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Background

Endovascular Thrombectomy (EVT) is a treatment involving the removal of blood clots from vessels in the event of ischemic stroke. EVT has been shown to reduce the severity of stroke, however for every 60-minute delay to EVT, patients have a 5% absolute or 15-20% relative worse functional outcome at 90 days, with net monetary loss estimated at S$26,255/hour[1]. Between March 2021 to June 2021, the median time taken to start EVT (i.e. groin puncture) for acute stroke patients presenting at SGH Emergency Department (ED) was 130 minutes.

Aims

To reduce the time taken to start EVT for acute stroke patients presenting at SGH ED from a median of 130 minutes to 80 minutes within 2 years.

Methodology

Gemba walks and time motion studies were conducted to map out and analyse the workflows of all relevant departments (ED, Neurology, Interventional Radiology, Radiography and Anaesthesia) between patient arrival at ED to EVT. Identified areas of improvement are highlighted in Figure 1 below:

1) ED Door to EVT Decision by IR Consultant Workflow
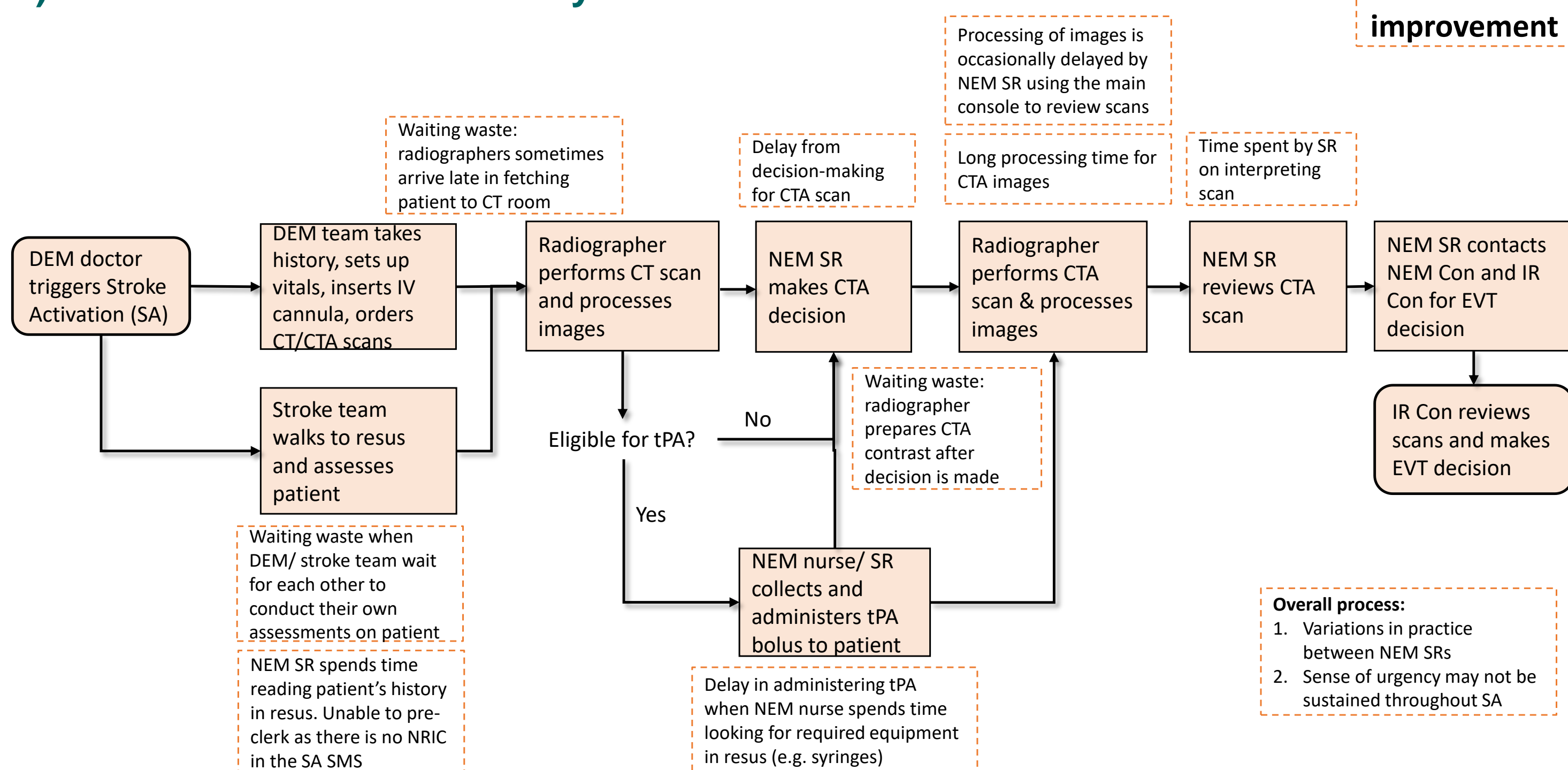
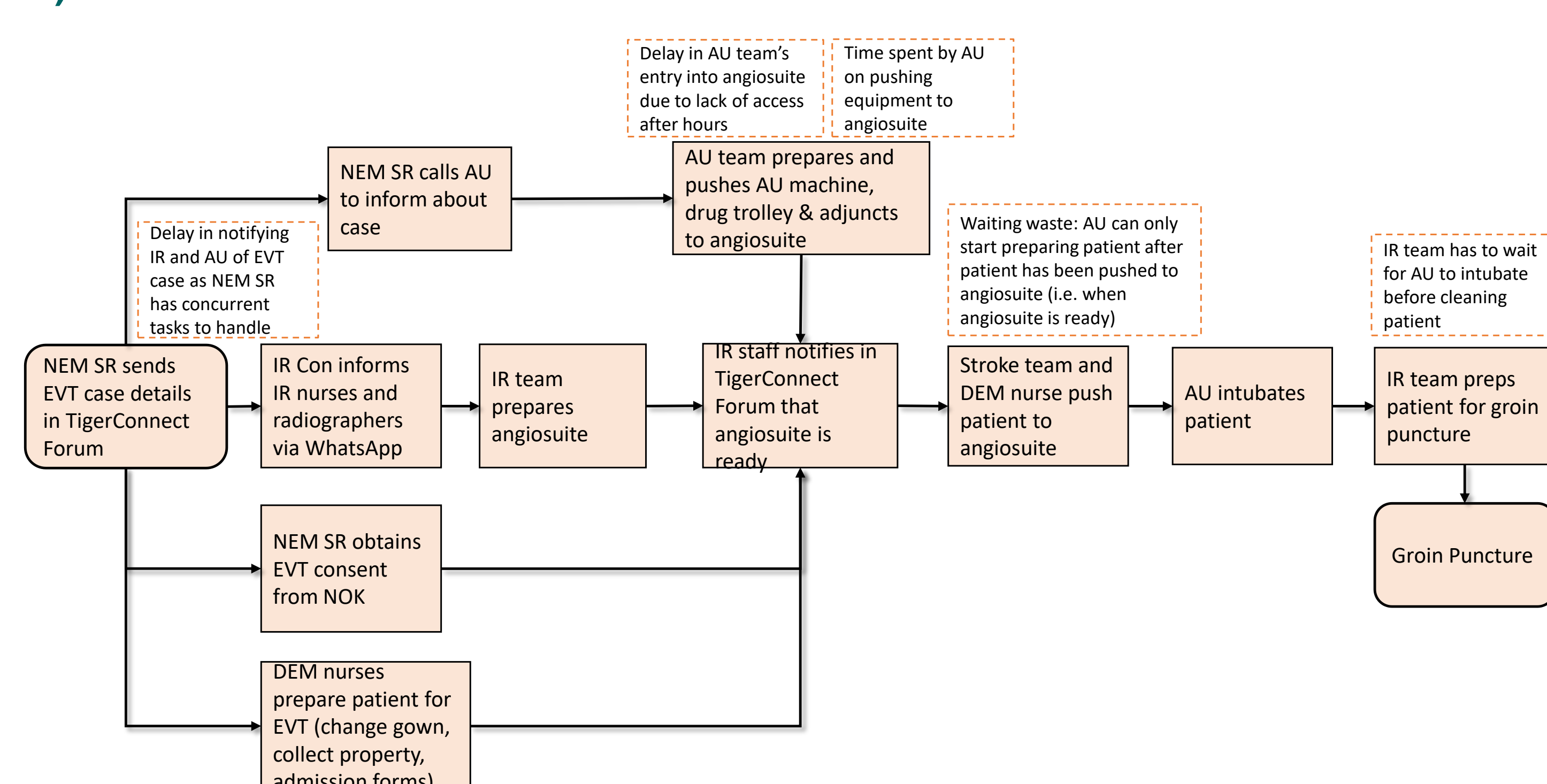### 2) EVT Decision to Groin Puncture Workflow

Figure 1. Pre-intervention workflows between patient arrival at ED to groin puncture
*DEM – Department of Emergency Medicine; NEM – Neurology Department; tPA – Thrombolysis; SR – Senior Resident, Con – Consultant; IR – Interventional Radiology; AU – Anaesthesia Unit*

Implementation

Interventions were piloted across **5 Plan-Do-Study-Act (PDSA) cycles** over 2 years (June 2021 to January 2023):

- **Lean methodology** was employed to address the areas of improvement:
  1) Processes were streamlined through **elimination of steps and parallel processing**
  2) Waste and variation were reduced through **protocols and standardisation of workflows**
  3) **Pre-notifications** were used for earlier initiation of steps
  4) **Push systems** were adopted over pull systems to reduce waiting and increase the sense of urgency at points of patient handover between staff
- **Role-based messaging platform** for more efficient inter-department communication
- **CTA image training** for Neurology residents

1) ED Door to EVT Decision by IR Consultant Workflow
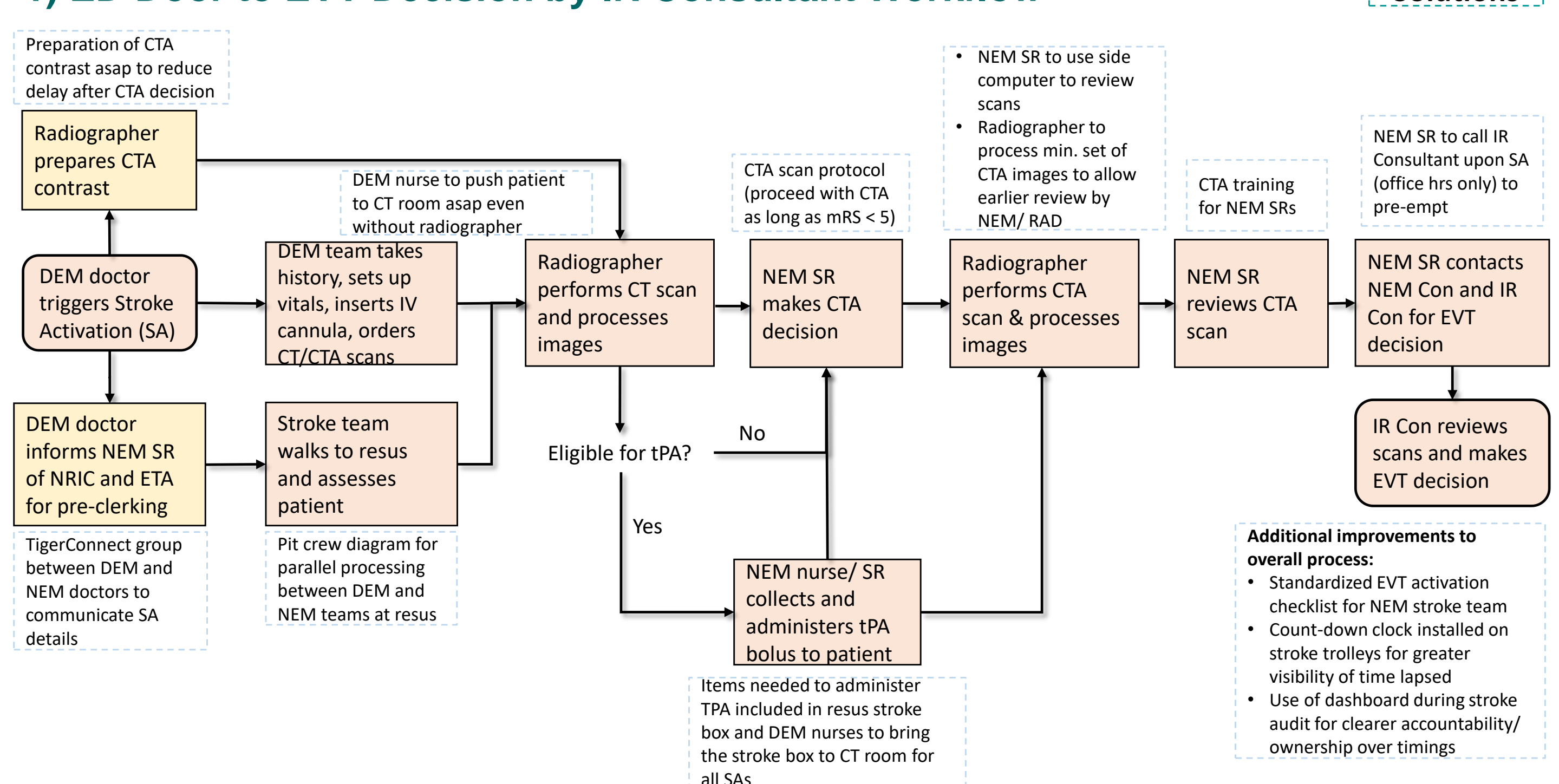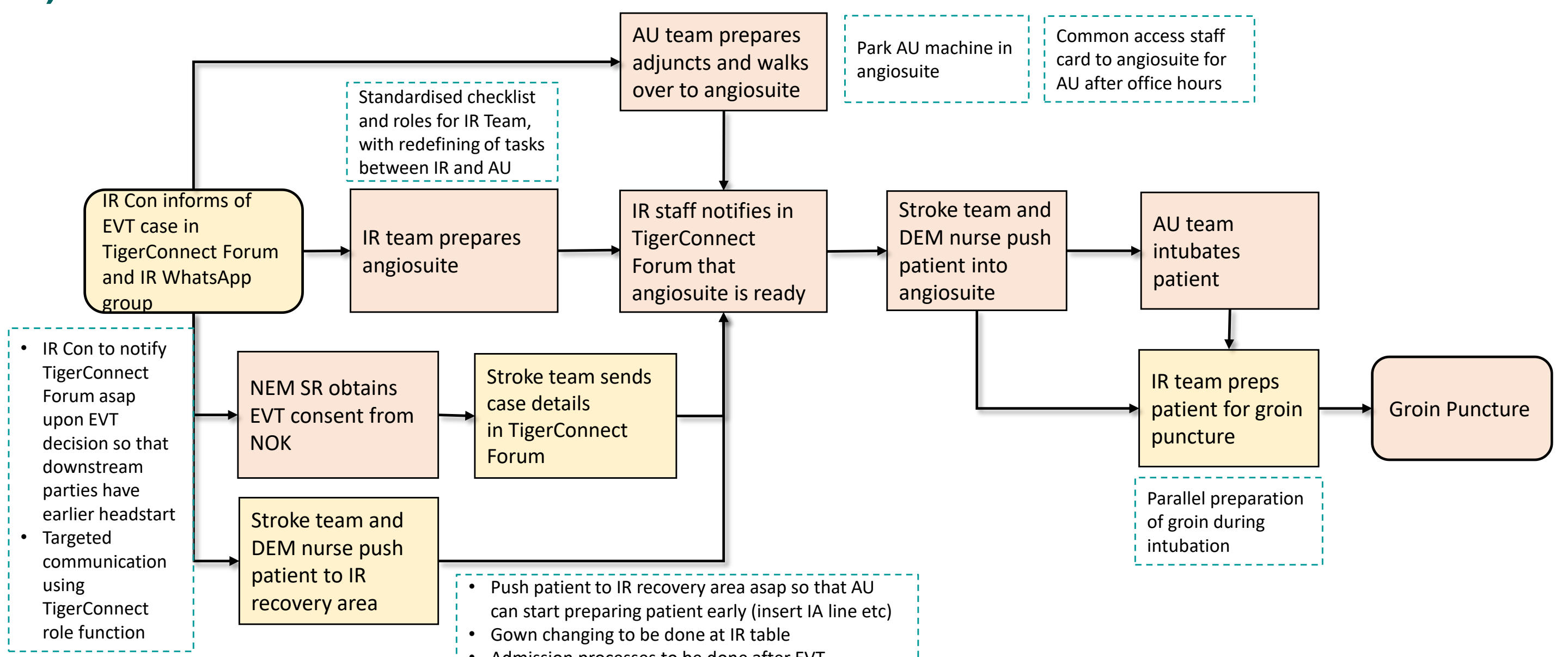

2) EVT Decision to Groin Puncture Workflow

Figure 2. Post-intervention workflows between patient arrival at ED to groin puncture

Results

- Timings for the overall door-to-puncture process and sub-processes (door-to-imaging, imaging-to-EVT decision, decision-to-puncture) were tracked at monthly audits.
- Median door-to-puncture timings decreased by **37%** from a baseline of 130 minutes (March 2021 - June 2021) to **82 minutes** in PDSA 5 (November 2022 - January 2023). **Statistical signal of improvement** was achieved, as demonstrated by a shift in the run chart in Figure 3.
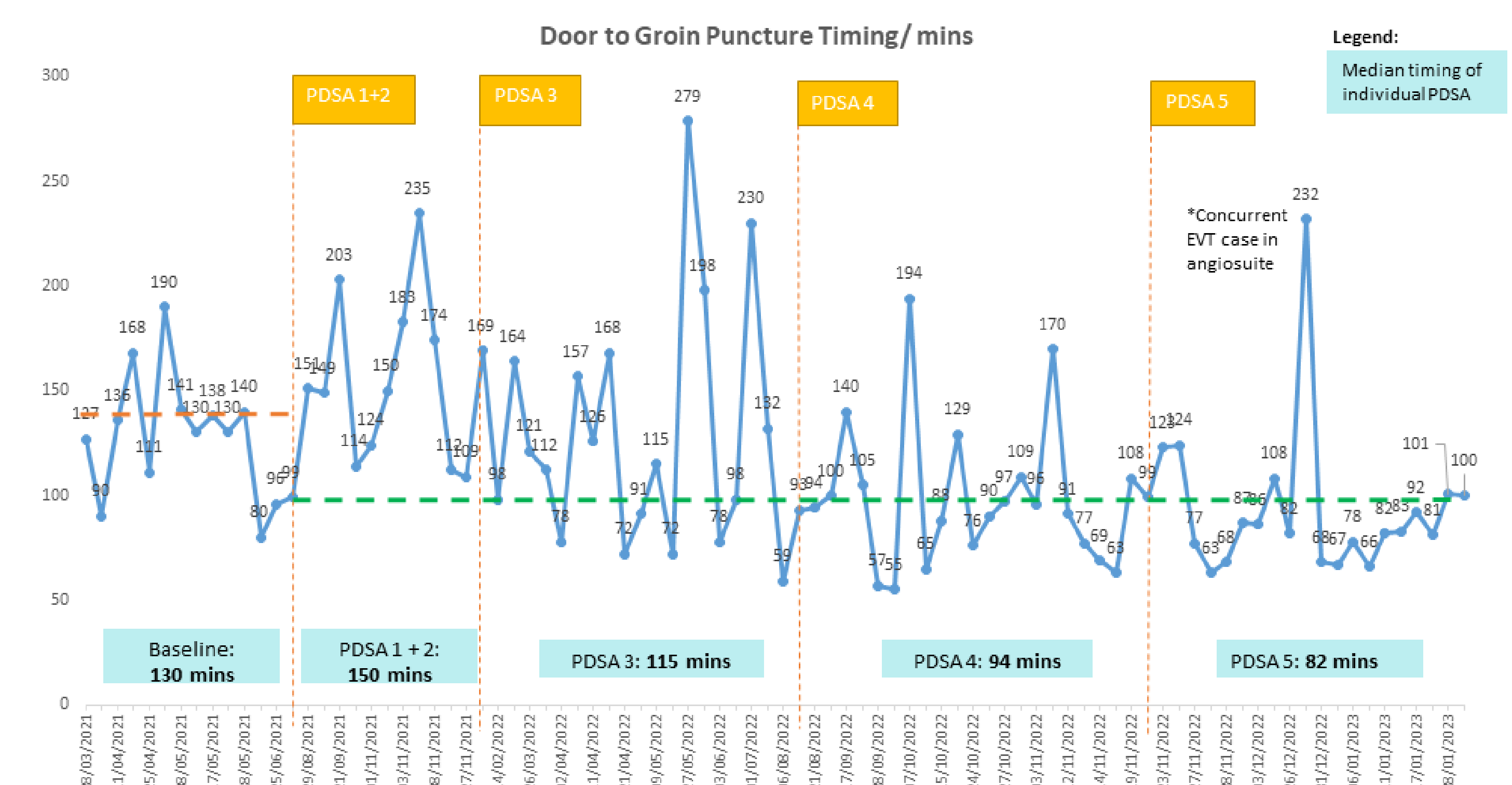

Figure 3. Run chart of door-to-puncture timings between March 2021 to January 2023

Conclusion

- The implementation of process improvements via an iterative approach and close collaboration within a multi-disciplinary team were effective in reducing door-to-puncture timings.
- Future directions to sustain results and further improve timings:
  ➢ Mobile Stroke AI solution to automatically detect and notify stroke team of large vessel occlusions, and allow for simultaneous review of imaging and decision-making by offsite clinical team
  ➢ Planning of facility layout and equipment in the new Emergency Medicine Building (2024) and the new SGH Campus (2035) to facilitate more streamlined workflows (e.g. ED direct to angiosuite)

Reference:
1) Ni W, Kunz W, Goyal M, et al. Lifetime quality of life and cost consequences of delays in endovascular treatment for acute ischaemic stroke: a cost-effectiveness analysis from a Singapore healthcare perspective. BMJ Open 2020;10:e036517. doi:10.1136/ bmjopen-2019-036517