Leveraging AI to Reduce ICU Length of Stay

Clint Chiodo, M.S., CLSSBB, Data Scientist II | Keith Dombrowski M.D. | Jennifer Glover M.D.

Project Overview

As part of an integrated Neuro ICU performance improvement project, our LOS reduction workgroup identified the admission-discharge and transfer (ADT) process as key metrics with opportunity. Our group identified clinical factors consistent with downgrade readiness as well as barriers preventing transition to the next phase of care.

Intervention Detail

Creation of an AI driven model was identified as a mechanism to drive earlier downgrade and reduce LOS in the Neuro ICU. The integration of technology into established rounding methods to tackle important flow metrics is an essential part of any quality improvement initiative. We identified over 40 clinical elements from the electronic medical record that are programmed and monitored in real-time with a desired accuracy of over 95%. If no criteria are present, and no bed is requested or assigned, the Tile will recommend ready for transfer. If three or greater criteria are present, the Tile recommends that the patient is not eligible for transfer.
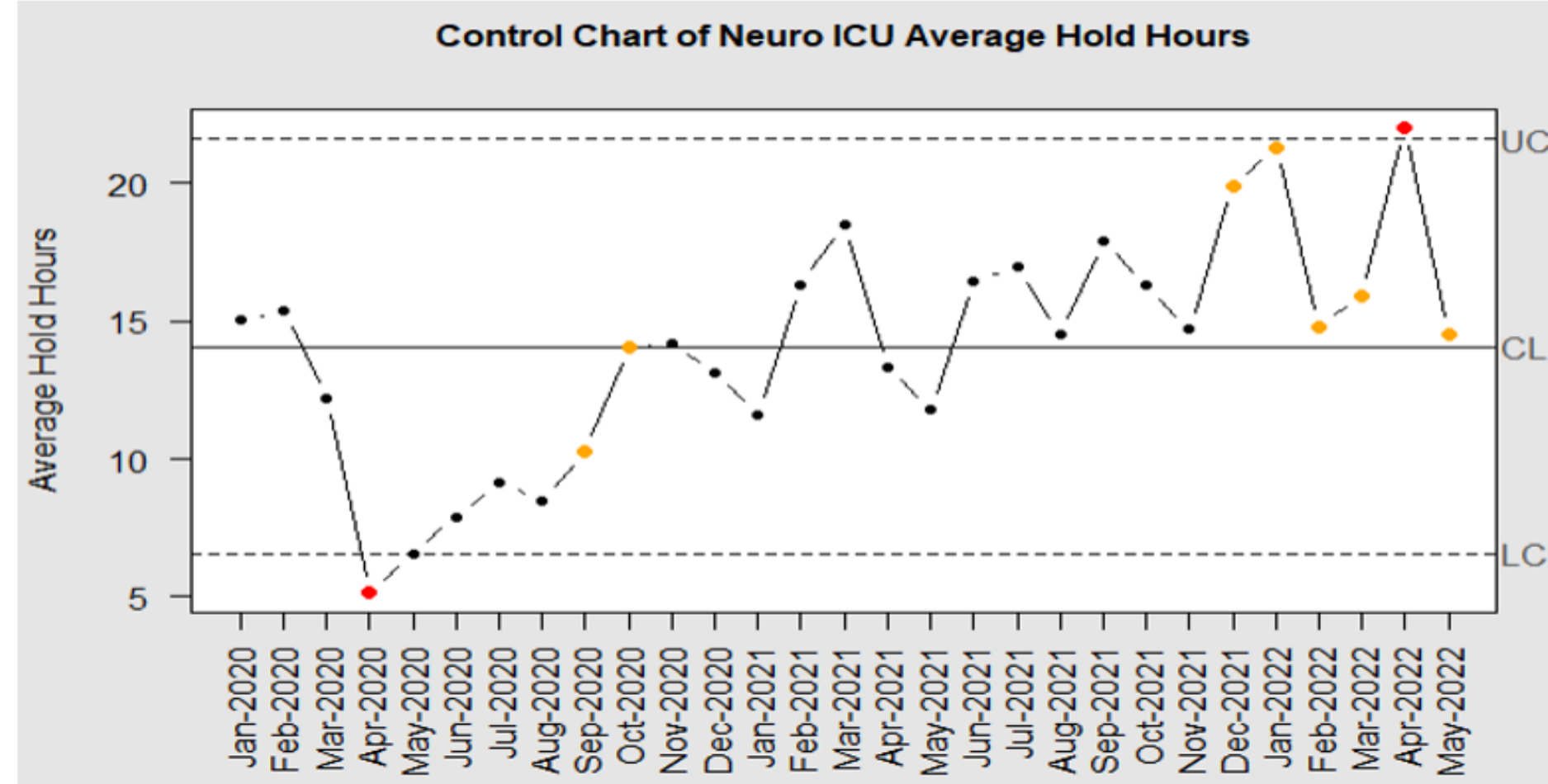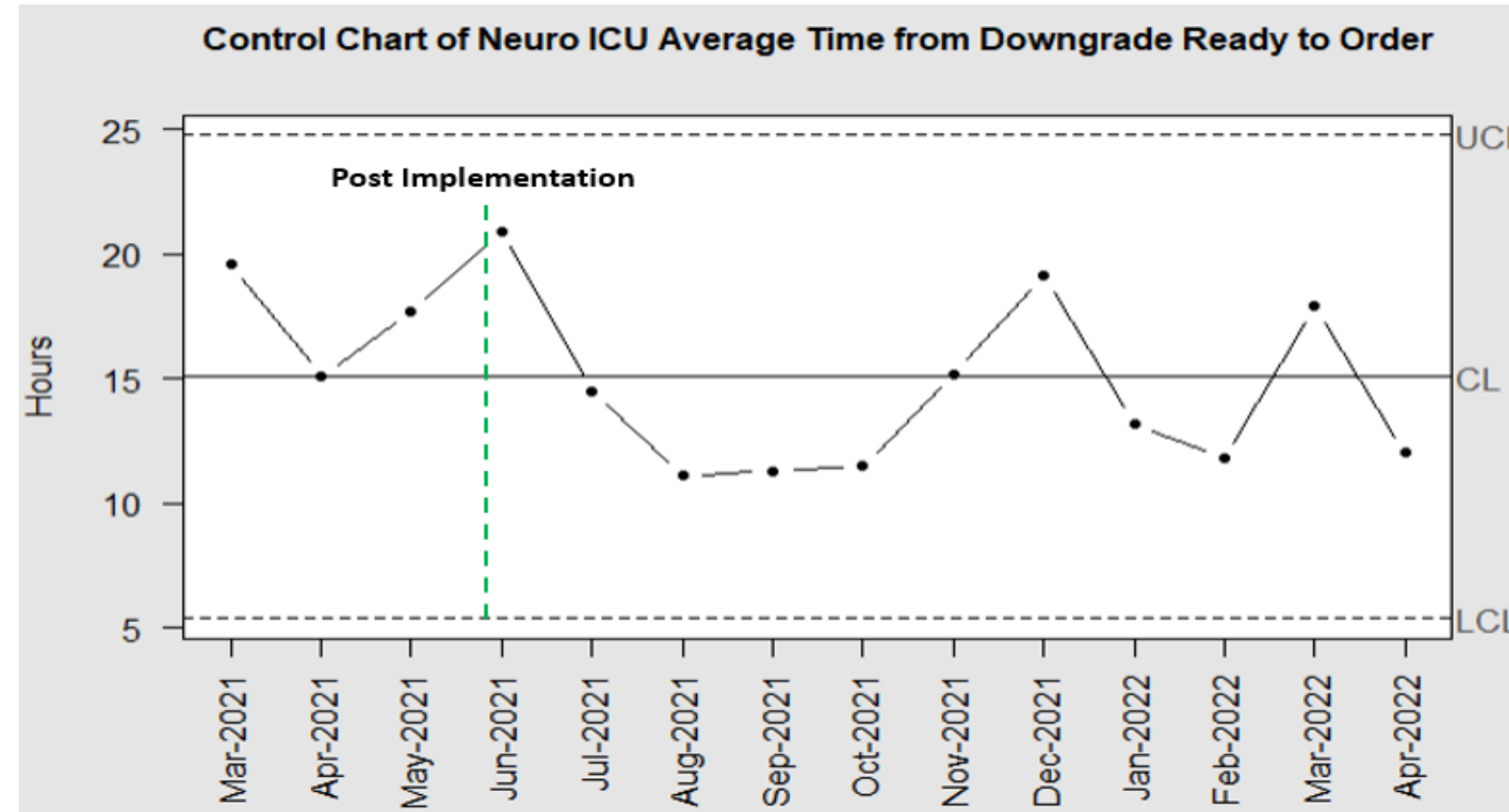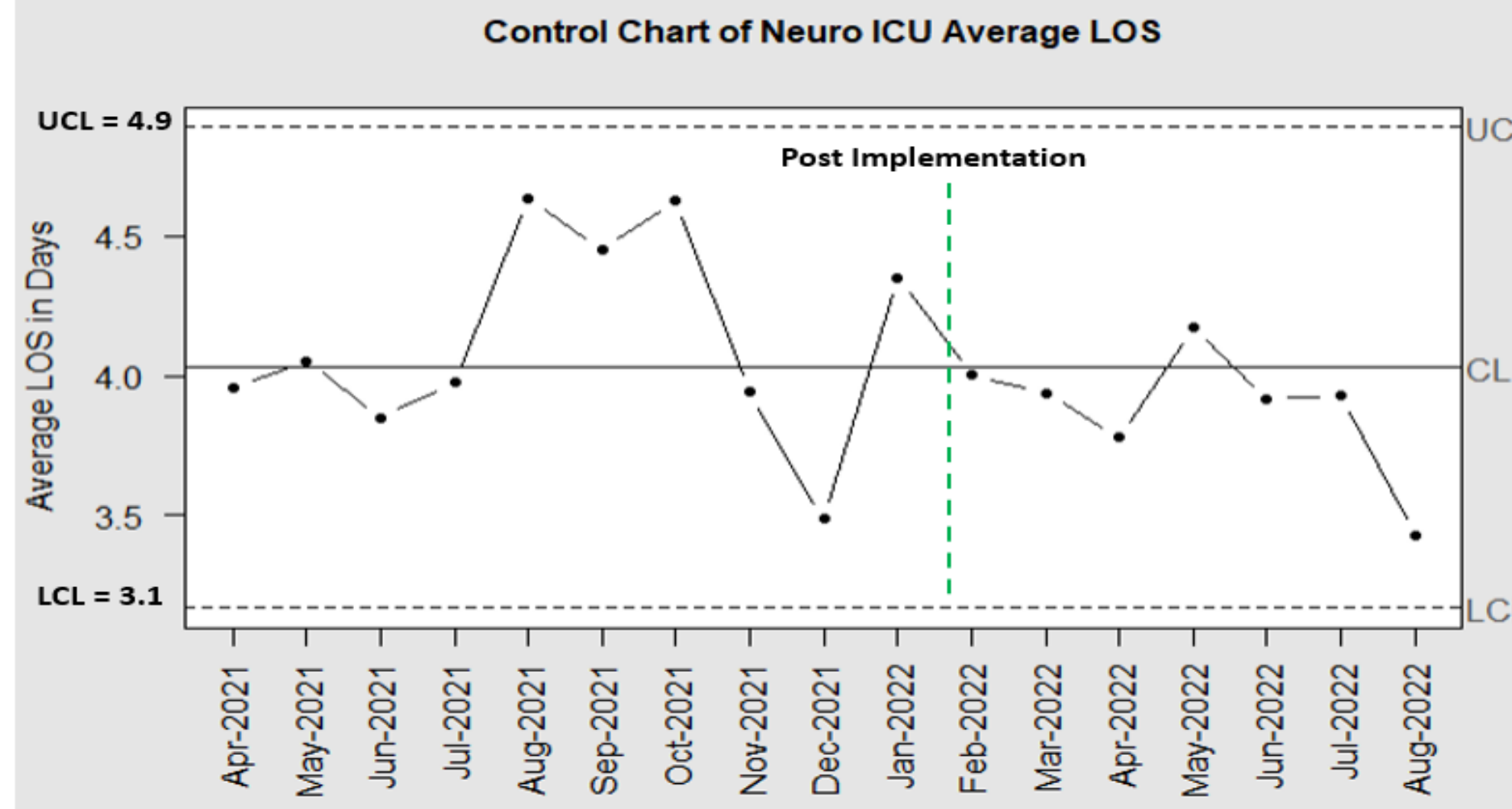
Outcomes and Impact

The Downgrade Tile was implemented in January 2022 and is used not only during MDR's but is displayed on monitors positioned throughout the Neuro ICU. 6 months post implementation period of the Tile and MDRs, the Neuro ICU has seen a 7%- or roughly 8-hour reduction in the ICU length of stay (4.13 to 3.88 days) with a 3+ hour earlier placement of a transfer order. These results have happened despite ICU hold time continuing to increase. This work is uniquely innovative as it shows that artificial intelligence can be easily integrated into traditional interdisciplinary rounds to provide synergistic effects.

Speaker Contact Information

gloverj@usf.edu; kdombrowski@usf.edu; cchiodo@tgh.org

No one in a position to control the content of this educational activity has relevant financial relationships with ineligible companies.

Control Chart of Neuro ICU Average LOS

UCL = 4.9
LCL = 3.1
Post Implementation
(Average LOS in Days, Apr-2021 to Aug-2022)

Control Chart of Neuro ICU Average Time from Downgrade Ready to Order

Post Implementation
(Hours, Mar-2021 to Apr-2022)

Control Chart of Neuro ICU Average Hold Hours

(Average Hold Hours, Jan-2020 to May-2022)

Learning Objectives

- Describe methods to reduce intensive care unit length of stay.
- Discuss the implementation of artificial intelligence within interdisciplinary rounds.

Patient Manager – What is on the ICU/SD Unit View / ICU Downgrades Profile?

① Patient Information
② Key Dates & Flags
③ Downgrade Readiness
④ Disposition
⑤ ICU/SD Criteria
⑥ Safety Alerts
⑦ Incomplete Tasks
⑧ Incomplete Discharge Milestones
⑨ Notes

Downgrade Recommendation*
In order of most ready to least ready

- Bed Assigned and Clean (Critical)
- Bed Assigned and Clean
- Bed Assigned and Dirty
- Bed Assigned and Occupied
- 7A1 Bed Requested, Not Assigned
- READY FOR MS — Status: Ready for Med/Surg
- POSSIBLE DG — Status: Ready for Downgrade
- READY FOR SD — Status: Ready for Step Down
- READY FOR CT — Status: Ready for Cardiac Tele
- LATERAL TX — Status: Ready for Lateral Transfer
- NOT ELIGIBLE — Status: Not eligible for downgrade

*Recommendation is based on individual or combination of patient criteria

Acuity Scores

Modified Early Waring Score
0 - 3
>=4

Glasgow Coma Score
1 - 8
>=9

Patient Downgrade Readiness Criteria
76 different criteria are evaluated to create a downgrade readiness recommendation. Only relevant criteria based on established thresholds are displayed on the Tile.

1. Abdominal Pressure
2. Centrimag
3. Coma - Alertness
4. Heated High Flow Nasal Canula
5. High-Flow Nasal Canula
6. Impella
7. Intracranial Pressure
8. LVAD
9. Pacemaker (CT)
10. Pacemaker (ICU)
11. Suction > 2 Hours
12. Suction > 4 Hours
13. Therapeutic Hypothermia & Cardiac Arrest
14. Unstable High Degree Block
15. Ventricular Rhythm
16. Transcranial Doppler
17. Excessive Blood Loss
18. Increasing Sodium
19. Increasing Troponin
20. Lactic Acid - High
21. Sodium Imbalance
22. Toxic Substance in Bloodwork
23. Arterial Line
24. Central Line (ICU)
25. Chest Tube with Suction
26. ECMO
27. EVD
28. Intra-Aortic Balloon Pump
29. Invasive Ventilator
30. Lumbar Drain
31. Lumbar Drain Removed
32. Non-Invasive Ventilator
33. Rectal Tube
34. Sheath
35. Swan Ganz Catheter
36. Trialysis Catheter
37. Ventilator Extubated
38. ACE Inhibitors
39. Alteplase (TPA)
40. Beta Blockers
41. Calcium Channel Blockers (Nicardipine, Cleviprex, Cardizam)
42. Continuous Dialysis
43. Continuous Sedation
44. Dexmedetomidine
45. Fenoldopam
46. GLEOLAN
47. Insulin Drip
48. Isuprel
49. IV 23%
50. IV 3% W/Rate > 30
51. Ketamine
52. Mannitol
53. Neuromuscular Blockade
54. Nitrates (nitroglycerin)
55. Opioids
56. PDE Inhibitors
57. Pulmonary Hypertension
58. Reversal Agents
59. Vasoactive Meds not Titrated
60. Vasoactive Meds Titrated
61. Code Blue
62. Continuous EEG
63. New ICU Patient
64. Decrease in GCS
65. Decrease in RASS
66. MEWS - High
67. BP - Abnormal (SD)
68. BP - Abnormal (ICU)
69. HR - Abnormal
70. O2 Flow Rate - High (ICU)
71. O2 Flow Rate - High (SD)
72. Oxygen Saturation - Low
73. Respiratory Rate - Abnormal (ICU)
74. Respiratory Rate - Abnormal (SD)
75. Temperature - Low
76. Ventilator w/ Tracheostomy

*Refer to the General Patient Manager Overview Document for more details

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In order of most ready to least ready

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⊟✓⊡ D	Bed Assigned and Dirty
⊟✓⊡ O	Bed Assigned and Occupied
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Acuity Scores
Calculation

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Glasgow Coma Score

| 1 - 8 |
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Patient Downgrade Readiness Criteria
76 different criteria are evaluated to create a downgrade readiness recommendation. Only relevant criteria based on established thresholds are displayed on the Tile.

1.	Abdominal Pressure	28.	Intra-Aortic Balloon Pump	54.	Nitrates (nitroglycerin)
2.	Centrimag	29.	Invasive Ventilator	55.	Opioids
3.	Coma – Alertness	30.	Lumbar Drain	56.	PDE Inhibitors
4.	Heated High Flow Nasal Canula	31.	Lumbar Drain Removed	57.	Pulmonary Hypertension
5.	High-Flow Nasal Canula	32.	Non-Invasive Ventilator	58.	Reversal Agents
6.	Impella	33.	Rectal Tube	59.	Vasoactive Meds not Titrated
7.	Intracranial Pressure	34.	Sheath	60.	Vasoactive Meds Titrated
8.	LVAD	35.	Swan Ganz Catheter	61.	Code Blue
9.	Pacemaker (CT)	36.	Trialysis Catheter	62.	Continuous EEG
10.	Pacemaker (ICU)	37.	Ventilator Extubated	63.	New ICU Patient
11.	Suction > 2 Hours	38.	ACE Inhibitors	64.	Decrease in GCS
12.	Suction > 4 Hours	39.	Alteplase (TPA)	65.	Decrease in RASS
13.	Therapeutic Hypothermia & Cardiac Arrest	40.	Beta Blockers	66.	MEWS – High
14.	Unstable High Degree Block	41.	Calcium Channel Blockers (Nicardipine, Cleviprex, Cardizam)	67.	BP – Abnormal (SD)
15.	Ventricular Rhythm			68.	BP – Abnormal (ICU)
16.	Transcranial Doppler	42.	Continuous Dialysis	69.	HR – Abnormal
17.	Excessive Blood Loss	43.	Continuous Sedation	70.	O2 Flow Rate - High (ICU)
18.	Increasing Sodium	44.	Dexmedetomidine	71.	O2 Flow Rate - High (SD)
19.	Increasing Troponin	45.	Fenoldopam	72.	Oxygen Saturation - Low
20.	Lactic Acid - High	46.	GLEOLAN	73.	Respiratory Rate - Abnormal (ICU)
21.	Sodium Imbalance	47.	Insulin Drip		
22.	Toxic Substance in Bloodwork	48.	Isuprel	74.	Respiratory Rate - Abnormal (SD)
23.	Arterial Line	49.	IV 23%		
24.	Central Line (ICU)	50.	IV 3% W/Rate > 30	75.	Temperature - Low
25.	Chest Tube with Suction	51.	Ketamine	76.	Ventilator w/ Tracheostomy
26.	ECMO	52.	Mannitol		
27.	EVD	53.	Neuromuscular Blockade		

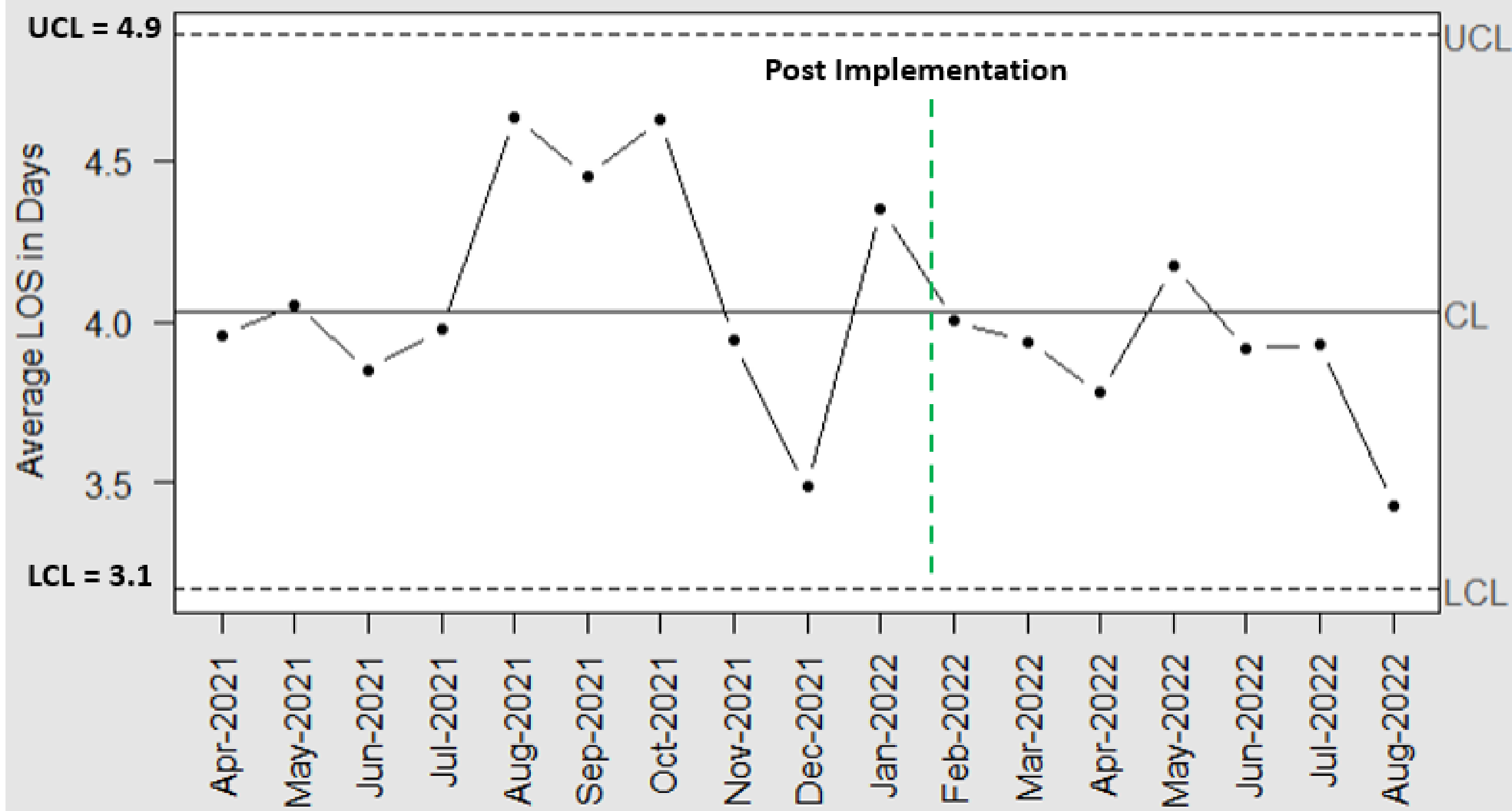*Refer to the General Patient Manager Overview Document for more details*

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Statistics	Timeframe	5K3-5
Baseline	Apr 2021 - Jan 2022	4.15
Post Implementation	Feb 2022 - Aug 2022	3.88
	% Change	-7%

Control Chart of Neuro ICU Average Time from Downgrade Ready to Order

Statistics	Timeframe	5K5
Baseline	Mar 2021 -May 2021	17.47
Post Implementation	Jun 2021 - Apr 2022	14.41
	% Change	-18%

Control Chart of Neuro ICU Average Hold Hours