Doctorate of Nursing Practice Project: Neurosurgical Intensive Care Provider Team Perceptions of the Clinical Utility of Routine Postcraniotomy Computed Tomography

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Abstract

Background: Variability in practice regarding early postoperative computed tomography (EPOCT) exists between hospitals providing neurosurgical services. Utilization of a computed tomography (CT) scan in managing the postoperative neurosurgical patient has been questioned. It is routine practice for elective craniotomy for tumor resection patients at Oregon Health and Science University Hospital (OHSU) to undergo a CT scan within 60 minutes of arrival to the recovery room.

Method: A web-based 12 question survey was developed from the literature for a qualitative study, designed to better understand the research evidence to practice gap observed. Literature was reviewed to identify best practices for postcraniotomy CT along with national policies and initiatives designed to increase quality of care and utilization of CT to reduce cost and risk.

Intervention: Physicians, surgeons, residents, fellows, nurse practitioners, and physician assistants in the Neurosurgical Intensive Care Unit (NSICU) at OHSU were invited to participate in a survey examining these practices.

Results: 20 of 45 providers participated (44% response rate). 12 (60%) identified as NSICU providers who manage postoperative craniotomy patients, and 8 (40%) were neurosurgeons. The majority of surgeons operated on two to four patients/week, and ICU providers managed five to seven patients/week. All participants "strongly agreed" that hourly neurological exams were necessary (20/20, 100%) and that a postoperative decline in neurological status warranted a CT scan (20/20, 100%).

Conclusion: The findings support the best practices and rationale identified in the reviewed literature, regarding the importance of postcraniotomy hourly neurological examinations and the need for CT among patients presenting with a postoperative decline in neurological status.

Inconsistencies in the data may be attributed to those found in the literature, which described inaccuracies in provider self-reported CT ordering practices and perceptions of peers' ordering practices, versus the actual ordering practices of individual providers.

Introduction

Problem Description

Currently, no validated practice guidelines exist for postoperative computed tomography (CT) use among patients following elective craniotomies. This is despite the fact that a number of studies have evaluated imaging practices and their effects on patient management (Alkhalili et al., 2018; Boissonneau et al., 2017; Fontes et al., 2014; Schar et al., 2016; Zygourakis et al., 2016). Varying practices exist regarding the preferred timing of follow-up imaging for postoperative craniotomy patients, and the use of early CT remains controversial for patients who are neurologically intact or show no new focal deficits (Altieri et al., 2018; Gessler et al., 2015; Wen et al., 2016). Current evidence demonstrates that in the absence of a neurological decline, routine postoperative CT following elective craniotomy does not improve patient outcomes (Boissonneau et al., 2017; Schar et al., 2016).

In the postanesthesia care unit at OHSU, the expectation is that postoperative craniotomy patients are to be transported for a CT scan within 60 minutes of the surgery end time. No clear rationale exists for this practice. The principal investigator's prior experience at Carle Hospital one of the University of Illinois' teaching hospitals was for neurosurgeons to obtain a CT scan for the same population of patients immediately after surgery only when a neurological change indicative of a complication occurred, which is consistent with the literature. The variability in practice experienced between these two neurosurgical hospitals led to this quality improvement analysis.

Available Knowledge

A literature search was conducted using PubMed and CINAHL. The literature review focused on identifying studies that analyzed the utility of routine postcraniotomy head CT.

MeSH terms included “Craniotomy” and “X-Ray Computed Tomography.” The initial search returned 2,955 articles. “Postoperative” was added to the search terms, which reduced findings to 1,046. Filters including “human studies,” “English,” “19+ years,” and “available with full text” were applied and reduced the number to 557. The “similar articles” function in PubMed was used for each of the records that closely matched the focus of this study. This left 82 articles, of which 11 were selected. Additionally, the references from the cited studies were evaluated to find other potential sources, for a total of 15 articles.

The timing of and clinical indication for postcraniotomy head CT along with their utility and impact on management of the postcranitotomy patient were two major themes in the literature. Evidence demonstrates no impact of routine EPOCT on clinical management in elective postcraniotomy patients without neurological decline (Schar et al., 2016). However, only a paucity of literature assesses the utility of routine or systematic postoperative head CT in elective craniotomies for tumor resection. The following reviewed studies conclude that routine postoperative craniotomy CT rarely leads to an immediate surgical intervention and should be limited to patients who manifest neurological changes or to those with comorbidities that place them at increased risk (Benveniste et al., 2014; Boissonneau et al., 2017; Freyschlag et al., 2018; Garrett et al., 2013; Hussain et al., 2001). Reducing unnecessary head CT would positively impact overall patient healthcare and institutional operational costs and decrease patient exposure to safety risks (Garrett et al., 2013; Zygourakis et al., 2016).

Indication for Postoperative Head CT

According to Fontes et al. (2014), a routine postoperative CT of the head is performed for two reasons: to evaluate the surgical technique (e.g., placement of implants, extent of tumor resection), particularly in the context of surgical residency programs, and to assess for surgical

complications. It may also be ordered by providers to establish a new anatomical baseline for comparison in future CT or for teaching/educational purposes (Khaldi et al., 2010). The studies and authors selected for this review all demonstrate that the indication or timing of a postoperative CT should be based on a clinical finding, not obtained routinely and have made practice changes based on this evidence (Altieri et al., 2018; Fontes et al., 2014; Gessler et al., 2015; Jiang et al., 2013; Khaldi et al., 2010; Schar et al., 2016; Zygourakis et al., 2016).

Schar et al. (2016) designed a prospective observational study of 492 elective craniotomy patients who did not have routine postcraniotomy CT. Out of the 492-patient cohort, 449 (91.3%) did not have immediate postoperative CT and had an uneventful postoperative course and 43 (8.7%) patients went for CT within 48 hours of surgery because of unexpected neurological findings. Eight of these 43 patients needed urgent surgical interventions (n=4, 0.8%, re-craniotomy for ICH, and n=4, 0.8%, EVD for edema and hydrocephalus). Sensitivity and specificity for ordering head CT and the need for urgent reoperation or EVD were 100% and 92.77%, respectively, with a positive predictive value for surgical intervention of 18.6% (based on a yield of 8/43 patients who went for CT and needed urgent surgical intervention).

In another prosepctive study Gessler et al. (2015) collected data on 113 patients who had undergone a craniotomy for meningioma removal. The purpose of the study was to determine the role of routine postoperative imaging (PI) and its effect on clinical management. PI was performed for all patients on postop day one or when neurological changes occurred. The majority of patients (83 (73.5%)) had no new neurological deficits, PI results did not affect clinical management in any of the asymptomatic patients (p<0.001).

Altieri et al. (2018) found that forgoing CT scans within the first 24 hours was safe for those without neurological decline in their retrospective chart review of 264 patients who

underwent postcraniotomy for high-grade glioma. Fontes et al. (2014) evaluated a total of 892 patients who underwent cranial procedures followed by an EPOCT in a retrospective chart review. The study showed that awake and cooperative postcraniotomy patients do not require routine postoperative CT.

Khaldi et al. (2010) conducted a retrospective study as a result of variable practice patterns of post-elective and emergent craniotomies including no CT scan, CT scan done with transfer out of recovery, and CT scan done 24–48 hours postoperatively. The aim of the retrospective study was to identify optimal timing and evaluate the use of postoperative CT to determine the probability of return to the OR. Three categories of patients were created for the 251 cases studied; Group A, (<7h) ; Group B, (8–24h); and Group C, CT ordered because of a new neurological finding. The data showed that no patients who had a CT 0-24 hours postoperatively returned to the OR, whereas patients with a new neurological deficit in the postoperative period had a 30% (p<0.05) chance of emergency reoperation. Additionally, Khaldi et al. reported that early postoperative scans (0–7 hours) have the potential to miss CT changes that happen over time.

Alkhalili et al. (2018) performed a retrospective review of 755 patients at their institution who underwent an elective craniotomy for tumor resection followed by An EPOCT scan (<4h postoperatively). Patients with unexpected neurological exams, were more likely to have CT findings (p<0.001) requiring a surgical intervention (p<0.001). A total of 31 (4.1%) of the 755 scans evaluated had unexpected EPOCT findings. All unexpected EPOCT findings in patients with changed or unreliable postoperative neurological exams led to a non-surgical or surgical change in clinical management. The data did not support routine postoperative CT scans, and

Alkhalili et al. concluded that postoperative CT scans should not be routine but instead reserved for patients who have a changed or unreliable neurological examination.

Benveniste et al. (2014) evaluated 218 patients retrospectively, who underwent craniotomies from for resection of brain metastases (BrM) to determine the yield and utility of postoperative imaging. Neurological deficits occurred in 21 of the 226 (9%) patients, and 19 were taken for postoperative imaging. Of these, nine (47%) had significant findings on imaging, and two required a return to the OR. Of the 201 patients who did not demonstrate neurological deficits (91%), 23 had no postoperative imaging. The postoperative imaging conducted for the remaining 178 asymptomatic patients, demonstrated no complications and no change in management was required (incidence of 0%, 95% CI undetermined). Benveniste et al. thus concluded that routine postoperative imaging has a very low yield and may not be appropriate for asymptomatic patients.

Utilization and Cost

According to the Centers for Medicare and Medicaid Services (CMS), healthcare spending in the United States grew by 4.8% in 2019. For 2020–2027, health spending in the United States is projected to have a 5.7% growth average and reach nearly $6 trillion by 2027, which is predicted to be 19.4% of the gross domestic product (CMS, 2019).

Overutilization in radiology is defined as the use of medical imaging in situations where indications demonstrate that the results are not likely to improve patient outcomes (Hendee et al., 2010). The aforementioned key factors involved in overutilization are incentives and payment methods in the US healthcare system, provider practice preferences, defensive medicine, lack of familiarity with appropriate use criteria, patient requests, and fragmented care (Garrett et al., 2013; Hendee et al., 2010; Owlia et al., 2014). The cost of imaging services has grown to twice

the level of other healthcare technologies according to Garrett et al. (2013), who studied the efficient use of CT among neurosurgical patients. They calculated an annual total care cost of $56 million: 8% of the total was attributed to imaging, of which 50% was from CT scans, at an estimated cost of $1,000/scan.

Zygourakis et al. (2016) reviewed 304 patients who underwent elective (nonruptured) brain aneurysm clipping and postoperative CT and calculated the cost of treating patients in order to identify those who require a change in management. From the data collected, Zygourakis et al. concluded that postoperative neurological examinations were statistically significant in determining whether a postoperative CT affected clinical management ($p<0.0192$). They reported a noncontrast head CT cost of $292 and a total hospital cost per procedure of $72,227 (±$53,966). Of 99 neurologically intact postoperative patents who had routine CT, at a total cost of $28,908, only one patient had a CT finding that influenced medical management. However, among 11 patients with neurological deficits who had routine CT, at a total cost of $3,212, one patient had a CT finding that resulted in a change in management.

Rationale

The United States has seen a dramatic increase in the number of annual computed tomography (CT) scans, rising from approximately 3 million per year in 1980 to approximately 81 million per year in the early 2010s (Mansouri, 2016; Smith-Bindman et al., 2009). Key factors involved in this increase have been identified and include incentives and payment methods in the US healthcare system, provider practice preferences, defensive medicine, lack of familiarity with appropriate use criteria, patient requests, and fragmented care (Garrett et al., 2013; Hendee et al., 2010; Owlia et al., 2014). It is estimated that out of all the “high-tech” imaging done, 20–50% provides no useful information and may be unnecessary (Owlia et al.,

2014; Rao & Levin, 2012). Postoperative CT scanning is routine in neurosurgery (Alkhalili et al., 2018; Boissonneau et al., 2017; Schar et al., 2016), and CT is fast and readily accessible, and can be used to assess for possible postoperative complications such as intracranial hemorrhage, edema, hydrocephalus, or ischemia (Boissonneau et al., 2017; Khaldi et al., 2010; Schar et al., 2016).

This has led to a situation in which providers frequently obtain CT scans for patients who are asymptomatic, are neurologically intact, or have no new deficits. In an effort to reduce risk and cost for patients and healthcare institutions, national initiatives have been put in place to raise the level of awareness around the overutilization of radiographic imaging (Hendee et al., 2010; Shinagare et al., 2014). This idea is further supported by current US policy that ties reimbursement for healthcare services to evidence-based practice and quality metrics (Agarwal et al., 2018). With the growing cost of healthcare and concerns around radiation exposure, the relevance and utilization of CT scans in managing the postoperative neurosurgical patient should be based on a clinical indication that may lead to an intervention or a change in management and not done routinely.

Evaluation of the literature regarding the clinical utility of routine postcraniotomy CT scans identified a gap between evidence and practice. It is routine practice for many neurosurgical providers to order a postcraniotomy CT scan in asymptomatic patients with no clinical indication (Alkhalili et al., 2018; Schar et al., 2016). According to the literature, however, routine early CT in postoperative elective craniotomy patients without unexpected neurological deterioration is not necessary (Alkhalili et al., 2018; Schar et al., 2016). Evidence shows that patient outcomes are affected when postcraniotomy CT scans are performed only for those patients who are symptomatic with a clinical indication (Khaldi et al., 2010; Schar et al.,

2016). The studies selected for this review all demonstrate that the indication or timing of a postoperative CT should be based on a clinical finding and that CT should not be performed routinely (Gessler et al., 2015; Jiang et al., 2013; Khaldi et al., 2010; Zygourakis et al., 2016) None of the articles reviewed supported the practice of routine postcraniotomy head CT, whereas all provided evidence supporting the practice of limiting postcraniotomy head CT to those situations in which a clinical indication of increased risk of complications is identified. Finally, postoperative neurological decline was found to be an accurate predictor of complications, with a clear indication for an urgent CT of the head, providing a high diagnostic yield (Alkhalili et al., 2018)

This project was designed to learn the perception of the practice of EPOCT among the NSICU team at OHSU. Survey questions were developed from literature reviewed for this project in order to better understand the potential research evidence to practice gap observed.

Specific Aims

This paper aims to present a quality improvement project regarding the practice of obtaining postcraniotomy CT scans, as well as to present the data obtained from a qualitative study designed to examine this practice at Oregon Health and Science University Hospital (OHSU). The data can be used to identify potential stakeholders willing to engage with care providers and drive further study or a practice change if indicated.

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Methods

Context

The project was carried out at OHSU in Portland, OR, the state's only academic health center. OHSU has more than 400 adult patient beds, is a Level I trauma center, and is the first hospital to be designated as a comprehensive stroke center in the Pacific Northwest. Participants

in this study include members of the neurosurgical team, such as advanced practice providers (APPs), residents, and attendings. Over 30,000 surgeries are done each year at OHSU, and the volume of neurosurgical patients, including those undergoing craniotomy is rising (see Appendix B). There were approximately 400 elective craniotomies performed in 2012 and almost 700 in 2018. As mentioned above, it is routine practice for patients who undergo elective craniotomy for brain tumor at OHSU to receive a CT scan within 60 minutes of arrival in the recovery room, meaning that several hundred CT scans are carried out every year, regardless of neurological exam findings which is costing the hospital, and patients financially and safety.

Stetler (2001) has proposed a model of research utilization that served as the framework for this project. The model has five phases through which, relying on internal data and external evidence, the practitioner uses critical thinking and decision-making to determine how best to integrate research in practice. Phases I to III of Stetler's model have been used in this DNP project. During Phases I and II, a clinical practice was identified to formulate the following question: "What is the standard evidence-based practice in obtaining postcraniotomy CT scans for elective neurosurgery patients?" A review of the literature was completed, and a critical analysis/synthesis of the literature was performed, which revealed controversy and variability in practice. Phase III of Stetler's model underpinned the bulk of the project, and a 12-question survey was used for this qualitative study designed to examine providers' perceptions and attitudes toward obtaining routine postcraniotomy CT scans for patients undergoing elective tumor resection at OHSU (see Appendix A).

Intervention

This project was designed to learn the perception of the practice of EPOCT among the members of the NSICU team at OHSU. The use of a qualitative study according to Korstjens and

Moser (2017) is a useful study design when examining behaviors and decisions made for phenomena of interest particularly in small sample sizes which in this study was 45 potential participants. Survey questions were developed from literature reviewed for this project in order to better understand the research evidence to practice gap observed and described in the summary of the literature. The purpose of this DNP project was therefore to examine neurosurgical providers' current practices and perceptions of practices regarding the use of routine head CT following elective craniotomy for tumor resection at OHSU. Physicians, surgeons, residents, fellows, nurse practitioners, and physician assistants in the neurosurgery team at OHSU were invited to participate in a survey examining these practices.

Potential subjects were identified using the OHSU School of Medicine Neurosurgical Department website and neurosurgery inpatient team email group lists used at OHSU. The list of eligible participants was reviewed by a member of the NSICU team. Invitations to participate were emailed that contained a brief summary of the study, the estimated time commitment, the expectations of participants, and a consent form. If consent to participate was received, a brief online survey was sent to the participant by email via Research Electronic Data Capture (REDCap). Study data were collected and managed using REDCap electronic data capture tools hosted at Oregon Health and Science University (Harris et al., 2009). REDCap is a secure, web-based software platform designed to support data collection for research studies, providing 1) a survey or database design tool for data capture and storage, 2) audit capabilities to track data input and export procedures, 3) a data download function for export to common statistical software for analysis, and 4) procedures for merging data and exchanging data with external sources. The project was completed according to the following timeline.

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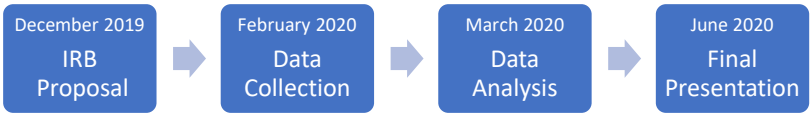
Figure 1

Project Completion Timeline



Study of the Intervention

The survey was created using a modified version of the Consolidated Criteria for Reporting Qualitative Research (COREQ) checklist devised by Tong et al. (2007). Within COREQ is a tool for developing questionnaires to use during interviews and to collect data from focus groups. Potential subjects were identified using the OHSU School of Medicine Neurosurgical Department website and neurosurgery inpatient team email group lists used at OHSU. The list of eligible participants was reviewed by a member of the NSICU team. Invitations to participate were emailed that contained a brief summary of the study, the estimated time commitment, the expectations of participants, and a consent form. If consent to participate was received, a brief online survey was sent to the participant by email via Research Electronic Data Capture (REDCap). Study data were collected and managed using REDCap electronic data survey tool hosted at Oregon Health and Science University (Harris et al., 2009).

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Measures & Analysis

Once the survey was designed, tested, and approved by the Oregon Clinical and Translation Research Institute (OCTRI) Informatics Support Team at OHSU, sending out the survey and obtaining data took less than two weeks. One of the key elements that contributed to the success of this project was having a colleague on the NSICU team who reviewed the survey questions and invitation list. Other than the time for project research and development and the

time given by the many people who have supported this project, there were no costs involved in its implementation. REDCap software data reports and statistical module were used to produce and display project data in aggregate graphical format and descriptive statistics (see Appendix C Figure C1).

Ethical Consideration

An expedited OHSU Institutional Review Board (IRB) application was submitted for this project, and there were no identified ethical considerations. Participant anonymity was protected. Survey results were deidentified and stored in the Box software program.

Results

Of the 45 eligible participants, 20 responded (44% response rate). Of these, 12 (60%) indicated that they were intensive care unit (ICU) providers (nurse practitioners, physician assistants, critical care attendings, and neurosurgical residents) who manage postoperative craniotomy patients, and 8 (40%) were surgeons (attending neurosurgeons and neurosurgical residents) (see Appendix C, Table C2). The majority of surgeons operated on two to four patients/week, and ICU providers managed five to seven patients/week. All participants strongly agreed that hourly neurological exams were necessary (20/20, 100%) and that a postoperative decline in neurological status warranted a CT scan (20/20, 100%), consistent with the literature (Alkhalili et al., 2018; Altieri et al., 2018; Boissonneau et al., 2017; Fontes et al., 2014; Freyschlag et al., 2018; Garrett et al., 2013; Gessler et al., 2015; Hussain et al., 2001; Jiang et al., 2013; Kalfas & Little, 1988; Khaldi et al., 2010; Schar et al., 2016; Wen et al., 2016; Zygourakis et al., 2016).

Discussion

Postoperative patient management following elective cranial surgery varies substantially between different neurosurgical institutions and is guided in large part by provider preference and training (Khaldi et al., 2010). Evidence demonstrates no impact of routine early postoperative CT on clinical management in elective postcraniotomy patients without neurological decline (Schar et al., 2016). Immediate routine postoperative craniotomy CT rarely leads to an immediate surgical intervention and should be limited to patients who manifest neurological changes or those with comorbidities that place them at increased risk. US government healthcare policy and professional organizations are working to educate providers to reduce overutilization of CT scans. Forgoing routine head CT following neurosurgery and limiting the use of CT to patients with clinical symptoms would reduce the cost of healthcare for patients and the greater system as well as reduce risk for all.

Interpretation

Surgeon Discrepancies

Both the response rate (20/45, 44%) and the number of attending neurosurgeons who participated (5/7, 71%) were unexpected (see Appendix C, Table C1). One of the attending neurosurgeons sent direct communication offering support for this "important issue" and expressed thanks for taking on this project. Responses to the question of whether EPOCT is a routine practice at OHSU indicated discrepancies with self-reported ordering practices. All of the ICU providers answered "Yes" (12/12, 100%) and six out of eight surgeons answered "Yes" (75%) to whether ordering EPOCT was a routine practice, yet 75% of surgeons answered "No" to "I always order EPOCT for patients in this population." This may represent a lack of self-awareness among surgeons of their own postoperative CT utilization. Kadhim-Saleh et al. (2018)

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similarly studied the CT ordering rates of emergency room physicians and found a poor correlation between self-reported ordering rates and actual ordering for each physician (r=0.19, CI: −0.11 to 0.46, p=0.21). In addition, of the 17 physicians in the group of highest CT orderers, only three were aware that they were high orderers. In another study by Bodley et al. (2019), internal medicine physicians' self-reported test ordering and perceptions of their colleagues' test ordering were compared, and the results similarly illustrated that the majority (73%) identified their colleagues as high test utilizers but only 15% self-identified as high-test utilizers. This discrepancy in provider self-reported CT ordering and actual CT ordering illuminates current practice trends.

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ICU Provider Group–Surgeon Group Discrepancies

The discrepancy in responses to the question addressing EPOCT and its effect on management for patients who have stable neurological exams postoperatively was surprising. Among the surgeon group, 37.5% strongly disagreed that EPOCT affected management in neurologically stable postcraniotomy patients, and none strongly agreed that it did affect management. Among the ICU provider group, 16.7% strongly agreed that EPOCT affected management in the same situation and none strongly disagreed (see Appendix C, Figure C1-C3 for the response distribution among all groups). Lastly, the majority (75%) of NSICU team members agreed that EPOCT is not necessary for patients with stable neurological postoperative exams. However, of the 25% who felt EPOCT is necessary, only one was a surgeon, the other four being ICU providers. This was surprising, as the surgeon typically orders EPOCT, rather than the ICU provider. One would expect more surgeons to find EPOCT necessary, given the majority of the NSICU team acknowledges it as a routine practice.

Potential Cost Savings

By applying the data reported by Altieri et al. (2018), Benveniste et al. (2015) and Gessler et al. (2015) who studied tumor resection we can calculate the potential cost savings of reducing EPOCT for post elective craniotomy tumor resections at OHSU. Altieri et al. (2018) reported that around 10% of postoperative patients presented with a neurological change, while Benveniste et al. (2014) reported 9% and Gessler et al. (2015) reported 26%. Zygourakis et al. (2016) reported that it took 1 in 99 neurologically intact patients to find an unexpected result on EPOCT and 1 in 11 for those who presented with neurological deficits. Using these as a reference for OHSU and Zygourakis et al.'s (2016) estimate of around $300 per CT it is clear there is potential for significant savings. Assuming that OHSU is performing 700 elective craniotomies for tumor resection per year and all involve an EPOCT at $300 per scan, the total cost of CT per year is around $210,000. If the NSICU at OHSU would change its practice to only scanning patients who have unexpected neurological changes postoperatively ((10% or 70, according to Altieri et al. (2018)), the overall cost would be $21,000 per year, a cost saving of $189,000. If we use a more conservative number—25% or 175 patients presenting with neurological changes—the cost per year would be $52,500 per year, with a cost saving of $157,000. All of these numbers could be even higher if we were to use the Garrett et al.'s (2013) estimate of $1,000 per CT.

Limitations

There are several limitations to this study. Firstly, the small sample size of 45 with an even smaller group of 20 participants this study is underpowered. A contributing factor for the low response rate among neurosurgery residents/fellows (5/18, 28%) could have been the timing of their residency and rotation, as some of the residents were out of the NSICU and OHSU

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altogether when the survey was sent out. Secondly, the primary investigator has a known bias and believes OHSU overutilizes CT in the neurosurgical population, while the known contact in the NSICU may have contributed to sample bias. The questions asked were designed to be non-judgmental and non-directive, asking for participants to answer with their individual opinions. Likert scale or yes/no questions were used with the aim of increasing participation as opposed to asking open-ended questions requiring participants to write out their answers. In this first attempt to examine the practice of EPOCT in the NSICU at OHSU, incongruities in some of the answers may have resulted from different interpretations of the questions. As with many qualitative studies, asking questions becomes an iterative process: as results are produced, more questions are created to redefine the focus Korstjens and Moser (2017). Lastly, an assumption was made that the surgeon was the provider ordering CT scans, whereas the results demonstrate that ICU providers could be ordering them as well. As a quality improvement, future studies should investigate both the surgeons' and ICU providers' ordering practices more specifically. Obtaining actual data and comparing it to the team's perceptions will also help illuminate the current state. The results of this survey can be shared with the NSICU team to help design a future project. With the key stakeholders identified in this initial project further study can be done to help define appropriate use of EPOCT for neurosurgical patients undergoing tumor resection at OHSU.

Conclusions

This quality improvement project shows that of the majority of the NSICU team surveyed at OHSU believe that EPOCT is a routine practice (18/20, 90%). Studies demonstrate that the indication or timing of a postoperative CT should be based on a clinical finding and that CT should not be performed routinely (Gessler et al., 2015; Jiang et al., 2013; Khaldi et al., 2010; Zygourakis et al., 2016). Key stakeholders have been identified who have expressed the need to

obtain and present OHSU data on provider ordering practices. The next steps would utilize a team approach with interested members from the NSICU team to design a project for further study. A quality improvement project utilizing a retrospective chart review, designed to examine the actual EPOCT ordering rates of providers in the NSICU. This would be either followed by or conducted simultaneously to an evaluation of how EPOCT after elective craniotomy affects patient management at OHSU. The data from such a project, along with its potential cost savings and the potential for increased patient safety, could be presented to incentivize a practice change at OHSU more consistent with the evidence available in the literature.

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Appendix A

Figure A1

Neurosurgical ICU Team Perception Survey

Questions and answers are based on your opinion of early postoperative CT scans (< 4hrs post op) in patients who underwent an elective craniotomy for a brain tumor at OHSU and did not have a device or implant placed during surgery.

Please answer the following questions from the perspective of your role in caring for these patients.

Jennifer Shatzer AGACNP
Principal Investigator IRB #20480
OHSU SON DNP student
shatzer@ohsu.edu

Survey date

_____

Before we begin, I would like to learn a little bit more about you and your practice

What is your primary role on Neurosurgical Intensive Care Unit Team?

☐ Nurse Practitioner/Physician Assistant
☐ Neurosurgery Resident/Fellow
☐ Anesthesia Resident/Fellow
☐ Anesthesia Attending
☐ Neurosurgery Attending
☐ Critical Care Attending

For the following answer each question from your provider perspective

◯ Provider performing craniotomy
◯ Provider managing care of postcraniotomy patient

Please answer the following in the context of patients undergoing elective craniotomy for tumor resection.

		< 1	2 ≤ 4	5 ≤ 7	8 ≤ 10	>10
1	On average how many elective craniotomies for tumor resection do you perform in a week?	◯	◯	◯	◯	◯

		Yes	No
2	Early postoperative CT is routine practice at OHSU?	◯	◯
3	I always order an early postoperative CT for patients in this population.	◯	◯

		Always	Very Often	Sometimes	Rarely	Never
4						

	How frequently do you order early postoperative CT scans for patients who have stable neurological exams postoperatively?	○	○	○	○	○

		< 1	2 ≤ 4	5 ≤ 7	8 ≤ 10	>10
1	On average how many patients who have elective craniotomies for tumor resection do you manage in a week?	○	○	○	○	○

		Yes	No
2	Early postoperative CT is routine practice at OHSU?	○	○
3	I always order an early postoperative CT for patients in this population.	○	○

		Always	Very Often	Sometimes	Rarely	Never
4	How often are early postoperative CT scans ordered for patients who have stable neurological exams postoperatively?	○	○	○	○	○

Please mark how much you agree or disagree with the following statements.

		Strongly Agree	Somewhat Agree	Neither Agree Nor Disagree	Somewhat Disagree	Strongly Disagree
1	I believe postoperative CT scans after should be done within the first four hours postoperatively.	○	○	○	○	○

		Strongly Agree	Somewhat Agree	Neither Agree Nor Disagree	Somewhat Disagree	Strongly Disagree
2	I believe an early postoperative CT scan is helpful in detecting the presence of significant hemorrhage, other procedure-related complications and the status of the ventricles.	○	○	○	○	○

		Strongly Agree	Somewhat Agree	Neither Agree Nor Disagree	Somewhat Disagree	Strongly Disagree
3	I believe early postoperative CT scans affect management for patients with stable neurological exams postoperatively.	○	○	○	○	○

4	I believe hourly postoperative neurological exams are necessary.	Yes ○	No ○

		Strongly Agree	Somewhat Agree	Neither Agree Nor Disagree	Somewhat Disagree	Strongly Disagree
5	I believe hourly neurological exams detect postoperative complications.	○	○	○	○	○

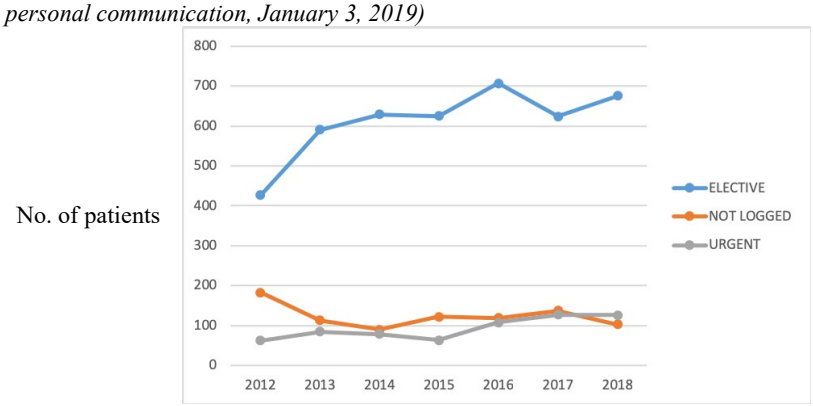
6	I believe early postoperative CT scans are necessary in patients with stable neurological postoperative exams.	Yes ○	No ○

		Strongly Agree	Somewhat Agree	Neither Agree Nor Disagree	Somewhat Disagree	Strongly Disagree
7	I believe a patient with a decline in their postoperative neurological exam compared to their preoperative status, clearly warrants an early CT scan.	○	○	○	○	○

		Strongly Agree	Somewhat Agree	Neither Agree Nor Disagree	Somewhat Disagree	Strongly Disagree
8	I believe early postoperative CT scans have limited, utility in the management of neurologically stable patients in the postoperative period.	○	○	○	○	○

Appendix B

Oregon Health & Science University Craniotomy Patient Volume 2012–2018 (M. Eggling, personal communication, January 3, 2019)



Appendix C

Table C1
Survey Respondents

Provider Type	Participants	Eligible Participants
Critical Care Providers	4	8
Surgeons	5	7
NP/PAs	6	9
Residents/Fellows	5	21
Total	20	45

Table C2

Survey Participant Data

Record ID	NP/PA	Resident/ Fellow	Neurosurgery Attending	Critical Care Attending	Surgeon/ICU Provider	Avg surgeries/wk?	EPOCT routine@ OHSU?	Always order EPOCT?	Freq of order EPOCT in neuro stable pt	Avg manage/ wk	EPOCT routine@ OHSU?	Always order EPOCT?	Perception of Freq of order EPOCT in neuro stable pt	EPOCT within 4hrs	EPOCT helpful in detecting complications	EPOCT affect management in neuro stable pt	Q1hr neuro exam necessary	Q1hr neuro exam detect complications.	EPOCT necessary in neuro stable pt	Neuro decline warrants CT	EPOCT limited, utility in managing neuro stable pt
27	- - -	- - -	- - -	Checked	ICU Provider					5 ≤ 7	Yes	No	Sometimes	Neither Agree Nor Disagree	Strongly Agree	Neither Agree Nor Disagree	Yes	Somewhat Agree	No	Strongly Agree	Neither Agree Nor Disagree
28	- - -	- - -	- - -	Checked	ICU Provider					8 ≤ 10	Yes	No	Very Often	Strongly Agree	Somewhat Agree	Somewhat Disagree	Yes	Strongly Agree	No	Strongly Agree	Somewhat Agree
30	- - -	- - -	- - -	Checked	ICU Provider					8 ≤ 10	Yes	Yes	Very Often	Neither Agree Nor Disagree	Somewhat Agree	Somewhat Disagree	Yes	Strongly Agree	No	Strongly Agree	Strongly Agree
31	- - -	- - -	- - -	Checked	ICU Provider					2 ≤ 4	Yes	Yes	Very Often	Strongly Agree	Strongly Agree	Somewhat Agree	Yes	Somewhat Agree	Yes	Strongly Agree	Strongly Disagree
35	Checked	- - -	- - -	- - -	ICU Provider					8 ≤ 10	Yes	Yes	Sometimes	Strongly Agree	Somewhat Agree	Somewhat Disagree	Yes	Strongly Agree	No	Strongly Agree	Somewhat Agree
36	Checked	- - -	- - -	- - -	ICU Provider					5 ≤ 7	Yes	No	Very Often	Somewhat Agree	Strongly Agree	Somewhat Disagree	Yes	Strongly Agree	No	Strongly Agree	Somewhat Agree
37	Checked	- - -	- - -	- - -	ICU Provider					5 ≤ 7	Yes	Yes	Always	Strongly Agree	Strongly Agree	Strongly Agree	Yes	Strongly Agree	Yes	Strongly Agree	Strongly Disagree
39	Checked	- - -	- - -	- - -	ICU Provider					5 ≤ 7	Yes	No	Very Often	Somewhat Agree	Somewhat Agree	Somewhat Agree	Yes	Somewhat Agree	Yes	Strongly Agree	Somewhat Disagree
41	Checked	- - -	- - -	- - -	ICU Provider					5 ≤ 7	Yes	No	Very Often	Neither Agree Nor Disagree	Strongly Agree	Neither Agree Nor Disagree	Yes	Somewhat Agree	No	Strongly Agree	Somewhat Agree
42	Checked	- - -	- - -	- - -	ICU Provider					5 ≤ 7	Yes	Yes	Very Often	Somewhat Agree	Somewhat Agree	Somewhat Agree	Yes	Strongly Agree	No	Strongly Agree	Somewhat Agree
43	- - -	- - -	Checked	- - -	Surgeon	2 ≤ 4	No	No	Sometimes					Neither Agree Nor Disagree	Neither Agree Nor Disagree	Neither Agree Nor Disagree	Yes	Strongly Agree	No	Strongly Agree	Strongly Agree
44	- - -	- - -	Checked	- - -	Surgeon	< 1	Yes	Yes	Very Often					Strongly Agree	Strongly Agree	Somewhat Agree	Yes	Strongly Agree	Yes	Strongly Agree	Somewhat Disagree
48	- - -	- - -	Checked	- - -	Surgeon	5 ≤ 7	Yes	No	Very Often					Strongly Agree	Strongly Agree	Somewhat Agree	Yes	Somewhat Agree	No	Strongly Agree	Somewhat Agree
50	- - -	- - -	Checked	- - -	Surgeon	2 ≤ 4	No	No	Never					Strongly Disagree	Strongly Disagree	Strongly Disagree	Yes	Strongly Agree	No	Strongly Agree	Strongly Agree
51	- - -	- - -	Checked	- - -	Surgeon	< 1	Yes	No	Rarely					Strongly Agree	Strongly Agree	Strongly Disagree	Yes	Strongly Agree	No	Strongly Agree	Somewhat Agree
60	- - -	Checked	- - -	- - -	Surgeon	2 ≤ 4	Yes	No	Very Often					Strongly Agree	Strongly Agree	Neither Agree Nor Disagree	Yes	Strongly Agree	No	Strongly Agree	Strongly Disagree
66	- - -	Checked	- - -	- - -	Surgeon	< 1	Yes	Yes	Always					Strongly Agree	Strongly Agree	Neither Agree Nor Disagree	Yes	Strongly Agree	No	Strongly Agree	Somewhat Agree
67	- - -	Checked	- - -	- - -	Surgeon	2 ≤ 4	Yes	No	Sometimes					Strongly Agree	Somewhat Disagree	Strongly Disagree	Yes	Somewhat Agree	No	Strongly Agree	Strongly Agree
68	- - -	Checked	- - -	- - -	ICU Provider					8 ≤ 10	Yes	No	Very Often	Somewhat Agree	Strongly Agree	Somewhat Agree	Yes	Strongly Agree	No	Strongly Agree	Somewhat Agree
75	- - -	Checked	- - -	- - -	ICU Provider					2 ≤ 4	Yes	Yes	Very Often	Somewhat Agree	Strongly Agree	Strongly Agree	Yes	Somewhat Agree	Yes	Strongly Agree	Somewhat Disagree

Figure C1

OCTRI 7036 Neurosurgery Team Perceptions of the Clinical Utility of Routine Postcraniotomy Computed Tomography: All Survey Data

OREGON CLINICAL & TRANSLATIONAL Research Institute

OHSU

Oregon Health & Science University

Oregon Clinical and Translational Research Institute

OCTRI 7036 - Neurosurgery Team Perceptions of the Clinical Utility of Routine Postcraniotomy Computed Tomography

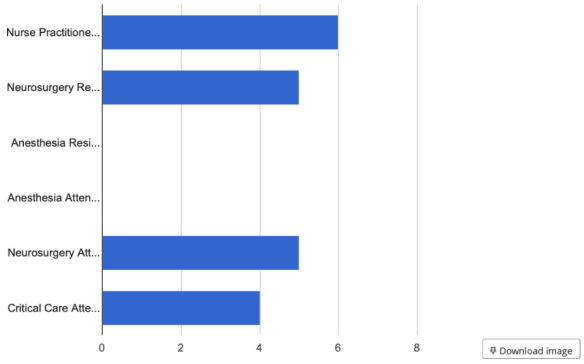
Data Exports, Reports, and Stats

Survey Data All (8&12&20)

What is your primary role on Neurosurgical Intensive Care Unit Team? *(provider)*

Total Count (N)	Missing*	Unique
20	0 (0.0%)	4

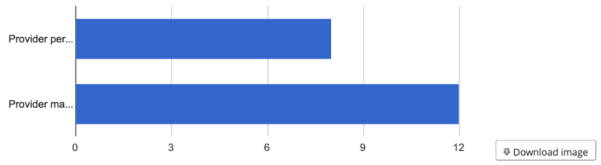
Counts/frequency: Nurse Practitioner/Physician Assistant (6, 30.0%), Neurosurgery Resident/Fellow (5, 25.0%), Anesthesia Resident/Fellow (0, 0.0%), Anesthesia Attending (0, 0.0%), Neurosurgery Attending (5, 25.0%), Critical Care Attending (4, 20.0%)



For the following answer each question from your provider perspective *(provider_perspective)*

Total Count (N)	Missing*	Unique
20	0 (0.0%)	2

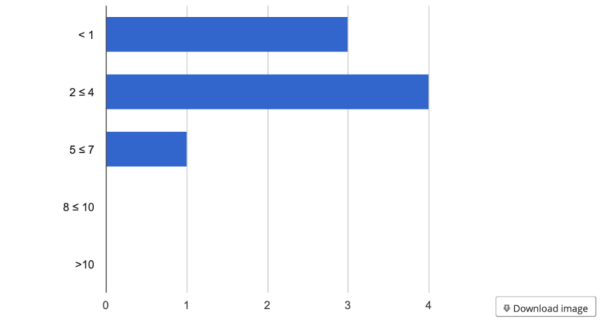
Counts/frequency: Provider performing craniotomy (8, 40.0%), Provider managing care of postcraniotomy patient (12, 60.0%)



On average how many elective craniotomies for tumor resection do you perform in a week? *(surgeon_avg_crani_wk)*

Total Count (N)	Missing*	Unique
8	12 (60.0%)	3

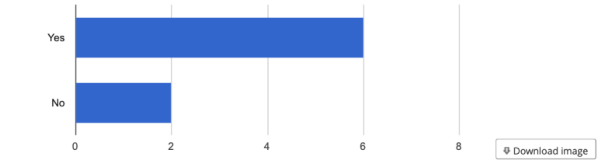
Counts/frequency: < 1 (3, 37.5%), 2 ≤ 4 (4, 50.0%), 5 ≤ 7 (1, 12.5%), 8 ≤ 10 (0, 0.0%), >10 (0, 0.0%)



Early postoperative CT is routine practice at OHSU? *(srgn_epoct_rtn_ct)*

Total Count (N)	Missing*	Unique
8	12 (60.0%)	2

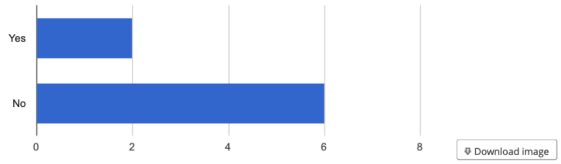
Counts/frequency: Yes (6, 75.0%), No (2, 25.0%)



I always order an early postoperative CT for patients in this population. *(srgn_epoct_practice)*

Total Count (N)	Missing*	Unique
8	12 (60.0%)	2

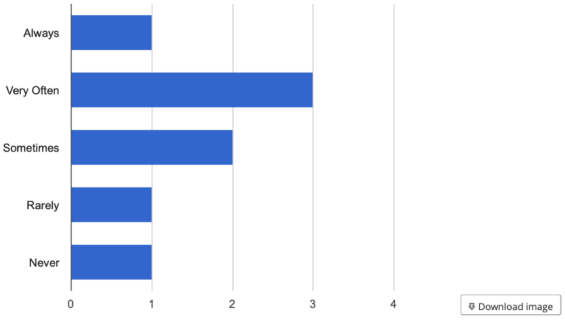
Counts/frequency: Yes (2, 25.0%), No (6, 75.0%)



How frequently do you order early postoperative CT scans for patients who have stable neurological exams postoperatively? *(srgn_order_freq)*

Total Count (N)	Missing*	Unique
8	12 (60.0%)	5

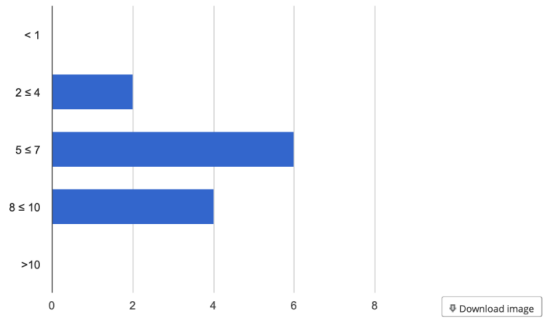
Counts/frequency: Always (1, 12.5%), Very Often (3, 37.5%), Sometimes (2, 25.0%), Rarely (1, 12.5%), Never (1, 12.5%)



On average how many patients who have elective craniotomies for tumor resection do you manage in a week? *(provider_mgt_weekly)*

Total Count (N)	Missing*	Unique
12	8 (40.0%)	3

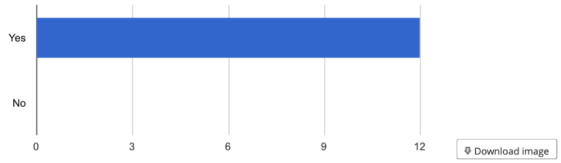
Counts/frequency: < 1 (0, 0.0%), 2 ≤ 4 (2, 16.7%), 5 ≤ 7 (6, 50.0%), 8 ≤ 10 (4, 33.3%), >10 (0, 0.0%)



Early postoperative CT is routine practice at OHSU? *(provider_rtn_ct)*

Total Count (N)	Missing*	Unique
12	8 (40.0%)	1

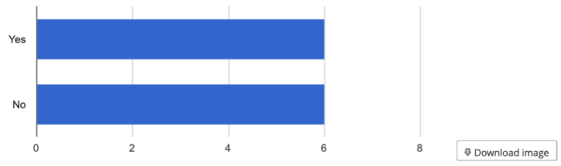
Counts/frequency: Yes (12, 100.0%), No (0, 0.0%)



I always order an early postoperative CT for patients in this population. *(provider_rtn_practice)*

Total Count (N)	Missing*	Unique
12	8 (40.0%)	2

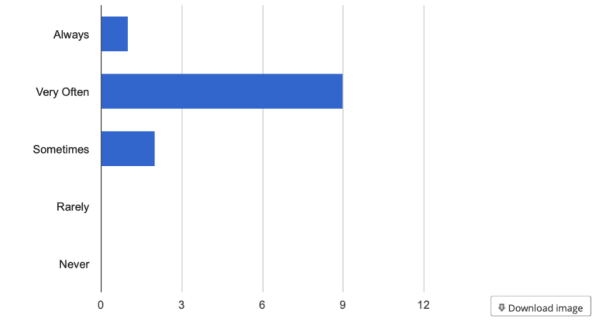
Counts/frequency: Yes (6, 50.0%), No (6, 50.0%)



How often are early postoperative CT scans ordered for patients who have stable neurological exams postoperatively? *(provider_order_freq)*

Total Count (N)	Missing*	Unique
12	8 (40.0%)	3

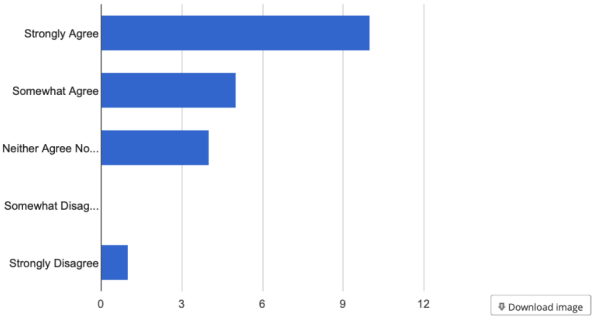
Counts/frequency: Always (1, 8.3%), Very Often (9, 75.0%), Sometimes (2, 16.7%), Rarely (0, 0.0%), Never (0, 0.0%)



I believe postoperative CT scans after should be done within the first four hours postoperatively. *(opinion_ct_should_b_done)*

Total Count (N)	Missing*	Unique
20	0 (0.0%)	4

Counts/frequency: Strongly Agree (10, 50.0%), Somewhat Agree (5, 25.0%), Neither Agree Nor Disagree (4, 20.0%), Somewhat Disagree (0, 0.0%), Strongly Disagree (1, 5.0%)

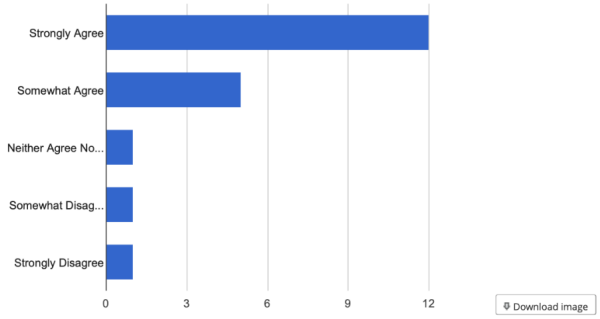


I believe an early postoperative CT scan is helpful in detecting the presence of significant hemorrhage, other procedure-related complications and the status of the ventricles. *(opinion_ct_is_helpful)*

Total Count (N)	Missing*	Unique

20	0 (0.0%)	5

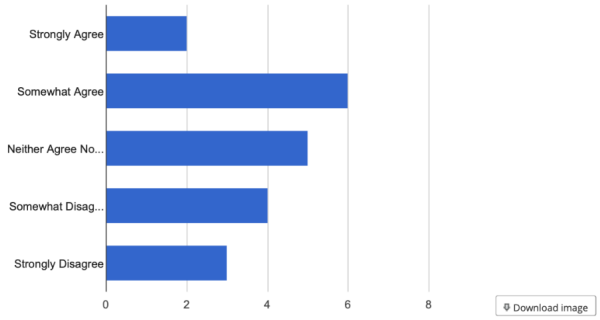
Counts/frequency: Strongly Agree (12, 60.0%), Somewhat Agree (5, 25.0%), Neither Agree Nor Disagree (1, 5.0%), Somewhat Disagree (1, 5.0%), Strongly Disagree (1, 5.0%)



I believe early postoperative CT scans affect management for patients with stable neurological exams postoperatively. *(opinion_ct_mgmt)*

Total Count (N)	Missing*	Unique
20	0 (0.0%)	5

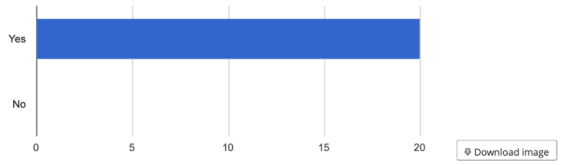
Counts/frequency: Strongly Agree (2, 10.0%), Somewhat Agree (6, 30.0%), Neither Agree Nor Disagree (5, 25.0%), Somewhat Disagree (4, 20.0%), Strongly Disagree (3, 15.0%)



I believe hourly postoperative neurological exams are necessary. *(opinion_q1hr_neuro)*

Total Count (N)	Missing*	Unique
20	0 (0.0%)	1

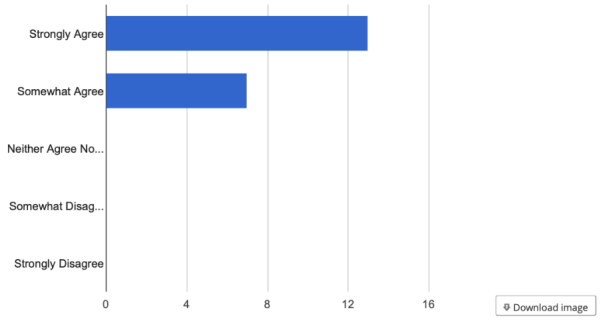
Counts/frequency: Yes (20, 100.0%), No (0, 0.0%)



I believe hourly neurological exams detect postoperative complications.
(opinion_q1hr_neuro_ck_comp)

Total Count (N)	Missing*	Unique
20	0 (0.0%)	2

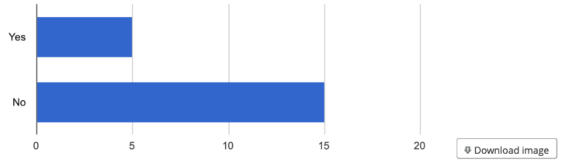
Counts/frequency: Strongly Agree (13, 65.0%), Somewhat Agree (7, 35.0%), Neither Agree Nor Disagree (0, 0.0%), Somewhat Disagree (0, 0.0%), Strongly Disagree (0, 0.0%)



I believe early postoperative CT scans are necessary in patients with stable neurological postoperative exams. *(opinion_ct_stable_pt)*

Total Count (N)	Missing*	Unique
20	0 (0.0%)	2

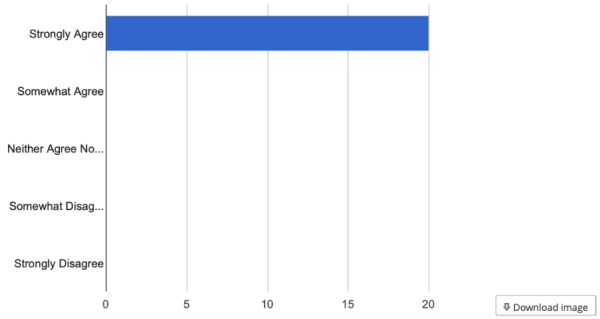
Counts/frequency: Yes (5, 25.0%), No (15, 75.0%)



I believe a patient with a decline in their postoperative neurological exam compared to their preoperative status, clearly warrants an early CT scan. *(opinion_neuro_decline_ct)*

Total Count (N)	Missing*	Unique
20	0 (0.0%)	1

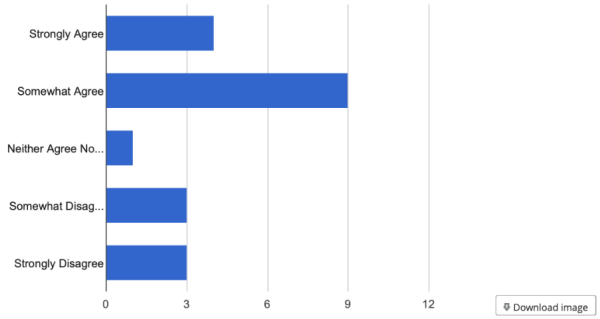
Counts/frequency: Strongly Agree (20, 100.0%), Somewhat Agree (0, 0.0%), Neither Agree Nor Disagree (0, 0.0%), Somewhat Disagree (0, 0.0%), Strongly Disagree (0, 0.0%)



I believe early postoperative CT scans have limited, utility in the management of neurologically stable patients in the postoperative period. *(opinion_low_utility_stable)*

Total Count (N)	Missing*	Unique
20	0 (0.0%)	5

Counts/frequency: Strongly Agree (4, 20.0%), Somewhat Agree (9, 45.0%), Neither Agree Nor Disagree (1, 5.0%), Somewhat Disagree (3, 15.0%), Strongly Disagree (3, 15.0%)



* Note: Values listed as 'Missing' may include records with a Missing Data Code (if Missing Data Codes are defined).

Figure C2

OCTRI 7036 Neurosurgery Team Perceptions of the Clinical Utility of Routine Postcraniotomy Computed Tomography: ICU Provider Survey Data

OREGON CLINICAL & TRANSLATIONAL Research Institute
OHSU
Oregon Health & Science University
Oregon Clinical and Translational Research Institute

OCTRI 7036 - Neurosurgery Team Perceptions of the Clinical Utility of Routine Postcraniotomy Computed Tomography

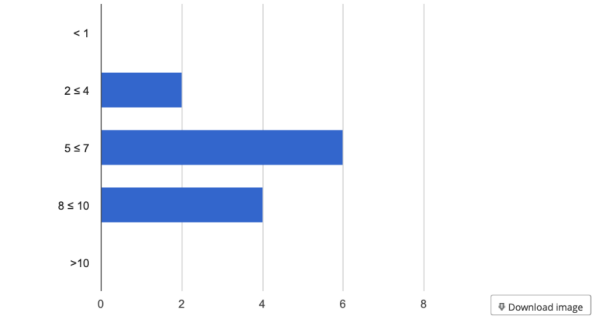
Data Exports, Reports, and Stats

Survey Data ICU Provider (12)

On average how many patients who have elective craniotomies for tumor resection do you manage in a week? *(provider_mgt_weekly)*

Total Count (N)	Missing*	Unique
12	-132 (110.0%)	3

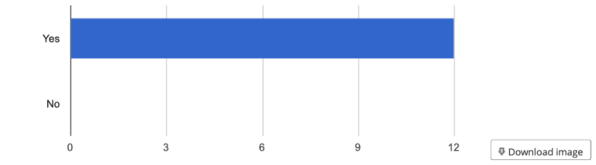
Counts/frequency: < 1 (0, 0.0%), 2 ≤ 4 (2, 16.7%), 5 ≤ 7 (6, 50.0%), 8 ≤ 10 (4, 33.3%), >10 (0, 0.0%)



Early postoperative CT is routine practice at OHSU? *(provider_rtn_ct)*

Total Count (N)	Missing*	Unique
12	-132 (110.0%)	1

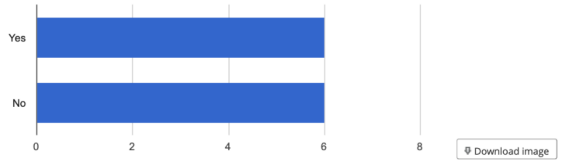
Counts/frequency: Yes (12, 100.0%), No (0, 0.0%)



I always order an early postoperative CT for patients in this population. *(provider_rtn_practice)*

Total Count (N)	Missing*	Unique
12	-132 (110.0%)	2

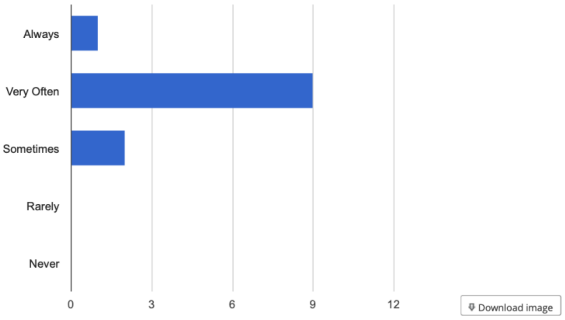
Counts/frequency: Yes (6, 50.0%), No (6, 50.0%)



How often are early postoperative CT scans ordered for patients who have stable neurological exams postoperatively? *(provider_order_freq)*

Total Count (N)	Missing*	Unique
12	-132 (110.0%)	3

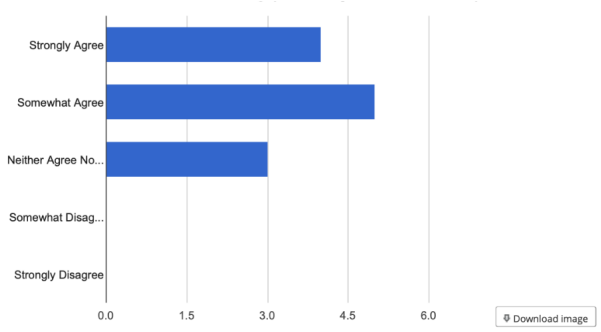
Counts/frequency: Always (1, 8.3%), Very Often (9, 75.0%), Sometimes (2, 16.7%), Rarely (0, 0.0%), Never (0, 0.0%)



I believe postoperative CT scans after should be done within the first four hours postoperatively. *(opinion_ct_should_b_done)*

Total Count (N)	Missing*	Unique
12	-132 (110.0%)	3

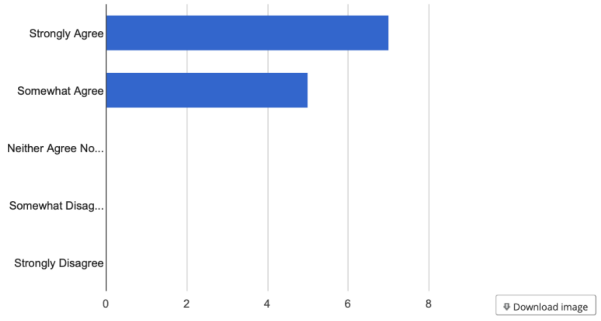
Counts/frequency: Strongly Agree (4, 33.3%), Somewhat Agree (5, 41.7%), Neither Agree Nor Disagree (3, 25.0%), Somewhat Disagree (0, 0.0%), Strongly Disagree (0, 0.0%)



I believe an early postoperative CT scan is helpful in detecting the presence of significant hemorrhage, other procedure-related complications and the status of the ventricles. *(opinion_ct_is_helpful)*

Total Count (N)	Missing*	Unique
12	-132 (110.0%)	2

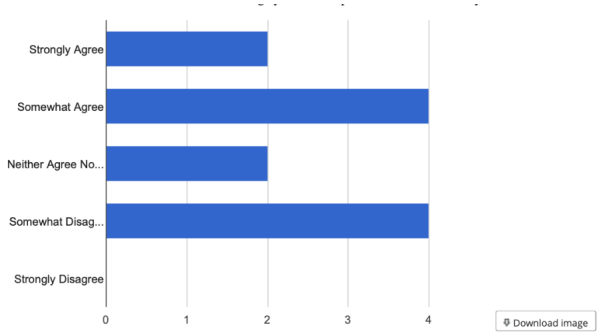
Counts/frequency: Strongly Agree (7, 58.3%), Somewhat Agree (5, 41.7%), Neither Agree Nor Disagree (0, 0.0%), Somewhat Disagree (0, 0.0%), Strongly Disagree (0, 0.0%)



I believe early postoperative CT scans affect management for patients with stable neurological exams postoperatively. *(opinion_ct_mgmt)*

Total Count (N)	Missing*	Unique
12	-132 (110.0%)	4

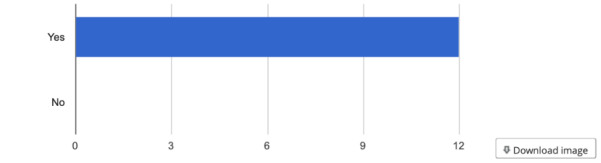
Counts/frequency: Strongly Agree (2, 16.7%), Somewhat Agree (4, 33.3%), Neither Agree Nor Disagree (2, 16.7%), Somewhat Disagree (4, 33.3%), Strongly Disagree (0, 0.0%)



I believe hourly postoperative neurological exams are necessary. *(opinion_q1hr_neuro)*

Total Count (N)	Missing*	Unique
12	-132 (110.0%)	1

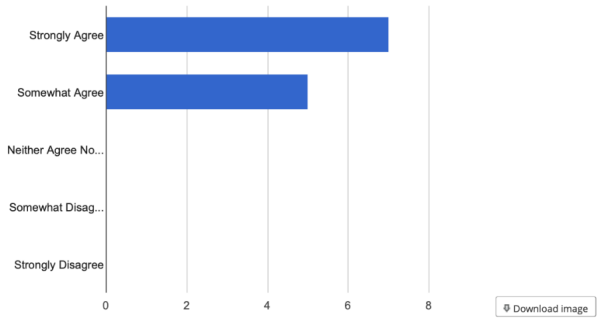
Counts/frequency: Yes (12, 100.0%), No (0, 0.0%)



I believe hourly neurological exams detect postoperative complications.
(opinion_q1hr_neuro_ck_comp)

Total Count (N)	Missing*	Unique
12	-132 (110.0%)	2

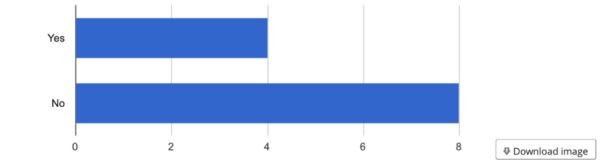
Counts/frequency: Strongly Agree (7, 58.3%), Somewhat Agree (5, 41.7%), Neither Agree Nor Disagree (0, 0.0%), Somewhat Disagree (0, 0.0%), Strongly Disagree (0, 0.0%)



I believe early postoperative CT scans are necessary in patients with stable neurological postoperative exams. *(opinion_ct_stable_pt)*

Total Count (N)	Missing*	Unique
12	-132 (110.0%)	2

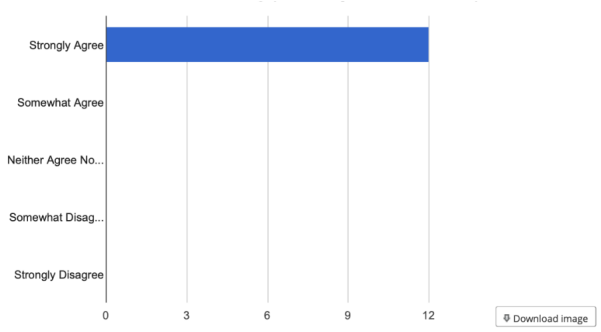
Counts/frequency: Yes (4, 33.3%), No (8, 66.7%)



I believe a patient with a decline in their postoperative neurological exam compared to their preoperative status, clearly warrants an early CT scan. *(opinion_neuro_decline_ct)*

Total Count (N)	Missing*	Unique
12	-132 (110.0%)	1

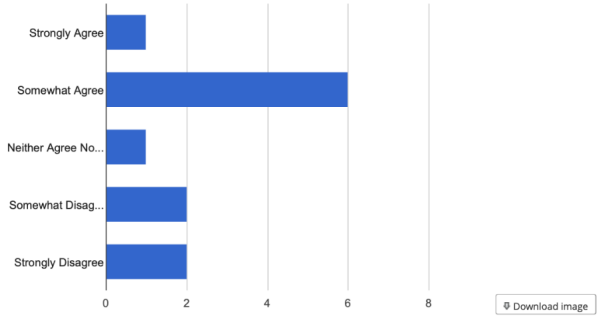
Counts/frequency: Strongly Agree (12, 100.0%), Somewhat Agree (0, 0.0%), Neither Agree Nor Disagree (0, 0.0%), Somewhat Disagree (0, 0.0%), Strongly Disagree (0, 0.0%)



I believe early postoperative CT scans have limited, utility in the management of neurologically stable patients in the postoperative period. *(opinion_low_utility_stable)*

Total Count (N)	Missing*	Unique
12	-132 (110.0%)	5

Counts/frequency: Strongly Agree (1, 8.3%), Somewhat Agree (6, 50.0%), Neither Agree Nor Disagree (1, 8.3%), Somewhat Disagree (2, 16.7%), Strongly Disagree (2, 16.7%)



* Note: Values listed as 'Missing' may include records with a Missing Data Code (if Missing Data Codes are defined).

Figure C3

OCTRI 7036 Neurosurgery Team Perceptions of the Clinical Utility of Routine Postcraniotomy Computed Tomography: Surgeon Survey Data

OREGON CLINICAL & TRANSLATIONAL Research Institute
OHSU
Oregon Health & Science University
Oregon Clinical and Translational Research Institute

OCTRI 7036 - Neurosurgery Team Perceptions of the Clinical Utility of Routine Postcraniotomy Computed Tomography

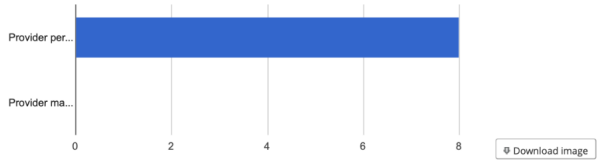
Data Exports, Reports, and Stats

Survey Data Surgeon (8)

For the following answer each question from your provider perspective *(provider_perspective)*

Total Count (N)	Missing*	Unique
8	-96 (109.1%)	1

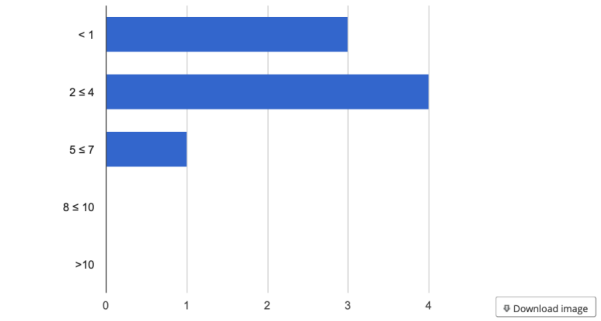
Counts/frequency: Provider performing craniotomy (8, 100.0%), Provider managing care of postcraniotomy patient (0, 0.0%)



On average how many elective craniotomies for tumor resection do you perform in a week? *(surgeon_avg_crani_wk)*

Total Count (N)	Missing*	Unique
8	-96 (109.1%)	3

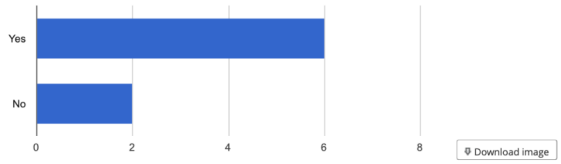
Counts/frequency: < 1 (3, 37.5%), 2 ≤ 4 (4, 50.0%), 5 ≤ 7 (1, 12.5%), 8 ≤ 10 (0, 0.0%), >10 (0, 0.0%)



Early postoperative CT is routine practice at OHSU? *(srgn_epoct_rtn_ct)*

Total Count (N)	Missing*	Unique
8	-96 (109.1%)	2

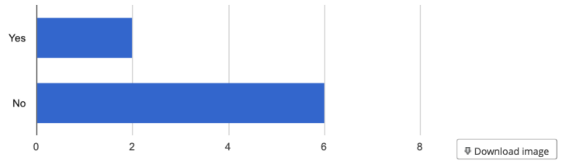
Counts/frequency: Yes (6, 75.0%), No (2, 25.0%)



I always order an early postoperative CT for patients in this population. *(srgn_epoct_practice)*

Total Count (N)	Missing*	Unique
8	-96 (109.1%)	2

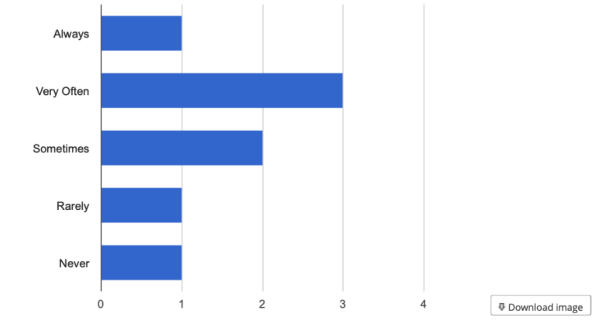
Counts/frequency: Yes (2, 25.0%), No (6, 75.0%)



How frequently do you order early postoperative CT scans for patients who have stable neurological exams postoperatively? *(srgn_order_freq)*

Total Count (N)	Missing*	Unique
8	-96 (109.1%)	5

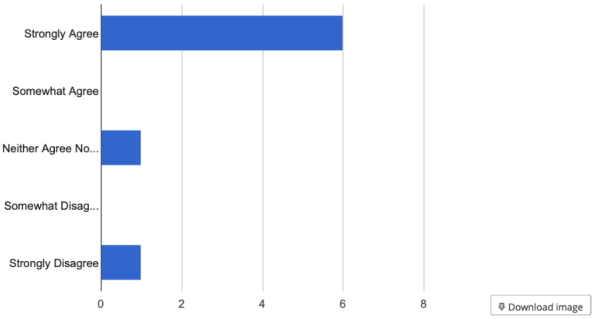
Counts/frequency: Always (1, 12.5%), Very Often (3, 37.5%), Sometimes (2, 25.0%), Rarely (1, 12.5%), Never (1, 12.5%)



I believe postoperative CT scans after should be done within the first four hours postoperatively. *(opinion_ct_should_b_done)*

Total Count (N)	Missing*	Unique
8	-96 (109.1%)	3

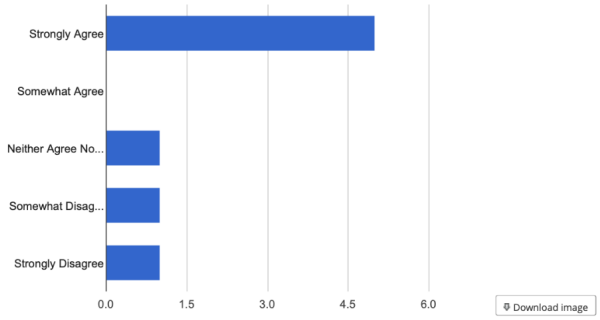
Counts/frequency: Strongly Agree (6, 75.0%), Somewhat Agree (0, 0.0%), Neither Agree Nor Disagree (1, 12.5%), Somewhat Disagree (0, 0.0%), Strongly Disagree (1, 12.5%)



I believe an early postoperative CT scan is helpful in detecting the presence of significant hemorrhage, other procedure-related complications and the status of the ventricles. *(opinion_ct_is_helpful)*

Total Count (N)	Missing*	Unique
8	-96 (109.1%)	4

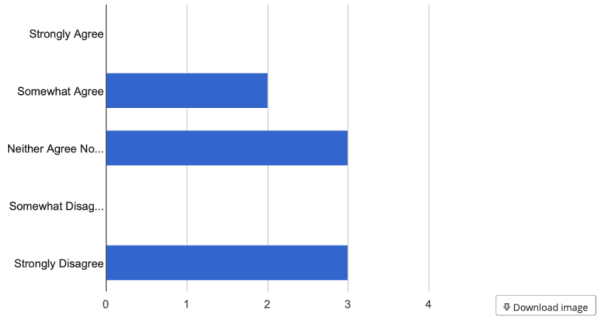
Counts/frequency: Strongly Agree (5, 62.5%), Somewhat Agree (0, 0.0%), Neither Agree Nor Disagree (1, 12.5%), Somewhat Disagree (1, 12.5%), Strongly Disagree (1, 12.5%)



I believe early postoperative CT scans affect management for patients with stable neurological exams postoperatively. *(opinion_ct_mgmt)*

Total Count (N)	Missing*	Unique
8	-96 (109.1%)	3

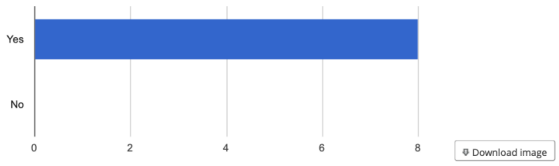
Counts/frequency: Strongly Agree (0, 0.0%), Somewhat Agree (2, 25.0%), Neither Agree Nor Disagree (3, 37.5%), Somewhat Disagree (0, 0.0%), Strongly Disagree (3, 37.5%)



I believe hourly postoperative neurological exams are necessary. *(opinion_q1hr_neuro)*

Total Count (N)	Missing*	Unique
8	-96 (109.1%)	1

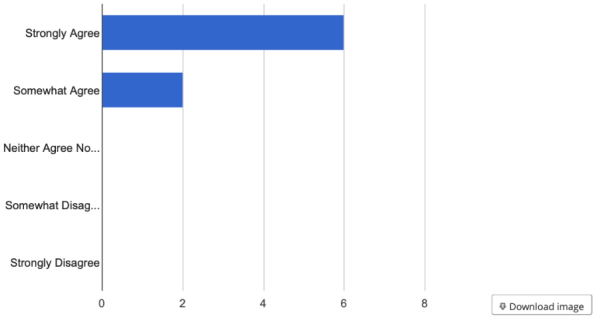
Counts/frequency: Yes (8, 100.0%), No (0, 0.0%)



I believe hourly neurological exams detect postoperative complications.
(opinion_q1hr_neuro_ck_comp)

Total Count (N)	Missing*	Unique
8	-96 (109.1%)	2

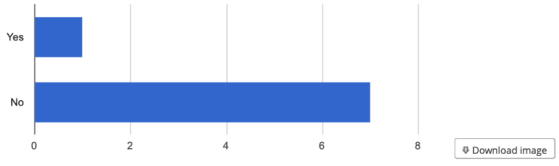
Counts/frequency: Strongly Agree (6, 75.0%), Somewhat Agree (2, 25.0%), Neither Agree Nor Disagree (0, 0.0%), Somewhat Disagree (0, 0.0%), Strongly Disagree (0, 0.0%)



I believe early postoperative CT scans are necessary in patients with stable neurological postoperative exams. *(opinion_ct_stable_pt)*

Total Count (N)	Missing*	Unique
8	-96 (109.1%)	2

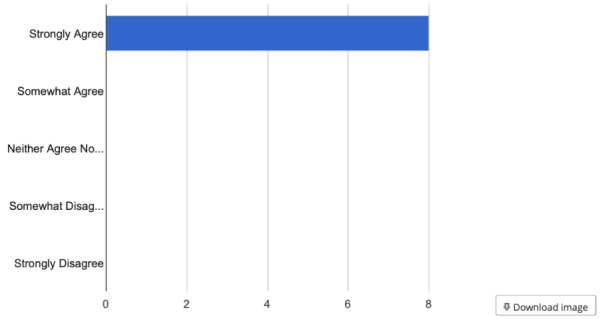
Counts/frequency: Yes (1, 12.5%), No (7, 87.5%)



I believe a patient with a decline in their postoperative neurological exam compared to their preoperative status, clearly warrants an early CT scan. *(opinion_neuro_decline_ct)*

Total Count (N)	Missing*	Unique
8	-96 (109.1%)	1

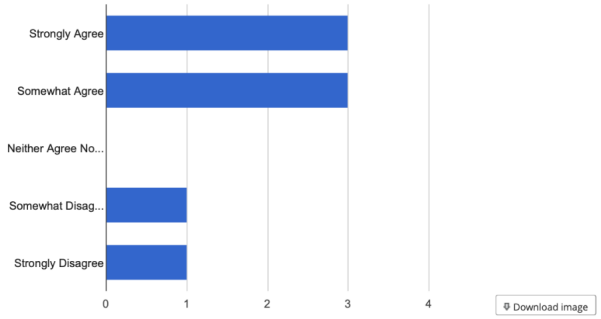
Counts/frequency: Strongly Agree (8, 100.0%), Somewhat Agree (0, 0.0%), Neither Agree Nor Disagree (0, 0.0%), Somewhat Disagree (0, 0.0%), Strongly Disagree (0, 0.0%)



I believe early postoperative CT scans have limited, utility in the management of neurologically stable patients in the postoperative period. *(opinion_low_utility_stable)*

Total Count (N)	Missing*	Unique
8	-96 (109.1%)	4

Counts/frequency: Strongly Agree (3, 37.5%), Somewhat Agree (3, 37.5%), Neither Agree Nor Disagree (0, 0.0%), Somewhat Disagree (1, 12.5%), Strongly Disagree (1, 12.5%)



* Note: Values listed as 'Missing' may include records with a Missing Data Code (if Missing Data Codes are defined).