Supplement 1. Gamma Knife (GK) process tree. Our FMEA analysis identified a high-level process tree with 14 subprocesses (S1-S14) including 3 pre-procedure (blue), 9 on the day of procedure (green), and 2 post-procedure (gold). Each subprocess consisted of 4 to 32 steps that totaled 177 steps from initial consult to post-procedure visit.

Appendix 1. Gamma Knife process tree

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S1 Consult	S2 Schedule Procedure	S3 Pre-procedure Chart	S4 Patient Registration	S5 Pre-frame Tasks	S6 Frame Placement	S7 Imaging
Neurosurgeon and radiation oncologist 1. Review records (include OR, RT) 2. Review imaging studies 3. Review MRI in Gamma Plan if previously treated patient 4. Patient education 5. Informed consent 6. Treatment medications	 Select date Insurance preauthorization Confirm availability of neurosurgery, radiation oncology, and medical physics Confirm Gamma Plan review by MD Schedule anesthesia Schedule ARRI ± CT scan Patient instructions Check medications Check allergies Prior cranial surgery or radiation Discuss logistics Schedule H&P Schedule specialty consultations Order & check labs 	 Face sheet Office note MRI report Rad Onc note Med Onc note Med Onc note H & P Consents Imaging form Op notes Previous radiation records Lab results Audiogram Visual fields Hormones Insurance/preauth Anesthesia confirmation Medications Allergies 	 Hospital consent Consent to bill insurance HIPAA form ID and bracelet 	RN 1. Vital signs 2. IV/PortaCath 3. Blood draw 4. Medication review 5. Check allergies 6. CT & MRI screens 7. QOL form Neurosurgeon 1. Informed consent 2. Mark site of surgery (if applicable) 3. Confirm side of target and affix capsule (unilateral tumors) 4. Confirm side of pain and affix capsule (trigeminal neuralgia) 5. Fit frame 6. Select front posts (0, 5, 10, or 15 degrees) 7. Interim H & P in Epic	 Review MRI Conscious sedation Vital signs every 5 min Skin prep Local anesthesia Pin placement Torque pins Collision cap Recovery Frame measurements 	 Complete imaging form Transfer to scanner Monitoring by RN (SpO2, pulse) MRI scan Attach localizer Attach adapter Dock with table CT scan Dock with table CT scan Dock with table Attach localizer Transfer DICOM images Check image quality in Gamma Plan Transfer patient to procedure room

Anesthesiologist

- History and screen
 Epic note

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S8 Treatment Planning	S9 Physics QA	S10 Treatment Delivery	S11 Frame Removal	S12 Post-procedure Chart	S13 Post-procedure Call	S14 Post-procedure Visit
 Import prior imaging Verify prior cranial imaging Confirm images are from correct patient Check image quality Register images (check error) Enter frame measurements Generate skull contours Contour critical structures Contour target(s) Select dose and prescription Determine plan quality objectives Place shots Check plan quality Compare CT vs. MRI when available Confirm laterality Review official radiology report Check critical structure doses Confirm plan & screenshots Gamma plan validation (Mu) Signatures 	Physics Checklist 32 steps See Supplement E	 Check medications Export plan to console Verify treatment parameters Unlock mechanical lock on treatment door Properly seat and attach frame adapter Position patient and dock Connect monitor and pulse oximeter Place compression boots Shut door Communicate with patient Initiate Gamma Knife treatment (Rad Onc) Vital signs monitoring (RN) Treatment break (optional) Additional medications (optional) End of treatment Verify treatment completed properly (all shots delivered) Undock patient Remove frame adapter Back to procedure room Print operator and system reports 	 Vital signs Pin removal Pin site closure Remove IV or de- access and heparinize PortaCath Review medications Discuss pin site care Provide follow-up appointment Discharge to home 	 Nursing note (Epic) Neurosurgery op note (Epic) Radiation oncology op note (Epic) Scan and save copy of plan on radiation oncology shared drive Submit hard copy plan to medical records for scanning into Epic Enter case into SRS registry 	 Interim history Assess pain level Review medications Confirm follow-up Epic phone note 	 Vital signs Interim history Review medications Pin site check Neuro exam Medication instructions Schedule follow-up