

Implementing Best Practices at Your Medical Center through Computerized Clinical Decision Support (CDS)

SGIM Evidence Based Medicine Task Force

May 15, 2009

SGIM 32nd Annual Meeting Workshop

Miami Beach, FL



Objectives

1. Identify key studies demonstrating the impact of computerized clinical decision support on best practices
2. Use case studies to identify key stakeholders for the development and implementation of computerized clinical decision support
3. Use case studies to identify common features of computerized clinical decision support
4. Describe study designs used to monitor the impact of computerized clinical decision support

Outline

- | | |
|------------------|--|
| 1030-1035 | Faculty Introductions |
| 1035-1040 | Evidence-based Practice and CDS |
| 1040-1100 | Case 1: CDS in the Inpatient Setting |
| 1100-1120 | Case 2: CDS in the Outpatient Setting |
| 1120-1140 | Case 3: CDS in the Research Setting |
| 1140-1155 | Monitoring the Impact of CDS |
| 1155-Noon | Wrap Up |

Faculty Introductions

- Craig A Umscheid, MD, MS
University of Pennsylvania
- David A Dorr, MD, MS
Oregon Health and Science University
- Nirav R Shah, MD, MPH
New York University and Geisinger Clinics
- Colin P West, MD, PhD
Mayo Clinic

Audience Poll

- Primary role: clinician, operations, research?
- Most interested in: development or implementation of CDS?

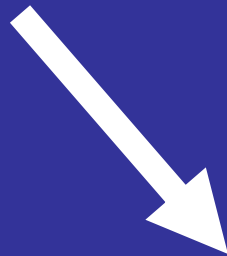
Evidence-based Practice and CDS

Drivers of Evidence-based Policy

Public reporting and
pay-for-performance



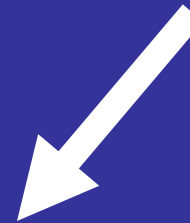
Quality of health care



Stagnant reimbursements
and increasing costs



Cost-effectiveness of health
care dollar



Practice of EBM at the Organizational
Level

Using CDS to Implement EBM

- **Dexter PR. *JAMA*. 2004.**
 - Increasing influenza and pneumococcal vaccinations
- **Kucher N. *NEJM*. 2005.**
 - Preventing venous thromboembolism
- **Evans RS. *Arch Intern Med*. 2000.**
 - Decreasing surgical site infections by increasing use of preoperative empiric antibiotics
- **Chertow GM. *JAMA*. 2001.**
 - Increasing appropriate prescribing in those with renal insufficiency
- **Teich JM. *Arch Intern Med*. 2000.**
 - Improving formulary adherence and reducing costs

What is CDS?

“Providing clinicians or patients with clinical knowledge and patient-related information, intelligently filtered or presented at appropriate times, to enhance patient care.”

– NOT just rules or alerts

Examples of CDS

- Relevant data presentation: *flowsheets, surveillance*
- Order creation facilitators: *order sets*
- Reference information: *infobuttons, Web*
- Unsolicited alerts: *proactive warnings*
- Documentation templates: *visit note*
- Protocol support: *pathways*

Impact of CDS on Physician Performance

Type of CDS	Improve Physician Performance N (%)
All CDS	62 (64%)
Diagnostic CDS	4 (40%)
Disease Prevention CDS (Reminders)	16 (76%)
Disease Mgmt CDS	23 (62%)
Dosing or Prescribing CDS	19 (66%)

Improvement associated with:

Auto prompt vs. self activate
(73 vs. 47%, $p=0.02$)

Local vs. Stock CDS
(74 vs. 28%, $p=0.001$)

Improvement in patient outcomes:

7 trials (13%)

Predictors of Improved Practice with CDS

- 48 (68%) studies showed practice improvement with CDS
- Four independent predictors of success:
 - automatic CDS
 - recommendations rather than assessments
 - CDS at the point-of-decision
 - computer based CDS

CDS Five Rights Model

To improve care outcomes with CDS you must provide:

the Right Information...

Evidence-based, useful for guiding action and answering questions

...to the Right Stakeholder...

Both clinicians and patients

...in the Right Format...

Alerts, Order Sets, answers, etc.

...through the Right Channel...

Internet, mobile devices, clinical information systems

...at the Right Point in the Workflow

to influence key decisions/actions

Case 1: CDS in the Inpatient Setting

Venous Thromboembolism Prophylaxis at Penn



Drivers

- VTE incidence rates at Penn higher than expected on national reports, particularly surgical services (ACS NSQIP)
- Joint Commission included anticoagulant safety as 1 of 16 National Patient Safety Goals for 2009 (3.05.01)
- Institute for Safe Medication Practices regional focus on anticoagulation
- Contract by Penn with major commercial payor in Philadelphia to reduce VTE incidence by 2009



General Timeline

8/2006

Anticoagulation Task Force created at Penn to develop Anticoagulation Guidelines

8/2007

Penn Anticoagulation Task Force and Center for Evidence-based Practice complete VTE prophylaxis guideline

1/2008

VTE prophylaxis guideline approved by Penn CMOs and P&T committees

4/2008

VTE prophylaxis computerized decision support developed, tested and launched

5/2009

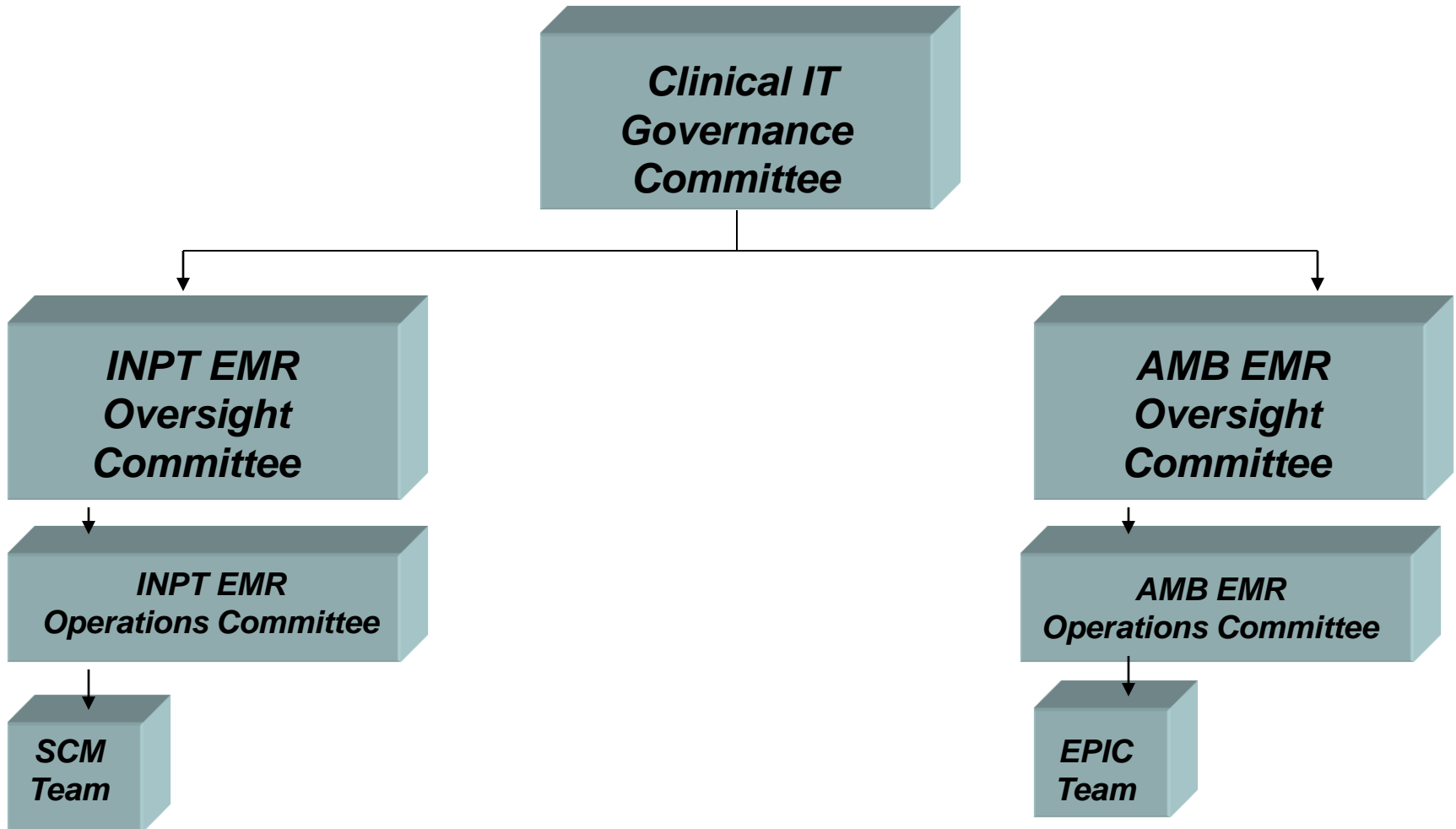
VTE prophylaxis process and outcome measures monitored using administrative and clinical databases at Penn (supported by Penn's NIH CTSA)

**Prophylaxis for Venous Thromboembolic (VTE) Disease in
Inpatients: Recommendations of the VTE Prophylaxis
Subcommittee of the UPHS Anticoagulation Taskforce in
Collaboration with the UPHS Center for Evidence-based Practice**

August 2007

Subcommittee Members: Vicente Gracias, Komal Jaipani, Emmanuel King, Mitch Laskin,
Eileen Maloney, Jodi Savitz, Denise Zappile, Todd Hecht (Chair)

Clinical IT Governance



Stakeholders in CDS Development and Implementation

- Co-Director, Center for Evidence-based Practice
- Physician Informatics Liaison
- Sunrise Team Analyst
- Pharmacy Director at HUP
- Directors of Anticoagulation Management at HUP, PPMC and PAH
- Surgical Critical Care Physician Leader
- Nursing Leader
- Quality Improvement Manager

Admit To: (HUP) - TEST, PATIENT

Order:

Requested By:

Messages:

Order ID:

Template Name:

Conditional Order Max # of activations:

STAT Assignment Required

Service Specific Room

Bed Placement:

Service:

Diagnosis:

Condition:

House Officer:

Beeper:

Attending Physician:

Additional Info:

Telemetry (This is not an Order)

Respiratory Isolation

Isolation

Police Custody

Single Rm Pt Pref

Lead Room

Chemotherapy

Single Rm Other

VTE Prophylaxis Order venous thromboembolism (VTE) prophylaxis unless patient is at low risk (has none of the below risk factors). Do not order prophylaxis if the patient is on therapeutic anticoagulation.

1. Age greater than 40 years	5. History of cancer	9. Reduced mobility
2. Recent surgery lasting 45 minutes or more	6. Obesity (BMI of 30 or greater)	10. Weakness or paralysis of one or more limbs
3. History of venous thromboembolism	7. Ongoing estrogen or antiandrogen use	11. Expected length of stay 3 days or more
4. History of hypercoagulability	8. History of varicose veins	

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Requested By: Template Name:

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Sunrise Clinical Manager

 You MUST order or decline VTE Prophylaxis

VTE Prophylaxis Order venous thromboembolism (VTE) prophylaxis if the patient meets any of the following criteria:

1. Age greater than 40 years	6. Obesity (BMI of 30 or greater)	10. Paraplegia, tetraplegia, or hemiplegia
2. Recent surgery lasting 45 minutes or more	7. Ongoing estrogen or antiandrogen use	11. Expected length of stay 3 days or more
3. History of venous thromboembolism	8. History of varicose veins	
4. History of hypercoagulability		

[If you want to order VTE prophylaxis, click here first](#)

[If you do not want to order VTE prophylaxis, click here to document a reason](#)

Relevant Results

Combined Measurements				Creatinine Clearance (Actual)	
Height (inches)	Height (cm)	Weight (lb)	Weight (kg)	Creatinine (mg/dl)	Creat Clear (actual)
<input type="text" value="68"/>	<input type="text" value="172.7"/>	<input type="text" value="150"/>	<input type="text" value="68"/>	<input type="text"/>	<input type="text"/>
Jul-08-2008 13:10		Jul-08-2008 13:10		<input type="radio"/> Actual <input type="radio"/> Estimated	

Admit To: (HUP) - TEST, PATIENT

Order: Admit To: (HUP) Order ID: 001MwWTZX
 Requested By: Umscheid, Craig A (HUP) Template Name:
 Messages:

Additional Info: Checkboxes below are bed placement parameters only. The Telemetry check box allows admissions to select the correct bed; a separate order for telemetry needs to be created for the patient

Telemetry (This is not an Order) Respiratory Isolation
 Isolation Police Custody
 Single Rm Pt Pref Lead Room
 Chemotherapy Single Rm Other

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 Select or type in reason *

Relevant Results

Combined Measurements

Height (inches)	Height (cm)	Weight (lb)	Weight (kg)	BSA	BMI
64	162.6	160	72.7	1.78	27.5
Sep-17-2008 13:55		Sep-17-2008 13:55			

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Creatinine (mg/dl)	Creat Clear (actual)

Actual Estimated

enoxaparin contraindicated when creatinine clearance is less than 30

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Select or type in reason *

- Patient has none of the above risk factors
- Patient is on therapeutic anticoagulation

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If you want to order VTE prophylaxis, click here first If you do not want to order VTE prophylaxis, click here to document a reason

Please proceed to the VTE Prophylaxis order set by clicking OK. Order NON-pharmacologic therapy if any of the following contraindications apply.

Pharmacologic contraindications

1. Active or recent bleeding	5. History of HIT or allergy to heparin
2. Known bleeding disorder or coagulopathy (INR greater than 2)	6. Creatinine clearance less than 30 mL/min (ONLY for enoxaparin use)
3. Patient on therapeutic anticoagulation with heparin or warfarin	7. Pregnancy (ONLY for warfarin use)
4. Platelet count less than 50,000	8. Epidural catheter/hematoma

Relevant Results

Combined Measurements				BSA	BMI
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SPECIFIC PHARMACOLOGIC CONTRAINDICATIONS: enoxaparin contraindicated in patients with an epidural catheter/hematoma or creatinine clearance less than 30; warfarin contraindicated in pregnancy

MEDICINE AND NEUROLOGY

	Use unfractionated heparin or enoxaparin	Dose	Units	Route	Frequency
[-] Order CBC for all on heparins - 4 item(s)					
<input type="checkbox"/>	Heparin Injection	5	Thou...	Subcutaneous	Every 8 Hours
<input type="checkbox"/>	Enoxaparin Injection 40 mg	40	mg	Subcutaneous	Daily
<input type="checkbox"/>	Intermittent Compression Device.				
<input type="checkbox"/>	CBC- w/out Diff (Heme Profile)				

ACUTE ISCHEMIC STROKE

	Use enoxaparin or unfractionated heparin	Dose	Units	Route	Frequency
[-] Order CBC for all on heparins - 5 item(s)					
<input type="checkbox"/>	Enoxaparin Injection 40 mg	40	mg	Subcutaneous	Daily
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HIP FRACTURE SURGERY

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<input type="checkbox"/>	Heparin Injection	5	Thou...	Subcutaneous	Every 8 Hours
<input type="checkbox"/>	Warfarin Tablet 5 mg-HUP	1		PO	Once
<input type="checkbox"/>	Intermittent Compression Device.				
<input type="checkbox"/>	CBC- w/out Diff (Heme Profile)				

TOTAL HIP AND KNEE REPLACEMENT SURGERY

	Use enoxaparin or warfarin	Dose	Units	Route	Frequency
[-] Order CBC for all on heparins - 4 item(s)					
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TRAUMA AND SPINAL CORD INJURY

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VASCULAR SURG (no heparins until POD2-3)

	Use unfractionated heparin or enoxaparin	Dose	Units	Route	Frequency
[-] Order CBC for all on heparins - 4 item(s)					
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NEUROSURGERY

	Use heparin or enoxaparin per NSG.01 CPG	Dose	Units	Route	Frequency
[-] Order CBC for all on heparins - 5 item(s)					

ALL OTHER SURGERY

	Use heparins except for transurethral surgery	Dose	Units	Route	Frequency
[-] Order CBC for all on heparins - 4 item(s)					

SPECIFIC PHARMACOLOGIC CONTRAINDICATIONS: enoxaparin contraindicated in patients with an epidural catheter/hematoma or creatinine clearance less than 30; warfarin contraindicated in pregnancy

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Combined Measurements

Height (inches)	Height (cm)	Weight (lb)	Weight (kg)	BSA	BMI
64	162.6	160	72.7	1.78	27.5

Sep-17-2008 13:55 Sep-17-2008 13:55

Creatinine Clearance (Actual)

Creatinine (mg/dl)	Creat Clear (actual)

Actual
 Estimated

SPECIFIC PHARMACOLOGIC CONTRAINDICATIONS: enoxaparin contraindicated in patients with an epidural catheter/hematoma or creatinine clearance less than 30; warfarin contraindicated in pregnancy

MEDICINE AND NEUROLOGY

	Use unfractionated heparin or enoxaparin	Dose	Units	Route	Frequency
[-] Order CBC for all on heparins - 4 item(s)					
<input type="checkbox"/>	Heparin Injection	5	Thou...	Subcutaneous	Every 8 Hours
<input type="checkbox"/>	Enoxaparin Injection 40 mg	40	mg	Subcutaneous	Daily
<input type="checkbox"/>	Intermittent Compression Device.				
<input checked="" type="checkbox"/>	CBC- w/out Diff (Heme Profile)				

ACUTE ISCHEMIC STROKE

	Use enoxaparin or unfractionated heparin	Dose	Units	Route	Frequency
[-] Order CBC for all on heparins - 5 item(s)					
<input type="checkbox"/>	Enoxaparin Injection 40 mg	40	mg	Subcutaneous	Daily
<input type="checkbox"/>	Heparin Injection	5	Thou...	Subcutaneous	Every 8 Hours
<input type="checkbox"/>	Heparin Injection	5	Thou...	Subcutaneous	Every 12 Hours
<input type="checkbox"/>	Intermittent Compression Device.				
<input checked="" type="checkbox"/>	CBC- w/out Diff (Heme Profile)				

HIP FRACTURE SURGERY

	Use enoxaparin unless contraindicated	Dose	Units	Route	Frequency
[-] Order CBC for all on heparins - 5 item(s)					
<input checked="" type="checkbox"/>	Enoxaparin Injection 30 mg	30	mg	Subcutaneous	Every 12 Hours
<input type="checkbox"/>	Heparin Injection	5	Thou...	Subcutaneous	Every 8 Hours
<input checked="" type="checkbox"/>	Warfarin Tablet 5 mg-HUP	1		PO	Once
<input type="checkbox"/>	Intermittent Compression Device.				
<input checked="" type="checkbox"/>	CBC- w/out Diff (Heme Profile)				

TOTAL HIP AND KNEE REPLACEMENT SURGERY

	Use enoxaparin or warfarin	Dose	Units	Route	Frequency
[-] Order CBC for all on heparins - 4 item(s)					
<input type="checkbox"/>	Enoxaparin Injection 30 mg	30	mg	Subcutaneous	Every 12 Hours
<input checked="" type="checkbox"/>	Warfarin Tablet 5 mg-HUP	1		PO	Once
<input type="checkbox"/>	Intermittent Compression Device.				
<input checked="" type="checkbox"/>	CBC- w/out Diff (Heme Profile)				

TRAUMA AND SPINAL CORD INJURY

	Use enoxaparin unless contraindicated	Dose	Units	Route	Frequency
[-] Order CBC for all on heparins - 4 item(s)					
<input type="checkbox"/>	Enoxaparin Injection 30 mg	30	mg	Subcutaneous	Every 12 Hours
<input type="checkbox"/>	Heparin Injection	5	Thou...	Subcutaneous	Every 8 Hours
<input type="checkbox"/>	Intermittent Compression Device.				
<input checked="" type="checkbox"/>	CBC- w/out Diff (Heme Profile)				

VASCULAR SURG (no heparins until POD2-3)

	Use unfractionated heparin or enoxaparin	Dose	Units	Route	Frequency
[-] Order CBC for all on heparins - 4 item(s)					
<input type="checkbox"/>	Intermittent Compression Device.				
<input type="checkbox"/>	Heparin Injection	5	Thou...	Subcutaneous	Every 8 Hours
<input type="checkbox"/>	Enoxaparin Injection 40 mg	40	mg	Subcutaneous	Daily
<input checked="" type="checkbox"/>	CBC- w/out Diff (Heme Profile)				

NEUROSURGERY

	Use heparin or enoxaparin per NSG.01 CPG	Dose	Units	Route	Frequency
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ALL OTHER SURGERY

	Use heparins except for transurethral surgery	Dose	Units	Route	Frequency
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Impact of CDS on VTE Prophylaxis

Medicine Service						
	HUP		PPMC		PAH	
Prophylaxis Type	Pre	Post	Pre	Post	Pre	Post
Recommended (%)	37.0	45.8	36.3	44.9	9.7	41.5
Any Pharmacologic (%)						
Any Prophylaxis (%)						

Impact of CDS on VTE Prophylaxis

Orthopedics and Trauma Services

	HUP		PPMC		PAH	
Prophylaxis Type	Pre	Post	Pre	Post	Pre	Post
Recommended (%)	32.6	37.6	34.8	42.5	56.5	57.2
Any Pharmacologic (%)						
Any Prophylaxis (%)						

Impact of CDS on VTE Prophylaxis

Other Surgical Services						
	HUP		PPMC		PAH	
Prophylaxis Type	Pre	Post	Pre	Post	Pre	Post
Recommended (%)	26.0	39.6	31.0	48.0	10.1	25.1
Any Pharmacologic (%)						
Any Prophylaxis (%)						

SCIP Measures for VTE Prophylaxis

Ordering and Timely Administration of Appropriate VTE Prophylaxis Before and After Decision Support (%)										
	Before					After				
	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug
HUP										
Ordering	100	100	100	97	100	95	94	100	100	100
Timely Admin	100	100	96	97	100	92	91	98	100	95
PPMC										
Ordering	49	61	61	53	60	95	98	100	99	92
Timely Admin	49	61	61	53	60	95	98	99	99	92

Impact of CDS on DVT/PE

DVTs and PEs at Penn Hospitals Before and After Decision Support (%)			
	4/07-3/08	4/08-9/08	Goal
DVT	1.64	1.55	1.63
PE	0.53	0.53	0.53
DVT or PE	2.11	1.90	2.09

Impact of CDS on Safety Measures

Percent of Patients with Critical PTTs (>100)					
Pre			Post		
Hospital	N	%	N	%	
HUP	2080	8.44	999	5.95	
PAH	448	3.13	217	2.43	
PPMC	1004	10.10	460	6.65	
UPHS	3532	7.22	1676	5.13	

Impact of CDS on Safety Measures

Percent of Patients on Prophylactic LMWH with Renal Contraindications (CrCl < 30)					
Pre			Post		
Hospital	N	%	N	%	%
HUP	14	1.65	20	1.28	1.28
PAH	24	6.40	36	6.37	6.37
PPMC	28	4.33	26	3.32	3.32
UPHS	66	3.59	82	3.23	3.23

Type of Prophylaxis Ordered Stratified by User Response to CDS

Prophylaxis Type	Responded Yes to VTE Order (%)	Responded No to VTE Order (%)
Recommended	53.8	6.8
Any Pharmacologic	90.0	35.4
Any Prophylaxis	65.8	21.4
No Prophylaxis	10.0	64.6

Reasons for Not Ordering VTE Prophylaxis

Reason	N	%
No risk factors	11275	66.8
Therapeutic Anticoagulation	4320	25.6
Research Protocol	284	1.7
Other	988	5.9

Case 2: CDS in the Outpatient Setting

Overview

Outpatient CDS experiments

1. Education
2. Reminders
3. Audit and feedback
4. Comparisons of clinical performance between peers
5. Institutional incentives

Overview

Outpatient CDS experiments

1. Education – **WHY** – easy; **HOW** - hard
2. Reminders – **fatigue vs. ignore passive**
3. Audit and feedback – **Making it Useful**
4. Comparisons of clinical performance between peers - **TEAMS**
5. Institutional incentives – **the CATALYST**

Education: Oliveria

- **Guideline -> Practice**
- **Most people (2/3) know guideline (WHY), just too busy / distracted to follow**

Education: experiential

- All Quality improvement exercises should be educational (e.g., audit and feedback as educational vs. accountable)
- Combining practical with

Reminders:

- **Active** : higher success *initially*
- **Fatigue** : start ignoring > 80%
- **Passive** : 1 example that works (worksheet), 1 that does not (mammogram)

Patient Worksheet

Mammogram alert

Audit / feedback + education

- **Resident training practice for Chronic illness management**
- **Curriculum for**
 - **QI / Population management**
- **Process**
 - **Registry review with data from practice**
 - **PDSA cycles with improvements**
- **Team-based**

Audit / feedback examples

Competition – educational teamwork

Institutional incentives: CATALYST

- **At an academic medical center: do people listen to the outpatient generalists?**
- **What talks?**
 - **Money**
 - **Satisfaction**
 - **Reputation**
 - **Accountable quality metrics**
 - **All require data**

Money: payment reform

- **Advanced medical home performance measurement**
- **Physician Quality Reporting Initiative**

Satisfaction: care management

Case 3: CDS in the Research Setting

Measuring the Impact of Clinical Decision Supports

CDS Impact

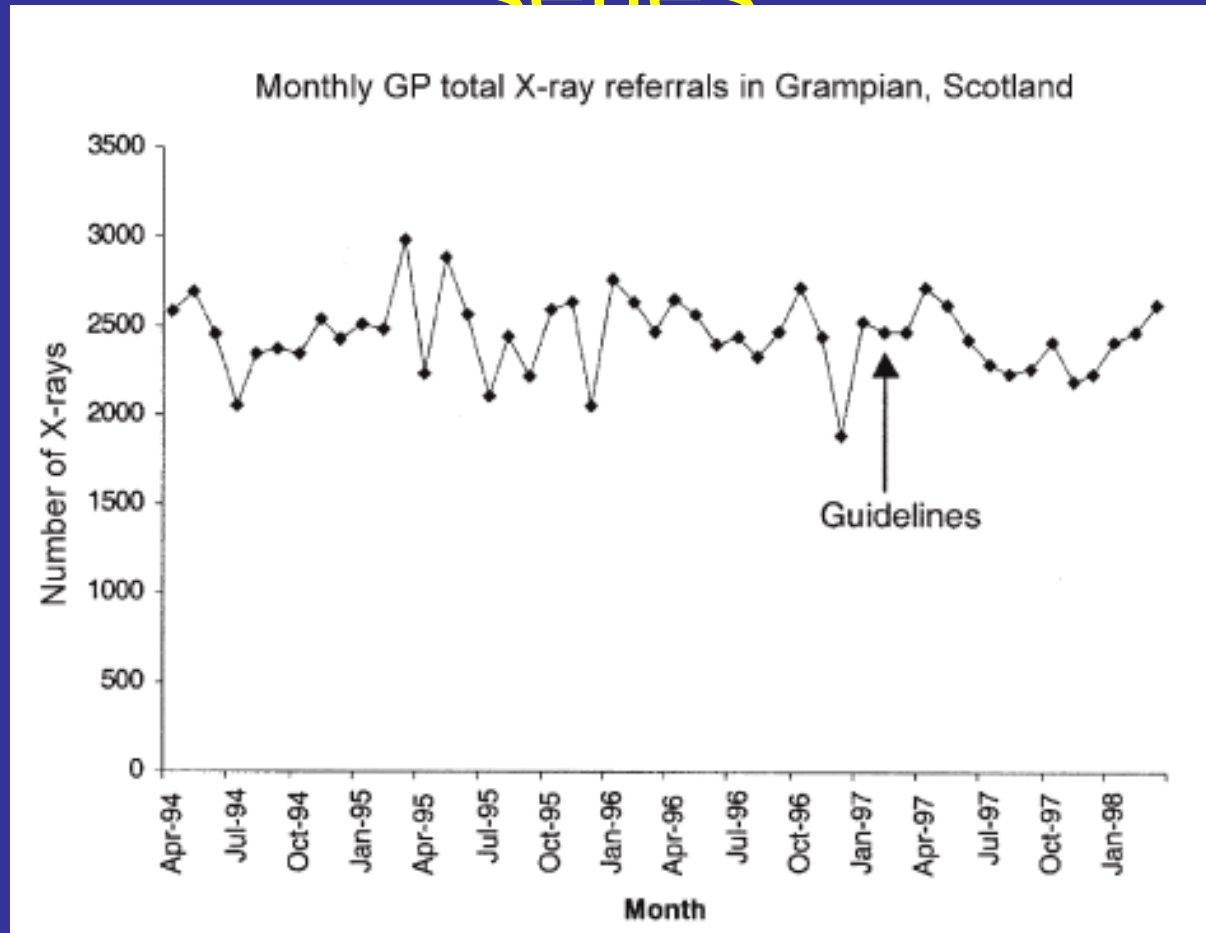
- Most common
 - Uncontrolled before-after study at single site
- Evidence pyramid



CDS Impact

- Preferred alternatives
 - Randomized Controlled Trials
 - Practical designs
 - Time-series design
 - Multiple time periods before and after to assess baseline variations more accurately
 - Controlled before-after design
 - Multiple comparable sites, some with intervention and some without

Monitoring implementation: time-series



Matowe et al. Clinical Radiology. 2002

Monitoring implementation: controlled before-after

Hospital Ward	Infection rate BEFORE	Infection rate AFTER
Intervention	50%	25%
Control 1	50%	50%
Control 2	50%	25%

Wrap Up

Communication Network:

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Session Evaluation

Additional Resources

- National CDS Roadmap
 - <http://www.jamia.org/cgi/content/abstract/14/2/141>
- CDS Implementation Guide for Providers
 - Improving Medication Use and Outcomes with Clinical Decision Support: A Step-by-Step Guide. Osheroff JA, ed. 2009. Healthcare Information Management and Systems Society.
 - (www.himss.org/cdsguide)
- Recent Systematic Reviews on CDS
 - Garg AX et al. Effects of Computerized Clinical Decision Support Systems on Practitioner Performance and Patient Outcomes: A Systematic Review. *JAMA*. 2005; 293: 1223-1238.
 - Kawamoto K et al. Improving Clinical Practice Using Clinical Decision Support Systems: A Systematic Review of Trials to Identify Features Critical to Success. *BMJ*. 2005.