Slide 1: Use of handheld devices for point of care decision support

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Slide 2: The Context

- Medical knowledge base has exploded
- Complexity of decision-making much greater than before

Slide 3: The Context

- Clinical questions are common
- Questions are central to adult learning
- But questions often go unanswered

Slide 4: The Context

- Increasing number of clinical decision support tools
- Many have potential to improve shared decision-making
- But often too complex for easy point of care use

Slide 5: What are Handheld Decision Support Tools (HDST)?

- Subset of decision support tools designed for handheld computers (e.g. PDAs and smartphones)
- Includes algorithms, scoring systems, multivariate models, and formulas

Slide 6: What are advantages of HDST?

- They facilitate complex calculations as well as simpler point scoring systems, algorithms, and flowcharts.
- Readily updated
- Uniform access to information in multiple locations
- A single compact device can hold hundreds or thousands of HDST

Slide 7: Research

First reports in literature:

- Edward, 1986: critical care calculations on programmable calculator
- Ebell, 1994: pen-based system for Bayesian diagnosis
- Acuff, 1994: fluid calculator for burn patients on Palm

Source: Eisenberg Center Conference Series 2009, Translating Information Into Action: Improving Quality of Care Through Interactive Media, Effective Health Care Program Web site (http://www.effectivehealthcare.ahrq.gov/index.cfm)

Slide 8: Research

- Widely used by trainees (Kho, 2006; Tempelhof, 2009)
- Improved adherence to respiratory tract infection guideline in study of 99 PCPs (Rubin, 2006)
- Improved prescribing of NSAIDs in an RCT (Berner, 2006)
- RCT of handheld computer versus paper aids showed improved learning and practice of EBM (Leung, 2003)

Slide 9: How are HDSTs developed?

- Expert opinion
- Simple calculators
- Multivariate scores
- Point scores
- Classification and Regression Trees

Slide 10: Developing HDST: Expert opinion and calculators

- Expert opinion:
  - Apgar score for neonatal assessment (Apgar, 1953)
  - Mini-Mental State test for diagnosis of dementia (Folstein, 1975)
  - APACHE score for assessment of severity of illness in critical care (Knaus, 1981)
- Calculators
  - Bayesian calculators
  - BMI, creatinine clearance, etc

Slide 11: Developing HDST: Multivariate scores

Predicting outcome of near drowning (Graf, 1995)

$X = 6.38 - (4.23 * X_{Reflex}) - (0.01 * X_{Glucose}) - (2.3 * X_{Male})$

$p = 1 / (1 + e^{x})$

Slide 12: Developing HDST: Point scores

- Begin with multivariate model
- Create additive point score based on:
  - Counting (i.e. 1 point per clinical finding or risk factor). Example: Strep Score
  - Assign points based on beta or exp(beta), i.e. the odds ratio. Example: Score to predict rheumatoid arthritis at one year in patients with joint pain

Slide 13: Developing HDST: Point scores

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A chart of demographic variables and points for each.

Slide 14: Developing HDST: Point Scores

- Good balance between accuracy/validity and simplicity/practicality
- Lend themselves well to developing risk categories
- Work well on handhelds

Slide 15: Developing HDST: Classification and Regression Trees

- Series of multivariate analyses are used to identify best single value to partition patients into those with and without disease
- Creates treelike algorithm
- Good face validity
- Challenging on handheld device, though

Slide 16: Factors to Consider when Evaluating HDSTs

- Usefulness
- Clinical context
- Other factors

Slide 17: Factors to Consider when Evaluating HDST

- Usefulness = (Relevance x Validity) / Work
- Is it relevant?
    - Is it a common or important clinical problem? Or is dataset availability driving study?
    - Has it been shown to improve patient oriented outcomes?
    - Example: Ottawa Ankle Rules have been shown to reduce ER length of stay and save money

Slide 18: Factors to Consider when Evaluating HDST

- Usefulness = (Relevance x Validity) / Work
- Is it valid?

Slide 19: Factors to Consider when Evaluating HDST

- Usefulness = (Relevance x Validity) / Work
- Has work been minimized?
- Dropdown lists, not text:

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- Automatically fill in data from patient record, automatically recalculate values
- Choose simpler variables, i.e. CURB-65 (5 variables) rather than Pneumonia Severity Index (20 variables)

Slide 20: Factors to Consider when Evaluating HDST

- Clinical context
- Too often cutoff is chosen based on statistical considerations

(Image to the right is a ROC curve for RA data

Slide 21: Slide 21: Factors to Consider when Evaluating HDST

- Clinical context
- Remember threshold model for decision-making

Slide 22: Factors to Consider when Evaluating HDST
Clinical context: Option 1
Table of probabilities for RA at 1 year and clinical choices:

- Reassess: 0-3 points
- Monitor: 4-7 points
- Treat: > 7 points

Slide 23: Factors to Consider when Evaluating HDST
Table of probabilities for RA at 1 year and clinical choices:

- Reassure: -=3 points
- Monitor every 4 months: 4-6 points
- Monitor every 2 months: 7-8 points
- Treat: >8 points

Slide 24 Clinical context: Option 2
Factors to Consider when Evaluating HDST

- Clinical context
- How many patients benefit? 232 vs 183?

Slide 25: Factors to Consider when Evaluating HDST

- Other factors:
- Financial (dis)incentives

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- Mistrust of "black-boxes"
- Rule seen as overly simplistic
- Apprehension about using HDST in front of patients
- Using rule deprives physician of opportunity to reason independently

Slide 26: Final thoughts

- HDST were developed to bring computing power to the point of care
- What is the impact of increased use of EHRs on the need for HDST?
- Is there a role for HDST in a future that puts a terminal or laptop at every bedside?

Slide 27: Final thoughts

- Create HDST for new form factors: netbooks and beyond
- Build on unique features of smartphones such as integrated GPS, camera: for example, an automated system to diagnose skin lesions using smartphone camera and neural network
- Design applications to address specific needs of mobile healthcare professionals: home health care, ED physicians, hospitalists, students/residents, nursing home visits, military

Slide 28: Thank you!

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