

Chapter 15: Pharmacological treatment of congestive heart failure in Canada: A description of care in five provinces

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INTRODUCTION: Congestive heart failure (CHF) is responsible for significant morbidity, mortality and health resource consumption. There have been major advances in the treatment of this condition over the past two decades, yet little information is currently available regarding the current status of CHF management in Canada.

OBJECTIVE: To describe the pharmacological management of patients hospitalized with CHF in five provinces: Alberta, British Columbia, Nova Scotia, Ontario and Quebec.

DESIGN AND METHODS: Administrative data sources were used to identify all consecutive patients hospitalized with a principal diagnosis of CHF and discharged alive in the provinces of Alberta, British Columbia, Quebec and Ontario. Rates of use of prespecified medications at 30 days after hospital discharge were obtained for patients 65 years of age and older by linkage of their hospital records with drug benefit plans in these provinces. For Nova Scotia, the disease-specific registry of the Improving Cardiovascular Outcomes in Nova Scotia (ICONS) study was used to obtain discharge medications of individuals consecutively hospitalized with a diagnosis of CHF. Where available, data were acquired from 1997 to 2002.

RESULTS: Data were obtained for a total of 115,037 patients in the five provinces over the five-year period. Overall, 54.9% of patients received an angiotensin-converting enzyme inhibitor at or 30 days after hospital discharge, with minimal change in prescription rates over the five-year period. Beta-blocker prescription rates increased steadily during the study, more than doubling from 15.0% in 1997/1998 to 32.0% in 2001/2002. Spironolactone use increased dramatically, with only 2.2% of patients receiving this medication in 1997/1998 compared with 18.7% in 2001/2002. The rates of digoxin prescription decreased each year, while the use of angiotensin receptor blockers increased slightly throughout the observation period.

CONCLUSIONS: While the use of evidence-based treatment for CHF in Canada is increasing and is currently at levels similar to those reported in other developed countries, there is still the potential in every province for further improvement.

Key Words: Congestive heart failure; Drug use; Quality of care

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Le traitement pharmacologique de l'insuffisance cardiaque congestive au Canada : Une description des soins dans cinq provinces

INTRODUCTION : L'insuffisance cardiaque congestive (ICC) est responsable d'une morbidité, d'une mortalité et d'une consommation de ressources de santé significatives. Des progrès marqués ont été réalisés dans le traitement de cette maladie depuis vingt ans, mais on possède peu d'information sur l'état actuel de la prise en charge de l'ICC au Canada.

OBJECTIF : Décrire la prise en charge pharmacologique de patients hospitalisés par suite d'une ICC dans cinq provinces : l'Alberta, la Colombie-Britannique, la Nouvelle-Écosse, l'Ontario et le Québec.

MÉTHODOLOGIE : Des sources de données administratives ont été utilisées pour repérer tous les patients consécutifs hospitalisés pour un diagnostic principal d'ICC et encore vivants à leur congé dans les provinces de l'Alberta, de la Colombie-Britannique, du Québec et de l'Ontario. Les taux d'usage de médicaments préétablis le 30^e jour suivant le congé de l'hôpital ont été obtenus pour les patients de 60 ans ou plus en reliant le dossier hospitalier au régime d'assurance-médicaments de ces provinces. En Nouvelle-Écosse, le registre propre aux maladies de l'étude ICONS (sur les issues cardiovasculaires allant en s'améliorant) a été utilisé pour déterminer les médicaments pris au congé par des personnes hospitalisées consécutivement avec un diagnostic d'ICC. Lorsqu'elles étaient disponibles, les données ont été colligées entre 1997 et 2002.

RÉSULTATS : Des données ont été obtenues à l'égard de 115 037 patients des cinq provinces au cours de la période de cinq ans. Dans l'ensemble, 54,9 % des patients prenaient un inhibiteur de l'enzyme de conversion de l'angiotensine au congé hospitalier ou le 30^e jour suivant; ils ont subi des modifications minimales de leurs taux de prescription pendant la période de cinq ans. Les taux de prescription de bêta-bloquants ont augmenté régulièrement tout au long de l'étude. En effet, ils ont plus que doublé, passant de 15,0 % en 1997-1998 à 32,0 % en 2001-2002. Le recours à la spironolactone a augmenté de manière remarquable, seulement 2,2 % des patients en prenant en 1997-1998, par rapport à 18,7 % en 2001-2002. Les taux de prescription de digoxine ont diminué chaque année, tandis que le recours aux antagonistes des récepteurs de l'angiotensine a légèrement augmenté pendant la période d'observation.

CONCLUSIONS : Bien que le recours à des traitements contre l'ICC fondés sur des faits probants augmente au Canada et qu'il atteigne des taux similaires à ceux déclarés dans les autres pays industrialisés, il y a place à l'amélioration dans chacune des provinces.

Congestive heart failure (CHF) is a growing health care burden that is associated with substantial morbidity, mortality and health care costs (1-4). A recent study from Framingham (5) suggests that the lifetime risk of developing CHF is approximately 20% for both men and women. Once CHF is diagnosed, the median survival with CHF is 1.7 years for men and 3.2 years for women (5). In light of these statistics, it is of particular concern that CHF is the one cardiovascular disorder whose incidence is clearly increasing (6). Between 1979 and 1988, CHF deaths increased by 135%, while hospital discharges increased by more than 2.5-fold in the United States (7). Several recent publications (8-12) have shown that the burden is also high in Canada.

CHF is becoming increasingly prevalent for several reasons. Success in treating more acute cardiovascular diseases, such as myocardial infarction, has resulted in larger numbers of patients surviving to develop chronic conditions, such as CHF (13). Another contributing factor is that people are experiencing greater longevity and are thereby becoming more susceptible to age-related afflictions, including CHF. Indeed, population-based studies (10,14) have found that the majority of patients hospitalized with CHF are over 65 years of age. Thus, even if the incidence of CHF is static (15) or possibly decreasing (16), the aging population will lead to an increasing prevalence of this condition in the future.

However, there have been dramatic advances in the pharmacological treatment of CHF over the past two decades. Currently, ideal management of CHF, as recommended by recent clinical guidelines (17,18), involves therapy with multiple drugs. Angiotensin-converting enzyme (ACE) inhibitors and beta-blockers have been shown to decrease mortality and morbidity in patients with CHF (19-26), and digoxin decreases rehospitalization of these patients (27). Those with more severe symptoms who have the diuretic spironolactone added to their regimen have also been shown to have a reduction in mortality (28). Other drugs that may provide further clinical benefits include warfarin and loop diuretics. For patients whose CHF resulted from ischemic heart disease, additional drugs might include acetylsalicylic acid, 3-hydroxy-3-methylglutaryl coenzyme A reductase inhibitors (ie, statins) and nitrates. Thus, a patient with CHF might require up to eight or more cardiovascular drugs, independent of any additional treatments for other comorbid conditions.

Notwithstanding the importance of CHF, the availability of efficacious treatments and the promulgation of national consensus guidelines that outline ideal management (17,18), little information is available regarding the current status of acute and chronic CHF management in Canada. The few studies that exist (29-31) describe the practice from almost a decade ago or focus only on ACE inhibitor use. Accordingly, our objective in the present study was to examine and compare the contemporary process of pharmacological care relating to CHF across several provinces in Canada. While we recognize the increasing importance of other aspects of CHF therapy, including device therapy and CHF clinics, they are beyond the scope of the present work.

METHODS

Study population and data collection process

The methods used to create the study cohorts were similar in Quebec, Ontario, Alberta and British Columbia, while different data sources were used in Nova Scotia. Patients admitted in

Quebec with a most responsible discharge diagnosis of CHF (*International Classification of Diseases, 9th Revision* [ICD-9] [32] code 428) between April 1, 1997, and March 1, 2001, were identified in the Maintenance et Exploitation des Données pour l'Étude de la Clientèle Hospitalière database. The Canadian Institute for Health Information database was used to identify patients admitted with this diagnosis in Ontario and Alberta, and data were available for fiscal years 1997/1998 to 2001/2002. Patients hospitalized with CHF (ICD-9 code 428) in British Columbia were identified from the British Columbia hospitalization database, with data available for fiscal years 1997/1998 to 2000/2001. The Improving Cardiovascular Outcomes in Nova Scotia (ICONS) registry (33) was used to create a comparable cohort of elderly patients with CHF admitted in Nova Scotia, with data available from the start of that project on October 15, 1997, through to the end of the 2001/2002 fiscal year. All residents of Nova Scotia hospitalized with a clinical diagnosis of CHF (comparable with ICD-9 code 428) are included in the ICONS registry. All provincial cohorts excluded individuals younger than 65 years of age or older than 105 years of age, nonresidents of the respective provinces and transfers from another acute care hospital to avoid double counting of patients.

Using unique, encrypted health card numbers, the data for each cohort from Quebec, Ontario, Alberta and British Columbia were linked with the drug claims database in the respective province. The databases included la Régie de l'assurance maladie du Québec, the Ontario Drug Benefit Program, the British Columbia PharmaCare Plan, and the Alberta Health and Wellness Drug Benefit Plan. These databases contain information on all outpatient prescriptions filled for all elderly (aged 65 years and over) individuals who are enrolled in their respective provincial drug plans, amounting to approximately 97% of elderly individuals in Quebec and virtually 100% in Ontario, Alberta and British Columbia. Thus, the analyses in the present study were restricted to the subset of patients who were 65 years of age and older at the time of admission, and who survived their initial hospitalization for CHF. Because CHF is generally a highly symptomatic disease, it was postulated that a 30-day window following hospital discharge was a reasonable amount of time for such therapy to have been initiated and the relevant prescriptions filled. For patients hospitalized in Nova Scotia, the only available drug information concerned medications prescribed at discharge rather than prescriptions actually filled. Thus, drug use rates reflect prescriptions reimbursed through a provincial drug benefit program at 30 days in Ontario, Quebec, Alberta and British Columbia, and medications prescribed at discharge in Nova Scotia.

The specific drug classes analyzed were beta-blockers, ACE inhibitors and angiotensin receptor blockers (ARBs), and the specific drugs analyzed were digoxin and spironolactone. The selection of these drugs was directed by the results of a recent Canadian consensus panel that determined that these medications represented indicators of the quality of care for patients with CHF (34).

Data presentation

Annual rates of drug use for CHF were calculated by province to illustrate the changing temporal and provincial trends in CHF pharmacotherapy over the five-year study period. For combination products, such as those containing a beta-blocker, ACE inhibitor or ARB combined with a diuretic, each individual drug was included in the total numbers for the single entity drug product. Due to the different data sources and collection methods, results

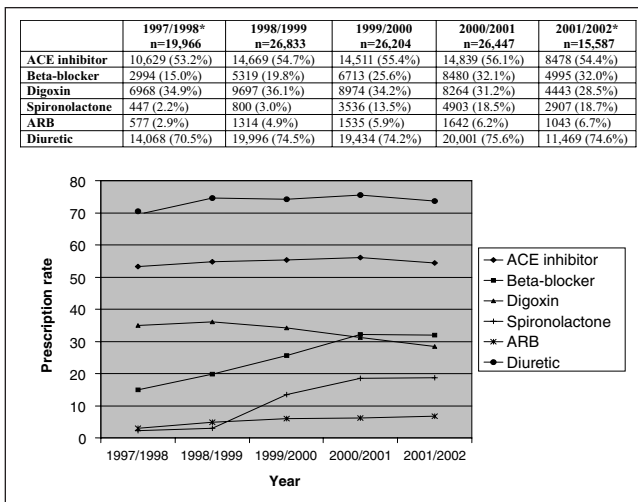


Figure 1) Medication use by year. Note: Quebec data are grouped with the next fiscal year (ie, 1998 data are in the 1998/1999 column). *Quebec data are not available for 1997/1998; Quebec and British Columbia data are not available for 2001/2002. ACE Angiotensin-converting enzyme; ARB Angiotensin receptor blockers

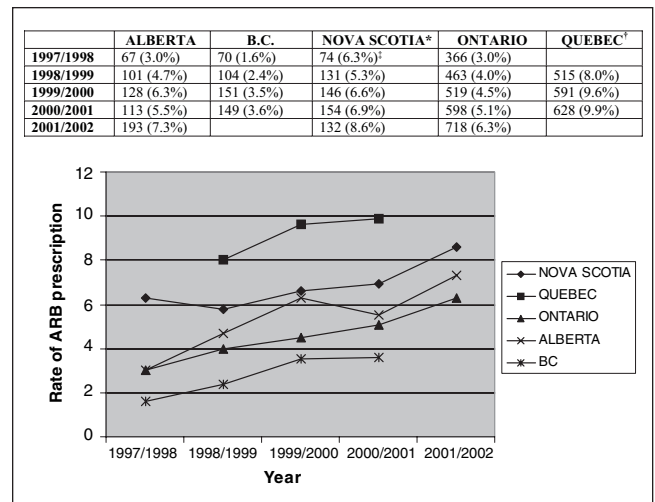


Figure 3) Thirty-day angiotensin receptor blocker (ARB) use by province and year. *Use rates at discharge; †Calendar year; ‡1997/1998 Nova Scotia data are based on a six-month period starting in October 1997. BC British Columbia

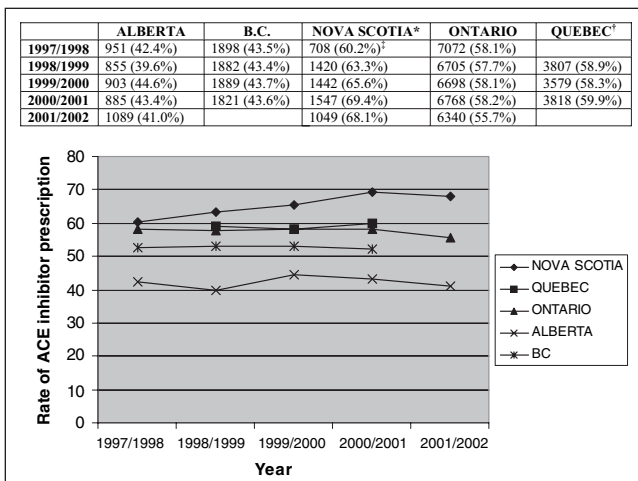


Figure 2) Thirty-day angiotensin-converting enzyme (ACE) inhibitor use by province and year. *Use rates at discharge; †Calendar year; ‡1997/1998 Nova Scotia data are based on a six-month period starting in October 1997. BC British Columbia

are presented using simple descriptive statistics for the purpose of comparing among provinces. Tests of significance are not provided. Furthermore, age and sex breakdowns are not reported because the results of those analyses will be reported in a separate manuscript dealing with biases in care.

RESULTS

Data were obtained for a total of 115,037 patients with CHF discharged alive in the provinces of Nova Scotia (9388), Quebec (18,974), Ontario (58,352), Alberta (11,129) and British Columbia (17,194).

CHF drug use by year

Pooled drug use data from all five provinces are presented in Figure 1. Overall, 54.9% of patients received an ACE inhibitor, with slight increases from 1997/1998 to 2000/2001 and then a slight decrease in 2001/2002. In contrast, beta-blocker prescription rates increased steadily over the five-year period, more than

doubling from 15.0% in 1997/1998 to 32.0% in 2001/2002. Likewise, spironolactone use increased dramatically, with only 2.2% of patients receiving this medication in 1997/1998 compared with 18.7% in 2001/2002. Rates of digoxin prescription, by contrast, decreased slightly over time, falling from 34.9% in 1997/1998 to 28.5% in 2001/2002, depending on the province. Use of ARBs, a newer class of drugs, increased slightly throughout the study period.

CHF drug use by province

Rates of ACE inhibitor use varied considerably across provinces (Figure 2), with the highest rates observed in Nova Scotia, followed closely by Quebec, and the lowest rates seen in Alberta. Between 1997/1998 and 2000/2001, ACE inhibitor use increased slightly each year in Nova Scotia, from 60.2% to 69.4%, before dropping slightly to 68.1% in 2001/2002. Rates were relatively constant over the study years in the other provinces. They ranged from 58.3% to 59.9% in Quebec, 55.7% to 58.2% in Ontario, 43.4% to 43.7% in British Columbia and 39.6% to 44.6% in Alberta.

ARB prescriptions increased sharply in all provinces over time in relative terms, but absolute rates remained low everywhere, especially by comparison with the other drug classes (Figure 3).

Beta-blocker prescriptions increased each year in all provinces by similar rates (Figure 4). However, use was much higher in Nova Scotia in all years, with rates many times higher than those documented elsewhere. Thus, beta-blocker prescription rates at discharge in Nova Scotia were 41.4% in 1997/1998 and climbed to 66.3% by 2001/2002. The highest rates documented in the other provinces were 37.0% in Quebec and 30.1% in British Columbia in 2000/2001, and 30.1% in Ontario and 20.4% in Alberta in 2001/2002.

Spirolactone use rose sharply in all provinces, especially between 1998/1999 to 1999/2000 (Figure 5). The highest rates of spironolactone prescription were observed in British Columbia, where use rose from 2.7% in 1997/1998 to 22.6% in 2000/2001. The lowest rates were seen in Nova Scotia, where only 13.7% of patients were prescribed this drug in 2001/2002.

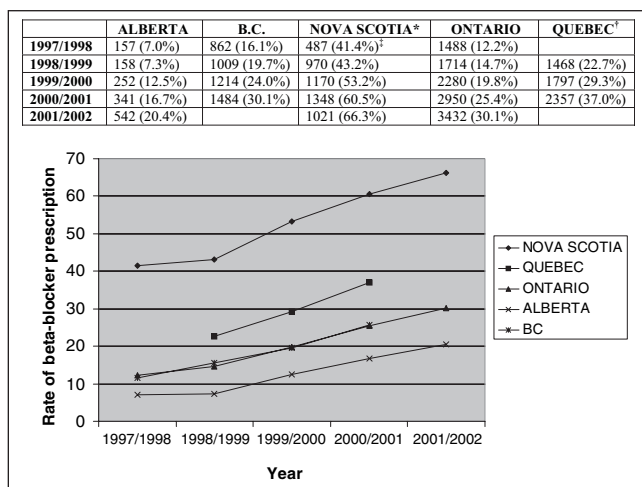


Figure 4) Thirty-day beta-blocker use by province and year. *Use rates at discharge; †Calendar year; ‡1997/1998 Nova Scotia data are based on a six-month period starting in October 1997. BC British Columbia

In contrast with the prescription rates of the other drugs examined, digoxin prescription rates decreased modestly over time (Figure 6). Digoxin use was highest in Quebec and Ontario, with rates of 43.3% in Quebec in 1998/1999 and 39.3% in Ontario in 1997/1998. The lowest rates were seen in Alberta, where 22.0% of patients were receiving this drug in 1997/1998.

DISCUSSION

The past 15 years have seen dramatic changes in the evidence-based management of CHF. Only a generation ago, digoxin and diuretics were the mainstay of therapy for patients with CHF. While these medications are still frequently used, several large, randomized controlled trials (19-26,28) have been published demonstrating clear mortality benefits of, most notably, ACE inhibitors, beta-blockers and spironolactone. These drugs have now become the standard of care in the management of patients with CHF and their use is an indicator of the quality of care provided to such patients (34).

ACE inhibitors were first shown to decrease morbidity and mortality among patients with CHF due to systolic dysfunction in the late 1980s, a benefit that has been reproduced in many subsequent large trials (19-22). It is somewhat surprising, given the weight of this evidence, that ACE inhibitors were only prescribed in just over one-half of patients discharged alive from hospital after an admission for CHF as recently as 2001/2002. Because ACE inhibitors primarily benefit patients whose CHF is due to systolic left ventricular dysfunction, and the administrative data sets used in the present study do not allow for the differentiation of patients with systolic versus diastolic heart failure, it is possible that a relatively higher number of 'ideal' patients for ACE inhibitors are in fact receiving such therapy. In contrast, ischemic heart disease remains a major cause of both systolic and diastolic dysfunction, is the major contemporary cause of CHF and independently merits treatment with an ACE inhibitor. Accordingly, higher rates of ACE inhibitor use were anticipated. It must be noted that the increasing use of ARBs during the study period means that approximately 60% or more of the CHF population was at least receiving some form of angiotensin-modifying treatment. It bears mentioning in this regard that any clinical trial

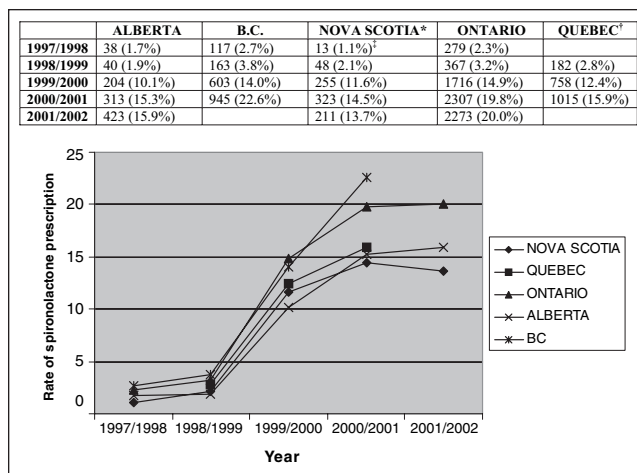


Figure 5) Thirty-day spironolactone use by province and year. *Use rates at discharge; †Calendar year; ‡1997/1998 Nova Scotia data are based on a six-month period starting in October 1997. BC British Columbia

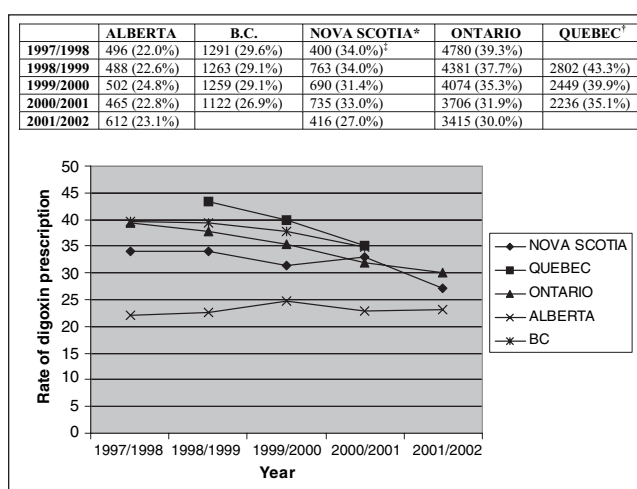


Figure 6) Thirty-day digoxin use by province and year. *Use rates at discharge; †Calendar year; ‡1997/1998 Nova Scotia data are based on a six-month period starting in October 1997. BC British Columbia

evidence for the benefit of ARBs in the CHF population has really only appeared since 2001 (31,35-37) (ie, late in our study time frame), and indeed the failure of the Evaluation of Losartan in the Elderly (ELITE II) study (35) to show superiority of ARBs over ACE inhibitors would hardly have been expected to stimulate greater adoption of the ARB drug class before then. It should also be noted that although the combination of nitrates and hydralazine has been shown to be disease modifying, it has been uncommonly used since the advent of ACE inhibitors and ARBs and, thus, is not reported here.

Studies suggesting that beta-blockers might clinically benefit patients with CHF have also been available since the 1980s (17,18), although many clinicians had difficulty accepting these findings because the traditional thinking held that the negative inotropy of beta-blockade would, in theory, worsen left ventricular systolic dysfunction. The landmark trials (23-26) that confirmed the morbidity and mortality benefits of beta-blocker therapy among patients with CHF are more recent. The initial study (23) of the American carvedilol program was

published in 1996, showing a mortality benefit among patients with CHF treated with carvedilol. Several subsequent trials (24-26) published in the late 1990s and early 2000s not only underscored this clinical benefit but extended it to a broader range of patients. The low rates of beta-blocker use in 1997/1998 may reflect physician skepticism about the original beta-blocker studies, while the rapid uptake of this therapy in subsequent years may be in response to the cumulating clinical trial evidence. However, separate from issues surrounding the evidence for beta-blocker use in the CHF population, and specifically in patients with systolic dysfunction, beta-blocker use is the mainstay of therapy for patients with ischemic heart disease and, as already mentioned, ischemia has become the most important etiology for the syndrome of CHF. One would, therefore, expect that more patients with CHF would be prescribed beta-blockers than appears to be the case. One important factor that could be moderating perceived uptake is the fact that this therapy is difficult to initiate in the setting of CHF and, furthermore, there is little evidence for benefit if initiated during the acute presentation. Therefore, it is possible that more patients with CHF across Canada could be receiving this therapy, with therapy being initiated outside our 30-day monitoring window.

Spironolactone use follows a similar pattern to that observed with beta-blockers. Discharge prescription rates of spironolactone rose dramatically, especially between 1999/2000 and 2001/2002. By contrast, use before 1999/2000 was low and only increased subsequent to the publication of the Randomized Aldactone Evaluation Study (RALES) in 1999 (28), which showed that spironolactone use in the patients more severely affected with CHF with left ventricular systolic dysfunction (ie, New York Heart Association classes III and IV) reduced mortality and cardiovascular morbidity.

Whereas digoxin has been shown to decrease hospitalization among patients with CHF, it has not been demonstrated to influence mortality (27). The slight reduction in use of digoxin over the five-year period studied may therefore reflect a physician preference to substitute medications with a proven mortality benefit. More likely, given that digoxin use curves are the mirror image of beta-blocker use curves, the decrease in digoxin use may reflect a physician drug selection bias in settings where dual rate-control therapies might be problematic. In other words, where heart rate lowering may be a concern, physicians may be preferentially selecting beta-blockers with their proven mortality benefit over digoxin.

The variation in pharmacotherapy seen across provinces – in particular, in ACE inhibitor and beta-blocker use – merits some additional discussion. These are the two most important medical therapies presently available to treat CHF and are advocated for both symptomatic and asymptomatic patients. Both ACE inhibitor and beta-blocker therapy appear to be used to a much greater extent in Nova Scotia than in the other provinces studied, although rates of ACE inhibitor use in Quebec and Ontario were not far behind. While it is difficult to explain the much lower rates of use of these drugs in Alberta and British Columbia, there may be at least three reasons why their use is highest in Nova Scotia. The first reason has to do with the fact that Nova Scotia has a single academic centre, and the cardiology group in Halifax has featured prominently in many of the multicentre, international heart failure studies that have established the evidence for the pharmacotherapy of CHF. Early adoption of evidence being disseminated by a

single academic institution with a unified message from its specialist opinion leaders may therefore be one explanation for the relatively greater uptake in Nova Scotia. The second reason for the higher rates of ACE inhibitor and beta-blocker use may relate to the impact of the ICONS study, which is a province-wide disease management initiative that specifically aimed to optimize the levels of use of evidence-based therapies at hospital discharge in, among others, patients with CHF. The third reason is that the rates for Nova Scotia reflect drugs prescribed at discharge, whereas those for the other provinces are prescriptions actually filled 30 days following hospital discharge; this might account for part of the disparity in rates. However, it seems highly unlikely that this would explain all of the interprovincial variation in CHF pharmacotherapy observed in the present study.

Regional trends in the use of spironolactone – the other drug with the ability to impact mortality – are slightly different. Rates of use of this drug are highest in provinces with relatively lower ACE inhibitor use, but the reason for this apparent inverse relationship is unclear, especially because most patients who would qualify for spironolactone should also qualify for ACE inhibitors. In all provinces, there seems to be a plateau developing in spironolactone use. This is not surprising because the drug is currently indicated only in those patients with the most severe disease and it may be that a high proportion of these patients are already being appropriately targeted.

There are few contemporaneous data on the patterns of medical treatment of CHF from other countries and fewer still from Canada. Those that are available suggest that treatment patterns in Canada differ minimally from those found elsewhere. Bungard et al (31) performed a systematic review of articles assessing ACE inhibitor use in CHF and found that rates of use among all patients with this condition ranged from 33% to 67%, with a median of 51%. Heckman et al (38) described the management of CHF in Canadian long-term care facilities. They found that 55% of residents surveyed were prescribed an ACE inhibitor, although fewer than one-half were receiving appropriate doses, with another 3% receiving an ARB, 34% receiving digoxin, 32% receiving a beta-blocker and 9% receiving spironolactone. A survey of Medicare patients hospitalized with a primary diagnosis of CHF found a rate of ACE inhibitor use of 54.7% in 1993 to 1994 (39) (ie, at levels similar to or greater than those observed in some Canadian provinces almost a decade later). A more recent survey (40) of practice patterns in several European countries reported a rate of ACE inhibitor use of 60%. The same study also reported a rate of beta-blocker use of 34%. In the United States, only 20% to 50% of patients with CHF are currently receiving a beta-blocker (41). Data regarding digoxin and spironolactone use are even more difficult to find. One study (42) of a managed care plan in North Carolina reported that digoxin was used by 34% of enrolled patients. In this same population, prescriptions for ACE inhibitors were filled by 52%, for ARBs by 9% and for beta-blockers by 25% of patients. It is also important to point out that reasonable drug use targets for any of the drugs reported on herein have not been established for the purpose of quality improvement initiatives. In more specialized settings, rates of ACE inhibitor use in excess of 82% (43) and of beta-blocker use of up to 75% (although only 69% remained adherent) (44) have been registered.

LIMITATIONS

There are important limitations to the present study, several of which have been alluded to above. First, we have studied rates of medication prescription in only five provinces of Canada. However, these provinces are geographically representative and there is no reason to believe that treatment should differ substantially in the provinces not sampled. Second, the databases from the various provinces studied were relatively heterogeneous both in their design and in the time periods covered, making comparisons difficult. However, it seems unlikely that systematic biasing of the data contained in any of these data sets could have prejudiced our results. Third, as mentioned previously, for one of the provinces (Nova Scotia), prescription rates at hospital discharge were substituted for prescription rates at 30 days following discharge, which were not available through the ICONS database. It is likely that a proportion of these discharge prescriptions was not filled by 30 days and this could have overestimated the Nova Scotia rates. However, in a disease that is as symptomatic as CHF, and one in which the average age of affected persons is such that drug costs are covered through private or public plans, it is unlikely that significant numbers of prescriptions went unfilled. Furthermore, there is also the possibility that some patients did not have drugs started in hospital but rather within 30 days following discharge, in which case the Nova Scotia rates could represent slight underestimates. In some cases, delayed prescription of medication may have been appropriate and, thus, systematically missed by limiting data gathering only to medications prescribed at hospital discharge or the following 30 days. For example, patients who were not euvolemic at hospital discharge may have been prescribed a beta-blocker at a later date. Fourth, the study only examined the pharmacotherapy of CHF in patients 65 years of age and older. However, to the extent that this represents approximately three-quarters of patients with CHF, the findings should nevertheless be reasonably representative. Fifth, rates of hydralazine and nitroglycerine in combination were not analyzed because use was low and not reported in some databases. It should also be mentioned that patients may have been on medications for indications other than CHF; for example, those with a history of coronary artery disease would probably be prescribed ACE inhibitors and beta-blockers for secondary prevention of acute coronary syndrome. Such patients may already have been prescribed these medications before the index CHF hospitalization. Sixth, as mentioned above, information was not generally available on ejection fraction and, as such, patients could not be characterized as having systolic versus diastolic

left ventricular dysfunction. Diastolic dysfunction is common, yet there is little in the way of proven therapy for this condition. Thus, rates of drug use would be higher than reported herein if it had been possible to define a population of patients with systolic dysfunction that would have been more 'eligible' to receive the pharmacotherapy surveyed. Last, the use of administrative data precludes our ability to fully understand the clinical circumstances of each patient and there may have been legitimate reasons for not initiating an evidence-based medication, including known drug intolerances or real or perceived concerns regarding the potential for drug-related adverse events. A major strength of the present work is the fact that it provides a true population-based analysis of the management of patients with CHF across several Canadian provinces and, as such, is the only major study of contemporary national pharmacological practice available.

CONCLUSIONS

Overall management of CHF in the five Canadian provinces studied appears to be similar, in aggregate, to what is being reported elsewhere in the developed world. Although we may be approaching optimal population-wide levels of ACE inhibitor and spironolactone use, there may still be some room for improvement in the prescribing of beta-blockers. More interesting, however, is the extent of variation in pharmacological practice across Canada, the reasons for which remain speculative. Clearly, more work is needed to appreciate whether the variation in rates of drug use is resulting in corresponding differences in clinical outcome.

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