Ways to Reduce Diabetes Burden

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Conflict of interest: none

Except that I’d rather be climbing
Diabetes Burden

Society

Cost of diabetes, the US, 2012

Patient

$ billion

Medical

Other

Type 1 DM  Type 2 DM  undiagnosed  Total

Dall T. Health Affairs 2012

Courtesy: Skyler J
## Burden of diabetes

<table>
<thead>
<tr>
<th>Societal concerns</th>
<th>Patient’s perspective</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Cost (complications)</td>
<td>• Impact on life-style</td>
</tr>
<tr>
<td>• Lost productivity</td>
<td>• Psychological burden</td>
</tr>
<tr>
<td>• Access to care</td>
<td>• Cost</td>
</tr>
<tr>
<td>• Quality of care</td>
<td>• Employment</td>
</tr>
<tr>
<td></td>
<td>• Family, children</td>
</tr>
<tr>
<td></td>
<td>• Complications</td>
</tr>
</tbody>
</table>
Kids are not small adults
Their burden and needs are different
Diabetes burden for kids vs. adults.
How to reduce the burden of diabetes?

Prevent new diabetes or delay onset
# Type 1 Diabetes in the U.S.

<table>
<thead>
<tr>
<th></th>
<th>Children</th>
<th>Adults</th>
</tr>
</thead>
<tbody>
<tr>
<td>Existing patients</td>
<td>170,000</td>
<td>1,300,000</td>
</tr>
<tr>
<td>New cases per year</td>
<td>25,000</td>
<td>25,000</td>
</tr>
<tr>
<td>Cumulative risk</td>
<td>1:200</td>
<td>1:100</td>
</tr>
<tr>
<td>by age 20</td>
<td></td>
<td>by age 60</td>
</tr>
</tbody>
</table>
Why is T1D incidence doubling every 20 yrs?
What environmental factors are responsible?

Incidence /100,000/ yr in children 0-14 yr

TEDDY Ann NYAS, 2008
Primary Prevention of T1D

• Find the environmental trigger (virus, gut microbes, diet)

• 424,000 newborns screened

• 8,677 high-risk children followed

• Develop “vaccine”

• Public health screening and prevention

NIDDK
NIAID
NICHD
NIEHS
CDC
JDRF
Primary Prevention
(before islet autoantibodies appear)

TRIGR cow's milk hydrolyzate

100 %

Prevent appearance of islet autoantibodies

20 %

Diabetes diagnosis

Beta cell function

Time
Secondary Prevention (in subjects with islet autoantibodies)

Islet autoantibodies

TrialNet

Oral insulin

Delay diagnosis of diabetes
Islet autoimmunity phenotypes

β-cell function

100 %

Insulin dependency

Early IA 40%
Late IA 30%
Rемitting IA 30%
DM
DM
adult DM?
Would an earlier treatment improve outcomes?

• Preservation of residual insulin secretion
• Lower risk of hypoglycemia (DCCT)
• Lower risk of vascular complications (DCCT)
• Metabolic memory (DCCT)
• Prevent DKA
DKA at diabetes onset

Annually (U.S.):

- up to 40% of all newly diagnosed children
- 8000 hospitalizations
- $150 million
- 70-200 deaths
Lower $\text{HbA}_{1c}$ in Screening-detected Cases

DAISY

Barker J, et al. Diabetes Care 2004
Lower Insulin Dose in Screening-detected Cases

**DAISY**

U/kg/d

0 0.2 0.4 0.6 0.8 1

Duration of DM (months)

0 1 2 3 4 5 6 7 8 9 10 11 12

p<0.05

* * *

Barker J, et al. Diabetes Care 2004
Early Diagnosis of T1 Diabetes by CGM
Islet Autoantibody Positive Boy, DAISY

1/25/2012
A1c = 6.1%
>200  8%

4/5/2012
A1c = 6.1%
>200   15%
Close-loop pump in newly diagnosed T1D subjects (The Metabolic Study)

HP Chase, 2012
Natural History of Type 2 Diabetes

Diabetes Prevention – The Path Forward?

Glucose (mg/dL) / Body weight
- High risk for diabetes
- Post-meal glucose
- Diabetes diagnosis
- Fasting glucose

Relative amount
- Insulin resistance
- Insulin level
- Beta-cell function

Onset

Years

# Type 2 Diabetes in the U.S.

<table>
<thead>
<tr>
<th></th>
<th>Children</th>
<th>Adults</th>
</tr>
</thead>
<tbody>
<tr>
<td>Existing patients</td>
<td>15,000</td>
<td>18,200,000</td>
</tr>
<tr>
<td>- diagnosed</td>
<td></td>
<td>13,000,000</td>
</tr>
<tr>
<td>- undiagnosed</td>
<td></td>
<td>5,200,000</td>
</tr>
<tr>
<td>Cumulative risk</td>
<td></td>
<td>1:3 by age 80</td>
</tr>
</tbody>
</table>
The Raise of Diabetes Epidemic

Boyle et al. Population Health Metrics 2010,
We need:

• a societal change
• better personal decisions
• improved preventive care

Yeah, those darn genes but also 4000 calories a day…
The Fall of Smoking Epidemic

How to reduce the burden of diabetes?

Prevent complications
Risk of Hypoglycemia vs. Vascular Complications

Severe hypoglycemia /100 p-yrs

Diabetic retinopathy
Nephropathy
Neuropathy
Microalbuminuria

ISPAD 2007

Skyler. DCCT 1996
A1c as close to normal as possible without severe hypoglycemia
Mean HbA1c in BDC T1D patients
Diabetes duration > 1 year

HbA1c

<6 yr 6-12 yr 13-19 yr >19

Mean HbA1c in BDC T1D patients

Diabetes duration > 1 year
Declining cumulative incidence of microvascular complications

Steno Clinic, Denmark, Patients with T1 DM onset 1965-84

Improving survival among T1 DM patients
Allegheny County IDDM Registry 1965-1999


General Population $SMR = 100$

1975-79 $SMR = 235$

1970-74 $SMR = 367$

1965-69 $SMR = 497$

Duration of diabetes (yrs)
The incidence of coronary artery disease in T1D is increasing

684 Patients diagnosed 1950-1980

*Orchard T, Pittsburgh EDC Study*
How to reduce the burden of diabetes?

Lower the complexity and cost of treatment
Diabetes Management
Getting more complex and costly

Urine Sugar → Blood Sugar → MDI / Analogs → CGM
Pens, Pumps → closed loop

pre 1980 1980s 1990s 2000s

Glargine
Detemir
Lispro    Lispro   Lispro
Aspart    Aspart  Aspart
Glulisine Glulisine Glulisine

HP Chase, modified
CGM - use it or lose it

Mean sensor use (days/wk)

Median change HbA1c (%)
How to reduce the burden of diabetes?

Improve quality of life

• Change from syringes to pens, and to pumps
• CGM - almost there
• Reduce burden of record keeping and decision making – smart phones?
• Reduce restrictions on diet, life-style
• Provide access to quality education, telemedicine, and transition programs
• Lower the barriers in schools, workplace