



A Call to Action: Optimizing the Electronic Health Record in Parenteral Nutrition

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Disclosure

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Baxter Healthcare: Advisory Board

All other planners, presenters, and reviewers of this session report no financial relationships relevant to this activity.

Learning Objectives

- Discuss the multi-organizational call to action paper regarding the electronic health record (EHR) in the parenteral nutrition process.
- Describe the challenges of building and configuring the EHR to optimize use in the parenteral nutrition process.
- Explain how to implement safe parenteral nutrition ordering using the EHR.

Presentation Outline:

- Safe parenteral nutrition (PN) prescribing recommendations, errors and risk associated with PN prescribing
- PN workflow in EHR
- Optimizing PN Orders and PN Clinical Decision Support (CDS) in EHR
- Challenges faced when implementing/converting to new EHR vendor
- Informatics solutions to key PN workflow issues & continued challenges
- Key takeaways and future recommendations

Parenteral Nutrition Safety Efforts

- ASHP- A.S.P.E.N. PN Safety Website
<http://pnsafeuse.org/>
- A.S.P.E.N. PN Safety Guidelines
- A.S.P.E.N. PN Safety Committee
 - ✓ PN Safety Recommendations
 - ✓ PN Competencies
- A.S.P.E.N. Clinical Nutrition Informatics Committee
 - ✓ A.S.P.E.N.-Epic PN Workgroup
Prioritized list of PN enhancements
 - ✓ A.S.P.E.N.-ASHP-AND Workgroup
Joint White Paper: Optimizing the EHR and PN Process

Clinical Recommendations

A.S.P.E.N. Parenteral Nutrition Safety Consensus Recommendations

Phil Ayers, PharmD, BCNSP, FASHP¹; Stephen Adams, MS, RPh, BCNSP²; Joseph Boullata, PharmD, RPh, BCNSP³; Jane Gervasio, PharmD, BCNSP, FCCP⁴; Beverly Holcombe, PharmD, BCNSP, FASHP⁵; Michael D. Kraft, PharmD, BCNSP⁶; Neil Marshall, RN, BSN, CRNI, CNSC⁷; Antoinette Neal, RN, CRNI, CNSC, VA-BC⁸; Gordon Sacks, PharmD, BCNSP, FCCP⁹; David S. Seres, MD, ScM, PNS¹⁰; Patricia Worthington, MSN, RN, CNSC¹¹; and the American Society for Parenteral and Enteral Nutrition

Boullata JI, et. al. *JPEN J Parenter Enteral Nutr* 2014; Ayers P, et. al. *JPEN J Parenter Enteral Nutr* 2014; Guenter P, et. al. *Nutr Clin Pract* 2015; Boullata JI, et. al. *Nutr Clin Pract* 2016

PN Prescribing Errors

- Observational study of inpatient PN use → 1.6% error rate
 - 40% of errors during transcription (39%) & prescribing (1%)
- PN ingredients for a 16-year-old boy ordered in amounts/kg/day → PN prepared in amounts/day
 - CPOE PN order template did not match ACD
 - Lack of CDS and warnings in CPOE PN order and ACD
 - Multiple points of manual transcription, lack of redundancies
- ISMP Medication Error Reporting Program- PN-related errors = 44 reports between 2006-2016
 - Compounding/dispensing = 17
 - Administration = 14

Safe PN Prescribing – Key Recommendations

- Healthcare organizations shall use a standardized process for PN management
 - PN Policies and Procedures
 - Comprehensive PN education and competency assessment, at least annually
 - Policy addressing credentials, training and competency of individuals involved in PN ordering
 - Applicable to all patients/ages/disease states
- PN-specific Policies and Procedures
- Optimization of CPOE (EHR) and clinical decision support (CDS)
- PN-use process shall include clinicians with expertise in the area of nutrition support, preferably from multiple disciplines

ISMP Recommendations

Improving PN Safety

- Match prescribing and pharmacy templates
- Build, test, and heed automated warnings
- Heighten suspicions of errors
- Carry out effective redundancies
- Provide clear labeling
 - Label should always match the PN order template in the PN order form/CPOE system and the ACD
- Educate and validate competency
- Eliminate transcription of PN orders

Safe PN Prescribing – Key Recommendations

- PN shall be prescribed using a standardized order format and review process
 - Standardized electronic PN orders
 - Verbal/telephone/handwritten orders should be avoided
 - All components ordered in amounts per day (or per kg per day), avoid amount/liter, % concentration or volume
- Clinical decision support should be available and utilized to avoid exceeding recommended/safe clinical limits and limits of compatibility
 - When CPOE is not available → use a standardized order template as an editable electronic document (avoid hand-written orders)
 - Required components for the PN order and suggested sequence
 - PN label should match the sequence on the PN order

Reducing PN Prescribing Errors

Do the Recommendations Improve Safety?

- A children's hospital adopted standardized PN process
 - Reduced PN errors from 9 (in 2004) to 2 (in 2011) per 1000 PN orders
 - Pharmacist interventions needed: 26 per 100 orders (2004) down to 6 per 100 orders (2006 and again 2009)
- Impact of computerized PN order worksheet (outside of CPOE)
 - Reduced overall PN prescribing errors 14.5% → 6.8% (p=0.016)
 - Peripheral PN order errors 29.3% → 9.6% (p=0.002)
 - 12 errors in 177 PN orders all due to data entry or transcription errors (avoidable)

Reducing PN Prescribing Errors

Do the Recommendations Improve Safety?

- Children's hospital implemented electronic PN ordering & compounding
 - Interdisciplinary committee evaluated PN process, identified potential error-prone practices, prioritized, developed and implemented solutions
 - Included implementation of CPOE & ACD; CDS with limits; eliminated transcription; compliance with A.SP.E.N. Guidelines & Recommendations
 - Reviewed errors reported between 2007-2013
 - Total 230 errors / 84,503 PN prescriptions
 - **Frequency of errors = 0.27%** (vs. ~ 1.6% from a previous study)
 - **Transcription errors = 0**
 - Most errors (95%) occurred during administration

Are We Making Progress?

Table 10. Comparison of the 2 A.S.P.E.N. PN Surveys (2003 and 2011) and the 2014 A.S.P.E.N. Member and Nonmember EHR Surveys Combined Regarding Responses to Questions on Processes Used to Order and Prepare PN.^a

Characteristic	2003 PN Survey	2011 PN Survey	2014 EHR Survey
Method of ordering PN	n = 536	n = 876	n = 689
Handwritten	382 (71)	589 (67)	253 (37)
Nonstandard	NA	45	22
Standard	NA	544	231
Electronic	154 (29) ^b	287 (33) ^b	436 (63) ^b
Nonstandard	NA	121	95
Standard	NA	166	341
Used to limit order entry errors^c	NA	n = 114	n = 491
Limit space in free text fields	NA	43 (38)	149 (30)
Use checkboxes instead of free text	NA	57 (50) ^d	296 (60)
Auto-populate as many fields as possible	NA	38 (33)	204 (42)
Maintain entire order on a single screen	NA	57 (50)	205 (42)
Dosing guidelines and decision support tools are built into the system	NA	62 (54)	246 (50)
Order cannot be submitted until all required fields are complete	NA	60 (53)	263 (54)
Pharmacy computer software system separate from organization's EHR	NA	n = 722	n = 630
Yes	NA	353 (49)	339 (54)
Method of data entry into pharmacy system	NA	n = 337	n = 600
Automatic electronic interface with EHR	NA	51 (15) ^d	188 (32)
Barcode entry from a printed label/requisition	NA	11 (3)	26 (4)
Do you use ACD for PN compounding?^e	n = 159	n = 608	n = 465
Yes	140 (88) ^f	410 (67) ^b	330 (71) ^b
How are PN orders entered into ACD?	n = 123	n = 396	n = 416
Manual entry (technician)	NA	112 (28) ^d	68 (16)
Manual entry (pharmacist)	103 (84)	211 (53)	233 (56)
Automatic electronic interface with EHR	20 (16) ^b	73 (19) ^b	115 (28) ^b

- Overall ~ 94% of respondents using an EHR (vs. 86% in 2012, p<0.05)
- Overall ~ 52% favorable response to PN ordering
 - Pharmacists: 55/120 (46%)

Vanek VW, et. al. *Nutr Clin Pract* 2016

Many Challenges...

- Substantial time & effort, input/expertise from all disciplines
 - Including pharmacists, physicians, dietitians, nurses, NPs/PAs
 - **Informatics team/experts**
- May depend on EHR vendor, EHR version, “package” purchased
- No standard amongst EHR platforms (yet...)
- Integration of EHR and separate pharmacy system and/or ACD
 - May include customized/compounded PN vs. standard commercial PN
 - May utilize external company to outsource PN compounding
- Education, adoption by end-users
- Refining and optimizing system and process
- Transitions of care / home care

Limitations to Technology and CDS



University of Michigan PN Order Process

PN order entered/
verified by
RPh at UM

Electronically
transmitted
to Outside
Vendor

Vendor
receives
order into
electronic
system, prints
label

Pharmacist
scans label,
loads order
into ACD
program

PN
compounded
on ACD

Learning Assessment Question #1

Which of the following is the MOST accurate statement regarding PN safety ?

- A. A.S.P.E.N. and ISMP recommend using non-standard PN orders on paper to maximize flexibility and customizability of PN orders
- B. There have been almost no coordinated efforts or advances in PN safety over the past ~ 5 years
- C. Based on a recently published survey, most hospitals have optimized PN ordering in their EHR systems, including complete electronic transmission of PN orders and optimized use of CDS
- D. Recent data suggest that optimizing PN orders and CDS in EHR systems can improve PN safety and reduce PN-associated errors

PARENTERAL NUTRITION WORKFLOW IN THE ELECTRONIC HEALTH RECORD

PN Workflow in EHR

- Organization and availability of orders
 - Consideration of patient population (adult/adolescent, pediatric, neonate)
 - Site (central and peripheral)
 - Day #1 defaults
 - Use of order set to help organize above

▼ Parenteral Nutrition - Adult/Adolescent (Recommended for >30 kg) Manage My Version▼

Must be ordered by **2:00 PM** the day the PN solution is to be administered.

Central Line:

Collapse

> Suggested Day #1

> Non Standard

> Non Standard (CYCLIC)

Peripheral Line:

Collapse

Peripheral Parenteral Nutrition in adult patients is restricted to patients who are chronically TPN-dependent, have lost central line access, and will not be able to obtain central access for at least 5-7 days.

> Suggested Day #1

> Non Standard

PN Workflow in EHR

- Ordering layout and components designed to support thought process and steps when designing patient's parenteral nutrition regimen and safe practices for parenteral nutrition
 - 1) Standardized & organized format, essential components, appropriate & safe units of measure, etc.
 - 2) Display of relevant patient information (e.g, laboratory, height/weight)
 - 3) Entry of volume, rate, duration/cycle and site (central vs peripheral)
 - 4) Entry of macronutrients (amino acids, dextrose, lipids)
 - 5) Entry of electrolytes
 - 6) Entry of other micronutrients (vitamins and trace elements)
 - 7) Entry of other supporting mediations (H2 blocker, insulin, levocarnitine, other vitamins, etc.)

PN Workflow in EHR

- Display of other supporting information to facilitate and guide ordering process (i.e., clinical decision support “CDS”)
 - Real-time display of calculation information (e.g., mg/kg/min of dextrose, protein and non-protein calorie information)
 - Cation and anion amounts in mEq/L with display of limit information if out of range
 - Soft- and hard-stops on various PN components

Parenteral Nutrition (CENTRAL) - Adult/Adolescent (Recommended for >30 kg)

TPN Order Summary

	Range	Total
Amino Acids (g/kg per DOSE)	<=4	60 g
Dextrose (g)	--	150 g
Dextrose Concentration (%)	<=35	
Glucose Infusion Rate (mg/kg/min)	<=7	
Infusion Rate (mL/hr)		41.7
Infusion Site	Central	
Weight Used		96 kg

Caloric Contribution			
	kcal/kg	kcal	%
Protein	2.45	240	32
Dextrose	5.2	510	68
Lipids	--	--	--
Total	7.65	750	


Electrolytes			
	Amount	Range	Total
Cations			
Sodium (mEq/L)	210	<=154	210
Potassium (mEq/L)	40	<=120	40 mEq
Calcium (mEq/L)	5	<=20	5 mEq
Magnesium (mEq/L)	8.12	<=20	8.12 mEq
Anions			
Phosphate (mmol/L)	15	<=30	15 mmol
Central Chloride (mEq/L)	215	--	215 mEq
Acetate (mEq/L)	75.4	--	75.4 mEq
Chloride: Acetate Ratio	2.85	--	

Mixture Compatibility			
		Range	
Calcium Phosphate Solubility Curve (mEq of Calcium)		5	<=10,050
Calcium Magnesium Sum (mEq/L)	13.12	<=20	
Osmolality	1,876.24	--	

Medication Warnings

New Warnings Report

New Warnings (1 unfiltered, 10 filtered)



Hard Stop TPN Warning

⚠️ ⬆️ Sodium exceeds limit by 36% (Hard Stop)

Details

This warning cannot be overridden.

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PN Workflow in EHR

- Vendor-specific design considerations
 - Major differences among EHR vendors in support of PN design and configuration
 - Allscripts
 - Provides an extensively customizable format and tools to design PN order layout
 - Ordering form fields can be created from scratch, provide custom input (e.g., mg/kg/min dextrose), and placed anywhere on form. CDS can be layered in and integrated with ordering form fields, so based on users input, additional fields and appear, disappear, vary input, etc. Fields can
 - Extensive CDS capabilities (Medical Logic Modules) to allow custom calculations for neonatal fluid requirements, programming hard-stops based on order- or patient-specific information (e.g., lock-out ordering after 2 PM).
 - Transmission to CAPS via flat file upload or real-time HL7 interface

PN Workflow in EHR

- Vendor-specific design considerations
 - Major differences among EHR vendors in support of PN design and configuration
 - Epic
 - Order form based on template (i.e., fields and layout more restricted to system-supplied configuration - limited customizability of layout and cannot build customized fields)
 - » Cannot configure a custom-fluid calculator for neonates to guide PN order volume based on fluid requirements
 - » Cannot build a field to input Dextrose based on mg/kg/min or auto-calculate mg cysteine based on grams of amino acid
 - Provides for incorporation of calcium-phosphate solubility curve CDS based on Trissel's (starting with version 2014)
 - CDS not as customizable (e.g., cannot easily program formulas for various fluid macro-/micronutrient checks)
 - Challenges with cyclic-PN
 - Transmission via flat file upload or real-time HL7 interface

PN Workflow in EHR

Allscripts PN Order Layout

Dosing Weight (kg):

Measurements:
Height (cm): Weight (kg): BSA (m²):
11-22-2013 07:19 05-28-2014 23:23

Relevant Results:

Access Line:

TOTAL FLUID CALCULATOR:

Total Fluid Goal (mL/kg/day): mL/day:

Volume of Lipids (mL/day): Enter the amount of Lipids ordered for today (mL/day)

Volume of Non-PN IV's (mL/day):

Volume of Feedings (mL/day):

PN Volume (mL/kg/day): mL/day: Additive Volume:

Infuse: Rate:

Additives/24 hr:

amino acids - Trophamine (g/kg):	<input type="text" value="3"/>	<input type="text" value="null g"/>	<input type="text" value="null %"/>
dextrose (mg/kg/min):	<input type="text" value="8"/>	<input type="text" value="null g"/>	
dextrose (%):	<input type="text"/>		

PARENTERAL NUTRIENT SUMMARY:

Total Kcal:	<input type="text" value="null Kcal/kg/day (0 Kcal total)"/>
Amino Acids:	<input type="text" value="null % 0 Kcal/kg/day (0 Kcal - null% of total)"/>
Dextrose:	<input type="text" value="0 Kcal/kg/day (0 Kcal - null% of total)"/>
Lipids:	<input type="text" value="null Kcal/kg/day (0 Kcal - null% of total)"/>
Total Potassium:	<input type="text" value="null mEq/kg (null mEq total)"/>
Total Sodium (Includes Amino Acids):	<input type="text" value="null mEq/kg (null mEq total) [null mEq/liter]"/>
Total Phosphate:	<input type="text" value="null mMol/kg (null mMol total)"/>
Total Chloride:	<input type="text" value="null mEq/kg (null mEq total)"/>
Total Acetate (Includes Amino Acids):	<input type="text" value="null mEq/kg (0 mEq total)"/>
Total Calcium:	<input type="text" value="0.5 mEq/kg (null mEq total)"/>
Total Magnesium:	<input type="text" value="0.5 mEq/kg (null mEq total)"/>
Calcium : Phosphorus Ratio:	<input type="text" value="null mEq : 1 mmol (optimal = 2.6 : 1)"/>
Calcium (mEq) + Phosphorus (mmol):	<input type="text" value="Ordered: null / kg - Maximum: null / kg"/>

potassium acetate (mEq/kg):	<input type="text"/>	<input type="text"/>
potassium chloride (mEq/kg):	<input type="text" value="2"/>	<input type="text" value="null mEq"/>
potassium phosphate (mmol/kg):	<input type="text"/>	<input type="text"/>
sodium acetate (mEq/kg):	<input type="text"/>	<input type="text"/>
sodium chloride (mEq/kg):	<input type="text" value="2.2"/>	<input type="text" value="null mEq"/>
sodium phosphate (mmol/kg):	<input type="text" value="0.5"/>	<input type="text" value="null mmol"/>
magnesium sulfate (mEq/kg):	<input type="text" value="0.5"/>	<input type="text" value="null mEq"/>
calcium gluconate (mEq/kg):	<input type="text" value="0.5"/>	<input type="text" value="null mEq"/>

multivitamins ped per protocol (mL):

*** Chloride : Acetate Ratio: ***

PN Workflow in EHR

Epic PN Order Layout

Parenteral Nutrition w/Cysteine (CENTRAL) - Neonate/Infant (Recommended for <10 kg) - WITHOUT LIPID
✓ Accept ✗ Cancel

TPN Order Summary

Amino Acids (g/kg per DOSE)		Range	Total	Electrolytes		
Dextrose Concentration (%)	0	<=35	21.13	Cations	Amount	Range
Glucose Infusion Rate (mg/kg/min)	0	<=14	3.02	Sodium (mEq/L)	105.65	<=154
Infusion Rate (mL/hr)	8.3		2	Potassium (mEq/L)	70	<=120
Infusion Site	Central		2	Calcium (mEq/kg per DOSE)	0.5	<=4
Weight Used (Dosing Weight)	7 kg		0.5	Magnesium (mEq/L)	17.86	<=20
Energy Contribution			Anions			
Protein	12	84	100	Phosphate (mmol/kg per DOSE)	0.5	<=2
Dextrose	--	--	--	Chloride (mEq/L)	150.15	--
Lipids	--	--	--	Acetate (mEq/L)	101.85	--
Total	12	84		Chloride: Acetate Ratio	1.47	--

Mixture Compatibility

	Range
Osmolarity	1,472.04 --
Calcium Phosphate Solubility Curve (mEq/kg per DOSE of Calcium)	0.5 <=0.88
Cysteine (mg/g of amino acid)	-- --
Total Cysteine (mg) needed for 40 mg/g of amino acid	840 --
Calcium: Phosphate Ratio (mEq: mmol)	1 --

Summary Report: Show TPN Medications

Report: Lab Test Results

Component	Time Elapsed	Value	Range	Status
Creatinine	82 days (05/19/17 0720)	1.8		Final result

Reference Links: 1. Fluid & Dextrose Calculator

Weight: 7 kg

Type: Dosing weight: 7 kg (recorded in the last hour)

Volume: mL

Administer Over: Hours

Rate: mL/hr

200 mL / 24 hr = 8.3 mL/hr (rounded to the nearest 0.1 mL/hr from 8.3333 mL/hr)

Infusion Site:

Route:

Admin. Inst.:

Prod. Admin. Inst.: Use a 0.22- micron filter during administration. When decreasing feedings, changing drip rates or making N...

Note to Pharmacy: [Click to add text \(F6\)](#)

Amino Acids (Selection Required)

amino acids 10 % g/kg per DOSE

Next Required
✓ Accept ✗ Cancel

PN Workflow in EHR

Epic PN Order Layout

Parenteral Nutrition w/Cysteine (CENTRAL) - Neonate/Infant (Recommended for <10 kg) - WITHOUT LIPID ✓ Accept ✗ Cancel

TPN Order Summary

	Range	Total	Electrolytes	
Amino Acids (g/kg per DOSE)	3	<=4	21 g	
Dextrose Concentration (%)	0	<=35		
Glucose Infusion Rate (mg/kg/min)	0	<=14		
Infusion Rate (mL/hr)	8.3			
Infusion Site	Central			
Weight Used (Dosing Weight)	7 kg			
Energy Contribution				
	kcal/kg	kcal	%	
Protein	12	84	100	
Dextrose	--	--	--	
Lipids	--	--	--	
Total	12	84		

	Range	Total	Weight-Based Total
Cations			
Sodium (mEq/L)	105.65	<=154	21.13 3.02
Potassium (mEq/L)	70	<=120	14 mEq 2
Calcium (mEq/kg per DOSE)	0.5	<=4	3.5 mEq 0.5
Magnesium (mEq/L)	17.86	<=20	3.57 0.51
Anions			
Phosphate (mmol/kg per DOSE)	0.5	<=2	3.51 0.5
Chloride (mEq/L)	150.15	--	30.03 4.29
Acetate (mEq/L)	101.85	--	20.37 2.91
Chloride: Acetate Ratio	1.47	--	

	Range
Mixture Compatibility	
Osmolarity	1,472.04 --
Calcium Phosphate Solubility Curve (mEq/kg per DOSE of Calcium)	0.5 <=0.88
Cysteine (mg/g of amino acid)	-- --
Total Cysteine (mg) needed for 40 mg/g of amino acid	840 --
Calcium: Phosphate Ratio (mEq: mmol)	1 --

Pharmacy

Amino Acids (Selection Required)

amino acids 10 % g/kg per DOSE

Dose calculation will be based on dosing weight for all ingredients.
[Jump to weight selection](#)

Calc. Dose = 21 g
 3 g/kg per DOSE × 7 kg (Dosing weight as of Wed Aug 9, 2017 1609)
 = 21 g × 100 mL/10 g
 = 210 mL × 10 g/100 mL
 = 21 g

Dextrose (Selection Required)

dextrose g

QS Base (Selection Required)

sterile water

Electrolytes

potassium acetate

potassium chloride mEq/kg per DOSE

Dose calculation will be based on dosing weight for all ingredients.
[Jump to weight selection](#)

Calc. Dose = 14 mEq
 2 mEq/kg per DOSE × 7 kg (Dosing weight as of Wed Aug 9, 2017 1609)
 = 14 mEq × 1 mL/2 mEq
 = 7 mL × 2 mEq/mL
 = 14 mEq

potassium phosphate

sodium acetate

sodium chloride mEq/kg per DOSE

Dose calculation will be based on dosing weight for all ingredients.
[Jump to weight selection](#)

Calc. Dose = 15.4 mEq
 2.2 mEq/kg per DOSE × 7 kg (Dosing weight as of Wed Aug 9, 2017 1609)
 = 15.4 mEq × 1 mL/4 mEq
 = 3.85 mL × 4 mEq/mL
 = 15.4 mEq

sodium phosphate mmol/kg per DOSE

Next Required
✓ Accept ✗ Cancel

PN Workflow in EHR

- Overall impact on design / re-design between EHRs
 - Re-evaluate neonatal PN order entry workflow on impact of not having fluid calculator integrated as part of order
 - Conversion of hard- to soft-stop on due time for PN order entry
 - No longer able for system to directly evaluate dose checking across all micronutrients (e.g., checking for total dose of between distinct trace elements in trace elements solution and amounts additionally added)
→ required embedding directions on order
 - Legacy EHR allowed entry of dextrose in gram or mg/kg/min and conversion to new EHR only allowed entry in gram
 - Additional versions of PN order templates in order set to accommodate cyclic PNs

PN Workflow in EHR

- Key considerations during EHR PN design
 - Work closely with Information Technology
 - Informatics pharmacist to help translate clinical to IT workflow in consideration with EHR features and limitations
 - Establish a multidisciplinary team of clinical subject matter experts in parenteral nutrition (e.g., adult and pediatric) and informatics pharmacist
 - Close relationship with vendor
 - Help understand, translate workflow and adapt to EHR design
 - Communication of EHR limitations based on best practices
 - Enhancements to future EHR versions (e.g., Ca-Phos solubility curve checking, CDS on trace elements, etc.)

Learning Assessment Question #2

Which of the following is a barrier or challenge when designing PN workflow in an EHR or changing EHR vendors?

- A. Limited active clinical decision support capabilities (e.g., alerts)
- B. Limited passive clinical decision support capabilities (e.g., display of relevant results or protein / calorie information as order summary information)
- C. Inability to customize order entry fields as appropriate for macro- or micronutrient
- D. Limited options to customize layout of PN order entry form / order composer
- E. All the above

Optimizing CDS and PN Orders in EHRs: Achieving the Unachievable?

UMCL PHARM ADULT

UMCL-1001-02

Allergies: Egg

060001029 / 0600010290367

ZZ_GenUser1, Production Test

Requested By: Me Other: ZZ_GenUser1, Production Test

Source: Written

Allergy Details

Session:

Type: Standard ACTIVE Orders

Reason:

Manual Entry

Searching for ...

TPN

Order	Cost
TPN < 10kg (neonatal) (Parenteral Nutrition < 10kg (neonatal))	
TPN > 30kg (Adult/Adol) (Parenteral Nutrition > 30kg (Adult/Adol))	
TPN 10-30kg (Pediatric) (Parenteral Nutrition 10-30kg (Pediatric))	
TPN After Hours Starter (Parenteral Nutrition After Hours Starter)	

Restricted to infants less than 24 hours of age AND

Sunrise Clinical Manager

This patient's actual weight is greater than 30 kg. Cancel this order set and use the parenteral nutrition > 30 kg order set.

OK

UMCL PHARM ADULT
 UMCL-1001-02
 Allergies: Egg

Parenteral Nutrition > 30kg (Adult/Adol)

Must be ordered by 2:00 PM the day the PN solution

Lipid Emulsion:

Order
 lipid emulsion 20% injection UH

Central Line:

Order	Amino Acids:	Volume:	Units:	Amino Acids (g):	Dextrose (g):	Access Line:	Infuse:	Kcal:
- Suggested Day 1 - 1 item(s)								
<input type="checkbox"/>	parenteral nutrition > 30kg	Amino Acids 15%*	1000	mL	60	150	Central Venous Line	Infuse over 24 hr
- Non-Standard - 1 item(s)								
<input type="checkbox"/>	parenteral nutrition > 30kg	Amino Acids 15%*		mL			Central Venous Line	Infuse over 24 hr

Peripheral Parenteral Nutrition in adults is restricted to patients who are chronically TPN-dependent, have lost central line access, and will not be able to obtain central access for at least 5-7 days.

Peripheral Line:

Order	Amino Acids:	Volume:	Units:	Amino Acids (g):	Dextrose (g):	Access Line:	Infuse:	Kcal:
- Suggested Day 1 - 1 item(s)								
<input checked="" type="checkbox"/>	parenteral nutrition > 30kg	Amino Acids 15%*	2000	mL	50	200	Peripheral Line	Infuse over 24 hr
- Non-Standard - 1 item(s)								
<input type="checkbox"/>	parenteral nutrition > 30kg	Amino Acids 15%*		mL			Peripheral Line	Infuse over 24 hr

Order Set: Parenteral Nutrition > 30kg (Adult/Adol)

The following Order Sets and/or Orders either have informational messages, warnings or contain errors. Correct any errors by editing the order.

Order Items:

Peripheral Parenteral Nutrition in adult is restricted to patients who are chronically TPN-dependent, have lost central line access, and will not be able to obtain central access for at least 5-7 days.

Select All Deselect All Edit OK Help

Weight (kg): 90

12-20-2012 16:51

*Test patient, does not contain actual patient information

dextrose rate: 1.2 mg/kg/min

potassium acetate (mEq):		Dextrose:	510 Kcal (5.7 Kcal/kg/day - 44%)
potassium chloride (mEq):	40	Lipids:	400 Kcal (4.4 Kcal/kg/day - 35%)
potassium phosphate (mmol):		Total Potassium:	40 mEq
		Total Sodium (Includes Amino Acids):	187 mEq (187 mEq/liter)
sodium acetate (mEq):	17	ate (Includes Amino Acids):	15 mMol
sodium chloride (mEq):	150	Total Chloride:	190 mEq
sodium phosphate (mmol):	15	ate (Includes Amino Acids):	77.4 mEq
		Total Calcium:	null mEq
magnesium sulfate (mEq):	10	Total Magnesium:	10 mEq
calcium gluconate (mEq):			
		*** Chloride : Acetate Ratio: ***	71.05 : 28.94

multivitamins per protocol (mL): 5

Select trace minerals option: Selenium is the only trace element currently available

Standard protocol

Individualized (select below)

Zinc (mg):	
Selenium (mcg):	40
Copper (mg):	
Manganese (mg):	
Chromium (mcg):	

Optional Additives:

famotidine (mg):

Sunrise Clinical Manager

The following maximums have been exceeded:
sodium concentration > 154 mEq/L
Call the TPN Pharmacy at 68244 (734-936-8244) with questions.

OK

Order Sets

TPN

+ Add | Advanced

Record Select

Search: TPN

%	Type	Display Name	Record Name	ID
■		Parenteral Nutrition 10-30 kg (Pediatrics)	UM RX PARENTERAL NUTRITI...	27
■		Parenteral Nutrition < 10 kg (Neonatal)	UM RX PARENTERAL NUTRITI...	586
■		Parenteral Nutrition > 30 kg (Adult/Adolescent)	UM RX PARENTERAL NUTRITI...	26
■		Parenteral Nutrition Starter / Metabolic Orders	UM RX PARENTERAL NUTRITI...	408000050

4 records total, all records loaded.

Accept Cancel

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Orders ↑

Clear All Orders

Order Sets

▶ Manage User Order Sets

▼ Parenteral Nutrition > 30 kg (Adult/Adolescent) Add Order

Must be ordered by 2:00 PM the day the PN solution is to be administered.

▼ Central Line:

▼ Suggested Day #1

- Parenteral Nutrition (Central) > 30 kg (Adult/Adolescent) - WITH LIPID
- parenteral nutrition (Central) > 30 kg (Adult/Adolescent) - WITHOUT LIPID
Intravenous, for 24 Hours

▼ Non Standard

- Parenteral Nutrition (Central) > 30 kg (Adult/Adolescent) - WITH LIPID
- Parenteral Nutrition (Central) > 30 kg (Adult/Adolescent) - WITHOUT LIPID
Intravenous, for 24 Hours

▼ Non Standard (CYCLIC)

- Parenteral Nutrition (Central-Cyclic) > 30 kg (Adult/Adolescent) - WITH LIPID
- parenteral nutrition (Central-Cyclic) > 30 kg (Adult/Adolescent) - WITHOUT LIPID

▶ Peripheral Line:

▼ Additional SmartSet Orders Add Order

Click the Add Order button to add an order in this section

Close F9 ↑ Previous F7 ↓ Next F8

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parenteral nutrition (Central) > 30 kg (Adult/Adolescent) - WITHOUT LIPID

1,000 mL, at 41.7 mL/hr, Intravenous, Central, for 24 Hours

= 68.959 mL for display (within 1% of actual 68.96 mL dose)

Electrolytes

- potassium acetate
- potassium chloride 40 mEq
- potassium phosphate
- sodium acetate 25 mEq
- sodium chloride 155 mEq

*Test patient,
does not contain
actual patient
information

Medication Warnings

Current Warnings Report

Current Warnings (1 unfiltered, 18 filtered)

TPN Warning
High Sodium exceeds limit by 29% (Hard Stop)
Details

Intolerance not an aller

Associated Orders
parenteral nutrition (Central) > 30 kg (Adult/Adolescent) - WITHOUT LIPID
Facility administered New. Remove

Interaction Warnings
These warnings cannot be overridden because there is an order whose dose exceeds its hard stop maximum or there is a TPN order with at least one component that violates the hard stop min-max range.
OK

Override All Warnings...
Override and Accept Cancel

Show filtered warnings (18)

Total
198 mEq
40 mEq
10 mEq
10.15 mEq
15 mmol
196.8 mEq
78.4 mEq
Range
<=200
--

Orders [?] [Resize] [Close X]

Active | Signed & Held | Home Meds | Cosign | Order History | **TPN**

TPN Rounding Summary Report

TPN INSTRUCTIONS

To MODIFY the new TPN order, click the "Modify" hyperlink below. NOTE: the use of 'modify' is only allowed on new orders ordered before 3:30 PM.

To REORDER the current TPN order for the next day, click the "Reorder" hyperlink below.

To DISCONTINUE the TPN order, click the "Discontinue" hyperlink below.

Current Order	Start Date/Time			
* parenteral nutrition (Central) > 30 kg (Adult/Adolescent) - WITHOUT LIPID	10/08 2100	Modify (do not use on currently infusing order)	Reorder	Discontinue

TPN Medication Recent History (Show up to 4 orders; newest on the left.)

Start date and time	
10/08/2014 2100	parenteral nutrition (Central) > 30 kg (Adult/Adolescent) - WITHOUT LIPID [188673493]
Order Status	Active
Macro Ingredients	
amino acids 10 %	60 g
dextrose	150 g
Electrolytes Ingredients	
potassium chloride	40 mEq
sodium acetate	25 mEq
sodium chloride	35 mEq
sodium phosphate	9 mmol
magnesium sulfate	10 mEq
calcium gluconate	10 mEq
QS Base Ingredients	
sterile water	98.96 mL
MVI/Trace Elements (All individualized trace elements are now available) Ingredients	
multivitamin-vitamin K-adult 3,300 unit- 150 mcg/10 mL	10 mL
zinc	5 mg
selenium	60 mcg
copper	1 mg
manganese chloride	0.1 mg
chromium chloride	10 mcg

New Vendor → New Challenges

- CDS available, but more limitations (e.g., can check vs. one field/limit but not multiple)
- Order set functionality
 - Order date (ordering for future)
 - “Modify” on currently infusing orders
- Ca-Phos solubility
- Cyclic PN orders: Rate/schedule – requires separate order set (order re-entry when changing to/from cycle); POC glucose also challenging
- PN orders for neonatal patients
- IV lipids
 - “Linked” orders – alternating days
 - Split IV lipids (neonates, syringes)
- Charting of infusion rates/intake

parenteral nutrition (Central) > 3
1,000 mL, at 41.7 mL/hr, Intravenous, (

Electrolytes

- potassium acetate
- potassium chloride
- potassium phosphate
- sodium acetate
- sodium chloride
- sodium phosphate
- magnesium sulfate
- calcium gluconate

TPN Medication Recent Histo

Start date and time

Order Status

Macro Ingredients

amino acids 10 %

dextrose

Electrolytes Ingredients

potassium chloride

sodium acetate

sodium chloride

sodium phosphate

magnesium sulfate

calcium gluconate

QS Base Ingredients

sterile water

MVI/Trace Elements (All indiv

multivitamin-vitamin K-adult 3,300 unit

zinc

selenium

copper

manganese chloride

chromium chloride

NAME: ADULT, TPN

Patient ID: ██████████

DOB: 04 FEB 1942

MRN: ██████████

Physician: Unknown

Area: NONE

Room: UHOR

Bed: OR

Weight: 45.4 kg

Hosp Rx#: 176265696

SAMPLE LABEL

POTASSIUM CHLORIDE
SODIUM ACETATE
SODIUM CHLORIDE
SODIUM PHOSPHATE
MAGNESIUM SULFATE
CALCIUM GLUCONATE
MVI-ADULT
ZINC SULFATE
SELENIUM
COPPER
MANGANESE
CHROMIUM

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*Test patient, does not contain actual patient information

TPN Order Summary

	Range	Total
Amino Acids (g/kg per DOSE)	1.29 <=4	110
Dextrose (g)	300 --	300
Dextrose Concentration (%)	15 <=35	9
Glucose Infusion Rate (mg/kg/min)	2.45 <=7	9
Infusion Rate (mL/hr)	83.3	
Infusion Site	Central	
Weight Used (Order-Specific)	85 kg	

Caloric Contribution

	kcal/kg	kcal	%
Protein	5.18	440	30.14
Dextrose	12	1,020	69.86
Lipids	--	--	--
Total	17.18	1,460	

Electrolytes

Cations	Amount	Range	Total
Sodium (mEq/L)	90	<=154	180 mEq
Potassium (mEq/L)	40	<=120	80 mEq
Calcium (mEq)	20	--	20 mEq
Magnesium (mEq/L)	5.08	<=20	10.15 mEq

Anions	Amount	Range	Total
Phosphate (mmol)	45	--	45 mmol
Chloride (mEq/L)	85	--	170 mEq
Acetate (mEq/L)	70.37	--	140.73 mEq
Chloride: Acetate Ratio	1.21	--	

Mixture Compatibility

	Amount	Range
Calcium Phosphate Solubility Curve (mEq of Calcium)	20	<=47.52
Osmolarity	1,590.15	--

QS Base (Selection Required)

sterile water mL

Electrolytes

- potassium acetate
- potassium chloride mEq
- potassium phosphate
- sodium acetate mEq
- sodium chloride mEq
- sodium phosphate mmol
- magnesium sulfate mEq
- calcium gluconate mEq

Calc. Dose = 20 mEq
 20 mEq × 1 mL/0.465 mEq
 = 43.01 mL × 0.465 mEq/mL (rounded to the nearest 0.01 mL from 43.0108 mL)
 = 19.9997 mEq (rounded to the nearest 0.0001 mEq from 19.9997 mEq)
 = 20 mEq for display (within 1% of actual 19.9997 mEq dose)

MVI/Trace Elements (select standard trace elements or individualized trace elements)

- multivitamin-vitamin K-adult 3,300 unit-150 mcg/10 mL mL
- trace elements adult (chromium, copper, manganese, selenium, zinc) mL
- zinc
- selenium
- copper

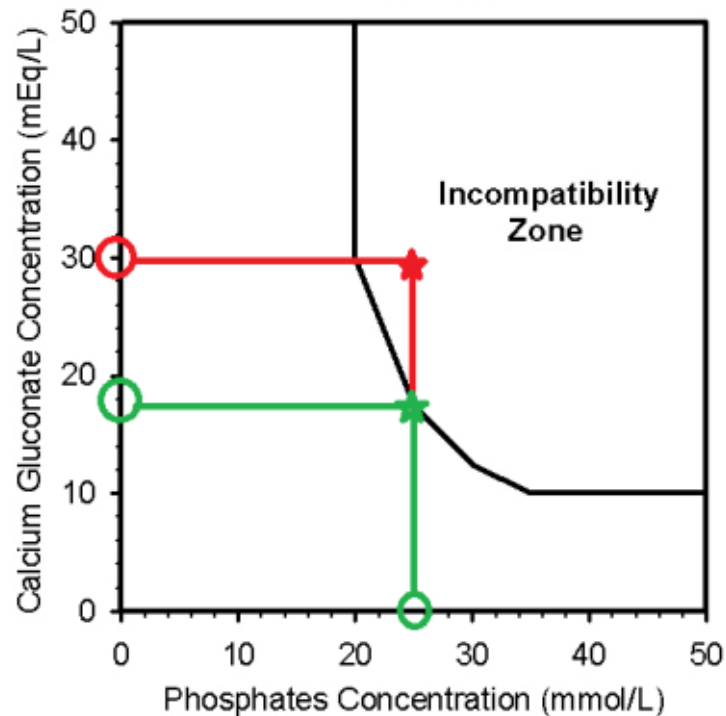
[Show Ingredient Information](#)

Mixing Compatibility	Range
Calcium Phosphate Solubility Curve (mEq of Calcium)	30 <= 18
Cysteine (mg/g of amino acid)	-- --
Osmolality	1,700.2 --

<input checked="" type="checkbox"/> sodium acetate	15	mEq
<input checked="" type="checkbox"/> sodium chloride	45	mEq
<input checked="" type="checkbox"/> sodium phosphate	45	mmol
<input checked="" type="checkbox"/> magnesium sulfate	10	mEq
<input checked="" type="checkbox"/> calcium gluconate	30	mEq

Calc. Dose = 30 mEq
 $30 \text{ mEq} \times 1 \text{ mL}/0.485 \text{ mL} = 64.52 \text{ mL} \times 0.485 \text{ mEq/mL} = 30.0018 \text{ mEq} = 30 \text{ mEq for display (wt)}$

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*Test patient, does not contain actual patient information

Medication Warnings

New Warnings **Report**

New Warnings (1 unfiltered, 1 filtered)

TPN Warning

 Calcium Phosphate Solubility Curve: Calcium of Ingredients (20 mEq/L) > Maximum Calcium (12 mEq/L) (**Hard Stop**)

[Details](#)

Associated Orders

parenteral nutrition (Central) > 30 kg (Adult/Adolescent) - WITHOUT LIPID Remove

Hospital medication: New.

Interaction report for Willow-Zimmerman, Testpatient (100018420)

TPN Warning Report

Calcium Phosphate Solubility Curve: Calcium of Ingredients (20 mEq/L) > Maximum Calcium (12 mEq/L)

Significance: Exceeds Calcium Phosphate Solubility Curve (Hard Stop)

TPN Component	Actual	Minimum	Maximum	Hard Stop?
Calcium Phosphate Solubility Curve*	20 mEq/L (30 mEq)	-	12 mEq/L (18 mEq)	Yes

*Calcium Phosphate Solubility is based on a curve with less than 40 mg of cysteine per g of amino acid (no cysteine).

Adjust amino acid, phosphate, calcium, or cysteine accordingly:

If you want to adjust calcium:

AA Type	Curve	Amino Acid	Phosphate	Allowed Maximum Calcium to Avoid Precipitate
Novamine	4 %	6 %	45 mmol	18 mEq

If you want to adjust phosphate:

AA Type	Curve	Amino Acid	Calcium	Allowed Maximum Phosphate to Avoid Precipitate
Novamine	4 %	6 %	30 mEq	36 mmol

Print Close

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EHR Systems Are Not Perfect!

Still Requires Expertise of Nutrition Support Clinicians!

Volume (24hr):
(excludes lipids) Units: mL Access Line: Central Venous Line

Additive Volume:

Infuse: Rate:

Additives (24hr):

Amino Acids Solution: Amino Acids 15% should only be used for persistent hyperphosphatemia in the absence of additional sources of phosphate.

amino acids (g): <input type="text" value="60"/>	amino acids %: <input type="text" value="0.3 %"/>	Total Kcal: <input type="text" value="10440 Kcal (150.6 Kcal/kg/day)"/>
dextrose (g): <input type="text" value="3,000"/>	dextrose %: <input type="text" value="15"/>	Amino Acids: <input type="text" value="240 Kcal (3.5 Kcal/kg/day - 2% of total); 0.9 g/kg"/>
dextrose rate: <input type="text" value="30.1 mg/kg/min"/>		Dextrose: <input type="text" value="10200 Kcal (147.2 Kcal/kg/day - 98% of total)"/>

*Does not contain patient identifiers

EHR Systems Are Not Perfect!

Still Requires Expertise of Nutrition Support Clinicians!

Adult PN (> 30 kg) admixture

1000 mL

AA = 60 g/day (6%)

Dex 150 g/day (15%)

Sodium phos = 15 mmol/day (15 mmol/L)

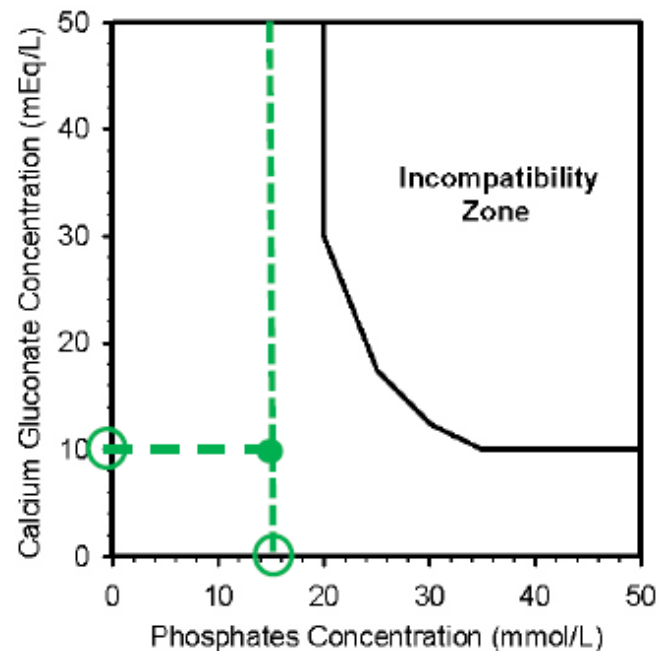
CaGluconate = 10 mEq/day (10 mEq/L)

Mixture Compatibility

	Range
Calcium	10 <-- 10,850
Phosphate	
Solubility Curve (mEq of Calcium)	
Cysteine (mg/g of amino acid)	-- --
Osmolality	1,838.3 --

<input checked="" type="checkbox"/> sodium acetate	15	mEq
<input checked="" type="checkbox"/> sodium chloride	45	mEq
<input checked="" type="checkbox"/> sodium phosphate	15	mmol
<input checked="" type="checkbox"/> magnesium sulfate	10	mEq
<input checked="" type="checkbox"/> calcium gluconate	10	mEq

Calc. Dose = 10 mEq
10 mEq × 1 mL/0.465 mEq



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INFORMATICS SOLUTIONS TO KEY PN WORKFLOW CHALLENGES

- Cyclic PN Orders
- Order modification/re-ordering
- Split lipid syringes
- Medication Shortages
- Neonatal dosing and fluid calculator

Informatics Solutions to Key PN Workflow Issues

- Cyclic PNs
 - Previous ability with legacy EHR to auto-calculate PN rate and display cyclic directions for durations < 24 hours
 - With conversion to Epic, required several changes:
 - Several field manipulations (rather than one field) to properly associate cyclic PNs (*volume, administer over and SmartText in Admin. Instructions*)
 - Remove rate field given display of fixed rate on MAR
 - Order Set adjusted with an additional order option for cyclic PNs with administer over field not defaulted to 24 hours and providing additional standard administer over options
 - Epic has provided enhancement starting with version 2017 to better handle symmetric cycle ordering (ramp up and taper down buttons)

Informatics Solutions to Key PN Workflow Issues

- Cyclic PNs

Parenteral Nutrition - Adult/Adolescent (Recommended for >30 kg)

Must be ordered by **2:00 PM** the day the PN solution is to be administered.

▼ Central Line:

▼ Suggested Day #1

Parenteral Nutrition (CENTRAL) - Adult/Adolescent (Recommended for >30 kg)

▼ Non Standard

Parenteral Nutrition (CENTRAL) - Adult/Adolescent (Recommended for >30 kg)

▼ Non Standard (CYCLIC)

Parenteral Nutrition (CYCLIC) - Adult/Adolescent (Recommended for >30 kg)

▶ Peripheral Line:

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Order Inst: If using Cyclic TPN frequency, enter desired volume and duration and then find appropriate rate instructions within Admin. Instructions by typing in 'TPN' to search Smart Text. Infusion starts at 21:00

Weight Type: **Recorded** Dosing Order-Specific
100 kg 75 kg

Recorded weight: 100 kg (recorded 201 days 20 hours ago)

Volume: 1,500 mL 1,000 mL **1,500 mL** 1,680 mL 1,800 mL 2,000 mL 2,400 mL 2,500 mL 3,000 mL

Administer Over: 22 Hours **22 Hours** 20 Hours 18 Hours 16 Hours 14 Hours 12 Hours

Infusion Site: Central

Route: Intravenous **Intravenous** **TPN 1500 ML OVER 22 HOURS**

Admin. Inst.:

Rate Instructions (1500 mL over 22 hours): 30 ml/hr x 1 hr, 45 ml/hr x 1 hr, 75 ml/hr x 18 hrs, 45 ml/hr x 1 hr, 30 ml/hr x 1 hr, off

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Informatics Solutions to Key PN Workflow Issues

- Order Modifications / Re-Ordering
 - Display of PN orders in active medications order tab in Epic may lead to inadvertently modifying or prematurely discontinuing the currently infusing or new order. (The current and new PN orders display next to each other)
 - Use of an additional tab ‘PN Navigator’ to specifically address PN ordering workflow (PN orders are filtered from the active medications order tab)
 - The tab provides guidance on how/when to use reorder and more clear organization of PN orders
 - Modification hyperlink was removed. Conversion to 3-in-1 PNs resulted in modification button persisting past cut-off time on new orders

Informatics Solutions to Key PN Workflow Issues

Orders ? Actions ▾ Resize ⇅ Close

Active Signed & Held Home Meds Cosign Order History **TPN**

TPN Rounding Summary Report ↻

TPN INSTRUCTIONS

To REORDER the current TPN order for the next day, click the "Reorder" hyperlink below (modifications can be made during order entry before signing/submitting the order) **before 2 PM**.

To DISCONTINUE the TPN order, click the "Discontinue" hyperlink below.

Current Order	Start Date/Time		
* Parenteral Nutrition (CENTRAL) - Adult/Adolescent (Recommended for >30 kg)	08/15 2:00	Reorder	Discontinue
Parenteral Nutrition (CENTRAL) - Adult/Adolescent (Recommended for >30 kg)	08/14 2:00	Reorder	Discontinue
Parenteral Nutrition (CENTRAL) - Adult/Adolescent (Recommended for >30 kg)	08/13 2:00	Reorder	

TPN Medication Recent History (Show up to 4 orders; newest on the left. Changes between the two most recent orders are indicated.)

Start date and time	08/15/2017 2:00	08/14/2017 2:00	08/13/2017 2:00
Order Status	Parenteral Nutrition (CENTRAL) - Adult/Adolescent (Recommended for >30 kg) [311151690] Active	Parenteral Nutrition (CENTRAL) - Adult/Adolescent (Recommended for >30 kg) [311151662] Active	Parenteral Nutrition (CENTRAL) - Adult/Adolescent (Recommended for >30 kg) [310967558] Expired
Last Given		08/14/2017 2:00	08/13/2017 2:22
Macro Ingredients			
parenteral amino acid 15%	60 g	60 g	60 g
dextrose	100 g	100 g	100 g
Electrolytes			
potassium chloride	↓ 15 mEq	25 mEq	25 mEq
potassium phosphate	↓ 12 mmol	24 mmol	24 mmol
sodium acetate	20 mEq	20 mEq	20 mEq
sodium chloride	55 mEq	55 mEq	55 mEq
magnesium sulfate	↓ 8 mEq	12 mEq	12 mEq
calcium gluconate	5 mEq	5 mEq	5 mEq

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Informatics Solutions to Key PN Workflow Issues

- PN Management Order
 - Address and communicate changes to currently infusing PN order

Parenteral nutrition management ✓ Accept ✗ Cancel

Priority: Routine

Frequency: Until Discontinued

For: Hours Days Weeks

Starting: Today Tomorrow At:

Starting: **Today 1336** **Until Specified**

Scheduled Times: [Hide Schedule](#)
8/15/17 1336

❗ Select from one of the following:

- Discontinue after current bag
- Stop current bag - start new bag at 9 PM
- Decrease rate by 50% x 2 hours, then D/C
- Current TPN discontinued inadvertently. Do not stop infusing and continue ...
- Ordering lipids only today (no TPN)
- Hold infusion for (enter number of hours in comments)
- Okay to continue infusing home PN until next PN is due

Comments: [Click to add text \(F6\)](#)

❗ Next Required Link Order ✓ Accept ✗ Cancel

Informatics Solutions to Key PN Workflow Issues

- Split Lipid Syringe Workflow

- Lipid dose split into two syringes if < 100 mL (continuous) or 50 mL (cyclic)
- Original workflow with Epic: Pharmacy dispenses two syringes, and Nurses have to remember to add a 2nd task 12 hours later and adjusted the infused over field so will accurately reflect on MAR at the end of the PN infusion interval.
- Modified workflow: BPA reminder when scanning syringe and use of MAR actions to auto-schedule 2nd syringe 12 hours later
- New Epic enhancement for split dose workflow to auto-generate MAR tasks during verification and better reflect infused over information

Informatics Solutions to Key PN Workflow Issues

- Split Lipid Syringe Workflow

BestPractice Advisory - Bcnmattpoc,Adult-One

Important (Advisory: 1)

Note: A split lipid dose has been scanned.

A split lipid dose has been scanned. This dose needs to be documented correctly in order for the second MAR task to populate the MAR.

- Change the MAR Action to '1st Split Lipid Syringe'.
- Enter half of the 'Admin Dose' in the dose field.
- Enter the listed rate into the 'Rate' field.
- Change the 'Infuse Over' field to 12 Hours.

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Accept Dismiss

Infusion

X fat emulsion 20 % injection 20 mL : Dose 0.5 g/kg per DOSE x 8 kg (Order-Specific) : Admin Dose 20 mL : 0.83 mL/hr : Intravenous : CONTINUOUS

Show Flowsheet

Admin Amount: 20 mL
Frequency: CONTINUOUS
Route: Intravenous
Order Dose: 0.5 g/kg per DOSE x 8 kg (Order-Specific)
Ordered Infusion Rate: 0.83 mL/hr
Infused Over: 24 Hours

Admin Instructions:
Dispensed amount contains overflow; Please note actual infusion volume carefully;

Product: fat emulsion 20 % Emul
Order Start Time: Today 05/02/16 at 1400
Order End Time: Tomorrow 05/03/16 at 1359

Action: 1st Split Lipid Syringe ②

Date: 5/2/2016 Time: 1318

Comment: Enter Comment

Route: Intravenous

Site:

Dose: 10 ③ mL

Rate: 0.83 ④ mL/hr

Infused Over: 12 ⑤ Hours

Admin Dose: 20 mL

Order Concentration: 1 mL/mL

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fat emulsion 20 % injection 20 mL : Dose 0.5 g/kg per DOSE x 8 kg (Order-Specific) : Admin Dose 20 mL : 0.83 mL/hr : Intravenous : CONTINUOUS

2100 1 Lipid Syr 10 mL

0900 Due (2 Lipid Syr)

Admin Amount: 20 mL

Last Admin: Yesterday 05/01/16 at 2100

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Informatics Solutions to Key PN Workflow Issues


- Other Challenges
 - Medication shortages
 - Require quick-turnaround on configuration changes / testing in EHR
 - Existing configuration may need to be backed-out to accommodate changes and the replicated/tested in other EHR environments (development, testing, production)
 - Additional testing when interfacing to compounding vendor (i.e., CAPS) or automated compounding device
 - PN orders may need to be discontinued and re-entered to accurately reflect changes which creates additional work and transcription errors
 - 3-in-1 PN conversion (adult and some pediatric)
 - CDS may not be fully support
 - Minimum lipid concentration (20 gm / liter). To support, needed to use pre-configured alert using 200 kcal/liter (could not customize to gm/liter)

Informatics Solutions to Key PN Workflow Issues


- Order Modifications / Re-Ordering
 - No hard-stop to prevent ordering after cut-off times; use of a best practice advisory (BPA) to provide warning (soft-stop)

BestPractice Advisory [REDACTED]

Important (1) 

 TPN orders are only filled for orders placed before 2 PM. This TPN order will not be filled. Please contact Pharmacy with questions.

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 **Accept** **Cancel**

Continued Challenges to Key PN Workflow Issues

- Cyclic PN Workflow
 - Currently rely on user selecting and syncing volume, administer over and rate instructions to properly convey cyclic PN order information
 - MAR does not provide the rate given initiation and taper adjustments required (i.e., MAR can only provide a set rate)
 - With version 2017, Epic has provided functionality to better reflect the cyclic PN ordering process
 - Can indicate 1-2 steps (initiation & taper) for symmetric and asymmetric rate adjustments which will automatically translate to administration instructions
 - Will simplify orders (i.e., do not need to create specific cyclic PN order)
 - Dynamic population of MAR rate in future release

Continued Challenges to Key PN Workflow Issues

- Cyclic PN workflow

Adult 3-in-1 TPN

TPN Order Summary

TPN Order Summary		Electrolytes	
Amino Acids (g/kg)	1.6	0.5-2.5	Range
Lipids (g)	100	1-100	Amount
Dextrose (g)	199.99	1-600	Range
Dextrose Concentration (%)	8.33	0-30	60 60-150
Glucose Infusion Rate (mg/kg/min)	1.06-2.12	<=7	82 40-240
Non-Protein (kcal): Nitrogen (g)	96.51	--	12 3-30
Volume	2,400	--	12.18 10-45
Infusion Rate (mL/hr)	52-104	--	15 15-50
Infusion Site	Central	--	1 1-4
Weight Used (Order-Specific)	68 kg	--	

Energy Contribution		Mixture Compatibility	
Non-Protein		Osmolarity	1,036.36
Dextrose	679.97 kcal, 40.47%	Calcium Phosphate Solubility	75.28 <=200
Lipids	1,000 kcal, 59.53%	Calcium Magnesium Sum	10.07
Non-Protein Total	1,679.97 kcal	Iron-Fat Interaction	Pass
With Protein		Amino Acids 3-in-1 (g/L)	45.33
Protein	435.18 kcal, 20.57%	Lipids 3-in-1 (kcal/L)	416.67
Dextrose	679.97 kcal, 32.15%	Dextrose 3-in-1 (kcal/L)	283.32
Lipids	1,000 kcal, 47.28%		
Total	2,115.15 kcal		

Administration Instructions

Agitate bag before administering.
Use a 1.2 micron filter.
Start rate at 52 mL/hr for 1 hours.
Increase rate to 104 mL/hr for 22 hours.
Decrease rate to 52 mL/hr for 1 hours, then stop.

Frequency: CONTINUOUS (ORD) CONTINUOUS

For: 24 Hours

Starting: 3/10/2017 Today Tomorrow At: 1617

Starting: Today 1617 Ending: Tomorrow 1616

Scheduled Times: Hide Schedule

3/10/17 1617

Ramp up for: 1 Hours 0 Hours 1 Hours 2 Hours

Taper down for: 1 Hours 0 Hours 1 Hours 2 Hours

Rate: 52-104 mL/hr 60 mL/hr 75 mL/hr 100 mL/hr 125 mL/hr

Start rate at 52 mL/hr for 1 hours.
Increase rate to 104 mL/hr for 22 hours.
Decrease rate to 52 mL/hr for 1 hours, then stop.

Volume: 2,400 mL 1,440 mL 1,800 mL 2,400 mL 3,000 mL

Administer Over: 24 Hours 24 Hours

Route: Intravenous Intravenous

Admin. Inst.: Agitate bag before administering.

Continued Challenges to Key PN Workflow Issues

- Fluid Management and Dextrose Requirements (Neonates/Pediatrics)
 - Precise calculation of fluid and intake requirements critical to neonatal and pediatric care
 - Dextrose requirements for PN typically dosed by mg/kg/min
 - Ability to incorporate and dynamically show required PN volume based on daily fluid goal and intake sources (e.g., lipid, IV fluid, etc.) greatly facilitates PN ordering process and reduces error
 - Currently rely on a hyperlink from order to launch Excel-based fluid calculator in order to calculate PN volume and convert dextrose into g/day
 - “Clunky” and can cause transcription errors when copy and pasting in amounts to volume and dextrose order fields
 - Optimally, to build in ‘fluid calculator’ directly on PN order to pre-populate with appropriate PN volume
 - Allow ability to enter dextrose based on mg/kg/min

Continued Challenges to Key PN Workflow Issues

- Externally linked fluid calculator & dextrose rate converter

Total Fluid Calculator	
Dosing Weight (kg)	7
Total Fluid Goal (mL/kg/day)	70
Total Fluid Goal (mL/day)	490
Volume of Lipids (mL/day)	50
Volume of Non-PN IV's (mL/day)	0
Volume of Feedings (mL/day)	0
PN Volume (mL/kg/day)	62.86
PN Volume mL/day	440
Copy PN Volume (mL/day) into TPN order	

Dextrose Rate Converter	
Dosing Weight	7
Dextrose (mg/kg/min)	4
Dextrose (g/day)	40.32

Learning Assessment Question #3

Which of the following would be the preferred functionality to optimize safety of cyclic PN orders?

- A. Manually typing the rate instruction information for initiation- and discontinuation taper in the administration instructions field
- B. Selecting from a list of pre-configured instructions to populate the administration instructions field based on ordered PN volume and administer over fields
- C. Provide fields on the existing PN order that can be used to indicate initiation and taper rates, which all automatically translate into the PN cycle administration instructions, and which allows clinicians to reorder a PN order and carry all components forward (i.e. avoids manual transcription)
- D. None of the above – Cyclic PNs should not be entered into an EHR given the complexity of their change in administration rate requirements
- E. Any of the above

Key Takeaways

- Key Takeaway #1
 - Following A.S.P.E.N. and ISMP Recommendations for PN Safety can reduce PN-associated errors and improve safety
- Key Takeaway #2
 - PN use process is complex, requires input and expertise of clinicians from multiple disciplines, including experts in informatics, to optimize PN orders in EHR systems
- Key Takeaway #3
 - Challenges remain to optimize PN orders in EHR systems, share best practices, advocate for change with your vendor, work with A.S.P.E.N. and other organizations to advocate for standards and improvements



A Call to Action: Optimizing the Electronic Health Record for Parenteral Nutrition

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