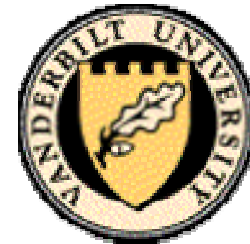


The Art, Science, History and Future of Clinical Decision Support Systems



Randolph A. Miller, MD '71 P '03



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Russ Waitman, PhD, Eric Neilson, MD & the VU Resource Utilization Committee, and

Numerous VUMC employees in the Informatics Center and School of Medicine

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Disclosure of (Non) Conflicts of Interest

Dr. Miller receives royalties from the University of Pittsburgh for his work there in authoring the Quick Medical Reference program for diagnostic decision support in Internal Medicine; donated to charity

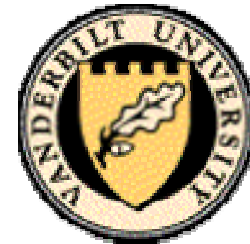
Dr. Miller receives royalties through Vanderbilt University based on Vanderbilt's commercialization of the WizOrder clinician order entry system, which he helped to develop and support. The majority of income from WizOrder goes directly to Vanderbilt School of Medicine, per se.



BIOMEDICAL INFORMATICS PhD TRAINING OPPORTUNITIES AT VANDERBILT



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Mrs. Jones on her 75th birthday



You are on call in your hospital for the Internal Medicine service, and at 9pm are paged to come to the Emergency Room to admit Mrs. Jones to your care.

Mrs. Jones is now 77 years old, and had worked for many years as a part-time clerk in an office. She has been healthy all her life, but has become progressively short of breath, with swelling in her legs and abdomen, over the past 6 months. She has no history of high blood pressure, chest pain or heart attack, heart disease of any type, or liver disease. She has been a non-smoker and not consumed alcohol her entire life. She is a widow and lives alone.

Her first words to you, while gasping for breath in the ER, are: “It is against my religion to be seen or cared for by a physician. A practitioner of my faith told me to go to the hospital because prayer was no longer working. Please help me.”

WHAT ARE YOUR IMPRESSIONS NOW?



1. **Diagnosis?**
2. **Therapy?**
3. **Prognosis?**
4. **Sociocultural / psychological?**
5. **Clinical Information Needs?**



You give her oxygen, and take her history & perform physical exam.

- 1. She has shortness of breath on exertion which is now so severe she cannot walk more than a small fraction of the distance across the room without resting**
- 2. She is breathless at rest with respiratory rate 30/min (nl 14-18); BP low at 100/70 without orthostatic change; temperature normal.**
- 3. Jugular veins distended to angle of jaw, estimated CVP > 15 cm H₂O (nl < 7)**
- 4. Breath sounds decreased with dullness to percussion 1/3 way up on R, 1/2 way up on L, decreased vocal and tactile fremitus in areas of dullness.**
- 5. Heart sounds distant, barely audible. No gallops or rubs. Apical impulse (PMI) not palpable.**
- 6. Abdomen distended, pitting edema of abdominal wall, shifting dullness and fluid wave present. No palpable masses or organomegaly (hard to tell). Normal superficial venous pattern.**
- 7. Extremities – no arthritis. 4+ pitting edema of legs to abdomen.**
- 8. Chest Xray – gross cardiomegaly, large pleural effusions L > R, heart border obscured**



You continue oxygen and admit her to her room upstairs in the hospital.

You administer a diuretic (agent to remove fluid through renal excretion).

After two hours, her blood pressure falls to a very low 85/60.

She becomes anxious and is less comfortable than before, despite oxygen.

[NEED FOR DECISION SUPPORT]

Current Understanding of Human Diagnostic Reasoning

1. Clinicians make diagnoses by “pattern recognition”

using compiled knowledge, based on reading & experience

2. Expert diagnostic reasoning is based on:

- Recognition of key or pivotal findings (Eddy & Clanton)
- Refinement of hypotheses as more is learned (Kassirer, Gorry, Pauker, Elstein)
- Early diagnostic hypothesis formation; therapy before Dx at times (Elstein, others)
- Quasi-probabilistic reasoning using prevalence (Tversky & Kahneman, others)
- Pathophysiological reasoning (“first principles”) in unfamiliar settings

3. Experts reason more efficiently than novices: (Newell & Simon)

- Greater store of compiled knowledge, and array of strategic approaches
- Awareness of diagnostic "weight of evidence" in hypothesis formation (Kassirer, Patel)

INTERNIST-I Project 1973-1985

J.D. Myers, M.D., H.E. Pople, Jr. Ph.D., R.A. Miller (then med student)

Goals and Objectives

Develop algorithm & KB that could support expert consultations for diagnosis in general internal medicine

Create program whose input would be patient's history, physical exam, and laboratory data;

Produce output consisting of either concluded diagnoses or differential diagnosis

Endow program with ability to lead physician through cost-effective patient "work-up"

Develop and maintain knowledge base for clinical diagnosis

INTERNIST-I Project 1973-1985

Sample case analysis

Positive Findings..... NEJM V324P527 1991

SEX Male

AGE Gtr Than 55

ABDOMEN Pain Epigastrium

ABDOMEN Pain Severe

UNCONSCIOUSNESS Recent Hx

HYPERTENSION Hx

MYOCARDIAL Infarction Hx

ANGINA Pectoris Hx

HEART Catheterization Recent Hx

CORONARY Arteriography Fixed Luminal Narrowing 70 Percent Or Gtr

HEART Angiocardiography Left Ventricle Adynamic Area <S>

HEART Surgery Recent Hx

PRESSURE Arterial Diastolic Gtr Than 125

DYSPNEA At Rest

BOWEL Sound <S> Decreased

INTERNIST-I Project 1973-1985

Sample case analysis

CONSIDERING: SEX Male, AGE Gtr Than 55, ABDOMEN Pain Epigastrium, ABDOMEN Pain Severe, UNCONSCIOUSNESS Recent Hx, HYPERTENSION Hx, MYOCARDIAL Infarction Hx, ANGINA Pectoris Hx, HEART Catheterization Recent Hx, HEART Surgery Recent Hx, PRESSURE Arterial Diastolic Gtr Than 125, DYSPNEA At Rest

DISCRIMINATE: AORTIC DISSECTION, MYOCARDIAL INFARCTION ACUTE

DIABETES MELLITUS HX?

MARFANS SYNDROME FAMILY HX?

MYOCARDIAL INFARCTION FAMILY HX?

INTERNIST-I Project 1973-1985

Lessons learned

**Standard model for building expert systems non-sustainable:
collaboration of domain expert and knowledge engineer**

**Recommendation: Use of the Biomedical Literature
as a “Gold Standard” for Clinical Knowledge Bases**

For what are the classics but the noblest thoughts of man?
They are the only oracles which are not decayed, and
there are such answers to the most modern inquiry in
them as Delphi and Dodona never gave.

Henry David Thoreau, *Walden*, “Reading” (1854).



INTERNIST-I Project 1973-1985

Lessons learned

“Feedback loop” of running system required to build and maintain high-quality KB –

Beware of KBs built by committees of experts sitting in armchairs

Giuse NB, Giuse DA, MILLER RA, Bankowitz RA, Janosky JE, Davidoff F, Hillner BE, Hripcsak G, Lincoln MJ, Middleton B, Peden JG. **Evaluating Consensus Among Physicians in Medical Knowledge Base Construction.** *Meth Inform Med.* 1993; 32:137-45.



INTERNIST-I Project 1973-1985

J.D. Myers, M.D., H.E. Pople, Jr. Ph.D., R.A. Miller (then med student)

PROFILE: ARSENIC POISONING CHRONIC 84 FINDINGS

Past Medical History..... 12

0 1 AGE 16 To 25

0 3 AGE 26 To 55

0 2 AGE Gtr Than 55

1 1 ALCOHOL Illicit Ingestion Hx

2 3 ARSENIC Exposure Or Ingestion Hx

1 2 OCCUPATION Farm Worker

1 1 OCCUPATION Miner

1 2 OCCUPATION Sandblaster Smelter FoundryOr Ceramics Worker

1 1 PHARYNGITIS Recent Hx

0 2 SEX Female

0 4 SEX Male

0 2 WEIGHT Loss Gtr Than 10 Percent

Symptoms of Current Illness..... 20

1 2 ABDOMEN Pain Acute

1 2 ABDOMEN Pain Chronic

INTERNIST-I Project 1973-1985

J.D. Myers, M.D., H.E. Pople, Jr. Ph.D., R.A. Miller (then med student)

DIFFERENTIAL DIAGNOSIS: DIARRHEA INTERMITTENT

Item MILDLY SUGGESTS Disease..... 2

2 3 Ulcerative Colitis

2 2 Intestinal Giardiasis

Item MINIMALLY SUGGESTS Disease.. 39

1 4 Eosinophilic Gastroenteritis <MUCOSAL FORM>

1 4 Lactose Intolerance

1 3 Amebic Colitis

1 3 Carcinoid Syndrome

1 3 Glucagonoma

1 3 Pancreatic Cholera

1 2 Anxiety Neurosis

1 2 Autonomic Neuropathy

1 2 Campylobacter Enteritis

1 2 Carcinoma Of Left Colon

1 2 Carcinoma Of Right Colon

1 2 Ceramide Trihexoside Lipoidosis <FABRYS DISEASE>

...

INTERNIST-I Project 1973-1985

J.D. Myers, M.D., H.E. Pople, Jr. Ph.D., R.A. Miller (then med student)

ASSOCIATED DISORDERS: ARSENIC POISONING CHRONIC

Disease Causes..... 8

- 1 1 CAUS Anemia Of Folate Deficiency**
- 1 1 CAUS Aplastic Anemia**
- 1 1 CAUS Cardiomyopathy Secondary**
- 1 1 CAUS Granulocytopenia Idiopathic Or Chemical Induced**
- 1 1 CAUS Hepatitis Acute Toxic**
- 1 1 CAUS Macronodal Cirrhosis <POSTNECROTIC>**
- 1 3 CAUS Peripheral Neuropathy**
- 1 1 CAUS Presinusoidal Portal Hypertension**

Disease Predisposes to..... 3

- 1 1 PDIS Bronchogenic Carcinoma Squamous Cell Type**
- 1 1 PDIS Carcinoma Of Esophagus**
- 1 1 PDIS Pulmonary Small Cell Carcinoma <OAT CELL>**

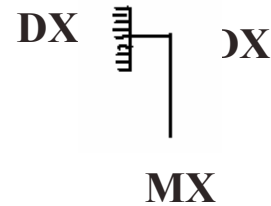
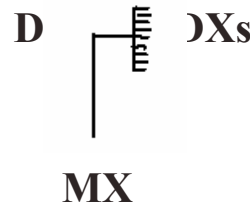
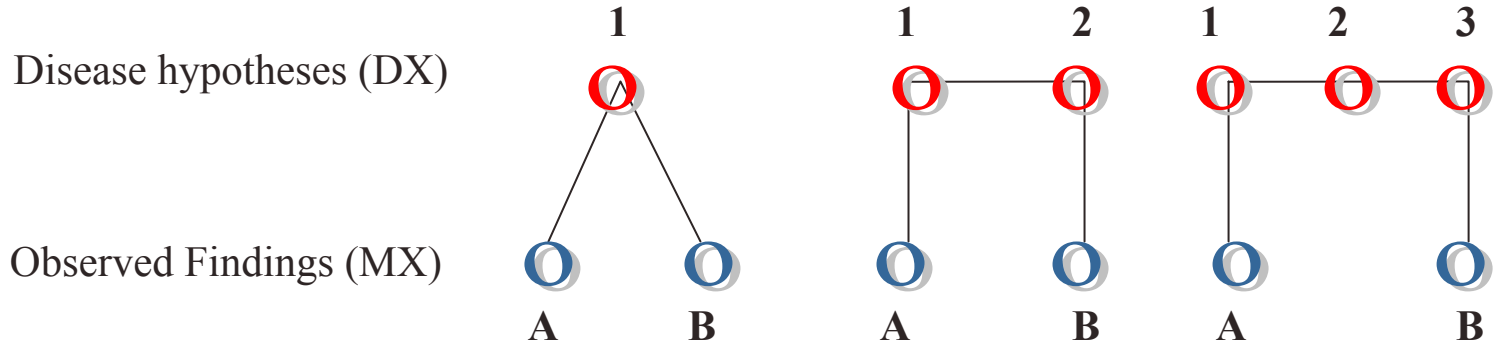
Quick Medical Reference (QMR) : 1984-1994

R.A. Miller, M.D., F.E. Masarie, Jr., M.D., and J.D. Myers, M.D.

Goals

- Recognize expertise of clinician-user, in role as system "pilot"**
- Emphasize real-world diagnostic decision-making by physicians, rather than by "AI" algorithm**
- Replace "Greek Oracle" approach to diagnosis with Catalyst/Toolkit model**
- Exploit the INTERNIST-1/QMR knowledge base for diagnostic reasoning**
- Change to microcomputer-based, ubiquitous platform**

Quick Medical Reference (QMR) : 1984-1994



Quick Medical Reference (QMR) : 1984-1994

QMR Program

QMR View Explore Simulation Case Utilities Window Help

Relationships

Contains 130 Hypotheses arranged by relative score (1-100)

EV-FR		SCORE	EV	FR
0 4	Fever and			
2 2	Splenomegaly Moderate and			
0 4	Heart Murmur Present and			
1 4	Hemoglobin Blood Less Than 12			
▶ Endocarditis Subacute Infective Left Heart		91		
Leukemia Acute Lymphoblastic		86		
Rheumatoid Arthritis Causes Anemia Of Chronic Disease		85	2	3
Endocarditis Acute Infective Left Heart		83		
Rheumatoid Arthritis is the Systemic Component of Feltys Syndrome Causes Anemia Of Chronic Disease		82	5 1	2 4

Line 1 of 416

Focus-ENTER Menu-ALT

Quick Medical Reference (QMR) : 1984-1994

QMR Program

QMR View Explore Simulation Case Utilities Window Help

Relationships

Contains 130 Hypotheses arranged by relative score (1-100)

EV	FR		SCORE	EV	FR
0	2	Fever and			
1	2	Splenomegaly Moderate and			
0	2	Heart Murmur Present and			
1	5	Hemoglobin Blood Less Than 12			
▶ Autoimmune Hemolytic Anemia Involving Warm Reacting Antibody			81		
Endocarditis Infective Right Heart			81		
Pernicious Anemia			81		
Myeloid Metaplasia (Primary Myelofibrosis)			80		
Anemia Of Decreased Vitamin B12 Absorption			79		
Crohns Disease Of Small Intestine Causes Iron Deficiency Anemia			79	1	3

Line 14 of 416

Focus-ENTER Menu-ALT

Rationale for Clinical Decision Support: Recent Observations by Clinical Researchers

**Institute of Medicine,
National Academy of Sciences
November 1999 Report: To Err is Human**

interpreted by lay press to imply:

**“Doctors and nurses are
incompetent & cause errors through
lack of knowledge;
their errors kill ~100,000 annually”**

Recent Case Report: The Imperfectability of Man

**Protocol-based computer reminders, the quality of care,
and the non-perfectability of man**

**McDonald CJ, New England Journal of Medicine
1976; 295(24):1351-5**

“Using controlled crossover design, nine physicians given computer suggestions from 390 protocols related to conditions managed (e.g., elevated blood pressure) or caused (e.g., liver toxicity) by drugs. Physicians responded to 51 per cent of 327 events when given, and 22 per cent of 385 events when not given computer suggestions.”

“It appears that the prospective reminders do reduce errors, and that many of these errors are probably due to man's limitations as a data processor rather than to correctable human deficiencies.”

[HANDOUTS]



1 Patient-Specific Information

Core “Portable” Patient Summary:

Problems, Allergies, Meds

Local Electronic Patient Record

Orders: Active/Inactive

2 Local Knowledge

“Best of Care” Pathways

Institutional policies & costs

Drug interactions & formulary

Physician preferences

IDEA

**Patient Care Provider
at Decision Point**



ACTION

**Decision
Support
Integrated
into
Workflow**

3 Global Knowledge

Medical literature

Diagnostic databases regarding diseases

National guidelines

Patient databanks with outcome data

4 Algorithms to enhance care

Reminders, Alerts

Quality checks

Self-Generated Monitors

Decision support programs

WizOrder purpose and demographics

WizOrder was developed at Vanderbilt by DBMI faculty and Informatics Center staff to help ensure the highest quality of care for our patients, reducing medical errors.

It provides “point-of-care” relevant information resources to enhance and support clinicians’ decision-making at the time of order entry.

It has been refined by ongoing clinical feedback from House staff, nurses, attending MDs, committees, others at VUMC for the past 6 years.

WizOrder is now used on 640 of 650 beds at VUH by: Medicine, Surgery, Pediatrics, and OB/GYN services.

Over 12,000 orders/day, 70% by MDs, rest by clinical staff



WizOrder Main Screen Layout: Simple, fixed format: functionally oriented, designed with users

The screenshot shows the WizOrder main screen layout. The top bar displays the patient name 'B __, A __ /ALLEN'. The left sidebar contains several sections: 'ADC VAAN DISML display', 'Pharmacy alerts', 'Admission', 'Diagnosis', 'Condition', 'Vital signs', 'Activity/limitations', 'Allergies', and 'Nursing instructions'. The right pane is titled 'MICU common orders' and lists 14 items, including emergency drugs, STAT labs, MICU orders, medications, workups, and collaborative care paths. A search bar at the bottom of the right pane contains the text 'gen 80 iv q12h'. The bottom of the screen features a navigation bar with buttons for 'Print', 'Change display F2', 'D/C', 'C/S', 'Order sets F4', 'ops F5', 'Help F6', 'Another patient F7', and 'Print orders F8'. A copyright notice for Vanderbilt University Medical Center is visible in the bottom right corner.

1) Active orders

2) Common useful orders based on patient location

3) What to do next in WizOrder

4) Buttons for commonly used features

Physician enters order for antibiotic, Gentamicin, by partially typing its name

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Generic name: gentamicin. Trade name: GENTAMICIN SULFATE ←

Currently ordered medication

Recommended doses are:

- less than 7 days: 0 to 5 mg/kg/24h
- between 7 days and 12 years: 6 to 7.5 mg/kg/24h
- more than 12 years: 1 to 2 mg/kg/dose

all iv gentamicin doses should be infused over 30 minutes regardless of dose

indications: treatment of serious aerobic bacterial infections due to susceptible organism, including pseudomonas, klebsiella, proteus, e. coli & staph.

Dose: im or iv over 30 min: dose based on body wt & renal function (calculated crcl). Adult dose: based on recent meta-analysis (ann intern med 1996;124:717-725) in pts w/crcl >60ml/min, dose is 1.3-1.6mg/kg q8hrs; or 2-3mg/kg q12hrs; or 4-6mg/kg q24hrs (hartford hospital suggests up to 7mg/kg/day w/normal crcl) max dose used in pts >70yrs was 4mg/kg/day; w/elderly maintain trough <1.4mg/l children: 6-7.5mg/kg/day or 240mg/m² in 3-4 divided doses; infants & neonates 7.5 mg/kg/day in 8hr intervals; premature neonates, 2.5mg/kg/dose q12hrs.

Reduce dosage or prolong interval w/renal impairment. Side eff: nephrotoxicity (reversible tubular damage) & ototoxicity (high pitched hearing loss/vertigo).

Notes: individualized dosing may be needed based empirically on renal function measured peak/trough. Usual peak/trough w/qd dosing 10-14mcg/ml & <2mcg/ml.

◆ gentamicin

- ℓ succinylcholine ▶ Aminoglycosides may potentiate neuromuscular blockade
- ℓ metocurine ▶ Aminoglycosides may potentiate neuromuscular blockade
- ℓ atracurium besylate ▶ Aminoglycosides may potentiate neuromuscular blockade
- ℓ ethacrynic acid ▶ Ethacrynic acid may enhance ototoxicity of aminoglycosides

◆ *gentamicin sulfate

- ℓ *viaflex 250ml iv fluids ▶ All gentamicin doses go in 100ml bags

◆ aminoglycoside class

- ℓ *temafloxacin protocol m91-626 ▶ Additional antimicrobials prohibited-temafloxacin protocol

◆ *aminoglycosides-parenteral

Monographs prepared by VUMC pharmacy available for medications as MDs order them

ADC VAAN DISML display

Pharmacy alerts ♦ (click on alerts for more information)
Zosyn no longer available-click here for information
Amiodarone may enhance pharmacologic effects of hydantoin

- a) Dose: 80 MG
- b) Route: IV
- c) How often: Q12H
- d) When to start (first dose): NEXT SCH
- e) For how long: UNTIL D/C

Currently ordered medication

Admission

admit to micu ▶ Apr 15 01:00...

admit to service: rec

attending: snapper x

initiate collaborativ

initiate level of care

Diagnosis

diagnosis: heart fail

patient specific data

Condition

condition: guarded

Vital signs

measure weight qam

vital signs q2h ▶ Apr

Activity/limitations

activity-bedrest ▶ A

Allergies

no known allergies ▶ Apr 15 01:00...

Nursing instructions

catheter drng-measure & record per unit save

- to gravity drainage ▶ Apr 15 01:00...

- to gravity drainage ▶ Apr 15 01:00...

Warning

Dose: 80 mg q12h
 Dosing weight: 53.5 kg
 Creatinine clearance: 21.76 ml/min
 Estimated steady-state levels:
 peak: 10.9 ug/ml
 trough: 5.6 ug/ml

Trough level too high!

Suggested dose: 80 mg q24h
 peak: 7.4 ug/ml
 trough: 1.8 ug/ml

Click <OK> or press <ENTER> to continue.

WizOrder uses pharmacokinetic model to estimate drug distribution in this patient, based on parameters such as weight and renal function, and displays warning and suggested proper dose if MD's dose out of range (too high or too low).

WizOrder: Pharmacy warning about potential drug interaction

8021X ZTESTPAC, Reagon 1498664-0 33y/o M (TRAINIO)

ADC VAAN DISML display

Admission

- o "protocol: gvhd (csa and mtx)"
- o day 0 for bmt: 3/5/99 6:00
- o weight: 54.885kg/121lb; height: 152cm/60.0in; ibw: 50.0kg/110.2lb; bsa: 1.51m2;

Pharmacy warning for CYCLOSPORINE INJ. SANDIMMUNE:

1. Aminoglycosides may potentiate cyclosporine nephrotoxicity
2. Avoid aminoglycosides + cyclosporine in renal transplant pts

2) Clicking on drug interaction warning displays monograph from VUMC pharmacists about nature and severity of interaction

1) MD prescribed "cyclosporine" with currently active "gentamicin" order; WizOrder displays drug interaction warnings

WizOrder Popup

Aminoglycosides may potentiate cyclosporine nephrotoxicity

Aminoglycoside antibiotics, when used in combination with cyclosporine a have been shown to have additive nephrotoxicity when used in combination. The severity of this reaction probably depends on the duration of combined use and the diagnosis of the patient. Bone marrow transplant patients on dr wolff's or dr greer's service should generally *Not* receive the two drugs in combination since therapy with an aminoglycoside in these patients can be expected to be prolonged due to profound neutropenia. In cardiac & renal transplant patients the potential for toxicity may be offset by the benefit of aminoglycoside therapy.

If this warning occurs in a patient on the bone marrow transplant service or in a patient of dr's greer, wolf, or stein then notify the physician about the potential for increased nephrotoxicity. Don't call in the middle of the night, however-leave a note for the day pharmacist to follow up

Back Home Print Close

Pharmacy warning

a order it anyway
b don't order it

or select an item to display more information

3) WizOrder NEVER stops MDs from doing what they want to (they know patients better than computer does), so option to override warning always offered; log is kept of MD being warned

print <F1> display <F2> D/C <F3> renew cosign order sets <F4> oops <F5> help <F6> comments <F7> done <F8>

Start Microsoft Pow... Wizorder Dae... wizscr07.bmp - ... WizOrder 1:54 PM

The VUMC Antibiotic Subcommittee recommends Cefepime (Maxipime ®) over Ceftazidime (Fortaz ®) for most indications where an anti-pseudomonal cephalosporin is needed.*

Cefepime 1000 mg q12h = Ceftazidime 1000 mg q8h

* Exception for neonates and selected pediatric patients. Safety and effectiveness of Cefepime in pediatric patients below the ages of 2 months have not been established.

Compared to ceftazidime, Cefepime has the following advantages:

- Similar coverage against *Pseudomonas*, improved coverage against *Enterobacter* species
- Enhanced stability against inducible/derepressed chromosomal beta-lactamases
- Better activity against Gram-positive pathogens, including *Staphylococci*, *S. viridans*, *pneumococcus*
- Q12 hour dosing except for empiric therapy for febrile neutropenia

[View Cefepime Fact Sheet](#)

[Go to Pediatric Recommendations](#)

[Go to Renal Dosing Recommendations](#)

Adults (Age > 16 years)

Dose	Example of Infection being treated
<input type="radio"/> 500 mg IV q12h	Uncomplicated urinary tract infection
<input type="radio"/> 1000 mg IV q12h	Nosocomial pneumonia in ICU patient
<input type="radio"/> 1000 mg IV q8h	Empiric coverage of febrile neutropenic patient
<input type="radio"/> 2000 mg IV q8h	<p>The FDA approved a dose of 2 gm IV q8h for febrile neutropenic patients and this is preferred over the 1gm IV q8h dose if cefepime is given as <u>monotherapy</u> for this indication.</p> <p>The 1 gm IV q8h dose has been used in the Bone Marrow Units and is appropriate for febrile neutropenic patients receiving other antibiotics with activity against Gram-negative aerobic pathogens such as aminoglycosides or quinolones. Documented infection with <i>Pseudomonas aeruginosa</i> should be treated with the higher (2 gm IV q8h) dose.</p>

Other

Intramuscular	<input type="radio"/> order I.M. Cefepime (with Lidocaine)
Non-standard Dose	<input type="radio"/> order non-standard dose of Cefepime

[Order Cefepime](#)

[Start Over](#)

"Click" the CLOSE button to return to WizOrder without ordering cefepime

[Order Ceftazidime](#)

[Back](#)

[Home](#)

[Close](#)

Adult Low Molecular Weight (LMW) Heparin / Unfractionated Heparin Anticoagulation Treatment Advisor (Revised 9/1/03)

Guidelines Regarding Enoxaparin (LMW Heparin): The resource utilization committee recommends the use of **low molecular weight heparin (enoxaparin)** over unfractionated heparin based on studies demonstrating equal or improved efficacy and safety for DVT prophylaxis, DVT/PE treatment, and acute coronary syndrome. Enoxaparin is more cost effective because of its predictable dose-response curve and lack of costs associated with need for monitoring. **NOTE:** Unfractionated heparin may be preferred over LMWH in selected patients, including those with renal insufficiency (GFR < 30), those who are obese (>160kg), or those where **reversibility in under 12 hours** may be required.

1 Review Clinical Data: Last Serum Creatinine: None available () -- Estimated Creatinine Clearance: Unknown mL/min

Select appropriate indication, test, and/or heparin type from the list below:

2 Pick an Indication (pick ONE from below)	3 Pick a Test to order		4 Pick a Heparinoid (if applicable)	
	LE Venous Doppler	V/Q Scan	LMW Heparin	Unfractionated Heparin
<input type="radio"/> DVT prophylaxis	N/A	N/A	Click Here for DVT Prophylaxis Advisor	
<input type="radio"/> DVT or PE, suspected (initial workup)	<input type="checkbox"/>	N/A	<input checked="" type="radio"/> (Recommended)	<input type="radio"/>
<input type="radio"/> PE suspected (with negative bilateral LE Doppler)	N/A	<input type="checkbox"/>	<input checked="" type="radio"/> (Recommended)	<input type="radio"/>
<input type="radio"/> PE suspected and... LE Doppler negative AND V/Q Scan inconclusive	Consider chest CT (helpful only if positive), pulmonary arteriogram, or pulmonary consult		<input checked="" type="radio"/> (Recommended)	<input type="radio"/>
<input type="radio"/> Massive PE suspected and patient in shock	Start with CT Chest		Consider thrombolytics or invasive radiological embolectomy	
<input type="radio"/> DVT or PE, confirmed	N/A	N/A	<input checked="" type="radio"/> (Recommended)	<input type="radio"/>
<input type="radio"/> Acute Coronary Syndrome	N/A	N/A	<input checked="" type="radio"/> (Recommended)	<input type="radio"/>
<input type="radio"/> Atrial Fibrillation or Prosthetic Valve			<input type="radio"/>	<input checked="" type="radio"/> (Recommended)
<input type="radio"/> Other Indications for Heparin use	N/A	N/A	<input type="radio"/>	<input type="radio"/>
<input type="radio"/> Diagnostic test only (Not for acute DVT/PE workup)	<input type="checkbox"/>	<input type="checkbox"/>	N/A	N/A

5 Verify / enter patient weight: kg lb

Clinical Warnings: Current renal function is unknown. Patient weight is not entered.

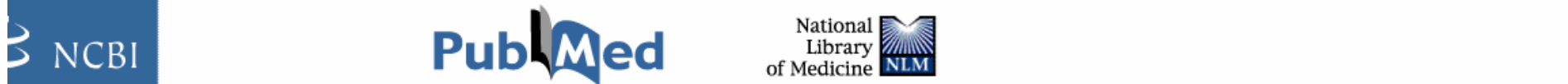
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Major Contraindications to All Forms of Heparin Therapy

- intracranial hemorrhage
- active internal bleeding
- bleeding peptic ulcer
- heparin-induced thrombocytopenia anytime in the past
- concern for spontaneous bleeding
- imminent surgery/invasive procedure planned or likely
- malignant hypertension

More Information and Recommendations

- [diagnostic tests to confirm or exclude the diagnosis of DVT](#)
- [diagnostic tests to confirm or exclude the diagnosis of PE](#)
- [acute coronary syndrome \(MI,NQWMI,USA,and CP\)](#)
- [medical therapy of acute DVT](#)
- [medical therapy of acute PE](#)
- [Low molecular weight heparin](#)
- [heparin induced thrombocytopenia](#)



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Citation Matcher
Citation Queries
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1: Chest 2002 Sep;122(3):960-2

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Full text article at
www.chestjournal.org

Deep venous thrombosis in a general hospital.

Stein PD, Patel KC, Kalra NK, El Baage TY, Savarapu P, Silbergleit A, Check FE.

St. Joseph Mercy Oakland Hospital, Pontiac, MI 48341, USA. steinp@trinity-health.org

PURPOSE: To determine the prevalence of proximal deep venous thrombosis (DVT) in a general hospital. BACKGROUND: In spite of the importance of proximal DVT, its prevalence in hospitalized patients has been only sparsely studied. METHODS: Patients hospitalized with DVT between July 1998 and June 2000 were identified by a computer search of discharge diagnoses. The discharge diagnosis was confirmed by a review of the records for positive findings on compression ultrasound or venogram of the lower extremities. In addition, records of all compression ultrasound examinations and venograms during that period were examined. RESULTS: The prevalence of proximal DVT in adults > or = 20 years old was 271 of 34,567 patients (0.78%). DVT was associated with pulmonary embolism in 57 of 271 patients (21.0%). The prevalence of DVT in adult men was 117 of 13,722 patients (0.85%), and in adult women was 154 of 20,845 patients (0.74%) [not significant]. The prevalence of DVT among men aged 20 to 49 years was higher than in women the same age: 19 of 3,982 patients (0.48%) vs 22 of 9,442 patients (0.23%), respectively (p < 0.02). The prevalence of DVT, however, was comparable among men and women > or = 50 years old. The prevalence of DVT was also comparable in black adults (30 of 4,344 patients; 0.69%) and in white adults (240 of 28,615 patients; 0.84%) [not significant]. CONCLUSION: Proximal DVT continues to be a frequent illness among hospitalized patients.

PMID: 12226039 [PubMed - indexed for MEDLINE]



Adult Deep Venous Thrombosis Prophylaxis Advisor

Your patient is not receiving a treatment known to deter deep venous thrombus formation (or you specifically requested this advisor).

Recent literature ([click HERE for information](#)) indicates the risk of DVT is significant in hospitalized patients due to multiple DVT risk factors ([CLICK for risk factors](#)). Almost all patients should receive some form of prophylaxis. Anticoagulant therapy is preferred over mechanical devices unless anticoagulants are contraindicated (See contraindications - below).

For the **highest risk** patients ([CLICK for list](#)) lacking contraindications to anticoagulation, low molecular weight heparin is the preferred agent. For all other patients, 5000 Units of unfractionated subcutaneous heparin every 8 to 12 hours is the preferred treatment.

Would you like to order any form of DVT prophylaxis at this time?

- Order unfractionated heparin 5000 U sq q 12 hours (preferred) (\$2/day)
- Order unfractionated heparin 5000 U sq q 8 hours (\$3/day)

Patient is in a high risk group and requires low molecular weight heparin now:

- Order enoxaparin 40 mg sq q day (preferred) (\$16/day)
- Order enoxaparin 30 mg sq q 12 hours (\$24/day)

Patient has a **contraindication to anticoagulation** and should receive mechanical prophylaxis:

- Order lower extremity sequential compression devices now. cost varies with size (\$35 - \$65)

Add elastic stockings?

- TED Hose - Knee High (\$4)
- TED Hose - Thigh High (\$7)

OR: Please provide reason below:

- I am not a physician, but I will contact physician responsible for this patient regarding DVT prophylaxis (tell physician to use "dvt prophylaxis advisor")
- Patient admitted for **labor or delivery** so heparin not ordered
- I do not wish to order DVT prophylaxis at this time because:

reason for not ordering:

Anticoagulation contraindications:

1. Active serious bleeding or bleeding in a critical location (e.g. intracranial)
2. Current or history of heparin-induced thrombocytopenia
3. Severe thrombocytopenia
4. Recent or scheduled procedure or operation with high bleeding risk
5. Presence of, or plans to insert epidural catheter

Current Date and Time: 11/27/2002 01:40 PM

Labs	Value	Date
PTT	42.3	11/27/2002 00:15 AM
INR	1.6	11/27/2002 00:15 AM
Platelet Count	149	11/27/2002 00:15 AM

NOTE: It is NOT appropriate to order PTT tests to monitor PROPHYLAXIS of DVT.

Submit Order or Reason

Return to WizOrder

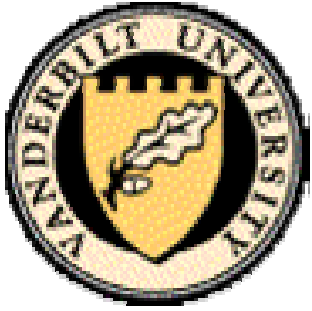
WizOrder Development History

Key concepts:

System implementation represents a profound workflow change for users

Users' concerns must be continuously respected, listened to, and addressed.





**The PC-POETS Study:
Integrating
Patient Care-Provider
Order Entry with Tactical Support**

Research Supported by NIH / NLM:
1 R01 LM06226



PC-POETS Goal: Use of Decision Support

The project tested a fundamental and long-held tenet in medical informatics, that:

medical decision support systems can gain widespread acceptance when a critical mass of functionality is delivered through a common interface on a readily available platform

“Good counselors lack no clients”

(Shakespeare, Measure for Measure, 1605; Act I, Scene ii)



PC-POETS interventions in WizOrder

(“Standard” safety already in place)

1. Cost/Charge for current order session for RADIOLOGY, LAB, PHARMACY
2. Lab trend Alerts (abnormal or about to be so)
3. Pharmacy monographs: WizRx, Mosby GenRx
4. Diagnostic Electronic Textbook Medicine (QMR KB)
5. Literature searches based on patient diagnoses
6. Antibiotic adviser (developed with Dr. D. Kernodle)



ADC VAAN DISML display

Admission

Diagnosis

Condition

Vital signs

Activity/limitations

Allergies

Nursing instructions

Diet

Medications

=Antibiotics

cefazolin inj: ancef 750 mg iv q6h »Feb 15 12:00...

=Scheduled medications

nicardipine: cardene 30 mg po q8h »Mar 3 14:00...

=PRN medications

acetaminophen elixir: tylenol 650 mg po q4h prn »Mar 3 07:29

IV fluids

d5 1/2 ns: 50 ml/hr iv »Mar 3 07:29...

Laboratory tests

Radiographic studies

Miscellaneous orders

Bells and whistles »

Sn common orders

1. general medicine orders »
2. SN admission orders »
3. pulmonary medicine/critical care orders »
4. STAT labs / tests »
5. next morning STAT labs / tests »
6. next morning ROUTINE labs / tests »
7. QAM STAT labs / tests »
8. QAM ROUTINE labs / tests »
9. medications »
10. workups »
11. « Return to previous list

PC-POETS Control Screen:
Use B&W to seek interventions

Select an item from the list

or enter another order

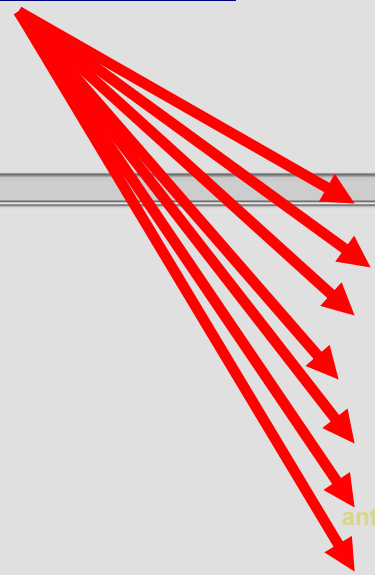
Reminder: the Clinical Informatics Conference for house staff and attendings takes place:
on Mondays 2/1, 2/15, 3/1, 3/15, 4/5, 4/19 12-1pm in 4109A MCE and
on Thursdays 2/4, 2/18, 3/4, 3/18, 4/1, 4/15 12-1pm in 8108 VUH.
New features and problems in WizOrder and MARS are discussed.
PIZZA and sodas are provided.

8016X ZTRAINSSS, Oe40 1199707-9 21y/o F (TRAINIO)

CIPROFLOXACIN: CIPRO

- a) Dose: 500 MG
- b) Route: PO
- c) How often: Q12H
- d) When to start (first dose): NOW

PC-POETS Interventions



- admit as inpatient
- admit as inpatient
- patient care unit: "orthopaedic unit"

- Diagnosis
- fracture of shaft of femur, closed (821.01)
 - pericarditis acute nonsuppurative

- Condition
- critical but stable
 - good

- Vital signs
- neurovascular checks q4h

Activity/limitations

- Allergies
- allergy: keflex

- Nursing instructions
- nursing: "femostop pressure 60 mmhg for 30 min. then decrease press
 - nursing: "femostop protocol: strict bedrest for six hours then oob with
 - nursing: "femostop protocol: for bleeding, apply direct pressure and ne
 - nursing: "femostop protocol: notify md for diminished pulses" as dir
 - nursing: "femostop protocol: vital signs q15 min x4, q30 min x2 then q

Diet

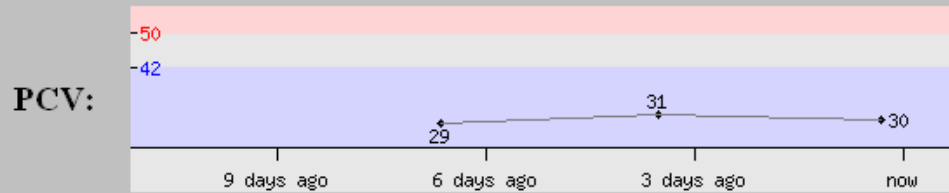
For how long:

- n D(ays)
- n H(ours)
- n DO(ses)
- or ENTER = UNTIL D/C

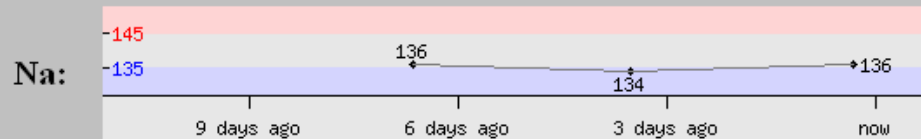
- GenRx
- WizRx
- \$159.65
- literature
- antibioticsQMR
- antibiotics
- alerts

Lab trend Alerts

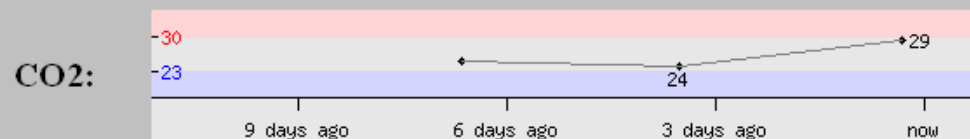
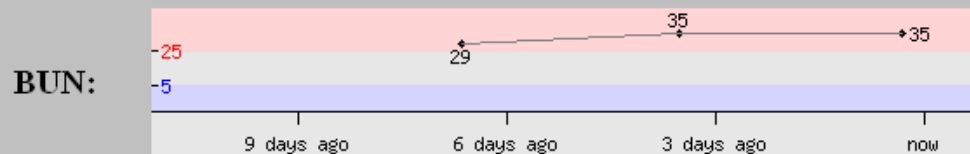
Alarming Values/Trends



Watch These Borderline Values/Trends



Normal Values/Trends



Pharmacy monographs

WizOrder PopUp

1998 Mosby's GenRx

The Complete Reference for Generic and Brand Drugs

Browse by:

Enter the first few letters
then click:

FIND

- Keyword
- Drug Name
- FDA Drug Class
- Indications
- Drug Master Plus
- Interactions
- USP Off-Label Uses
- Suppliers
- Full Word Search

Contents:

- [top](#)
- [Interacts With](#)
- [Prescribing Info:](#)
- [Boxed Warning](#)
- [Description](#)
- [Clinical Pharmacology](#)
- [Indications and Usage](#)
- [Contraindications](#)
- [Warnings](#)
- [Precautions](#)
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- [Adverse Reactions](#)
- [Overdosage](#)
- [Dosage and Administration](#)
- [How Supplied](#)
- [Product Listing](#)

- [User's Guide](#)
- [Preferences](#)

History: Cyclosporine

Cyclosporine (000932)

Categories: [Pregnancy Category C](#); [FDA Approved 1983 Nov](#); [Orphan Drugs](#); [WHO Formulary](#)

FDA Drug Class: Immunomodulators

Brand Names: Cyclosporin; *Consupren*; *Implanta*; *Imusporin*; Neoral; *Sandimmun*; *Sandimmun Neoral*; **Sandimmune**
(Foreign brand names outside U.S. in italics)

Cost of Therapy: \$4,663.38 (Transplantation; Solution; 100 mg/ml; 2/day; 365 days)

HCFA JCODE(S): J7503 50 mg IV

Warning:

Only physicians experienced in immunosuppressive therapy and management of organ transplant patients should prescribe cyclosporine. Patients receiving the drug should be managed in facilities equipped and staffed with adequate laboratory and supportive medical resources. The physician responsible for maintenance therapy should have complete information requisite for the follow-up of the patient.

Cyclosporine should be administered with adrenal corticosteroids but not with other immunosuppressive agents. Increased susceptibility to infection and the possible development of lymphoma may result from immunosuppression.

The absorption of cyclosporine during chronic administration of cyclosporine soft gelatin capsules and oral solution was found to be erratic. It is recommended that patients taking the soft gelatin capsules or oral solution over a period of time be monitored at repeated intervals for cyclosporine blood levels and subsequent dose adjustments be made in order to avoid toxicity due to high levels and possible organ rejection due to low absorption of cyclosporine. This is of special importance in liver transplants. Numerous assays are being developed to measure blood levels of cyclosporine. Comparison of levels in published literature to patient levels using current assays must be done with detailed knowledge of the assay methods employed. See [DOSAGE AND ADMINISTRATION, Blood Level Monitoring](#).

NEORAL

Neoral may be administered with other immunosuppressive agents. Increased susceptibility to infection and the possible development of lymphoma and other neoplasms may result from the degree of immunosuppression.

Neoral Soft Gelatin Capsules (cyclosporine capsules for microemulsion) and Neoral Oral Solution (cyclosporine oral solution for microemulsion) have increased bioavailability in comparison to Sandimmune Soft Gelatin Capsules (cyclosporine capsules) and Sandimmune Oral Solution (cyclosporine oral solution). Neoral and Sandimmune are not bioequivalent and cannot be used interchangeably without physician supervision. It is recommended that cyclosporine blood concentrations be



Add to My List

Diagnostic Electronic Textbook (QMR KB)

Links to the diagnostic information (Quick Medical Reference)

Description of disorders ("disease profiles") based on previously entered "diagnosis" order(s)

not reviewed yet [aortic valvular stenosis](#)

not reviewed yet [cardiac failure left chronic congestive](#)

not reviewed yet [arteriolar nephrosclerosis benign \(essential hypertension\)](#)

Additional information on a disease or finding

Differential diagnosis tool

Diagnostic Electronic Textbook (QMR KB)

WizOrder PopUp

aortic valvular stenosis Copyright © 2004, Vanderbilt University Medical Center

Past medical history

- 0 4 [sex male](#)
- 0 3 [age gtr than 55](#)
- 2 2 [angina pectoris hx](#)
- 2 2 [rheumatic fever hx](#)
- 2 2 [syncope or syncope recent hx](#)
- 1 2 [heart disease family hx](#)
- 1 2 [heart failure congestive hx](#)
- 0 2 [age 26 to 55](#)
- 0 2 [heart murmur hx](#)
- 0 2 [sex female](#)
- 1 1 [chorea hx](#)
- 1 1 [seizure\(s\) grand mal hx](#)
- 0 1 [age 16 to 25](#)

Symptoms of current illness

- 2 3 [dyspnea exertional](#)
- 1 2 [chest pain substernal at rest](#)
- 1 2 [chest pain substernal crushing](#)
- 0 2 [palpitation\(s\)](#)
- 1 1 [chest pain substernal lasting 20 minute\(s\) or gtr](#)

Findings on physical examination

- 3 4 [heart murmur systolic ejection second right interspace](#)
- 2 4 [heart impulse apical forceful localized](#)
- 2 4 [heart sound\(s\) s4 left atrial gallop](#)
- 0 4 [heart murmur present](#)
- 0 4 [heart gallop rhythm present](#)
- 3 3 [heart murmur systolic ejection second right interspace transmitted to neck](#)
- 3 3 [heart sound\(s\) a2 decreased](#)
- 3 3 [pulse arterial plateau](#)
- 2 3 [heart impulse apical lateral displacement](#)
- 2 3 [heart percussion left border lateral displacement](#)
- 4 2 [heart thrill systolic second right interspace](#)
- 4 2 [pulse arterial anacrotic](#)
- 2 2 [heart murmur decreased during valsalva](#)

causes

- 2 2 [cardiac failure left chronic congestive](#)
- 2 2 [left ventricular failure acute](#)
- 1 1 [schizocytic hemolytic anemia](#)

predisposes to

- 1 3 [angina pectoris](#)
- 2 2 [endocarditis subacute infective left heart](#)
- 2 1 [endocarditis acute infective left heart](#)

coincides with

- 2 2 [aortic regurgitation chronic](#)
- 2 2 [mitral stenosis](#)
- 1 2 [angiodyspasia of right colon](#)
- 1 2 [patent ductus arteriosus](#)
- 1 1 [mitral regurgitation rheumatic](#)
- 1 1 [pulmonic valvular stenosis](#)

is caused by

- 1 1 [carcinoid syndrome](#)
- 1 1 [ceramide trihexoside lipoidosis \(Fabry's disease\)](#)

is preceded by

- 2 2 [rheumatic carditis acute](#)

Moderately similar diseases

- 65 [hypertensive heart disease](#)
- 64 [hypertrophic subaortic stenosis](#)
- 59 [arteriosclerotic heart disease](#)
- 58 [cardiomyopathy primary](#)
- 57 [aortic regurgitation chronic](#)
- 54 [mitral regurgitation due to papillary muscle dysfunction](#)
- 54 [mitral valve prolapse](#)
- 52 [cardiomyopathy secondary](#)
- 51 [thyrotoxic heart disease](#)

Back

Home

Print

Close



Literature search based on patient diagnoses

WizOrder Popup

NCBI PubMed PubMed QUERY PubMed ?

Details (Aortic Valve Stenosis[MESH]) Search Clear

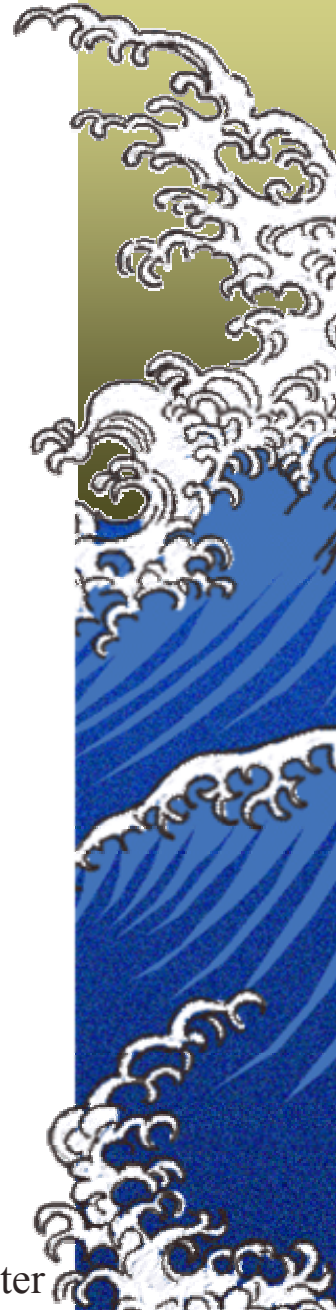
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citations 1-20 displayed (out of 8017 found), page 1 of 401

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- [Sabet HY, et al.](#) [\[See Related Articles\]](#)
Congenitally bicuspid aortic valves: a surgical pathology study of 542 cases (1991 through 1996) and a literature review of 2,715 additional cases. Mayo Clin Proc. 1999 Jan;74(1):14-26. PMID: 9987528; UI: 99142001.
- [de Tapia Barrios JM, et al.](#) [\[See Related Articles\]](#)
[Goltz syndrome: report of a case in a male]. An Esp Pediatr. 1998 Nov;49(5):513-5. Spanish. No abstract available. PMID: 9949597; UI: 99134756.
- [Jadavvel DM, et al.](#) [\[See Related Articles\]](#)
The BCL7 gene family: deletion of BCL7B in Williams syndrome. Gene. 1998 Dec 11;224(1-2):35-44. PMID: 9931421; UI: 99132633.
- [Silberman S, et al.](#) [\[See Related Articles\]](#)
Aortic valve replacement using circulatory arrest. Ann Thorac Surg. 1998 Dec;66(6):2158-9. No abstract available. PMID: 9930527; UI: 99127717.
- [Smith JD, et al.](#) [\[See Related Articles\]](#)
Effect of HLA mismatching and antibody status on "homovital" aortic valve homograft performance. Ann Thorac Surg. 1998 Dec;66(6 Suppl):S212-5. PMID: 9930450; UI: 99127640.
- [Jones TK, et al.](#) [\[See Related Articles\]](#)
Comparison of Ross procedures and aortic valve allografts in children. Ann Thorac Surg. 1998 Dec;66(6 Suppl):S170-3. PMID: 9930442; UI: 99127632.
- [Prat A, et al.](#) [\[See Related Articles\]](#)
Aortic root replacement with a pulmonary autograft in young adults: medium-term results in 70 patients. Ann Thorac Surg. 1998 Dec;66(6 Suppl):S148-52. PMID: 9930437; UI: 99127627.



PC-POETS: Evaluation - Results

Opportunity Type	Rate Ratio	95% Confidence Interval
ABA antibiotic advisor	1.45	0.98 - 21.34 (small N)
MSB Mosby Drug Ref	12.97	4.31 - 39.03 **
WRX AHFS drug info	10.64	3.12 - 36.30 **
MSH Pub Med Search	6.04	2.32 - 15.73 **
QMR Diagnostic KB	11.64	2.76 - 49.14 **
TRD Lab Trend Alerts	11.12	3.62 - 34.18 **
LMR Cost/Charge Details	1.36	0.56 - 3.30
OVERALL	4.41	2.35 - 8.26

PGY1 rate ratio 6.02 (2.30-15.78)

PGY2/3 2.53 (.91-7.05)

Overall, there were 364 responses (1 per 2000 opportunities)



PC-POETS: Evaluation – Results

Effect of LMR availability on session costs

78, 480 LMR opportunities overall

Mean LMR costs per control session \$411.75

Mean intervention LMR cost \$410.22

(p=0.003)

**Approx potential savings \$120k per year on
Medicine; if effect similar on other wards, up
to \$500K/yr overall**



Problem: Excess test ordering

**RUC = Resource Utilization Committee,
Eric Neilson, MD, Chair**

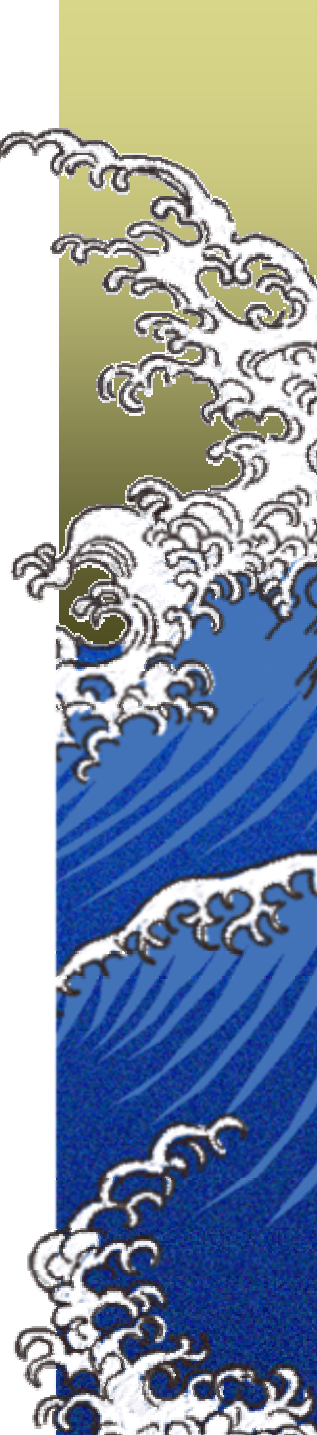
**In December, 1999 RUC and DBMI
used WizOrder to examine more closely
patterns of test ordering.**



February 2000 Most Common Tests Ordered at VUH, All WizOrder Wards

00648 === part thromboplastin (ptt) bld	** UNIT: 7n
00686 === osmolality bld	** UNIT: 11si
00686 === sodium bld	** UNIT: 11si
00715 === basic metabolic panel	** UNIT: 7smi
00753 === prothrombin time (pt) blood	** UNIT: 3n/c
00756 === basic metabolic panel	** UNIT: 7n
00763 === basic metabolic panel	** UNIT: 8s
00799 === cbc / plt ct	** UNIT: 3n/c
00821 === abg resp	** UNIT: 10n
01029 === basic metabolic panel	** UNIT: 11nm
01046 === basic metabolic panel	** UNIT: 3n/c
01084 === basic metabolic panel	** UNIT: 10n
01218 === cbc (wbc,rbc,hgb,pcv,ind)	** UNIT: 10n
01556 === abg resp	** UNIT: 3n/c

Chem7 (BUN, Creat, Lytes, Gluc = Basic Metabolic Panel) was identified as most commonly ordered test; and, in some ICU settings, daily CXRs were being done for weeks



Problem: Excess test ordering

1. **First intervention: Pop-up for tests recurring > 3 days**
2. **Based on RUC discussion and deliberation:**

- a. On Jan. 20th, 2000, WizOrder limited all radiology orders to “one time only”
- b. On Feb. 1, 2000, WizOrder limited all EKG orders to 1x or 2x (q8h)
- c. On Mar. 20, 2000, WizOrder limited LBCG to “only within 24 hrs”
- d. Subsequently, ordering of Comprehensive Metabolic Profile restricted



WizOrder: LBCG Ordering

WizOrder Popup

Lytes, BUN, Creatine, Glucose

Patient: 8001X Demo, Patient One (1111111-1) Click [here](#) for help.

Components	Graphs																																						
<div style="border: 1px solid gray; padding: 5px; margin-bottom: 5px;"> <div style="background-color: #00aaff; color: white; border-radius: 50%; width: 20px; height: 20px; display: flex; align-items: center; justify-content: center; margin: 0 auto;">1</div> <p>Select test(s)</p> <p><input type="checkbox"/> Na</p> <p><input type="checkbox"/> K</p> <p><input type="checkbox"/> Cl</p> <p><input type="checkbox"/> CO2</p> <p><input type="checkbox"/> BUN¹</p> <p><input type="checkbox"/> Creat¹</p> <p><input type="checkbox"/> Gluc</p> </div>	<div style="border: 1px solid gray; padding: 5px; margin-bottom: 5px;"> <p>Na</p> <table border="1" style="font-size: small; margin-top: 5px;"> <tr><th>Time</th><td>6 days ago</td><td>3 days ago</td><td>now</td></tr> <tr><th>Value</th><td>145</td><td>141</td><td>138</td></tr> <tr><th>Low Range</th><td>135</td><td></td><td></td></tr> </table> </div>	Time	6 days ago	3 days ago	now	Value	145	141	138	Low Range	135			<div style="border: 1px solid gray; padding: 5px; margin-bottom: 5px;"> <p>K</p> <table border="1" style="font-size: small; margin-top: 5px;"> <tr><th>Time</th><td>6 days ago</td><td>3 days ago</td><td>now</td></tr> <tr><th>Value</th><td>5.0</td><td>4.3</td><td>3.8</td></tr> <tr><th>Low Range</th><td>3.5</td><td></td><td></td></tr> </table> </div>	Time	6 days ago	3 days ago	now	Value	5.0	4.3	3.8	Low Range	3.5			<div style="border: 1px solid gray; padding: 5px; margin-bottom: 5px;"> <p>Cl</p> <table border="1" style="font-size: small; margin-top: 5px;"> <tr><th>Time</th><td>6 days ago</td><td>3 days ago</td><td>now</td></tr> <tr><th>Value</th><td>105</td><td>111</td><td>112</td></tr> <tr><th>Low Range</th><td></td><td></td><td></td></tr> </table> </div>	Time	6 days ago	3 days ago	now	Value	105	111	112	Low Range			
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<div style="border: 1px solid gray; padding: 5px;"> <p>Gluc</p> <table border="1" style="font-size: small; margin-top: 5px;"> <tr><th>Time</th><td>6 days ago</td><td>3 days ago</td><td>now</td></tr> <tr><th>Value</th><td>110</td><td>129</td><td>132</td></tr> <tr><th>Low Range</th><td></td><td></td><td></td></tr> </table> </div>	Time	6 days ago	3 days ago	now	Value	110	129	132	Low Range																														
Time	6 days ago	3 days ago	now																																				
Value	110	129	132																																				
Low Range																																							

Graph color codes: Clinically high range Clinically normal range Clinically low range

NOTE(S): 1 Creat & BUN will be ordered "once, routine, now" if ordered via "Q??H" option.

2 Select timing/urgency

once, in am 05, routine

once, now, routine

3 Go to another page or exit

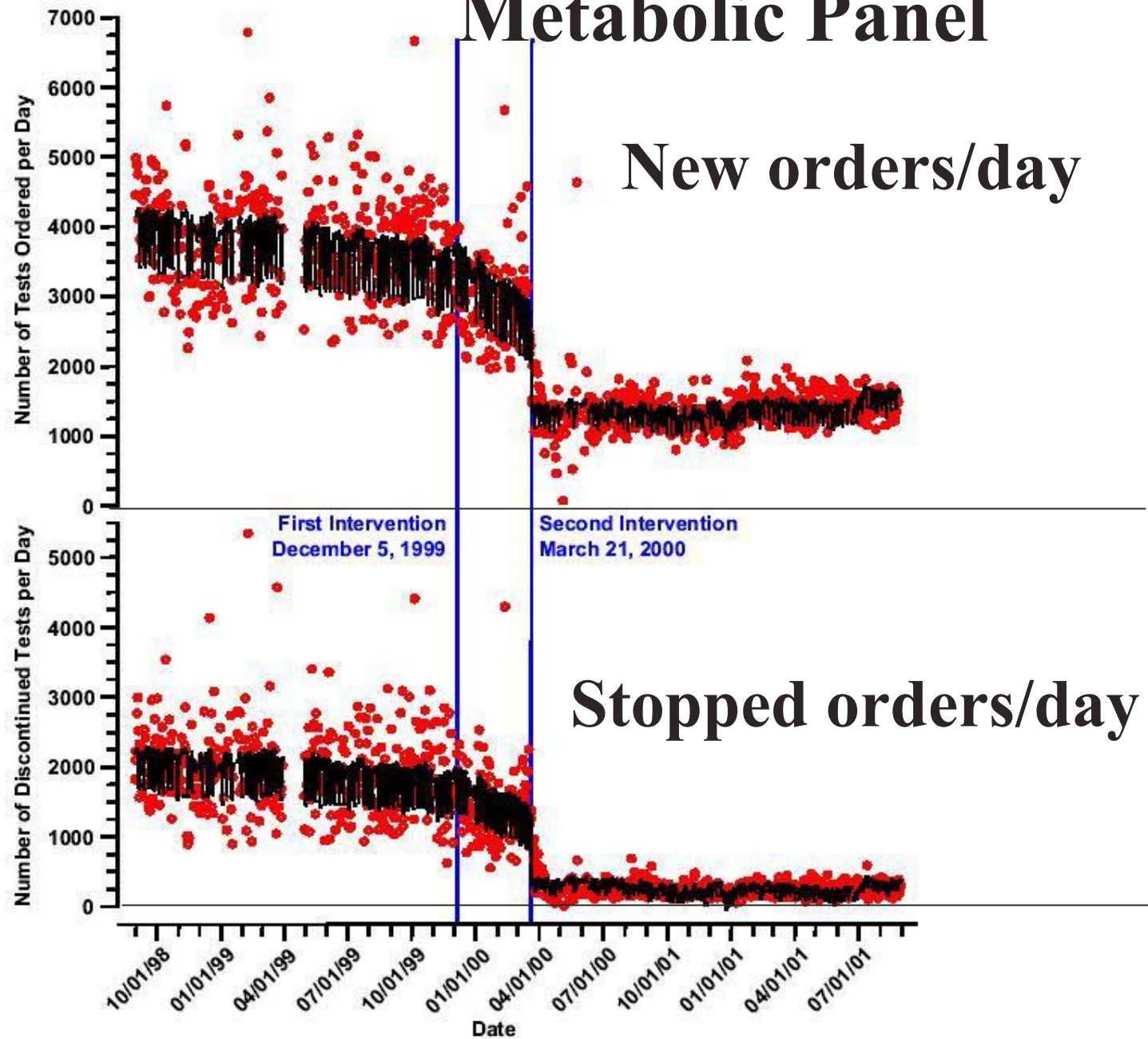
RUC Portable CXR Intervention

$$\text{\$145/xray} * 20/\text{day} * 365 \text{ days} = \text{\$1,058,500 / yr}$$

Table 1. Effect of interventions on the ordering of metabolic panel tests (sodium potassium, chloride, bicarbonate, glucose, BUN, and creatinine), complete blood count orders, chest X-rays and echocardiograms.

Test	Variable	Orders Entered		Orders Discontinued		Net Orders	
		Value	P Value**	Value	P Value**	Value	P Value**
Portable Chest X Ray							
A*	Mean daily orders during baseline interval	128		40.6		87.0	
B*	Trend in the baseline daily order rate	-0.0844	< 0.0005	-0.0409	0.001	-0.0440	0.001
C*	Expected tests at end of baseline interval	114		34.2		80.0	
D*	Trend in daily order rate between interventions	-0.392	0.18	-0.140	0.47	-0.240	0.22
E*	Expected tests just prior to second intervention	94.1		27.3		67.2	
F*	Overnight drop in orders after second intervention	-18.6	0.03	-15.9	0.002	-2.93	0.63
G*	Trend in the post-intervention daily order rate	0.00996	0.32	-0.00718	0.04	0.0152	0.01
H*	Mean daily orders after second intervention	75.8		8.746		67.1	

Metabolic Panel



**If it takes a village to raise a child,
What does it take to build and implement
order entry for a Neonatal ICU?**

**Randolph A. Miller, MD
William W. Stead, MD
WizOrder Development team,
VUMC System Support Services,
VUMC Informatics Center, Clinical Staff of VUMC**

In a remote location and at a time long ago ...

***After planning and postponing NICU implementation
for several years (mostly due to concerns about safe
medication dosing) ...***

***In mid-July, 2002, both the WizOrder team and the
System Support Services Group began having
discussions about a Fall 2002 NICU go-live target ...***

***Followed by an initial visit of both teams to the NICU
to see: what work is done where; where equipment is
needed and will fit; what sorts of equipment, etc ...***

Teamwork

WizOrder development group

8 people: 4 MDs, 4 code developers, 3 content/data

Informatics Center WizOrder Support

10 people: 1 MD/CIO, 8 technical, 3-4 administrative

System Support Services NICU Group

9 people: 7 RNs; 2 clerical; most long-term VUMC employees

Pharmacy NICU Group

5+ Pharmacists

NICU MDs and Staff

2 MD Directors; 2 nurse directors; dozens of other MDs, RNs, ancillaries from Unit

Setting: VUMC NICU

57 Beds total, 7 rooms

NI Step-Down

Newborn
Nursery

NISD

Medical
Center
East

Vanderbilt University Hospital

ECMO

1

2

Main Nursing Station

4

3

First e-mail in audit trail ...

Subject: NICU Order Entry implementation

Date: Tue, 24 Sep 2002 16:49:03

From: Holder, Gwen (System Support Services RN)

**To: Strauss, Arnold (MD Chair, Pediatrics Department); Lead Pediatrics Services RN;
NICU MD Leadership; NICU Nursing Leaders/Staff; System Support Services NICU Team;
Randolph A. Miller (For Wiz Team); Pharmacy Director**

The original plan was to implement WIZ order entry in one room of the NICU area in mid November and the remainder of the unit in mid to late January.

The phased approach was proposed for two reasons. First, to accommodate the physicians request to initially implement in a small controlled area allowing time to "work out any kinks" before rolling out to the entire unit. Secondly, from a support standpoint, Systems Support Services does not have the number of staff needed to adequately support a 60 bed unit implementing at one time.

Staged implementation planned across NICU rooms

First E-mail (continued)

As we move through the pre-implementation process, **several key people have voiced concern about the feasibility of this plan. Consensus is needed** from the key players involved in this project for implementation to be successful.

Resolution to these issues is needed as soon as possible. Are you available to meet on 10/7 anytime except 2-3:30? If this doesn't work, is there any day/time the week of 10/7 that would work for you.

Desired outcomes of this meeting include:

Agreement on implementation approach (phased roll out, timing)

Agreement on programming required in WIZ prior to implementation

Agreement on timeframes for implementation of NICU Order Entry and Peds ED (considering move to new Children's Hospital)

Please feel free to contact me if you have any questions.

Gwen Holder

System Support Specialist II

“Kickoff” meeting involving ALL parties key to launch project

Unit-focused Critical Issues Tracking Form

Used by System
Support Services
during planning
meetings for CPOE
implementation

Column Headers:
Feature/NICU contact
Description/Comments
Resource (s) required
Current Status
Priority (for go-live)

Not typical committee-based approach

NICU Order Entry Implementation

Critical Features Required

Phase 1 live 11/19/02

Phase 2 live 1/16/03

Revised 10/7/02

Feature NICU Contact	Description/ Comments	Resource	10-7-02	Priority
TPN Ordering (Delinda/Derenda)	Re-use work done on Adult TPN; Won't need many of these features. Printing of order in Phm not ready yet & is required	Wiz- Pharmacy?	Very close to having adult tpn ready- printer is in Phm. Need to review work on peds TPN Trent did & compare to present adult tpn method & determine which is best to use.	Required due to hi volume of TPN orders.
Label Printing (Diane)	Printing Medipac labels done in the ED & these printers are supported by CWS team. Getting non reg staff the screen to allow this functionality would require vendor code change. Chuck is requesting CSR/ ROI, Etc. O/R is also using these label printers but data coming from IPATH. Label Printing from WIZ on 8N but printers not supported by CWS. Is there a way to modify WIZ printing so that it is will print on the printer that ED uses for their labels from Medipac?	? Medipac ?Wiz Will require ordering of printers Intermec Label Maker 3400 -- \$1364 each and a maintenance contract price for Mon-Fri. 8a-5p at \$282 each.	Jon was able to generate labels from this printer from WIZ. Labels did not smudge when wet etc. Solomon said that CWS would support but that it was not in their budget to purchase this year. He would incorporate these printers in the recycle plan for hardware once purchased. Will need to determined if Diane has \$ to purchase or if will come out of Dr Stead's budget. Also need to know how many Diane would need.	Not in critical path for order entry
Notification Engine	Set up by room & way to view all at the nurses station.	Jon	Ideally would like to have NICU split into several	

Subject: RE: NICU Order Entry meeting rescheduled for 10/21

From: Karen Hughart **Date: Thu, 10 Oct 2002 07:34:08**
To: NICU group: Wiz, Pharmacy, System Support, NICU MDs, NICU Staff

Gwen and I are concerned that yesterday's meeting did not happen. We spent literally hours finding a time when most key players were to be available, only to have it cancelled because of a mandatory meeting that rendered some of these key players unavailable.

When critical events do not occur: evaluate why, evaluate impact, quickly reformulate, and keep on trucking

Subject: RE: NICU Order Entry meeting rescheduled (contin)

Some of the **barriers to success** with the original plan and timeline:

- **Nursing Leadership** learned that the **Nursing Interns** hired in the summer would not be available for staffing until right before Christmas

NICU has very serious staffing shortages that cause them to have a lot of mandatory overtime. This limits ability of staff to take time off to attend training.

Nursing shortage impacts order entry implementation

Subject: RE: NICU Order Entry meeting rescheduled (contin)

For all of these reasons, we identified the need to **revisit the plan and get a more formal endorsement from all stakeholders on the best way to stagger the implementation** (given that we don't have the resources to go live in a single day with all 60 patients in 7 rooms in 2 buildings)

As I said, it took a lot of time to schedule the meeting and now it's been cancelled. The earliest we were able to reschedule is Oct. 21. **My honest assessment is that we cannot meet a Nov. 19 go-live date at this point** even if we had consensus that it is a good date. I think **the best we can do is to do a lot of staff training before Christmas and then implement in January** with much less of a stagger between rooms than originally planned.

Focus on stakeholder concerns: be flexible, adjust go-live, but only for good cause (s) agreed upon by all parties at table

Subject: RE: NICU Order Entry meeting rescheduled (contin)

To meet January go-live, very aggressive development needed in next month:

- 1. NICU has stated since the beginning that they will not go live without some type of **TPN** solution. They are not asking for something elegant with a lot of decision support but are instead just looking for a way to enter the order electronically instead of writing on paper.**
- 2. Pharmacy has considerable work to do modifying Wiz Pharmacy orders and Web-based VGR ordering pages to accommodate pts. < 2000 Gms.**
- 3. A few other order sets are needed.**
- 4. Minor modifications to the Once/Stat VGR are needed.**
- 5. Once we do ADT System Room and Bed Master changes (I hope to get agreement on the plan today), we need to get the Notification Engine and printer mapping work done.**
- 6. We need to test everything and incorporate changes into training.**

Wiz Developers and Pharmacy observe NICU

From: "Russ Waitman" Lead WizOrder Developer
To: "Fred Hargrove" Lead Pharmacy WizOrder Liason
Cc: "Randy Miller"
Subject: Round with NICU
Date: **Fri, 25 Oct 2002 16:25:51 -0500**

I think I need to spend some time watching how the NICU works, enters orders, and their volume. I called & they said no problem to come up and round with them. I was wondering, if it would make sense for you to join as well to get an idea of

- 1. dosing, weight/age issues**
- 2. the volume of orders**
- 3. the pink sheet issues**
- 4. how much lends itself to DPOT/VGR versus underlying code changes and how much work will be required to do either method (get and idea of the risk of trying to reach implementation in Jan).**

Monday might be nice because we could then invite people to discuss further at pizza.

Technical team MUST observe clinicians before, during, and after implementation to see impact; pizza weekly debriefing conf

Pharmacy Concerns about 01/03 NICU go-live

Date: **Mon, 18 Nov 2002 15:12:43**

From: "Holder, Gwen" System Support Services

To: "Miller, Randolph A", Wiz Team, System Support Services

I just wanted to let ya'll know I talked with the Lead NICU Pharmacist re: changes needed for NICU & she expressed serious concerns about getting all the work done on the drips, TPN, and VGRs that is required to meet the Jan 21 implementation date. She has discussed this with other key pharmacists as well. One key person has been working from home but will be out 3 weeks in Dec. Another is working on the TPN. The Lead NICU Pharmacist reports that she has only 90min/day to devote to NICU work & there are no more resources to assist.

At the meeting tomorrow, I suggest we discuss projections for getting work done & set a more realistic live date. Other thoughts????

Pharmacy safety concerns are allowed to delay implementation

Decision to delay NICU Implementation made

Date: **Wed, 20 Nov 2002 16:33:29**

From: "Rudge, Nancy" System Support Services

Representatives from Pharmacy, WIZ Team and Systems Support Services met yesterday to discuss the feasibility of meeting our January 21st implementation date. **We are 9 weeks from our January implementation date. Our budget for purchase of the necessary hardware is still in the approval process. The hardware has not been ordered. The pharmacy is requesting additional time to complete the programming necessary for the specific NICU needs.** There are no additional pharmacy resources to allocate to this project. Realistically, we cannot meet the January implementation date.

The group discussed alternative dates. **March 4th has been identified as the new implementation date. Training for nursing staff would begin in mid January** and continue throughout February.

Delay in ordering/delivering equipment for ward impacts go-live

Shitake: New Wiz DB to support NICU Pharmacy

SuperShitake : Database (Access 2000 file format)

REGION : Table

	region_id	region_name	lowergestage	uppergestage	lowerage	upperage	lowerweight	upperweight	lastmodified
+	3	< 20 kgs*						19.999	12/6/2002 11:19:24
+	4	Gest age=< 27wks		189					12/11/2002 9:23:15
+	5	Gest age > 27wks to 1 mo	190	310		30			12/11/2002 9:46:55
+	6	1 to 6 mo; < 2kg			31	180		1.999	12/11/2002 9:48:02
+	7	1 to 6 mo; 2 to 3.5 kgs			31	180	2	3.5	12/11/2002 9:49:17
+	8	1 to 6 mo; > 3.5 kgs			31	180	3.501		12/11/2002 9:52:37
+	9	Gest age < 32wks*		223					12/26/2002 2:59:29
+	10	Gest age < 35wks*		244					12/26/2002 3:08:48
+	11	Gest age >= 32wks*	224						12/26/2002 3:11:39
+	12	Gest age >= 35 wks, < 30 d post natal	245			30			12/26/2002 3:12:19
+	13	Gest age < 30 wks, < 3 mo*		209		90			12/26/2002 3:36:33
+	14	30 =< Gest age < 35 wks, < 3 mo*	210	244		90			12/26/2002 3:37:53
+	15	Gest age >=30, Gest age< 37 wks, < 14 days	210	258		14			12/26/2002 3:38:49
+	16	Gest age =< 29 wks		209					12/26/2002 3:46:16
+	17	Gest age > 30 wks	211						12/26/2002 3:47:20
+	18	=< 7 d, >= 1.2kg*				7	1.2		12/26/2002 3:48:19
+	19	=< 7 d, 1.2 - 2 kg*				7	1.2	2	12/26/2002 3:48:59
+	20	=< 7 d, =< 2 kg*				7		2	12/26/2002 3:51:51
+	21	=< 7 d, > 2 kg*				7	2.001		12/26/2002 3:52:27
+	22	=< 7 d*				7			12/26/2002 3:52:54
+	23	=< 7 d, > 1.5 kg*				7	1.501		12/26/2002 4:12:55
+	24	> 7 d			8				12/26/2002 4:13:28
+	25	> 7 d, < 1.2 kg*			8			1.199	12/26/2002 4:15:55
+	26	> 7 d, >= 1.2 kg*			8		1.201		12/26/2002 4:16:18
+	27	7 d < age < 31 d, > 2 kgs*			8	30	2.001		12/26/2002 4:18:20

Pharmacy DB defines regions by gestational & birth ages + weight

Shitake: New Wiz DB to support NICU Pharmacy

SuperShitake : Database (Access 2000 file format)

REGIONINSTANCE : Table

	regioninstance_id	instance_id	instance_name	region_id	lastmodified	modifiedby
+	7	232	big blue pill	3	002 9:15:47 AM	Russ Waitman
+	9	19487	MEROPENEM INJECTION	29	003 9:07:57 AM	Lori Wright
+	10	19487	MEROPENEM INJECTION	22	002 9:24:49 AM	Russ Waitman
+	11	19487	MEROPENEM INJECTION	27	002 9:32:11 AM	Russ Waitman
+	12	19487	MEROPENEM INJECTION	35	002 9:33:29 AM	Russ Waitman
+	13	19487	MEROPENEM INJECTION	40	002 9:47:29 AM	Russ Waitman
+	15	18783	CEFEPIME INJECTION: MAXIPIM	31	02 10:10:31 AM	Russ Waitman
+	18	18783	CEFEPIME INJECTION: MAXIPIM	41	02 12:02:34 PM	Russ Waitman
+	20	9743	METRONIDAZOLE INJ: FLAGYL	32	02 12:05:17 PM	Russ Waitman
+	21	9743	METRONIDAZOLE INJ: FLAGYL	19	02 12:08:53 PM	Russ Waitman
+	22	9743	METRONIDAZOLE INJ: FLAGYL	21	02 12:10:57 PM	Russ Waitman
+	23	9743	METRONIDAZOLE INJ: FLAGYL	29	02 12:11:59 PM	Russ Waitman
+	24	9743	METRONIDAZOLE INJ: FLAGYL	27	02 12:13:12 PM	Russ Waitman
+	25	9743	METRONIDAZOLE INJ: FLAGYL	34	02 12:14:26 PM	Russ Waitman
+	26	6288	ACYCLOVIR INJ: ZOVIRAX	36	02 12:16:07 PM	Russ Waitman
+	27	6288	ACYCLOVIR INJ: ZOVIRAX	37	02 12:18:09 PM	Russ Waitman
+	30	9665	PHYTONADIONE INJ:AQUA-MEF	38	02 12:27:11 PM	Russ Waitman
+	31	9665	PHYTONADIONE INJ:AQUA-MEF	39	02 12:29:10 PM	Russ Waitman
+	32	19028	METOCLOPRAMIDE ORAL SOLI	31	003 4:10:57 PM	Russ Waitman
+	33	7450	METOCLOPRAMIDE INJECTION:	31	003 4:23:47 PM	Russ Waitman
+	36	19028	METOCLOPRAMIDE ORAL SOLI	44	003 3:20:04 PM	Russ Waitman
+	37	19028	METOCLOPRAMIDE ORAL SOLI	45	003 9:15:43 AM	Lori Wright
+	40	7450	METOCLOPRAMIDE INJECTION:	44	03 10:15:08 AM	Lori Wright
+	41	7445	METOCLOPRAMIDE: REGLAN	44	03 10:19:00 AM	Lori Wright
+	42	7450	METOCLOPRAMIDE INJECTION	45	03 10:22:11 AM	Lori Wright
+	43	7445	METOCLOPRAMIDE: REGLAN	45	03 10:24:21 AM	Lori Wright
+	44	7133	MIDAZOLAM INJ: VERSED	46	03 10:26:01 AM	Lori Wright
+	45	7133	MIDAZOLAM INJ: VERSED	47	03 10:28:56 AM	Lori Wright
+	46	7133	MIDAZOLAM INJ: VERSED	48	03 10:31:36 AM	Lori Wright
+	47	8144	CLINDAMYCIN INJ: CLEOCIN	20	03 10:35:40 AM	Lori Wright

Region “instance” for use of any “generic routed drug” in a region

Shitake: New Wiz DB to support NICU Pharmacy

SuperShitake : Database (Access 2000 file format)

RI_DEFAULTDOSE : Table

	regioninstance	value	unit	lastmodified	m
▶ +	7	5	MG/KG	1/6/1900	
+	9	20	MG/KG	1/8/1900	
+	10	20	MG/KG	1/9/1900	
+	11	20	MG/KG	1/10/1900	
+	12	20	MG/KG	1/11/1900	
+	13	1000	MG	1/12/1900	
+	15	50	MG/KG	1/14/1900	
+	18	50	MG/KG	1/17/1900	
+	20	7.5	MG/KG	1/19/1900	
+	21	7.5	MG/KG	1/20/1900	
+	22	7.5	MG/KG	1/21/1900	
+	23	7.5	MG/KG	1/22/1900	
+	24	15	MG/KG	1/23/1900	
+	25	7.5	MG/KG	1/24/1900	
+	26	20	MG/KG	1/25/1900	
+	27	20	MG/KG	1/26/1900	
+	30	0.5	MG	1/29/1900	
+	31	1	MG	1/30/1900	
+	32	0.1	MG/KG	1/31/1900	
+	33	0.1	MG/KG	2/1/1900	
+	36	0.1	MG/KG	2/4/1900	
+	37	10	MG	2/5/1900	
+	40	0.1	MG/KG	2/8/1900	
+	41	0.1	MG/KG	2/9/1900	
+	42	10	MG	2/10/1900	
+	43	10	MG	2/11/1900	
+	44	0.1	MG/KG	2/12/1900	
+	45	0.05	MG/KG	2/13/1900	
+	46	1	MG	2/14/1900	
+	47	5	MG/KG	2/15/1900	

For each drug-specific “region instance”, pharmacy can define default dose (s), minimum & maximum doses per single administration, per day, per “course”, and per lifetime.

Adding Educational Web Resource Links to Wiz

Subject: accessing the NICU Protocol manual from the selected web resources page

Date: Fri, 6 Dec 2002 10:35:53

From: "Holder, Gwen" System Support Services

To: "Stone, John" WizOrder Team, System Support Services,
NICU MD Leadership, NICU Staff

We would like to have a link to the NICU protocol manual placed on the selected Web Resources page. Here is its current site: <http://www.xyzyzy/nicuman3.htm>

We begin training nursing staff 1/3 & so I need this put out there soon so we can incorporate into training how to toggle between an order entry session & the protocol manual. Is this timeframe doable?

Institutional Web-based resources such as manuals should be linked into CPOE system as “just-in-time” resources. All changes impact training and must be coordinated.

Working out need/format for new ventilator orders for NICU implementation

Subject: Meeting with NICU re: Order Entry

Date: Wed, 11 Dec 2002 13:01:36

From: "Holder, Gwen" System Support Services

To: "Miller, Randolph A"

Randy,

12/17 3-430 the Wiz team & NICU folks are meeting to discuss issues. One of the issues that is slated for this meeting is management of Ventilator Orders. I think your input on this topic is essential- will you be able to attend for all or part of this time?

Let me know.

Thanks

As each new unit/ward is implemented on CPOE, its unique features MUST be considered – especially orders and order sets (order outlines). Stagger implementation !!

NICU Plan as of 12/17 is go-live February 18

Subject: Turning WIZ on for NICU

Date: Tue, 17 Dec 2002 12:39:30

From: "Holder, Gwen" System Support Services

To: WizOrder Team, System Support Services

In the Downtime Review Committee meeting today, Network Team wanted to know when NICU would be turned on for WIZ. I think we need to have WIZ enabled by 0700 on 2/17 since we will need to check printing to verify the documents print where they should, & then we will start entering orders for RM 3 to go live in the afternoon.

What are your thoughts- Is 0700 2/17 OK with the WIZ tech team? Are there other things to consider?

“Little” details like where items print from each workstation, and where each type of document should print for optimal workflow can become showstoppers during “go-live” if not anticipated and addressed beforehand.

January 2003 Pharmacy-related NICU progress

Subject: RE: NICU IV Fluid ordering page Date: **Tue, 28 Jan 2003**

From: NICU MD Leader

To: Chief Pharmacy Wiz Implementer, System Support Services, Pharmacy WizOrder

I polled the surgeons and Neonatologists about Replacement fluids and the leading answers to be pre-existing choices were:

1/2 NS + 10 meq/L KCL

1/2 NS + 20 meq/L KCl

D5W 1/2 NS + 10 meq/L KCl

D5W 1/2 NS + 20 meq/L KCl

LR

5% albumin

-----Original Message-----

From: Chief Pharmacy Wiz Implementer

I've done more work on the NICU iv fluid page. You can view it by typing @VGR=nivf

I have incorporated the changes that were suggested Tuesday by NICU MD.

I have also included a warning if you attempt to change the weight by > 10% on the IV fluid page. This alert does not show on the replacement fluid page since weight is not a factor in any of the calculations on this screen.

GOOD SIGN when MD leadership of Unit integrally involved

Report from Jan 28 NICU MD Wiz Training

Date: **Wed, 29 Jan 2003 11:36:18**

From: "Holder, Gwen" System Support Services

To: Pharmacy Team, WIZ team, System Support Services

Just wanted to give you some **input from the MD training class we had yesterday:**

1. IVF Page

Need to be able to order > 1 U AC fluid There was concern that the section labeled rate would be confusing to users ie they'd think they were to enter the hourly rate instead of the 24h volume in this section. **NICU MD Leaders suggested that this section be re-titled " Fluid Volume ____ ml/kg/day " and the ml/h calculation be placed on the line underneath & have it labeled Rate ___ ml/h (calculated)**

TPN Page - one person ordered 0 pepcid but got a message that the dose for pepcid was too high & an enormous amt was ordered on TEST patient.

One clicked on peripheral & didn't get asked for cc/kg/day-

Wiz Team I assume you just haven't gotten this done yet but wanted to FYI.

Carefully observe MD training – can prevent disasters later and be a source of good new ideas

Safety Concerns day before last development mtg

From: Lead NICU Pharmacist

Sent: Tuesday, February 11, 2003 9:01 AM

To: System Support Services, WIZ team, Pharmacy

Subject: RE: Tomorrow FINAL NICU Order Entry Meeting (before going LIVE)

I have had discussions with other NICU pharmacists this morning regarding the testing we have been doing on Shitake. Based upon what we have tested so far, we have significant concerns about going live on 2/18. Those concerns are focused around issues related to patient safety. This will need to be part of the discussion we have this afternoon.

-----Original Message-----

From: Holder, Gwen System Support Services

Sent: Monday, February 10, 2003 4:41 PM

To: All involved in NICU implementation

Subject: Tomorrow FINAL NICU Order Entry Meeting (before going LIVE)

Please let me know if you are unable to attend

Pharmacy safety concerns again delay implementation

Next NICU Order Entry Meeting 2/25 & Notes from 2/18

Date: **Mon, 24 Feb 2003 17:19:50**

From: "Holder, Gwen" System Support Services

To: Wiz Team, Pharmacy Team, System Support Services, NICU MDs, NICU Staff, NICU respiratory therapy

New implementation date set for 3/4. 3/1 & 3/3 residents& interns change so better to wait until after that. Meet 2/25 to review of progress on outstanding issues

Highlights of 2/18 meeting- feel free to forward corrections to all.

Pharmacy testing is going well but need to fix bugs & retest.

Order set testing - 3/4 of orders have been tested; additional order sets being pushed to developer on Wed. Most likely, all order sets will need to be touched.

TPN- a lengthy discussion re: how TPN should behave. Main points are: to enable the load previous- Ty must add in the wt piece need a TPN rate order that will display under IVF section. Need a lipid rate order just like the TPN rate- ie display under IVF, suppress on COS/CM&R etc

Wiz Team to create a way to d/c the BB "irradiated" flag when pt discharged from NICU

Blood Cultures- peds ID approved the X1 component. Randy shared a mock up of the NICU BC page- NICU and Wiz MDs to work on finalizing.

Test & re-test up to last minute

NICU TPN-Outstanding Issues February 19, 2003

Minimum TPN volume calculation change:

If Magnesium 5 mEq/L is ordered AND neotrace/selenium, calculate based on 1.3 mEq/mL.
If no Mg ordered, selenium and neotrace can be calculated based on 2ml/L

Load previous orders currently is not working

Can this work when modifying an order as well?

Modifying order does not delete old order on orderable side

Selenium/NTE not appearing as ordered

Special instructions not appearing as ordered

Cycle rate instructions are not appearing on orderable side correctly. Does this need to be a separate orderable? (Probably prefer not)

Will we be able to hide other “TPN” menu options such as “TPN orders (initiate, renew, change)”. Currently options are available under this listing such as “discontinue TPN” which creates a miscellaneous order.

Carefully track all issues, knowing who is responsible for addressing each by what date/time. Communicate to all teams.

Notice of Final Pre-Go-Live Meeting, March 4

Subject: NICU Order Entry Meeting

Date: Thu, 27 Feb 2003 12:11:11

From: "Holder, Gwen" System Support Services

To: **All involved in NICU implementation**

NICU Order Entry Meeting

Tuesday 3/4 Large conference room

Review of progress on outstanding issues

Final Decision about Go-Live on March 11

All involved stakeholders should have say into whether they (and their units/functions) are ready to go-live.

Post-go-live debriefing meeting notes, March 13

From: "Holder, Gwen" System Support Services

1. All is going very well since room #3 went live on Tues am March 11. Ordered 1 TPN this am w/o problems. The census has been down and room 3 quiet so it has been very nice. Gwen made changes to some order sets & there are a few WizOrder data dictionary changes that WizTeam will be making.

Russ (WizTeam) did a new code/data push so these should be in place:

No more warning re: D5w unable to check dose when ordered as a flush with Ampho B Heparinized Saline Broviac order;

2. ECMO orders. NICU MDs have approved the use of the PCCU ECMO orders.

They added a few orders so we'll clone the PCCU ones & add in the ones for NICU

3. Getting closer to having labels printing. WizTeam has finished its part.

Just waiting for all the network stuff to be finished.

4. WizTeam reviewed items on "TO DO LIST FOR NICU"

10-20 % dosing wt change alert. Two solutions discussed.

“Go-live” is not end – beginning of learning what should have been done, mission-critical adjustments must be made rapidly. MUST have unit-based debriefing meetings to identify key issues, assign people to address them in timely manner.

Post-go-live debriefing meeting notes, March 17

March 17 Debriefing Meeting Notes (from System Support Services)

PROGRESS UPDATES:

- 1. All continues to go well, Room #2 will go live tomorrow morning.** NICU MD and TPN Pharmacist will be on hand in the morning to help get the TPN orders entered for room #2. Three SSS folk will load orders this afternoon.
- 2. Decided to implement room 1 by itself next week on Monday and ECMO and the small intermediate room together on Thursday.**

WORKFLOW / WORK PROCESSES:

- 1. Who is supposed to print the COS and CMR?** Unit leadership decided that the MR should print the COS and CMRs for the next shift somewhere around 5 am and 5pm. NICU leaders to inform staff.
- 2. Issue around getting timely registration of new admits in the computer.** E-mail sent to registration supervisor to reinforce process. Also preadmission form can be used to obtain medications from pharmacy.

Unit-based debriefing meetings similar to MD following sick patient: see often enough to avoid trouble, adjust course PRN

Frequent Wiz Code Updates post-NICU go-live date

Subject: RE: NICU debriefing 3/25 & Update

Date: **Wed, 26 Mar 2003 09:40:55**

From: **Russ Waitman, WIZ Lead developer**

Another update. I just released new code and data this morning which will address:

- 1. Pharm issue: drug dose checks Wiz uses from Pharmacy will now incorporate the drug dose check variances provided by Pharmacy.** For example, the dose check on vitamin A was 4000/kg before and it was a hard limit. A dose for a 2.89 kg baby was getting rounded by Shitake to 12000 (which was according to the rounding table from Pharm) but that caused the dose per kg to exceed 4000 so you would get a warning. Now, Wiz checks and sees that the allowed dose check variance for Vitamin A is 20%, a dose fo 12000 will no longer generate the warning.
- 2. The switching logic in unitinfo.dmf (see below) should now be in production (a couple servers still need to recycle).**
- 3. The revised lab messages should now be in production (a couple servers still need to recycle).** In addition to the new specimen messages regarding neonates, we also revised several VGGG codes, lab subdepartments, and updated other messages. Basically we did a major overhaul of all lab orderables.

Neonatal ICU display

Admission »

"actual weight: 4.000kgs/8lb13." »Jul 1 09:18...
"gestational age: 41 weeks, 3 days"
"peds dosing weight: 4.300kgs; " »Jul 1 09:17...

Diagnosis »

Condition »

Vital signs »

Activity/limitations »

Allergies »

Nursing instructions »

Diet »

Medications »

Fluid intake: 0.0 ml/kg/day (all calculations use actual weight)

TPN: 0.0 ml/kg/day
Lipids: 0.0 ml/kg/day
Drips: 0.0 ml/kg/day
IV fluids: 0.0 ml/kg/day
Feeds: 0.0 ml/kg/day

IV fluids »

Respiratory orders »

VANCOMYCIN INJECTION:

Weight=4.000 kgs on Tue Jul 1 09:18
Peds dosing weight=4.300 kgs on Tue Jul 1 09:17
No Creat or BUN result available.
Non-CSF infections: 15 mg/kg/dose IV Q8H

Meningitis: 20 mg/kg/dose IV Q8H

Renal impairment:

Give one 15mg/kg dose and redose based on levels

Shitake in Action

Dose:

- a 15 MG/KG (default)
- b 20 MG/KG

or enter another value (in MG)
or press ENTER = 15 MG/KG

GenRx

WizRx

\$0.00

literature

QMR

antibiotic

NICU

specific Wiz enhancements

NICU Maintenance IV Fluids

- D7.5W + Trophamine 10 grams/L + CaGluconate 10 mEq/L + Heparin 1/4 unit/ml
- D10W + NaCl 20 mEq/L + KCl 10 mEq/L + CaGluconate 10 mEq/L
- D10W + CaGluconate 10 mEq/L

Plain IV Fluid

- D5W
- NS
- D5 1/4 NS
- D5 1/2 NS
- D5NS
- D10W
- D5LR
- LR

IV Fluid + KCl

- D5 1/4 NS + KCl 10 mEq/L
- D5 1/4 NS + KCl 20 mEq/L
- D5 1/2 NS + KCl 10 mEq/L
- D5 1/2 NS + KCl 20 mEq/L
- D5 1/2 NS + KCl 30 mEq/L

Custom Dextrose IVF

- D7.5W
- D12.5W
- D15W
- D17.5W
- D20W
- D25W
- D W

Custom Saline IVF

May be combined with Dextrose Options

- 1/4 NS
- 1/2 NS
- NS

1/2 NS+ Heparin 1/4 unit/ml

Rate ml/hr (3 ml/kg/day) (1) (2) (3) Bag(s)

1/2 Na Acetate + Heparin 1/4 unit/ml

Rate ml/hr (3 ml/kg/day) (1) (2) (3) Bag(s)

1/2 NS + Heparin 1/2 unit/ml + Lidocaine 4 mg

Rate ml/hr (6 ml/kg/day) (1) (2) (3) Bag(s)

Umbilical Line Flush Protocol NS 1/2 Na Acetate

Custom Additive(s)

NaCl mEq/L

Na Acetate mEq/L

KCl 10 mEq/L

KCl 20 mEq/L

KCl 30 mEq/L

KCl 40 mEq/L

KCl mEq/L

K Acetate mEq/L

Ca Gluconate mEq/L

Heparin 1/4 unit/mL

Heparin 1/2 unit/mL

Other Additives

Replacement Fluid Order Screen

Start Over

Exit Without Ordering

1

Calculate

Weight kg **4000 GRAMS**

"Fluid Volume" field below is for Maintenance IV Fluid Only.
Does NOT include Umbilical Line/Art Line Fluid Volume

Fluid Volume ml/kg/day

Calculated Rate **ml/hr**

Route Central IV Peripheral IV

Duration Until D/C Other

When to Start Stat Now Routine

Comments

ORDER TO BE SUBMITTED:

ZTESTSSS, 7 Do 1 months 4 kg female 4NI3 4NI3I

IV Fluid

IV ml/hr now until_dc

delivers:

Sodium : mEq / kg / 24 hours (rounded to nearest 0.1 mEq)

Potassium : mEq / kg / 24 hours (rounded to nearest 0.1 mEq)

Dextrose Infusion Rate : mg / kg / min (rounded to nearest 0.1 mg)

Umbilical Line / Art Line Fluid

delivers:

Sodium : mEq / kg / 24 hours (rounded to nearest 0.1 mEq)

2

Submit Order

NICU

IV Fluid Advisor

NICU: WizOrder "Final" Product

Select Another Infusion

Dopamine Infusion

Exit Without Ordering

Patient Demographics

ZTESTSSS, 7 Do

1 months ; female

Fluid Restriction Protocol

Weight in Wiz: 4 kg

4NI3 4NI3I

Already have infusion

Date/Time: 07/10/03 11:54

Order Infusion

Dosing Weight kg

Ordered Dose mcg/kg/min

Enter Requested Rate ml/hr *(pump can be set to nearest 0.1 ml)*

Calculate

Diluent: D5W NS D10W

Mix 64.5 mg Dopamine in 250 ml

Concentration = 258 mcg/ml

Specify Concentration (optional) mcg/ml *(Cannot specify BOTH rate and concentration)*

Based upon above mixture, 2 ml/hr delivers 2 mcg/kg/min

Comments:

Drug Information

Suggested Maximum conc = 3200 mcg/ml

Absolute Maximum conc = 20000 mcg/ml

Standard: 1 ml/hr = 1 mcg/kg/min

Intermediate: 1 ml/hr = 5 mcg/kg/min

Concentrated: 1 ml/hr = 10 mcg/kg/min

Dose Range 2-20 mcg/kg/min

Medication Drip Calculator

Dopamine Rate Chart (258 mcg/ml) Dosing Wt: 4.3 kg

Start Chart at mcg/kg/min Increment mcg/kg/min

mcg/kg/min	Rate (ml/hr)	mcg/kg/min	Rate (ml/hr)	mcg/kg/min	Rate (ml/hr)	mcg/kg/min	Rate (ml/hr)
0.5	0.5 ml/hr	5.5	5.5 ml/hr	10.5	10.5 ml/hr	15.5	15.5 ml/hr
1	1 ml/hr	6	6 ml/hr	11	11 ml/hr	16	16 ml/hr
1.5	1.5 ml/hr	6.5	6.5 ml/hr	11.5	11.5 ml/hr	16.5	16.5 ml/hr
2	2 ml/hr	7	7 ml/hr	12	12 ml/hr	17	17 ml/hr
2.5	2.5 ml/hr	7.5	7.5 ml/hr	12.5	12.5 ml/hr	17.5	17.5 ml/hr
3	3 ml/hr	8	8 ml/hr	13	13 ml/hr	18	18 ml/hr
3.5	3.5 ml/hr	8.5	8.5 ml/hr	13.5	13.5 ml/hr	18.5	18.5 ml/hr
4	4 ml/hr	9	9 ml/hr	14	14 ml/hr	19	19 ml/hr
4.5	4.5 ml/hr	9.5	9.5 ml/hr	14.5	14.5 ml/hr	19.5	19.5 ml/hr
5	5 ml/hr	10	10 ml/hr	15	15 ml/hr	20	20 ml/hr

NICU: WizOrder "Final" Product

1 TPN fluid requirement: ml/kg/day
(not including lipids)

Cycle TPN over hours

Central Line TPN Order Sheet

2 [<Review Current Lab Trends>](#)
Patient: ZTESTSSS, 7 Do (female) TPN Calculation Weig

Link to Lab Data

3 **Amino Acids as Trophamine** grams/kg/day
add Cysteine [0] [30 mg/g of protein]

Dextrose %

Lipids 20% grams/kg/day over hours
Carnitine (10 mg/kg/day) added if lipids ordered

Sodium mEq/kg/day
Calculated ___ mEq/liter

Acetate/Chloride
 Minimal Chloride
 1:1 ratio

4 **Calculate** (Updates Fields)

Amino Acid Calories: ___ kcal/kg/day Fat Calories: ___ kcal/kg/day
 Dextrose Calories: ___ kcal/kg/day Total Calories: ___ kcal/kg/day
 Lipid Rate: ___ ml/hr Lipid Volume: ___ ml/kg/day
 Calculated minimum TPN Rate: ___ ml/hr
 Calculated minimum TPN Volume: ___ ml/day
 Calculated TPN Rate: ___ ml/hr
 Calculated TPN Volume: ___ ml/day
 Total Fluid Volume (TPN + Fat): ___ ml/kg/day

Potassium mEq/kg/day

Calcium [0] [15 mEq/liter]

Magnesium [0] [5 mEq/liter]

Phosphate ___ mmol/liter
(calculated from calcium dose)

5 **Submit Final Order**

OR

Exit Without Ordering

Added Medications and Supplements
 MVI-PEDIATRIC: 5 ml (wt >= 2.5 kg)
 Neotrace & Selenium [daily] [M. TH]
 heparin [0] [0.25 units/ml]

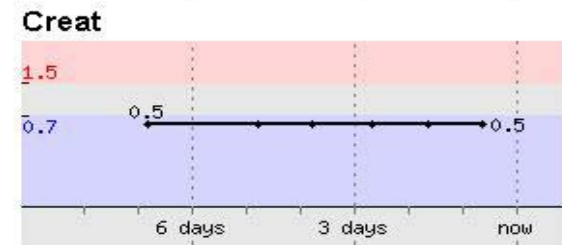
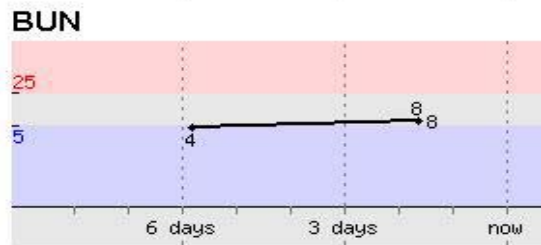
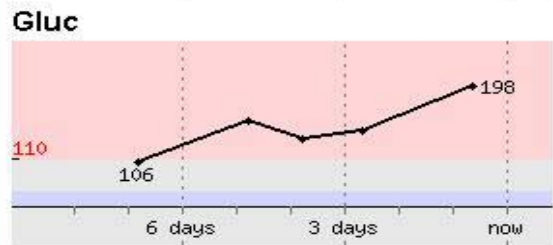
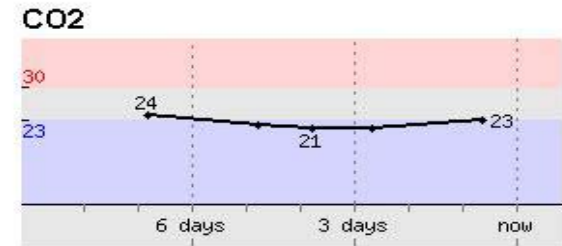
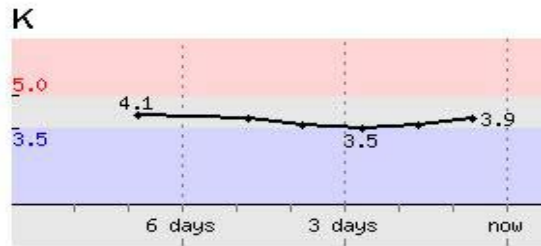
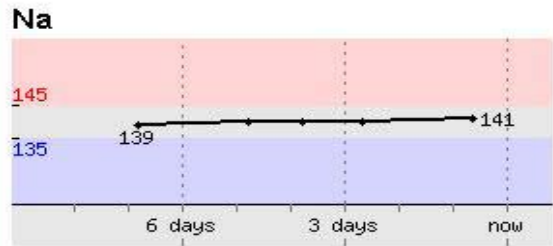
Other Possible Additives
 Vitamin K [0] [1 mg/day]
 famotidine (Pepcid) (mg/kg/day) [0] [1] [2]
 albumin (g/kg/day) [0] [0.5] [1]

Special Instructions to Pharmacy:

NEW TPN module designed for NICU

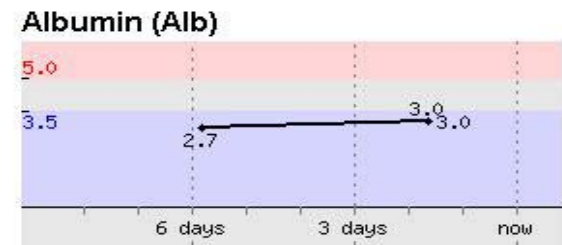
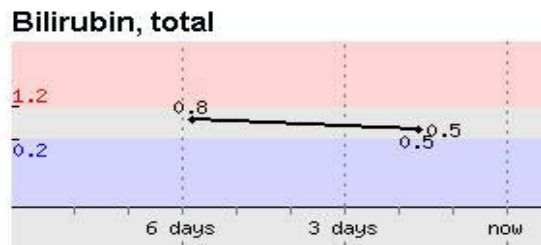
TPN Related Lab Trends

[<Return to Order Page>](#)



Protein, total

No Data Available



Calcium

PO4

Magnesium

Labs relevant to TPN displayed showing TRENDS

Graph color codes: Clinically high range Clinically normal range Clinically low range

⚠ TPN fluid requirement must be a least 20 ml/kg/day.

← NOTE ERROR MESSAGE

1 TPN fluid requirement: ml/kg/day
(not including lipids)

Cycle TPN over hours

Central Line TPN Order Sheet

2 [<Review Current Lab Trends>](#)
Patient: ZTESTSSS, 7 Do (female) TPN Calculation Weight: 3.8 kg

3 **Amino Acids as Trophamine** grams/kg/day
add Cysteine [0] [30 mg/g of protein]

Dextrose %

Lipids 20% grams/kg/day over hours
Carnitine (10 mg/kg/day) added if lipids ordered

Sodium mEq/kg/day
Calculated 5000 mEq/liter

Potassium mEq/kg/day
Calculated 500 mEq/liter

Calcium [0] [15 mEq/liter]
[30 mEq/liter]

Magnesium [0] [5 mEq/liter]

Phosphate 15 mmol/liter
(calculated from calcium dose)

Acetate/Chloride

Minimal Chloride
 1:1 ratio
 Minimal Acetate

4 **Calculate** (Updates Fields)

Amino Acid Calories: 8 kcal/kg/day Fat Calories: 20 kcal/kg/day
Dextrose Calories: 3.4 kcal/kg/day Total Calories: 31.4 kcal/kg/day
Lipid Rate: 1.6 ml/hr Lipid Volume: 10 ml/kg/day
Calculated minimum TPN Rate: 6.3 ml/hr
Calculated minimum TPN Volume: 152 ml/day
Calculated TPN Rate: 1.6 ml/hr
Calculated TPN Volume: 38 ml/day
Total Fluid Volume (TPN + Fat): 20 ml/kg/day

5 **Submit Final Order** OR **Exit Without Ordering**

Added Medications and Supplements

MVI-PEDIATRIC: 5 ml (wt >= 2.5 kg)
Neotrace & Selenium [daily] [M TH]
heparin [0] [0.25 units/ml]

Other Possible Additives

Vitamin K [0] [1 mg/day]
famotidine (Pepcid) (mg/kg/day) [0] [1] [2]
albumin (g/kg/day) [0] [0.5] [1]

Special Instructions to Pharmacy:

NICU follow-up and evolution continue: Weekly Pizza mtg

From: Waitman, Lemuel Russell (Lead WIZ developer)

Sent: Monday, June 30, 2003 1:43 PM

Subject: Pizza feedback on NICU pharmacy issues.

NICU MD director visited Pizza session today and brought up the following points:

1. In the "NICU General Admission Orders" orderset:

- **Items 36 and 37 (vitamin A and indocin) are confusing in layout because they fall under the "Buffers" heading even though they are not buffers.**
- **Suggestion is to move them up under the rest of the Medications. At a minimum we should create a separate heading or at least a spacer between them and the buffers. This would be a straightforward change.**

2. Tromethamine inj: THAM

- **Because of the caustic nature of THAM, NICU MD would like a warning when THAM is ordered that says:**

"Never give via umbilical catheters (either arterial or venous)".

- **This warning would display as an order entry message. Any issues applying this housewide or would we want to use a custom NICU only message (tied to Shitake)?**

Pizza follow-up: NICU still evolving

Take-Home Ideas and Messages for CPOE

IMPLEMENTING CPOE IS DIFFERENT

At go live - everyone's work changes at once

So all need to be at the table - but all are busy...

An implementation has many moving parts & each affects others

Unit & Ancillaries – buy in, workflow, protocol & order set development, staff levels, meeting and rotation schedules

System Support – phasing, content development, new functions, hardware placement and funding, training, SWAT team support

HAVING SYSTEM SUPPORT TEAM, DEDICATED 24x7 TO PLAN, IMPLEMENT & SUPPORT END-USERS IS CRITICAL

CONCLUSION:

Early Advice on Ideal Behavior of Clinical Decision Support Systems And Their Developers

**The essence of knowledge is,
having it, to apply it;**

**not having it,
to confess your ignorance**

Confucius. ~2500 years ago

