Desktop Medicine: for the Center for eHealth Information Adoption and Exchange

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Disclosure

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- Shares in Senior Bridge Inc.
CONCEPTS OF DISEASE ARE ESSENTIAL FOR DEFINING medicine. By the 20th century, the dominant concept was pathology in an individual, the foundation for the bedside model of medicine. Bedside medicine organizes the patient-physician relationship around the chief concern, which guides the focus of the history taking and physical examination; medical training that concentrates this. A physician gathers a patient’s 12 clinical risk factors, enters data about those risk factors into an online model, and receives the patient’s 10-year probability of a fracture, and then determines whether to recommend treatment.4

Desktop medicine has begun to transform how physicians diagnose bedside diseases. Risk measurements compete with signs and symptoms and encompass progressively milder stages of disease. For example, Alzheimer disease is transforming from a diagnosis based on disabling memory decline to a biomarker of early neurodegeneration.
Discovery of desktop disease

Longitudinal, epidemiological data shows a factor is associated with risk of negative health event

Randomized controlled trial shows an intervention on the factor reduces the likelihood of the event

Factor is redefined as a disease
Framingham Heart Study shows association between systolic hypertension and cardiovascular disease in the elderly

SHEP trial shows chlorthalidone to reduce incidence of stroke and other cardio/coronary events

Systolic Hypertension in the Elderly is transformed from an inevitable part of aging to a treatable disease
## Desktop diseases

<table>
<thead>
<tr>
<th>Disease</th>
<th>Diagnostic tool (DT)</th>
<th>Discrete clinical event (DCE)</th>
<th>Intervention to validate link between DT and DCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dyslipemia</td>
<td>NCEPIII</td>
<td>stroke, MI</td>
<td>statin drug</td>
</tr>
<tr>
<td>HTN</td>
<td>BP</td>
<td>stroke, MI</td>
<td>thiazide, beta-blocker</td>
</tr>
<tr>
<td>Osteoporosis</td>
<td>FRAX</td>
<td>bone fracture</td>
<td>bisphosphonate</td>
</tr>
<tr>
<td>Diabetes</td>
<td>HgA1C</td>
<td>Dx of DM</td>
<td>insulin, thiazolitazine</td>
</tr>
</tbody>
</table>
Desktop Disease Prevalence (2006)

<table>
<thead>
<tr>
<th>Condition</th>
<th>Prevalence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypertension</td>
<td>33.3</td>
</tr>
<tr>
<td>Prehypertension</td>
<td>25.0</td>
</tr>
<tr>
<td>High total cholesterol</td>
<td>45.1</td>
</tr>
<tr>
<td>High LDL cholesterol</td>
<td>32.8</td>
</tr>
<tr>
<td>Low LDL cholesterol</td>
<td>15.5</td>
</tr>
</tbody>
</table>

Leading Causes of Death, 2006

1. Heart disease (26%)
2. Cancer
3. Cerebrovascular diseases (5.7%)
4. Chronic lower respiratory diseases
5. Accidents
6. Diabetes mellitus (3%)
7. Alzheimer’s disease
8. Influenza and pneumonia
9. Kidney disease
10. Septicemia
11. Intentional self-harm
12. Chronic liver disease and cirrhosis
13. Essential hypertension and hypertensive renal disease (1%)
14. Parkinson’s disease
15. Assault

Red = desktop diseases

Medical Economics

The Rating Game

Patients & Insurers Are Rating the Quality of Your Care. Do You Know What They're Saying? p.18

Plus: Don't Let a Bad Rating Ruin You p.27

• Coding changes for 2009 p.30
• An upswing in downcoding? p.9
Please answer the questions below to calculate the ten year probability of fracture with BMD.

**Questionnaire:**

1. Age (between 40-90 years) or Date of birth
   - Age: [ ] [ ] [ ] [ ] [ ] [ ]
   - Date of birth: [ ] [ ] [ ] [ ] [ ]
2. Sex
   - [ ] Male
   - [ ] Female
3. Weight (kg)
   - [ ]
4. Height (cm)
   - [ ]
5. Previous fracture
   - [ ] No
   - [ ] Yes
6. Parent fractured hip
   - [ ] No
   - [ ] Yes
7. Current smoking
   - [ ] No
   - [ ] Yes
8. Glucocorticoids
   - [ ] No
   - [ ] Yes
9. Rheumatoid arthritis
   - [ ] No
   - [ ] Yes
10. Secondary osteoporosis
    - [ ] No
    - [ ] Yes
11. Alcohol 3 or more units per day
    - [ ] No
    - [ ] Yes
12. Femoral neck BMD (g/cm²)
    - T-Score: [ ] [ ]

**BMI 20.0**

The ten year probability of fracture (%) with BMD

- Major osteoporotic: 7.7%
- Hip fracture: 1.9%

**Risk factors**

For the clinical risk factors a yes or no response is asked for. If the field is left blank, then a "no" response is assumed. See also [notes on risk factors](#).

The risk factors used are the following:
Risk Assessment Tool for Estimating Your 10-year Risk of Having a Heart Attack

The risk assessment tool below uses information from the Framingham Heart Study to predict a person’s chance of having a heart attack in the next 10 years. This tool is designed for adults aged 20 and older who do not have heart disease or diabetes. To find your risk score, enter your information in the calculator below.

Age: [ ] years
Gender: [ ] Female [ ] Male
Total Cholesterol: [ ] mg/dL
HDL Cholesterol: [ ] mg/dL
Smoker: [ ] No [ ] Yes
Systolic Blood Pressure: [ ] mm/Hg
Are you currently on any medication to treat high blood pressure. [ ] No [ ] Yes

Calculate Your 10-Year Risk
MEDLINE citations for [biomarker AND Alzheimer’s], per 100,000 articles

Year (5 year span)

- 1980-1984: 0
- 1985-1989: 0.26
- 1990-1994: 0.25
- 1995-1999: 1.31
- 2000-2004: 9.96
- 2005-2009: 39.71

Search results

Articles with Alzheimer's AND biomarker found in title, abstract, text word
Consequences of desktop diseases

- Drugs are critical for the *discovery* of disease
- “Disease” is the result of a multi-variate risk calculation.
  - Biomarker = disease fades (e.g. FRAX, NCEP)
- Label of “disease” as a category makes little sense
- Categories of prevention make little sense
- Prevalence of persons in need of treatment (i.e. disease) is very unstable.
## Concept of Disease

<table>
<thead>
<tr>
<th>Bedside Model</th>
<th>Desktop Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disease as pathology in an individual; typically identified by symptoms and signs</td>
<td>Disease as a risk of future impairment in an individual</td>
</tr>
<tr>
<td>examples: Alzheimers disease, congestive heart failure, ulcerative colitis, influenza pneumonia</td>
<td>examples: diabetes, dyslipemia, hypertension, osteoporosis. Also, early stages of bedside diseases such as ACC/AHA Stage A heart failure which describes “high risk for heart failure”</td>
</tr>
</tbody>
</table>
## Approach to Diagnosis

<table>
<thead>
<tr>
<th>Bedside Model</th>
<th>Desktop Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>History and Physical (the “H and P”), typically initiated by patient’s chief</td>
<td>Running the numbers. Results guide clinical-actuarial correlation which uses one or more factors to calculate a patient’s personalized risk assessment</td>
</tr>
<tr>
<td>complaint. Results guide clinical-pathological correlation</td>
<td><em>example</em>: WHO FRAX criteria to calculate 10 year risk of fracture (<a href="http://www.sheffield.ac.uk/FRAX">www.sheffield.ac.uk/FRAX</a>)</td>
</tr>
<tr>
<td>Distinguishes among primary, secondary, and tertiary prevention</td>
<td>Does not distinguish among primary, secondary and tertiary prevention</td>
</tr>
</tbody>
</table>
Clinical Inertia
recognition of the problem, but failure to act

<table>
<thead>
<tr>
<th>Disease</th>
<th>Intervention target (specific goal varies by patient population)</th>
<th>% of treated patients at treatment target</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypertension</td>
<td>Systolic blood pressure Diastolic blood pressure</td>
<td>45%</td>
</tr>
<tr>
<td>Hypercholesterolemia</td>
<td>LDL cholesterol</td>
<td>14%- 38%</td>
</tr>
<tr>
<td>Diabetes</td>
<td>hemoglobin A1c</td>
<td>33%</td>
</tr>
</tbody>
</table>

while the difficulties in managing asymptomatic problems are understandable… they do not mitigate the need to improve care for disorders such as hypertension, dyslipidemia, and diabetes

Running the numbers first?

**Pro**

Phillips & Twombly: *deal with blood pressure and glucose before asking about other problems*

*it is our responsibility to help patients appreciate the importance of such disorders as hypertension and diabetes*
Running the numbers first?

**Con**

Boyd & Leff: [running the numbers first] *does not adequately acknowledge a patient-centered perspective of chronic illness care*

Vijan, Hayward, Ubel: [the paradigm is] *at odds with fundamental principles of primary care interactions... [physicians would be] imposing their own priorities onto patients*
Criticism of traditional approach

Evidence-based paralysis: The failure to act in the absence of specific trial-based information

RCTomyopia: The belief that randomized and controlled trials are the only justification for clinical action

New paradigm

Responsible physicians and patients should make decisions based on the best available evidence—including cell and animal studies, observational studies, and controlled trials, if available—and the strengths and weaknesses of the findings with each approach should be given due consideration.

Case Study: NCEP guidelines

Cholesterol lowering treatment recommended for women at high risk of cardiac events despite lack of specific clinical trial evidence

The approach…is to review the entire body of scientific evidence…, including animal, pathologic, genetic, and epidemiological studies and clinical trials.

The alternative approach…would mean that many women would have a potentially preventable heart attack before they are accorded the benefits of therapy.

## Approach to Treatment

<table>
<thead>
<tr>
<th>Bedside Model</th>
<th>Desktop Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinical judgment with a preeminence for the</td>
<td>Clinical-actuarial correlation that integrates the patient’s measured risk</td>
</tr>
<tr>
<td>results of randomized and controlled trials to</td>
<td>with the results of biological and cohort studies and clinical trial data</td>
</tr>
<tr>
<td>select the best treatments for the pathology</td>
<td>to determine the value of reducing that patient’s risk</td>
</tr>
<tr>
<td>and to relieve the patient’s symptoms</td>
<td></td>
</tr>
</tbody>
</table>
Consequences of desktop practice

• Pre-eminence of the “chief complaint” to organize the medical encounter diminished

• The H&P is replaced by, stands beside “running the numbers”

• Pre-eminence of the randomized-controlled trial as the mechanism to determine therapy diminished
  – diagnosis and treatment are an actuarial exercise
## Medical Residents’ understanding of biostatistics and results in the medical literature

### Table 3. Percentages of Correct Answers for the Knowledge-Based Questions

<table>
<thead>
<tr>
<th>Question No.</th>
<th>Objective</th>
<th>Correct (95% CI), %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a</td>
<td>Identify continuous variable</td>
<td>43.7 (37.8-49.5)</td>
</tr>
<tr>
<td>1b</td>
<td>Identify ordinal variable</td>
<td>41.5 (35.7-47.3)</td>
</tr>
<tr>
<td>1c</td>
<td>Identify nominal variable</td>
<td>32.9 (27.3-38.4)</td>
</tr>
<tr>
<td>2</td>
<td>Recognize a case-control study</td>
<td>39.4 (33.6-45.1)</td>
</tr>
<tr>
<td>3</td>
<td>Recognize purpose of double-blind studies</td>
<td>87.4 (83.5-91.3)</td>
</tr>
<tr>
<td>4a</td>
<td>Identify ANOVA</td>
<td>47.3 (41.4-53.2)</td>
</tr>
<tr>
<td>4b</td>
<td>Identify $\chi^2$ analysis</td>
<td>25.6 (20.5-30.8)</td>
</tr>
<tr>
<td>4c</td>
<td>Identify $t$ test</td>
<td>58.1 (52.3-63.9)</td>
</tr>
<tr>
<td>5</td>
<td>Recognize definition of bias</td>
<td>46.6 (40.7-52.4)</td>
</tr>
<tr>
<td>6</td>
<td>Interpret the meaning of $P$ value $&gt; .05$</td>
<td>58.8 (53.0-64.6)</td>
</tr>
<tr>
<td>7</td>
<td>Identify Cox proportional hazard regression</td>
<td>13.0 (9.0-17.0)</td>
</tr>
<tr>
<td>8</td>
<td>Interpret standard deviation</td>
<td>50.2 (42.3-56.1)</td>
</tr>
<tr>
<td>9</td>
<td>Interpret 95% CI and statistical significance</td>
<td>11.9 (8.0-15.7)</td>
</tr>
<tr>
<td>10</td>
<td>Recognize power, sample size, and significance-level relationship</td>
<td>30.3 (24.9-35.7)</td>
</tr>
<tr>
<td>11</td>
<td>Determine which test has more specificity</td>
<td>56.7 (50.8-62.5)</td>
</tr>
<tr>
<td>12</td>
<td>Interpret an unadjusted odds ratio</td>
<td>39.0 (33.3-44.7)</td>
</tr>
<tr>
<td>13</td>
<td>Interpret odds ratio in multivariate regression analysis</td>
<td>37.4 (31.9-43.3)</td>
</tr>
<tr>
<td>14</td>
<td>Interpret relative risk</td>
<td>81.6 (77.0-86.2)</td>
</tr>
<tr>
<td>15</td>
<td>Determine strength of evidence for risk factors</td>
<td>17.0 (12.6-21.4)</td>
</tr>
<tr>
<td>16</td>
<td>Interpret Kaplan-Meier analysis results</td>
<td>10.5 (6.9-14.1)</td>
</tr>
</tbody>
</table>

**Abbreviations:** ANOVA, analysis of variance; CI, confidence interval.

*See Appendix.
% of Third-Year Residents Enrolled in U.S. Categorical and Primary Care Internal Medicine Training Programs Planning to Pursue a Career in General Internal Medicine, 1998–2003

Desktop medicine and medical education

• A gap exists between reality of desktop diseases and how physicians are selected & trained

• Medical education should increase focus on desktop sciences (epidemiology, decision sciences, biomarker-focused lab. sciences)
  – attract students who are likely to be interested in desktop medicine
  – ensure that new physicians are adequately trained to care for desktop diseases
Core Sciences for premed and medical education

<table>
<thead>
<tr>
<th>Bedside Model</th>
<th>Desktop Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Anatomy</td>
<td>• Laboratory sciences oriented toward biomarker discovery (e.g. genomics)</td>
</tr>
<tr>
<td>• Biology</td>
<td>• Economics</td>
</tr>
<tr>
<td>• Biochemistry</td>
<td>• Epidemiology</td>
</tr>
<tr>
<td>• Histology</td>
<td>• Information sciences</td>
</tr>
<tr>
<td>• Organic chemistry</td>
<td>• Psychology</td>
</tr>
<tr>
<td>• Pathology</td>
<td>• Statistics</td>
</tr>
<tr>
<td>• Physiology</td>
<td></td>
</tr>
</tbody>
</table>
Talking about Desktop Diseases

• Bedside diseases are categorical
  “I have osteoporosis.”

• Desktop diseases are dimensional
  “I have a 1.9% chance of major osteoporotic fracture”

• Implications for patient communication and decision-making
Feeling risk: getting the gist

“I know what you told me, but this is what I think:’ Perceived risk of Alzheimer disease among individuals who accurately recall their genetics-based risk estimate.”

- Among 158 participants who accurately recalled their AD risk assessment 6 weeks after risk disclosure…
  - 75 (47.5%) said AD risk was more than 5% points different from their calculated AD risk estimate.

Linnenbringer et al. Genetics in Medicine. in press.
Significant impact on reducing time out of INR range in 2-arm RCT using daily lotteries

- **Predicted Probability of INR Out-of-range**

<table>
<thead>
<tr>
<th>Overall</th>
<th>INR below @ baseline</th>
<th>INR in @ baseline</th>
</tr>
</thead>
<tbody>
<tr>
<td>OR=0.81</td>
<td>OR=0.49</td>
<td>OR=0.99</td>
</tr>
</tbody>
</table>

- **Kimmel, Loewenstein, Troxel, Doshi, Volpp, 2011**

- **R01 HL090929** (Kimmel/Volpp Mult PIs) will test impact of incentives vs. reminders vs. incentives and daily reminders

Kevin Volpp, MD, PhD – not for reproduction without permission

Kimmel, Loewenstein, Troxel, Doshi, Volpp, 2011 under review
Consequences of desktop treatment

- Physicians need to learn how to make their patients “feel their” risk
- Physicians need to become comfortable with mechanisms that manipulate behavior, including seemingly non-medical approaches such as payments for adherence
LET ME JUST ENTER A FEW DETAILS INTO THE COMPUTER

CLICK.... CLICK.... CLICK....
TAP.... TAP.... TAP....
WELL THE GOOD NEWS IS THAT YOUR CARDIOVASCULAR DISEASE RISK IS VERY LOW.

UNFORTUNATELY IT WOULD APPEAR THAT YOU ARE AT MODERATE TO HIGH RISK OF BEING A CLown.

WE'LL RE-CHECK IN 3 MONTHS. MEANWHILE IT MAY BE PRUDENT TO MODIFY YOUR RISK-FACTORS:

- USE LESS FACE-PAINT
- WEAR A LARGER HAT
- MORE APPROPRIATE FOOTWEAR
ANY QUESTIONS MR. BOZO?

WOULD YOU LIKE TO SNIFF MY FLOWER?

THE END
Closing thoughts on desktop medicine and the EMR

• The electronic medical record is as essential to desktop medicine as the hospital-based laboratory was to bedside medicine.
  – discover, diagnose, treat, and track disease
• “electronic medical record” is an incomplete term
• Electronic medical database is better – the EMDB
Closing thoughts on desktop medicine and the EMDB

• The more the EMDB is national and public, not local and private, the more it will serve scientific interests
  – the conjoining of EMDB data with $ creates a potential conflict of interest

• Drugs are for as long as their patents remain, but databases and technology are forever...
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Information Adoption and Exchange

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