Integrating Digital Health into Clinical Practice

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The Web of Health, 15 May 2019
The Web Conference, San Francisco
Arnold Munk
Challenge #1: High demand.
Challenge #2: High cost.

Health expenditure, public and private, as a share of GDP, OECD countries, 2012 or latest year

Source: OECD
Challenge #3: Doctors and patients are struggling.
The system is struggling.
People are turning elsewhere for help.
We all want:

Better care, for more people, in a new era.
There are many models suggesting this should work.

Source: IHI, Europuls, HBR
Healthcare can be elegant.
But how does that happen, exactly?

"I think you should be more explicit here in step two."
OO + NT = EOO

Source: Michael Hammer
OO + NT = EOO

Old organization + New Technology = Expensive old organization

Source: Michael Hammer
Change is hard to embrace.
Reality is hard to embrace.
We are here.
Diverse landscape
National Health Insurance Law

Mandatory, universal coverage
Every one of the over 8 million residents belongs to one of four health funds

Single, comprehensive system
Every fund provides the same basic services, which are updated yearly by an independent committee

Universal access
Funded by the government through capitation
Clalit Health Services

Largest health fund:
• 4.5+ million members
• 53% of population
• >1,500 clinics
• 14 hospitals
Potential for excellence

Bridging the Silos
Comprehensive digital warehouse

- Hospital inpatient, ED and discharge data
- Community primary care clinic data
- Laboratory data
- Administrative data (costs)
- Allied health services data
- Pharmacy, medications data
- Disease registries
- Diagnostic and imaging data
- Dental, complementary health services data
- Socio-demographic data

Linked to:
- Ministry of Health
- National Cancer registry
- Linked to national database
Resources are scarce.

Source: Taub Center
Even with all our potential, we were missing something.
Cla lit Research Institute

- Established in March 2010, nearly 100 years after Clalit
- Mandate: Turn data to insights, insights to policy
  - Real world outcomes
  - Risk stratification
  - Personalization
- Interdisciplinary teams
- Multidisciplinary collaborations

24 May 2019
Maya Leventer-Roberts, MD, MPH
Clalit Research Institute
Our method of integration

• Deliver the right intervention,
  Using real world outcomes to guide clinical decision support

• at the right time,
  Empowering providers to intervene efficiently with risk stratification

• to the right patient.
  Integrating personalization into clinical practice
Pneumococcal disease

What do they all have in common?

Bill, Age 28
Smoker

Lily, Age 65

Carl, Age 37
HIV

Diane, Age 50
Heart Disease

David, Age 30
Asthma

Patricia, Age 41
Lymphoma

Miguel, Age 55
Diabetes

They are all at increased risk for an infection called pneumococcal disease

Source: CDC
Pneumococcal Polysaccharide Vaccine: Efficacy Remains Controversial

Allan S. Brett, MD

Disclosures
Does the vaccine work or not?

Effectiveness of 23-Valent Pneumococcal Polysaccharide Vaccine Against Invasive Disease and Hospital-Treated Pneumonia Among People Aged ≥65 Years: A Retrospective Case-Control Study

Maya Leventer-Roberts, MD, MPH

Table 3. Odds Ratio for Invasive Pneumococcal Disease and Hospital-Treated Pneumonia Morbidity in Patients Vaccinated With 23-Valent Pneumococcal Polysaccharide Vaccine, Matched by Age, Sex, and Risk

<table>
<thead>
<tr>
<th>Group</th>
<th>No. of Subpopulation (No. of Cases)</th>
<th>Adjusted† OR (95% CI)</th>
<th>P Value</th>
<th>No. of Subpopulation (No. of Cases)</th>
<th>Adjusted† OR (95% CI)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>IPD</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>HTP</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age group, y</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>65-74</td>
<td>420 (84)</td>
<td>0.54 (32-90)</td>
<td>.02</td>
<td>20 217 (6739)</td>
<td>1.12 (1.03-1.21)</td>
<td>.01</td>
</tr>
<tr>
<td>≥75 (75-84, ≥85)</td>
<td>615 (123)</td>
<td>0.80 (53-1.22)</td>
<td>.30</td>
<td>49 521 (16 507)</td>
<td>0.97 (92-1.01)</td>
<td>.18</td>
</tr>
<tr>
<td>Risk group</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>200 (40)</td>
<td>0.63 (30-1.33)</td>
<td>.23</td>
<td>9140 (1961)</td>
<td>1.00 (0.85-1.16)</td>
<td>.56</td>
</tr>
<tr>
<td>Moderate + high</td>
<td>835 (167)</td>
<td>0.70 (49-99)</td>
<td>.05</td>
<td>60 598 (21 296)</td>
<td>1.01 (0.97-1.06)</td>
<td>.97</td>
</tr>
</tbody>
</table>

Abbreviations: CI, confidence interval; HTP, hospital-treated pneumonia; IPD, invasive pneumococcal disease; OR, odds ratio.
† All models adjusted for ethnicity, socioeconomic status, John Hopkins Adjusted Clinical Groups morbidity, smoking status, pre-existing pulmonary disease, influenza vaccination, previous general hospitalization, and hospitalization in long-term care.
It works in practice.

IPD rate (per 100,000) and prevalence (%) of PPSV vaccination in Clalit Members (65+ year old)

Source: Clalit Health Services
It works however you target it.

Pneumococcal vaccine targeting strategy for older adults: Customized risk profiling

Ran D. Balicer, Chandra J. Cohen, Morton Leibowitz, Becca S. Feldman, Ilan Brufman, Craig Roberts, Moshe Hoshen
The vaccine remains a national priority.

Pneumococcal vaccination for older adults

Description: The percentage of individuals aged 65–71 years who received a pneumococcal vaccination.

Rationale: Improvement of pneumococcal vaccination coverage in older adults likely reduces morbidity and mortality that is caused by the Pneumococcus bacterium.

Denominator: Individuals aged 65–71 years

Numerator: The number of individuals in the denominator who received a pneumococcal vaccination once after age 65 years or within the past five years.

Comments: This indicator relates to the 23-valent formulation of the pneumococcal polysaccharide vaccine. The age range used for the present report (2008–2010) is a function of data availability.

Source: Ministry of Health
Bariatric Surgery
Is bariatric surgery worth it?

Weight-loss Surgery Becoming Increasingly Popular in Israel, the Land of Milk and Honey
But while obesity has been spreading, Israelis are still notably trimmer than many of their Western counterparts.

Judy Maltz | Apr 27, 2015 1.05 PM

Weight loss surgery: do the benefits really outweigh the risks?

By Honor Whiteman | Published Thursday 28 November 2013
It works.
Table 2. Association Between Bariatric Surgery and Mortality

<table>
<thead>
<tr>
<th></th>
<th>Laparoscopic Banding</th>
<th>Gastric Bypass</th>
<th>Laparoscopic Sleeve Gastrectomy</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Surgical Patients</td>
<td>Nonsurgical Patients</td>
<td>Surgical Patients</td>
<td>Nonsurgical Patients</td>
</tr>
<tr>
<td>Follow-up, median (IQR), y</td>
<td>6.2 (4.3-8.5)a</td>
<td>5.7 (3.7-8.2)a</td>
<td>5.5 (3.0-6.7)a</td>
<td>4.8 (2.6-6.6)a</td>
</tr>
<tr>
<td>Total deaths, No. (%)</td>
<td>61 (1.7)a</td>
<td>338 (3.1)a</td>
<td>18 (1.3)a</td>
<td>116 (2.8)a</td>
</tr>
<tr>
<td>Mortality/1000 person-years (95% CI)</td>
<td>2.6 (2.0-3.4)</td>
<td>5.3 (4.7-5.8)</td>
<td>2.6 (1.6-4.2)</td>
<td>6.0 (5.0-7.2)</td>
</tr>
<tr>
<td>Mortality rate difference/1000 person-years, mean (95% CI)</td>
<td>[Reference]</td>
<td>2.6 (1.7-3.5)</td>
<td>[Reference]</td>
<td>3.4 (1.7-5.0)</td>
</tr>
</tbody>
</table>

Nonsurgical patients vs surgical, hazard ratio (95% CI) for mortality

Unadjusted 1 [Reference] 2.00 (1.52-2.63) 1 [Reference] 2.29 (1.39-3.76) 1 [Reference] 1.66 (1.09-2.54) 1 [Reference] 1.97 (1.59-2.42)
Adjusted, before multiple imputationb,c 1 [Reference] 2.13 (1.47-3.09) 1 [Reference] 2.46 (1.43-4.24) 1 [Reference] 1.59 (1.00-2.53) 1 [Reference] 2.03 (1.58-2.61)
Adjusted, after multiple imputationd 1 [Reference] 2.01 (1.50-2.69) 1 [Reference] 2.65 (1.55-4.52) 1 [Reference] 1.60 (1.02-2.51) 1 [Reference] 2.02 (1.63-2.52)

Figure 3. Kaplan-Meier Estimated Mortality Curves for 3 Types of Surgical Patients and Matched Nonsurgical Obese Patients

Clalit Research Institute

It saves lives.

Maya Leventer-Roberts, MD, MPH
24 May 2019
Risk Stratification
CHRONIC RENAL FAILURE (CRF)

ESRD - END STAGE RENAL DISEASE

↓15 ml/min GFR

- Neurological
  Weakness / Fatigue
  Confusion

- Cardiovascular
  ↑BP
  Pitting Edema
  Periorbital Edema
  ↑CVP
  Pericarditis

- Pulmonary
  SOB
  Depressed Cough
  Thick Sputum

- GI
  Ammonia Odor to Breath
  Metallic Taste
  Mouth / Gum Ulcerations
  Anorexia
  Nausea / Vomiting

- Psychological
  Withdrawn
  Behavior Changes
  Depression

- Hematological
  Anemia
  Bleeding Tendencies
  ↑Serum K

- Skin
  Dry Flaky
  Pruritus
  Ecchymosis
  Purpura
  Yellow-Gray Skin Color

- Musculoskeletal
  Cramps
  Renal Osteodystrophy
  Bone Pain

Hemodialysis

Evaluate access site for:
Patency & signs of infection
DO NOT take BP or obtain blood samples from extremity that has access site.
Trends: Renal Replacement Therapy

Prevalence rates (per 1,000 members):
Relative increase vs. 2004, Clalit

Source: Clalit Health Services
Identify patients at:
Pre-clinical stage (Pre-disease)
Risk for acquiring the condition

Tailor interventions to:
Prevent progression to chronic disease
Treat when treatment most effective
Preventing Renal Failure

5-year deterioration rates to RRT among CKD stage 3 patients, Clalit

100-fold
RRT increased risk!
Screening for Colorectal Cancer
The 14 easy steps to doing a FIT.
No FIT in the last year

- **FIT Recommended:** 55,000
  - **Top 0.5%:** 250
    - **10**
  - **Top 10%:** 5,000
    - **100**

- **Not eligible:** 5,000

- **Standard risk:** 45,000
  - **CRC:** 350

Source: Clalit Health Services, approximate counts from one district
Patient engagement is sorted based on risk.
Personalization
The SPRINT Data Analysis Challenge

To explore the potential of clinical trial data sharing, the New England Journal of Medicine (NEJM) is hosting a challenge: use the data underlying a recent NEJM article to identify a novel clinical finding that advances medical science.
Learning What We Didn’t Know — The SPRINT Data Analysis Challenge

Nancy S. Burns and Pamela W. Miller
April 26, 2017 | DOI: 10.1056/NEJMp1705323

The team that won first place was made up of physicians and data analysts from the Clalit Research Institute in Tel Aviv, Israel. They developed a weighted risk-benefit calculator for examining the pluses and minuses of intensively treating an individual patient with hypertension. The round...
Personalizing clinical trials outcomes

Outcome-specific Predictive model
(1000 bootstraps)

Acute Myocardial Infarction (iNNT=384)

1.4%
**ENTER PATIENT’S DATA**

- **Age**: 78
- **Sex**: Female
- **Weight**: 77 Kg
- **Height**: 1.63 M
- **Black Race**: No
- **Smoking Status**: Former Smoker
- **Cardio-vascular disease (clinical or subclinical)**: No
- **eGFR (mL/min/1.73 m²)**: 47
- **Total cholesterol (mg/dL)**: 212
- **Blood pressure lowering medications (number)**: 0
- **High density cholesterol (HDL) (mg/dL)**: 75

**RESULTS**

- **Acute Myocardial Infarction (iNNT=384)**: 1.4% (↓3.3%)
- **Acute Decompensated Heart Failure (iNNT=113)**: 2.2% (↓0.9%)
- **Stroke (iNNT=442)**: 1.9% (↓1.0%)
- **Cardio-Vascular Death (iNNT=101)**: 2.3% (↓1.0%)
- **Serious Hypotension (iNNH=61)**: 2.5% (↓1.5%)
- **Serious Syncope (iNNH=75)**: 4.5% (↓1.3%)
- **Serious Electrolyte Abnormality (iNNH=47)**: 6.4% (↓2.13%)
- **Serious Acute Renal Failure (iNNH=32)**: 3.0% (↓1.0%)

* For a time period of 3 years

**RECOMMENDATION**

**Do Not Treat BP Intensively**

Systolic blood-pressure target: ≤140 mmHg

The recommendation is based on the ratio between the individual ARR and ARIs, weighted by severity ranks assigned to the different outcomes. The current ranks are averages of ranks given by several physicians. You can change the ranks and update the recommendation.

**UPDATE RECOMMENDATION**

with new severity ranks
I-PREDICT HTN Individualized Predictive Risk Evaluation & Decision Integration Clinical Tool for Hypertension

INTENSIVE VS. NON-INTENSIVE HYPERTENSION TREATMENT

I-PREDICT Recommendation

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24 May 2019
Thank you!

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