Primary Care Electronic Health Record
Data: Good to the last byte

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I have no conflicts of interest related to this presentation.
Objectives

1. The importance of using data for the health system and quality clinical care.
2. Overview of the Canadian Primary Care Sentinel Surveillance Network (CPCSSN).
3. Examples of use of EMR data for surveillance, research and clinical practice.
Commonwealth Fund International Scorecard

EXHIBIT ES-1. OVERALL RANKING

<table>
<thead>
<tr>
<th>Country</th>
<th>AUS</th>
<th>CAN</th>
<th>FRA</th>
<th>GER</th>
<th>NETH</th>
<th>NZ</th>
<th>NOR</th>
<th>SWE</th>
<th>SWI</th>
<th>UK</th>
<th>US</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall Ranking (2013)</td>
<td>4</td>
<td>10</td>
<td>9</td>
<td>5</td>
<td>5</td>
<td>7</td>
<td>7</td>
<td>3</td>
<td>2</td>
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<td>11</td>
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<tr>
<td>Quality Care</td>
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<td>9</td>
<td>8</td>
<td>7</td>
<td>5</td>
<td>4</td>
<td>11</td>
<td>10</td>
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<td>5</td>
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<td>Effective Care</td>
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<td>9</td>
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<td>2</td>
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<td>3</td>
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<td>4</td>
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<td>7</td>
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<td>11</td>
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<td>1</td>
<td>6</td>
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<td>Patient-Centered Care</td>
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<td>6</td>
<td>11</td>
<td>9</td>
<td>2</td>
<td>1</td>
<td>4</td>
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<tr>
<td>Access</td>
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<td>9</td>
<td>11</td>
<td>2</td>
<td>4</td>
<td>7</td>
<td>6</td>
<td>4</td>
<td>2</td>
<td>1</td>
<td>9</td>
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<tr>
<td>Cost-Related Problem</td>
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<td>10</td>
<td>4</td>
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<td>6</td>
<td>3</td>
<td>1</td>
<td>7</td>
<td>1</td>
<td>11</td>
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<td>Timeliness of Care</td>
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<td>10</td>
<td>4</td>
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<td>8</td>
<td>9</td>
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<td>8</td>
<td>9</td>
<td>7</td>
<td>3</td>
<td>4</td>
<td>2</td>
<td>6</td>
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<td>11</td>
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<td>7</td>
<td>4</td>
<td>8</td>
<td>10</td>
<td>6</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>11</td>
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<tr>
<td>Healthy Lives</td>
<td>4</td>
<td>8</td>
<td>1</td>
<td>7</td>
<td>5</td>
<td>9</td>
<td>6</td>
<td>2</td>
<td>3</td>
<td>10</td>
<td>11</td>
</tr>
<tr>
<td>Health Expenditures/Capita, 2011*</td>
<td>$3,800</td>
<td>$4,522</td>
<td>$4,118</td>
<td>$4,495</td>
<td>$5,099</td>
<td>$3,182</td>
<td>$5,669</td>
<td>$3,925</td>
<td>$5,643</td>
<td>$3,405</td>
<td>$8,508</td>
</tr>
</tbody>
</table>

Notes: * Includes ties. ** Expenditures shown in $US PPP (purchasing power parity); Australian $ data are from 2010.
2012 IOM Recommendations

1. Digital Infrastructure
2. Data Utility
3. Clinical Decision Aids
10 Building Blocks of High-Performing Primary Care

T Bodenheimer et al Ann Fam Med March 2014
Doctors’ Use of Electronic Medical Records in Their Practice, 2009 and 2012

Source: 2009 and 2012 Commonwealth Fund International Health Policy Survey of Primary Care Physicians.
Doctors with Electronic Medical Records and Multifunctional Health IT Capacity

Percent

<table>
<thead>
<tr>
<th>Country</th>
<th>Uses EMR</th>
<th>Uses EMR with multifunctional HIT capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>UK</td>
<td>97</td>
<td>68</td>
</tr>
<tr>
<td>AUS</td>
<td>92</td>
<td>60</td>
</tr>
<tr>
<td>NZ</td>
<td>97</td>
<td>59</td>
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<tr>
<td>NETH</td>
<td>98</td>
<td>33</td>
</tr>
<tr>
<td>US</td>
<td>98</td>
<td>27</td>
</tr>
<tr>
<td>SWE</td>
<td>88</td>
<td>12</td>
</tr>
<tr>
<td>SWIZ</td>
<td>56</td>
<td>11</td>
</tr>
<tr>
<td>CAN</td>
<td>82</td>
<td>10</td>
</tr>
<tr>
<td>GER</td>
<td>67</td>
<td>7</td>
</tr>
<tr>
<td>FR</td>
<td>6</td>
<td>4</td>
</tr>
</tbody>
</table>

Note: Multifunctional health IT capacity—uses electronic medical record and at least two electronic functions: for order entry management, generating patient information, generating panel information, and routine clinical decision support.

Source: 2012 Commonwealth Fund International Health Policy Survey of Primary Care Physicians.
Primary Care Data goes into a ‘black hole’

The data gets sucked in but never comes out
The Canadian Primary Care Sentinel Surveillance Network:

- 1.5 million Canadian patients
- 1200 practices
- 11 PBRNs in 7 provinces, 1 territory
- Some EMR data back to 2003
- Started in 2008
- $12.5M funding from PHAC
- Strong partnerships with College of Family Physicians of Canada, Queen’s and other Universities

B.C. (BCPCReN), Alberta (SAPCReN, NAPCReN), NWT, Manitoba (MaPCReN), Ontario (DELPHI, UTOPIAN, EON, MUSIC), Quebec (RRSPUM), Nova Scotia/New Brunswick (MaRNet), Newfoundland (APBRN)
Privacy and Ethics

- Opt-out consent
- 12 Research Ethics Board approvals
- Stored in a highly secure facility
- Data is de-identified
Security Overview

Practice Environment

- EMR Data
- ELF (.csv)
- PIK (.csv) (only when needed)
- CPCSSN Site Data (MS Access)

CPCSSN Appliance Environment

- ELF (.csv)
- PIK (.csv) (only when needed)
- CPCSSN Site Data (MS Access)

VPN

Firewall

Regional & Central Servers Environment

LAN

LAN

Internet

DatasetDelivery Area

Researchers & Analysts

Notes:
ELF = EMR Linkage File (used for re-identification purposes within the practice)
PIK = Patient Identifier Key (used for data linkage to other data sources)
• Provider profile
• Patient socio-demographics
• Disease/health condition
• Encounter data
• Risk factor data
• Examination data
• Medications
• Laboratory data
• Referral data
• Procedure data
Data Quality Framework

- Accuracy
- Comparability
- Usability
- Relevance
Issues with Data

- **“Dirty data”** (misspellings, extra words in field, inconsistent strings (ex smoker, ex-smoker), multiple diagnoses in a single field
  - Can be cleaned by data managers

- **“Missing data”** (dosages, dates of onset, occupation, ethnicity)
  - Cannot be fixed, other than having it entered

- **“Inconsistent data”** (Diagnoses stored in several different places – notes, PMH, problem list, Inconsistent Risk Factors coexisting – smoker, ex-smoker)
  - Need to find the best source of data for each EMR

- **“Cloudy data”** (referral to xray or Dr. Jones)
  - Cannot be fixed, other than enter correctly
Issues with Data

- "Lacking Meta Data" (Diagnosis not in problem list, Medication in encounter notes,)
  - Cannot be fixed, other than enter correctly

- "Lacking standardization" (multiple, changing, inconsistent names or results for lab tests – HbA1C, glycosylated hemoglobin, 7% vs. 0.07 for test results)
  - Must be fixed by national lab standards

- "Lacking data feeds" (lab results not coming in electronically)
  - Needs to be fixed at clinic level
Representativeness
Chronic Disease

Patients in Database

- Chronic Obstructive Lung Disease 29,146
- Depression 108,775
- Diabetes 67,651
- Hypertension 148,300
- Osteoarthritis 77,235
- Dementia 18,199
- Epilepsy 8,477
- Parkinson’s Disease 2,675
<table>
<thead>
<tr>
<th>Number of Chronic Diseases</th>
<th>Number of Patients (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>685,593 (69.6)</td>
</tr>
<tr>
<td>1</td>
<td>186,876 (19)</td>
</tr>
<tr>
<td>2</td>
<td>76,900 (7.8)</td>
</tr>
<tr>
<td>3</td>
<td>27,412 (2.8)</td>
</tr>
<tr>
<td>4</td>
<td>7,362 (0.75)</td>
</tr>
<tr>
<td>5</td>
<td>1,391 (0.14)</td>
</tr>
<tr>
<td>6</td>
<td>162 (0.02)</td>
</tr>
<tr>
<td>7</td>
<td>13</td>
</tr>
</tbody>
</table>
Chronic Disease Surveillance
Figure 9: Prevalence of Obesity by Sex from 2008 to 2012*

* data as of December 31, 2012 is based on a cohort of 304,412 patients who had one or more encounters in the last 24 months with a CPCSSN sentinel.
Uses of the Data

Research

- Creativity
- Experience
- Innovation
- Vision
Herpes Zoster Infection (VZV) in People with Diabetes in Canadian Primary Care Practice
## Risk Ratios for VZV by select disease status

<table>
<thead>
<tr>
<th>Variable</th>
<th>With Zoster (n)</th>
<th>Without Zoster (n)</th>
<th>Unadjusted 95% CI</th>
<th>Age-sex adjusted 95% CI</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>RR</td>
<td>Lower</td>
</tr>
<tr>
<td>No indication of diagnoses of interest*</td>
<td>3343</td>
<td>470407</td>
<td>Reference</td>
<td></td>
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<tr>
<td>With Diabetes</td>
<td>1210</td>
<td>60950</td>
<td>2.73</td>
<td>2.55</td>
</tr>
<tr>
<td>With COPD</td>
<td>521</td>
<td>22546</td>
<td>2.87</td>
<td>2.57</td>
</tr>
<tr>
<td>With any Neoplasm</td>
<td>1454</td>
<td>73947</td>
<td>3.57</td>
<td>3.29</td>
</tr>
<tr>
<td>With HIV/AIDS</td>
<td>48</td>
<td>1418</td>
<td>6.13</td>
<td>4.16</td>
</tr>
</tbody>
</table>

Patients who have no indication of Diabetes, COPD, Hypertension, Depression, Osteoarthritis, Dementia, Epilepsy, Parkinsonism, any Neoplasm, or HIV/AIDS.
Uses of the Data

Data Linkage
Primary Care EMR with Administrative data

- Hospital Records
- Emergency Department Records
- Social Determinants of Health (e.g. neighbourhoods, income, education)
## Results

### Level of HbA1c and hospital and emergency room utilization

<table>
<thead>
<tr>
<th>Variable</th>
<th>A1c level</th>
<th>&lt;7</th>
<th>7-8</th>
<th>&gt;8</th>
<th>Missing</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td></td>
<td>5526</td>
<td>2662</td>
<td>1814</td>
<td>2356</td>
<td></td>
</tr>
<tr>
<td>Age (yr)</td>
<td>Mean</td>
<td>65.7</td>
<td>64.7</td>
<td>58.1</td>
<td>61.0</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Female</td>
<td>%</td>
<td>50.1</td>
<td>47</td>
<td>45.4</td>
<td>50.3</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Any acute complication</td>
<td>%</td>
<td>1.9</td>
<td>3.1</td>
<td>6.0</td>
<td>-</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Any chronic complication</td>
<td>%</td>
<td>2.1</td>
<td>3.3</td>
<td>3.8</td>
<td>-</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>ER visits</td>
<td>Mean</td>
<td>0.63</td>
<td>0.67</td>
<td>0.95</td>
<td>-</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Inpatient episodes</td>
<td>Mean</td>
<td>0.18</td>
<td>0.22</td>
<td>0.26</td>
<td>-</td>
<td>&lt;.001</td>
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<td>ADGs</td>
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<td>6.39</td>
<td>6.15</td>
<td>5.98</td>
<td>6.35</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>
Data Analytics
Personalized Medicine

- EMR with Omic Data
Advanced Data Analytics

- Multiple Data Sources
- Natural language processing (NPL)
- Machine learning
Practice Quality Improvement
CPCSSN Data Presentation Tool
DPT Case Finder

Name: Urge, urgency incontinence, overactive bladder

General Patient Rules:
- Gender: Female
- Age Range: 18

Clinical Criteria (Each line represents an OR search)
- Criteria Set Name: HC Texts - Overactive Bladder; Urge; Frequency
- Criteria Set Name: Billing Texts - Overactive Bladder; Urge; Frequency
- Criteria Set Name: Encounter Texts - Overactive Bladder; Urge;
- Criteria Set Name: HC Texts - Nocturia, Polyuria, Other
- Criteria Set Name: Billing Texts - Nocturia, Polyuria, Other
- Criteria Set Name: Encounter Texts - Nocturia, Polyuria, Other
- Criteria Set Name: HC ICD9 Codes - 596 variations
- Criteria Set Name: Billing ICD9 Codes - 596 variations
- Criteria Set Name: Encounter ICD9 Codes - 596 variations
- Criteria Set Name: HC ICD9 Codes - 788 variations
- Criteria Set Name: Billing ICD9 Codes - 788 variations
- Criteria Set Name: Encounter ICD9 Codes - 788 variations
- Criteria Set Name: Medications - ATC Codes G04BD04
- Criteria Set Name: Medications - ATC Codes G04BD07
- Criteria Set Name: Medications - ATC Codes G04BD11

Select Denominator: Patient - Females > 17

Total Processing Time: .2 min

Encounter ICD9 Codes - 788 variations (Each line represents an AND search)
- Description: 788.3 or 788.4 or 788.6 or 788.9

Other Case Definitions
- Chronic Non-Cancer Pain
- Fecal Incontinence
- IHD
- Mechanical Valve
- Other PFD
- Speech Disorders: Aphasia
- Stress Urinary Incontinence
Custom Searches

Top 20 Medications
By Unique Patients and Based on ATC Coding

- Levothyroxine Sodium: 2.692
- Rosuvastatin: 2.354
- Atorvastatin: 2.189
- Salbutamol: 1.987
- Pantoprazole: 1.795
- Metformin: 1.791
- Lorazepam: 1.704
- Hydrochlorothiazide: 1.666
- Amoxicillin: 1.665
- Pantoprazole: 1.636
- Amlodipine: 1.634
- Escitalopram: 1.488
- Zopiclone: 1.396
- Hydroxyzine: 1.275
- Naproxen: 1.203
- Clozapine: 0.901
- Venlafaxine: 0.927
- Warfarin: 0.927
GIS mapping

Demographics
- Population

Conditions
- Diabetes Mellitus
- Dementia
- COPD
- Epilepsy
- Depression
- Hypertension
- Parkinson's Disease
- Osteoarthritis
CPCSSN Partner Universities
Canadian Primary Care Sentinel Surveillance Network
Réseau canadien de surveillance sentinelle en soins primaires

http://www.cpcssn.ca