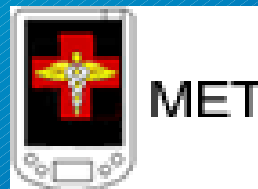


Triaging Pediatric Abdominal Pain in the ED

Could the Answer Be in the Palm of Your Hand?

Ken Farion
Emergency



Outline

- Dilemmas assessing children with abdominal pain
- Clinical Decision Support Systems
 - What are they?
 - How could they help?
- Development of MET-AP
- MET-AP validation trial
- The future . . .



Kids and Abdominal Pain

- common presenting complaint
 - 3300 patient visits per year
 - 8-10 patients/day
 - other patients presenting with other complaints
 - significant abdominal pain found during assessment
- large number of outside referrals
 - “R/O Appendicitis”



Assessing Abdominal Pain

- large differential
 - constipation and gas pains most common
 - associated “tummy ache” with most viral illnesses
 - appendicitis most common surgical problem
- history and description of pain often incomplete
- physical exam can be difficult
 - apprehension
 - “ticklish”



Assessing Abdominal Pain

- normal WBC doesn't rule out pathology
- imaging - Ultrasound
 - not readily available after hours
 - many inconclusive studies
 - “can't visualize the appendix”
 - time-consuming and costly
 - “Can't U/S them all!”



Appendicitis Scores

- several versions out there
- some appear to perform well
 - Cut-off 6/10 Sens 1.0, Spec 0.92, PPV 0.96, NPV 0.99
 - Samuel M “Pediatric Appendicitis Score” *J Ped Surg* 2002;37;877-81.
- pretest selection bias
 - referred to surgery as R/O appendicitis
- many not prospectively validated
 - tested on those undergoing laparotomy



Assessing Abdominal Pain

- Time-consuming process
 - average arrival to MD 60-90 minutes
 - average MD to disposition 150-180 minutes
 - 55% have lab, 26% have imaging



Kids admitted with AP

- 240 admitted with appendicitis
- 300 more admitted with other causes
 - 100 discharged as “Abd Pain NYD”
- average LOS in ER
 - all AP patients 210-270 minutes
 - appendicitis >300 minutes
 - other causes >380 minutes



How can we do better?

- Make an accurate disposition decision earlier
 - avoid tests/observation time that delays
 - consulting the surgeon for those with appendicitis
 - discharging those with benign problems
- Clinical Decision Support System



Clinical Decision Support

- Multiple definitions/applications
 - capturing clinical data on which to base
 - program/operational decisions
 - financial data (cost of doing business)
 - increasingly tied to clinical outcomes
 - point-of-care clinical decisions
 - for individual patients
 - may include tools for the patient



Potentials for CDSS

- Increase health care quality
 - change clinician behaviors by promoting EBM
 - literature-based evidence
 - local practice-based evidence
- Increase health care efficiency
 - standardize care/reduce variation
- Reduce medical errors
 - built-in safety net



Examples of CDSS

- Alerts
 - highlighting out-of-range lab values
 - patient ready for R/A
- Reminders
 - patient due for next vaccination
- Critiquing
 - screening in CPOE for drug interactions
- Interpretation
 - ECG



Examples of CDSS

- Predicting
 - risk of mortality from a severity-of-illness score
- Diagnosis
 - listing a differential diagnosis based on the patient's symptoms and findings
- Assisting
 - calculating adjusted drug dosages for renal function
- Suggestions
 - analyse recent PTT make suggestions heparin dosing to keep PTT in therapeutic range



ISABEL

- web-based differential diagnosis aid for Peds
- information retrieval engine
- matches patterns within unformatted text
- uses standard pediatric textbooks as source
- produces a differential diagnosis based on clinical features entered

www.isabel.uk.org

- remind the clinician of potentially important diagnoses



Leeds, UK Project

- Computer-based diagnosis for abdominal pain
- multiple studies since 1972
- computer database of known patients
- analyzed using Bayesian theory
- structured data collection form, entry into a computer, and feedback mechanism
- baseline rate of initial diagnostic accuracy 45%
 - improves to 57% with structured data collection
 - improves to 65% with whole system
 - post-investigation accuracy also improves
- 1998 estimated cost savings £25m /yr NHS



MET CDSS

- Mobile Emergency Triage (MET)
- Developed with the following goals
 - improved data collection
 - assist physician decision-making
 - promote earlier, more accurate triage/disposition decisions
 - NOT a diagnostic test



MET-AP CDSS

- Defined three distinct categories of patients
 - appendicitis
 - benign or resolving causes (constipation, viral)
 - other pathology
- Corresponding triage dispositions
 - consult surgery
 - D/C home with F/U prn
 - continue to investigate/observe



MET-AP CDSS

- retrospective data collection
- >700 patients with abdominal pain
- large number of attributes
 - history
 - physical exam
 - investigations
- each patient assigned to one category



MET-AP CDSS

- Data mining to find patterns that discriminate between the three categories
 - Rough sets
 - Shapely fuzzy values
- Answer the following questions
 - which attributes are most relevant for the discrimination process?
 - what is the relationship between the attribute and the final decision category?



MET-AP CDSS

- Result
 - series of *if ... then ...* statements
 - relative weighting of how strongly a given patient matches each of the three decision categories
- Recommendation can be made despite incomplete data
 - more data → more accurate recommendation



MET-AP CDSS

- 13 attributes identified
 - Demographics
 - age, gender
 - History
 - location of pt's complaint, duration, constant vs intermittent, shifting, vomiting, previous ER visit
 - Physical exam
 - temperature, location of maximal tenderness, rebound, guarding
 - Investigations
 - WBC

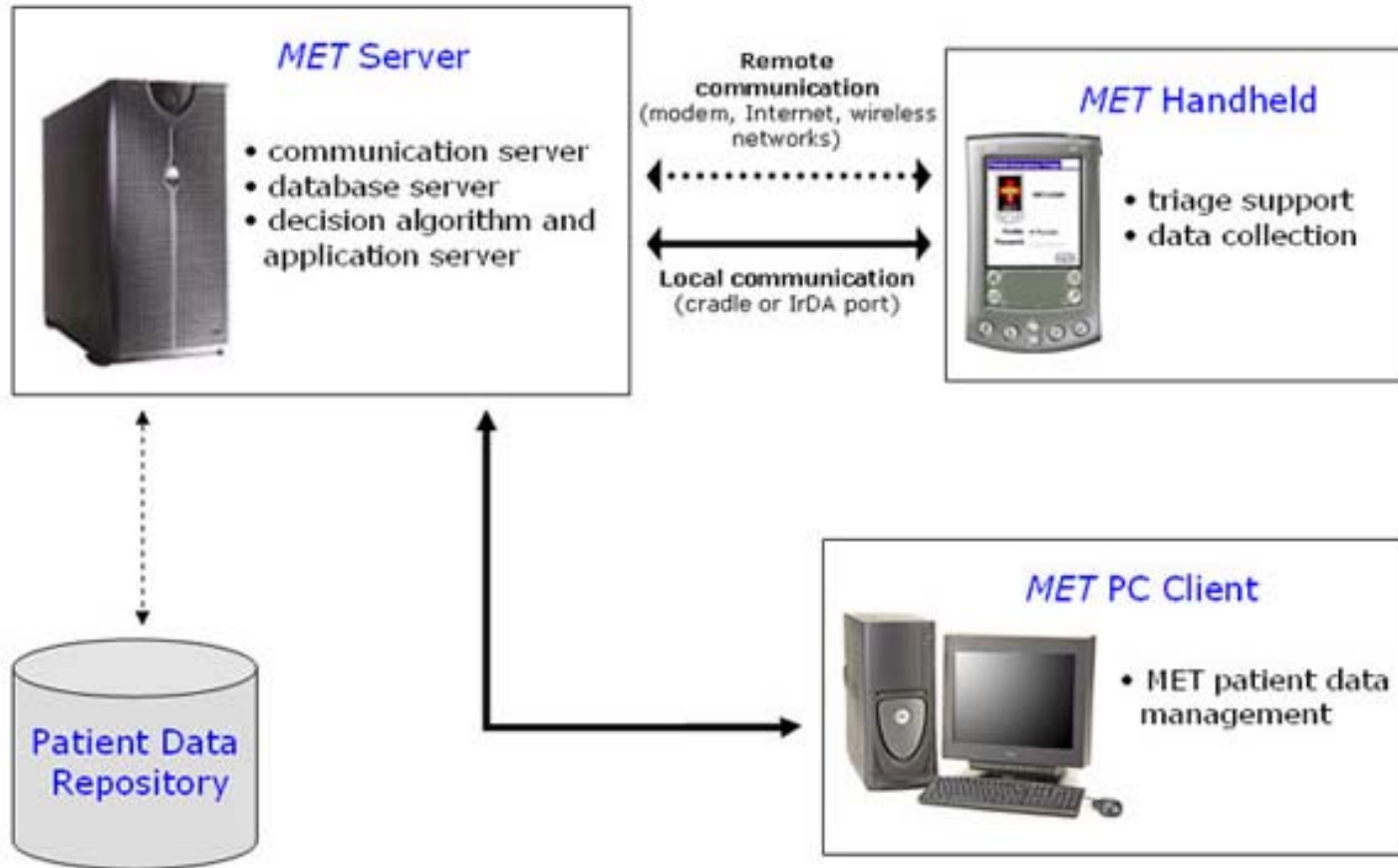


MET on Palm

- PDA technology ideally suited
 - takes the “computer” to the bedside
 - quick, easy data entry
 - built-in Sync functionality
 - maintain data centrally
 - communicate with other hospital IT systems
 - transfer patient data between users
 - new generation ready for wireless



MET Architecture



MET on Palm



- Programmed on Palm OS
 - patient database
 - data collection tool for entry of attributes
 - >200 algorithmic steps to produce a triage recommendation






MET-AP Screens


Patient Peterson, James


Hx **History** **PE** **Lx** **TR**


i Site of Pain: RLQ  

Duratrn of Pain: 5h 30min 

Type of Pain: Intermit.  

i Shifting of Pain: Yes 



i Previous Visit: No 



Vomiting: Yes 


Main


Patient Peterson, James

Hx **PE** **Physical Exam** **Lx** **TR**

i Site of Tender.: RLQ  

i Rebound: No  


i Loc. Guarding: Yes 

Temperature: 38.7 °C 

Main

Patient Peterson, James

Hx **PE** **Lx** **Tests** **TR**

WBCC: 6.0 x 1000 

Main



MET-AP Screens

Patient Peterson, James

History PE Tx TR

Site of Pain

RLQ Lower abd. Other



Cancel Clear

Patient Peterson, James

Hx History PE Tx TR

Site of Pain: RLQ  

Duration of Pain: 5h 30min 

Type of Pain: Intermit.  

Shifting of Pain

Yes No

Cancel Clear



MET-AP Screens



Prospective Validation Trial

- Retrospective pilot shows promise
- Could it be used in real practice?
- What is the accuracy of MET in real practice?
- What is physician accuracy and is MET better or worse?
- Could we quantify the potential benefits/costs?



Retrospective Pilot Data

MET Recommendation	Final Diagnosis			Totals
	Benign	Appendicitis	Other	
Discharge/ Follow-up FD	45	1	2	48 (41%)
Surgery Consult	8	34	1	43 (37%)
Further Investigation	7	2	17	26 (22%)
Totals	60 (51%)	37 (32%)	20 (17%)	117 (100%)
Accuracy	45/60 (75%)	34/37 (92%)	17/20 (85%)	96/117 (82%)



Question

- Question:

How reliably can MET-AP triage pediatric ED patients with acute abdominal pain to one of three disposition categories corresponding to three final diagnosis categories?



Objectives

- To determine the proportion of patients in which
 - MET-AP (trainee, staff) recommendation
 - ED personnel (trainee, staff) predictionagrees with the final diagnosis category.
- To compare these proportions to see if there is a difference between MET-AP and ED personnel performance
- To determine inter-observer agreements between staff and trainees for patient attributes
- To descriptively estimate potential cost savings of following MET-AP recommendation
- To compile a prospective data set on which to improve the algorithm's accuracy



Trial Design

- prospective cohort study
- recruit patients with acute abdominal pain presenting to our ED
- 24/7 recruitment by triage/registration/resident/staff
- informed consent to collect patient data and make follow-up telephone call
- where possible – 2 independent observations by staff/resident or resident/staff



Trial Design

- all personnel blinded to MET-AP recommendation
 - only revealed after patient assigned a final category
- patients followed until final category established
 - review of patient chart
 - telephone follow-up about ongoing symptoms, outpatient investigations/management



Sample Size

- Literature estimates physician accuracy at 50%
 - assume trainees are, at best, similar
- MET-AP likely better (pilot data)
- To estimate staff accuracy to within 5%, 19 times out of 20, requires 384 patient assessments
 - trainees and MET-AP require smaller numbers
- Since we want 384 patients with assessments by both staff and trainees and assuming 60% inter-observer rate -> 640 patients



Trial Version of MET-AP

- Trial computer receives all patient demographics from hospital ADT system
- Separate trial management system overlying MET
 - manage lists of current patients
 - inclusion/exclusion criteria on palm
 - capture physician prediction of patient's triage category
 - keep MET-AP recommendation blinded
 - record all follow-up information



Kick-off

- PSI funding awarded Mar 2003
- Patient enrollment started July 2nd
- Orientation to the palm
 - 17 FT staff
 - 5 fellows
 - >20 PT staff
 - >50 residents



Numbers to Date

- 340 patients enrolled
 - 123 staff physician only
 - 78 resident only
 - 141 both (41% inter-observer)
- Analysis of 230 patients with completed F/U
 - accuracy of MET-AP (staff) 66%
 - 2x2 appendicitis vs not appendicitis
 - Sens 65%, Spec 85%, Accuracy 82%



The Future . . .

- Multiple potential paths for this work
 - MET-AP
 - refining the CDSS based on prospective data
 - implementation and testing in different settings
 - community physicians/ED's
 - physician acceptance and how they use the recommendation
 - effects on patient outcomes and economic analysis
 - Other clinical problems
 - Scrotal pain (MET-AS) and Hip pain (MET-HP)
 - Asthma/Bronchiolitis decision to D/C vs LS vs admit
 - Adult problems



The Future . . .

- Multiple paths
 - Other platforms – seamlessly integrated
 - wireless environment
 - Pocket PC, tablets
 - digital phones
 - Web-based
 - Integration with EHR
 - running in the background
 - eliminates duplicate data collection
 - self-adapting as the system is now also linked to outcome



Thank you

- Please visit us at:

www.mobiledss.uottawa.ca

