Informatics at the Bedside  
Data is the key to Improvement  

Chris Maloney MD PhD  
Professor, Department of Pediatrics  
Adjunct Professor, Department of Biomedical Informatics  
Associate Chief Medical Officer, Primary Children’s Hospital
Disclosure:
Dr. Maloney has licensed eAsthma Tracker software to Symptom.ly
He has received no royalties to date
Outline

1. Informatics at Primary Children’s Hospital
2. Management of inpatient bronchiolitis
3. Management of inpatient asthma
4. Management of ambulatory asthma
5. Managing flow from the ED to inpatient
6. Managing flow from the ICU to inpatient
Informatics at Primary Children’s Hospital

HELP in 1990: Health Evaluation through Logical Processing
Hierarchical database with computerized decision support
Homer Warner, Al Pryor, Reed Gardner, Scott Evans
Ptext Application Language required to develop reports

HELP2 in 2000: Graphical User Interface with relational database
Computerized Decision support via
ForeSite object oriented rules engine
Paul Clayton, Stan Huff, Scott Narus, Beatrice Rocha
Clinical Data Repository – CDR
Electronic Data Warehouse – EDW
Java and JavaScript language for executable code
Relational database ➔ easy report generation
Informatics at Primary Children’s Hospital

Chameleon (formerly known as Patient Tracker) 2003
Local command and control with computerized decision support
Doug Wolfe, Joe Hales, Fred Farr, Kent Ward, Chris Maloney
Java and JavaScript language for executable code
Requires access to HELP2 ADT (Admission, Discharge, Transfer) table
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2. Management of inpatient bronchiolitis
3. Management of inpatient asthma
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Management of inpatient bronchiolitis

- Lower airway infection caused by variety of viruses
  - Respiratory Syncytial Virus (RSV) is most common
- Most common diagnosis effecting children < 2 years
- Fills up hospital beds across the country during winter
- No vaccine available
- Care is completely supportive
- Very low mortality
Management of inpatient bronchiolitis

☐ Q: When is patient discharged on home oxygen?
   A: When we need the bed.

☐ Variation increases costs

☐ Standardization improves outcomes

☐ Value = quality/cost

☐ The hospital is our laboratory
Management of Inpatient Bronchiolitis

- Instituted admit order set
- Developed adequately explicit discharge criteria
- Standardized inpatient care for:
  - Nutrition
  - Suctioning
  - Bronchodilator use
  - Oxygen therapy
Management of Inpatient Bronchiolitis

- Educated nursing staff
- Educated physicians
- Educated respiratory therapy staff
- Rolled out winter season 2004-2005
- Had measurement systems in place
Average Length of Stay Hours, PCMC Bronchiolitis Admissions

SOI 1 & 2, exclusions applied

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SOURCE: EDW CaseMix & Transactions
you
MANAGE
what
you
MEASURE
# Bronchiolitis Discharge Assessment
**Patient < 12 months of age**

## Oxygen saturation
- **Patient on room air?**
  - Yes  ❌ No
- **Hours oxygen sats > 88% on RA**
  -  
  - > 6  ❌ None

## Nutrition (meet at least one nutrition criteria before discharge)
- **Hours patient has taken 100% maintenance fluids po?**
  -  
  - > 24  ❌ None
- **Hours patient’s UOP >= 1 mL/kg/hr?**
  -  
  - > 24  ❌ None

## Suctioning
- **Able to manage patient’s secretions with a bulb syringe?**
  - Yes  ❌ No

## Education
- **Parents educated about oxygen therapy (if going home on oxygen)?**
  - Yes  ❌ No  ❌ N/A
- **Parents educated about nutrition / hydration?**
  - Yes  ❌ No
- **Parents educated about suctioning (bulb only)?**
  - Yes  ❌ No
- **Parents comfortable with all aspects of discharge?**
  - Yes  ❌ No

## Post discharge needs
- **Home oxygen arranged?**
  - Yes  ❌ No  ❌ N/A
- **Do parents have transportation available if the patient deteriorates?**
  - Yes  ❌ No
- **Do parents have access to a phone if the patient deteriorates?**
  - Yes  ❌ No

[Submit] [Cancel]
Average Length of Stay Hours, PCMC Bronchiolitis Admissions

SOI 1 & 2, exclusions applied

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SOURCE: EDW CaseMix & Transactions
Average Length of Stay Hours, PCMC Bronchiolitis Admissions

SOI 1 & 2, exclusions applied

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Average cases: 509 | 369 | 523 | 430 | 649 | 503 | 641 | 385 | 625 | 589 | 915 | 807 | 732

SOURCE: EDW CaseMix & Transactions

CPM fully implemented for 2005-2006 season

CPM implemented on IMSU for part of 2004-2005 season

LOS was the shortest it has been since the CPM was implemented
A Disruptive Innovation was needed
Observation Unit Home Oxygen Therapy
(OU-HOT)

Inclusion Criteria
3-24 months
No bacterial infection
Family willing and able to manage home oxygen
Reliable transportation
Has primary care provider
Lives within 30 minutes of health care facility

Exclusion
Other medical conditions affecting current illness
Possible asthma
Observed or history of apnea
Observation Unit Home Oxygen Therapy (OU-HOT)

• Wean oxygen to discharge threshold
  – <12 months: ≤ 0.5 liters per minute
  – >12 months: <0.8 liters per minute

• Minimize intervention
  – ie. suctioning

• Discharge after 8 hours of stability
OU-HOT 2010-11

• 309 patients admitted to OU-HOT
  – 72% discharged in less than 24 hours
  – 60% discharged on oxygen
  – Average length of stay 17 hours
  – 23% admitted to inpatient status
PCMC Bronchiolitis Inpatient Admissions, Percent \(\leq 24\) hours Length of Stay

APR-DRG SOI 1 & 2, Exclusions Applied
Average Length of Stay Hours, PCMC Bronchiolitis Admissions

SOI 1 or 2, exclusions applied

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Average: 60.8 hrs
Global mean: 66.1 hrs

Average LOS: 48.6 hours

SOURCE: EDW CaseMix & Transactions
Outline

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3. **Management of inpatient asthma**
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Asthma Working Definition

- Characterized by
  1. Variable and Recurring Symptoms
  2. Airflow Obstruction
  3. Bronchial Hyper-responsiveness
  4. Underlying Inflammation
Key: GM-CSF, granulocyte-macrophage colony-stimulating factor; IgE, immunoglobulin E; IL-3, interleukin 3 (and similar); TNF-α, tumor necrosis factor-alpha
**Key:** Alphabetical order is used when more than one treatment option is listed within either preferred or alternative therapy. EIB, exercise-induced bronchospasm; ICS, inhaled corticosteroid; LABA, long-acting inhaled beta2-agonist; LTRA, leukotriene receptor antagonist; SABA, inhaled short-acting beta2-agonist.
Pediatric Asthma: Epidemiology

- Most common pediatric chronic illness (prevalence: 13.8%)

- 7.1 million children < 18 years of age had asthma (2009)

- High health care use and costs ($20.7 billion/year in total costs)
  - 640,000 ED and 456,000 hospital visits in children < 18 (2007)
  - Readmission rates: 10-30% at 6 months to 20-50% at 12 months

- Suboptimal chronic asthma control in the ambulatory setting
Asthma: Epidemiology

1. Asthma is the most common chronic illness in children, with a lifetime prevalence of 14% and a significant impact on health care use and costs.
2. Readmission rates are high, ranging from about 10-30% within 6 months and 20-50% within 12 months of hospital discharge.
3. Children who are hospitalized for asthma are at increased risk for subsequent admissions.
4. Significant gap between asthma evidence and actual care provided to children.
5. Preventing readmissions in children hospitalized with asthma can reduce health care costs related to asthma.
Management of Inpatient Asthma
Inpatient Interventions

Medical Management
- Acute Severity Assessment
- Use of Short Acting Beta Agonist
- Appropriate Delivery of Albuterol
- Appropriate Use of Atrovent
- Use of Systemic Corticosteroids
- Oral Systemic Corticosteroids vs. IV

Readmission Prevention
- Chronic Severity Assessment
- Adequate Preventive Treatment
- Asthma Education
- Written Action Plan
- Follow-up Care Arrangement

On-Going Monitoring
# Asthma Quality Measures: PCH 2005

* Nkoy et al. Pediatrics 2008

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<td>38%</td>
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<td>2. Use of Quick Relievers</td>
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<tr>
<td>3. Use of systemic corticosteroid for all patients</td>
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<tr>
<td>4. Use of oral (not IV) systemic corticosteroids</td>
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<td>5. Use of Ipratropium Bromide restricted to &lt; 24 hrs after admission</td>
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<tr>
<td>6. Use of albuterol delivered by MDI (not nebulized)</td>
<td>23%</td>
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<td><strong>Re-exacerbation/readmission prevention measures</strong></td>
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<tr>
<td>7. Documented chronic asthma severity assessment</td>
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<td>8. Parental participation in an asthma education class</td>
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<td>9. Written asthma action plan</td>
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<td>10. Scheduled follow-up appointment with the PCP at discharge</td>
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Initiatives to Improve Asthma Care at PCH

- Developed and implemented an inpatient asthma care process model
  - Standardized Admission order set
  - Standardized Discharge order set
  - Standardized clinical care of:
    - Bronchodilators
    - Oxygen

- Developed measurement tools for CMS quality measures
  - Children’s Asthma Care (CAC) Measures
### Quality Measures for Asthma Inpatient Care

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<th>2010</th>
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<tr>
<td>10. Scheduled follow-up appointment with the PCP at discharge</td>
<td>22%</td>
<td>96%</td>
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</table>
Inpatient Interventions

Medical Management
- Acute Severity Assessment
- Use of Short Acting Beta Agonist
- Appropriate Delivery of Albuterol
- Appropriate Use of Atrovent
- Use of Systemic Corticosteroids
- Oral Systemic Corticosteroids vs. IV

Readmission Prevention
- Chronic Severity Assessment
- Adequate Preventive Treatment
- Asthma Education
- Written Action Plan
- Follow-up Care Arrangement
- On-Going Monitoring

Follow-up Care Arrangement

Oral Systemic Corticosteroids vs. IV
“Making it Easy to do it Right”

Brent C. James, MD Mstat
Asthma CDS Facilitates Pediatric Core Measure Compliance

Home Management Plan of Care Addresses All Measures

<table>
<thead>
<tr>
<th>Month</th>
<th>Numerator</th>
<th>Denominator</th>
<th>Percent</th>
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<td>Jan-Jun 2007</td>
<td>0</td>
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<td>185</td>
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<td>130</td>
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<td>Jan-Jun 2009</td>
<td>198</td>
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<td>79%</td>
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<tr>
<td>Jul-Dec 2009</td>
<td>162</td>
<td>85%</td>
<td>81%</td>
</tr>
<tr>
<td>Jan-Jun 2010</td>
<td>46</td>
<td>87%</td>
<td>85%</td>
</tr>
<tr>
<td>Jul-Dec 2010</td>
<td>50</td>
<td>93%</td>
<td>87%</td>
</tr>
<tr>
<td>Jan-Jun 2011</td>
<td>28</td>
<td>98%</td>
<td>93%</td>
</tr>
<tr>
<td>Jul-Dec 2011</td>
<td>44</td>
<td>98%</td>
<td>92%</td>
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<tr>
<td>Jan-Jun 2012</td>
<td>46</td>
<td>89%</td>
<td>90%</td>
</tr>
<tr>
<td>Jul-Dec 2012</td>
<td>13</td>
<td>88%</td>
<td>92%</td>
</tr>
<tr>
<td>Jan-Jun 2013</td>
<td></td>
<td>89%</td>
<td>92%</td>
</tr>
<tr>
<td>Jul-Dec 2013</td>
<td></td>
<td>88%</td>
<td>89%</td>
</tr>
<tr>
<td>Jan-Jun 2014</td>
<td></td>
<td>88%</td>
<td>89%</td>
</tr>
<tr>
<td>Jul-Dec 2014</td>
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<td>82%</td>
<td>90%</td>
</tr>
<tr>
<td>Jan-Jun 2015</td>
<td></td>
<td>96%</td>
<td>92%</td>
</tr>
<tr>
<td>Jul-Dec 2015</td>
<td></td>
<td>93%</td>
<td>90%</td>
</tr>
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</table>
Management of Inpatient Asthma
Impact on Asthma Length of Stay
Inpatient Interventions

Medical Management
- Acute Severity Assessment
- Use of Short Acting Beta Agonist
- Appropriate Delivery of Albuterol
- Appropriate Use of Atrovent
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Readmission Prevention
- Chronic Severity Assessment
- Adequate Preventive Treatment
- Asthma Education
- Written Action Plan
- Follow-up Care Arrangement
- On-Going Monitoring
Management of Inpatient Asthma Impact on Asthma Readmission
Asthma Readmissions: PCH vs. Freestanding Children’s Hospitals

2008 Asthma Inpatient Encounter (APR-DRG 141) Returns to Hospital within 180 Days – Same APR-DRG

- % Inpatient Returns
- % ED Returns
- % Observation Returns
PCH vs. Other Children’s Hospitals

2010 Asthma Inpatient Encounter (APR-DRG 141) Returns to Hospital within 180 Days – Same APR-DRG

- % Inpatient Returns
- % ED Returns
- % Observation Returns
Outline

1. Informatics at Primary Children’s Hospital
2. Management of inpatient bronchiolitis
3. Management of inpatient asthma
4. Management of ambulatory asthma
5. Managing flow from the ED to inpatient
6. Managing flow from the ICU to inpatient
TAKING CHARGE OF YOUR ASTHMA

Live your life to the fullest!
Take control of your asthma by monitoring your symptoms, tracking your progress and improving communication with your healthcare provider.

© 2011 Asthma Tracker • Terms & Conditions • Developed by the SDC
Live your life to the fullest!

Take control of your asthma by monitoring your symptoms, tracking your progress and improving communication with your healthcare provider.

5) How would you rate your asthma control?

- 1. Not controlled at all
- 2. Poorly controlled
- 3. Somewhat controlled
- 4. Well controlled
- 5. Completely controlled

Next
SAMPLE WORK AND INFORMATION FLOW OF THE e-ASTHMA TRACKER
During the PAST WEEK:

How much of the time did your asthma keep you from getting as much done at home, school, or work?

- 1. All of the time
- 2. Most of the time
- 3. Some of the time
- 4. A little of the time
- 5. None of the time

How often have you had shortness of breath?

- 1. More than once a day
- 2. Once a day
- 3. Three to six times
- 4. Once or twice
- 5. Not at all

How often did your asthma symptoms (wheezing, coughing, shortness of breath, chest tightness or pain) wake you up at night or earlier than usual in the morning?

- 1. Four or more nights
- 2. Three nights
- 3. Two nights
- 4. A little of the time
- 5. None of the time

How often have you used your quick-relief inhaler or nebulizer medication (such as albuterol, Ventolin®, Proventil®, or Maxair®)?

- 1. Three or more times per day
- 2. One or two times per day
- 3. Two or three times during the week
- 4. Once this week
- 5. Not at all

How would you rate your asthma control?

- 1. Not controlled at all
- 2. Poorly controlled
- 3. Somewhat controlled
- 4. Well controlled
- 5. Completely controlled
Your asthma score is 20
Please complete questions below to see the recommendation

Person filling this out (relationship to patient): [Select One]

Did you use any controller medications this week? [Select One]

Did your asthma flare up this week causing you to take a steroid liquid or pill by mouth? [Select One]

This week, did you use anything besides your prescription medication to ease asthma symptoms? [Select One]

Any unscheduled sick visits to the doctor this week? [Select One]

Any unscheduled sick visits to the hospital (Instacare, or Emergency Room) this week? [Select One]

Question Submission Date? (For testing only) [Enter Date]

Comments: (Optional) [Enter Text]
Weekly ACT score is 16:

Your asthma control **should be better**. Continue following all parts of your Asthma Action Plan. Your score has been in the yellow zone for 2 weeks, schedule a visit with your doctor.
Information for patient AND provider
Asthma control over time

ACT Date: 04/05/12
Asthma Control Test Score: 18

ACT Recommendation:
Your asthma control should be better. Continue following all parts of your Asthma Action Plan.
Your weekly Asthma Control Test scores higher than 19 are in the green zone.

Follow the recommendations of your asthma care according to your score.
# Clinic Interface – SHARING ACCOUNTABILITY

![AsthmaTracker](image)

## Table of Patients

<table>
<thead>
<tr>
<th>Email</th>
<th>First Name</th>
<th>Last Name</th>
<th>Last 20 Days</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><a href="mailto:eunhea.kim1@gmail.com">eunhea.kim1@gmail.com</a></td>
<td>Tinker</td>
<td>Bell</td>
<td>24 24 25</td>
<td>add</td>
</tr>
<tr>
<td><a href="mailto:eunhea.kim1@gmail.com">eunhea.kim1@gmail.com</a></td>
<td>John</td>
<td>Doe</td>
<td>24 24 18</td>
<td>add</td>
</tr>
<tr>
<td><a href="mailto:eunhea.kim1@gmail.com">eunhea.kim1@gmail.com</a></td>
<td>Jane</td>
<td>Doe</td>
<td>25 11 16</td>
<td>add</td>
</tr>
<tr>
<td><a href="mailto:eunhea.kim1@gmail.com">eunhea.kim1@gmail.com</a></td>
<td>Donald</td>
<td>Duck</td>
<td>25 24 22</td>
<td>add</td>
</tr>
<tr>
<td><a href="mailto:eunhea.kim1@gmail.com">eunhea.kim1@gmail.com</a></td>
<td>Goofy</td>
<td>Goof</td>
<td>24 25 13</td>
<td>add</td>
</tr>
<tr>
<td><a href="mailto:eunhea.kim1@gmail.com">eunhea.kim1@gmail.com</a></td>
<td>Jim</td>
<td>Jensen</td>
<td>25 25 25</td>
<td>add</td>
</tr>
<tr>
<td><a href="mailto:eunhea.kim1@gmail.com">eunhea.kim1@gmail.com</a></td>
<td>Mickey</td>
<td>Mouse</td>
<td>25 25 25</td>
<td>add</td>
</tr>
<tr>
<td><a href="mailto:eunhea.kim1@gmail.com">eunhea.kim1@gmail.com</a></td>
<td>John</td>
<td>Smith</td>
<td>24 20</td>
<td>add</td>
</tr>
</tbody>
</table>

*< Previous Next >*
Review patient’s responses to the Asthma Control Test (ACT) by clicking on the score. Any comments the patient included will also show.
A list of patients with "Unresolved Issue" checked under comments will show in the "Flagged Patients" page. Once "Unresolved Issue" is unchecked under comments, the patient will no longer be listed on this page.
New Patterns (Intermittent Asthma)

Stepping up to reach good control
New Patterns (Persistent Asthma)

“I ran out of my controller”

“The cat”
Asthma Readmissions: users vs. non users

Time to First (ED/hospital) Readmission (adjusted for age and race)

No Days since Hospital Discharge

Proportion

Non Users

Users
Outline

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Movement from ED to Floor

• ED leadership upset with patient flow
• ED leadership claims floor is barrier
  o Patient is ready, but floor is not
  o Need an admission nurse
• Developed measurements systems
• Shared the results
Dr. Paul Batalldan

“Every system is perfectly created to achieve the results it gets”
Movement from ED to Floor

Request to nurse supervisor response

Response to bed available

Bed available to floor arrival
you
MANAGE
what
you
MEASURE
Measuring The Process

Minutes

Available to Completion
Assigned to Available
Request to Assigned
Better to remain *silent*
and be thought a fool
than to *speak*
and remove all doubt
Measuring The Process

Available to Completion
Assigned to Available
Request to Assigned

Minutes

August 2013 to August 2014
"Nurse? I think I'd like a pilot to perform my surgery."
Outline

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Patient Flow

ED

Transfer

Direct Admit

Hospital Stay

Discharge Short Term Facility

Discharge Home

Discharge Long Term Facility

PCP

Intermountain
Primary Children’s Hospital
The Child First and Always®

Department of Pediatrics

University of Utah
School of Medicine
Patient Flow

- ED
- Transfer
- Direct Admit
- Medical Ward
- ICU
- Surgery Ward
- OR
- Discharge Short Term Facility
- Discharge Home
- Discharge Long Term Facility
- PCP

Intermountain Primary Children’s Hospital
Department of Pediatrics
CICU / PICU Patient Transfer

**Patient:**
- Rogers, Mister
- Room: PICU - 2304
- Birthdate: 01/21/2011
- Age: 3Y
- Sex: F
- Encounter #: 78172525
- EMMI #: 552507809
- Medical Record #: 72-22-68

**CICU / PICU LIP Section**
- Submitting LIP: Lincoln, Abe
- CICU/PICU LIP's Schedule (names / times): please call Lincoln, Abraham Gen via vocera with questions until 1430

**Service to Attend on Patient:**
- ENT

**Will a Surgeon be Attending:**
- Yes
- No

**Nursing Supervisor Section**
- Unit: CSU
- Room: 3076
- Time Available: 04/26/2014
- Time: 12:00

[Submit and Send Page] [Cancel]
Movement from PICU to Floor

Request to nurse supervisor response

Response to bed available

Bed available to floor arrival

Goal is < 180 minutes
Time to Transfer Patient from PICU to Floor

- Median

Time (hrs)
Outline

1. Informatics at Primary Children’s Hospital
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Thank You