

Medicare 646 program aims

- Fulfill IOM 2001 goals: safety, effectiveness, efficiency, patient-centeredness, timeliness and equity
- Adoption and use of decision support tools by physicians and their patients, such as evidence-based medicine guidelines, best practice guidelines, and shared decision-making programs;





*Clinical Decision Support:
Improving Safety, Efficiency, and
Quality of Care*

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The Case for CDS

- 1 in 15 inpatient admissions include a significant adverse drug event
- Adverse drug events occur in up to 18% of ambulatory patients/yr (Gandhi, Honigman)
- 6% of admissions are caused by an ADE
- Preventable medication errors cost \$2B/year
- Poor medication utilization costs another \$27B
- CDS reduces adverse events by 55% (inpt)/60-70% (ambulatory)



1. Reactive Alerts

iCare

Stephen Brooks

Recent Patients: Shah, James 1 item to SIGN

Shah, James 67y Male DOB: 07/18/1936

Major warning summary

WARNING: You are prescribing aspirin PO.

Warnings noted - Continue Rx **Cancel Rx**

Therapeutic Duplication for ASPIRIN.

An active order for **aspirin** exists and may represent therapeutic duplication by category **nonsteroidal anti-inflammatories**

Continue Rx **Cancel Rx**

Therapeutic Duplication for NAPROXEN.

Major Drug-Drug interaction aspirin + warfarin.

GENERALLY AVOID: Aspirin, even in small doses, may increase the risk of bleeding in patients on oral anticoagulants by inhibiting platelet aggregation and inducing gastrointestinal lesions.
MANAGEMENT: Aspirin-containing products, including topical products, should be avoided in patients on anticoagulants. Alternatively, a lesser degree of anticoagulation, if feasible, may allow aspirin and an oral anticoagulant to be safely combined. Patients should be advised to promptly report any signs of bleeding to their physician, including pain, swelling, headache, dizziness, weakness, prolonged bleeding from cuts, increased menstrual flow, vaginal bleeding, nosebleeds, bleeding of gums from brushing, unusual bleeding or bruising, red or brown urine, or red or black stools. Patients should also be counseled to avoid any other over-the-counter salicylate products. [View References](#)

Continue Rx **D/C existing warfarin** **Cancel Rx**

Done Internet



2. Documentation Templates

History | Multi-System Exam | Medical Decision Making

Established patient New patient Consult Referring physician:

CC/HPI: (Location, Quality, Duration, Timing, Severity, Context, Modifying Factors, Associated Signs & Symptoms)
CONSULT/NEW: LVL 5,4,3(>=4); LVL 2,1(<=3)
EST: LVL 5,4(>=4); LVL 3,2(<=3); LVL 1(N/A)

Medications: PERCOCET 5-325 MG OR TABS
METHADONE HCL 10 MG OR TABS
LOPRESSOR 50 MG OR TABS
ZETIA 10 MG OR TABS

Allergies: Verified on 10/24/1998
No Known Allergie

Review of system: CONSULT/NEW: LVL 5, 4 (10); LVL 3(2); LVL 2 (1); LVL 1(0)
EST: LVL 5(10); LVL 4(2); LVL 3(1); LVL 2(0); LVL 1 (N/A) Remainder ROS negative

	NL	Comments (positives or pertinent negs)		NL	Comments (positives or pertinent negs)
Constitutional	<input type="checkbox"/>		Musculoskeletal	<input type="checkbox"/>	
Eyes	<input type="checkbox"/>		Skin	<input type="checkbox"/>	
Ears/Nose/Mouth/Throat	<input type="checkbox"/>		Neurologic	<input type="checkbox"/>	
Respiratory	<input type="checkbox"/>		Psychiatric	<input type="checkbox"/>	
Cardiovascular	<input type="checkbox"/>		Endocrinologic	<input type="checkbox"/>	
Gastrointestinal	<input type="checkbox"/>		Hematologic	<input type="checkbox"/>	
Genitourinary	<input type="checkbox"/>		Immuno/Lymph	<input type="checkbox"/>	

Family history: Patient's family history
None on file

Social history: wife is post menopausal/Social History
Marital Status: MARRIED Spouse Name
Years of Education: Number of childre

Past medical/surgical history: There is no previous medical history on file.
There is no previous surgical history on file.

Gynecologic History:
L.P. : 12:00:00 AM Cycle length/interval: Birth control method:
Last mammo: Last pap:

Accept Cancel

3. Relevant Data Display

Software interface showing a schedule table with columns: Time, Patient, Status, Age, MRN #, Length, Type. The table lists four patients: Daniel (90 Yrs, PENDING), Pauline G (74 Yrs, ARRIVE), Charles F (70 Yrs, PENDING), and Ellen (88 Yrs, PENDING). Above the table is a toolbar with icons for Show Orders, Enc Summary, Print AVS, No Show, SnapShot, Review, Scans, and Dictations.

Time	Patient	Status	Age	MRN #	Length	Type
08:40 A...	[REDACTED] Daniel	PENDING	90 Yrs	[REDACTED]	20	RETU
09:00 A...	[REDACTED] Pauline G	ARRIVE	74 Yrs	[REDACTED]	20	RETU
09:00 A...	[REDACTED] Charles F	PENDING	70 Yrs	[REDACTED]	20	RETU
09:20 A...	[REDACTED] Ellen	PENDING	88 Yrs	[REDACTED]	20	RETU

4. Order Creation Facilitators

Order Set Summary

Order Set: Chest Pain High Risk Orders PMC

Order Items

- Admit To: [PMC] - CCU
- Vital Signs - Every 1 Hour
- Activity - Bedrest
- Precautions:
- Call Physician For: - Routine
Blood Glucose < 70 or > 400 mg/dL
Chest Pain
Open form if .. / Temp > 101.0 degrees F
- Food & Nutrition Services**
- NPO Past 00:01
- Cardiac Na 3-4 GM/Chol/Fat Controlled
- Diabetic 1800 Calorie - If Diabetic
- Nursing**
- Monitor For: - Continuous ECG
- IV - PMC - NSS: Flush Q 12 Hours
- Weigh Patient - On Admission
- I&O (Strict) - On Admission
- Educate Patient - on No Smoking
- Laboratory - If Not Done in ED**
- CK Isoenzymes - MD/RN to Collect
- Troponin-I - MD/RN to Collect STAT

5. Time-Based Checks & Pathways

Path Order Help					
ALL 2993 - Induction Phase 1					
Close					
	Day 14	Day 15	Day 16	Day 17	Day 18
	Day 14 Start of Chemotherapy +13	Day 15 Start of Chemotherapy +14	Day 16 Start of Chemotherapy +15	Day 17 Start of Chemotherapy +16	Day 18 Start of C
Chemotherapy		Ondansetron Tablet 24 mg. Ch...		Asparaginase Skin Test - Giv...	
		DAUNOrubicin injection(Undilu...		Asparaginase Skin Test Contr...	
		Vincristine Sulfate injection - ...		Diphenhydramine 25 mg cap/t...	
		Methotrexate (intrathecal) (Un...		Acetaminophen Tablet 325 mg...	
				Asparaginase injection - Give:...	



6. Context-Sensitive Reference Info

The screenshot shows a medical software interface with a navigation sidebar on the left and a main content area. The sidebar includes links for Home, Message Center, Patient Records, Patient Search, What's New?, Demographics, Lists, Summary, Problems, Medications, Allergies, End of Visit, Reference Library, Personalized News, Clinical, Administration, Preferences, and Logout. At the bottom of the sidebar, there is a user ID: ID = 1000000111, name: e = phil, and other identifiers: = 1, = 13.

The main content area is titled "Prescription Page" and displays a warning: **WARNING: Drug-Drug interaction (DDI)**. Below the warning, there are three entries: "Moderate DDI - atenolol + Ampicillin. [More Info](#)", "Moderate DDI - atenolol + Warfarin. [More Info](#)", and "Moderate DDI - atenolol + aspirin. [More Info](#)".

The prescription details are as follows: Med Name: atenolol, Route: PO. The Rx form includes fields for Strength/form (100 mg tablet), Disp (30), Refills (0), and Start Date (07/20/2000). The Sig is 1 TAB QD For 30 day(s). There are checkboxes for PRN, Alternating, Variable, Taper, Instruction, Prescription, Print Patient leaflet, Print Rx, No substitutes, and Add to favorites. A "Tell Me More About ..." dropdown menu is open, showing options: Multum Drug Monograph, All, Brand Names, Category, Pharmacology, Side Effects, Warnings, Pregnancy, and Lactation. Buttons for "Cancel" and "Done" are visible at the bottom right.



atenolol

Side Effects

Cardiovascular: Cardiovascular side effects occur in less than 3% of patients, and include bradycardia, hypotension, precipitation of heart failure, and cold extremities. Less than 1% of patients report flushing symptoms. These side effects may require discontinuation of therapy or dosage reduction. The use of atenolol may be associated with reduced HDL cholesterol and increased total cholesterol. These changes may be deleterious in some patients with heart disease.

Gastrointestinal: Gastrointestinal side effects include diarrhea and nausea in 2% and 4% of patients, respectively. Retroperitoneal fibrosis has rarely been associated with atenolol.

Hepatic: Hepatic dysfunction has rarely been associated with atenolol.

Hypersensitivity: Hypersensitivity reactions are rare.

Neurological: Nervous system side effects, such as complaints of sleep disturbances, depression, and headache occur in up to 4% of patients. Nervous system side effects are less common than with some beta-

Philip M. New

Change Patient

Garcia, Sergio M

hives; **dust**, sneezing; **Morphine**, nausea;

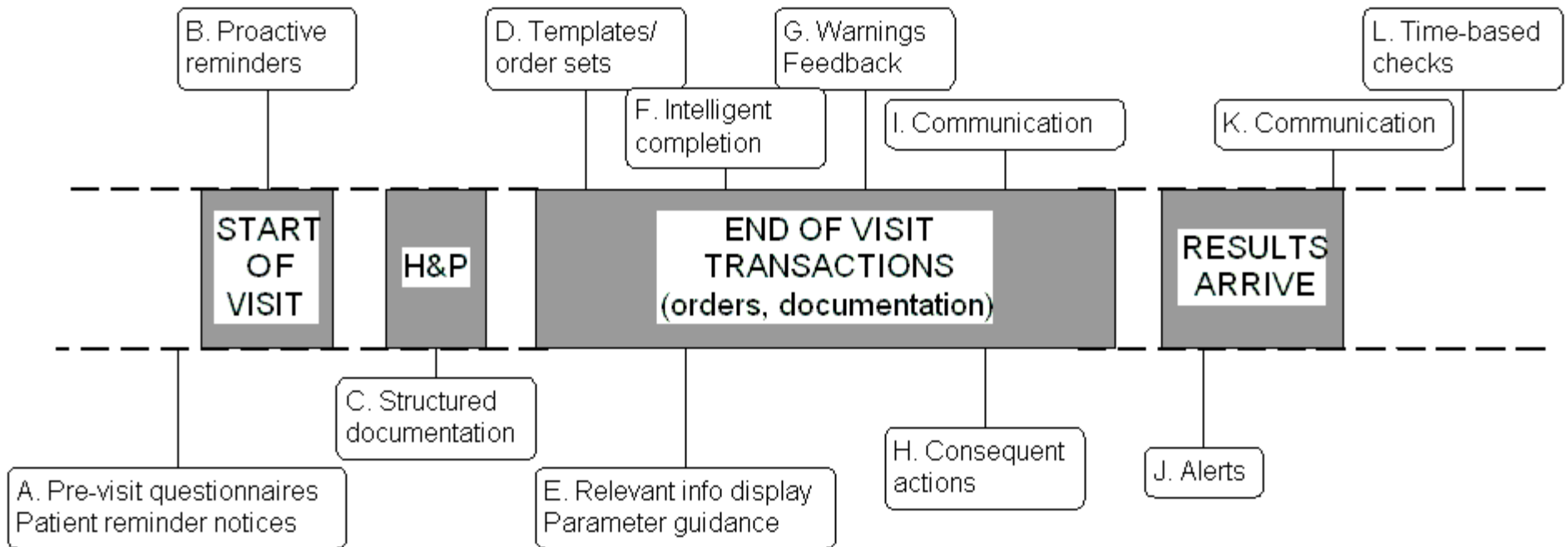
cillin. [More Info](#)

arin. [More Info](#)

- st Results
- tes
- d of Visit
- pointments
- ssages
- Reference Library
- Personalized News
- Clinical
- Administration
- ferences
- Logout

Strength/form	Disp	Refills	Start Date	
Rx 100 mg tablet		0	5/9/2000	Change date
Dose	Frequency	Duration		
Sig: 1 TAB	QOD	For [] day(s)	<input type="checkbox"/> PRN	
Other dose options:				
<input type="radio"/> Alternative <input type="radio"/> Variable <input type="radio"/> Taper				
<input type="checkbox"/> Instruction		Tell Me More About ...		
<input checked="" type="checkbox"/> Prescription	<input type="checkbox"/> Print Patient leaflet	View patient leaflet	<input checked="" type="radio"/> English	<input type="radio"/> Spanish
<input type="checkbox"/> Print Rx	<input type="checkbox"/> No substitutes			

Opportunities for CDS



Needed info + simple suggestions

ViewOrders PtLookup Feedback Help Goodbye
JTTEST, JON 36F 11111111 Adm: 11/01/91 Room: 17A-117

(*)New Medication Name DOSE: GENTAMICIN IV
Route

< dose List >

ALTERNATE DAYS ▲
VARIABLE
40 MG
60 MG
70 MG
80 MG
90 MG
100 MG
120 MG ▼

D Dose: []
F Frequency: []
T Start Time: [TODAY]
U Duration: [] Days
P PRN []
H Hold if: []
I Instructions:

ALLERGIES: BACTRIM, MORPHINE,
-----RECENT LABS-----
GENT: ---
CRE: 1.0# 08/03/95

Ok Cancel

Move to desired choice with mo



Appropriate test utilization

ViewOrders PtLookup Feedback Help Goodbye

KUB (supine only) Indications

Relevant History (please enter primary reason first):

[JA Nausea & Vomiting	[IE Acute abdomen	[II Renal colic
[IB N		ion
[IC H		leus
[ID F		
[IO O		

Comment on Indications

Please consider the following:
If you suspect appendicitis, a KUB is unlikely to change management. Appendicolith is found in approximately 1% of KUBs. If a question exists about appendicitis, consider U/S.

Direct comments to David Bates, M.D. x7063

Cancel order Continue with order

Ok

Enter Relevant



Chemotherapy safety

[ViewOrders](#) [PtLookup](#) [Feedback](#) [Help](#) [Goodbye](#)
 TEST,TEST 34F 00000000 Adm: 11/01/91 Room:

Chemotherapy Orders --(page 3)
Chemotherapy Drugs

		Freq	Days/Doses
B		1	1,3
A		1	2,4,6
B		1	1,2,3,4,5,
C		1	
D		1	
E		1	
F		1	
G		1	
H		1	

WARNING -- HIGH CHEMOTHERAPY DOSE

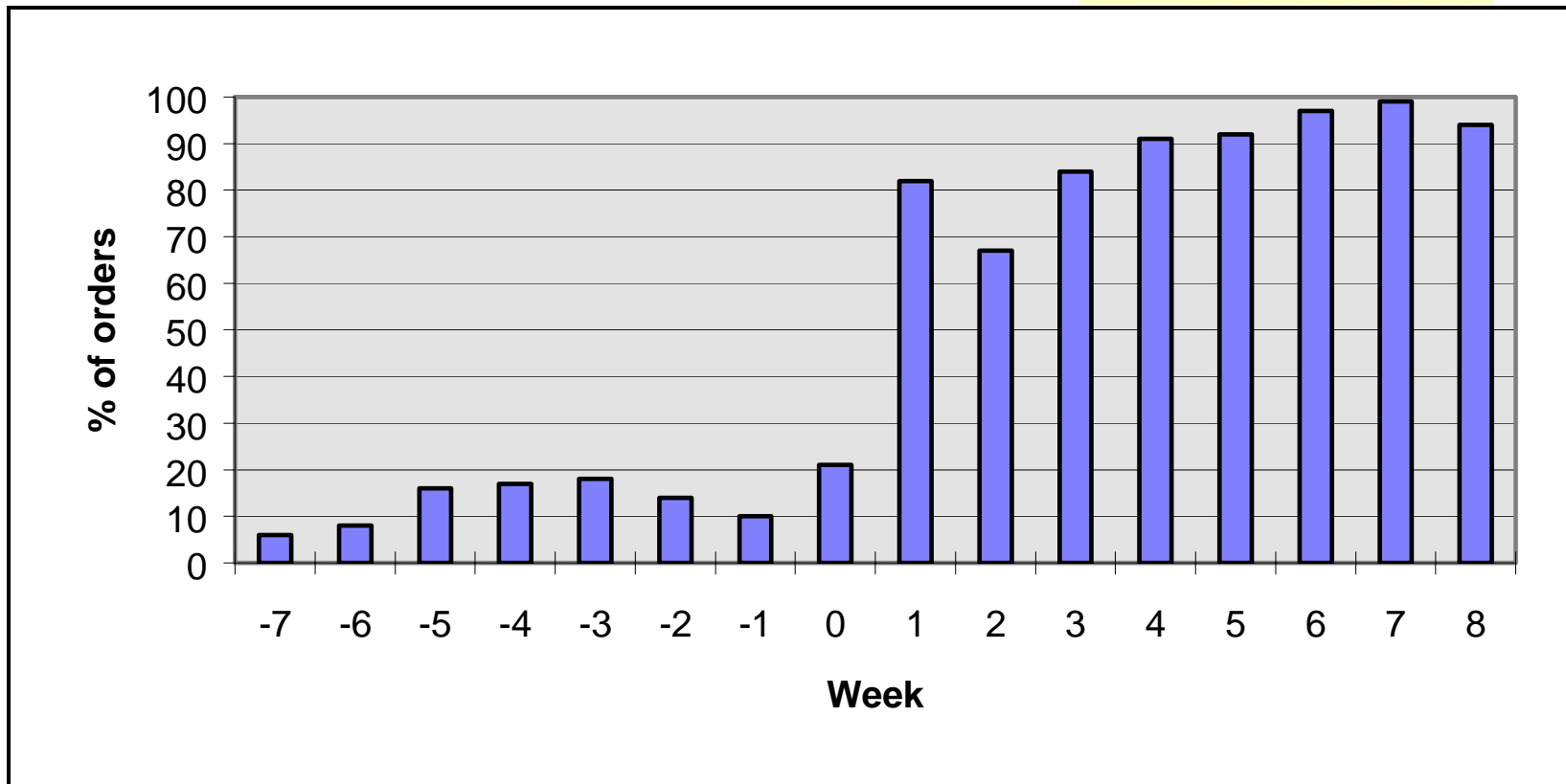
1989mg/m² x1 exceeds the daily maximum dose limit of
 1000mg/m² for FLUOROURACIL
 Are you sure about this order?

rders



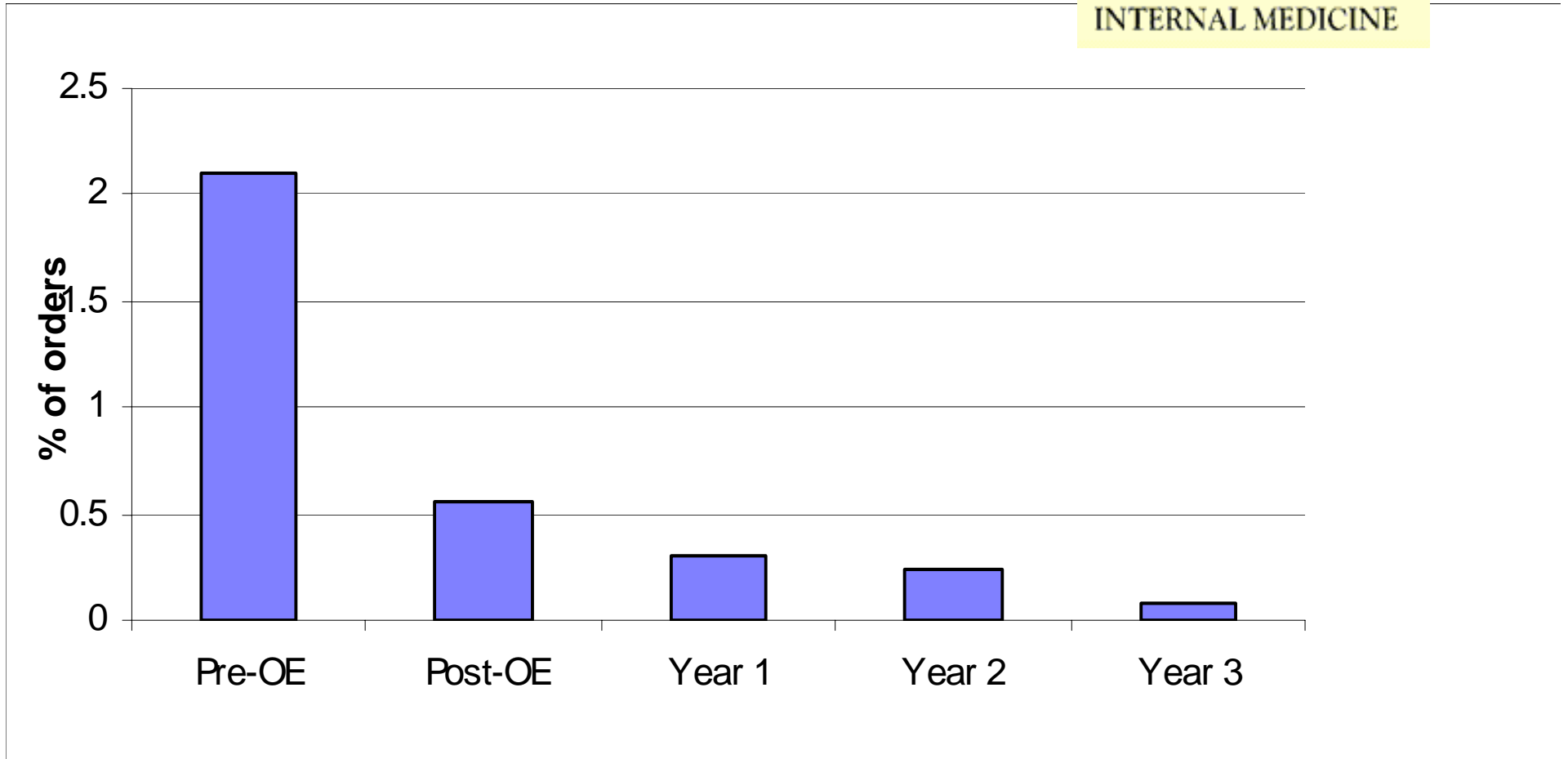
Impact: use of recommended drug

ARCHIVES
OF
INTERNAL MEDICINE



Teich, Merchia, et. al., Arch. Int. Med., 2000

Excessive doses





How-to: Implementation and Management

1. Computers can do wonderful things for healthcare.
2. #1 doesn't apply if nobody uses the computers.





Design: Make it usable first

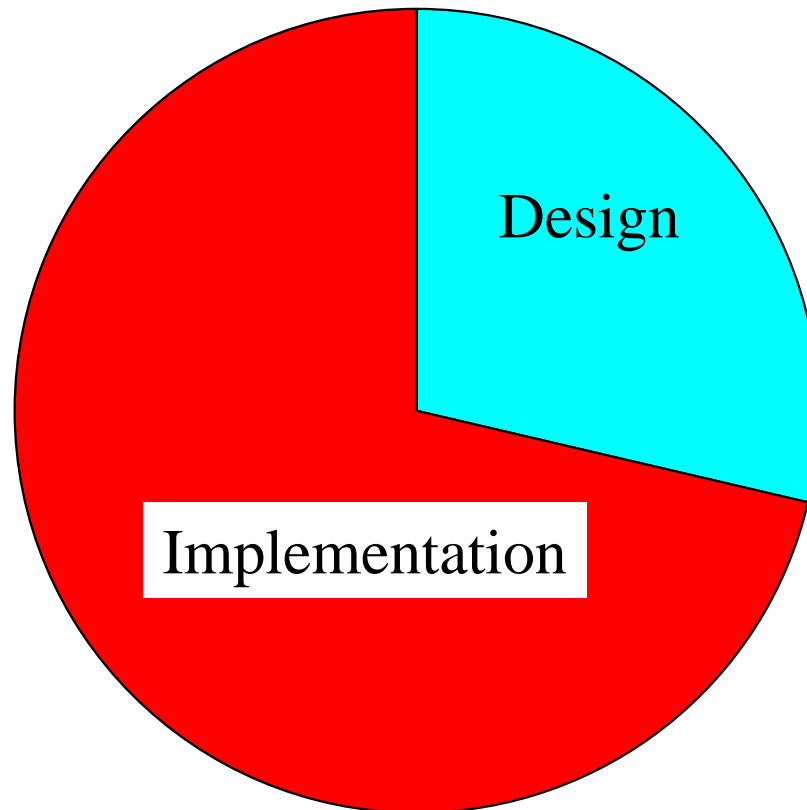
- Make the computer a friend first
- *Clinically-oriented* display & entry
- Support typical practice patterns
- Enhance workflow

Add high-value safety features *after* the system has been accepted!

Where did CDS produce change?

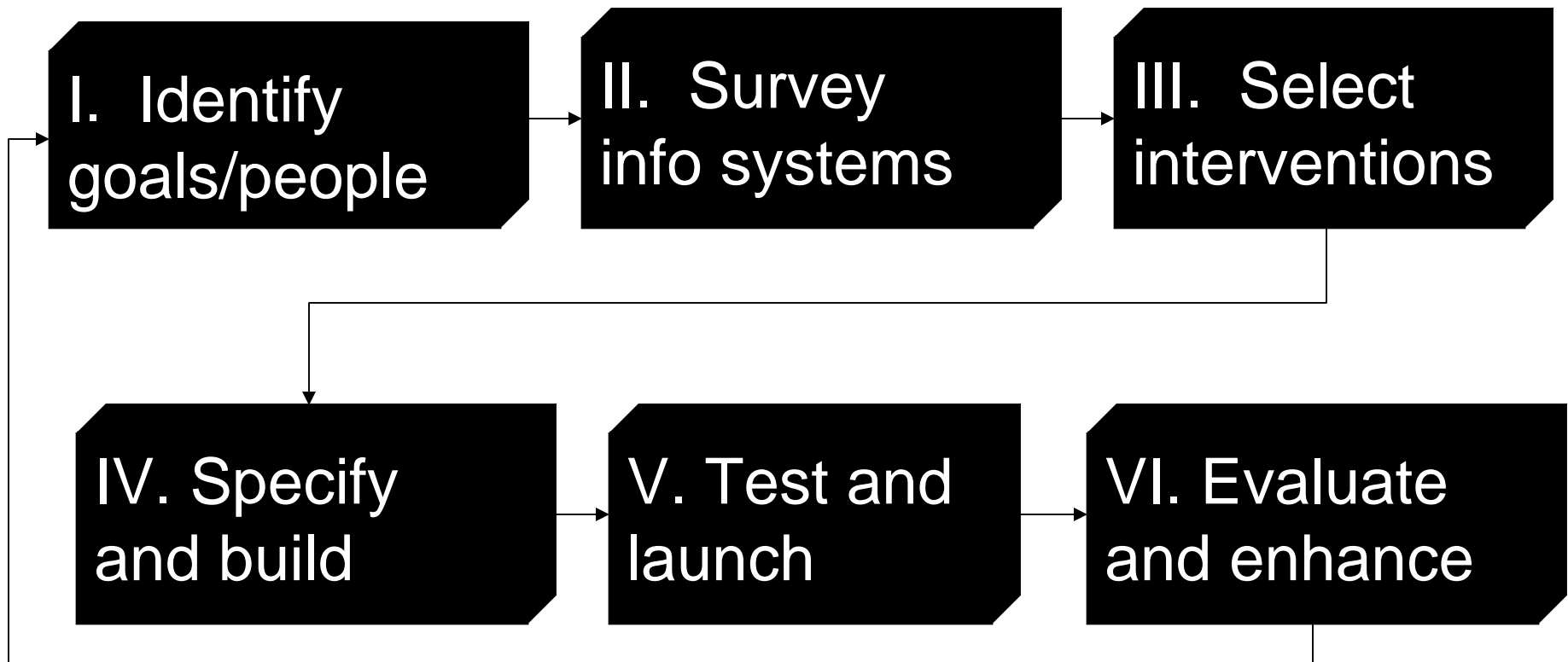
- Showing errors without changing basic care plan – well accepted
- Changing care plans – less well accepted
- *Proactive* care plan changes are acceptable
- CDS needs to appear within the normal workflow

 *Implementation: takes time & effort*





Steps to successful CDS





Enablers

- Avoid reinventing the CDS wheel in every site
- Make it easy for new knowledge to be incorporated
- Legal protection for use of CDS
- Financial incentives
- CDS-based certification to guide above



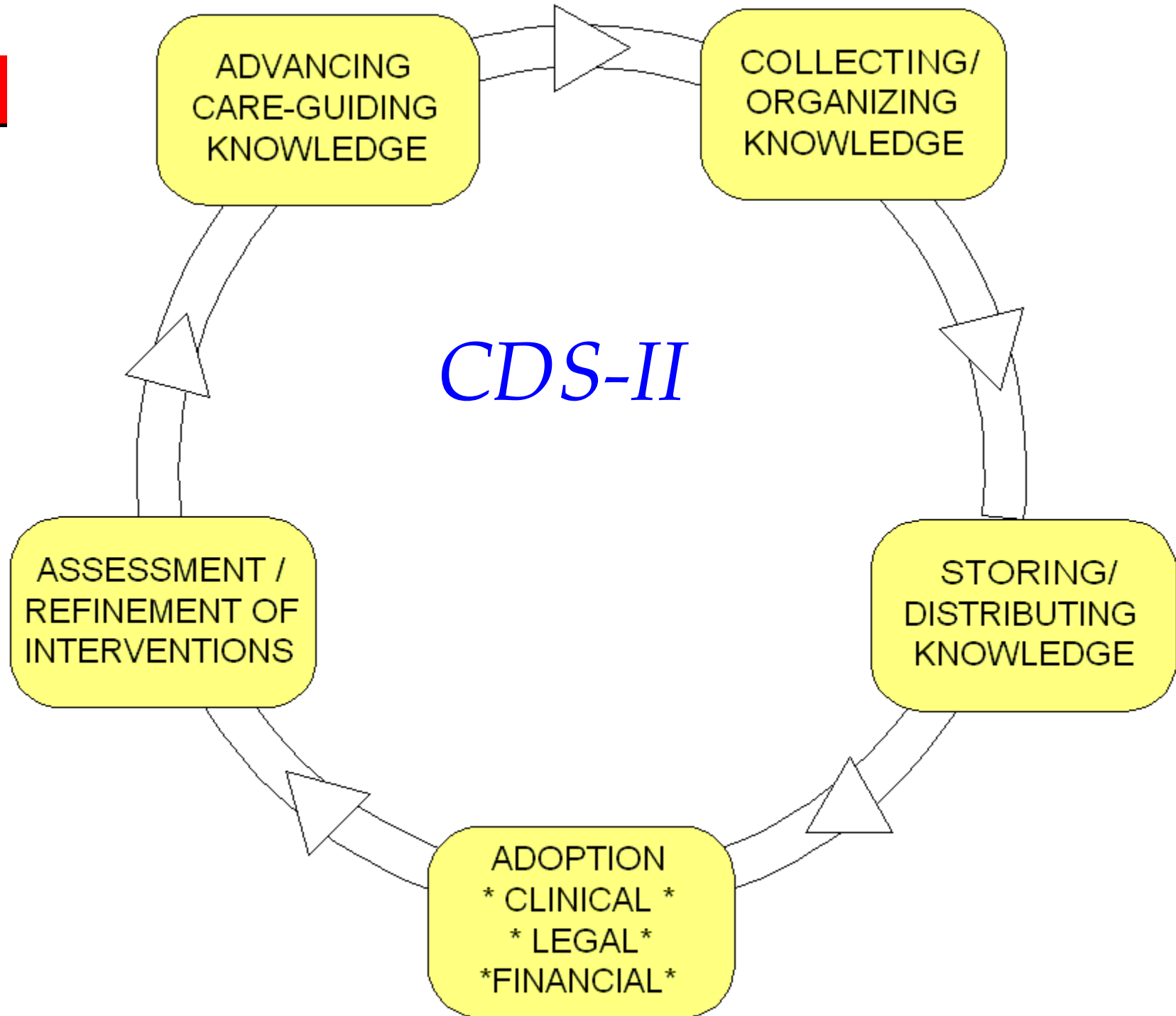
AMIA Position Paper ■

Clinical Decision Support in Electronic Prescribing: Recommendations and an Action Plan: Report of the Joint Clinical Decision Support Workgroup

JONATHAN M. TEICH, MD, PhD, JEROME A. OSHEROFF, MD, ERIC A. PIFER, MD, DEAN F. SITTIG, PhD,
ROBERT A. JENDERS, MD, MS, THE CDS EXPERT REVIEW PANEL

Abstract Clinical decision support (CDS) in electronic prescribing (eRx) systems can improve the safety, quality, efficiency, and cost-effectiveness of care. However, at present, these potential benefits have not been fully realized. In this consensus white paper, we set forth recommendations and action plans in three critical domains: (1) advances in system capabilities, including basic and advanced sets of CDS interventions and knowledge, supporting database elements, operational features to improve usability and measure performance, and management and governance structures; (2) uniform standards, vocabularies, and centralized knowledge structures and services that could reduce rework by vendors and care providers, improve dissemination of well-constructed CDS interventions, promote generally applicable research in CDS methods, and accelerate the movement of new medical knowledge from







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Improving Outcomes with Clinical Decision Support: An Implementer's Guide

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hIMSS

