Spirometry utilization in Ontario: practice patterns and policy implications

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Abstract

Objective: To describe growth and regional variation in the use of spirometry (flow studies) in Ontario.

Design: Retrospective analysis of Ontario Health Insurance Plan (OHIP) fee-for-service billing data for spirometry from the 1989–90 to 1994–95 fiscal years.

Setting: Physicians' office practices in Ontario.

Outcome measures: Number of flow studies and associated expenditures, number and specialty of physicians performing flow studies and the distribution of their billings, number of studies per capita by age group of patients, expenditures by region and measures of variation among regions.

Results: In 1994–95, $14.13 million was spent on flow studies in Ontario. This expenditure increased by 36.9% from 1989–90 to 1994–95, exceeding the overall growth rate of 20.8% for all expenditures under OHIP. Expenditure growth was driven by an increase in the number of physicians performing spirometry rather than a higher volume of services performed per physician. The substitution of flow–volume loops, for which the fee is higher, for simple spirograms also contributed to expenditure growth. There were wide regional variations in spirometry utilization. A small number of general practitioners and family physicians accounted for much of the regional variation.

Conclusions: The rapid growth in spirometry utilization may stem from the diffusion of inexpensive spirometers in physicians' offices and from increased awareness of guidelines promoting the use of flow measurements. However, the wide regional variation in utilization may indicate either incomplete implementation of spirometry guidelines or lack of direction on the appropriate frequency of spirometry use. Clearer, evidence-based guidelines and an implementation strategy are needed. Also required is further study of possible inadequate access to spirometry in low-use regions and inappropriate use in high-use regions, where spirometry use is concentrated among a small number of physicians.

Résumé

Objectif : Décrire la croissance de l'utilisation de la spirométrie en Ontario et les variations entre les régions.

Conception : Analyse rétrospective des données du Régime d'assurance-maladie de l'Ontario (RAMO) sur la rémunération à l'acte dans le cas de la spirométrie, pour les exercices 1989–1990 à 1994–1995.

Contexte : Cabinets de médecins de l'Ontario.

Mesures des résultats : Nombre de tests de spirométrie et dépenses consacrées à ces tests, nombre et spécialité des médecins qui ont procédé à des tests de spirométrie et répartition de leur facturation, nombre de tests par habitant par groupe d'âge de patients, dépenses par région et mesures de la variation entre les régions.

Résultats : En 1994–1995, on a consacré 14,13 millions de dollars aux tests de spirométrie en Ontario. Cette dépense a augmenté de 36,9 % de 1989–1990 à 1994–1995, ce qui est supérieur au taux de croissance global de toutes les

Evidence

Études

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dépenses du RAMO, qui ont grimpé de 20,8 %. La croissance des dépenses a été propulsée par une augmentation du nombre de médecins qui ont effectué des tests de spirométrie plutôt que par l'augmentation du volume des services rendus par médecin. Le remplacement des spirogrammes simples par des tests à boucle débit–volume qui entraînent le paiement d'honoraires plus élevés a aussi contribué à l'augmentation des dépenses. L'utilisation de la spirométrie a varié considérablement entre les régions. Un petit nombre d'omnipraticiens et de médecins de famille sont à l'origine de la majeure partie de la variation entre les régions.

Conclusion : La croissance rapide de l'utilisation de la spirométrie peut découler de la diffusion de spiromètres peu coûteux dans les cabinets de médecins et d'une plus grande connaissance de guides qui préconisent l'utilisation de mesures de débit. L'importante variation de l'utilisation entre les régions peut toutefois indiquer soit une mise en oeuvre incomplète des guides sur la spirométrie, soit un manque d'orientation quant à la fréquence appropriée du recours à la spirométrie. Des guides plus clairs fondés sur des données probantes et une stratégie de mise en oeuvre s'imposent. Il faut aussi pousser plus loin l'étude sur la possibilité d'un accès insuffisant à la spirométrie dans les régions à faible utilisation et de l'utilisation indue dans les régions à forte utilisation, où l'utilisation de la spirométrie est concentrée chez un petit nombre de médecins.

Of the many factors shaping modern medical care, clinical practice guidelines[1] and new technologies[2] are of particular interest to researchers and policy-makers. Guidelines provide a mechanism for defining evidence-based care and have become a focus of quality-assurance and cost-containment initiatives. Although producing guidelines may be necessary to promote consistent clinical decision-making, guideline dissemination alone is often not enough to change practice.[3] Differences in clinical decision-making are the main driving force behind regional variations in utilization. Analysis of regional variation in the utilization of carotid endarterectomy has shown that variation may result from the practice patterns of a limited number of high-volume providers.[4] Therefore, targeting these physicians in guideline implementation may reduce regional variation.

There has been considerable interest in the diffusion of resource-intensive, institution-based technologies such as surgical procedures[5] and imaging.[6] However, there has been less interest in the diffusion of office-based technologies, which require smaller capital investments but have important consequences for overall health care costs. Studies of new technologies suggest that their utilization is limited to a small number of providers and is shaped by both clinical and economic factors.[7]

This article examines trends in the use of spirometry (also called "pulmonary flow studies") in Ontario from the 1989–90 to 1994–95 fiscal years. Flow studies measure rates of flow and certain lung volume measures, such as vital capacity; they are part of the family of pulmonary function tests (PFTs), which includes lung-volume studies, tests of diffusing capacity, oxygenation studies and exercise tests.[8] Flow studies are classified into spirograms and flow–volume (FV) loops. Spirograms record expired volume over time, whereas FV loops provide additional dynamic information on flows at different phases of inspired and expired volumes. FV loops are particularly useful in diagnosing certain forms of upper airway obstruction, an uncommon condition, as well as small airways obstruction,[9] and may also provide additional information on the adequacy of patient effort during the study.

Clinical, technological and economic factors may have affected spirometry utilization. Many guidelines for asthma management[10–12] published during the study period emphasized the importance of periodic quantitative airway flow measurements. These guidelines coincided with a period of increased concern about mortality and morbidity caused by asthma in North America.[13] A major technologic advance in the late 1980s was the advent of inexpensive, portable spirometers suitable for use in physicians' offices. The decreasing cost of spirometers was not, however, accompanied by a lowering of the fees for performing flow studies. Furthermore, the OHIP fee schedule remunerates FV loops at a rate almost twice that for spirograms ($31.90 and $16.20, respectively, in 1994–95). The capability of the new portable spirometers to do FV loops and higher fees for FV loops may have led to an increased preference for this test and increased expenditure growth.

We hypothesized that there was a rapid diffusion and increased utilization of spirometric devices between the 1989–90 and 1994–95 fiscal years and that there were

large regional variations in spirometry use. We further hypothesized that much of the variation was attributable to a small number of high-volume providers. Our study is descriptive and cannot determine the causes of utilization and variation. Nevertheless, we suspected that there was rapid growth in utilization, given the guidelines supporting the use of flow studies and the economic incentives encouraging their diffusion. We also suspected that there were persistent regional variations, given that the publication of the guidelines was not accompanied by a comprehensive, coordinated strategy to implement them in Ontario.

Methods

We examined Ontario Health Insurance Plan (OHIP) data from the National Physician Database (NPDB) maintained by the Canadian Institute for Health Information. For each fee code, the number and value of services provided to Ontario residents are recorded in the database by the age and sex of the patient. For each physician, the registered postal code, specialty, and number of services and amount billed for each fee code per quarter are also recorded. Certified family physicians and general practitioners are grouped together. Medical subspecialists are not required to distinguish themselves from general internists; hence, we grouped internists and respirologists together for this study.

OHIP remunerates all flow studies conducted on an outpatient basis except those performed by the 5% of physicians practising outside the fee-for-service system (Paul Brochu, Ministry of Health, Toronto, Ont.: personal communication, 1995). Inpatient hospital services are remunerated through hospital global budgets and were therefore excluded, as were services received out of province.

The data do not include retroactive payments of approximately 2% of total claims from 1989–90 to 1991–92 or the $16 million in 1993–94 and $178 million in 1994–95 recovered from physicians for billings higher than a negotiated ceiling. The data also exclude reductions in payments to physicians who billed above a certain threshold ($402 000 in 1994–95), which represented less than 1% of total OHIP billings. For each test performed, OHIP provides a technical fee to cover a technician's time and a portion of equipment costs as well as a professional fee to reimburse the physician for interpreting the results.

To calculate the billings by region, we used the physician's postal code. Because the database contained information on the physician rather than the patient, it was impossible to determine whether patients received all of their care in a particular area or whether there were a significant number of referrals outside of the area. To minimize the error associated with crossregional referral, we assigned physicians to 1 of 6 large planning regions used by the Ontario Ministry of Health. For general practitioners and family physicians (GP/FPs), for whom this referral error was less problematic, we used the smaller region served by each district health council (DHC) as the unit of analysis. The systematic component of variation (SCV) was used to measure changes in variation over time.[14]

The NPDB provides age- and sex-specific utilization data for the whole province, but not for specific regions. It was therefore impossible to calculate standardized regional rates directly. Indirect standardization, however, was possible with the use of data from the Canadian census on age- and sex-specific populations in each region.

Results

Growth in overall utilization and billings

In 1994–95 Ontario physicians billed OHIP for 462 846 flow studies, amounting to $14.13 million in claims or 0.32% of total OHIP billings (Table 1). Total billings for flow studies rose by 36.9% from 1989–90 to 1994–95, compared with a 20.8% growth rate for total OHIP billings during the same period. All of the growth in billings for flow studies occurred in the first 3 years of the study period. Billings for flow studies and total OHIP billings peaked in 1992–93, declined in 1993–94 and in-

Table 1: Flow-study utilization for the 1989–90 to 1994–95 fiscal years

Fiscal year	No. of studies performed	% that were flow–volume loops	Billings for studies, $ million	No. of physicians who billed for studies
1989–90	353 217	75.8	10.32	1300
1990–91	424 275	77.5	12.43	1464
1991–92	469 271	81.0	13.67	1691
1992–93	480 335	82.4	14.39	1780
1993–94	465 125	84.3	13.78	1912
1994–95	462 846	84.8	14.13	1858

creased in 1994–95, although not enough to reach the level in 1992–93.

Table 2 compares the rates of growth in billings, price-adjusted billings, the overall number of tests, the number of tests per capita and the number of tests per capita adjusted for age and sex. This table shows the relative effect of price changes, substitution from spirograms to more expensive FV loops, population growth and population aging on the growth in billings. Population growth and substitution from spirograms to FV loops made important contributions to the growth in billings. However, even after controlling for all of these factors, we found that the volume of flow studies increased by 19.6% during the study period.

Distribution of physicians who performed tests

We calculated the number of physicians in each major specialty group who submitted claims for flow studies. We excluded physicians who billed for fewer than 12 tests per year or less than $35 000 overall for the purposes of calculation. Physicians thus excluded accounted for 1.5% of total billings.

The number of physicians who billed for flow studies rose from 1300 in 1989–90 to 1858 in 1994–95, an increase of 42.9% (Table 1). In 1994–95, 70.1% of these physicians were GP/FPs (Table 3). Internists/respirologists, however, billed for flow studies more often than GP/FPs and accounted for 55.4% of total billings. Overall billings for each specialty group increased during the study period (Table 3). There was no increase in the median number of flow studies per physician who billed for such studies in each specialty group; in the case of pediatricians, the median fell during the study period.

Billings for flow studies were distributed unevenly among physicians. When GP/FPs were ranked according to their 1994–95 billings, the 7.0% with the highest billings accounted for 40% of total billings by GP/FPs. This percentage had increased slightly during the study period (from 5.8% in 1989–90), suggesting that the unevenness in the distribution of billings had decreased. We examined the possibility that these high-volume GP/FPs were essentially operating as respirologists in PFT laboratories. However, out of the 91 high-volume GP/FPs, only 3 had billed for PFTs more sophisticated than flow studies.

Patient age and sex profiles

Elderly people (those older than 65 years) made up 12.0% of the population in 1994 but accounted for 22.8% of flow studies in 1994–95. The testing rate was highest among patients 70 to 74 years of age. However, the percentage increase in tests per capita from 1989–90 to 1994–95 was highest among children and adolescents (from birth to 19 years of age, Fig. 1). The age-adjusted per capita rate of flow studies among girls and women

Table 2: Crude and adjusted rates of growth in billings for flow studies in Ontario, 1989–90 to 1994–95

Utilization measure	Growth, %	Factor affecting billings	Billing growth attributable to factor, %
Total billings	36.9	Price change	–0.5
Price-adjusted billings	37.6	Substitution from spirograms to flow–volume loops	5.0
Price-substitution-adjusted billings	31.0	Population growth	7.7
Per capita price-substitution-adjusted billings	21.7	Population aging	1.7
Age-, sex- and price-substitution-adjusted billings	19.6	Flow-study utilization (independent of above)	19.6

Table 3: Changes in distribution of physicians performing flow studies

	No. of physicians who submitted claims for studies		Median no. of studies per billing physician		Total expenditures accounted for by specialty,%		Expenditure growth rate from 1989–90 to 1994–95, %
Specialist	1989–90	1994–95	1989–90	1994–95	1989–90	1994–95	
GP/FP	886	1303	51	46	30.4	30.7	38.1
Internist/ respirologist	326	384	296	293	58.9	55.4	28.7
Pediatrician	60	105	316	149	9.4	11.2	62.3

was 0.044, slightly higher than the rate among boys and men (0.041).

Geographic distribution of physicians who performed tests

There was large regional variation in OHIP expenditures for flow studies. The Central East region had the highest crude expenditure rate ($1221 per 1000 population in 1989–90), 3.5 times greater than the Northeast region ($308 per 1000 population in 1989–90, Table 4). Geographical variations were stable over time (SCV 148 in 1989–90 and 149 in 1994–95). Indirect age and sex standardization produced a similar level of variation (the high-to-low-rate ratio was 3.6).

Geographic variations were greater when only GP/FPs were considered. The crude expenditure rate among GP/FPs in Metropolitan Toronto in 1994–95 was $725 per 1000 population, whereas 10 DHC regions had rates of less than $100 per 1000 population. The provincial mean was $382. There was wide variation even among DHC regions with major teaching centres. The regions of Thames Valley and of Kingston, Frontenac, Lennox and Addington had GP/FP billings of $62 and $39 per 1000 population, respectively, in contrast to the high rate for Metropolitan Toronto.

Much of the variation was attributable to the 91 GP/FPs who accounted for 40% of the total GP/FP billings for flow studies in 1994–95 (Fig. 2). More than half of these high-volume physicians were located in Metropolitan Toronto and another quarter in DHC regions near Toronto (Hamilton–Wentworth, Peel, York and Durham). Among GP/FPs, the amount of variation decreased between 1989–90 and 1992–93 (SCV 738 in 1989–90 v. 385 in 1992–93). From 1992–93 to 1994–95, however, the amount of variation remained stable (SCV 384 in 1994–95).

Discussion

Between 1989–90 and 1992–93 the number of flow studies billed to OHIP increased by 36%, and expendi-

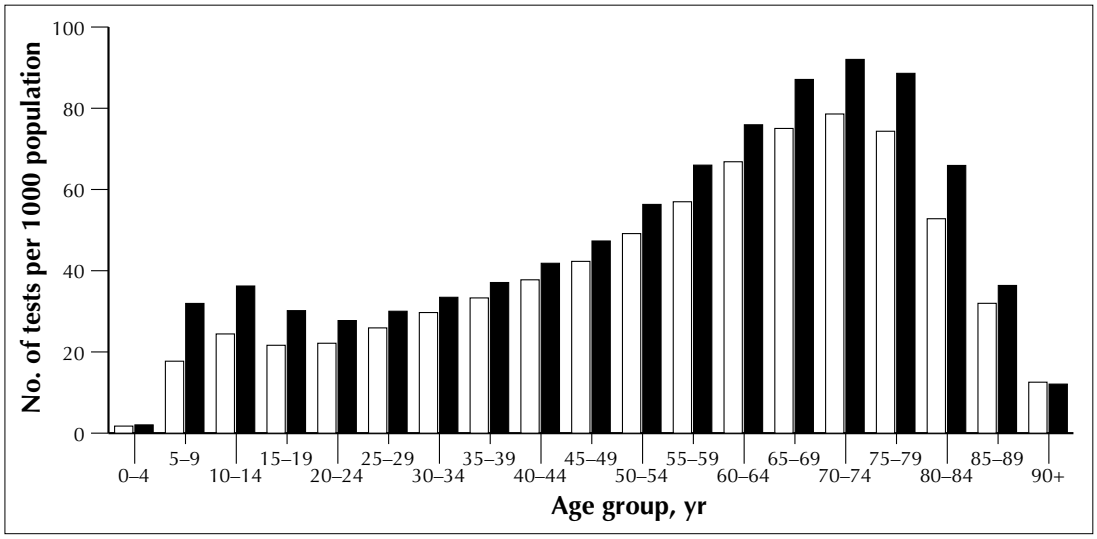

Fig. 1: Rate of flow studies performed in the population of Ontario by age group in the 1989–90 fiscal year (white bars) and the 1994–95 fiscal year (black bars).

Table 4: Rates of flow-study utilization in 6 Ontario regions

Region	Crude expenditure rate per 1000 population, $		Change in crude expenditure rate, 1989–90 to 1994–95, %	Indirect age- and sex-standardized utilization ratio, 1994–95
	1989–90	1994–95		
Central East	1221	1568	28.5	1.23
Eastern	900	990	10.0	0.76
Central West	1133	1454	28.3	1.12
Southwest	685	831	21.3	0.64
Northeast	308	446	44.8	0.34
Northwest	525	687	30.9	0.54

tures on these tests increased by 39%. Population growth and aging accounted for some of the increase, but the major factor was an increase in per capita utilization. This finding indicates a rapid shift in clinical practice. Utilization may have been affected by clinical factors such as reports of increased morbidity caused by asthma,[13] recent dissemination of practice guidelines[10–12] and publication of articles suggesting that spirometry is more sensitive than clinical assessment in evaluation of flow abnormalities.[15,16] The increasing trend from inpatient to outpatient testing may also have contributed to an apparent growth in the use of flow studies, since inpatient services are not remunerated through OHIP and do not appear in our data. Our analysis lacks the clinical detail required to determine the specific clinical factors behind this shift in practice. However, there was increased use of flow studies for younger patients, among whom asthma is most prevalent.

Utilization growth was driven by a rise in the number of physicians billing for tests, rather than in the number of tests billed per physician. This result is consistent with the rapid diffusion of new office-based spirometers. According to estimates from 3 Ontario suppliers, closed-circuit dry spirometers traditionally used by laboratories cost approximately $10 000, whereas the new portable units cost $2850 to $4000. The lower equipment cost, without a concomitant decrease in OHIP remuneration, may have contributed to the widespread diffusion of spirometers.

The increasing reliance on FV loops rather than spirograms contributed to expenditure growth. This reliance may have been driven, in part, by economic factors. The marginal cost of performing an FV loop rather than a spirogram is small, but the fee for an FV loop is about twice that for a spirogram. We conducted a search of MEDLINE and consulted the *Directory of Clinical Practice*

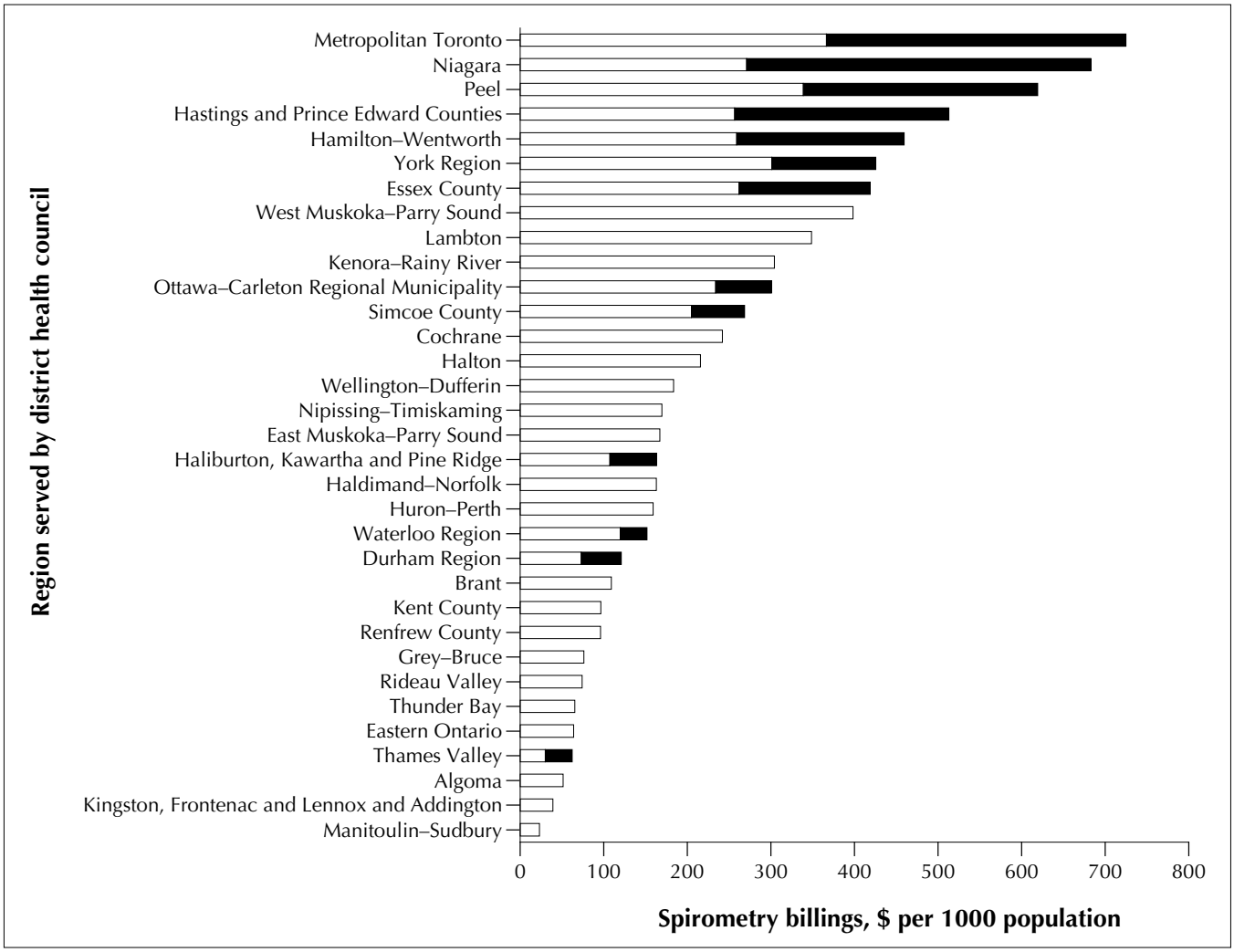

Fig. 2: Rate of billings for spirometry by low-billing GP/FPs (white portion of bars) and by high-billing GP/FPs (the 7% of GP/FPs who billed the most for spirometry, black portion of bars) in 1994–95. The high-billing physicians accounted for 40% of expenditures on flow studies.

Guidelines[1] and commonly cited guidelines;[10–12] however, we could not identify any specific recommendations advocating FV loops over spirograms in common clinical situations. In fact, in many clinical situations, peak expiratory flow rate (PEFR) meters provide an effective, inexpensive and convenient way to monitor flow abnormalities once the diagnosis has been confirmed by a flow study.[10] Reusable PEFR meters are inexpensive (equivalent to the cost of 1 FV loop); however, their use is not covered by OHIP.

Although the publication of asthma management guidelines[10–12] coincided with some reduction in regional variation in spirometry utilization, large variations persist. A small percentage of physicians accounted for a large percentage of total billings and much of the variation. Most of these physicians were located near Toronto, in regions with the highest supply of primary care physicians and the highest utilization of specialist services.[17] Hence, most high-volume billers were not practising in relatively underserviced regions.

Geographic variation due largely to a small number of high-volume physicians has been observed in other studies.[4] The reasons for variation may include underutilization of a service in the low-rate areas or overutilization in the high-rate areas. Both of these hypotheses deserve further study. In regions with low physician supply, physicians may be too busy to perform flow studies in the office setting, and full PFT laboratories may be available only in more distant specialized facilities. In high-use areas, overutilization may be difficult to define, given the lack of guidelines on the frequency of and indications for tests. However, it would be useful to ascertain whether physicians were performing flow studies repeatedly among the same patients or among a wide variety of patients and whether these physicians had a high proportion of patients with asthma. Future studies of the appropriateness of spirometry utilization could include physician surveys and random practice audits, which could involve both high- and low-volume physicians.

Although spirometry use increased rapidly between 1989–90 and 1992–93, there was a slight decrease in use from 1992–93 to 1994–95, which mirrored a decrease in overall OHIP fee-for-service billings during the same period.[18] At that time, physicians were under considerable pressure to keep total OHIP expenditures below a fixed ceiling, thereby avoiding retroactive adjustments to billings. The dynamics of the political environment were complex.[17] Interestingly, utilization growth halted in both high- and low-utilization areas during this 2-year period, and regional variations remained constant. With minor exceptions, the expenditure-control policies were applied uniformly in the province, with clawbacks applied to physicians regardless of regional population needs. The desirability of creating incentives for selective utilization control in high-use areas will be the subject of intense future debate.

Conclusions

Sophisticated diagnostic technologies once limited to specialized settings are becoming increasingly affordable and available in many physicians' offices. Our analysis of spirometry utilization suggests that such technologies can diffuse rapidly and generate substantial costs. Although technology diffusion may improve access to and quality of care, policy-makers should be aware that economic incentives can influence the use of these technologies. Quality of care will improve only if these technologies are used in a manner consistent with evidenced-based clinical practice guidelines.

This study shows rapid growth and persistent geographic variation in spirometry use. Two hypotheses deserve further research: first, that patients in low-rate areas have inadequate access to these tests; and, second, that there is inappropriate use in high-rate areas. The variations highlight the need for clearer, evidence-based practice guidelines that define the indications for spirometry and recommend how often it should be performed and when peak expiratory flow rates can be cost-effectively substituted. The guideline development process should include a comprehensive strategy for implementation.[19]

Clearer guidelines could serve as the gold standard to aid all physicians in determining whether they are practising high-quality, cost-effective medicine. However, given the high concentration of flow studies performed by a small number of GP/FPs, it may be prudent for policymakers to ensure that these high-volume users, in particular, are practising according to guidelines. Conversely, the high cost of hospital admissions and emergency visits due to inadequate management of respiratory disease makes it imperative to investigate whether patients in low-use areas have sufficient access to spirometry.

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