Bringing Evidence-Based Medicine to the Bedside: The Cleveland Clinic Clinical Decision Support System (DSS)

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Bringing Evidence-Based Medicine to the Bedside

1. Current Status of Perioperative Care
   a. Handwritten Anesthesia Record

Problems

1. Difficult to read (often not legible)
2. Not updated in real time
3. Not accessible electronically

Still being used in more than 85% of anesthesia practices in the U.S.
Bringing Evidence-Based Medicine to the Bedside

1. Current Status of Perioperative Care
   a. Handwritten Anesthesia Record
   b. Automatically-generated Record
Bringing Evidence-Based Medicine to the Bedside

1. Current Status of Perioperative Care
   a. Handwritten Anesthesia Record
   b. Automatically-generated Record
   c. Latest (second/third generation) Record >> Compliance language
Patient Medication History: Patient has no admission medications.

Patient Care and Monitoring

**Patient Care:**
Pressure PITS padded; Eye care; Warming blanket

**Patient Position details:** Right Lateral Decubitus

**Monitoring:**
O2 monitor; EKG monitor applied; ETCO2 monitor; Disconnect alarm; NM block monitor; Temperature; BIS

**Temp1:** Bladder; **Temp2:** Not Monitored; **Warming Devices:** Forced air warming device; Warm water mattress;

Regional

**Time:** 08:40
- **Present for Block:** Sale, Shiva
- **Epidural/NBK for postop pain per surgeons request:** Yes
- **Block:** Epidural
- **Performed:** In OR
- **Catheter used:** Yes, **Needle:** 10ga Touhy 3.5"
- **Site:** T5-6
- **Technique:** LOR, **LOR to:** Saline
- **Paresthesia:** No
- **CSF:** No
- **Test Dose:** 1.5% Lido + 1:200,000 EPI cc: 5 Neg? Yes
- **Catheter Length (cm):** 12
- **Sterile prep and drape?:** Yes
- **Catheter:** In

**Controlled Drug Use**

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<tr>
<th>Drug Name</th>
<th>Taken</th>
<th>Used</th>
<th>Return</th>
<th>Disc</th>
<th>Witness</th>
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<tr>
<td>Bupi0.1%</td>
<td>300</td>
<td>8</td>
<td>0</td>
<td>292</td>
<td>A, B</td>
</tr>
<tr>
<td>/Fent2mcg [cc]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Ephedrine[MG]</td>
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<tr>
<td>Fentanyl[MG]</td>
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<td>100</td>
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<tr>
<td>Midazolam[MG]</td>
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<tr>
<td>Hydromorphone[MG]</td>
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<td>0.6</td>
<td>A, B</td>
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<tr>
<td>Witnesses:</td>
<td></td>
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<tr>
<td></td>
<td>A-Hardaway, Tiffany, B-Conway, Ellen</td>
<td></td>
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</tbody>
</table>

Airway Details

**Time:** 09:05
**Mask:** Yes; **Easy Mask:** Yes; **Airway Adjunct:** Oral; 4

**Intubation:** Asleep
**Airway:** DLT, Left, 37; # Trials: 1; Leak <20 cm H2O: No; Styllette: Yes

**Intubating Device(s):** Laryngoscope, MAC, Blade #: 4, Grade: 1

**BBS:** Yes; **ETCO2:** Yes

**Trauma:** Atraumatic; **Difficulty Comments:** Placement

Line Placement

08:12: IV; 18 ga; Right; Hand
09:24: IV; 16 ga; Left; Hand
09:36: ART; 22-5.5": Right; Radial; Difficult access; Sterile drapes

**Staff:** Sale, Shiva

End of Case

**Disposition:** JSS/09

**EndCase Params @11:56:** Temp: 35.9; HR: 59; SpO2: 99; O2 Flow: 6; RR: 18; ART Sys: 176; ART Dia: 40; O2 Mask: Yes

**Condition:** Stable; Report was given to ICU CTA staff; Report was given to ICU nurse;**Mental Status:** Alert; Awake

**Temp Probes:** Oral/PO/by mouth

**Transport Items:** EKG: Yes BP: Yes ETT: No CR: Yes O2, 6 (LPM)

Input & Output Fluid Summary

**Input**

- LR: 2700 cc

**Output**

- Urine: 300 cc

**Total Fluid (cc):** 2700

**Total Fluid (cc):** 300
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Advantages
1. Legible
2. Accurate
3. Compliant (Billing Compliance)
4. Queryable
Bringing Evidence-Based Medicine to the Bedside

1. Current Status of Perioperative Care
   Problem if there are Complications
Three Important Issues

1) Time to respond is limited
2) Correct diagnosis and intervention may matter
3) Process is prone to (not immune from) failure
Healthcare Reliability Terminology
(Different from the mathematical)

- Unstable process: Failure in greater than 20% of opportunities
- $10^{-1}$: 80 or 90 percent success. 1 or 2 failures out of 10 opportunities
- $10^{-2}$: 5 failures or less out of 100 opportunities
- $10^{-3}$: 5 failures or less out of 1000 opportunities
- $10^{-4}$: 5 failures or less out of 10,000 opportunities
Model 10\(^{-1}\) concepts

Intent, Vigilance and Hard Work:

10\(^{-1}\) Performance

(designed basic failure prevention)

- Common equipment, standard orders sheets
- Personal check lists
- Feedback of information on compliance
- Awareness and training
- Working harder next time

Model 10\(^{-2}\) concepts

Human Factors and Reliability Science:

10\(^{-2}\) Performance

(designed sophisticated failure prevention, basic failure identification and mitigation)

- Decision aids and reminders built into the system
- Desired action the default (based on evidence)
- Redundancy
- Takes advantage of habits and patterns
- Standardization of process
Electronic Recordkeeping and Decision Support

1. Current Status of Perioperative Care
2. Concept of Decision Support (DSS)

Pertinent, Patient-Specific Information (the right information at the right time to make the right decision)
Electronic Recordkeeping and Decision Support

1. Current Status of Perioperative Care
2. Concept of Decision Support (DSS)

Supervising Physician

OR

EMR

DSS

Knowledge Base

Web-Based
Secure (electronically, physical)
Compliant with Standards
(HL7, SNOMED nomenclature)
Platform-Independent
Scalable
Universally Applicable

Pertinent, Patient-Specific Information
Electronic Recordkeeping and Decision Support

1. Current Status of Perioperative Care
2. Concept of Decision Support (DSS)

 Allows adverse physiologic developments to be addressed before they become crises
Cleveland Clinic  Clinical Decision Support System (DSS)

Version 1.0 rolled out in January, 2010

Staff was in-serviced >> DSS Button became active in ARKS

Passive information (vital signs, incl. pulse pressure variability; reference texts, with links from patient diagnoses; CC Formulary links; guidelines)
Location: OR18 (Encounter ID #108676)

Medical History
- DEPRESSIVE DISORDER NOT ELSEWHERE CLASSIFIED
- STRESS INCONTINENCE FEMALE
- ALLERGIC RHINITIS CAUSE UNSPECIFIED
- ASTHMA UNSPECIFIED
- ESSENTIAL AND OTHER SPECIFIED FORMS OF TREMOR
- POSTMENOPAUSAL ATROPHIC VAGINITIS
- MIXED HYPERLIPIDEMIA
- UNSPECIFIED VITAMIN D DEFICIENCY
- BARRETT'S ESOPHAGUS
- CORONARY ATHEROSCLEROSIS OF UNSPECIFIED TYPE OF VESSEL NATIVE OR DRAFT
- LUMBAGO
- ESOPHAGEAL REFLUX
- OTHER VOICE DISTURBANCE
- CERVICAL SPONDYLOSIS WITH MYELOPATHY

Inpatient Med
- Patient has no admission medications.

Outpatient Med
- OMEGA-3 FATTY ACIDS 1,000 MG CAP
- ASPIRIN 81 MG TAB
- TRAZODONE 50 MG TAB
- gabapentin (NEURONTIN) 300 MG CAP
- simvastatin (ZOCOR) 10 MG TAB
- clonazepam (KLONOPIN) 0.5 MG TAB
- fexofenadine hcl (ALLEGRA) 180 MG TAB
- calcium carbonate (CALTRATE 900 + D PLUS MINERALS 600 MG+400 UNIT TAB)
- MULTIVITAMIN TAB
- omeprazole (PRILosec) 20 MG CAP
- ALBUTEROL 90 MG/C ACTUATION AEROSOL INHALER
- LAMOTRIGINE 100 MG TAB
- estradiol (ESTRACE) 0.01 % (0.1 MG/ g) VAGINAL CREAM
- acetaminophen (TYLENOL EXTRA STRENGTH 500 MG TAB)
UNSPECIFIED VITAMIN D DEFICIENCY
BARRETT'S ESOPHAGUS
CORONARY Atherosclerosis OF UNSPECIFIED TYPE OF VESSEL NATIVE OR GRAFT
LUMBAR DYSFUNCTION
ESOPHAGEAL REFLUX
OTHER VICE DISTURBANCE
CERVICAL SPONDYLOYSIS WITH MYELOPATHY
Hyperlipidemia LDL Goal < 100
HLP, MILD CAD, RCA 40% STENOSIS, MILD ASTHMA, BARRETT'S ESOPHAGUS, DEPRESSION ANXIETY, CERVICAL AND LUMBAR S Different WITH CK MYELOPATHY, BLADDER DYSFUNCTION POSSIBLE LUPUS ANTICOAGULANT, LR PELVIS, GERR PAIN

References
Miller's Anesthesia, 7th ed.
Bennett's Clinical Anesthesia, 5th ed.
Clinical Guidelines
Malignant Hyperthermia
Operating Room Fire

ACLS
Pulseless Electrical Activity
Tachyarrhythmia
Results in Miller: Miller's Anesthesia, 7th ed.

1. Antiphospholipid Syndrome
   From: Miller: Miller's Anesthesia, 7th ed., Chapter 55 - Coagulation - ... Common Acquired Thrombotic Disorders
   Characteristically, antiphospholipid syndrome results in mild prolongation of the aPTT and positive testing for lupus anticoagulant or anticardiolipin antibodies.

2. Coagulopathies
   From: Miller: Miller's Anesthesia, 7th ed., Chapter 34 - Preoperative Evaluation - ... Hemostatic Disorders
   ...cause prolongation of the aPTT. Further testing for a prolonged aPTT includes a repeat aPTT, an aPTT mixing study, lupus anticoagulant; ...
UNSPECIFIED VITAMIN D DEFICIENCY
BARRETT'S ESOPHAGUS
CORONARY ATHEROSCLEROSIS OF UNSPECIFIED TYPE OF VESSEL NATIVE OR GRAFT
LUMBAGO
ESOPHAGEAL REFLUX
OTHER VISCERAL DISTURBANCE
CERVICAL SPONDYLOYSIS WITH MYELOPATHY
Hyperlipidemia LDL Goal < 100
HLP MILD CAD - RCA 60% STENOSIS MILD ASTHMA, BARRETT'S ESOPHAGUS, DEPRESSION ANXIETY, CEREBRAL AND LUMBAR SACRAL SPONDYLOSIS WITH CK MYELOPATHY, BLADDER DYSFUNCTION, POSSIBLE LUPUS ANTICOAGULANTS, LUMBAR DISC HERNIA, CHRONIC PAIN

Search "Miller's Anesthesia, 7th ed."
Click words above to build search phrase. Click a word below to remove it from the phrase.

Search Clear

Case Summary

References
Miller's Anesthesia, 7th ed.
Bennet's Clinical Anesthesia, 5th ed.
Clinical Guidelines
Malignant Hyperthermia
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Pulseless Electrical Activity
Tachyarrhythmia
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Staff was in-serviced >> DSS Button became active in ARKS

Passive information (vital signs, incl. pulse pressure variability; reference texts, with links from patient diagnoses; CC Formulary links; guidelines)

Active alerts (No BP for > 5 min; Hypothermia, per SCIP; Risk of Awareness)

• Role of Time
Cleveland Clinic Clinical Decision Support System (DSS)

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Active alerts (No BP for > 5 min; Hypothermia, per SCIP; Risk of Awareness)

• Role of Time
• Specific Rules
Active Encounters as of 10/21/2009 11:10:21 AM

<table>
<thead>
<tr>
<th>Start</th>
<th>Location</th>
<th>Department</th>
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<tbody>
<tr>
<td>7:23 AM</td>
<td>OR01</td>
<td>GENA</td>
</tr>
<tr>
<td>8:41 AM</td>
<td>OR03</td>
<td>GENA</td>
</tr>
<tr>
<td>9:00 AM</td>
<td>OR15</td>
<td>GENA</td>
</tr>
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</table>
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Active alerts (No BP for > 5 min; Hypothermia, per SCIP; Risk of Awareness)

• Role of Time
• Specific Rules
• Multiple Parameters
Location: OR12
Tel. 52946  Who is signed in?  Encounter ID #382708

In case of emergency, call the E Control Desk at 4.6550

NBP

120
110
100
90
80
70
60
50
40
30
20
10
0

NBP Sys
NBP Dia
NBP Mean

Heart Rate

110

Inpatient Med
Lidocaine (PF) 10 mg/mL (1%) 1-2 mg
Injection (XYLOCAINE)
NaCl 0.9% infusion
Vancomycin 1 g in DSW 200 mL

Outpatient Med
Patient has no current outpatient medications

References
Miller's Anesthesia, 7th ed.
Barash's Clinical Anesthesia, 5th ed.
Clinical Guidelines
Malignant Hyperthermia
Operating Room Fire
Blood Tube Colors
Glucose Control Protocol

ACLS
Pulseless Electrical Activity
Tachyarrhythmia
Local Anesthetic Toxicity (LAST)
Clinical Decision Support System (DSS)

- Passive information (vital signs, incl. pulse pressure variability; reference texts, with links from patient diagnoses; CC Formulary links; guidelines)
- Active alerts (No BP for > 5 min; Hypothermia, per SCIP; Risk of Awareness)

- Role of Time
- Specific Rules
- Multiple Parameters

And

ARMS Infusion Data duration(minutes)
ARMS Infusion Data starting "m" minutes ago
ARMS Infusion Data Data_Name = Propofol
ARMS Infusion Data dose_amount_injecting (dose value)
Cleveland Clinic Clinical Decision Support System (DSS)

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Passive information (vital signs, incl. pulse pressure variability; reference texts, with links from patient diagnoses; CC Formulary links; guidelines)

Active alerts (No BP for > 5 min; Hypothermia, per SCIP; Risk of Awareness)

• Role of Time
• Specific Rules
• Multiple Parameters

Personalized alerts and notifications
Customizable and Dynamic DSS Content
Customizable and Dynamic DSS Content
Customizable and Dynamic DSS Content
Customizable and Dynamic DSS Content
DSS - Blackberry Version

Access to DSS
- Directly from Blackberry Browser
- From within DSS e-mail alerts
- Either method features auto logon

- Vitals
- Medical History
- Case Summary
- Medications (Inpatient & Outpatient)
- Alerts (can be acknowledged from BB)

- Allows direct calls to the OR
Allows adverse physiologic developments to be addressed before they become crises.

Allows staff assignment according to needs.
Clinical Dashboard

E BUILDING

Observation Time: 9:54 AM
NBP Mean: 57.00
14 minutes ago
Clinical Dashboard

E BUILDING
Operational Dashboard
Operational Dashboard
Operational Dashboard

OR23
130 1:2
104

OR24
9

OR25
150 1:2 5
56

OR14
138 1:1 MD
221

OR13
85 1:2 MD
62

OR12
141 1:2 MD
83

OR11
84 1:2

OR02

Ebrahim, Zeyd Logged in at: 07:39 Logged out at: 08:11
Kurz, Andrea Logged in at: 08:11 Logged out at: 08:33
Ebrahim, Zeyd Logged in at: 08:33

E BUILDING
Operational Dashboard
Operational Dashboard

E BUILDING
Operational Dashboard

E BUILDING
Operational Dashboard

E BUILDING
8 staff (instead of 13)  4 staff (instead of 7)  2 staff (instead of 3)

9 staff freed up

Operational Dashboard