A Safe Transitions Pathway for Post Craniotomy Neurological Surgery Patients: High Value Care that Bypasses the Intensive Care Unit

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- None
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UCSF Numbers

Parnassus Campus – Adult Neurosurgery

- Volume of Crani Cases for FY17 - **1337**
- Crani Tumor Surgeons - **7**
- Crani Tumor NPs - **6**
- Neurosurgery Residents - **21**
- Adult Crani Neuro Nursing Beds (29 NICU, 28 NTCU, 35 Floor; **N=92**)
Background

- **Historical practice:**
  - All post-operative craniotomy patients recovered in the Neuro-ICU

- **Problem:**
  - Mandatory ICU placement creates bottleneck

- **Consequence:**
  - Domino effect on throughput causes case delays and possible cancellations

- **Context:**
  - Disparity among patients’ levels of acuity in the Neuro ICU
  - Acquisition of 20 additional Neuro Transitional Care Unit (NTCU) beds
Goal

- Identify patient populations in cranial Neurosurgery that can bypass the ICU post-operatively
- Focus on patients who have overall short LOS, planned 1 night ICU stay, with predictable post-operative courses
- In 2016, discussions began in our unit based leadership group

![ICU Days Distribution Chart]

<table>
<thead>
<tr>
<th>Department</th>
<th>ICU Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neurosurgery</td>
<td>42%</td>
</tr>
<tr>
<td>Neurology</td>
<td>34%</td>
</tr>
<tr>
<td>Heart and Lung Transplant</td>
<td>39%</td>
</tr>
<tr>
<td>Neurospine</td>
<td>14%</td>
</tr>
<tr>
<td>General Surgery</td>
<td>11%</td>
</tr>
</tbody>
</table>
Cost Savings Projection

- FY2015: $20.2M total direct cost for R&B for Neurosurgery

- Potential target population: 5-20 patients/month that could fall within a Safe Transitions Pathway (STP)

- Target population: 60-240 additional ICU days: resulting in $105,000 to $400,000 additional direct cost

- Cost differential per day between ICU and NTCU: $1504/day
Solution:

Safe Transitions Pathway (STP)

Goal:
- Improve patient experience
- Cost savings

- No ICU postop
- PACU to Neuro-Transitional Care Unit (6L)
- q1 -> q2h neuro checks and vital signs, CPO, telemetry
Advantages

Patient

• q1h absolutely necessary?
  • Decreased ICU delirium
  • Improved sleep: impact recovery?

• Impact on quality?
  • Private room (6L)
  • Family can be present overnight
  • ICU delay in transfer

• Less Transfers w/in Hospital
  • OR -> 6L -> Home

Quality

• Reduced Cost of Care
  • $$ Transitional Care Unit < ICU
  • Delayed transfers out of ICU have additional cost

• Increased ICU Bed Availability

• Throughput

• Improved Patient Satisfaction
CONSIDERATIONS

AT TIME OF SURGICAL BOOKING

Planned Procedures:
- Routine craniotomy for supratentorial tumor resection;
- Chiari decompression;
- MVD

Suggested Inclusion Criteria:
- If tumor is < 3cm;
- Age < 65;
- Surgery < 5hrs;
- No medical comorbidities that warrant ICU observation

INTRAOPERATIVELY

- No intraoperative adverse events;
- Routine extubation;
- Blood loss <500mL

Note: Can change postoperative destination to Neuro ICU if any intraoperative concerns arise

POSTOPERATIVE MONITORING

Includes:
- PACU until transfer to 6Long Neuro TCU;
- Telemetry and continuous pulse oximetry;
- Vital signs and Neuro checks Q2 hours
Trial- 10 Tumor Patients
Trial- 10 Tumor Patients

- **Meningioma**
  - 55yo F
  - 1.2 cm
  - Supratentorial
  - 50 mL EBL
  - Discharged: POD 2

- **Meningioma**
  - 55yo M
  - 2.2 cm
  - Supratentorial
  - 50 mL EBL
  - Discharged: POD 2

- **Meningioma**
  - 75yo F
  - 2.8 cm
  - Supratentorial
  - 50 mL EBL
  - Discharged: POD 4

- **Meningioma**
  - 55yo F
  - 4 cm
  - Supratentorial
  - 100 mL EBL
  - Discharged: POD 2

- **Meningioma**
  - 53yo M
  - 3.1 cm
  - Supratentorial
  - 100 mL EBL
  - Discharged: POD 2

- **Glioma**
  - 34yo M
  - 7 cm
  - Supratentorial
  - 200 mL EBL
  - Discharged: POD 1

- **Glioma**
  - 45yo F
  - 1.4 cm
  - Supratentorial
  - 100 mL EBL
  - Discharged: POD 3

- **Metastasis**
  - 48yo M
  - 1.7 cm
  - Supratentorial
  - 50 mL EBL
  - Discharged: POD 2

- **Metastasis**
  - 53yo M
  - 3.1 cm
  - Supratentorial
  - 100 mL EBL
  - Discharged: POD 2

- **Glioma**
  - 29yo M
  - 2.5 cm
  - Supratentorial
  - 100 mL EBL
  - Discharged: POD 2

- **Glioma**
  - 41yo F
  - 1.4 cm
  - Supratentorial
  - 100 mL EBL
  - Discharged: POD 2
Safe Transitions Timeline

- **First Patient:** Craniotomy for Meningioma Resection
- **First Chiari Decompression**
- **Award Granted**
- **First Microvascular Decompression**
- **Caring Wisely Launch**
- **Surgery Scheduler View Modification**
- **Epic Case Request Prompts**

**Timeline Dates:**
- August 16
- December 16
- March 17
- July 17
- January 18
- January 18
- March 18
Implementation

**Education**

Nursing Education
- Classes to Review New Patient Populations

Patient Pamphlets
- Tumor
- Chiari
- MVD

Workflows
- Surgeons
- Residents
- NPs
- Anesthesia

**Systems**

EPIC
- Dedicated Order Sets
- Eligibility screen

Email
- Weekly Case List Communication
- OR Booking Visibility

**Measurement**

Satisfaction
- Patient Surveys
- Nurse Surveys

Outcomes
- LOS
- Costs
- Adverse Outcomes
Nursing Education

Safe Transitions Pathway patients
Selected Craniotomy Cases | Brain Tumor Resection | Chiari Decompression | Microvascular Decompression | Arachnoid Cyst Decompression
should have the following ordered when patients first received from PACU

vital signs every 2 hours
neuro checks every 2 hours
continuous cardiac monitoring
continuous pulse oximetry
otherwise page resident on call (443-4323)

Posters on Clinical Requirements on the Units

Post-Op Destination Visibility on Surgery Booking Schedule

OR View
2/21/2018 0000 1000 1100 1200 1300 1400 1500 1600 1700 1800
WL 01
WL 02
WL 03
WL 04
WL 05
WL 06
WL 07
WL 08
WL 09

Booked/Actual List Cases OR Bed Ctrl PACU Log Anesthesia Equip Instru Surgeon Age

McDermott / Sigal
Melino / Leberman
Burch / Lieberman
Van de Veen / Beattie
Kramer / Hays
Marr / Anderson
Decoteau / Nol

McDermott / Sigal
Melino / Leberman
Burch / Lieberman
Van de Veen / Beattie
Kramer / Hays
Marr / Anderson
Decoteau / Nol
Familiarizing Nurses with the Neurosurgery Team
Education for the Department of Anesthesia

- Know the surgeon’s intended post-operative destination for every patient

- Select lower narcotic option for post-operative cranial neurosurgery patients

- Advocate for higher level of care if concern of hemodynamic instability

- Call the neurosurgery team for any concerns
Neurosurgeon Education

Surgeon Workflow Checklist

**At Time of Surgical Booking**
- **Identify** eligible patients for Safe Transitions Pathway
- **If placing booking order** (in APEX = Surgical Case Request): Postoperative care destination field should indicate **Transitional Care**

**On Day of Surgery**
- **Review** PACU/6Long as postoperative destination during pre-/postoperative debriefs

**Note:** Can change postoperative destination to Neuro ICU if any intraoperative concerns arise
STP Potential Eligibility

11 Procedures

Eligible for STP

No comorbidities warranting ICU observation

- **Crani for resection of glioma**
- **Crani for tumor resection asleep 4-6 hours**
- **Crani for tumor resection MAC with motor mapping**
- **Craniectomy & cervical laminoplasty with/without duraplasty for Chiari malformation**
- (Craniectomy) **Crani for resection of meningioma > 2.5 cm but < 5 cm**
- (Craniectomy) **Crani for resection of meningioma < 2.5 cm**
- **Crani for open biopsy; possible microdissection**
- **Suboccipital craniectomy with microvascular decompression (MVD) of cranial nerve**
- **Crani for tumor resection MAC with speech/language/ECOG mapping 4-6 hours**
- **Crani for retrosigmoid approach to CPA tumor resection**
- **Crani for tumor resection w/ I-125 seed implantation**
**EPIC Build Surgical Booking Prompt**

**Safe Transitions Pathway**

B. Here are the STP and non-STP case requests:

- **Case Requests**
  - STP Case Requests
  - Transitional Care Case Requests
  - Standard Case Request - no defaults
**EPIC Build** Post-Operative Order Sets to Ensure Safety:

- **Neuro Checks**
  - **STP related orders**
    - Your patient is currently on the Safe Transitions Pathway (STP). The orders below are recommended.
  - **Vital signs Q2 Hours**
    - Routine, Every 2 Hours First occurrence Today at 1400 Until Specified
  - **Neuro checks (Transitional Care Only)**
    - Routine, Every 2 Hours First occurrence Today at 1400 Until Specified
  - **Continuous Pulse Oximetry Orders**
    - Please order both the Initiate and the Continuous orders
    - For Mission Bay Birth Center patients: Continuous cardiac monitoring MUST be ordered with continuous pulse oximetry. Please order the “Continuous Pulse Ox with Cardiac Monitoring (for Birth center patients)” panel.
    - **Initiate Continuous Pulse Oximetry**
      - Routine, Once First occurrence Today at 1335
    - **Continuous Pulse Oximetry**
      - Routine, Continuous starting Today at 1335 Until Specified
  - **Continuous Cardiac Telemetry Orders**
    - Please order both the Initiate and the Continuous orders
    - **Initiate Continuous Cardiac monitoring**
      - Routine, Once First occurrence Today at 1335
      - Notify Provider for change in rhythm
    - **Continuous Cardiac monitoring: Indication =**
      - IP: Details
Patient Educational Pamphlets

-supporting that the patients’ expectations will meet their experience

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Pathway Of Care Plan Following Cranietomy For Tumor Resection

Pathway Of Care Plan: Microvascular Decompression Surgery for Trigeminal Neuralgia

Trigeminal neuralgia (TN), also called tic douloureux, is a chronic pain condition affecting the fifth cranial nerve (CNV) — the trigeminal nerve. This condition is characterized by sudden, severe, stabbing or shock-like episodes of facial pain in one or more of the branches of the trigeminal nerve. It typically occurs when the trigeminal nerve is compressed by an artery, or less commonly a vein, but may also be present with no apparent cause.

Trigeminal neuralgia surgery is reserved for people who still experience debilitating pain despite best medical management. Surgical evaluation for TN includes:

- Confirm the diagnosis of trigeminal neuralgia
- Review of brain magnetic resonance imaging (MRI) scan to investigate evidence of possible vascular compression
- Exclude other treatable causes of facial pain
- Evaluate the severity of the pain
- Evaluate the possibility of medical management for the patient
- Discuss patient preference regarding treatment goals and benefits versus risk

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Pathway Of Care Plan Following Chiari Decompression Surgery
Measurement of Patients who have completed STP (July 2017 – May 2018)

<table>
<thead>
<tr>
<th>Month</th>
<th>CHIARI</th>
<th>MVD</th>
<th>Glioma/Mets</th>
<th>Meningioma</th>
<th>Other</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jul-17</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>Aug-17</td>
<td>5</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>Sep-17</td>
<td>6</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>0</td>
<td>11</td>
</tr>
<tr>
<td>Oct-17</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td>Nov-17</td>
<td>7</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>Dec-17</td>
<td>5</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td>Jan-18</td>
<td>10</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>13</td>
</tr>
<tr>
<td>Feb-18</td>
<td>6</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td>Mar-18</td>
<td>12</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>15</td>
</tr>
<tr>
<td>Apr-18</td>
<td>15</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>18</td>
</tr>
<tr>
<td>May-18</td>
<td>8</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>11</td>
</tr>
</tbody>
</table>
Patients who did not complete STP as initially planned:

- 1 escalation in care to a cardiac ICU due to bradycardia post-op
- 1 cancellation due to intended STP plan not communicated to OR team by neurosurgery team
- 1 cancellation due to an intra-operative complication
- 1 cancellation due to prolonged operative time
- 1 cancellation due to extensive tumor growth on pre-op MRI
**Financial Outcomes**

**DIRECT COST PER CASE STANDARD VERSUS STP**

- **Standard Pathway**: $20,401
- **Safe Transitions**: $16,102

\[ \Delta \text{ of } $4,298 \]
Length of Stay Reduction

<table>
<thead>
<tr>
<th></th>
<th>Q1/Q3 Post-Op LOS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
</tr>
<tr>
<td>STP</td>
<td>54</td>
</tr>
<tr>
<td>Non-STP</td>
<td>153</td>
</tr>
<tr>
<td>Difference</td>
<td>0.27</td>
</tr>
</tbody>
</table>
Mean Number of ICU Days Saved Per Case: 1.20

\[ \times \]

Number of STP patients: 94

= 113 ICU Days Saved
## Actual FY18 Year to Date Direct Cost Savings

<table>
<thead>
<tr>
<th>Q1</th>
<th>Q2</th>
<th>Q3</th>
</tr>
</thead>
<tbody>
<tr>
<td>$81,413</td>
<td>$50,862</td>
<td>$99,833</td>
</tr>
</tbody>
</table>
STP: Average time in PACU:
1 hour 38 minutes
Range: 1-4 hours
Current percent of eligible patients using STP by procedure type

CHIARI

MVD

TUMOR

%Eligible Cases

%STP Cases
Survey Outcomes

- Survey sent to PACU Nurses
- 30 answered out of 59
  - (51% participation)

PACU Nurse Survey Report
Have you worked with Safe Transitions Pathway (STP) patients in the last year?

<table>
<thead>
<tr>
<th>Responses</th>
<th>Counts/Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>YES</td>
<td>8 (26.7%)</td>
</tr>
<tr>
<td>NO</td>
<td>5 (16.7%)</td>
</tr>
<tr>
<td>Not Sure</td>
<td>17 (56.7%)</td>
</tr>
</tbody>
</table>

What has your overall experience been like working with STP (Chiari, craniotomy for simple tumor resection) patients?

<table>
<thead>
<tr>
<th>Responses</th>
<th>Counts/Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Satisfied</td>
<td>1 (12.5%)</td>
</tr>
<tr>
<td>Satisfied</td>
<td>6 (75.0%)</td>
</tr>
<tr>
<td>Unsure</td>
<td>1 (12.5%)</td>
</tr>
<tr>
<td>Dissatisfied</td>
<td>0</td>
</tr>
<tr>
<td>Very Dissatisfied</td>
<td>0</td>
</tr>
</tbody>
</table>

![Bar chart showing survey results](chart.png)
Survey Outcomes

- Survey sent to NTCU nurses
- 30 out of 31 answered
- 96.8% participation

Q: Do you want to see more neurosurgical patients admitted to your unit?

A: 100% YES!

What is your comfort level working with patients with surgical hemovac drains:

- Very Low: 7%
- Low: 40%
- Unsure: 22%
- High: 30%
- Very High: 53%
## Patient Survey Metrics

### How would you rate your post-surgical experience?

<table>
<thead>
<tr>
<th>Privacy/Noise</th>
<th>Support for independent movement (i.e. Encouraged me to walk and get myself out of bed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Excellent</td>
<td>1 Excellent</td>
</tr>
<tr>
<td>2 Above Average</td>
<td>2 Above Average</td>
</tr>
<tr>
<td>3 Average</td>
<td>3 Average</td>
</tr>
<tr>
<td>4 Below Average</td>
<td>4 Below Average</td>
</tr>
<tr>
<td>5 Poor</td>
<td>5 Poor</td>
</tr>
</tbody>
</table>

### My Comfort

<table>
<thead>
<tr>
<th>My Comfort</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Excellent</td>
<td></td>
</tr>
<tr>
<td>2 Above Average</td>
<td></td>
</tr>
<tr>
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<td></td>
</tr>
<tr>
<td>4 Below Average</td>
<td></td>
</tr>
<tr>
<td>5 Poor</td>
<td></td>
</tr>
</tbody>
</table>

### Family Comfort

<table>
<thead>
<tr>
<th>Family Comfort</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Excellent</td>
<td></td>
</tr>
<tr>
<td>2 Above Average</td>
<td></td>
</tr>
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<td>3 Average</td>
<td></td>
</tr>
<tr>
<td>4 Below Average</td>
<td></td>
</tr>
<tr>
<td>5 Poor</td>
<td></td>
</tr>
</tbody>
</table>

### Do you have any additional feedback or comments on your experience?
Mitigation Plan

- Continued consensus building among neurosurgeons to reduce variation in practice

- Enhanced Recovery After Surgery (ERAS) craniotomy pathway discussions under way
Lessons Learned:

- Culture change is slow
- Executive leadership support is critical
- Requires team approach
- Sustainability reliant on building consensus around “new norm”
- Ongoing participation of key stakeholders is necessary
- IT modifications and builds take time
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- Sustainability reliant on building consensus around “new norm”
Cost-effectiveness development for the postoperative care of craniootomy patients: a safe transitions pathway in neurological surgery

Joseph A. Osorio, MD, PhD; Michael M. Safase, MD; Jennifer Viner, NP; Sujatha Sankarsan, MD; Sarah Imerheim, MPH; Ezekiel Adigun, BS; Gabriela Weigel, BS; Michael S. Berger, MD; and Michael W. McDermott, MD

1 Department of Neurological Surgery; 2 Division of Hospital Medicine; 3 Division of Strategic Improvement; and 4 School of Medicine, University of California, San Francisco, California

OBJECT The authors’ institution is in the top 5th percentile for hospital costs in the nation, and the neurointensive care unit (NICU) is one of the costliest units. The NICU is more expensive than other units because of lower staff/patient ratio and because of the equipment necessary to monitor patient care. The cost differential between the NICU and Neuro transitional care unit (NTCU) is $1504 per day. The goal of this study was to evaluate and to pilot a program to improve efficiency and lower cost by modifying the postoperative care of patients who have undergone a craniootomy, sending them to the NTCU as opposed to the NICU. Implementation of the pilot will expand and utilize neurosurgery beds available on the NTCU and reduce the burden on NICU beds for critically ill patient admissions.

METHODS Ten patients who underwent craniootomy to treat supratentorial brain tumors were included. Prior to implementation of the pilot, inclusion criteria were designed for patient selection. Patients included were less than 65 years of age, had no comorbid conditions requiring postoperative intensive care unit (ICU) care, had a supratentorial meningioma less than 3 cm in size, had no intraoperative events, had routine extubation, and underwent surgery lasting fewer than 5 hours and had blood loss less than 500 ml. The Safe Transitions Pathway (STP) was started in August 2016.

RESULTS Ten tumor patients have utilized the STP (5 convexity meningiomas, 2 metastatic tumors, 3 gliomas). Patients’ ages ranged from 29 to 75 years (median 49 years; an exception to the age limit of 65 years was made for one 75-year-old patient). Discharge from the hospital averaged 2.2 days postoperative, with 1 discharged on postoperative day (POD) 1, 7 discharged on POD 2, 1 discharged on POD 3, and 1 discharged on POD 4. Preliminary data indicate that quality and safety for patients following the STP (moving from the operating room (OR) to the neuro transitional care unit (OR-NTCU)) are no different from those of patients following the traditional OR-NICU pathway. No patients required reoperation in lieu of nursing care, and there were no readmissions. This group has been followed for greater than 1 month, and there were no morbidity.

CONCLUSIONS The STP is a new and efficient pathway for the postoperative care of neurosurgery patients. The STP has reduced hospital cost by $22,261 for the first 10 patients, and there were no morbidities. Since this pilot, the authors have expanded the pathway to include other surgical cases and now routinely schedule craniootomy patients for the (OR-NTCU) pathway. The potential cost reduction in one year could reach $500,000 if we reach our potential of 20 patients per month.

https://thejns.org/doi/abs/10.3171/2016.2.FOCUS1812

KEYWORDS craniootomy; intensive care unit; cost-effectiveness; quality; brain tumor
Actual FY18 Direct Cost Savings

- Actual FY18 direct cost savings to the Health System from 94 patients who went through the Safe Transitions Pathway was $422,128
- Because STP resulted in lower LOS and 113 fewer ICU days, there is an opportunity for higher revenue from increased high acuity patient cases/volume
- Direct cost savings in the STP group compared to the standard care group is statistically significant after adjusting for CMI, age, procedure type, time variation, and surgeon.  \(p = 0.02\)
- Direct cost savings in this generalizable model is approximately $1,632 per case with an actual cost savings to the hospital of $4,491 per case for each STP patient
Other Groups with Similar Pathways

REPORTS OF ORIGINAL INVESTIGATIONS

Same-day discharge after craniotomy for supratentorial tumour surgery: a retrospective observational single-centre study

Congé le jour même après craniotomie pour chirurgie sur tumeur sus-tentorielle: étude observationnelle rétrospective d’un centre hospitalier

Lashmi Venkatraghavan, MD; Suparna Bharadv
Mark Bernstein, MD; Pirjo Manninen, MD

A protocol for postoperative admission of elective craniotomy patients to a non-ICU or step-down setting

Jeffrey E. Florman, MD; Deborah Cushing, RN, MPH; Lynne A. Keller, RN, CNRN; and Anand I. Rughani, MD

1Neuroscience Institute, Maine Medical Center, Portland, Maine; and 2Department of Neurosurgery, Tufts University Medical Center, Boston, Massachusetts
Other Groups with Similar Pathways

- Florman et al found there were no major complications during the hospital stay when 200 consecutive elective craniotomy and supratentorial tumor resection patients were admitted directly to the neurosurgical floor. Only 5 (2.0%) of these patients required escalation to transitional-level nursing care within the first 48-hours post-operatively. No patients required transfer to the ICU.
- In 2016, Venkatraghavan et al showed that patients with supratentorial tumors who undergo operations shorter than four hours utilizing an enhanced recovery after surgery pathway may be discharged home on the same day with minimal readmissions or complications.
What could go wrong?

- Most serious complications after craniotomy occur within hours, not days, of the procedure.
- Moreover, longer admission times would not have prevented the subacute and delayed complications, such as a wound infection or CSF leak that lead to 30-day readmissions.
- Since shorter hospital stays are associated with fewer hospital acquired infections such as urinary tract infections (UTIs), decreased complications like deep venous thrombosis (DVT) and pulmonary embolism (PE), and lower costs, an added benefit of the STP pathway was decreased length of stay.