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A Pharmacy-Based Health Promotion Programme in Hypertension

Cost-Benefit Analysis

Isabelle Côté,[1] *Jean-Pierre Grégoire*,[2,3] *Jocelyne Moisan*,[2] *Isabelle Chabot*[3] and *Guy Lacroix*[4]

1 Faculty of Pharmacy, Laval University, Quebec, Canada*
2 Faculty of Pharmacy and Population Health Research Unit, Laval University, Quebec, Canada
3 Health Economics and Outcomes Research, Merck Frosst Canada Ltd, Kirkland, Quebec, Canada
4 Department of Economics and Research Centre in Applied Economics and Finance, Laval University, Quebec, Canada

Abstract

Objective: To weigh the costs and benefits of a pharmacy-based health promotion programme implemented in four pharmacies of the Quebec City area, Canada. This programme was developed to improve blood pressure control through activities aimed at improving the quality of prescribing and the adherence to treatment.

Design: Nine pharmacies in Quebec City were included, of which four pharmacies were assigned to the implementation of the health promotion programme. Each time a study participant came to one of these pharmacies to refill his/her antihypertensive medication, the pharmacist would measure and record the participant's blood pressure and assess adherence to drug treatment. The other five pharmacies delivered usual care. The duration of the intervention programme was 9 months. Costs included direct, indirect, and fixed costs, and the costs of pharmacist intervention. Benefits were measured using cost savings induced by pharmacist intervention. Willingness to pay was also considered. A bootstrap method was used to test the between-group difference.

Perspective: The study was performed from a societal perspective.

Study participants: 100 individuals aged between 34 and 80 years residing in the Quebec City area and taking antihypertensive medication.

Main outcome measures and results: Participants exposed to the programme had a significant decrease in mean direct costs and a significant increase in mean indirect costs compared with non-exposed participants. Pharmacist interventions involved a mean cost of 30.68 Canadian dollars ($Can) per participant exposed to the programme. On average, exposed participants were willing to pay $Can0.54 per month after the intervention period. Benefits were about ten times higher than costs (1998 values).

* Currently with Innovus Research Inc., Burlington, Ontario, Canada.

Conclusions: The implementation of this intervention programme seems promising in the quest to improve blood pressure control in terms of both costs and benefits.

Hypertension is a condition affecting a large proportion of the population worldwide. In Canada, 22% of adults have hypertension, corresponding to 4.1 million individuals.[1] Among these, 33% are treated with antihypertensive drugs. In Canada, total sales of antihypertensive drugs amounted to around 603 million Canadian dollars ($Can) in 1995–1996.[2]

Pharmacological treatment reduces cardiovascular morbidity and mortality among individuals with elevated blood pressure.[3,4] To benefit from these treatments, individuals with hypertension should be prescribed the appropriate drug regimen which they should adhere to. Unfortunately, only 16% of Canadians with hypertension aged between 18–74 years are treated and have their blood pressure controlled.[1] The lack of adherence to antihypertensive drug treatment is known to be a major barrier to blood pressure control.[5]

Pharmacists can contribute to a better control of high blood pressure.[6-9] They may help their patients to better manage the adverse effects of their antihypertensive drugs. They may also detect problems of non-adherence to drug treatment and respond to these problems by giving advice to their patients on how to better manage the use of their treatment.

In 1998, a pharmacy-based health promotion programme targeting individuals treated for hypertension was designed to improve blood pressure control through activities aimed at improving the quality of prescribing and the adherence to treatment. Decision support computer software was developed to facilitate the implementation of the intervention programme by pharmacists.

To assess the impact of this health promotion programme on blood pressure, we conducted a quasi-experimental cohort study in nine pharmacies in the Quebec city area.[10] We assigned four pharmacies to the implementation of our health promotion programme for a 9-month period and the five other pharmacies to the delivery of usual care. Patients enrolled in these nine pharmacies had their blood pressure measured at home both at baseline and 9 months later. Mean after-before changes in systolic and diastolic blood pressure were compared between participants exposed to the health promotion programme and those not exposed. Analyses revealed that the health promotion programme was successful in reducing blood pressure in a subgroup of participants. Indeed, in individuals with a high family income, a statistically significant mean net reduction of around 8mm Hg in systolic blood pressure was associated with exposure to the programme ($p = 0.01$); this change was adjusted for age and baseline blood pressure.[11] The programme was not successful in decreasing blood pressure in individuals from the low income strata. A detailed description of the implementation process of this programme and its clinical impact is available elsewhere.[10]

The objective of this paper is to describe the impact of the health promotion programme in terms of costs versus benefits from a societal perspective. This study was approved by Laval University's Ethics in Research Committee.

Methods

From the list of pharmacies using drug distribution software which was compatible with our decision support software, we selected ten pharmacies known to have a practice oriented toward the delivery of pharmaceutical care. Pharmacists owning nine of these pharmacies accepted to participate. Pharmacists from four different outlets agreed to administer the health promotion programme to their patients (exposed group) for a period of 9 months. Patients attending the five other outlets not administering the programme constituted the non-exposed group.

The Pharmacy-Based Intervention Programme

The programme was developed using the PRECEDE-PROCEED model[12] (a model developed by Green and Kreuter[12] to assess behaviour change in health programmes) and was specifically designed to: (i) positively modify factors that may have a negative impact on adherence to antihypertensive drug treatment; (ii) reinforce the use of non-pharmacological treatment; and (iii) optimise pharmacological treatments.

The intervention programme consisted of a computer-assisted educational program, which was implemented in the four study pharmacies offering the health-promotion programme. Each time an exposed participant came to the pharmacy to refill his/her antihypertensive medication, the computer program flagged him/her as a study participant. The pharmacist would then measure the participant's blood pressure and record it in the computer program.

The educational software was programmed to classify participants according to whether or not their blood pressure was controlled (blood pressure was considered controlled for individuals aged less than 60 years if systolic/diastolic blood pressure was lower than 140/90mm Hg; and for individuals aged 60 years or more if systolic/diastolic blood pressure was lower than 160/90mm Hg). The software was also programmed to assess adherence to drug treatment. Individuals were classified as being nonadherent if they were late by at least 8 days in refilling their antihypertensive medication. Taking into account the blood pressure and adherence status, the program suggested appropriate interventions.

Pharmacists asked their clients to take part in the study. Detailed information on those who agreed to participate was sent to a central office in charge of managing all relevant data. Each participant was visited prior to (between October 1998 and March 1999) and following (between October 1999 and December 1999) the intervention period by a research assistant blinded to the exposure state of participants who administered a computer-assisted structured questionnaire.

For each participant, we collected data on individual characteristics, treatment costs and willingness to pay (table I). Data from the following sources were used:

- in-home interviews
- pharmacy files of the participants
- the Régie de l'assurance maladie du Québec (RAMQ) databases
- the provincial Ministry of Health database
- the scientific literature
- participating pharmacists.

We used an in-home questionnaire to obtain individuals' characteristics, e.g. age, sex, education level, main occupation and level of household income. We measured household income level using two questions, one on gross annual household income and the other on number of household members.[13] These two questions were used to classify participants as being in a high or low income strata.

Participants were asked their usual means of transportation, the distance they had to travel and whether or not they were usually accompanied by someone when visiting the pharmacy or the medical clinic.

Data on the time spent by participants going to the pharmacy or to the clinic as well as their hourly wage were also collected during the interviews. For the 10 participants who did not report their wage, we used data from the 1994 study results from the Effects and Perceptions of Taxation in Quebec to attribute a wage.[14] Participants were imputed the mean wage of corresponding individuals in the taxation study subject to sex, age and level of education. For those retired participants not reporting an hourly wage, we assumed their income to be zero.

Lastly, we asked participants to state their maximum willingness to pay using the following open-ended question: "Suppose that the pharmacist can improve your quality of life by taking your blood pressure on a regular basis and by advising you on the best way to take your medication. In addition to what you actually pay for your drug insurance coverage, how much would you be willing to pay per month to benefit from this quality of life improvement?".

Table I. Information, support and source of information used to obtain data on personal information, treatment costs, costs of pharmacist interventions and willingness to pay variables in both exposed and not exposed groups (n = 100)

Variables	Information used to create the variable	Support used to obtain information	Source of information
Personal information			
Age	Date of birth	In-home questionnaire	Participants
	Date of the first in-home interview		
Sex	Question on sex	In-home questionnaire	Participants
Education level	Question on education level	In-home questionnaire	Participants
Main occupation	Question on main occupation	In-home questionnaire	Participants
Gross annual household income	Family income	In-home questionnaire	Participants
	Number of family members	In-home questionnaire	Participants
Treatment costs			
Direct costs			
Antihypertensive drugs	No. of pills	Pharmacy file	Pharmacists
	Price of antihypertensive drugs	List of the public programme of drugs	Software company
	Dispensing fees	Pharmacy file	Pharmacists
Physician visits	No. of physician visits	Database	RAMQ
	Fee for each visit	Database	RAMQ
Hospitalisations	No. of days at the hospital:		
	admission date	Database (Med-Echo)	Provincial Ministry of Health
	exit date	Database (Med-Echo)	Provincial Ministry of Health
	fee for each day at the hospital	List of the public hospitals	Provincial Ministry of Health
Travel[a]	No. of visits at the pharmacy		
	no. of refills	Pharmacy file	Pharmacists
	no. of visits at the clinic	Database	RAMQ
	Price of transportation		
	means of transportation	In-home questionnaire	Participants
	distance travelled	In-home questionnaire	Participants
	age	In-home questionnaire	Participants
	accompanist	In-home questionnaire	Participants
Indirect costs			
Time cost to the pharmacists	Time spent at the pharmacy	Scenario	Pharmacists
	No. of visits to the pharmacy:		
	no. of drug refills	Pharmacy file	Pharmacists
	Salary of pharmacists	Annual survey	AQPP
Time cost to participants[b]	Time of participants:		
	time at the pharmacy	Scenario	Pharmacists
	time at the clinic	Medline	Rethans
	travel time to go to the clinic or pharmacy	In-home questionnaire	Participants
	No. of visits to the pharmacy:		
	no. of refills	Pharmacy file	Pharmacists

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Table I. Contd

Variables	Information used to create the variable	Support used to obtain information	Source of information
	No. of visits to the clinic	Database	RAMQ
	Hourly rate of participants:	In-home questionnaire, study	Participants, researchers
	age	In-home questionnaire	Participants
	main occupation	In-home questionnaire	Participants
Costs of pharmacist interventions[c]			
Cost of blood pressure readings	No. of measurements	Software	Pharmacists
	Fee for two measurements		By design
Cost of verbal interventions	No. of interventions	Software	Pharmacists
	Fee for each intervention		By design
Cost of pharmaceutical opinions	No. of opinions	Software	Pharmacists
	Fee for each opinion		By design
Willingness to pay	Open-ended question	In-home questionnaire	Participants

a Travel cost of participants included travel cost of relatives.

b Time cost of participants included time cost of relatives also.

c Related to participants exposed to the programme only.

AQPP = Association Québécoise des Pharmaciens Propriétaires; **RAMQ** = Régie de l'assurance maladie du Québec.

We used pharmacy files of participants to obtain information on the number of pills and refills, the dosage and the name of their antihypertensive medication. We considered all antihypertensive drugs listed on the RAMQ drug formulary in 1999. We assumed the number of visits to the pharmacy to be equal to the number of antihypertensive drug refills.

We extracted from the RAMQ database the number of physician visits made by each participant and the cost of each of those visits. We obtained authorisation from the 'Commission d'accès à l'information du Québec' to extract this data. We took into account all physician visits whether related or not to hypertension since hypertension may have been partly responsible for the visit even though not listed as the main reason. We used the Med-Echo database to obtain the number of hospitalisations. We considered all hospitalisations for which the principal diagnosis might have been related to hypertension, i.e. code 401-405 (hypertensive disease) and 410-414 (ischaemic heart disease with mention of hypertension) of the International Classification of Diseases, 9th edition.[15]

We determined the costs of the prescribed antihypertensive drugs for each participant using the price list of the RAMQ formulary. We determined the daily cost of hospitalisation using the costs list for short-term hospitalisation published by the provincial Ministry of Health in 1996–1997. These 1996–1997 costs were the most recent available at the time.

On the basis of Rethans' work, which focused on evaluating the performance of general practitioners in daily practice,[16,17] we estimated the mean time spent by participants with their physician to be 15 minutes. This did not include waiting time at the clinic.

During the intervention period, we faxed a hypothetical scenario to the pharmacists offering the programme to estimate the time they were spending with participants to refill their antihypertensive medications and administering the programme. To estimate the time taken by pharmacists to refill antihypertensive drugs before the intervention period, we sent the same scenario to pharmacists not offering the programme. We assumed the time spent by the latter to be the same before and during the intervention period. We also assumed time spent by participants at the pharmacy to be the same as the time taken by pharmacists. This scenario had been constructed based on the working experience of two pharmacists not participating in the study.

We estimated the pharmacists' hourly salary at $Can23.29, based on the annual survey conducted by the 'Association Québécoise des Pharmaciens Propriétaires' in 1999.

Based on data recorded in the decision support computer software, we determined the number of blood pressure readings, verbal interventions and pharmaceutical opinions given by the pharmacists offering the programme during the intervention period.

Costs

We calculated the cost (in 1998 $Can) of hypertension treatment based on the health services used and the unit cost of these services. We calculated treatment cost for both the 9-month period preceding the first in-home interview and for the 9-month intervention period. We considered both direct and indirect costs.

Direct costs included antihypertensive drug cost (acquisition drug cost plus the dispensing fee), cost of physician visits, cost of hospitalisation and travel cost incurred by participants in obtaining medical care and pharmacy services.

Indirect costs included those costs related to the time taken by pharmacists to deliver the programme, time incurred by participants to obtain medical and pharmaceutical services (i.e. time spent at the pharmacy to refill antihypertensive drugs, time spent at the clinic with the physician and time to go to the pharmacy or to the clinic) and the time spent by relatives or friends (if any) aged over 17 years who usually accompanied the participant to the pharmacy or clinic.

The costs of pharmacist intervention included measuring blood pressure, verbal interventions and providing pharmaceutical opinions. These costs were computed using the number of blood pressure readings, verbal interventions, pharmaceutical opinions recorded and the cost of each of these interventions as determined by the investigators.

In addition to direct and indirect costs, there were costs related to the software development ($Can8500) and services contract with the computer company for the 9-month intervention period ($Can1175). These costs were considered as fixed.

Benefits

The benefits accruing from the programme included saved costs during the intervention period and willingness to pay. The saved costs per participant were estimated as the mean difference between total costs (direct and indirect costs) induced by the exposed participants and total costs induced by the non-exposed participants. We used the willingness to pay reported by exposed and non-exposed participants before and after the intervention period.

Cost Benefit

We determined the cost benefit of the intervention programme using the benefit (the sum of willingness to pay and saved costs) minus both the software and the pharmacist intervention costs. We also calculated the cost-benefit ratio.

Statistical Analysis

Baseline characteristics as well as healthcare utilisation for the 9-month period preceding the intervention period of participants exposed to the programme were compared to the characteristics and healthcare utilisation of the non-exposed group using Chi-square tests for categorical variables and Student's t-tests for continuous variables.

We calculated mean treatment costs with their standard deviations. Since within groups mean cost differences were skewed, we used a 1000 bootstrap replication of the original data to obtain a p value.[18] We also used the bootstrap method to obtain a p-value for the between-group difference of within-group changes. Changes were considered statistically significant when the p-value was equal or less than 0.05. We analysed the data using the SAS software package version 6.12 (SAS Institute Inc. Cary, North Carolina).

We measured fixed costs using a 5% discount factor on a 3-year period.[19] It was assumed that the computer program would remain unchanged for the next 3 years. We also used population census data for the province of Quebec compiled by Statistics Canada in 1996 and the percentage of people with hypertension in the province[20] to estimate the number of individuals who might benefit from the programme (717 538 individuals). We then performed a scenario analysis using two scenarios: (i) a publicly supported programme; and (ii) a privately supported programme. In the first scenario, we assumed all individuals with hypertension would be exposed to the programme and 0% profit would be made. In the second scenario, we assumed that 10% of the hypertensive population would be exposed to the programme and the pharmacists would make a 50% profit on fixed costs of the programme.

Results

One hundred and eleven individuals agreed to participate in this study. Eleven individuals did not complete the study (six not exposed and five exposed to the program). Of these eleven, one died during the intervention period, six could not be reached and four were not interested in continuing. Consequently, the study was completed by 100 participants of whom 41 were exposed to the intervention and 59 were not. Participant characteristics were statistically similar across exposition groups except for the following: the proportion of participants using a car to go to the pharmacy or the clinic was lower in the exposed group (table II); the mean number of antihypertensive drug refills during the 9-month period before the intervention period was 13.6 and 11.8 ($p = 0.04$) in the exposed and non-exposed groups, respectively (table III); the mean distance between participants' home and the clinic was longer in the non-exposed group than in the exposed group (table III).

In table IV, for both exposed and non-exposed groups, we present the mean direct and indirect costs of treatment for the 9-month period preceding the first in-home interview and those for the 9-month intervention period. Compared with baseline, the mean cost of pharmacist time increased during the intervention period in the exposed group ($Can29.8 before versus $Can62.2 during; $p < 0.001$) as well as the mean indirect costs ($Can37.9 before versus $Can69.7 during; $p < 0.001$). No significant change was observed in the non-exposed group. Compared with the non-exposed participants, those exposed had a significant decrease in mean direct costs (difference of $Can331.3; $p = 0.032$) and a significant increase in mean indirect costs (difference of $Can40.7; $p < 0.001$).

Total fixed costs were around $Can10 000 with software development costs accounting for the largest part of it (table V). Blood pressure readings accounted for the major part of the pharmacist intervention costs. On average, pharmacist intervention costs amounted to $Can30.68 per individual exposed to the programme.

Concerning the willingness to pay (table VI), the proportion of participants who answered the willingness to pay question before the intervention period was at least 2-fold higher than the proportion of those who did so after the intervention period in both the exposed (34/41 before compared with 12/41 after) and non-exposed (38/59 before compared with 19/59 after) groups. However, a few participants only reported their willingness to pay a given dollar amount. Of the 41 participants exposed, only two were willing to pay for the programme after having being exposed to it, which translates in to a mean of $Can0.54 per month for the group.

The benefits, costs and the scenario analysis results for fixed costs are presented in table VII. For the entire 9-month intervention period, exposed participants were willing to pay $Can4.86 (9 months × $Can0.54). In the province of Quebec, 717 538 individuals would be eligible to benefit from the intervention programme (14% of 5 125 270 individuals aged between 18 and 74 years). Within a privately supported programme offered to 10% of the hypertensive population (first scenario), fixed costs would be $Can0.24 per individual. In a publicly supported programme (second scenario), these costs would be divided by the entire hypertensive population giving a mean cost of $Can0.02. Comparing total benefits ($Can295.46) to total costs (range: $Can30.70–30.92), we observed that benefits were

Table II. Characteristics of participants with hypertension exposed and not exposed to the programme (n = 100)

Characteristic	Exposed (n = 41)		Not exposed (n = 59)		p value[a]
	n	%[b]	n	%	
Age (y)					0.16
<65	15	36.6	30	50.9	
≥65	26	63.4	29	49.2	
Sex					0.57
male	13	31.7	22	37.3	
female	28	68.3	37	62.7	
Highest level of education completed					0.88
elementary	13	31.7	18	30.5	
high school	14	34.2	23	39.0	
more than high school	14	34.2	18	30.5	
Main occupation					0.10
full or part-time employment	2	4.9	10	17.0	
retired	32	78.1	35	59.3	
other	7	17.1	14	23.7	
Income					0.06
low income strata	22	53.7	25	42.4	
high income strata	13	31.7	31	52.5	
missing	6	14.6	3	5.1	
Individuals usually go to the pharmacy:					0.59
accompanied	4	9.8	4	6.8	
not accompanied	37	90.2	55	93.2	
Individuals usually go to the clinic:					0.84
accompanied	5	12.2	8	13.6	
not accompanied	36	87.8	51	86.4	
Means of transportation to go to the pharmacy					0.001
walk	27	65.9	16	27.1	
bus	2	4.9	2	3.4	
car	27	29.3	41	69.5	
Means of transportation to go to the clinic					0.01
walk	18	43.9	13	22.0	
bus	4	9.8	3	5.1	
car	17	41.5	43	72.9	
other	2	4.9	0	0.0	

a Chi-square tests were used.

b Percentages may not total 100 because of rounding.

about 10-fold higher than costs no matter how the programme is supported.

Discussion

In summary, our results show that the intervention programme generated benefits that were 10-fold higher than costs. A saving in treatment costs, small fixed costs and small costs imputed to the intervention of the pharmacists, contributed to making the benefits arising from the intervention programme higher than the costs.

To our knowledge, no study has assessed the impact of pharmacists' interventions on cost and benefit using willingness to pay as part of the benefit. However, four studies[21-24] have assessed the impact of pharmacist intervention on cost. In these studies, costs were calculated among people with diabetes mellitus,[21,24] asthma,[21] hypercholesterol-

Table III. Description of healthcare utilisation during the 9-month period before the first in-home interview and during the 9-month intervention period of participants exposed and not exposed to the programme (n = 100)[a]

Healthcare utilisation	Exposed participants (n = 41) [mean ± 1 SD]			Not exposed participants (n = 59) [mean ± 1 SD]		
	during the 9mo before the intervention period	during the 9mo intervention period	mean difference	during the 9mo before the intervention period	during the 9mo intervention period	mean difference
No. of antihypertensive medication refills	13.6 ± 5.1[a]	13.0 ± 4.4	−0.6	11.8 ± 5.2	11.6 ± 5.9	−0.2
No. of visits to the pharmacy	10.8 ± 3.6	10.0 ± 2.6	−0.7	9.9 ± 3.5	9.2 ± 3.6	−0.7
No. of visits to the clinic	11.7 ± 12.0	9.0 ± 6.9	−2.7	9.2 ± 8.5	10.4 ± 10.9	1.2[b]
No. of days in the hospital related to hypertension	0.0 ± 0.0	0.0 ± 0.0	0.0	0.0 ± 0.0	0.0 ± 0.0	0.0
Distance (km) between domicile and the pharmacy	1.3 ± 2.8	1.3 ± 2.8	0.0	2.3 ± 2.8	2.3 ± 2.8	0.0
Distance (km) between domicile and the clinic	2.0 ± 3.4[a]	2.0 ± 3.4	0.0	4.2 ± 4.4	4.2 ± 4.4	0.0
Travel time (min) to the pharmacy	6.4 ± 4.4	6.4 ± 4.4	0.0	7.3 ± 6.5	7.3 ± 6.5	0.0
Travel time (min) to the clinic	7.9 ± 5.8	7.9 ± 5.8	0.0	9.1 ± 6.3	9.1 ± 6.3	0.0
Time (min) to refill antihypertensive medication	7.1 ± 1.5	13.8 ± 6.3	6.7	7.1 ± 1.5	7.1 ± 1.5	0.0
Time (min) to meet the physician	15.0	15.0	0.0	15.0	15.0	0.0

a Statistically significant difference between participants exposed and those not exposed to the programme ($p < 0.05$).

b Statistically significant difference between changes in the group exposed and changes in the group not exposed to the programme ($p < 0.05$).

aemia,[21] HIV,[23] anticoagulation therapy,[21,23] cardiovascular diseases[24] or hypertension.[21,22] No matter what the medical condition of the study population, pharmacist intervention resulted in cost savings. Since the costs of physician visits are higher in the US than in Canada, we may assume that if our programme was implemented in the US, the cost savings due to physician visits would be higher than those we observed in our study.

Pharmacist intervention can explain the increase in time costs of the pharmacists. As part of the intervention programme, the pharmacists were asked to take blood pressure readings and to record these in the participants' files each time the participant came to the pharmacy to refill their antihypertensive medications. Since this task is not part of usual in-pharmacy practice, its application resulted in an increase in the time pharmacists devoted to refilling antihypertensive medication. On the other hand, only few interventions were made by pharmacists[10] offering the programme suggesting that measuring blood pressure in a pharmacy may be enough to result in a decrease in treatment costs. Further research is needed to predict the impact on costs of a higher number of interventions.

The time cost for those pharmacists who delivered the intervention may have been overestimated. We imputed cost to this time spent by pharmacists at the pharmacy. Pharmacists were asked to estimate the time spent doing different tasks such as taking blood pressure readings, computer work, meeting with the patient, preparing drugs and concluding financial transactions. However, according to the research protocol, pharmacists were paid by researchers for each intervention performed including blood pressure readings i.e. pharmacists may have had costs imputed twice for the same task. This implies that the real time costs to pharmacists providing the programme may have been lower than that reported. Consequently, we may expect a smaller mean treatment cost in the exposed group resulting in a greater benefit from the programme.

Of those participants having being exposed to the programme, only two reported a willingness to pay higher than zero dollars. This lack in willingness to

Table IV. Mean treatment costs (1998 Canadian dollars [$Can]) of hypertension for the 9-month period preceding the first in-home interview and during the 9-month intervention period per participant exposed and not exposed to the programme (n = 100)[a]

Category of cost	Exposed participants (n = 41)			Not exposed participants (n = 59)			Between-group difference[b] of mean cost variation (p value)
	mean cost (±1 SD)		mean within group cost difference[a] (p value)	mean cost (±1 SD)		mean within group cost difference[a] (p value)	
	during the 9mo before the intervention period	during the 9mo intervention period		during the 9mo before the intervention period	during the 9mo intervention period		
Direct cost[c]							
Drug acquisition cost	435.8 (±230.6)	434.6 (±212.5)	−1.2 (0.95)	355.7 (±216.5)	374.8 (±214.4)	19.1 (0.43)	−20.3 (0.53)
Physician visit cost	524.8 (±738.9)	355.3 (±277.4)	−169.5 (0.22)	390.4 (±455.3)	532.1 (±762.9)	141.7 (0.12)	−311.2 (0.05)
Travel cost to go to the pharmacy or the clinic	5.6 (±14.8)	6.5 (±18.0)	0.9 (0.23)	14.8 (±22.8)	15.5 (±28.3)	0.7 (0.80)	0.2 (0.89)
Total direct cost (a)	966.2 (±814.3)	796.4 (±357.3)	−169.8 (0.19)	760.9 (±506.9)	922.4 (±809.5)	161.5 (0.11)	−331.3 (0.03)
Indirect cost							
Time cost to participants to go and meet the pharmacist and the physician	8.3 (±24.5)	7.7 (±22.5)	−0.6 (0.10)	28.9 (±96.9)	21.7 (±61.7)	−7.2 (0.29)	6.6 (0.37)
Time cost to pharmacists	29.8 (±9.9)	62.2 (±22.7)	32.5 (0.00)	27.5 (±9.6)	25.2 (±11.1)	−2.4 (0.09)	34.9 (0.00)
Total indirect cost (b)	37.9 (±29.1)	69.7 (±31.2)	31.9 (0.00)	53.5 (±91.0)	44.7 (±58.3)	−8.8 (0.26)	40.7 (0.00)
Total cost (a+b)	**1004.0 (±819.7)**	**866.1 (±360.7)**	**−137.9 (0.68)**	**814.4 (±530.7)**	**967.1 (±817.3)**	**152.7 (0.10)**	**−290.6 (0.06)**

a Bootstrap method. Negative cost differences indicate cost saving during the intervention period.

b Bootstrap method. Negative cost difference indicate cost saving associated with the exposed group.

c The cost of blood pressure measurements, the cost of the verbal interventions and the cost of the pharmaceutical opinions were not included since these costs were related to participants exposed to the programme only.

Table V. Costs related to the software acquisition (fixed costs) and to pharmacist intervention among participants exposed to the programme (n = 41)

Cost component	Cost (1998 $Can)
Fixed costs	
Software acquisition	8500.00
Services contract with the computer company for 9 months	1175.00
Total	9675.00
Pharmacist intervention costs[a]	
Blood pressure readings (n = 222) taken by pharmacists ($Can4.00 per 2 successive readings)	888.00
Verbal interventions (n = 70) with participants or prescribers ($Can5.00 per intervention)	350.00
Pharmaceutical opinions (n = 2) sent by pharmacists to prescribers ($Can10.0 per opinion)	20.00
Total	1258.00
Total per participant exposed to the programme	**30.68**

a Costs reimbursed to pharmacists by the investigators for their interventions as per the study protocol.

$Can = Canadian dollars.

pay may be explained by the fact that participants did not see much change in the way their disease had been managed. Moreover, they may not have perceived changes in their health-related quality of life. However, since the benefits were not sensitive to willingness to pay, even if all participants were unwilling to pay more than zero dollars, the intervention programme benefits would still be higher than the costs.

Two main reasons explain why the programme is cost beneficial. First, due to the large number of individuals with hypertension in Quebec, programme-fixed *per capita* costs are low. Secondly, few interventions were made by the pharmacists which contributed to keeping the costs low. Pharmaceutical opinions, which are written advice sent by pharmacists to physicians to report non-adherence to drug treatment, were the most expensive interventions in the programme and were the least performed by pharmacists. However, the least expensive of all interventions, blood pressure readings, were the most frequently performed. The fact that pharmaceutical opinions were the least performed by pharmacists was not a surprise. It has been shown that in 1996, pharmacists in Quebec billed opinions for 0.07% of dispensed prescriptions, whereas 0.7–1.4% of prescriptions were expected to need an intervention.[25]

Our study has strengths and limitations. We used a before-after quasi-experimental design with both an exposed and a non-exposed group. This study design minimises the risk of contamination of the programme in the non-exposed group.[26] The prospective design of this study allowed us to collect relevant variables including those pertaining to healthcare costs. The use of databases and pharmacy files enabled us to avoid potential bias related to participants' memory. Nevertheless, we were able to study a small number of individuals only. The assignment of pharmacies and patients to exposition or not to the health promotion programme or exposition to usual care (non-exposed group) was not randomised. However, this should not be viewed as a threat to the validity of this study. When evaluat-

Table VI. Number of participants exposed and not exposed to the programme and their willingness to pay for the programme before and after the intervention period (n = 100)

Amount willing to pay (1998 $Can)	No. of exposed participants (n = 41)		No. of not exposed participants (n = 59)	
	no. pre-intervention (%)	no. post-intervention (%)	no. pre-intervention (%)	no. post-intervention (%)
>0	7 (17.1) [median: 10, range: 5–50]	2 (4.9) [median: 10, range: 2–20]	7 (11.9) [median: 20, range: 2–100]	5 (8.5) [median: 10, range: 2–100]
=0	27 (65.9)	10 (24.4)	31 (52.5)	14 (23.7)
Do not know	7 (17.1)	18 (43.9)	21 (35.6)	28 (47.5)
Refuse to pay	0 (0.0)	11 (26.8)	0 (0.0)	12 (20.3)
Mean amount willing to pay ($Can)[a]	3.29 (9.3)	0.54 (3.1)	3.00 (13.7)	2.14 (13.1)

a We consider the answers 'I don't know' or 'I refuse' as a willingness to pay of $Can0.00.

$Can = Canadian dollars.

Table VII. Benefits, costs and scenario analysis on fixed costs per participant exposed to the programme over the 9-month intervention period

Costs/benefits	$Can
Benefits	
Willingness to pay[a] ($Can0.54 × 9 months)	4.86
Savings[b]	290.60
Total of benefits	295.46
Costs	
Scenario 1: privately supported programme	
fixed costs (10% of hypertensive population exposed to the programme, 50% profit)	0.24[c]
intervention costs	30.68
total costs with scenario 1	30.92
Scenario 2: publicly supported programme	
fixed costs (100% of hypertensive population exposed to the programme, 0% profit)	0.02[c]
intervention costs	30.68
total costs with scenario 2	30.70
Costs-benefits (with scenario 1)	−264.54
Costs-benefits (with scenario 2)	−264.76
Ratio costs : benefits (with scenario 1 or scenario 2)	1 : 9.6

a We consider the answers 'I don't know' or 'I refuse' as a willingness to pay of $Can0.00.

b Between-group difference of mean cost variation.

c Formula: ($Can8500 + $Can4700) × 0.8638 (discount factor) = 11 402.00 where $Can4700 is for services contracted on a 3-year period ($Can1175 for 9 months). For publicly supported programme: $Can11 402.00/717 538 hypertensive individuals (100%) = $Can0.02 per individual. For privately supported programme: ($Can11 402.00 + 5701) / 71 754 hypertensive individuals (10%) = $Can0.24 per individual.

$Can = Canadian dollars.

ing the impact of a health promotion programme, the motivation of those people who perform the intervention is critical to an appropriate implementation of the programme and consequently, to observe any impact on health. Indeed, in a real-life context, only those who have the appropriate level of motivation will in fact implement the programme.[27]

We did not include training costs in the analysis. We have therefore slightly underestimated the costs of the programme. Each pharmacist participated in a 1-hour training session at the pharmacy site. A similar amount of time was spent by the trainer who was also a pharmacist. Based on the pharmacists' hourly salary, this would amount to $Can48.58 per individual training session. Since training costs may impact on the cost-benefit ratio these costs need to be taken into account by those considering the launch of such a programme.

Our study population seems to be different from the hypertensive population of the province of Quebec, which has been described in a population-based study in 1991.[28] In our study population, 50% of participants had their blood pressure controlled at baseline, i.e. a systolic/diastolic blood pressure lower than 140/90mm Hg while in the provincial study, 75% of individuals taking antihypertensive medication had their blood pressure controlled.[27] Characteristics such as age and sex of our study population were different from the characteristics of the hypertensive population of the province. In our study, 45% of participants were aged less than 65 years. The majority (65%) were female. In the provincial population 79.4% were aged less than 65 years and the majority were male (53.2%).

These differences between our study population and the provincial hypertensive population imply that were the programme offered to all hypertensive individuals in Quebec, costs and savings would be different from those we have reported in the present study. As half of our study population had their blood pressure controlled at baseline compared with 75% at the provincial level, if the pharmacists made the same percentage of interventions among the provincial population as in our study, costs related to pharmacist intervention would be lower as would health services-related costs. Moreover, since the majority of the individuals in the province are aged less than 65 years, we may conclude that the costs for the physician visits would be lower given that healthcare costs usually increase with age.[29] On the other hand, lowering the costs related to physicians visits would also affect the benefits since avoided physician costs are one of the main benefits. Consequently, if the programme was implemented at the provincial level, we may expect smaller mean treatment costs resulting in a greater benefit from the programme.

The two study populations were different in some aspects; in particular the distance to the pharmacy/clinic, the mode of transport used and the mean number of drug refills in the 9-month period before the intervention period varied. Further research is needed to clarify the effect of these differences on the study results. This is a limitation of the quasi-experimental design.

Conclusions

Pharmacy-based programmes look promising in the quest to improve blood pressure control in the drug-treated hypertensive population. Although very few individual patients seem to be willing to pay for such programmes, our results suggest that, from a societal viewpoint, the benefits may be 10-fold higher than the costs. This finding warrants more research to assess the long-term clinical and economic impact of this pharmacy-based programme on a larger population and for a longer period of time.

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References

1. Joffres MR, Ghadirian P, Fodor JG, et al. Awareness, treatment, and control of hypertension in Canada. Am J Hypertens 1997; 10 (10 Pt 1): 1097-102
2. Chockalingam A, Fodor JG. Treatment of raised blood pressure in the population: the Canadian experience. Am J Hypertens 1998; 11 (6 Pt 1): 747-9
3. MacMahon S, Peto R, Cutler J, et al. Blood pressure, stroke, and coronary heart disease. Part 1, prolonged differences in blood pressure: prospective observational studies corrected for the regression dilution bias. Lancet 1990; 335 (8692): 765-74
4. Psaty BM, Smith NL, Siscovick DS, et al. Health outcomes associated with antihypertensive therapies used as first-line agents: a systematic review and meta-analysis. JAMA 1997; 277 (9): 739-45
5. Joint National Committee on Prevention Detection Evaluation and Treatment of High Blood Pressure. The sixth report of the joint national committee on prevention, detection, evaluation, and treatment of high blood pressure. NIH publication no. 98-4080. Bethesda (MD): National Institute of Health, 1997
6. Grégoire J-P, Guibert R, Archambault A, et al. Measurement of non-compliance to antihypertensive medication using pill counts and pharmacy records. J Soc Adm Pharm 1997; 14 (4): 198-207
7. McKenney JM, Slining JM, Henderson HR, et al. The effect of clinical pharmacy services on patients with essential hypertension. Circulation 1973; 48: 1104-11
8. Hammarlund ER, Ostrom JR, Kethley AJ. The effects of drug counseling and other educational strategies on drug utilization of the elderly. Med Care 1985; 23: 165-70
9. Erickson SR, Slaughter R, Halapy H. Pharmacists' ability to influence outcomes of hypertension therapy. Pharmacotherapy 1997; 17 (1): 140-7
10. Chabot I. Impact d'un programme d'intervention sur la tension artérielle d'hypertendus traités pharmacologiquement en pharmacie communautaire. Une étude exploratoire [PhD thesis]. Québec: Université Laval, 2001
11. Chabot I, Moisan J, Grégoire JP, et al. Effect of a pharmacy-based intervention program on blood pressure [abstract]. Pharmacoepidemiol Drug Saf 2000; 9: S122
12. Green LW, Kreuter MW. Health promotion planning: an educational and environmental approach. 2nd ed. Mountain View (CA): Mayfield Publishing Company, 1991
13. Santé Québec. Et la santé, ça va en 1992-1993? Rapport de l'enquête sociale et de santé 1992-1993: vol 1. Québec: Gouvernement du Québec, 1995
14. Fortin B, Garneau G, Lacroix G, et al. L'économie souterraine au Québec: mythes et réalités. Québec: Presses de l'Université Laval, 1996
15. World Health Organization. Manual of the international classification of diseases, injuries and causes of death. 8th rev. ed. Geneva: World Health Organization, 1967
16. Rethans JJ, Sturmans F, Drop R, et al. Does competence of general practitioners predict their performance: comparison between examination setting and actual practice. BMJ 1991; 303 (6814): 1377-80
17. Rethans JJ, Saebu L. Do general practitioners act consistently in real practice when they meet the same patient twice? Examination of intradoctor variation using standardised (simulated) patients. BMJ 1997; 314 (7088): 1170-3
18. Desgagné A, Castilloux AM, Angers JF, et al. The use of the bootstrap statistical method for the pharmacoeconomic cost analysis of skewed data. Pharmacoeconomics 1998; 13 (5): 487-97
19. Drummond M, O'Brien B, Stoddart G, et al. Methods for the economics evaluation of health care programmes. 2nd ed. Oxford: Oxford University Press, 1997
20. Santé Québec, Lavallée C, Belleronse C, et al. Aspects sociaux reliés à la santé. Rapport de l'enquête sociale et de santé 1992-1993, vol. 2. Montréal: ministère de la Santé et des Services sociaux, Gouvernement du Québec, 1995
21. Munroe WP, Kunz K, Dalmady-Israel C, et al. Economic evaluation of pharmacist involvement in disease management in a community pharmacy setting. Clin Ther 1997; 19 (1): 113-23
22. Jameson J, VanNoord G, Vanderwoud K. The impact of a pharmacotherapy consultation on the cost and outcome of medical therapy. J Fam Pract 1995; 41 (5): 469-72
23. Bozek PS, Perdue BE, Bar-Din M, et al. Effect of pharmacist interventions on medication use and cost in hospitalized patients with or without HIV infection. Am J Health Syst Pharm 1998; 55 (11): 1151-5

24. Galt KA. Cost avoidance, acceptance, and outcomes associated with a pharmacotherapy consult clinic in a Veterans Affairs Medical Center. Pharmacotherapy 1998; 18 (5): 1103-11
25. Kroger E, Moisan J, Gregoire JP. Billing for cognitive services: understanding Quebec pharmacists' behavior. Ann Pharmacother 2000; 34 (3): 309-16
26. Cook T, Campbell D. Quasi-experimentation: design and analysis issues for fields settings. Boston (MA): Houghton Mifflin Company, 1979
27. Rossi P, Freeman H. Evaluation. 5th ed. Newbury Park (CA): Sage Publications Inc, 1993
28. Santé Québec, Daveluy C, Chenard L, et al. Et votre coeur, ça va? Rapport de l'Enquête québécoise sur la santé cardiovasculaire 1990. Montréal: Ministère de la Santé et des Services sociaux, gouvernement du Québec, 1994
29. Baltussen R, Leidl R, Ament A. The impact of age on cost-effectiveness ratios and its control in decision making. Health Econ 1996; 5 (3): 227-39

Correspondence and offprints: Dr *Jocelyne Moisan*, Population Health Research Unit, Hopital St-Sacrement, 1050 Chemin Ste-Foy, Quebec City, Quebec G1S 4L8, Canada.
E-mail: jocelyne.moisan@pha.ulaval.ca