

# RESEARCH

## Effect of nurse-directed hypertension treatment among First Nations people with existing hypertension and diabetes mellitus: the Diabetes Risk Evaluation and Microalbuminuria (DREAM 3) randomized controlled trial

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An unabridged version of this article was published online on Apr. 4, 2006, and is available at [www.cmaj.ca/cgi/content/full/174/9/1267](http://www.cmaj.ca/cgi/content/full/174/9/1267)

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### ABSTRACT

**Background:** First Nations people with diabetes mellitus and hypertension are at greater risk of renal and cardiovascular complications than are non-native patients because of barriers to health care services. We conducted this randomized controlled trial to assess whether a community-based treatment strategy implemented by home care nurses would be effective in controlling hypertension in First Nations people with existing hypertension and type 2 diabetes.

**Methods:** We compared 2 community-based strategies for controlling hypertension in First Nations people with existing hypertension and diabetes. In the intervention group, a home care nurse followed a predefined treatment algorithm of pharmacologic antihypertensive therapy. In the control group, treatment decisions were made by each subject's primary care physician. The primary outcome measure was the difference between the 2 groups in the change in systolic blood pressure after 12 months. Secondary outcome measures were the change in diastolic blood pressure over time, the change in urine albumin status and the incidence of adverse events.

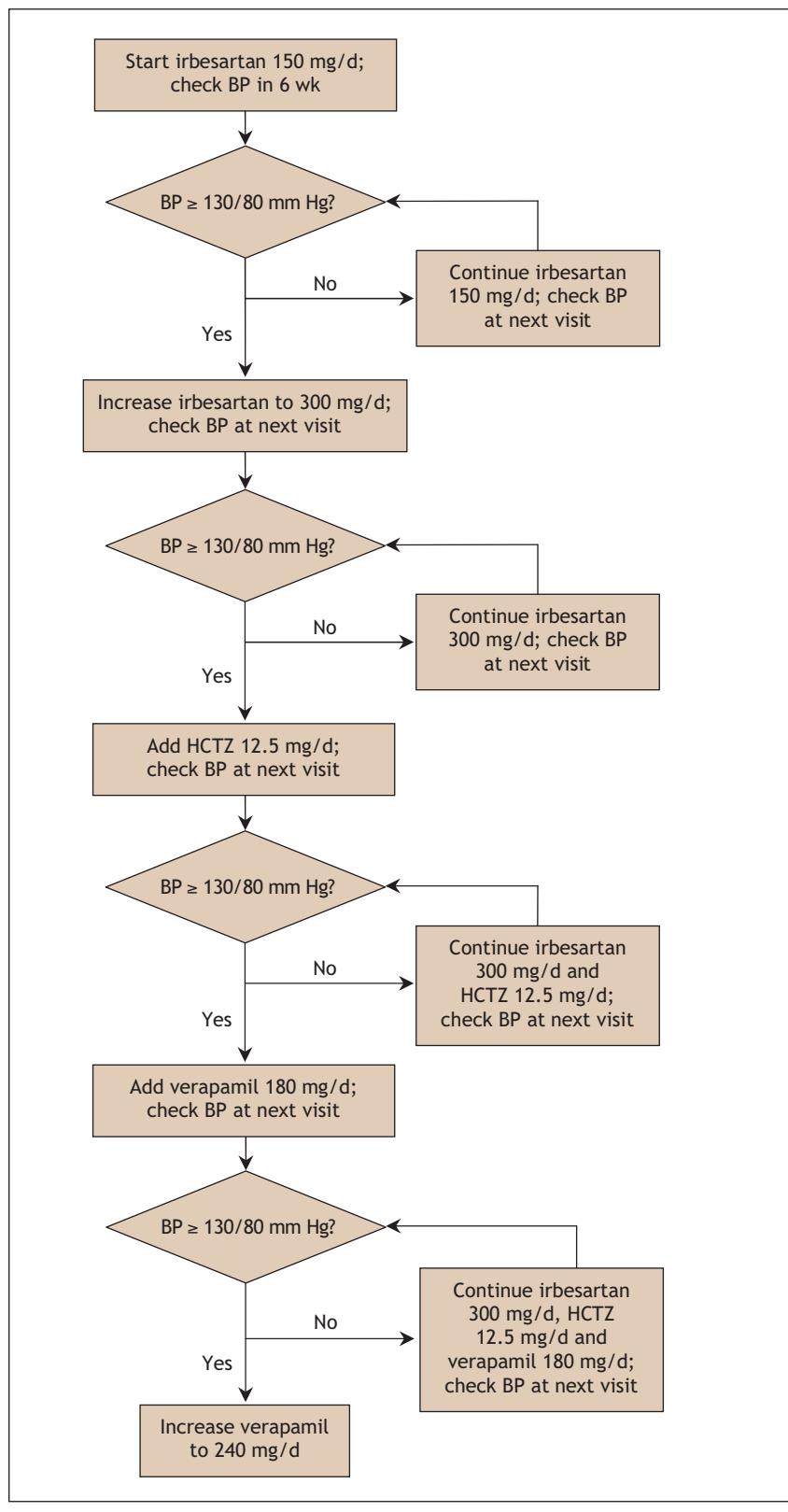
**Results:** Both groups experienced a significant reduction in systolic blood pressure by the final visit (by 24.0 [standard deviation (SD) 13.5] mm Hg in the intervention group and by 17.0 [SD 18.6] mm Hg in the control group);  $p < 0.001$  in each case). However, the difference between the 2 groups in this change was not significant. Patients in the intervention group had a larger decrease in diastolic blood pressure over time than did those in the control group (by 11.6 [SD 10.6] mm Hg v. 6.8 [SD 11.1] mm Hg respectively;  $p = 0.05$ ). The groups did not differ significantly in terms of changes in urine albumin excretion or incidence of adverse events.

**Interpretation:** High rates of blood pressure control in the community were achieved in both groups in the DREAM 3 study. The addition of a home care nurse to implement a treatment strategy for blood pressure control was more effective in lowering diastolic than systolic blood pressure compared with home care visits for blood pressure monitoring alone and follow-up treatment by a family physician.

CMAJ 2006;174(9):1267-71

Patients with type 2 diabetes mellitus and hypertension are at increased risk of cardiovascular events and chronic renal failure requiring dialysis.<sup>1</sup> In Canada, the risk of progression to end-stage renal disease among such people is 7 times higher in the First Nations population than in the non-native population.<sup>2</sup> Although effective strategies exist for treating hypertension, in First Nations populations treatment of hypertension is challenging because of reduced access to ambulatory care and a hesitancy regarding modern disease management strategies.<sup>3</sup> Clinical studies in hypertension have shown that high rates of blood pressure control are attainable;<sup>4</sup> in the research setting, nurse-implemented algorithms supervised by a physician have been found to contribute to efficacious blood pressure control.<sup>5</sup>

In 1998 the Diabetes Risk Evaluation and Microalbuminuria (DREAM 1) study was initiated at the request of the Battlefords Tribal Council Indian Health Services to assess the prevalence of risk factors for end-stage renal disease (ESRD) among First Nations people with type 2 diabetes in the Battlefords region of northern Saskatchewan.<sup>6</sup> In 2000 the DREAM 2 pilot study demonstrated a reduction of systolic blood pressure when home care nurses measured blood pressure at regular intervals and notified the patient's family physician.<sup>6</sup> In this article, we report the findings of the DREAM 3 study, which was designed



**Fig. 1:** Hypertension management algorithm followed by home care nurses for patients assigned to the intervention group. Patients were given irbesartan at a starting dose of 150 mg/d. During subsequent visits, if the blood pressure (BP) was greater than the target level, the regimen was stepped up according to the protocol. Verapamil was prescribed in a long-acting format. Note: HCTZ = hydrochlorothiazide.

to evaluate the effect on blood pressure control of an algorithm of pharmacologic therapy implemented by home care nurses in a community setting.

## Methods

A complete description of the methods can be found in the unabridged version of this article (available at [www.cmaj.ca/cgi/content/full/174/9/1267](http://www.cmaj.ca/cgi/content/full/174/9/1267)). In brief, we conducted a randomized controlled study that compared the effect of 2 community-based strategies of treating hypertension in First Nations people with existing hypertension and type 2 diabetes.

All patients were seen by a home care nurse in the medical clinic on their reserve at baseline, at 6 weeks and at 3, 6, 9 and 12 months. A hypertension specialist (S.W.T. or G.P.) saw all participants at their baseline and final visits. In addition, all patients received healthy lifestyle classes, focusing on a healthier dietary regimen, exercise (30 minutes per day, 5 days per week), smoking cessation, and drug adherence.<sup>7</sup> Following each visit, a letter summarizing the patient's current medications, blood pressure and updated laboratory test results was completed and forwarded to the primary care physician. A summary of the clinical practice guidelines for managing hypertension in people with diabetes<sup>8</sup> was included with each letter. Also included were algorithms for glucose and lipid control (see online appendices, available at [www.cmaj.ca/cgi/content/full/cmaj.050030/DC1](http://www.cmaj.ca/cgi/content/full/cmaj.050030/DC1)); these algorithms were developed from current clinical practice guidelines.<sup>8-10</sup>

In the intervention arm, hypertension was managed by a home care nurse who followed a predefined treatment algorithm of pharmacologic antihypertensive therapy (Fig. 1). In the control group, the home care nurse monitored the participants' blood pressure and, if necessary, arranged follow-up with their primary care physician.

The primary outcome measure was the difference in the change in systolic blood pressure over time between the 2 groups. Secondary outcome measures included the change in diastolic blood pressure over time, the change in urine albumin status and the incidence of adverse events.

## Results

First Nations people from the Battlefords region at increased risk of diabetes or with known diabetes were screened. A total of 179

were found to have either diabetes or, on further testing, a fasting blood glucose level in the diabetes range (Fig. 2). Of these, 61 had normal or controlled blood pressure ( $< 130/80$  mm Hg), and the rest were invited to participate in the study (see Fig. 2 of the unabridged version of the article, available at [www.cmaj.ca/cgi/content/full/174/9/1267](http://www.cmaj.ca/cgi/content/full/174/9/1267)). Seventeen people declined to participate for various reasons, including travel commitments and a fear of needles. Two other patients were excluded, one because of unstable retinopathy that required therapy and the other because she had become pregnant between the screening and baseline visits.

Data from the final 12-month visit, or from the last available visit for those lost to follow-up, were used in the intention-to-treat analysis. Four patients (2 from each group) were not included in the analysis: 2 (one from each group) were withdrawn from the study (one was found to have bilateral renal artery stenosis, an exclusion criteria, and was removed from the study for treatment; the other was enrolled into another study by the patient's family physician), and 2 (one from each group) withdrew their consent to allow use of their data for analysis. Three patients in the intervention group withdrew (one at 6 weeks and 2 at 9 months), and 5 in the control group withdrew (one after the baseline visit, one at 6 weeks, one at 3 months, one at 6 months and one at 9 months); their data were included in the intention-to-treat analysis. Therefore, 95 participants were included in the analysis: 48 in the intervention group and 47 in the control group. There were no significant differences between the 2 groups in demographic and clinical characteristics at baseline (Table 1) or at the final visit (data not shown).

In both the intervention and control groups, the change in blood pressure from baseline readings to those at the final visit was statistically significant (Table 2). The reduction in systolic blood pressure was 7.0 mm Hg greater in the intervention group than in the control group, but this difference was not statistically significant ( $p = 0.14$ ). The drop in diastolic blood pressure over time was 4.8 mm Hg greater in the intervention group than in the control group ( $p = 0.05$ ); the RANOVA analysis was repeated 1000 times using bootstrap methods and yielded a median  $p$  value of 0.042. Overall, blood pressure targets (systolic  $< 130$  mm Hg and diastolic  $< 80$  mm Hg) were achieved in 48% of the participants with no significant difference between the 2 groups. Most of the patients in the control group had the doses of their hypertension medications titrated upward during the study by their primary care physicians.

The urine albumin level decreased from baseline to the final visit in both groups, from 157.8 to 115.5 mg/L in the treatment group and from 164.8 to 124.9 mg/L in the control group. The differences between and within the 2 groups were not statistically significant (Table 2), even when log-transformed levels were analyzed (data not shown). Over the course of the study, the patients who had existing microalbuminuria did not have progression to overt nephropathy; in many cases of existing overt nephropathy, the condition regressed to microalbuminuria during the study, although a regression to normal urine albumin levels did not occur (see Table 3 of the unabridged version of the article, available at [www.cmaj.ca/cgi/content/full/174/9/1267](http://www.cmaj.ca/cgi/content/full/174/9/1267)).

## Adverse events

The incidence of adverse events did not differ significantly between the 2 groups. Ten patients in the intervention group and 7 in the control group required admission to hospital. Of those in the intervention group, 2 were admitted because of myocardial infarction and angina, 1 patient was admitted on 6 occasions (once for management of diabetes and 5 times for treatment of skin infections and a lower-leg amputation), 2 were admitted because of pneumonia, 1 for management of diabetes, 1 because of bleeding hemorrhoids, 1 for treatment of depression, 1 because of a nonspecific allergic reaction (did not require a change in medications) and 1 because of pyelonephritis. In the control group, 2 of the 7 patients were admitted because of myocardial infarction and angina, 1 was admitted because of stroke. The other 4 patients were admitted for cholecystectomy, diabetes management, treatment of pneumonia (admitted twice) and management of resistant hypertension. All 17 patients were assessed at the 12-month visit and were included in the intention-to-treat analysis.

## Interpretation

We found that, among First Nations people with existing hypertension and diabetes enrolled in the DREAM 3 study, the intervention of having a home care nurse monitor their blood pressure and follow a predefined treatment algorithm was as effective in lowering systolic blood pressure over time as was the control strategy of having a home care nurse monitor their blood pressure and their family physician decide on follow-up treatment. The intervention was, however, significantly more effective than the control strategy in lowering diastolic pressure. Improvement in blood

**Table 1:** Baseline demographic and clinical characteristics and biochemical status of patients in the DREAM 3 study

Variable	Group; mean (SD)*	
	Intervention <i>n</i> = 50	Control <i>n</i> = 49
Age, yr	55.4 (12.9)	55.9 (11.5)
Sex, no. (%) male	19 (38)	19 (39)
BMI, kg/m <sup>2</sup>	34.2 (2.6)	33.6 (2.1)
Hip circumference, cm	112.8 (15.0)	111.6 (11.1)
Waist circumference, cm	111.4 (15.5)	111.0 (12.1)
Serum creatinine, µmol/L	69.8 (17.1)	72.6 (16.0)
Serum potassium, mmol/L	4.1 (0.4)	4.1 (0.42)
Total cholesterol, mmol/L	5.1 (0.9)	5.2 (1.1)
HDL cholesterol, mmol/L	1.2 (0.4)	1.0 (0.3)
Hemoglobin A <sub>1c</sub> , %	7.9 (1.9)	7.7 (1.8)
Plasma glucose, mmol/L	9.7 (4.7)	10.1 (5.3)
Urine albumin:creatinine ratio, mg/mmol	25.1 (72.6)	33.3 (105.1)

Note: DREAM = Diabetes Risk Evaluation and Microalbuminuria, SD = standard deviation, BMI = body mass index, HDL = high-density lipoprotein.

\*Unless stated otherwise.

pressure in both groups over the study period may have been due in part to the patients' involvement in the study program, with education given and blood pressure measured by the home care nurse in both groups. The urine albumin levels fell in both groups, but the difference between the groups was not significant.

Reducing blood pressure to the lower end of the renal autoregulatory range (< 130/80 mm Hg) has been found to result in significant renal protection.<sup>11</sup> Achieving this target in people with diabetes is currently suboptimal (about 9% in Canada).<sup>12</sup> High rates of control of multiple cardiovascular risk factors in the research setting have been achieved with a multidisciplinary approach.<sup>13</sup> Furthermore, blood pressure control has been found to be cost-effective.<sup>14</sup> The challenge lies in achieving effective blood pressure control in the community, as has been attempted in Australia.<sup>15</sup> Specially trained nurses instructed to follow detailed protocols and algorithms under the supervision of a specialist has been shown to improve diabetes outcomes,<sup>16</sup> as have nurse-led clinics.<sup>17</sup> A Canadian outreach program was effective in lowering blood pressure among people with diabetes living in a rural setting.<sup>18</sup> New strategies and partnerships that include family physicians, nurses and specialists are required if cardiovascular risk factors such as hypertension are to be controlled.

**Table 2:** Blood pressure, urine albumin and hemoglobin A<sub>1c</sub> values at baseline and at final visit

Variable	Group; mean (SD)	
	Intervention	Control
<b>Systolic blood pressure, mm Hg</b>		
Baseline	149.7 (10.5)	150.5 (19.1)
Final visit	125.7 (16.6)	133.5 (18.1)
Change over time	-24.0 (13.5)†	-17.0 (18.6)†
p value*	< 0.001	< 0.001
<b>Diastolic blood pressure, mm Hg</b>		
Baseline	87.1 (8.4)	84.2 (11.1)
Final visit	75.5 (12.7)	77.4 (11.3)
Change over time	-11.6 (10.6)‡	-6.8 (11.1)‡
p value*	< 0.001	< 0.001
<b>Urine albumin, mg/L</b>		
Baseline	157.8 (507.0)	164.8 (446.0)
Final visit	115.5 (391.0)	124.9 (369.0)
Change over time	-42.3 (498.8)†	-40.9 (364.9)†
p value*	0.57	0.71
<b>Hemoglobin A<sub>1c</sub>, %</b>		
Baseline	7.7 (1.8)	7.7 (1.8)
Final visit	7.8 (2.1)	7.7 (1.9)
Change over time	0.1 (1.7)†	-0.0 (1.3)†
p value*	0.68	0.87

\*For comparison within group over time.

†p > 0.05 (not significant) for comparison between groups over time.

‡p = 0.05 for comparison between groups over time.

Our study had several limitations. The home care nurse may have had an effect on blood pressure control independent of the treatment algorithm, which may explain the change in blood pressure seen in the control group. In addition, there may have been a halo effect because patients in the intervention group and the control group shared family physicians. By witnessing effects on blood pressure control, a patient in the intervention group may have influenced his or her family physician's practice for managing hypertension in a control patient. In planning the study, we recognized that these effects could challenge the potential superior benefit of the treatment protocol but, because the care received would have the potential to improve overall health care delivery for the subjects and their community, we felt it to be a fair trade-off. The study was unblinded because it was unacceptable to conceal treatment in this population. There were insufficient family physicians in the region to randomize by practice. Because the sample was smaller than 60 in each group, a significant difference in the primary outcome measure may have been missed owing to a type II error. Finally, in addition to the effect of the visits by the home care nurse and education in both groups, confounding from interactions between subjects within a single reserve or subjects sharing a family physician may have affected the outcome of this study and should be explored in future investigations.

The DREAM 3 study was designed to evaluate the effectiveness of an algorithm of pharmacologic therapy on blood pressure control implemented by a home care nurse in a community setting. High rates of blood pressure control in the community were achieved in both groups. New strategies such as that used in the DREAM 3 study and partnerships that involve family physicians, nurses and specialists are required if hypertension, a major reversible cardiovascular risk factor, is to be treated to target levels.

This article has been peer reviewed.

From the Sunnybrook and Women's College Health Sciences Centre (Tobe, Kiss, Szalai [deceased], Perkins), Toronto, Ont.; St. Paul's Hospital and University of Saskatchewan (Pylypczuk), Saskatoon, Sask.; and Battlefords Tribal Council Indian Health Services (Wentworth, Hartman, Ironstand, Hoppe), North Battleford, Sask.

**Competing interests:** None declared for Joan Wentworth, Alexander Kiss, John Paul Szalai, Nancy Perkins, Susan Hartman, Laurie Ironstand or Jacqueline Hoppe. Sheldon Tobe Sheldon Tobe has received funding for non-peer-reviewed investigator-initiated research from Pfizer and Merck and for industry-supported contract research from Astra Zeneca, Pfizer, Ortho Biotech, Novartis, Bristol Myers Squibb, Sanofi, Amgen, Roche, Merck Frosst and Boehringer-Ingelheim, as well as speaker fees from Pfizer, Bristol Myers Squibb, Merck, Sanofi-Aventis, Amgen and Abbott. George Pylypczuk has a paid consultancy with Merck Frosst for the Expert MD education program for family physicians; he has also received educational grants and speaker fees from Merck Frosst, Biovail, Pfizer, BMS-Sanofi, Novartis, Amgen, Abbott and Boehringer Mannheim, and travel assistance to attend meetings from Biovail.

**Contributors:** Sheldon Tobe was responsible for the integrity and accuracy of the data analysis. All of the authors were responsible for the collection, management, and analysis and interpretation of the data and for the review and preparation of the manuscript.

**Acknowledgement:** Support for this study was provided by the Canadian Institutes of Health Research (CIHR), in partnership with Pfizer Canada. Neither the CIHR nor Pfizer Canada had a role in the design or conduct of the study or in the collection, management, analysis and interpretation of the data.

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