

Original Article

A 'radical' new rural model for pediatric diabetes care

Goss PW, Paterson MA, Renalson J. A 'radical' new rural model for pediatric diabetes care.

Pediatric Diabetes 2009.

Objective: The purpose of the study was to evaluate a new rural Australian multidisciplinary model of pediatric diabetes care.

Methods: In 2007, in response to insurmountable obstructions to establish an effective multidisciplinary team within the public health system, an Australian rural pediatric practice created a private multidisciplinary diabetes care model. The 'Rural Australian Diabetes – Inspiring Control Activity & Lifestyle' model – 'RADICAL' – comprised a locally based, co-located core team of general pediatrician, diabetes educator, and mental health nurse. Regular diabetes clinics were established, including team meetings where each individual patient was discussed. Therapy included proactive child and family emotional support and promotion of insulin regimes that aimed to match patient lifestyle, especially insulin pump therapy. By 2009, 56 of 61 children and adolescents with type 1 diabetes across a broad regional area had access to the model of care. The model was evaluated in terms of metabolic control, patient satisfaction, and quality of life.

Results: Since the RADICAL model was established, the average HbA1c has fallen from mean $9.6\% \pm 1.81$ (median 9.7%) in 2006 to mean $8.1\% \pm 1.25$ (median 7.9%) in 2009 ($p < 0.001$). Patient satisfaction with the model was overwhelming. The previously demonstrated reduced quality of life of Australian rural diabetic youth compared with urban diabetic youth was eliminated.

Conclusion: Multidisciplinary child diabetes care can be successfully achieved in rural settings using local resources with results comparable to international tertiary multidisciplinary diabetes units.

Peter W. Goss, Megan A. Paterson and Jay Renalson

Gippsland Pediatrics Diabetes Unit,
Sale, Victoria, Australia

Key words: diabetes – multidisciplinary – pediatric – rural – team

Corresponding author:
Dr Peter W. Goss, MB, BS, FRACP,
Gippsland Pediatrics Diabetes Unit
P. O. Box 601, Sale 3850
Victoria
Australia.
Tel: (61) 3-51445877;
fax: (61) 3-51431270;
e-mail: pwgoss@bigpond.com

Submitted 26 May 2009. Accepted for publication 30 July 2009

Every child and adolescent with type 1 diabetes mellitus, including those from rural and remote areas, should have access to optimal medical management, which includes a multidisciplinary team approach (1).

A decade ago, it was stated that rural Australian children and adolescents with diabetes 'remain disadvantaged in terms of their ability to access all aspects of specialist diabetes care and psychological support' (2). The only comparison of quality of life measurements in Australian of rural and urban diabetic youth showed a significantly greater adverse impact in the rural group, particularly in self-esteem, parent emotional impact, family cohesion, and mental health measurements (3). That study also showed rural youth had reduced access to credentialed diabetes educators

(CDEs), dieticians, and hence a multidisciplinary team. No rural multidisciplinary models of diabetes care been described that enact the NH&MRC recommendations or that have redressed the reduced quality of life of rural diabetic youth.

There are significant logistical issues in creating multidisciplinary diabetes teams in rural and regional areas of Australia. State Governments fund metropolitan multidisciplinary diabetes teams and equipment including onsite HbA1c analyzers. There is no such specific funding allocated to establish and maintain rural multidisciplinary diabetes teams. Rather, the Australian rural pediatric diabetes model has been generally based around regular Medicare rebatable private visits to a consultant pediatrician, while State

Government funded CDEs and other allied health professionals are located elsewhere within a public health service. Lack of a co-operative desire to facilitate a team approach across the public/private health service interface has stifled the development of multidisciplinary care. Without co-location of service providers and without onsite HbA1c testing, the burden of disease is increased by requiring the patient (and usually the parent) to attend over 16 visits per year to receive the same input that would be gained by only four visits to a co-located multidisciplinary team.

Not surprisingly, the response from patients to such a model of care has been poor adherence to the recommended visits. Cameron et al. (3) showed that less than half of the rural diabetic patients accessed a CDE in the preceding 12 months. A basic multidisciplinary team becomes unworkable if the model is so user unfriendly, it discourages patients from attending consultation.

To enact the 2006 NH&MRC recommendations and redress the inequity of pediatric diabetes services to rural areas, new rural models of care were required. Therefore, the primary aim of the study was to evaluate such a new rural Australian multidisciplinary model of pediatric diabetes care.

Methods

Gippsland Pediatrics is an independent, rural practice based in Sale, Victoria. Sale is located at 210 km east of Melbourne and is the regional pediatric service center for Central and East Gippsland, covering a population of about 100 000 people. Regular consultant pediatric outreach clinics are provided from Sale to Bairnsdale, a further 75 km east.

Between 1989 and 2006, the model of care for pediatric diabetes was the typical disjointed rural Australian approach of three monthly private general pediatrician consultations with occasional input from a CDE or dietician working within the public health system. A visiting endocrinologist occasionally consulted on some more difficult diabetic patients but rarely improved the outcome.

In 2007, an audit of the local pediatric patients showed that glycemic control had deteriorated beyond acceptable levels in 2006 and that attendance to other allied health support including CDEs was unacceptably suboptimal. In response to insurmountable obstructions to establish an effective multidisciplinary team within the public health system, Gippsland Pediatrics created a private Medicare rebatable multidisciplinary diabetes care model. Termed 'RADICAL' – 'Rural Australian Diabetes – Inspiring Control, Activity & Lifestyle' – the model embraced the NH&MRC guidelines on type 1 diabetes in children and adolescents.

The principles of the RADICAL model included:

- (i) a co-located multidisciplinary team;
- (ii) inclusion of a team member skilled in psychological and counseling skills;
- (iii) grouping of patients into three monthly 'clinic' appointments with team case meetings on each individual patient;
- (iv) onsite HbA1c testing;
- (v) an active promotion of insulin pump therapy (IPT);
- (vi) a philosophy of therapy aiming to match the patient's lifestyle.

In addition, there was active local community fundraising for pediatric diabetes equipment including HbA1c analyzer, insulin pumps, and continuous glucose monitoring systems (CGMS).

Eligibility for this study was defined as being less than 21 yr of age with type 1 diabetes and being a patient of 'Gippsland Pediatrics'. The practice comprises two pediatricians who provide the consultant regional pediatric outpatient services locally, including to all but three children with diabetes in the region. Gippsland Pediatrics cared for 48 children and adolescents with type 1 diabetes in 2006, increasing to 61 patients by the first quarter of 2009.

During 2007, Gippsland Pediatrics employed a CDE and a credentialed mental health nurse (counselor) with expertise in child, behaviour, and family loss, grief, and trauma counseling. Those psychological and counseling skills were considered imperative to proactively address the psychosocial needs of the child and family. The core multidisciplinary diabetes team comprised one general pediatrician with an interest in diabetes, the CDE, and the counselor. Other regional CDEs, dieticians, pediatricians, and general practitioners were invited to provide clinical input, including at multidisciplinary case meetings.

Rather than being reviewed in random appointments, patients were grouped and specific days set aside for 'Diabetes Clinics'. Three multidisciplinary diabetes clinics were established in Sale and two in Bairnsdale. Clinics were conducted at regular three monthly intervals comprising approximately 10 patients in each clinic. Patients were seen individually for approximately 20 minutes each by the CDE, counselor, and pediatrician. Team members shared information during consultations. Some consultations in 2007 included more than two professionals in the room but were later ceased at patient request. Following consultations in the morning, the multidisciplinary diabetes team met in case conference about all patients later in the day to further evaluate and analyze the clinical and family status and devise targeted management strategies.

Individual patient consultations with pediatric endocrinologists and tertiary diabetes team members were minimal, though we received great assistance with program development, particularly with IPT. We considered additional face-to-face consultations with a visiting endocrinologist to be an unnecessary burden in terms of patient time and resources if glycemic and emotional control was satisfactory.

An onsite HbA1c analyzer (Bayer DCA 2000) was purchased by a local children's charity (the Kate Buntine Children's Trust) for use in the diabetes clinics. The team considered onsite point of testing as imperative to reduce the impact of the disease on children by negating the need for an additional attendance at an offsite pathology department, apart from annual complication screening tests.

In mid-2007, the team commenced a locally run IPT or continuous subcutaneous insulin infusion program, one of the first of its kind in regional Australia. The multidisciplinary team model provided the framework for the establishment of the IPT program, including strategic direction, protocols, and upskilling.

The feasibility of the RADICAL team care model was measured in terms of effectiveness of glycemic control, patient satisfaction, and quality of life.

The patients who lived too remotely to attend the diabetes clinics or retained a preference for the old model of care were designated as 'non-clinic' patients.

A 12-month average HbA1c for each individual patient and frequency of measurement of HbA1c were compared in the years 2006 (48 patients), 2007 when clinics were in the establishment phase (53 patients), 2008 (47 clinic patients and 12 non-clinic patients), and the first quarter of 2009 (50 clinic patients and 6 non-clinic patients). Five patients were excluded from analysis in 2009 because of referral in the previous 3 months.

The Student's *t*-test was utilized to determine statistical significance of glycemic control differences compared with the measurements in 2006.

The authors devised a nine question patient satisfaction questionnaire to evaluate the response to the RADICAL team care concept (Appendix 1). The survey was offered to those having attended the multidisciplinary diabetes clinics for at least 12 months. The survey was completed by patients if 13 yr of age or older or by parents if the child was under 13 yr. Questions included whether the new model of care reduced the impact of diabetes upon lifestyle; whether the model gave more support than the old model; whether the patient or parent felt the diabetes was more controlled; whether the model facilitated a better understanding of diabetes and a better awareness of complications; whether the counselor helped; whether the patients or parents understood diabetic food issues better, whether an onsite HbA1c analyzer impacted

less upon their life, and whether the new clinic system was better than the old method of care. Responses were considered negative if answered 'not at all' or 'a little' and the response considered positive if the response was 'moderately', 'very', and strongly positive if rated 'extremely'.

The authorized Australian adaptation of health act child health questionnaire (CHQ) was selected as a tool to measure quality of life in order to compare with data utilizing the CHQ in a group of pediatric diabetic patients from the same region in 1999 (3), which are the only data available for Australian rural diabetic youth.

The CHQ tool has been validated on Australian children with diabetes (4). There are three sections – the physical, psychosocial, and family domains. The subscales in the physical domain comprise physical functioning, role physical, and bodily pain. The psychosocial domain includes role emotional/behavioral, behavior, mental health, and self-esteem. The family domain includes parent impact (emotional), parent impact (time), family activities, and family cohesion. The parent form (CHQ PF50) is suitable for children under 10 yr, and the youth self-report (CHQ CH87) was developed for ages 10 and older.

The CHQ was administered to patients in late 2008 if they had attended clinic for at least 12 months. The PF50 was completed by parents of children attending clinics less than 10 yr of age while an authorized Australian abridged CH87 (CHQ CH50) was completed by clinic patients between 10 and 18 yr.

A random sample of 20 patient records were examined to calculate the frequency of CDE visits in the 5 yr between 2002 and 2006 inclusive, excluding attendances in the first year after diagnosis or inpatient attendances and compared with CDE contacts after the clinic concept had been established.

In late 2008, the core diabetes team members met to discuss the concept, the strengths, and weaknesses of the model, including the professional satisfaction gained by working in such a team.

The study was approved by the KBCT Ethics Committee.

Results

The male-to-female patient ratio was similar, and mean age was approximately 14 yr (Table 1). Of 61 patients in the first quarter of 2009, 50 were classified as clinic patients, 6 were non-clinic patients, and 5 were excluded from analysis because of referral within the previous 3 months. The six patients who did not attend the clinic in 2009 included three patients residing in more remote areas of Gippsland or in Melbourne and three who continued to attend private consultations for reasons which included poor attendance reliability

Table 1. Age and sex distribution of patients

Year	Number	Male	Female	Mean age	N clinic	N non-clinic
2006	48	24	24	13.4	0	48
2007	53	25	28	13.6	36	17
2008	59	29	30	14.0	47	12
2009 Q1	61	30	31	13.9	55	6

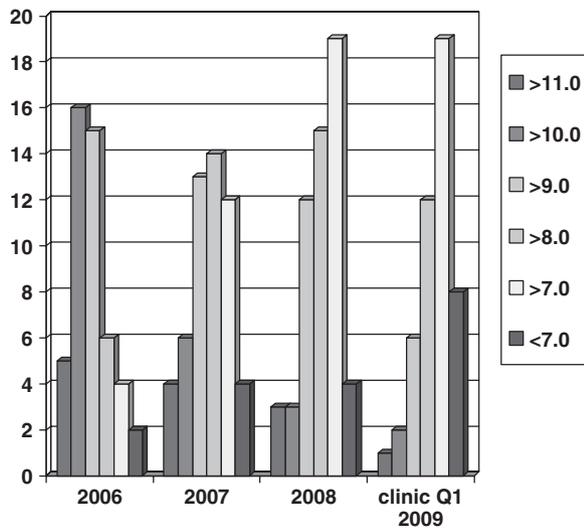


Fig. 1. HbA1c values from 2006 to first quarter of 2009.

(two patients) and reluctance to address outstanding psychological issues.

The improvements in glycemic control (Fig. 1) and frequency of HbA1c testing were significant (Table 2). The audit of 2006 metabolic control revealed 48 patients with a mean HbA1c of $9.6\% \pm 1.81$ (median 9.7%), which compared poorly with the Australian metropolitan tertiary mean HbA1c in 1999 of $8.6\% \pm 1.4$ (5). During the establishment of the RADICAL model in 2007, the mean HbA1c of 53 patients fell to $8.8\% \pm 1.40$ (median 8.9%) ($p = 0.003$). In 2008, mean HbA1c of the total 59 patients was $8.6\% \pm 1.39$ (median 8.2%) ($p = 0.002$). Of those 44 patients attending the multidisciplinary clinic, the mean HbA1c was $8.5\% \pm 1.26$ (median 8.1%).

Table 2. Glycemic control

Year	Number	Mean HbA1c	SD	Median HbA1c	Range	N $\leq 7.5\%$	N $\leq 8\%$	HbA1c tests/yr
2006	48	9.6	1.81	9.7	6.6–11.5	3 (6%)	5 (10%)	3.3
2007	53	8.8	1.40	8.9	5.6–11.5	8 (15%)	16 (28%)	3.0
2008	59	8.6	1.39	8.2	6.5–13.5	11 (20%)	24 (41%)	3.90
2008 clinic	44	8.5	1.26	8.1	6.5–13.5	10 (23%)	20 (45%)	4.0
Q1 2009	56	8.2	1.38	8.1	5.9–13	18 (32%)	28 (50%)	
Q1 2009 clinic	50	8.1	1.25	7.9	5.9–11.9	18 (36%)	27 (54%)	
Q1 clinic IPT	27	7.6	0.96	7.6	6.0–9.1	12 (44%)	18 (67%)	
Q1 clinic non-IPT	23	8.6	1.46	8.4	5.9–11.9	6 (26%)	9 (39%)	

The mean HbA1c in the first quarter of 2009 for all 56 patients was $8.2\% \pm 1.38$ (median 7.9%) ($p < 0.001$). Multidisciplinary clinic patients had a mean HbA1c of $8.1\% \pm 1.25$ (median 7.9%) ($p < 0.001$). The mean HbA1c of the six non-clinic patients in the first quarter of 2009 was $9.4\% \pm 1.88$ (median 8.9%), almost identical to the 2006 pre-clinic figures.

By the first quarter of 2009, 27 clinic patients had been managed with IPT for at least 3 months, with a mean HbA1c of $7.6\% \pm 0.96$ (median 7.6%). Two of the six non-clinic patients were also managed with IPT (HbA1c 7.7 and 9.6% , respectively). Overall, the IPT group had a mean HbA1c of $7.6\% \pm 0.84$ (median 7.7%). A further seven patients commenced IPT in the first quarter of 2009.

Glycemic control of patients on IPT in Q1 2009 was significantly better than that of non-IPT clinic patients whose mean HbA1c was $8.6\% \pm 1.46$ (median 8.4%) ($p = 0.003$). However, improvement in HbA1c of the non-IPT clinic group by Q1 2009 was still significant in comparison with the HbA1c of non-IPT patients ($n = 47$) in 2006 ($p = 0.002$).

The NH&MRC recommends a target HbA1c of less than 7.5% for older children and adolescents, with a slightly higher target for younger children. In 2006, only 3 patients (6.25% of all patients) achieved an HbA1c $\leq 7.5\%$ compared with 18 patients (36% clinic patients) by the first quarter of 2009 ($p < 0.001$).

The frequency of testing for glycemic control increased from overall 3.3 tests per year (2006) and 3.0 tests per year (2007) to 4.0 tests per year in 2008 for clinic patients while non-clinic patients in 2008 remained at 3.0 tests per year.

Episodes of severe hypoglycemia were rare. One patient only suffered a hypoglycemic seizure since

the RADICAL model commenced in August 2007. Three patients have received intramuscular glucagon (six occasions) for moderately severe hypoglycemia exhibited by reduced conscious state. Emergency department attendance and admissions to hospital for diabetic issues (apart from initial stabilization and insulin pump starts) reduced from 11 of 48 patients in 2006 (23%) to 5 of 59 patients (8%) in 2008 ($p = 0.04$).

The number of contact visits with a CDE after the first year of diagnosis and excluding inpatient stays increased from mean 0.8 ± 0.61 contacts per year (median 0.6) to mean 4.0 contacts per year for clinic patients in 2008 in the clinic setting ($p < 0.001$). In addition, those patients who commenced IPT had a further 6–10 CDE contacts each between August 2007 and March 2009. From September 2008, contact for those on IPT also included regular phone and e-mail.

The model was overwhelmingly accepted and embraced by patients and parents (Fig. 2). Thirty-eight clinic patients or their parent answered the survey (86%) in late 2008. Results showed 95% of respondents agreed that seeing the health team on one visit impacted less on their lifestyle, with 50% of respondents strongly agreeing; 89% felt more supported by the team approach; 86% felt that their diabetes was more controlled with the team approach; 91% felt they had gained a better understanding of their diabetes and were more aware of diabetic complications; 76% felt the counselor was important in supporting the emotional aspect of diabetes; 92% felt the clinic made them more aware of food issues, even though a dietician was not present at the three Sale clinics; 94% felt that onsite HbA1c impacted less upon their lifestyle, and 94%

(with 71% agreeing strongly) preferred the new clinic system.

Quality of life survey data have revealed significant improvements in previously reported adverse impact parameters for rural children with diabetes which had included moderate effect size on mental health and large effect sizes for self-esteem, parent impact (emotional), and family cohesion in 1999 (Fig. 3). Rural children with diabetes using the RADICAL model under 10 yr now outscore the 1999 urban diabetic youth data in 1 of 4 physical subscales, 3 of 4 psychosocial subscales, and 3 of 4 family subscales (Fig. 3). They also outscore non-diabetic rural youth of 1999 in 4 of the 12 subscales with marked improvement in psychosocial and family subscales. The improvements in all aspects of quality of life, including self-esteem, parent impact (emotional), family cohesion, and mental health, were sustained in the CH50 self-reporting questionnaires over 10 yr of age (Fig. 4).

Discussion

The impact of disease of type 1 diabetes is significant. The Juvenile Diabetes Research Foundation states life expectancy is reduced by 15 yr on average and that over 50% of patients with type 1 diabetes will develop severe health complications as a result of the disease after 20 yr (6). Maintaining optimal glycemic control minimizes risk of complications (7), so there is an urgency to address the discriminatory lack of access of rural children to optimal diabetes services, as defined by the NH&MRC. Those guidelines are unambiguous about the proven value of multidisciplinary team approach and the need to address family and emotional health (1).

Analysis of the ‘RADICAL’ model of rural pediatric diabetes care has shown clear benefits to the patients and their families and has achieved improved glycemic control. The HbA1c mean of 8.1% of patients utilizing the model has now improved to a point where it compares favorably with the Hvidoere mean of 8.2% (8) and published Australian tertiary diabetes clinics (5, 9).

The model has supported the introduction of IPT, which in itself has been shown to improve glycemic control and improve quality of life (10). Indeed the use of IPT produced significantly better glycemic control in our patients, though selection as suitable candidates for IPT is biased toward the more responsible and compliant patient. But IPT could not have been successfully established exclusively of the team model which provided the necessary framework for a rural IPT program. The rate of IPT usage in our patients is now more than all pediatric diabetes units in Australia. The successful initiation of IPT to a number of challenging patients has been the result of the

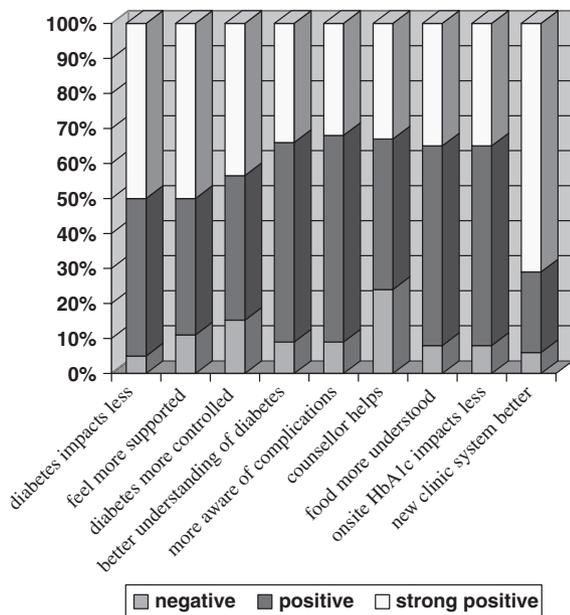


Fig. 2. Results of patient satisfaction survey December 2008 (n = 38).

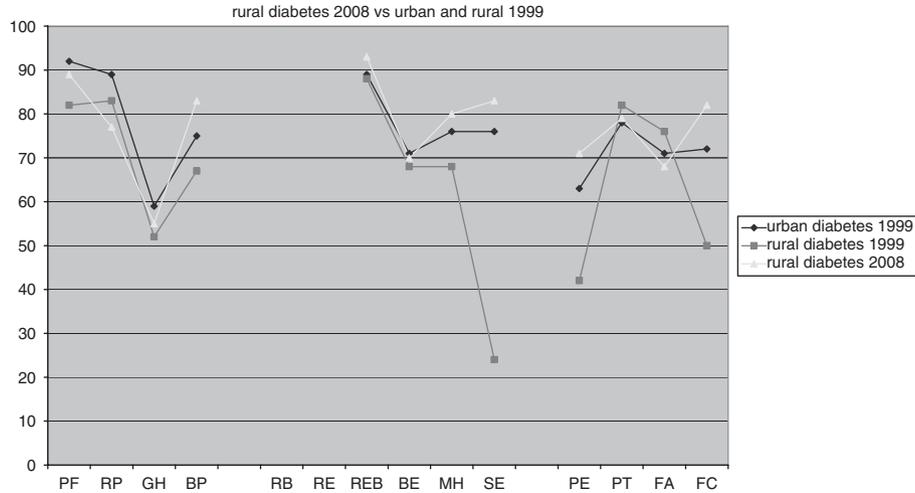


Fig. 3. Quality of life; comparison among urban diabetic youth 1999, rural diabetic youth 1999, and rural diabetic youth (RADICAL model) 2008 <10 yr. Physical domain [physical functioning (PF), role physical (RP), general health (GH), and bodily pain (BP)]. Psychosocial domain [role emotional/behavioral (REB), behavior (BE), mental health (MH), and self-esteem (SE)]. Family domain [parent impact (emotional) (PE), parent impact (time) (PT), family activities (FA), and family cohesion (FC)].

RADICAL team model. The introduction of CGMS in late 2008 may also have contributed to the ongoing improvement in glycemic control (11, 12).

Our preference would have been to measure the quality of life on the children prior to the introduction of the RADICAL model to corroborate 1999 findings for rural Australian diabetic youth (3). However, the lack of resources made such a study impossible. The 1999 data included many of the same individual patients utilizing the same model of care still evident in 2006 including the same personnel providing medical

and CDE advice. Hence, although not ideal, the population comparison is reasonable.

The previously described reduced quality of life for rural diabetic youth was hypothesized to be related to a sense of isolation and separateness (3). The strong survey response to feeling more supported by RADICAL model has redressed such perception in our patients.

Patient satisfaction is an integral part of caring for children with diabetes that has been shown to underpin adherence to treatment regimes, though in one metropolitan study (13) it was not associated

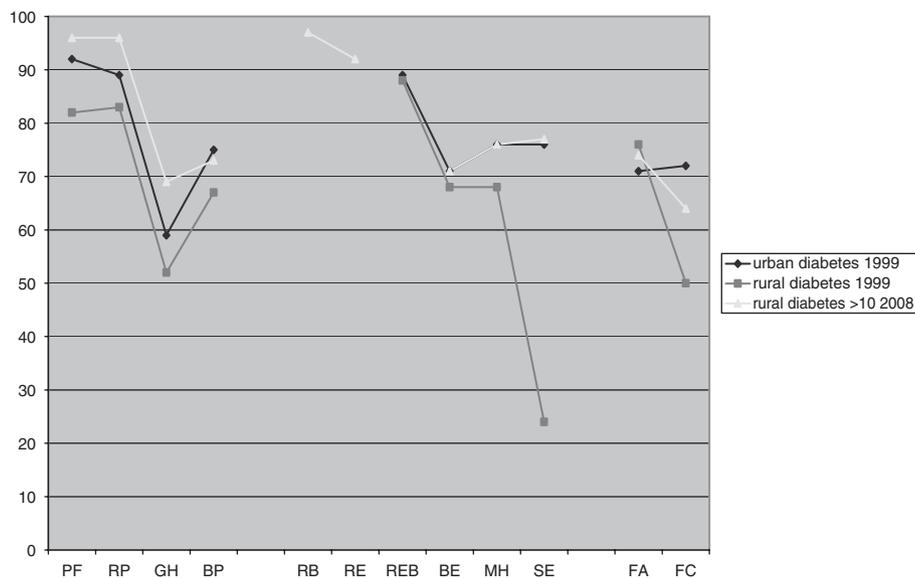


Fig. 4. Quality of life; comparison among urban diabetic youth 1999, rural diabetic youth 1999, and rural diabetic youth (RADICAL model) 2008 >10 yr. Physical domain [physical functioning (PF), role physical (RP), general health (GH), and bodily pain (BP)]. Psychosocial domain [role emotional (RE), role behavioral (RB), role emotional/behavioral (REB), behavior (BE), mental health (MH), and self-esteem (SE)]. Family domain [family activities (FA) and family cohesion (FC)].

with improved clinical outcome. Our patients showed improved glycemic control with a parallel improvement in patient satisfaction.

Consultation behavior, including personality expression and team interaction, was an important part of the success of the RADICAL model. The pediatrician was no longer carrying the sole burden of management, allowing a change in consultation behavior. The model facilitated an attitude which conveyed hope, positive expectation, patient empowerment, and realistic target setting.

A myriad of social situations were encountered in the families, including the terminal illness and death of a parent, domestic violence, parental separation, alcohol and drug addiction, and significant psychological disorders including severe anxiety disorder and personality disorder. Incorporating the counselor as a core member of the team facilitated much easier intervention when family and emotional problems arose.

Team members established regular practice review to refine the model, prevent burn out, and maintain an organized enthusiastic attitude. Major issues included role delineation and how best to ensure a supportive, non-intimidating approach. An efficient operational system, including secretarial support and keeping appointments to time was imperative. The core team members recognized the emotionally demanding, vicarious traumatizing nature of the work. Individual case meetings clarified the major influences on families and patients. Team members expressed great professional satisfaction with the RADICAL model.

An important part of the model was to encourage patients to engage in self-care and improve their awareness of diabetes and its complications. The model supported cohesive family function where possible and has developed a more personalized and realistic approach to diabetes care. A small team allows the same professional people to consult with the child and family on each occasion. The aim to empower but not further burden the child and family was the lynchpin of the supportive strategy.

There are limitations of the RADICAL model of care. In less populated regions, a small multidisciplinary team lacks back up of similarly skilled personnel in terms of annual leave, sick leave, or relocation of a team member. Succession planning should be an integral part of forward planning. Reliance on charitable organizations for funding and performance of onsite HbA1c analysis and CGMS is a potential problem for other rural areas. This should be addressed by Governments giving equal assistance to rural teams as given to metropolitan tertiary teams. Some rural areas and some more distant regions may simply not have the resources of an appropriately skilled general pediatrician, CDE, or CMHN to form the core team so advanced

communication technology including telemedicine may prove useful. Another limitation is the necessity for non-core team members (including metropolitan professionals) to understand and adhere to the team philosophy and so promote an effective and unified message to the patient and family. Our experience has shown that different messages coming from such professionals and failure of a metropolitan tertiary unit to support the rural team can seriously undermine the glycemic control and emotional well-being of the patient.

Outreach visits by pediatric endocrinologists working with local pediatricians had not been successful in gaining better glycemic control in poorly controlled patients. We believe this is because poor control is often a result of psychosocial, educational, or behavioral issues, which are best addressed by a multidisciplinary team that includes psychological skills.

The provision of outreach services by metropolitan tertiary diabetes teams occurs in some areas of Australia, but there are no published data as to the effectiveness of the model. The concept may work well if worked in collaboration with local services but risks local pediatricians and CDEs being somewhat sidelined, reducing their credibility and reducing opportunities to develop further skills with emerging technologies. Consequently, the ability to provide effective ongoing local medical and psychosocial support is compromised. In addition, scarce metropolitan resources may be wasted if locally driven regional and rural models are not encouraged.

The RADICAL model was funded through a number of sources. Patient payment for pediatrician consultation is partially rebatable under Medicare benefits system. Case conferences are also rebatable through the Medicare benefits system. Rebates for CDE and CMHN consultations are limited in total to maximum five per year through Medicare benefits system's enhanced primary care initiative. CDE financial assistance was also provided by an insulin pump company for pump education, initiation, and follow-up. A pharmaceutical company grant supported the establishment and evaluation of the service. The model did not incur any additional cost to the patient. The pediatrician and CDE provided a non-remunerated 24 phone contact service to all patients. Gippsland Pediatrics employed the CDE 12 h per week and counselor for 8 h on each clinic day and to follow-up children with psychological issues as required. Regional health services contributed few resources to the RADICAL model, despite receiving State Government funding to support local rural diabetic youth through CDEs, dieticians, and mental health workers and despite the request for such assistance.

Australian Medicare Benefits System item numbers do not fully reflect the NH&MRC recommendations for managing children with diabetes, particularly

addressing their psychosocial needs (1). Given the enormous cost to the taxpayer of managing the complications of diabetes and the humanistic burden of diabetes on youth and their families, it makes economic sense to fund models of care that reduce the risk of such complications as well as improving quality of life, particularly to underserved rural youth.

We believe that the RADICAL model is reproducible in other areas of rural Australia with Government support. We also believe the principles of the RADICAL model, particularly the smaller personalized teams with proactive psychosocial support and individual case meetings, may be applied to some metropolitan tertiary diabetes teams to the benefit of many patients and their families.

Conclusion

Multidisciplinary child and adolescent diabetes care can be successfully achieved in a rural setting with results comparable to large tertiary metropolitan units with excellent patient and professional satisfaction.

The improvement in glycemic control reduces the risk of longer-term complications for those rural patients. The model is one that corrects the current disadvantages experienced by rural diabetic youth by improving their health, emotional well-being, and quality of life, and reduces the burden of disease on the patient, their family, and the community.

Acknowledgements

This project was supported by a Novo Nordisk Regional Grant.

References

1. National Health and Medical Research Council Clinical practice guidelines: type 1 diabetes in children and adolescents. Prepared by the Australasian Paediatric Endocrine Group for the Department of Health and Ageing. March 2005.
2. HANDELSMAN P, JACKSON L. A national needs assessment of children and adolescents with diabetes

- in Australia 1999. Juvenile Diabetes Foundation Australia, Sydney, 1999.
3. CAMERON FJ, CLARKE C, HESKETH K et al. Regional and urban Victorian diabetic youth: clinical and quality of life outcomes. *J Paediatr Child Health* 2002; 38: 593–596.
4. WAKE M, HESKETH K, CAMERON F. The Child Health Questionnaire in children with diabetes: cross sectional survey of parents and adolescent-reported functional health status. *Diabet Med* 2000; 17: 700–707.
5. THOMSETT MJ, SHIELD GJ, BATCH JA, COTTERILL AM. How well are we doing? Metabolic control in patients with diabetes. *J Paediatr Child Health* 1999; 35: 479–482.
6. JDRF website (available from jdrf.com.au/)
7. Diabetes Control and Complications Trial Research Group. The relationship of glycaemic exposure (HbA1c) to risk of development and progression of retinopathy in the Diabetes Control and Complications Trial. *Diabetes* 1995; 44: 968–984.
8. DE BEAUFORT CE, SWIFT PG, SKINNER CT et al. Continuing stability of center differences in pediatric diabetes care: do advances in diabetes treatment improve outcome? The Hvidoere Study Group on Childhood Diabetes. *Diabetes Care* 2007; 30: 2245–2250.
9. AMBLER GR, FAIRCHILD J, CRAIG ME, CAMERON FJ. Contemporary Australian outcomes in childhood and adolescent type 1 diabetes: 10 years post the Diabetes Control and Complications Trial. *J Paediatr Child Health* 2006; 42: 403–410.
10. MCMAHON SK, AIREY FL, MARANGO DA et al. Insulin Pump Therapy in children and adolescents; improvements in key parameters of diabetes management including quality of life. *Diabet Med* 2005; 22: 92–96.
11. The Juvenile Diabetes Research Foundation Continuous Glucose Monitoring Study Group. Continuous glucose monitoring and intensive treatment of type 1 diabetes. *N Engl J Med* 2008; 359: 1464–1476.
12. DANNE T, BATTELINO T, JAROSZ-CHOBOT P. Kordonouri establishing glycaemic control with continuous subcutaneous insulin infusion in children and adolescents with type 1 diabetes: experience of the PedPump Study in 17 countries. *Diabetologia* 2008; 51: 1594–1601.
13. KOVES IH, BOUCHER A, ISMAIL D, DONATH S, CAMERON F. Satisfaction of care in a tertiary level diabetes clinic: correlation with diabetes knowledge, clinical outcomes and health related quality of life *J Paediatr Child Health* 2008; 44: 432–437.

Appendix 1

PATIENT SATISFACTION SURVEY

Please answer the following questions using the scale of 1-5 to indicate your satisfaction with various aspects of the diabetes clinics.

You do not need to put your name on the survey and the information will remain confidential.

Circle the number that best corresponds with your answer:

Age (please circle) under 13, (parent to complete) 13-18 years over 18 years

Not at all A little Moderately Very Extremely
1 2 3 4 5

1. Being able to see the health team in one visit impacts less on my lifestyle
1 2 3 4 5
2. I feel more supported by a “team” approach
1 2 3 4 5
3. I feel that my diabetes is more under control with the “team” approach
1 2 3 4 5
4. The “team” approach has made me gain a better understanding of diabetes.
1 2 3 4 5
5. The diabetes clinic concept has made me more aware of the potential of developing complications from diabetes
1 2 3 4 5
6. The councillor is helpful in supporting me to understand and deal with the emotional impact of diabetes
1 2 3 4 5
7. The diabetes clinic concept has made me more aware of food issues relating to diabetes
1 2 3 4 5
8. The on site HbA1C testing impacts less on my lifestyle.
1 2 3 4 5
9. I like the diabetes clinic concept much better than the old appointments system
1 2 3 4 5

What else do you think might be helpful for us to know about?