Data-driven care: Innovation in Practice

Prof. Ran Balicer MD, PhD, MPH

Director, Health Policy Planning, Clalit Healthcare Services, Israel
Director, Clalit Research Institute, Israel
Chair, Israel Society for Quality in Healthcare

Stanford, January 2017
Where we are
The resources vs. demand crisis

Our population grows **older**

Health professionals are in **relatively** short supply

Chronic **multi-morbidity** ensues

Costs are spiraling out of control

Age 65+, **5+ NCDs**

Patient expectations increase

Medical schools per 100,000

<table>
<thead>
<tr>
<th>Year</th>
<th>1995</th>
<th>1997</th>
<th>1999</th>
<th>2001</th>
<th>2003</th>
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</tr>
</tbody>
</table>

**Note:** PPP = Purchasing power parity.
Source: OECD Health Data 2014; U.S. National Health Expenditure Accounts.
The care quality crisis

Great physicians + Good intentions = excellent quality of care
The care quality crisis

«At best, care is outstanding. Often, care is sub-optimal to alarmingly poor.»

Dr. Donald Berwick
Of necessary interventions missed

30% Of care is futile, no net value added

Healthcare errors: cause of death

#3
Transformation is crucial

Work in silos
‘Equal’
Therapeutic
Reactive
Paternalistic
Wasteful interventions
System-centered

Coordinated
Equitable
Preventive
Proactive
Engaging
RWE Based
Patient centered
Paradigm shift: Our vision

Smart use of data

= a requisite and driving force for transforming care
Clalit Health Services: Israel’s integrated Sick Fund

» Established 1911

» 53% market share - 4.2 million members
  - Over-representing low SES, minorities, elderly

» All services under one ‘roof’
  -> 1,500 clinics
  - 30% of Israel hospital beds
  - National leader in tele-care, online services
Laboratory data
Community primary care clinic data
Diagnostic and imaging data
Pharmacy, medications data
Socio-demographic data
Linked to national database
Hospital inpatient, ED and discharge data
Allied health services data
Disease registries
Linked to Ministry of Health
National Cancer registry
Administrative data (costs)
Dental, complementary health services data
Linked to national database
Socio-demographic data
Integrated data

Decades of full life-span, Cross-setting, ID-tagged, Geo-coded, EMR-based data on > 4M people

* Claims+EMR data, untainted by financial upcoding drive (no DRG)
Value in care: What actually works?
What good are trials if the results aren’t applicable to real-world patients and if, because of excessive expense, they can be used to answer only a tiny fraction of our important clinical questions?
Are we providing futile care?

Medscape Multispecialty

News & Perspective Drugs & Diseases CME & Education

Journal Watch > Journal Watch (General)
Pneumococcal Polysaccharide Vaccine: Efficacy Remains Controversial

Allan S. Brett, MD

Disclosures
Determining treatment effectiveness

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

- IPD Rate (Per 100,000)
- Prevalence of PPSV23 vaccination (%)

Year:
- 2007: 22.5, 29.0%
- 2008: 19.4, 45.7%
- 2009: 60.4%, 13.1
- 2010: 73.4%, 13.0

Rate (per 100,000): 0.0, 5.0, 10.0, 15.0, 20.0, 25.0
Prevalence (%): 0.0%, 10.0%, 20.0%, 30.0%, 40.0%, 50.0%, 60.0%, 70.0%, 80.0%
Policy Implications

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.
## Pneumococcal vaccine targeting strategy for older adults: Customized risk profiling

Ran D. Balicer, Chandra J. Cohen, Morton Leibowitz, Becca S. Feldman, Ilan Bruzman, Craig Roberts, Moshe Hoshen

<table>
<thead>
<tr>
<th>Vaccination strategy</th>
<th>% of 50+ population targeted (n=526,717)</th>
<th>% of HTP cases in 2009-10 identified (n=10,423)</th>
<th>% of IPD cases in 2009-10 identified (n=90)</th>
<th>% of CTP cases in 2009-10 identified (n=4,603)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1  High and Moderate risk groups and all aged 65+</td>
<td>66% (347,008)</td>
<td>94% (9,818)</td>
<td>89% (80)</td>
<td>78% (3,572)</td>
</tr>
<tr>
<td>2  High and Moderate ACIP-based risk groups</td>
<td>51% (268,616)</td>
<td>83% (8,609)**</td>
<td>80% (72)</td>
<td>65% (2,980)*</td>
</tr>
<tr>
<td>3  Clalit model, 51% highest risk scores</td>
<td>51% (267,744)</td>
<td>85% (8,896)**</td>
<td>80% (72)</td>
<td>66% (3,045)*</td>
</tr>
<tr>
<td>4  ACIP-based highest risk group (Immunosuppressed)</td>
<td>17% (88,142)</td>
<td>35% (3,634)*</td>
<td>41% (37)</td>
<td>21% (971)*</td>
</tr>
<tr>
<td>5  Clalit model, 17% highest risk scores</td>
<td>17% (87,853)</td>
<td>54% (5,667)*</td>
<td>46% (41)</td>
<td>27% (1,246)*</td>
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<tr>
<td>6  Clalit model, 8.6% highest risk scores</td>
<td>8.6% (45,521)</td>
<td>35% (3,634)</td>
<td>31% (28)</td>
<td>15% (692)</td>
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<tr>
<td>7  Clalit model, 5% highest risk scores</td>
<td>5% (25,580)</td>
<td>23% (2,390)</td>
<td>18% (16)</td>
<td>9% (421)</td>
</tr>
</tbody>
</table>
Determining treatment threshold

LDL in high risk patients: “Lower is Better”?
Association Between Achieved Low-Density Lipoprotein Levels and Major Adverse Cardiac Events in Patients With Stable Ischemic Heart Disease Taking Statin Treatment

Morton Leibowitz, MD1,2; Tomas Karpatis, MD1; Chandra J. Cohen-Stavi, MPA1; Becca S. Feldman, ScD1; Moshe Hoshen, PhD1; Haim Bitterman, MD1,2; Samy Suissa, PhD4,5,6; Ran D. Balicer, MD, PhD1,7

[+] Author Affiliations

JAMA Intern Med. Published online June 20, 2016. doi:10.1001/jamainternmed.2016.2751

Figure 2. Estimated Cubic Spline Transformation of the Association Between Achieved Low-Density Lipoprotein Cholesterol (LDL-C) Level and the Risk of Major Adverse Cardiac Events (MACEs)

Vertical dotted lines separate index LDL-C groups (low, ≤70.0 mg/dL; moderate, 70.1-100.0 mg/dL; high, 100.1-130.0 mg/dL). HR indicates hazard ratio.
Controlling the public message

PILL-OCKS Statins are USELESS at preventing more heart attacks in recovering patients, say boffins

Doubts over effectiveness of pills taken by eight million Brits every day

21st June 2016, 1:20 am

CHOLESTEROL-slashing statins may not protect everyone against heart attacks, a study found.

Around eight million Brits take the pills daily to drive down harmful LDL cholesterol in the blood.
Policy Implications

**Percentage of adults after coronary artery bypass surgery and/or interventional cardiac catheterization with LDL levels less than or equal to 100 mg/dL (ages 35-74 years)**

Percentage of individuals with LDL levels less than or equal to 100 mg/dL (numerator) among individuals aged 35-74 years, after interventional cardiac catheterization and/or interventional cardiac catheterization who had a record of LDL cholesterol (denominator).

*Figure 84 by year*

<table>
<thead>
<tr>
<th>Year</th>
<th>Percent</th>
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<tbody>
<tr>
<td>2008</td>
<td>70.8%</td>
</tr>
<tr>
<td>2009</td>
<td>71.3%</td>
</tr>
<tr>
<td>2010</td>
<td>71.8%</td>
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</table>
Real-life Outcomes Research

- What is the impact of antibiotic choice on resistance?

### Quinolone resistance rates in urine culture e-coli by district, by relative use of quinolones

<table>
<thead>
<tr>
<th>Quinolone Resistance</th>
<th>Nitrofurantoin resistance</th>
<th>Rate of using quinolone vs nitrofurantoin</th>
<th>District</th>
</tr>
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<tbody>
<tr>
<td>30%</td>
<td>4%</td>
<td>4.74</td>
<td>1</td>
</tr>
<tr>
<td>23%</td>
<td>3%</td>
<td>5.50</td>
<td>2</td>
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<tr>
<td>22%</td>
<td>4%</td>
<td>4.26</td>
<td>3</td>
</tr>
<tr>
<td>21%</td>
<td>3%</td>
<td>2.01</td>
<td>4</td>
</tr>
<tr>
<td>20%</td>
<td>4%</td>
<td>3.94</td>
<td>5</td>
</tr>
<tr>
<td>20%</td>
<td>4%</td>
<td>0.85</td>
<td>6</td>
</tr>
<tr>
<td>12%</td>
<td>3%</td>
<td>1.06</td>
<td>7</td>
</tr>
<tr>
<td>8%</td>
<td>3%</td>
<td>2.79</td>
<td>8</td>
</tr>
<tr>
<td>21%</td>
<td>3%</td>
<td>Overall</td>
<td></td>
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</table>

4 million
6.6 million patients
22% of patients
4.8 million patients
2.3 million patients
1.9 million patients
18% of which
Care integration and readmissions
Reducing Readmissions

Real-time data sharing system

Bridging the Silos
7d readmission rate

Blue – to same hospital
Red – to any hospital
Patient experience surveying at Clalit:

» Ongoing, year round
» >250,000 individuals surveyed by phone
» In proximity (in time) to service delivery
» Most extensive customer survey in Israel
Readmission: PREMs

30-day readmission by perceived Hospital discharge preparedness

- High: 5.3%
- Medium: 7.4%
- Low: 12.6%

OR = 0.766; P-value = 0.01
Risk Prediction Models for Hospital Readmission

A Systematic Review

Devan Kansagara, MD, MCR; Honora Englander, MD; Amanda Salanitro, MD, MS, MSPH; David Kagen, MD; Cecelia Theobald, MD; Michele Freeman, MPH; Sunil Kripalani, MD, MSc

Readmission risk prediction remains a poorly understood and complex endeavor.
Readmission: Predictives

Predicting 30-Day Readmissions With Preadmission Electronic Health Record Data

Efrat Shadmi, PhD,* † Natalie Flaks-Manov, MPH, † Moshe Hoshen, PhD, † Orit Goldman, PhD, †
Haim Bitterman, MD, † ‡ and Ran D. Balicer, MD, PhD ‡ ‡

30-day Readmission Rate

Clalit Pre-admission Risk Score - Stratum
Readmissions prevention

- Indicator in hospital EMR
- Indicator in GP/nurse EMR
- Daily intervention reports
- Introduce to nursing rounds
- Add transition care nurses
- Add to community nurses morning routine + reports
- Monitoring and feedback
The patient is being discharged today. Admitted due to AF. Currently receiving a blood clotting agent (Warfarin). Should be monitored for INR levels on Monday and Warfarin dosage adjusted as needed + continued monitoring.

Thank you Smadar for this information. I will schedule a house call as I see the patients ADL assessment indicates mobility limitations.
Impact on patient outreach

7-day no-contact rates
Readmissions prevention

Readmission rates by predictive score

- 15% of admissions Repeated cases: 4.0% decline
- 15% of admissions Prediction targeted: 9.1% decline

Clalit Research Institute
Predictive proactive care
Definition of illness and health

- Full scale disease: Irreversible pathology with severe functional impact
- Early Disease
- Pre-disease signs
- Early tissue pathology
- Pre-pathology Changes: Cellular, epigenetic
- Healthy
Predictive proactive care

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!

Clalit Research Institute Risk Scores
External validation and comparison of three prediction tools for risk of osteoporotic fractures using data from population based electronic health records: retrospective cohort study

Noa Dagan,1,2 Chandra Cohen-Stavi,1 Maya Leventer-Roberts,1,3 Ran D Balicer1,4

Fig 1 | Population flowchart for comparative and tool specific external validation analyses (FRAX external validation population is same as population used for comparative analysis)
Predictive care in practice

» Nephrology
» Diabetes
» Influenza and pneumonia
» Geriatric syndrome
» Colon cancer
» Multi-morbidity risk
» ...

Clalit Research Institute
Reducing health disparities
Despite decades of work...

Decades of Work to Reduce Disparities in Health Care Produce Limited Success

Rebecca Voelker

The early weeks of 2008 brought discouraging news for advocates working to narrow health care disparities among racial and ethnic groups. In rapid succession, several studies published...
Reducing health disparities

### Inequality in OECD Countries

<table>
<thead>
<tr>
<th>Country</th>
<th>Gini coefficient, 2010</th>
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<tbody>
<tr>
<td>Chile (2009)</td>
<td>0.508</td>
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<tr>
<td>Mexico (2009)</td>
<td>0.466</td>
</tr>
<tr>
<td>Turkey (2009)</td>
<td>0.411</td>
</tr>
<tr>
<td>United States</td>
<td>0.380</td>
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<tr>
<td><strong>Israel</strong></td>
<td><strong>0.376</strong></td>
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<tr>
<td>Portugal</td>
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<td>United Kingdom</td>
<td>0.341</td>
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<tr>
<td>Spain</td>
<td>0.338</td>
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<td>Greece</td>
<td>0.337</td>
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<td>Japan (2009)</td>
<td>0.336</td>
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<td>Australia</td>
<td>0.334</td>
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<td>Italy</td>
<td>0.319</td>
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<tr>
<td>New Zealand (2009)</td>
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<tr>
<td><strong>OECD</strong></td>
<td><strong>0.316</strong></td>
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<tr>
<td>Korea</td>
<td>0.310</td>
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<tr>
<td>Poland</td>
<td>0.305</td>
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<tr>
<td>France</td>
<td>0.303</td>
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<td>Switzerland (2009)</td>
<td>0.298</td>
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<tr>
<td>Netherlands</td>
<td>0.288</td>
</tr>
<tr>
<td>Germany</td>
<td>0.286</td>
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</tbody>
</table>

**Relative poverty rates, % of persons living with less than 50% of median income**

- **Israel**: 25%
- **OECD**: 12%
- **EU**: 14%
Reducing health disparities

Step 1: Select Disparity Indicators:

1. Diabetes control
2. Blood pressure control
3. Hyperlipidemia control
4. Influenza immunization
5. Mammography tests
6. Fecal occult blood tests
7. Anemia in infants

= 

• Clear clinical impact
• Most severe disparities
• Prevention oriented
• Difficult to change
Reducing health disparities

**Disparity Indicators:**
1. Diabetes control
2. Blood pressure control
3. Hyperlipidemia control
4. Influenza immunization
5. Mammography tests
6. Fecal occult blood tests
7. Anemia in infants

**Target clinics: 400,000 members**
- Culturally tailored interventions
- Outreach initiatives: proactive care
- Extending work hours
- Teamwork enhancement
- Engaging local community leaders
- Monitoring drug compliance
Disparity Reduction in chronic disease prevention & management

7 Selected Indicators
» Diabetes control
» Blood pressure control
» Hyperlipidemia control
» Influenza immunization
» Mammography tests
» Fecal occult blood tests
» Anemia in infants

Composite Score

lowest performing clinics
(400,000 members)

7 indicators in 55 clinics

70 indicators in 55 clinics

Health outcomes of Various disadvantaged populations
Sustainable outcomes?

7 key disparity quality measures gap for 400,000 members vs rest

Clalit Average
55 disparity clinics

-60%
Disparity Reduction in chronic disease prevention & management

Preventive medicine measures scores

- Low
- Med
- High

Socioeconomic Status

2007: 64.5
2008: 67.14
2009: 68.43
2010: 70.09

2007: 66.07
2008: 68.26
2009: 69.68
2010: 70.28

2007: 67.24
2008: 69.16
2009: 69.68
2010: 70.19
Anemia in 1yr olds

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<tr>
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<tr>
<td>Jan-11</td>
<td>7%</td>
<td>5%</td>
</tr>
<tr>
<td>Jan-12</td>
<td>6%</td>
<td>5%</td>
</tr>
<tr>
<td>Jan-13</td>
<td>5%</td>
<td>5%</td>
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<td>Jan-14</td>
<td>4%</td>
<td>5%</td>
</tr>
<tr>
<td>Jan-15</td>
<td>3%</td>
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Sustainable outcomes?

7 key disparity quality measures gap for 400,000 members vs rest

Clalit Average

55 disparity clinics

-60%
Sustainable outcomes!

7 key disparity quality measures gap for 400,000 members vs rest

Clalit Average

55 disparity clinics

-60%
Box 3.3. Using evidence-based quality improvement measures to reduce inequalities at Clalit

Clalit (3.8 million enrollee) has the largest share of low SES groups, immigrants, rural inhabitants, elderly and people with disabilities. It has implemented several initiatives to improve health and access to care, and promote health education and cultural competency for disadvantaged populations. In 2008, Clalit developed a primary care focused strategy for reducing disparities. Seven evidence-based quality indicators for primary prevention and disease control that showed variation by SES and ethnicity were identified for quality improvement and disparity reduction.

Recognizing that quality improvement does not of itself reduce disparities, 55 low-performing clinics with 10% of Clalit enrollee were selected for implementation of disparity reduction interventions. The performance gap between the low-performing and other clinics fell by 40% after a year.

This success was based on a mix of a) top-down organizational policy change, goal-setting, continuous measurement, management support, use of incentives, and b) bottom-up empowerment of local staff to plan and implement interventions tailored to local populations. Clalit concludes that focusing organizational resources on clinics that serve disadvantaged populations but are failing to address their health needs is key to closing the health and health care quality gap. This case study illustrates how increased equity and quality improvement can be integrated, to raise the quality bar overall and reduce inequalities within.
» Multi-disciplinary group

» Mandate: Turn data to insights, insights to policy
  - Real-life Effectiveness / Outcomes Research
  - Advanced analytics and predictions
  - Data-driven care models design

» Innovation hub
  - Rapid Transition research -> practice
Big data
The human mind cannot compile so much data
Poker program Cepheus is unbeatable, claim scientists

Cepheus learned poker by playing over a billion billion hands - more than have been played in the entirety of human history.

‘Perfect’ online poker bot Cepheus has one flaw: it can’t adapt.
Transforming care through data

Proactive care: preventing deterioration

Precise Tx: Tx selection by personal expected impact

Improving test interpretation accuracy

Safeguards from error & missed care opportunities

De-vesting futile interventions & policies

Patient self-care decision support
Innovation in practice

START-UP NATION
The Story of Israel’s Economic Miracle
How can innovative data-driven approaches help tackle NCDs?

23-03-2015

The technical meeting on 10 March 2015 in Tel Aviv, Israel, centred around real-life complexities in the prevention and control of Noncommunicable Diseases (NCDs), and addressed how innovative data-driven approaches can assist in tackling them.

Two key types of complexities were discussed:

- The increasing trend of co-existing multiple risk factors for NCDs;
- Complexities associated with NCD multimorbidity, which is becoming the norm among middle-aged adults.

Clalit Research Institute, the newly designated WHO Collaborating Centre for NCD Research, Prevention and Control, that co-hosted the meeting, shared data and insights on the prevalence of these two phenomena, as well as hands-on experience in addressing them using data-driven innovative methods. Experts from ten Member States shared their experience and knowledge, and expressed the need for a new set of integrated tools to address these emerging issues.
We have so much more to do, together

“It is not enough to do your best; you must know what to do, and then do your best.

W. Edwards Deming
Thank you!