Evaluation of a mobile diabetes care telemedicine clinic serving Aboriginal communities in northern British Columbia, Canada

Andrew J. Jin1, David Martin2, David Maberley3, Keith G. Dawson4, David W. Seccombe5, Joyce Beattie6

1 Epidemiology consultant, Canada
2 Pacific Region, First Nations and Inuit Health Branch, Health Canada
3 Dept. of Ophthalmology, University of British Columbia, Canada
4 Division of Endocrinology, Dept. of Medicine, University of British Columbia, Canada
5 Canadian External Quality Assessment Laboratory, Vancouver, Canada
6 First Nations Summit Society, Vancouver, Canada

ABSTRACT

Introduction. In British Columbia, Aboriginal diabetes prevalence, hospitalization and mortality rates are all more than twice as high as in the rest of the population. We describe and evaluate a program to improve access to diabetes care for Aboriginal people in northern communities. Study design. Cost-effectiveness evaluation. Methods. A diabetes nurse educator and an ophthalmic technician travel to Aboriginal reserves, offering people with diabetes services recommended in current clinical practice guidelines: retinopathy screening by digital retinal fundus photography, glaucoma screening by tonometry, point-of-care urine and blood testing to detect microalbuminuria and dyslipidemia and to measure glycated hemoglobin, foot examinations and foot care advice, blood pressure and height and weight measurement and diabetes care advice. Via electronic communication, an ophthalmologist and an endocrinologist in Vancouver review the findings and supervise the mobile clinic staff. Results. During the first year, 25 clinics were held at 22 sites, examining 339 clients with diabetes. Exit surveys showed high levels of client satisfaction. Mean cost per client (Cdn$1,231) was less than for the alternative, transporting clients to care in the nearest cities (Cdn$1,437). Conclusions. The mobile clinic is cost-effective and improves access to the recommended standard of diabetes care.

Keywords: glycated hemoglobin, retinal photography, tonometry, urine sugar.

INTRODUCTION

In the province of British Columbia, Canada, diabetes mellitus is three times more prevalent among Aboriginal people than in the general population (1), and deaths (2) and hospitalizations (3) from diabetes are twice as frequent among Aboriginal people. The long-term complications of diabetes (blindness, kidney failure, heart attack, stroke, limb amputation) are preventable with good self-management and appropriate health care (4). However, due to geographic remoteness and socioeconomic disadvantage, Aboriginal people have difficulty accessing diabetes care services.

The British Columbia First Nations Mobile Diabetes Telemedicine Clinic serves Aboriginal people living in reserve communities in the northern part of the province. This area contains reserves belonging to 59 registered Aboriginal bands. The population of these reserves is 22,689 people (5). We estimate the prevalence of diabetes to be 3.6% (6) of this population, or about 817 persons. The clinic is intended to improve people’s capacity to comply with clinical practice guidelines for diabetes, to improve the standard of care for diabetic persons, and to reduce diabetes-related death, illness and disability in the target population. The clinic is managed by the Chief’s Health Committee of the First Nations Summit Society.
Circumpolar Health 2003 • Nuuk

(An association of elected Aboriginal chiefs representing 70% of the registered Aboriginal bands in British Columbia) and is supported by funds from the First Nations and Inuit Health Branch of Health Canada (Canadian federal government health agency).

The clinic staff, a nurse certified as a diabetes educator and an eye care technician, travel to reserve communities in northern BC, providing screening and education procedures recommended in current clinical practice guidelines (4). Each community is visited about once per year. The nurse maintains contact with clients by telephone in between visits. Clinic procedures include:

• retinal fundus photography to screen for diabetic retinopathy,
• tonometry to screen for chronic open-angle glaucoma,
• urinary microalbumin:creatinine ratio to screen for early diabetic nephropathy,
• fingerprick hemoglobin A1C measurement,
• fingerprick blood cholesterol and triglycerides profile,
• blood pressure, height and weight measurement,
• foot examination and foot care education,
• personal diabetes management advice from the nurse.

Blood and urine specimens are analyzed at the clinic site with portable, point-of-care laboratory equipment, providing immediate feedback to the client. The point-of-care testing is monitored by a program of daily internal quality control at each clinic site and periodic external quality assessment at a reference laboratory (D. Seccombe). The client record is transmitted by e-mail to a medical specialist in diabetes (K. G. Dawson) who verifies the appropriateness of the nurse’s advice. The retinal photographs are recorded in digital electronic format and transmitted to a retinal specialist ophthalmologist (D. Maberley) for interpretation. If any serious eye disease is detected, the clinic facilitates referral to the nearest ophthalmologist. A summary report of the entire clinic examination is sent to the client’s personal physician.

The program objectives for first year that we sought to evaluate were:

• to implement the clinic service for First Nations reserve communities in northern BC,
• to monitor and report the delivery of program services,
• to compile a descriptive profile of diabetes in the target population,
• to assess client satisfaction, and
• to assess the program’s cost-effectiveness.

METHODS

We monitored clinic activity (number and location of clinic sites, numbers of clinic-days of operation, numbers of clients examined) and resource consumption (capital purchases and operating expenses) from the clinic inception in March 2002 until the end of the first complete fiscal year (March 31, 2003). Client satisfaction was assessed by anonymous, self-administered survey questionnaires completed by clients as they exited the clinic. Descriptive information about the client’s diabetic condition was extracted from the clinical records.

We assessed the mean cost per client examined by the mobile clinic program as the total operating expenses plus one-fifth of the capital expenditures (we assumed that the major equipment items, the motor vehicle and the retinal camera, would have a useful life expectancy of 5 years), divided by the number of diabetic clients examined.

As the alternative service model, we assumed that the mobile clinic’s clients would otherwise have obtained equivalent services by travelling to the nearest primary care physician, clinical laboratory, diabetes education centre, ophthalmologist and medical diabetes specialist. For each site visited by the mobile clinic team, we determined the location of the nearest providers of these services, the cost of the services that would have been paid by the Medical Services Plan of British Columbia (the provincial health care insurance system) and the cost of a person travelling to these services that would have been reimbursed by the Non-Insured Health Benefits program (Health Canada’s supplemental health care insurance program for
registered Aboriginal persons with Indian Status). If more than one service was located in the same location, we assumed that a person would obtain all the services in one excursion. We ascertained the usual routes and modes of transportation to the services by interviewing local community health workers at each clinic site. We ascertained fares for transportation by commercial carriers from quotes obtained in August 2003. Use of a personal motor vehicle was assessed at Cdn$0.20 per kilometre driven. Overnight accommodation we assessed at Cdn$100.00 per night. Meals while travelling we assessed at Cdn$31.00 per day. If, for reasons of age, infirmity, illness or disability, a client would have required an escort person to accompany him or her during travel, then we multiplied the client’s assumed travel expenses by a factor of two. We assessed the mean alternative cost per client as the total Medical Services Plan costs plus the total Non-Insured Health Benefits program costs divided by the number of clients examined.

RESULTS

An office base was established in the northern city of Prince George, British Columbia. Personnel consist of a project coordinator (full time), an eye care technician (half-time), and a diabetes nurse-educator (full time). Capital purchases consisted of a motor vehicle (a 2002 GMC Suburban sport-utility vehicle), a digital retinal photography system, a Tonopen tonometer, miscellaneous other eye and medical examination equipment, and point-of-care blood and urine testing equipment (Ames/Bayer DCA 2000 and Cholestech LDX systems, two of each). Total capital expenditure was Cdn$160,260.

Clinic activity: The mobile clinic began examining clients in March 2002, offering eye examination, blood pressure, height and weight measurements and group diabetes education. Beginning in January 2003, foot examination and foot care advice, blood and urine testing, and personal diabetes care advice by the diabetes nurse educator were added. As of March 31, 2003, 25 clinics (operating 62 days) had been held at 22 sites. Three sites had been visited twice. The clinic examined 402 people, 339 had previously been diagnosed as diabetic by a health care professional. As for the other 63 persons who were examined, it was not clear if they were diabetic, glucose intolerant or merely at risk of diabetes. Of the 339 diabetic persons examined, 148 (44%) would have required an escort person for medical travel outside of their home communities. The number of diabetic persons examined at each clinic was highly variable, the fewest was one, the most was 41, at six clinics five or fewer diabetic persons attended, at five clinics 22 or more attended.

Descriptive profile of diabetic clients: Among diabetic persons examined by the mobile clinic up to March 31, 2003, we found:

- 41% were male, 59% were female,
- 3% were 34 years of age or younger, 62% were 35 to 64 years of age, 35% were 65 years of age or older,
- 75% (241 of 321) were obese (Body Mass Index (kg/m²) ≥ 30), 26% (85 of 321) were extremely obese (BMI ≥ 40),
- 57% had a history of high blood pressure, 28% had a history of high cholesterol,
- 10% had a previous heart attack, 34% had angina, 12% had a previous stroke,
- 11% had symptoms of neuropathy,
- 12% said they had protein in their urine,
- 18% smoked cigarettes daily, 11% smoked occasionally,
- 46% had had diabetes for five years or longer,
- 19% took insulin (with or without oral medication), 53% took oral hypoglycaemic medication alone, 28% took no medication for diabetes,
- 30% were due for a retinal examination (last dilated eye examination was 1 to 2 years ago), 23% were overdue (last dilated eye examination was more than 2 years ago, or never had such an examination),
- among those who had ever had a dilated eye examination, only 55% (160 of 289) had been examined by an ophthalmologist.
among 682 eyes (belonging to 341 diabetic clients), the mobile clinic photographed 639 eyes (94%), 582 eyes (85%) were photographed through dilated pupils, 589 eyes (86%) had photographs adequate for diabetic retinopathy grading.

among the 589 eyes that could be graded, 475 (81%) showed no retinopathy, 57 (10%) showed questionable or minimal retinopathy, 57 (10%) showed mild non-proliferative diabetic retinopathy or worse,

among the 304 diabetic clients with at least one eye that could be graded, diabetic retinopathy (of any degree) was present in 23%,

29% of clients (103 of 341) required referral to an ophthalmologist (for retinopathy or another reason), 2% (7 of 341) had a problem requiring prompt consultation with an ophthalmologist (within 2 months).

Client satisfaction: Among the 402 people examined by the mobile clinic up to March 31, 2003, 386 (96%) completed exit questionnaires. Client satisfaction was overwhelmingly positive: 358 (93%) agreed with the statement that using the mobile clinic was more convenient than travelling to the nearest medical specialists, 366 (95%) would use the mobile clinic again, 365 (95%) would recommend it to others.

Cost-effectiveness: Operating costs for the first year (ending March 31, 2003) were Cdn$348,665. This included non-recurring program development costs. At the same time, as noted above, not all program components were in operation during the entire year. Projected annual cost for the full program during the second year is Cdn$385,226. Assuming annual operating expenses of Cdn$385,226 plus capital expenditures amortized over five years (Cdn$160,260 / 5 = Cdn$32,052), divided by the number of diabetic clients examined in first year (339), we calculate the mean cost per client served by the mobile clinic as Cdn$1,231 (for the full panel of services). Alternatively, if each of these clients had obtained equivalent services by travelling to the nearest primary care physician, clinical laboratory, diabetes education centre, ophthalmologist and medical diabetes specialist, the mean cost per client would have been Cdn$1,437, consisting of professional and lab fees of Cdn$291 paid by the Medical Services Plan of BC, plus patient travel expenses of Cdn$805 and escort travel expenses of Cdn$340 paid by the federal Non-Insured Health Benefits program.

DISCUSSION

Our cost-effectiveness method evaluated cost per unit service delivered, for the mobile diabetes clinic and for the alternative of having clients travel to the nearest service providers. We did not evaluate cost per unit health outcome because we do not yet have an empiric method to predict, in the absence of the mobile diabetes clinic, either the likelihood of clients accessing services from alternate sources, or the health impacts of the alternate services. However, even if we assumed a "worst case" scenario, that in the absence of the mobile diabetes clinic all of the clients would have obtained equivalent services elsewhere, and that their health outcomes would have been just as good, we still have evidence that the mobile clinic is worthwhile, because it delivers equivalent services at less cost than the alternative.

Regardless of who provides the services, the relevance and the effectiveness of the specific screening and education procedures provided by the mobile diabetes clinic have already been established by previous researchers. This is reflected by the inclusion of these procedures in current, evidence-based clinical practice guidelines (4).

The mobile diabetes clinic continues to operate, making an annual circuit of its northern reserve community sites. In the second year, the Chiefs’ Health Committee will intensify efforts to promote the mobile clinic and increase diabetes awareness in the target population. It is anticipated that this will improve attendance at the clinics and further improve the mobile clinic’s cost-effectiveness. The mobile clinic also intends to develop a system to transmit the retinal photographs directly from the clinic sites using Internet communication, thus reducing the time clients have to
wait before obtaining interpretive advice from the consulting retinal specialist ophthalmologist. Funding from First Nations and Inuit Health Branch, Health Canada continues during the second year; afterwards, the source is uncertain.

We conclude that the mobile diabetes clinic program was needed, that it provides relevant services, known to be effective and beneficial, that it delivers the services at less cost than the existing alternative, and that the clients were very satisfied with the convenience and accessibility of the mobile clinic. The program is worth continuing.

REFERENCES
1. Custom analysis of data from the 1997 BC First Nations Regional Health Survey, and from the 1996/1997 National Population Health Survey, published in the Chiefs’ Health Examiner, May 2002. Http://www.fnchc.ca/_pdf/SpecialEdition_Diabetes_May2002.pdf (accessed October 29, 2003.)
2. Jin A, Martin JD, Sarin C. Diabetes mellitus in the First Nations population of British Columbia, Canada. Part 1. Mortality. Int J Circumpolar Health 2002; 61(3):251-3.
3. Jin A, Martin JD, Sarin C. Diabetes mellitus in the First Nations population of British Columbia, Canada. Part 2. Hospital morbidity. Int J Circumpolar Health 2002; 61(3):254-9.
4. Meltzer S, Leiter L, Daneman D, Gerstein HC, Lau D, Ludwig S, Yale J-F, Zinman B, Lillie D. 1998 clinical practice guidelines for the management of diabetes in Canada. Can Med Assoc J 1998; 159(8 suppl):S1-29.
5. Indian and Northern Affairs Canada. Housing and infrastructure assets summary report, 1999-2000.
6. BC First Nations Health Survey: Health and wellness of First Nations people in British Columbia. January, 2000. (Available from the First Nations Chiefs’ Health Committee, Suite 708, 100 Park Royal South, West Vancouver, BC V7T 1A2, Tel: (604) 913-2080.)

Dr. Andrew Jin
Epidemiology consultant
2762 – 133 Street, Surrey, BC V4P 1X9
Tel: 604-531-1454, Canada V4P 1X9
E-mail: ajin@unixg.ubc.ca