



HARVARD T.H. CHAN
SCHOOL OF PUBLIC HEALTH

Future of Stroke Care

Contacts:

Meagan Elam, DrPH: melam@ariadnelabs.org

Sandeep Kumar, MD, FAHA: skumar@bidmc.harvard.edu



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WOMEN'S HOSPITAL**



HARVARD T.H. CHAN
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We are a joint center for health systems innovation at Brigham & Women's Hospital and the Harvard T.H. Chan School of Public Health



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From developing checklists and conversation guides to fostering international collaborations and establishing global standards of measurement, our work has touched hundreds of millions of lives.

Safe Surgery Checklist template

Hospital Name: _____

Before Induction of Anesthesia Nurse and Anesthesia Professional verify: <ul style="list-style-type: none"> □ Patient identification (name and DOB) □ Surgical site □ Surgical procedure to be performed matches the consent □ Site marked □ Known allergies □ Patient positioning □ Essential imaging available □ Risk of hypothermia (if operation >1 hour) <ul style="list-style-type: none"> • Warmer in place □ Risk of venous thromboembolism <ul style="list-style-type: none"> • Bolus in place and/or anticoagulants □ Anesthesia safety check completed ANESTHESIA BRIEFING Anesthesia Professional shares: <ul style="list-style-type: none"> □ Anticipated airway or aspiration risk □ Risk of significant blood loss <ul style="list-style-type: none"> • Two IV/central access and fluids planned • Type and crossmatch/screen • Blood availability 	Before Skin Incision TIME OUT Circulating Nurse asks: <ul style="list-style-type: none"> • "Is everyone ready to perform the time out? Please state your name and role." Entire Surgical Team confirms: <ul style="list-style-type: none"> □ Patient name □ Surgical procedure to be performed □ Surgical site □ Essential imaging available □ Antibiotic prophylaxis given within the last 60 minutes <ul style="list-style-type: none"> • Anesthetic redosing plan discussed TEAM BRIEFING Surgeon shares: <ul style="list-style-type: none"> □ Operative plan □ Possible difficulties □ Expected duration □ Anticipated blood loss □ Impacts or special equipment needed Anesthesia Professional shares: <ul style="list-style-type: none"> □ Anesthetic plan □ Airway concerns □ Other concerns Circulating Nurse and Scrub Tech share: <ul style="list-style-type: none"> □ Sterility, including indicator results □ Equipment issues □ Other concerns Surgeon asks: <ul style="list-style-type: none"> • "Does anybody have any concerns? If you see something that concerns you during this case, please speak up." 	Before Patient Leaves Room Nurse reviews with team: <ul style="list-style-type: none"> □ Instrument, sponge, and needle counts □ Name of the procedure performed Nurse reads aloud to team: <ul style="list-style-type: none"> □ Specimen labeling, including patient's name TEAM DEBRIEFING Entire Surgical Team discusses: <ul style="list-style-type: none"> □ Key concerns for patient recovery and management □ Equipment problems that need to be addressed □ Other opportunities for improvement
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This checklist is not intended to be comprehensive. Additions and modifications to local practice are encouraged. Based on the WHO Surgical Safety Checklist (http://www.who.int/initiatives/2008-09/surgical-safety-checklist-for-patients-at-risk). ©2013 Ariadne Labs. All rights reserved. | SIC-Checklist Template - Revised 7/2013/15

Operating Room Crisis Checklists

>> Do not remove book from this room <<

BEFORE BIRTH WHO Safe Childbirth Checklist
 On Admission
 1
 World Health Organization

Does mother need referral?
 No
 Yes, organized

Partogram started?
 No, will start when <4cm
 Yes

Does mother need to start:
 Antibiotics?
 No
 Yes, given

Magnesium sulfate and antihypertensive treatment?
 No
 Yes, magnesium sulfate given

Confirm supplies are available to vaginal exam
 Encourage both companion to be present at birth
 Confirm as:

Start plotting when cervix <4cm, then cervix should dilate 1 cm/hr
 • Every 30 mins plus HR, contractions, fetal HR
 • Every 2 hrs plus temperature
 • Every 4 hrs plus BP

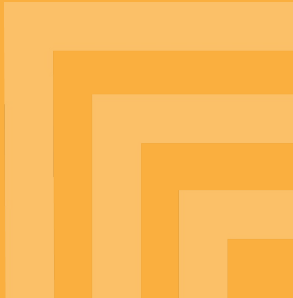
Ask for allergies before administration of any medication
 • Give antibiotics to mother if any of:
 • History of fetal meningitis/chorioamnionitis
 • Rupture of membranes >18 hrs

One magnesium sulfate to mother if any of:
 • Classic BP ≥160 mmHg and ≥3 contractions and any severe headache, visual disturbance, epigastric pain
 • Give antihypertensive medication to mother if systolic BP ≥160 mmHg
 • Goal: keep BP <150/100 mmHg

SUSPECTED EVENT	INDEX	wp if any of individual signs, including or without disturbance in
Air Embolism – Venous	1	
Anaphylaxis	2	
Bradycardia – Unstable	3	
Cardiac Arrest – Asystole/PEA	4	
Cardiac Arrest – VF/VT	5	
Failed Airway	6	
Fire	7	
Hemorrhage	8	
Hypotension	9	
Hypoxia	10	
Malignant Hyperthermia	11	
Tachycardia – Unstable	12	



The Problem

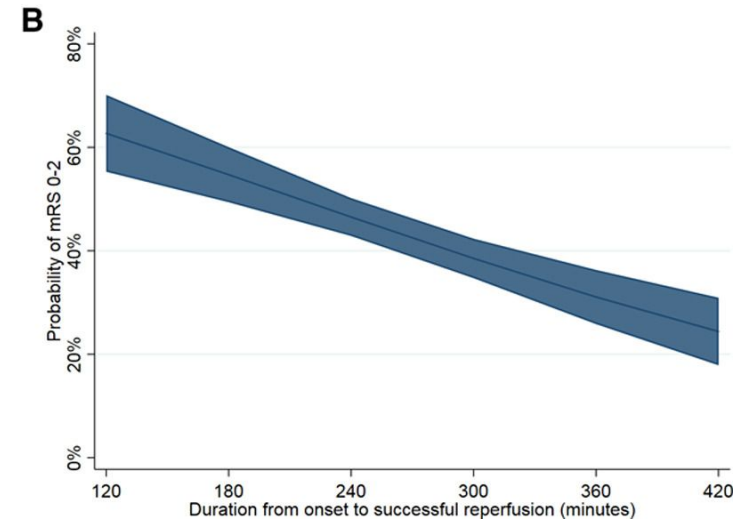
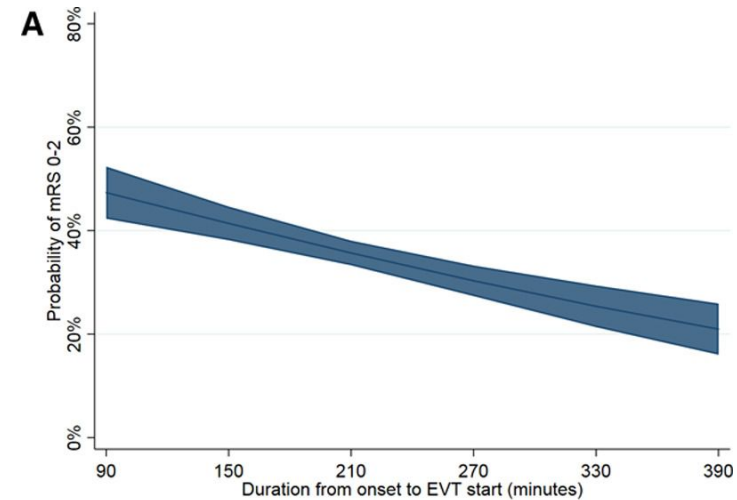


Every Minute Counts in Stroke Recognition and Treatment

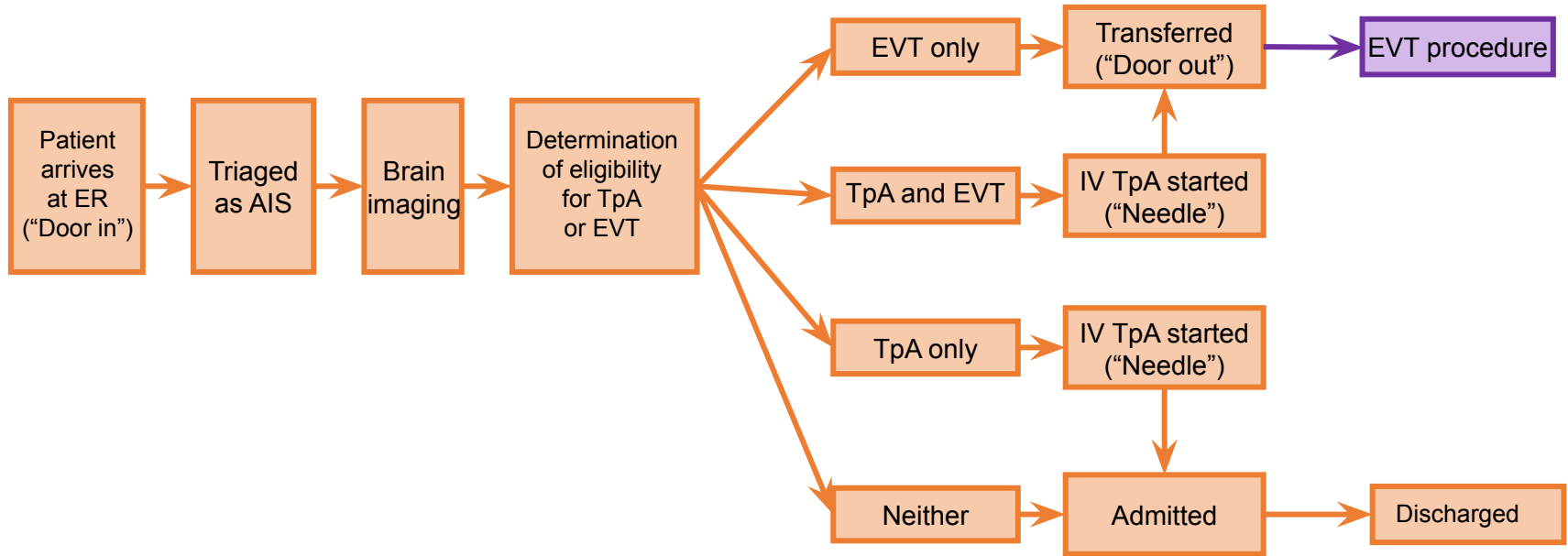
In a typical large vessel occlusion stroke, the brain loses ~ 1.9 million neurons, 14 billion synapses, and 7.5 miles of myelinated fibers every minute

Source:

<https://www.ahajournals.org/doi/full/10.1161/CIRCULATIONAHA.117.032600>



Patient flow during stroke triage includes multiple complex processes



AIS = Acute Ischemic Stroke

TpA = IV treatment, can be done at **Primary Stroke Center (PSC)**

EVT = surgical treatment, can be done only at **Comprehensive Stroke Center (CSC)**

Massachusetts Door-in-Door Out = 165-177 mins

Recommended Door-in-Door Out = <60 mins

We need **follow-through innovation** to ensure effective treatments reach every patient, everywhere, everytime.

“The challenge is that this medical innovation isn’t as deployable as a new pill or device... For a qualified specialist, the extraction of the clot itself can be fairly straightforward — but getting the patient to the table in time is a highly complex process, a series of steps requiring layers of training and a rethinking of the protocols that move people around within the medical system. The new “miracle treatment” is the easy part. Bringing it to the people who need it, around the world? Achieving that will be miraculous.”

The New York Times Magazine

This Revolutionary Stroke Treatment Will Save Millions of Lives. Eventually.

A procedure called EVT is creating radically better outcomes for patients, but only when it's performed quickly enough — and that requires the transformation of an entire system of care.



Holland, 2023

The Solution



The Stroke Triage Checklist

A communication tool to improve timely stroke care

The Checklist aims to improve the effectiveness and efficiency of ED stroke triage to get patients to treatment faster and improve outcomes

Stroke Triage Checklist

Express Patient Number _____

Patient Label Goes Here

Initial ED Evaluation

- Has an ED attending, PA, or triage nurse confirmed a suspected stroke?
- Have "PM prot-acute stroke" in CT orders been completed?
- Have Blood Sugar and Blood Pressure been completed by ED team or EMS?
- Has Registration completed "Quick Reg" or Express Pack and provided a name band/labels to RN?
- Has Imaging been notified to clear CT scanner for immediate scan?
- Has at least 1 minimum 18g IV been placed and connected, and blood drawn for labs?
- Has family contact information been collected from EMS, patient, or support person?

Imaging

Is NIHSS ≥ 6 or FAST-ED ≥ 4 AND LKW < 24 hours?

- Yes – notify inter-facility transport
- No

If NO allergies, have non-contrast Head CT and CTA Head and Neck been obtained, regardless of renal function?

Has Radiology been notified that CT scans are complete?

Have CT images been sent to Stroke Team?

Has patient eligibility for tPA been confirmed by ED Provider?

- Yes – Activate telestroke and refer to tPA order sheet
- No

Have the CT images been reviewed by the Stroke Team? *Note: Remind Stroke Team to search for images by Express Patient number*

Patient Room

- Has ED Provider confirmed patient plan with Stroke Team?

For patients receiving tPA:

- During Infusion:** Has the NIBP cuff been set to measure every 15 minutes?
- During Infusion:** Has a Q15 minute neurological exam been completed?
- After Infusion:** Have arrangements/reminders been set to ensure patient receives appropriate monitoring for up to 24 hours if not transferring? *Note: Patient should receive a neurological status and BP check every 15 minutes for the first hour; every 30 minutes hours 2-8 ; and every hour for hours 9-24 after infusion.*

Has the dysphagia screen been performed?

- Yes
- No

Is the patient remaining in the hospital?

- Yes
- No - Has the transfer been accepted by the receiving hospital and EMS?

Has the BiDMC neurology consult report from the TeleDoc Smart Notes been printed and scanned into the patient's Meditech medical record?

- Yes
- No - TeleDoc not used

NOTE: The information here is NOT part of a patient's medical record. When complete, return to the Stroke Checklist Folder at the ED Secretary Desk. Do NOT scan this document into the permanent record.

Stroke Triage Checklist

Initial ED Evaluation

- Has an ED attending, PA, or triage nurse confirmed a suspected stroke and LKW time?
- Has patient weight been taken and documented in EPIC?
- Has a 'Stroke Alert' burst page been sent to Neurology and Imaging?
- Has the patient been registered, received name band, and registered?
- Has family contact information been collected from EMS, patient, or support person?
- Have Blood Sugar and Blood Pressure been completed (by ED team or EMS)?
- Has at least 1 peripheral IV been placed (preferably 18g and antecubital) and blood drawn for labs?

Imaging

- Have non-contrast Head CT/CTA Head and Neck been performed?

Is patient eligible for tPA?

- Yes
- No

Is there a large vessel occlusion (LVO)?

- Yes – contact Neurology/Telestroke (see box below) and notify inter-facility transport
- No

Telestroke (if needed)

- Has the Telestroke cart and camera been brought to the patient's room?
- Has the patient been logged into the system?
- Have the CT images been reviewed by the receiving hospital? *If no, contact Radiology.*

tPA/Transfer

Has patient eligibility for tPA been confirmed by ED Provider?

- Yes – refer to tPA administration checklist
- No

For patients receiving tPA, has the NIBP cuff been set to measure every 15 minutes?

For patients receiving tPA, has the 15 minute neurological assessment been started?

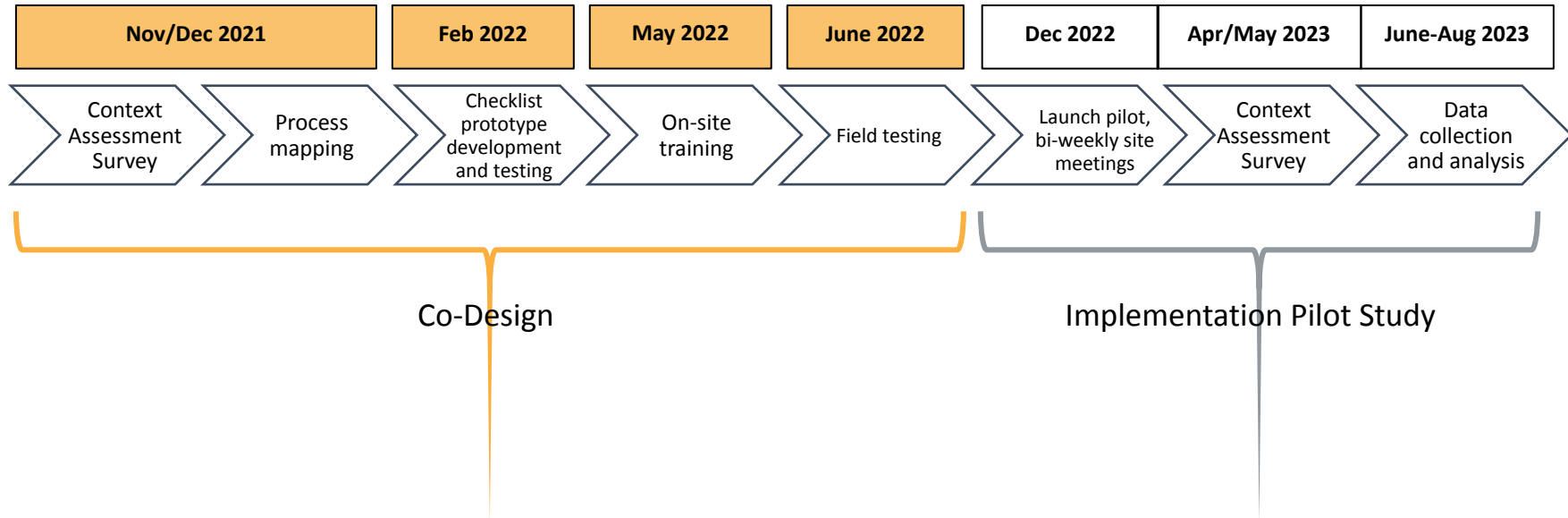
Is the patient being transferred for thrombectomy?

- Yes - Has the transfer been accepted by the receiving hospital and EMS notified?
- No - The patient will be admitted to MAH

NOTE: This checklist is meant to be an organizational tool. The information here is NOT part of a patient's medical record.

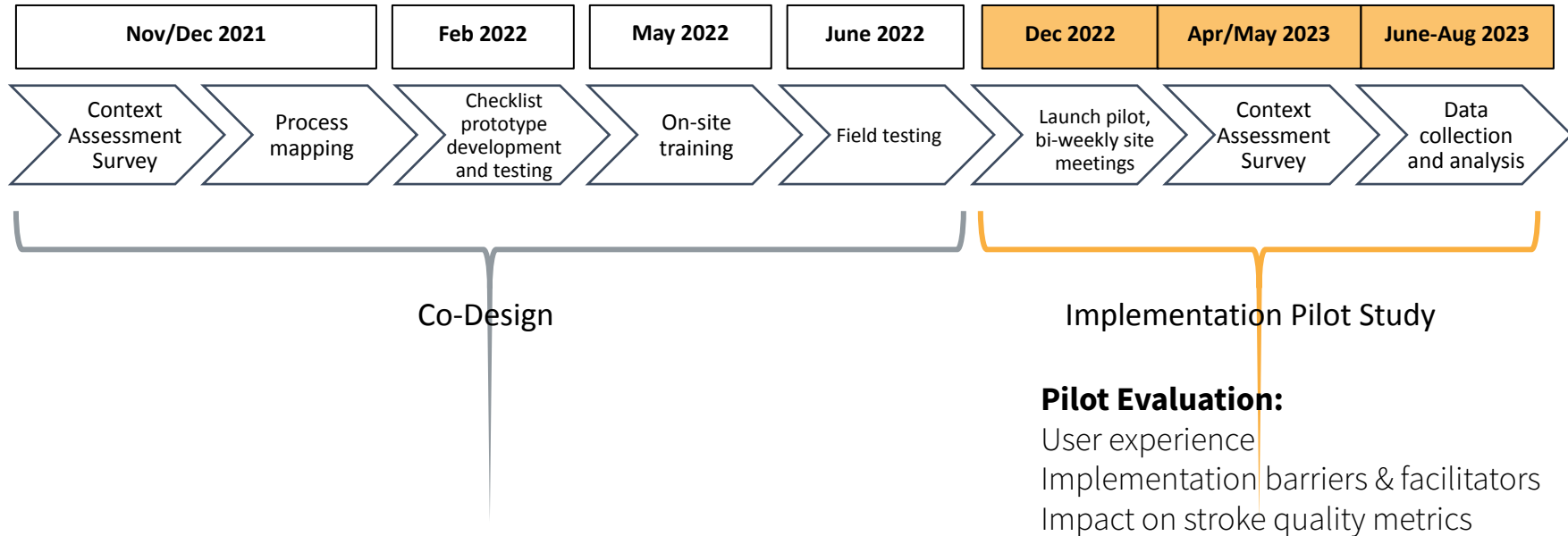
Stroke Checklist Development

Co-Design using Human Centered Design Principles



Stroke Checklist Pilot

Implementation and evaluation

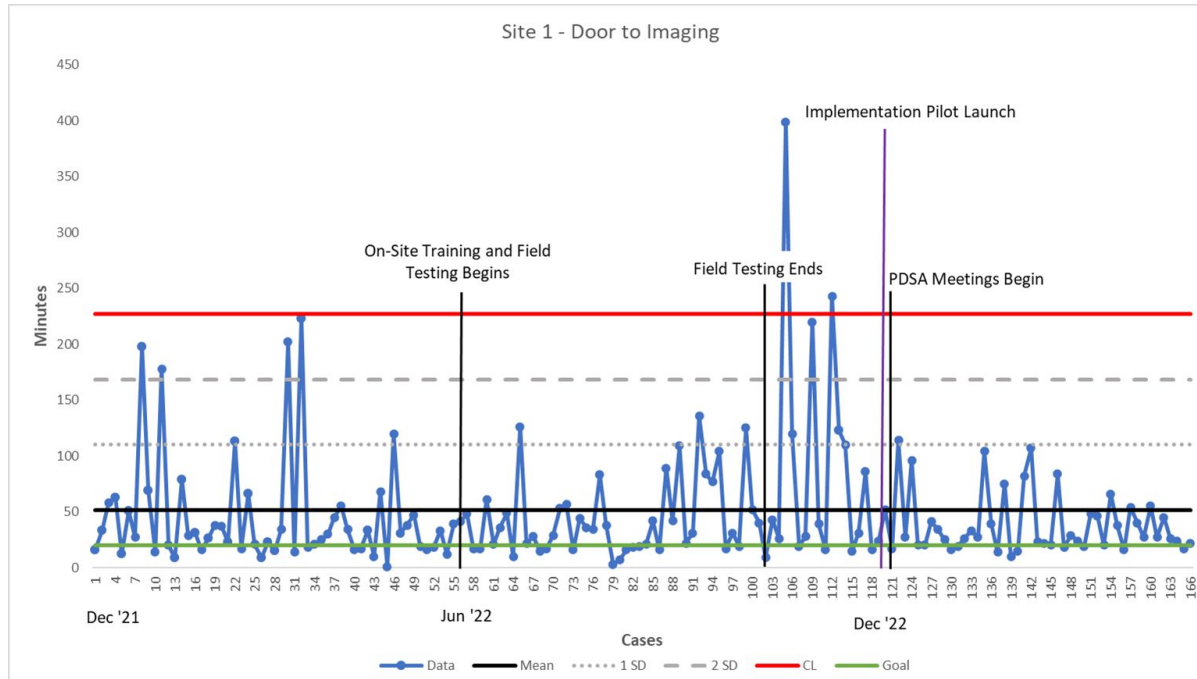


Implementation Pilot Results



Control Charts

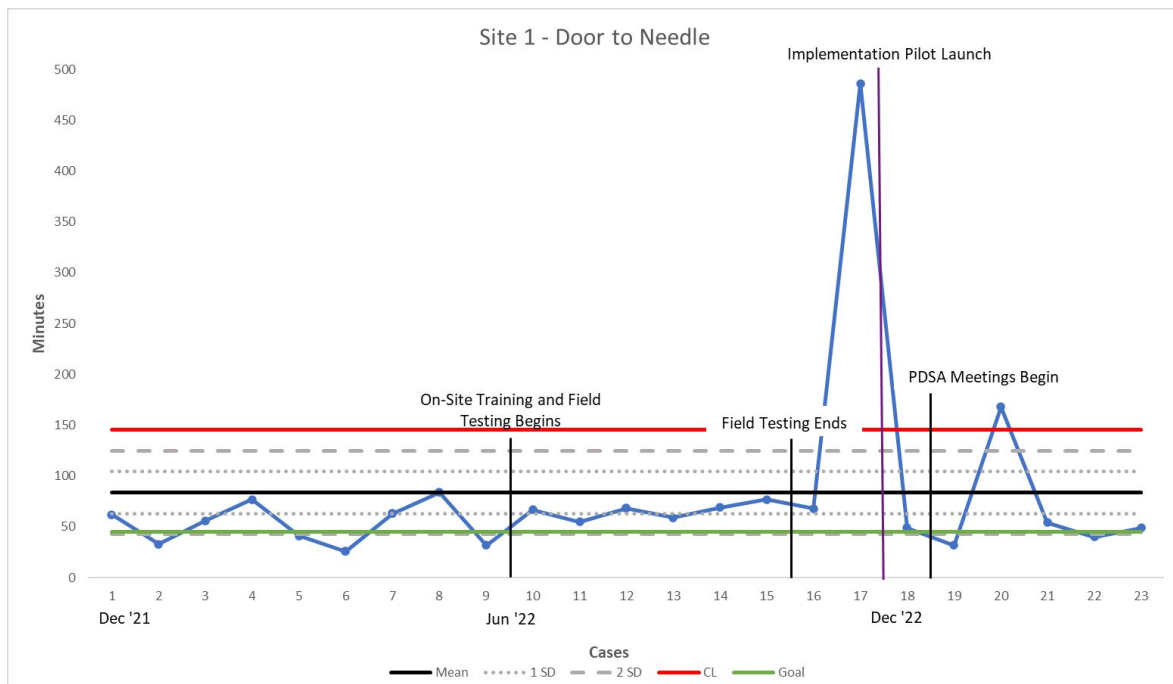
Site 1 Door-to-Imaging



Period	Mean (min)
Baseline	51.4
Post-implementation	38.5

Control Charts

Site 1 Door-to-Needle



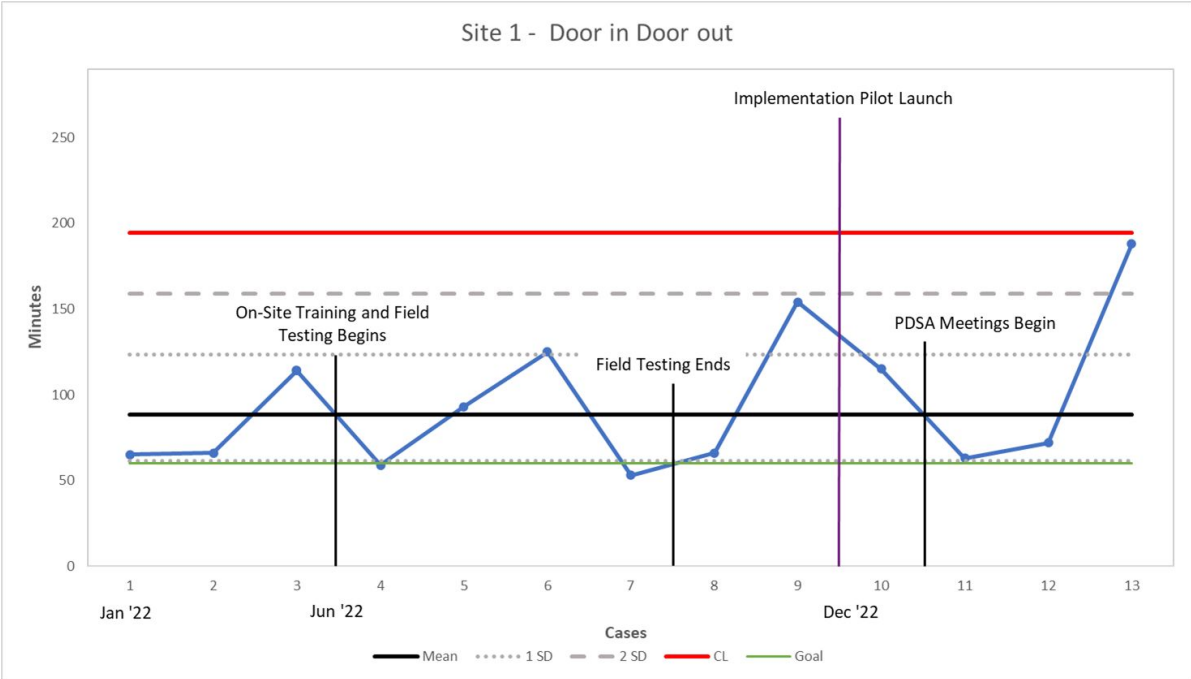
Period	Mean (min)
Baseline	83.7
Post-implementation	65.3

Baseline:
23% of cases within 45 min goal

Implementation:
33% of cases within 45 min goal

Control Charts

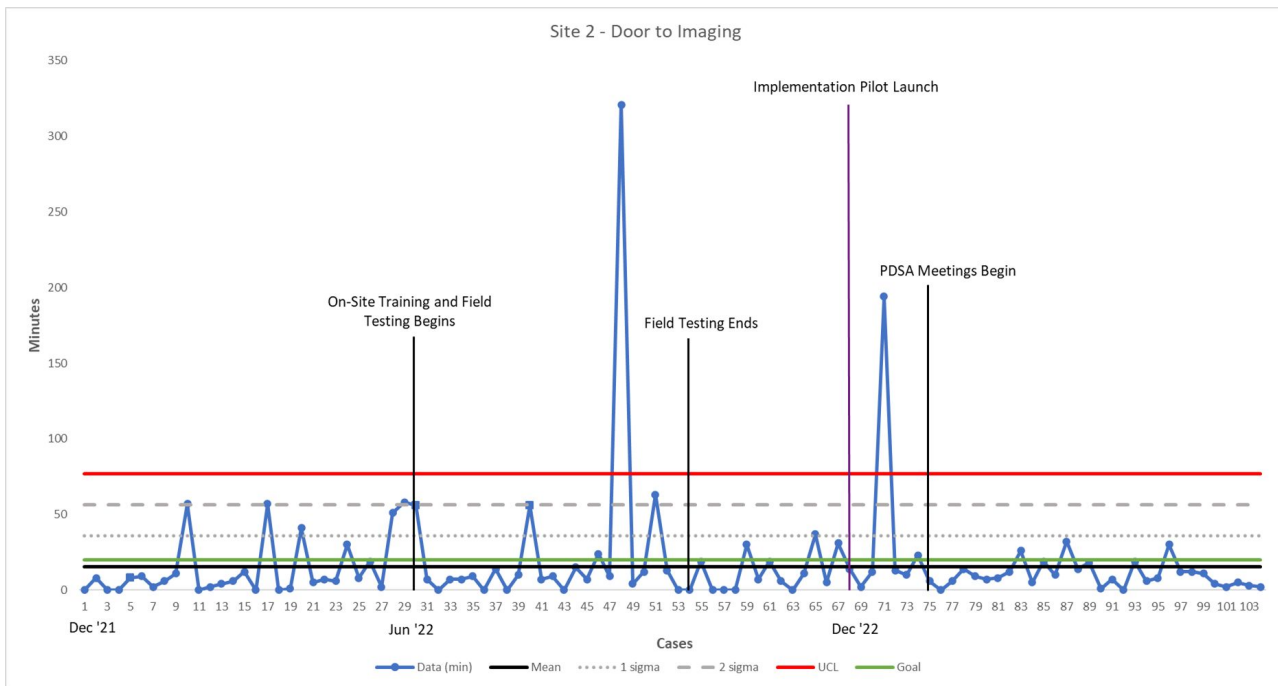
Site 1 Door-In-Door-Out



Period	Mean (min)
Baseline	88.3
Post-implementation	109.5

Control Charts

Site 2 Door-to-Imaging



Period	Mean (min)
Baseline	18.3
Post-implementation	15.6

Baseline:
79% of cases within 20 min goal

Implementation:
86% of cases within 20 min goal

Control Charts

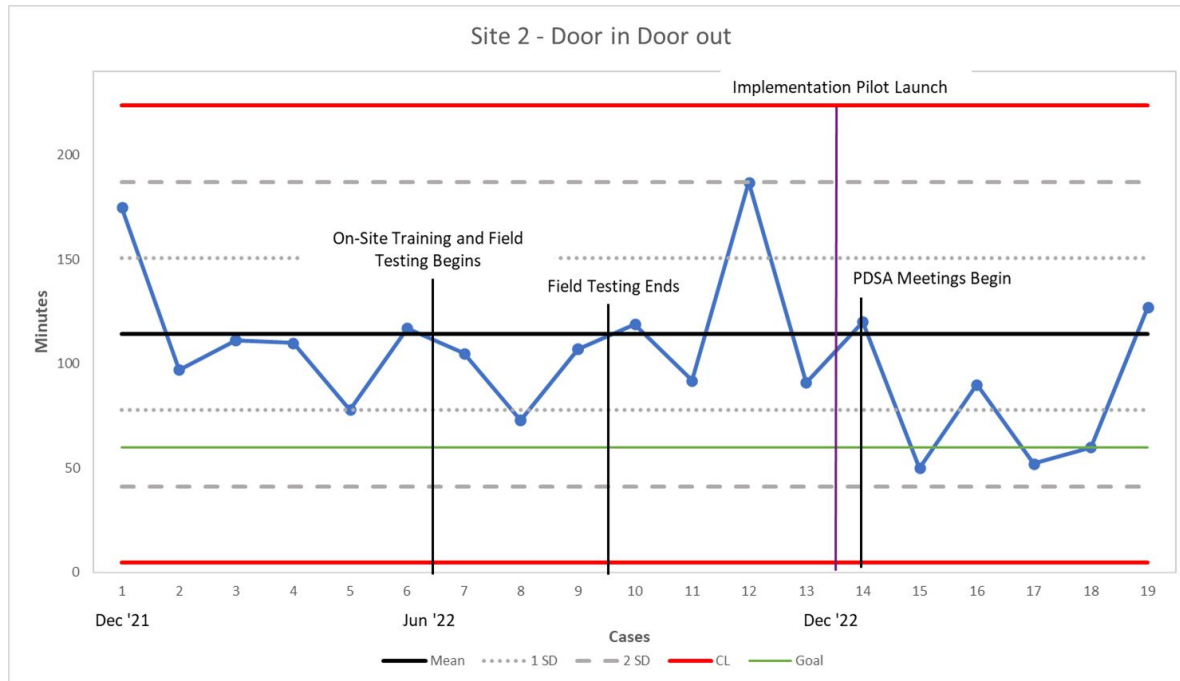
Site 2 Door-to-Needle



Period	Mean (min)
Baseline	68.3
Post-implementation	58.5

Control Charts

Site 2 Door-In-Door-Out



Period	Mean (min)
Baseline	114.3
Post-implementation	84.3

Baseline: 0 patients transferred within AHA 60 minute goal

Implementation: 3 patients (50%) transferred within AHA 60 minute goal

Pilot Results

Impact on Door-to-CT and Door-to-Needle Times

Door-to-CT	Door-to-Needle
<ul style="list-style-type: none">● 10.9 minute <i>decrease</i> on the average Door-to-CT times after implementation of the Stroke Checklist (p=0.09)● Patients had reduced odds of Door-to-CT times > 20 min after implementation of the Stroke Checklist (NS)	<ul style="list-style-type: none">● 13.9 minute <i>decrease</i> on the average Door-to-Needle (DTN) times after implementation of the Stroke Checklist (NS)● Patients were 85% less likely to have a DTN > 60 minutes after implementation of the Stroke Checklist (statistically significant, p=0.03)

*Not enough patients to establish relationship between checklist implementation and DIDO times

Patient Impact Projections

Based on Improved Door-to-Needle Times (<60 mins)

Number of stroke related deaths averted per thousand= **89**

Additional patients with improved ambulatory status at discharge: **11.8**

Additional patients discharged home: **4.2**

Projections based on 22% reduction in mortality with DTN < 60 mins (Fonarow et al., 2011, circulation) and improved clinical outcomes with reduced Onset-to-Treatment times (Saver et al., 2013 JAMA) and our preliminary results.

Qualitative Interviews with Leaders and Staff

Implementation	
Facilitators	Champions
	Consistent messaging and reminders
	Collaboration with the other site
	Sharing outcome data
	Increasing accessibility of the checklist
Barriers	Organizational changes
	Temporary staff members
	Emergency department environment
	Not fully embedded in workflow

User experience	
Utility	Improves patient outcomes
	Standardizes care
	Improves teamwork
Acceptability	Easy to use
	Checklist format
Feasibility	Flexibility in who uses the checklist
	Accessibility of the checklist

“Folks that do use it now do see how it is helpful and recognize that it’s not metric driven; It’s actually patient outcomes being improved by a tool like this.” (ED Physician)

Future Work



October 2021 -
September 2022

October 2022 -
September 2023

October 2023 -
March 2024

March 2024 -
October 2025

Year 1 Checklist Design

Goal: Design a tool ready for testing

Deliverables:

1. Prototype ready for testing
2. Build partnership with testing sites

Year 2 Implementation Pilot

Goal: Test the tool in clinical setting for feasibility, usability, acceptability

Deliverables:

1. Iterate and refine tool based on learnings
2. Collect early data on feasibility, usability, acceptability

Year 2.5 Solution Revision

Goal: Refine and iterate tool and develop implementation guidance based on pilot

Deliverables:

1. Hold convening to refine and iterate tool for spread
2. Develop implementation guidance and tools

Year 3 Outcomes Testing

Goal: Using an implementation effectiveness hybrid study the solution package and collect outcomes data.

Deliverables:

1. Tested solution package
2. Evidence showing improved outcomes

CURRENT FOCUS

Appendix



Express Patient Number

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- Have "RN prot-acute stroke" in CT orders been completed?
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- Has family contact information been collected from EMS, patient, or support person?

Imaging

Is NIHSS \geq 6 or FAST-ED \geq 4 **AND**
LKW < 24 hours?

- Yes – *notify inter-facility transport*
- No
- If NO allergies, have non-contrast Head CT and CTA Head and Neck been obtained, regardless of renal function?
- Has Radiology been notified that CT scans are complete?
- Have CT images been sent to Stroke Team?

Has patient eligibility for tPA been confirmed by ED Provider?

- Yes – *Activate telestroke and refer to tPA order sheet*
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- Yes - *Has the transfer been accepted by the receiving hospital and EMS notified?*
- No - *The patient will be admitted to MAH*