Demonstrating the Benefits of Digital Medicine through Improved Outcomes

Safe and effective medicines: Informatics for best practice

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Peer-reviewed Journals Disciplines

- Health Info Technology & Execs
  - Clinical/Medical Informatics
  - Financial Management
  - Physician & Nursing Leadership
    - Incl. Nursing Economics
- Quality & Patient Safety
  - Incl. AHRQ Journal
- Ob & Gynecology
  - Breast Cancer Research and Treatment
  - Mat, Fetal & Neonatology Med
- Pediatrics
  - Ped ENT
  - Ped Ophthalmology & Strabismus
  - Ped Critical Care
- Neonatal & Perinatal
  - Mat, Fetal & Neonatology Med
  - Neonatal & Low Birth Weight
- Otolaryngology, Head & Neck Surgery
- Epidemiology and Infection
- Orthopaedics
  - Orthopedic Trauma
  - Sports Medicine
  - Shoulder and Elbow Surgery
  - Spine
  - Bone & Joint Surgery
- Arthroscopic and Related Surgery
  - Clinical Ultrasound
  - Ultrasound in Medicine
  - Ultrasound in Ob & Gynecology
- Emergency
  - Emergency Nursing
  - Pediatric Emergency Care
  - Orthopedics
  - Head Injury
- Neurosurgery
Informatics-enabled
Safer Medicine

Dean Sittig MD
David Classen MD … IOM
Brent James MD
David Vawdrey MD
A metaphor ...

Slow change – Empowering Success
Stable figures – Attention to Needs
Strategic perspective – Org Excellence
MISSION …
Levels of Information: Needs and Perspectives

- **Routine change – Enabling Success**
  - Evolving figures – Process Improvement focus
  - Operational perspective – Managing Success
  - MISSION …

- **Slow change – Empowering Success**
  - Stable figures – Attention to Needs
  - Strategic perspective – Org Excellence
  - Populations patterns
  - MISSION …

- **Fluid change / Real-time figures**
  - Real results – NOW or catastrophic
  - Care and Continuum perspective
  - MISSION …

Beware of the Golden Rule

Only DOERs can reach real performance improvements
Drug-related Process

- **Ordering – Selection**
  - Alternatives
    - ID, Pat signs & symptoms
    - Labs
    - DDI, Allergy, Wt. …
    - Alert
- **Documentation**
- **Requesting**
  - Transcribed, translated
  - Communicated
- **Pharmacy**
  - Received
  - Transcribed, translated
  - Check Order
    - Appropriateness
    - DDI, Allergy
  - Dispensing
  - Delivery
- **Administration**
- **Documenting**
- **Patient-related Effects**

- **5 Rights … 6**
  - Patient
  - Drug – Medication
  - Dose
  - Route
  - Timing – Intervals
  - Treatment Appropriate

Can an EPR help?

If Yes … How?
Order Sets - CDS

Locally Defined Ideal Medications
  Disease
  Population
  Immediate Access at Decision-Making
  Innovation Ready – EBM, Local
  Education & Training – Juniors & PDevelopment

5 Rights
6 Related Processes
  CDS – Ideal Care, Safest
  Including CPOE – ePrescribing
  Alerting

Education - Consistency
Studied Causes and Sources of Pediatric Medical Errors/Incidents

Need to Overcome Alert Fatigue


Shaha SH, Bradley D (2012). *Technology helps reduce medication errors and alert fatigue through HIT.* HIMSS Asia Pac, Singapore, Sept 2012

Safer Physician Practices

31.2% fewer alerts for Users of Intelligent Order Sets w/CDS (p<.0001)
Safer Physician Practices

Comparative Alert Response Rate:
Intelligent Order Sets vs. CPOE Alone

122.8% more responsive to the fewer alerts they received for Users of Intelligent Order Sets w/CDS (p<.0001)
Safer Physician Practices

59.2% fewer medication-related errors reached patients when managed on Intelligent Order Sets w/CDS (p<.0001)

Patients managed through Intelligent Order Sets w/CDS experienced significantly fewer errors (p<.0001)

Errors "Reaching the Patient": Intelligent Order Sets vs. CPOE Alone

59.2% fewer medication-related errors reached patients when managed on Intelligent Order Sets w/CDS (p<.0001)
Safer Doctor Practices

59.2% fewer medication-related errors reached patients when managed on Intelligent Order Sets w/CDS (p<.0001)

Errors "Reaching the Patient": Intelligent Order Sets vs. CPOE w/Alerts Alone

Less than half the error rate (p<.001)

Cash Release estimated at £211,000 annually for PICU alone
Medication Incidents

44.8% Reduction in Mean Incidents reduced by 55.3 yr. 1 to yr. 4 (p<.001)

66.7% Reduction from highest to lowest (p<.001)

Annualized Savings estimated between £573 k and £1.13 m

Oncology

Wrong Does / Strength

Pre-Implementation  Post Implementation

78.6% reduction
Improved Nursing Productivity and Efficacy
Changes in Nursing Care

Changes in Nursing Care

46.3% Direct care, 22.0% increase (p<.001)

Changes in Nursing Care

- **49.2% Direct care, 29.7% increase** (p<.001)
- **16.7% decrease in indirect time** (p<.01)

Safer Medication Administration

**71.7% Decrease in mean Med Errors versus baseline (p<.001)**

Zero Med Errors in 3 of past 7 months Post implementation (p<.001)

The Impact of
EPR-enabled Prophylaxis
Compliance with Evidence-Based VTE Prophylaxis

97.4% Reduced Alerts (p<.001)
145.3% Increased Assessments (p<.001)
139.6% Improved Assessment Rate (p<.001)

Alert Fatigue replaced with Alert Efficacy ...

With CPOE and traditional CDS

With Outcomes Toolkit incl. Advanced CDS Order Sets

Does EPR-Driven Medication-associated Prophylaxis Make a Difference in VTE Rates?

DVT/VTE Rate per Bed Day

- **$736,578** *improved cash release* (p<.001)
- **0.8 Days reduced mean LOS** (p<.001)

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**62.6% decrease in mean DVT/VTE rate** (p<.001).
From mean rate of .431 to .161.

**59.4% decrease in variation** (p<.001)

That's approximately **167 fewer patients** suffering from VTEs each year *

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Impact of Advanced Clinical Decision Support with CPOE

Compliance with Evidence-based VTE Prophylaxis

139.6% Improved Assessment Rate (p<.001) with 97.4% Fewer Alerts (p<.001)

From 25,000 to 285 Alerts per mo

PRE - Alert-based CDS

POST - Advanced CDS w-CPOE

Impact of Advanced Clinical Decision Support with CPOE

Compliance with Evidence-based VTE Prophylaxis

- 62.6% REDUCTION in VTE Rate
- 302 Fewer VTEs annually
- $736,578 estimate reduction in annual Variable Costs (p<.001)
- 0.8 days reduced Length of Stay (p<.001)

**VTE Rate**

**Length of Stay**

PRE - Alert-based CDS
POST - Advanced CDS w-CPOE

PRE
POST - Advanced CDS w-CPOE

62.6% lower
(p<.001)

10.1% reduction
(p<.001)

Impact on One DRG Alone …

DRG 470 - Major joint replacement or reattachment of lower extremity w/o MCC

Each bubble represents a major surgeon, and bubble size reflects case volume.

- 16% decrease in Cost/Case ($1,315/case)
- 2% decrease in Length of Stay
- $3.1 Million saved in Variable Cost annually
- 25.6% decrease in Readmissions
- 14.2% decrease in Mortality Rate

The Impact of EPR-enabled Early Recognition and Intervention


Sepsis: An example of infections and “avoidables”

Statistics:
- The leading cause of death in hospitals globally – 1.7 Million cases a year
- Prolonged LOS in ICU w/ CCs, complex therapies, high costs. £18Bn annually

Solution:
- SQL query 12-month retrospective chart review
- MEWS: Perpetual, house-wide, imbedded monitoring and surveillance
Patient & Population-related sensitivities and specificities
Patient-adjusted Normalisation possibilities

LOW Acuity Patient

HIGH Acuity Patient
The Identification of Deteriorating Patients with Urgency for Intervention


Swartz C, DNP, MBA, RN. (2013). A Systematic Approach to Manage Clinical Deterioration on Inpatient Units in the Health Care System. ACE, Chicago
- Early Identification of Deterioration
- Drug Therapy Begun Quickly after Initial Labs
- Change of Drug Intervention as Needed Throughout LOS
- Reduce Frequency and Severity of Sepsis …
### The Process: Identification and Remediation

- **Document**
  - Vitals
  - Device integration
  - Key CCs

- **Query**
  - Key Indicators (Age, BMI)

- **Calculate**
  - Score via Matrix

- **Alert**
  - Does score exceed threshold? Send Alert

### Summary Impacts:

<table>
<thead>
<tr>
<th>Measure</th>
<th>Pre</th>
<th>Post</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timeliness of Recognition¹</td>
<td>571.2 minutes</td>
<td>93.7 minutes</td>
</tr>
<tr>
<td>Cardiopulmonary Arrest Rate Outside ICU²</td>
<td>5.54%</td>
<td>3.86%</td>
</tr>
<tr>
<td>ICU Length of Stay³</td>
<td>3.8 days</td>
<td>3.3 days</td>
</tr>
</tbody>
</table>

Significance levels:
- p<0.001
- p<0.01

Sepsis Outside of the ICU

40.2% reduction (p<.01)

37.5% addl. reduction (p<.01)
62.5% cumulative (p<.001)

£ 8.9 Million est. Cash Release

The Impact of EPR-enabled Blood Sugar Management
Impact of Advanced Clinical Decision Support with CPOE

Improved Blood Sugar Management

- **18.2%** Improved Blood Glucose levels day 1 post-op (p<.001)
- **11.0%** Improved Blood Glucose levels day 2 post-op (p<.001)
- **10.1%** Reduced Length of Stay (p<.001)

### Mean Blood Glucose Levels

- **18.2% lower (p<.001)**
- **11.0% lower (p<.001)**

### Length of Stay

- **10.1% reduction (p<.001)**
Impact of Advanced Clinical Decision Support with CPOE

Improved Blood Sugar Management

- 100% of patients meeting Blood Glucose goals
- 135.2% reaching improvement over baseline ($p<.001$)

Patient Meeting Blood Sugar Goals

135.2% improved ($p<.001$)
Impact of Advanced Clinical Decision Support with CPOE

 Improved Blood Sugar Management

- **18.2% Reduced Mediastinitis Rate** (p<.001)
- 0 Mediastinitis infections for 11 of 12 post-implementation months (p<.001)
- **Between $308,490 and $80,503** estimated savings (p<.001)

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**Mediastinitis Rate**

PRE POST - Advanced CDS w-CPOE
Mediastinitis Outcomes

- Seven fewer infections annually (p<.001)
- Implementation of Portland Protocol for blood glucose management
- Change in Mediastinitis Infection Rate
  - 6 Consecutive months at zero infections (p<.001)*
  - Savings of between $308,490 ¹ and $80,500 ² annually (p<.001)
  - Length of Stay reduced by 1.0 days (p<.001)

* 95% confidence interval for most recent data estimated from twelve previous inclusive months.
The Impact of EPR-enabled Blood Utilization
Improved Blood Utilization and Transfusion Rate
Achieved through a multi-faceted process powered by the EMR

Transfusion Rates for Complex Surgery
Hip & Knee Revisions, Complex & Ant/Post Spines

...Mean Transfusions per Complex Surgery continue to fall significantly despite increased volume (p<.0001)

Affecting an Estimated 1,680 surgeries per year for annualized average monthly volumes

Estimated $5.23 M mean Annualized savings from pre to post monthly means. *

From highest to most recent: Estimated $14.08 M mean Annualized savings from 11/06 versus 12/08 monthly means. *

Transfusions per Surgery

1  2  3   4   5   6   7   8   9  10  11 12 13 14 15 16 17  18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36

Months
**Complex Surgeries:**

Hip & Knee Revisions, Complex & Ant/Post Spines

**Even as volumes rose...**

- **Total Complex Surgeries**
- **Hip Revision**
- **Knee Revision**
- **Spine Anterior/Posterior**
- **Spine Complex**

**Affecting an Estimated 1,680 surgeries per year** for annualized average monthly volumes

**Estimated $5.23 M mean Annualized savings** from pre to post monthly means. *

**From highest to most recent:**

Estimated $14.08 M mean Annualized savings from 11/06 versus 12/08 monthly means. *

67.3% reduction (p<.001)

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EPR-Assisted Blood Utilization

Adoption of Evidence-Based Practices for Autologous RBC Transfusion Rate

76.1% Decreased in mean use (p<.001)
49.1% Decreased in monthly variation (p<.001)
Outcomes

Pediatric Transfusions

76.5% fewer
And Happier Clinicians ...

... Versus Fatigued and Frustrated
Clinical composite reached 60%, an improvement of 46.3% (*p* < .01).

Support composite reached 53%, an improvement of 44.5% (*p* < .01).
Clinical composite reached 57%, an improvement of 15.6% (p<.01).

Support composite reached 54%, an improvement of 18.3% (p<.01).
Pharmacist Satisfaction

Clinical composite reached 40%, an improvement of 35.9% (p=ns).

Support composite reached 45%, an improvement of 115.9%, more than double (p<.01).
The Impact of EPR-enabled CPOE
Recently published ...


Newly published ...

Improved Patient-flow Outcomes

Discharge Patterns
- Discharge to Home: 9.4% more (p<.001)
- Discharge to SNF: 16.0% fewer (p<.001)
- Discharge to IP Rehab: 21.4% fewer (p<.001)

Readmissions in 31 Days
- CDS-rich Order Set: 35.7% fewer (p<.001)
- Without Order Set: 35.7% fewer (p<.001)

Length of Stay
- CDS-rich Order Set: 7.5% lower, 0.35 fewer days avg. (p<.001)
- Without Order Set: 7.5% lower, 0.35 fewer days avg. (p<.001)

Financial Impact
- Average Direct Cost/Case: 11.4% lower (p<.05)
- Average Indirect Cost/Case: 12.7% lower (p<.05)

Estimated Impact: $230k-565k Annualized
Organization-wide Cost per Case

Pre-implementation

Post-implementation

Month
Single Source of Truth

Analytics and Insights

Patient and Consumer Engagement

Care Coordination and Connectivity

Core Clinical and Core Financial

Allscripts Community Architecture

Children

Genomic Map

FitBit

Scale

Sleep Monitor

Mental Health
Acute Care
Out of Hospital Care
Remote & Educated Care
Consistent, Standardised
Safest & Educated Care
Coordinated Availability & Care
Telehealth - eHealthcare
Patient Voice
Improved Outcomes

PPCI added

Arrests with Primary PCIs

Non-ICU
Improved Outcomes

Impacts & Benefits with the EPR:
- Clear tread of increased patient severity (80% more, 1.67 to 3.0)
- Less severe now treated through other healthcare alternatives
Impacts & Benefits with the EPR:

- Despite increased patient severity (80% more, 1.67 to 3.0)
- Controlled and decreased negative outcome
  - 100% lower pre month vs. recent low (3 to 0)
  - 33.3% lower pre-post year-to-year (3.0 to 2.0)

~£116,000 Annual Cash Release
How was that achieved?
- Constancy of 4-per-day
- Impact assessment ...
MEWs Impact on Outcomes

Impacts & Benefits with the EPR:
- Rising severity … Improving outcome
- MEWs rising: 18.1% rise recent year-over-year (3.42-4.04)
- Arrests falling: 75.0% from highest to lowest (4 to 1)
  25.2% improved year-over-year

- MEWs
- Deterioration
- Transfer to CCU
- 2/3 fewer mort’s

Resuscitation committee
- Resp, HR, BP, temp … EBM
- Score change/jump
- CDS c clinical judgment
Improve Mortality Rates

Impacts & Benefits with the EPR:
- Decreased negative outcome
  16.7% lower pre-post year-to-year (103.7 to 86.3)
EPR Impacts & Benefits

- Programmability
  - Local Relevance
  - Adaptability
  - Inculcate all Sources
    - Device input incl. Rx-focused
    - Patient-level Computed EBM through EPR
    - Vs. PDFs
    - Vs. “Wikipedia”

- Consistent, Safest, Most Cost-effective Care
- Less Error Susceptibility
  - Including Reduced Wastage
- Better Organisational Outcomes
  - Cash Release
- Better NHS Outcomes
Lesson Learnt

- 100% adaptable
- 100% programmable
- 100% reflective of local populations and healthcare needs
- 100% focused on optimizing clinician decisions, from which all stakeholders see goals met
- 100% Patients as individuals
- 100% Insight-based over opinions or hopes
Fortunately for Sparky, Zeke knew the famous "Rex maneuver."
Of course, Dr. Heimlich eventually improved his maneuver...
The process didn’t change.
It’s the Outcomes that matter.

Fortunately for Sparky, Zeke knew
the famous “Rex maneuver.”
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