effective (11) and less costly than traditional management using symptoms and spirometry (12), causes minimal discomfort to the patient and is, therefore, acceptable to patients. This is particularly important when repeat testing is required to monitor disease. Physicians also revealed an overall sense of satisfaction with the use of the test in clinical practice, providing they could receive the result more promptly and were in favour of the test being funded by OHIP. Now that billing codes are available, the procedure is feasible, practical and available in Quebec City, Montreal, Hamilton and Calgary, and it is time to implement quantitative sputum cell counts into routine clinical practice in all centres managing patients with airways disease.

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