Sanguine: Visual Analysis for Patient Blood Management

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JUNE 2021
Objectives

• List limitations of common patient blood management (PBM) metrics
• Consider how Creativity Workshops glean end user perspectives and insights
• Analyze Sanguine, a novel data visualization tool prototype for PBM in complex cardiothoracic surgery
• Evaluate how Sanguine can rapidly demonstrate PBM performance in context
• Consider how Sanguine can be used to generate “patients like mine”
Defining PBM

• Rationally optimizing anemia and hemostasis
• Goal of “restricting” blood utilization
• Improve patient outcomes, efficiency, and value

Value = Quality / Cost

sabm.org
Last Lab Value Prior to Transfuse Event/Order RBC

- **Hgb <= 5.9 or Hct <= 17.9**
- **Hgb [6.0-6.9] or Hct [18.0-20.9]**
- **Hgb [7.0-7.9] or Hct [21.0-23.9]**
- **Hgb [8.0-8.9] or Hct [24.0-26.9]**
- **Hgb [9.0-9.9] or Hct [27.0-29.9]**
- **Hgb >= 10.0 or Hct >= 30.0**

**Note:** The diagram shows the distribution of last lab values prior to transfusion events. Each bar represents the percentage of cases within the specified Hgb or Hct range.
RBC transfusion Best Practice Alerts (BPAs)

• **Alert 1**: Hemoglobin (7g/dL), hematocrit (21%) threshold

• **Alert 2**: Single unit transfusion policy
Hemoglobin/hematocrit BPA:

End user action to remove order 30% (very successful)
Single unit transfusion policy BPA

End user action to remove order <1% (not so good!)
An opportunity to further improve

• Changed single unit BPA default action
  » “Keep” → “remove”

• 4.5 month follow up
  » End user action to remove increased to 35%
  » Default action influences end-user behavior

Electronic clinical decision support: Evidence that default settings influence end-user behavior

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Best Practice Alert Results

• Pre-intervention: 4/2018 to 3/2019
• Post-intervention: 4/2019 to 3/2020

• Overall 11% reduction in RBCs transfused

• Projected acquisition cost savings
  ~$400k/year
Limitations of threshold approaches

• PBM is multifaceted
  » Perioperative anemia management
  » Blood conservation
  » Surgical technique
  » Antifibrinolytic agents

• Evaluate blood use beyond lab values?
  » For example: high blood loss surgeries
Risk-adjustment by organizational unit using billing codes

Level 1

All patients

Level 2

Admissions with Surgery

Admissions Without Surgery

Dept 1 Dept 2 Dept N Dept 1 Dept 2 Dept N

Level 3

Physician 1 Physician 2 Physician N

Level 4

Physician 1 Physician 2 Physician N

### Statistical vs Clinical Significance

<table>
<thead>
<tr>
<th>Model</th>
<th>DRG weight</th>
<th>p-value</th>
<th>Clinical LOS</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td>1.22</td>
<td>&lt;0.001</td>
<td>1.03</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Surgical</td>
<td>1.26</td>
<td>&lt;0.001</td>
<td>1.03</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Medical</td>
<td>1.05</td>
<td>&lt;0.001</td>
<td>1.04</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

DRG = diagnosis related group; IRR = incidence rate ratio

Application & next steps

- **Data visualization**: graphical representations of data to facilitate understanding and insights into the data

- **Sanguine**: a novel tool with rapid, flexible data visualizations in relevant PBM contexts
  - Institutional review board approval
  - Data use agreement

Cardiothoracic (CT) Surgery Database

• Worked closely with Enterprise Data Warehouse (EDW)

• CT surgery database core elements:
  » Patient demographic data
  » Encounter data
  » Billing codes (ICD, CPT, DRG)
  » Surgery case
  » Vital signs
  » Medications
  » Labs
  » Blood transfusions

ICD = international classification of diseases; CPT = current procedural terminology; DRG = diagnosis related group
Why CT Surgery?

• Highly complex patients that frequently require blood transfusions

• Several possible PBM modalities exist
  » Perioperative anemia management
  » “Restrictive” transfusion strategy
  » Antifibrinolytic agents
  » Intraoperative blood recovery

• Quality-oriented, collaborative culture
Data Visualization: What is possible?

• Cohort filter/zoom to any organizational unit
  » Department, procedure type, physician, patient, etc

• Create meaningful context:
  » Blood utilization
  » Surgeon and anesthesiologist
  » Procedures
  » Risk adjustment
  » Laboratory values
  » Use of PBM modalities
  » Time/intervention
  » Outcomes: mortality, complications, etc.
  » Cost
Creativity Workshop

- **End user stakeholders (participants):** CT surgeons, CT anesthesiologists, IT decision support
- **Facilitators:** Visualization expert*, PBM expert
- **Three hour session**
  - Opening/background, tool demo (20min)
  - Current workflow (30min)
  - Wishful thinking (50min)
  - Visualization analogies (30min)
  - Barrier removal (40min)
  - Reflection and next steps (10min)

*Scientific Computing and Imaging (SCI) Institute: scl.utah.edu

vdl.sci.utah.edu/CVOWorkshops
Activity 2: Wishful Thinking: Grouping / Prioritizing

Now we would like you to:
- Group your ideas by topics
- Rank them by importance
Creativity Workshop: Findings/Themes

• Transfusion can feel like an emotional decision, bias to transfuse if not sure
• My practice compared to a standard?
• Benchmarking my utilization with risk-adjustment would be useful
• Want info at hierarchical levels
• Incorporate patient outcomes
• Retrospective quality application
  » Beyond blood: include other quality measures?
Sanguine: Selected Use Cases

• Preoperative anemia management
• Transfusion appropriateness
• Antifibrinolytic agents
• Cell salvage
• “Patients like mine”
• General quality
• Financial impact
Switching Gears: Live Demo

Sanguine: Visual Analysis Tool for Patient Blood Management

Conclusions

• Limitations of static PBM metrics
• Risk-adjusted blood use for comparisons
• Creativity workshops for stakeholder input
• *Sanguine* identifies PBM patterns in context; examples:
  » Preop anemia management
  » Transfusion appropriateness
  » Antifibrinolytic use
  » Cell salvage use
  » “Patients like mine”
Future directions and next steps for Sanguine

- Deployed locally
- Beta site deployment
- Iterative refinement
  - State sharing, annotation, line up, etc.
- Generalization
- Beyond PBM?
Acknowledgements

• Visualization (SCI)
  • Alex Lex
  • Haihan Lin
  • Jack Wilburn

• Pathology and ARUP Laboratories
  » Mark Astill and Adam Barker
  » Tracy George
  » Bob Schmidt and Sandy White
  » Rob Blaylock and Kelly Cail
  » Jason Goodfellow, Dee Peel and Jenni Micholetti
  » Andrew Fletcher

• CT surgery and anesthesiology
  • Josh Zimmerman
  • Candice Morrissey
  • Vikas Sharma
  • Joe Tonna

• Enterprise Data Warehouse (EDW)
  • Michael White
  • Reed Barney
ARUP is a nonprofit enterprise of the University of Utah and its Department of Pathology.