



## Best Diabetes Practices in Canada


Daniel L. Metzger, MD  
Pediatric Endocrinologist







## Welcome to Vancouver, BC!






## Objectives

- Overview of Canada and Canadian health care
- Overview of the scope of diabetes in Canada
- Highlights of Canadian research in diabetes
- Overview of standards of care for kids with T1D
- My own personal recommendations
- BCCH resources





## Canada and Canadian Health Care

## Our Home and Native Land

Canada	USA
<input type="checkbox"/> parliamentary democracy, constitutional monarchy	<input type="checkbox"/> federal constitutional presidential republic
<input type="checkbox"/> 34,224,000 people (36 <sup>th</sup> )	<input type="checkbox"/> 310,101,000 people (3 <sup>rd</sup> )
<input type="checkbox"/> 9,984,670 km <sup>2</sup> (2 <sup>nd</sup> )	<input type="checkbox"/> 9,826,675 km <sup>2</sup> (3 <sup>rd</sup> /4 <sup>th</sup> )
<input type="checkbox"/> 3.41 people/km <sup>2</sup> (228 <sup>th</sup> )	<input type="checkbox"/> 32 people/km <sup>2</sup> (178 <sup>th</sup> )
<input type="checkbox"/> 10 provinces, 3 territories	<input type="checkbox"/> 50 states, 14 territories
<input type="checkbox"/> GDP \$39,668/person	<input type="checkbox"/> GDP \$46,381/person
<input type="checkbox"/> 10.0% of GDP spent on health	<input type="checkbox"/> 15.3% of GDP spent on health
<input type="checkbox"/> \$3,672/person on health	<input type="checkbox"/> \$6,714/person on health
<input type="checkbox"/> life exp: 78 men, 83 women	<input type="checkbox"/> life exp: 75 men, 80 women






## Our Home and Native Land

Canada	USA
	



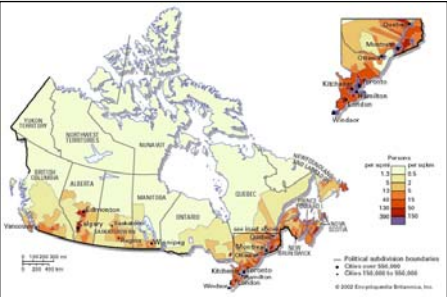
## Canadian Health Care



- “socialized medicine”
- Canada Health Act of 1962
  - **universally** available to permanent residents
  - **comprehensive** in the services it covers
  - **accessible** without income barriers
  - **portable** within and outside the country
  - **publicly** administered (provincially)
- covered: physician services, hospitalizations
- not always covered: drugs, diabetes supplies, dental care, optometry, cosmetic surgery



## Population Density

80% of Canadians live within 200 km (120 miles) of the border








## The Scope of Diabetes in Canada

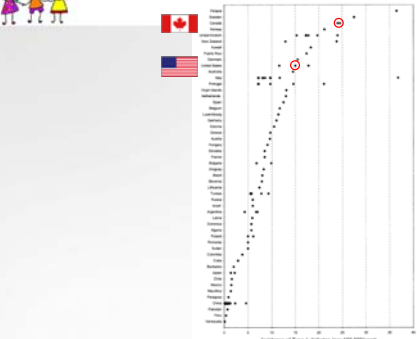





## Diabetes in Canada

- More than 3 million Canadians have diabetes.
- Over 300,000 Canadians live with type 1 diabetes.
- About 1 in 320 Canadian kids has diabetes.
- About 1 in 2,350 Canadian kids will develop diabetes this year.
- Canada has the 6<sup>th</sup> highest incidence rate of T1D in children in the world.
- Diabetes and its complications cost the Canadian economy more than \$17.4 billion a year.

NDSS: Diabetes in Canada, 2009
 




## Worldwide Incidence of Diabetes



WHO DiaMond Study, 2000
 


## Diabetes in BC

- More than 300,000 persons in BC have diabetes.
- About 2,000 kids (1–19 years) in BC have T1D (1 in 450).
- About 200 kids (1–19 years) in BC have T2D (1 in 4,500).
- About 240 BC kids will develop T1D this year (1 in 4,000).
  - 35 ages 1–4
  - 71 ages 5–9
  - 88 ages 10–14
  - 46 ages 15–19
- Direct cost for diabetes in BC is about \$1 billion/year.

BC Ministry of Health, 2005–2009
 


# Diabetes Research in Canada

# Diabetes Research in Canada

- public funding:
  - Canadian Institutes of Health Research
- private funding:
  - Canadian Diabetes Association
    - \$95 million since 1975
  - Juvenile Diabetes Research Foundation
    - \$13.9 million toward a Clinical Trial Network in 2009
  - Lawson Foundation
- industry funding

# Discovery of Insulin

- 1922
- University of Toronto

# Discovery of Insulin

Left: Teddy Ryder, July 10, 1922      Right: Teddy Ryder, July 10, 1923

DEAR DR. PARTING, I WISH YOU COULD COME TO SEE ME. I AM A FAT BOY NOW AND I FEEL FINE. I CAN CLIMB A TREE. MARGARET WOULD LIKE TO SEE YOU. LOTS OF LOVE FROM TEDDY RYDER.

# Transplants: Edmonton Protocol

Donor: Islet isolation → Islet in Pancreas

Recipient: Islet in Portal Vein → Infusion of islets



Timeline: Islet infusion (> 8,000 IE/kg) at Day 0. Blood sugar levels: Normalized (100-140 mg/dL) from Day 0 to Day 1; Normalized (100-140 mg/dL) from Day 1 to Day 2; Normalized (100-140 mg/dL) from Day 2 to Day 3; Normalized (100-140 mg/dL) from Day 3 to Day 6; Normalized (100-140 mg/dL) from Day 6 to Day 12; Normalized (100-140 mg/dL) from Day 12 to Day 18; Normalized (100-140 mg/dL) from Day 18 to Day 24; Normalized (100-140 mg/dL) from Day 24 to Day 30; Normalized (100-140 mg/dL) from Day 30 to Day 36; Normalized (100-140 mg/dL) from Day 36 to Day 42; Normalized (100-140 mg/dL) from Day 42 to Day 48; Normalized (100-140 mg/dL) from Day 48 to Day 54; Normalized (100-140 mg/dL) from Day 54 to Day 60; Normalized (100-140 mg/dL) from Day 60 to Day 66; Normalized (100-140 mg/dL) from Day 66 to Day 72; Normalized (100-140 mg/dL) from Day 72 to Day 78; Normalized (100-140 mg/dL) from Day 78 to Day 84; Normalized (100-140 mg/dL) from Day 84 to Day 90; Normalized (100-140 mg/dL) from Day 90 to Day 96; Normalized (100-140 mg/dL) from Day 96 to Day 102; Normalized (100-140 mg/dL) from Day 102 to Day 108; Normalized (100-140 mg/dL) from Day 108 to Day 114; Normalized (100-140 mg/dL) from Day 114 to Day 120.

# Transplants: Coated Islets



- University of Toronto
- "microencapsulation" with seaweed-derived polymer
- have been shown to keep monkeys insulin-free for up to 3 years
- islet cells from pigs

J Clin Invest 1996;98:1417-1422

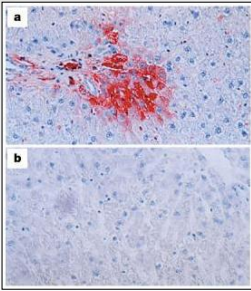
## Generex Biotechnology

- Oral-lyn™
- RapidMist™ device
- “buccal delivery”
- absorbed from mouth
- Canadian (Toronto)
- in Phase 3 trials
- approved in some countries






## Gene Therapy: Viral Vectors




- University of Calgary
- infected mice with a virus carrying a modified insulin gene
- this gene is integrated and expressed in liver
- liver insulin production is sufficient to keep blood glucose normal

Nature 2000;408:483-488






## Gene Therapy: K Cells




- University of Alberta
- used viruses to genetically modify mice, which can make human insulin in the K cells of their stomach and duodenum
- gut insulin production sufficient to keep blood glucose normal if  $\beta$  cells are destroyed
- mice lived up to 6 months without insulin

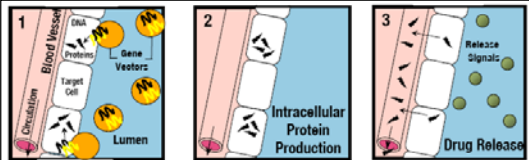
Science 2000;290:1959-1962






## enGene Inc.



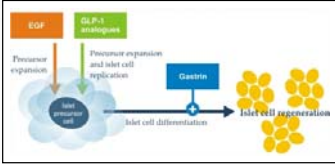

- GEMS™-Insulin (Gut Endocrine-cell Modification System)
- non-viral (chitosan- $\Phi$ C31) gene transfer
- large-animal trials (pigs) underway
- next: human trials!
- Canadian (Vancouver)





## Transition Therapeutics Inc.

- E1-I.N.T.™ and GLP-1-I.N.T.™ (Islet Neogenesis Therapy)
- use of epithelial growth factor (E1) or GLP-1 and gastrin (TT-223) analogs to stimulate the growth of new islets
- E1-I.N.T.™ Phase 2a trials: lowers insulin needs in T1D and lowers A1C in T2D
- Canadian (Toronto)


## Diabetes Research at BCCH

- Centre for Research on Childhood Diabetes
- CFRI Translational Research Building
- funding from CDA, JDRF, Canada Foundation for Innovation and the BC Knowledge Development Fund
- Research areas:
  - genetics of T1D
  - islet-cell biology and transplantation
  - viral pathogenesis of T1D
  - immunology of T1D
  - clinical diabetes research







## Standards of Care for Children with T1D

## Standards of Care

- Canadian Diabetes Association 2008 *Clinical Practice Guidelines for the Prevention and Management of Diabetes in Canada*
- evidence-based guidelines
- majority of diabetes specialists in Canada involved in development, review and dissemination of Guidelines
- revised every 5 years




## Standards of Care


**Type 1 Diabetes in Children and Adolescents**

*Canadian Diabetes Association Clinical Practice Guidelines for the Prevention and Management of Diabetes in Canada*

**INTRODUCTION**

**EDUCATION**

**INSULIN THERAPY**

## Other Guidelines

**Pediatric Diabetes**

VOLUME 10 • SUPPLEMENT 1 • SEPTEMBER 2008

WILEY-BLACKWELL



**Diabetes Care**

Volume 33

**Clinical Practice Recommendations 2010**

September 2010



WILEY-BLACKWELL

## CDA: A1C and Glucose Targets

- A1C:
  - under 8.5% for ages 0 to 5 years
  - under 8.0% for ages 6 to 12 years
  - 7% or under for ages 13 and up
- pre-meal blood glucose:
  - 6–12 (108–216) for ages 0 to 5 years
  - 4–10 (72–180) for ages 6 to 12 years
  - 4–7 (72–126) for ages 13 and up
- 2-hour post-meal blood glucose:
  - 5–10 (90–180) for ages 13 and up


CDA 2008 Clinical Practice Guidelines





## ADA: A1C and Glucose Targets

- A1C:
  - 7.5–8.5% for ages 0 to 5 years
  - under 8.0% for ages 6 to 12 years
  - under 7.5% for age 13 and up
- pre-meal blood glucose:
  - 100–180 (5.5–10) for ages 0 to 5 years
  - 90–180 (5–10) for ages 6 to 12 years
  - 90–130 (5–7.2) for age 13 and up


ADA 2010 Clinical Practice Recommendations






## ISPAD: A1C and Glucose Targets


- A1C:
  - under 7.5% for all ages
- pre-meal blood glucose:
  - 5–8 mmol/L (90–145 mg/dL)
- 2-hour post-meal blood glucose:
  - 5–10 mmol/L (90–180 mg/dL)
- bedtime blood glucose:
  - 6.7–10 mmol/L (120–180 mg/dL)
- overnight blood glucose:
  - 4.5–9 mmol/L (80–162 mg/dL)


ISPAD 2009 Clinical Practice Consensus Guidelines 



## Access to Care


- All children with diabetes should have access to an experienced pediatric diabetes health care team and specialized care starting at diagnosis.


CDA 2008 Clinical Practice Guidelines 



## Initial Management


- Children with new-onset type 1 diabetes who are medically stable should receive their initial education and management in an outpatient setting, providing appropriate personnel and daily telephone consultation service are available in the community.


CDA 2008 Clinical Practice Guidelines 



## Transition


- To ensure ongoing and adequate metabolic control, pediatric and adult diabetes care services should collaborate to prepare adolescents and young adults for the transition to adult diabetes care.


CDA 2008 Clinical Practice Guidelines 



## A1C >10%


- Children with persistently poor diabetes control (e.g. A1C >10%) should be referred to a tertiary pediatric diabetes team and/or mental health professional for a comprehensive interdisciplinary assessment.
- Intensive family and individualized psychological interventions aimed at improving glycemic control should be considered to improve chronically poor metabolic control.


CDA 2008 Clinical Practice Guidelines 



## Initial Management


- Children with new-onset diabetes should be started on at least 2 daily injections of short-acting insulin or rapid-acting insulin analogs combined with an intermediate- or long-acting insulin.


CDA 2008 Clinical Practice Guidelines 



## Insulin


- ❑ Insulin therapy should be assessed at each clinical encounter to ensure it still enables the child to meet A1C targets, minimizes the risk of hypoglycemia and allows flexibility in carbohydrate intake, daily schedule and activities. This assessment should consider:
  - increased frequency of injections
  - change in the type of basal (long-acting analog) and/or prandial (rapid-acting analog) insulin
  - change to pump


CDA 2008 Clinical Practice Guidelines 



## Glucagon


- ❑ In the home situation, severe hypoglycemia should be treated with glucagon:
  - in children 5 years of age or under: use 0.5 mg
  - in children over 5 years of age: use 1 mg
- ❑ The episode should be discussed with the diabetes healthcare team as soon as possible and consideration given to reducing insulin doses for the next 24 hours to avoid further severe hypoglycemia.


CDA 2008 Clinical Practice Guidelines 



## Mini-Dose Glucagon


- ❑ In children, the use of mini-doses of glucagon should be considered in the home management of mild or impending hypoglycemia associated with inability or refusal to take oral carbohydrate.
  - 10 µg per year of age
  - minimum 20 µg (2 units)
  - maximum 150 µg (15 units)


CDA 2008 Clinical Practice Guidelines 



## DKA Prevention


- ❑ To prevent DKA in children with diabetes:
  - Targeted public awareness campaigns should be considered to educate parents and other caregivers (e.g. teachers) about the early symptoms of diabetes.
  - Comprehensive education and support services, as well as 24-hour telephone services, should be available for families of children with diabetes.


CDA 2008 Clinical Practice Guidelines 



## Kidney Complications (Nephropathy)


- ❑ screen if age 12 years and above after 5 years or more of diabetes
- ❑ first-morning albumin-creatinine ratio (ACR)
- ❑ follow-up with timed overnight ACR
- ❑ treat as for adults if 3 or more high values

CDA 2008 Clinical Practice Guidelines 



## Eye Complications (Retinopathy)

- ❑ screen if age 15 years and above after 5 years or more of diabetes
- ❑ screen annually thereafter
- ❑ can screen every 2 years if control good and duration under 10 years


CDA 2008 Clinical Practice Guidelines 



## Nerve Complications (Neuropathy)

- screen if after 5 years or more of diabetes and poor control
- ask about numbness, pain, cramps and tingling
- examine for skin sensation, vibration sense, light touch and ankle reflexes



CDA 2008 Clinical Practice Guidelines

## Lipid Problems (Dyslipidemia)

- screen kids under 12 years if family history and/or obesity (BMI >95<sup>th</sup> percentile)
- screen all kids at 12 and then again at 17 years
- do full lipid panel (total, HDL, LDL, triglycerides)
- treat abnormal results as for adults



CDA 2008 Clinical Practice Guidelines

## High Blood Pressure (Hypertension)

- check all kids' blood pressure twice a year
- treat BP  $\geq$ 95<sup>th</sup> percentile for age with lifestyle modification, weight loss
- treat persistent high blood pressure as for non-diabetic kids



CDA 2008 Clinical Practice Guidelines

## Thyroid Disease

- thyroid problems occur in 15–30% of people with T1D
- TSH and thyroperoxidase antibodies at diagnosis
- repeat every 2 years
- more frequent if goiter, positive antibodies, or symptoms of hyper/hypothyroidism



CDA 2008 Clinical Practice Guidelines

## Celiac Disease

- celiac disease occur in 4–9% of people with T1D
- 60–70% of these have no symptoms
- screen for celiac disease (IgA-tissue transglutaminase antibodies) if classical or atypical symptoms
- gluten-free diet if affected
- screening in asymptomatic cases remains controversial


CDA 2008 Clinical Practice Guidelines

## Other Recommendations

- offer the influenza vaccine
- smoking prevention/cessation
- contraception (especially) for girls
- screen girls for eating disorders
  - 2-fold increase

CDA 2008 Clinical Practice Guidelines







## My Recommendations

## My Recommendations

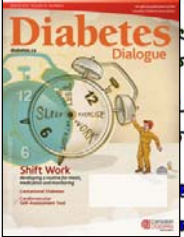
Learn as much as you can about diabetes.



CWD



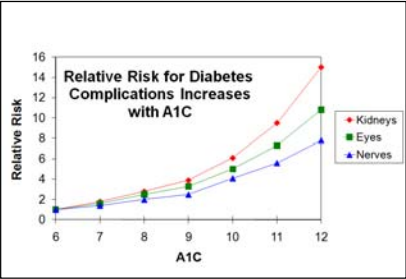
JDRF



CDA

## My Recommendations


Get the A1C in target.




A1C	Kidneys	Eyes	Nerves
6	1	1	1
7	2	2	2
8	4	3	3
9	8	5	4
10	16	8	6
11	32	16	10
12	64	32	18

## My Recommendations


Fear hyperglycemia as much as you fear hypoglycemia.



normal



hypoglycemia



hyperglycemia

Differential effects of lows and highs on developing brains.

## My Recommendations

Intensify the insulin regimen as much as possible.

- Go from two shots day to three, from three to four.
- Add in extra shots for extra food or high blood sugars.
- Move to multiple daily injections or a pump.
- Fine-tune the carb counting, adjust for protein and fat
- Use the advanced features of the pump (combo/dual-wave bolus, patterns, temp basals)
- Consider CGMS, at least intermittently.
- Download, analyze, and implement changes frequently.

## My Recommendations

Maximize your clinic visits by being prepared.

- Work with your team, they're nice people!
- Come prepared: logbook, meter and/or pump downloads.
- Write down questions.

## My Recommendations

- Send your kid to camp—you both need a break!





## My Recommendations

- Advocate for your child/yourself.
- Lend financial and emotional support.














## BC Children's Hospital Resources



## BCCH Online Insulin Dose-Adjustment Program







## BCCH MDI Handout

Basal-Bolus Insulin  
with Multiple  
Daily Injections

Focus on Children & Youth





## BCCH EDU Website



<http://endodiab.bcchildrens.ca>





**Enjoy the conference!**  
**Have fun and make new friends!**

