AUTOMATED IMAGE ANALYSIS ON MOBILE STROKE UNITS

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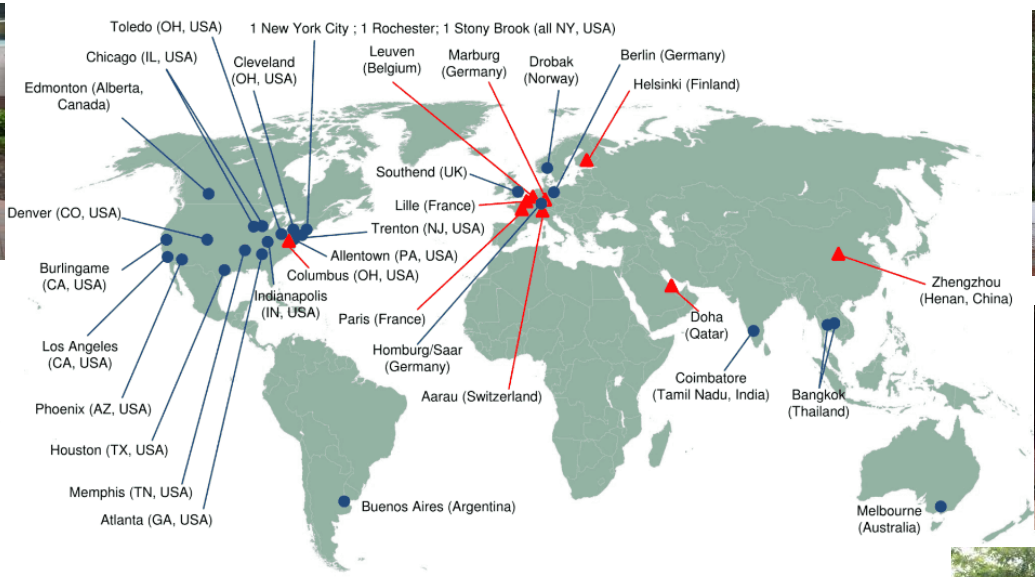
DISCLOSURE STATEMENT OF FINANCIAL INTEREST

I, SHREY MATHUR, DO NOT have a financial interest/arrangement or affiliation with one or more organizations that could be perceived as a real or apparent conflict of interest in the context of the subject of this presentation.

MSUs Worldwide



The MSU Concept

Improving Prehospital Stroke Services in Rural and Underserved Settings With Mobile Stroke Units

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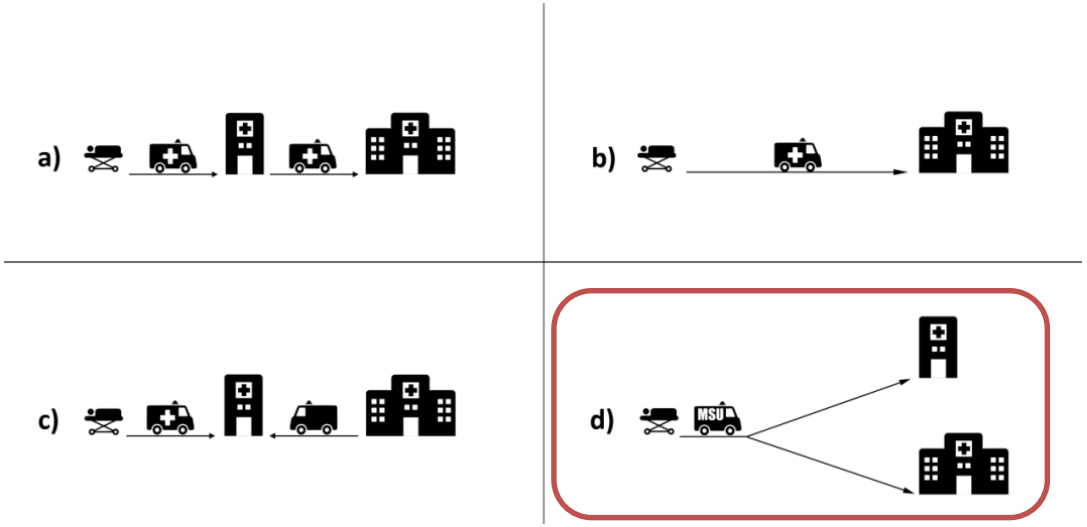
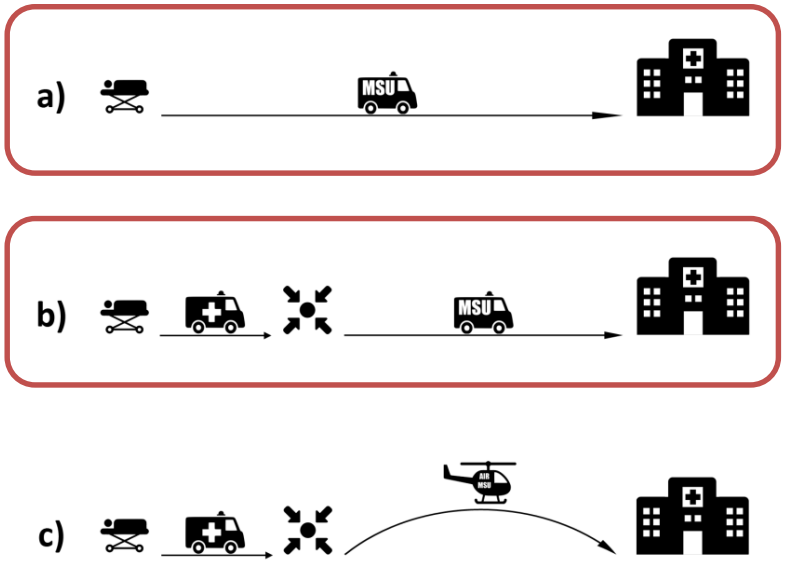


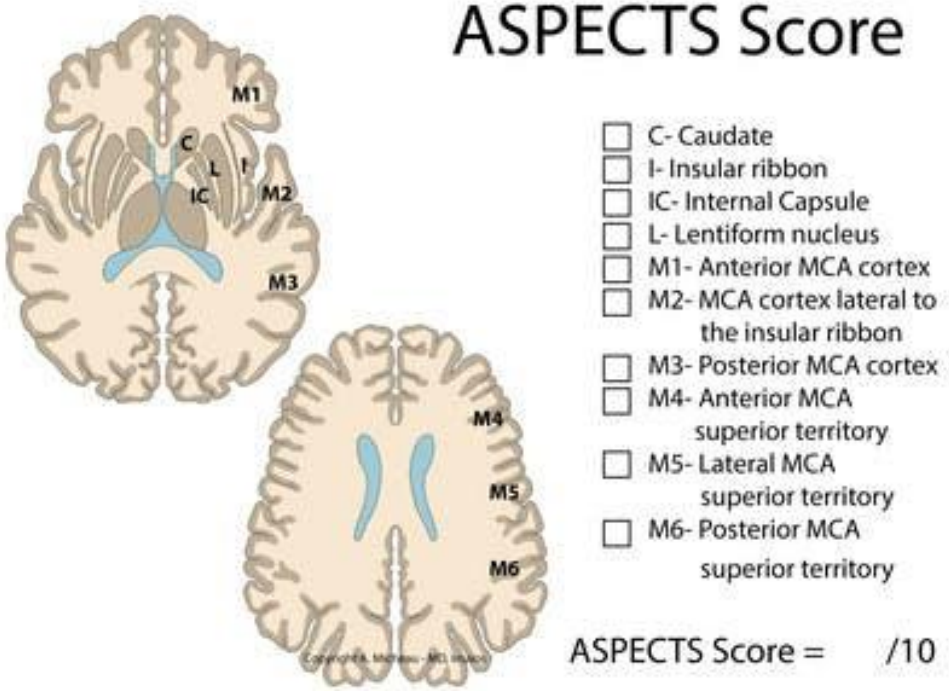


Imaging in an MSU

- Ceretom 8-slice portable CT scanner
- portable unit is smaller and lighter (~362 kg)
- capable of CT-A and CT-P
- decreased contrast between gray and white matter, higher level of noise and increased artifacts
- adequate diagnostic quality

ASPECTS

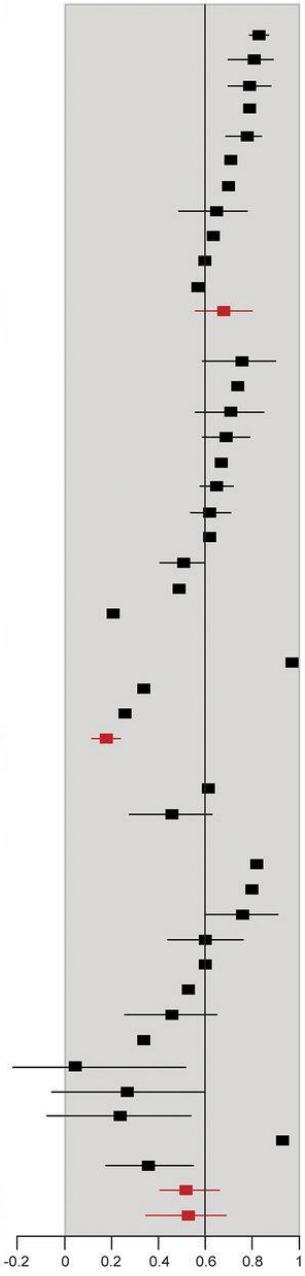
- Early signs of infarction predict poor response to IVT and high rate of AE
- Difficult to interpret subtle CT during first hours
- ASPECTS
  - divides middle cerebral artery (MCA) into 10 areas
  - 2 specified levels
    - basal ganglia
    - supraganglionic structure
- ASPECTS >7 will probably respond to treatment
- ASPECTS <5 are much less likely to benefit
- LIMITATION: detecting early ischemic changes requires expertise



Why Automate?

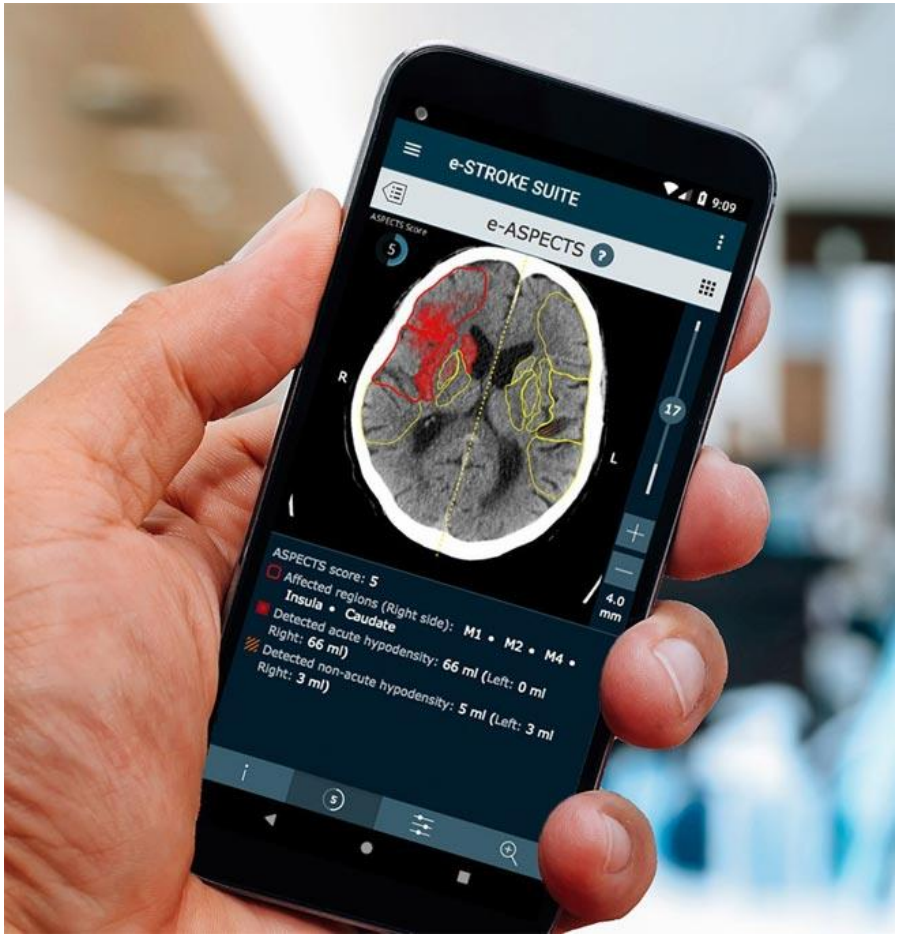
- Poor interrater agreement for manual ASPECTS (Farzin, *Neurology* 2016)
- Standardised rating
- Rapid rating
- Aid for less experienced clinicians

Ref. no. *	Number of patients	NIHSS Median (IQR) Mean ± SD	Number of raters	ASPECTS Median (IQR)	ASPECTS Mean ± SD	Dichotomized/ Trichotomized	Value	95% CI
							ICC	
1	181	6 (0 - 28)	4	-		-	0.83	0.79-0.87
2	44	16 (12 - 19)	5	9 (8 - 10)		-	0.81	0.70-0.89
3	37	16 (10 - 20)	5		8.9 ± 1.9	-	0.79	0.70-0.88
4	40	-	5	-		-	0.79	-
5	64	14 (9 - 19)	4	7.5 (6 - 8)		-	0.78	0.69-0.84
6	39	16 (9 - 22)	2	-		-	0.71	-
7	44	17 (13.5 - 20)	3	9 (8 - 10)		-	0.70	-
8	36	15	3	-		-	0.65	0.49-0.78
9	55	15	2	7		-	0.63	-
10	105	6 (3 - 12)	2	-		-	0.60	-
11	74	17 (12 - 20)	2		7.6	-	0.57	-
Our study	30	17.5 (14.25 - 23)	15	8 (6 - 9)		-	0.68	0.56-0.80
							Kw	
12	143	4 (2 - 10)	2	10 (9 - 10)		-	0.75	0.59 - 0.90
13	53	13 (2 - 32)	2	9		-	0.74	-
14	51	17.5 ± 6	2	8 (6.5 - 9)		-	0.71	0.56 - 0.85
15	214	5	2	-		-	0.69	0.59 - 0.79
7	44	17 (13.5 - 20)	3	9 (8 - 10)		-	0.67	-
16	91	15 (12 - 20)	2	8 (6 - 9)		-	0.65	0.58 - 0.72
17	351	6 (13)	2	10		-	0.62	0.54 - 0.71
18	102	9.5 (5 - 11)	2	9 (7 - 10)		-	0.62	-
19	432	12 (11)	2	10 (1)		-	0.51	0.41 - 0.60
20	103	15	2	10		-	0.49	-
10	105	6 (3 - 12)	2	-		-	0.21	-
							K	
21	30	10.3 ± 5.31	2		6.9	-	0.97	-
22	164	14	3	10		-	0.34	-
23	62	14	2	10		-	0.26	-
Our study	30	17.5 (14.25 - 23)	15	8 (6 - 9)		-	0.17	0.12-0.24
							Kw	
3	37	16 (10 - 20)	5		8.9 ± 1.9	0-3 vs 4-7 vs 8-10	0.61	-
11	74	17 (12 - 20)	2		7.6	0-4 vs 5-7 vs 8-10	0.46	0.28 - 0.63
							K	
24	68	-	2	8		0-7 vs 8-10	0.82	-
25	106	19 (15 - 24)	2	7 (7 - 8)		0-7 vs 8-10	0.80	-
16	91	15 (12 - 20)	2	8 (6 - 9)		0-5 vs 6-10	0.76	0.60 - 0.91
16	91	15 (12 - 20)	2	8 (6 - 9)		0-7 vs 8-10	0.60	0.44 - 0.76
26	230	-	2	-		0-6 vs 7-10	0.60	-
27	155	17 (14 - 20)	2	8 (7 - 9)		0-7 vs 8-10	0.53	-
11	74	17 (12 - 20)	2		7.6	0-7 vs 8-10	0.46	0.26 - 0.65
28	80	-	5	-		0-7 vs 8-10	0.34	-
29	34	5.5 (3 - 11.75)	2	-		0-5 vs 6-10	0.16	-0.21 - 0.52
29	34	5.5 (3 - 11.75)	2	-		0-6 vs 7-10	0.27	-0.05 - 0.60
29	34	5.5 (3 - 11.75)	2	-		0-7 vs 8-10	0.24	-0.07 - 0.54
30	62	15 (16)	2	-		0-7 vs 8-10	0.93	-
11	74	17 (12 - 20)	2		7.6	0-4 vs 5-7 vs 8-10	0.36	0.18 - 0.55
Our study	30	17.5 (14.25 - 23)	15	8 (6 - 9)		0-7 vs 8-10	0.52	0.41-0.66
Our study	30	17.5 (14.25 - 23)	15	8 (6 - 9)		0-6 vs 7-10	0.53	0.35-0.69



e-ASPECTS

- pre-processing of input images
- corrects for 3D rotation and misalignment (e.g. tilt)
- image features are extracted and regions are scored with a machine learning classifier that identifies early ischemic signs
- CE marked as a decision support tool for the detection of early ischemic damage
- Has been shown to be equivalent to expert neuroradiologists



e-STROKE SUITE

First e-ASPECTS Evaluation on MSU

Original Paper

Cerebrovascular Diseases

Cerebrovasc Dis 2016;42:332–338
DOI: 10.1159/000446861

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First Automated Stroke Imaging Evaluation via Electronic Alberta Stroke Program Early CT Score in a Mobile Stroke Unit

- Evaluated feasibility and utility of integrating e-ASPECTS in an MSU
- e-ASPECTS matched with results of conventional evaluation by neuroradiologists on the MSU team

- Fifteen consecutive patients
  - 2 men, 13 women
  - median age 82 years (IQR 71-85 years)
  - median score NIHSS 4 (IQR 1-6)
  - median LAMS 1 (IQR 0-4).
- Median stroke management times
  - onset to alarm, 54 min (IQR 19-125 min)
  - onset to MSU arrival, 64 min (IQR 30-159 min)
  - onset to CT scan, 93 min (IQR 62-181 min)
  - onset to thrombolysis, 85 min (IQR 58-154 min)

Case 1

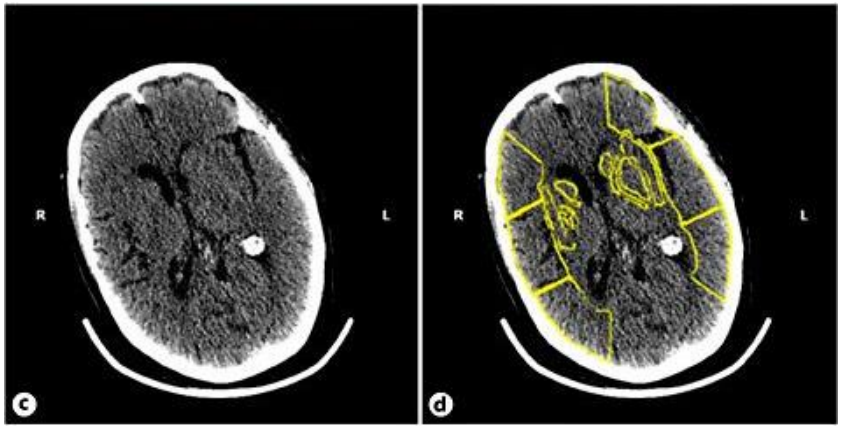
- 71-year-old woman collapsed
- Neurological exam
  - right-sided facial paresis, hemiparesis (grade 0/5), mild dysarthria (NIHSS 16; mRS 5; LAMS 5)
- POCT
  - INR, aPTT, glucose, WBC, PLT, RBC, p-amylase, GGT normal
- Prehospital CT
  - no intracranial bleeding, no demarcation of cerebral contusion, and no new infarction
- Prehospital CT-A
  - no large-vessel occlusion
- e-ASPECTS: 10
  - suggests absence of early signs of infarction
- Therapy decision: prehospital thrombolysis
- Patient responded well to thrombolytic treatment and was discharged after 1 week with no neurological deficit (NIHSS score 0; mRS score 0)

TAKEAWAY

e-ASPECTS excludes early signs of infarction, assisting MSU team in decision for immediate prehospital thrombolysis

Case 2

- 73-year-old woman on the floor
- Neurological examination
  - right-sided hemiparesis (grade 1/5), global aphasia, mild somnolence, and ocular deviation to the left side (NIHSS score 20; LAMS score 4)
- POCT
  - normal
- CT scans
  - no intracranial bleeding, no demarcation of cerebral contusion, and no infarction
- CT-A
  - proximal (M1) occlusion of the left MCA
- e-ASPECTS: 10
  - suggests absence of early signs of infarction
- Therapy Decision
  - Immediate bridging thrombolysis and triage to CSC
    - Because CT ruled out hemorrhage and e-ASPECTS confirmed the absence of early signs of infarction
- Outcome
  - Discharge to rehab facility after 10 days
  - Aphasia improved slightly, although the hemiparesis persisted (NIHSS score 14; mRS score 5)



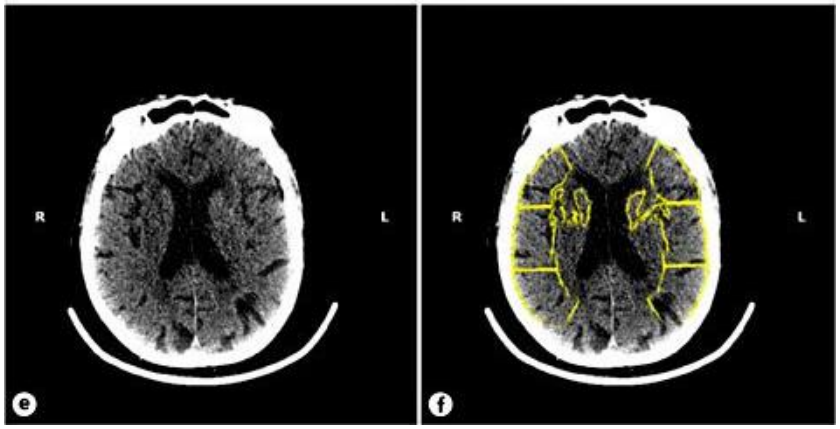
TAKEAWAY

Software supported the decision to provide bridging IV thrombolysis followed by IAT in a CSC for LVO and no early signs of infarction

e-ASPECTS can assist in triage decisions with regard to the most appropriate target hospital

Case 3

- 89-year-old woman reported acute onset paresis of the left extremities
- Neurological examination
  - Paresis of left arm (grade 4/5) and left leg (grade 0/5), but no sensory deficits (NIHSS score 5; LAMS score 2).
- POCT: normal
- Prehospital CT images
  - no intracranial bleeding and no demarcation of cerebral contusion
  - pre-existing pronounced cerebral microangiopathy and signs of older ischemic lesions in the left MCA territory
- e-ASPECTS: 10
  - suggests absence of early signs of infarction
- Therapy decision: prehospital thrombolysis
- Outcome
  - After 1 week, neurological status improved with a grade 4/5 paresis left arm and grade 3/5 paresis left leg (NIHSS score 3; mRS score 3)



TAKEAWAY

marked signs of pre-existing older cerebral microangiopathy and macroangiopathy made manual interpretation difficult

e-ASPECTS value (10) indicated robustness of this scoring tool against potential sources of non-acute ischemic hypodensities

Conclusions

- Correct identification of early signs are important for IVT and EVT patient selection
  - e-ASPECTS offers a standardised tool for evaluation
  - e-ASPECTS is feasibile in an MSU
  - Scores from software match with neuroradiologist scoring
- Limitations
  - Movement artefacts in agitated patients; correctly identified by software
- Implications for prehospital stroke treatment staffing
- **e-ASPECTS software could be a valuable second-opinion instrument that could assist the physician in making an assessment**


thank you
danke
謝謝
ngiyabonga
شكراً جزيلاً
рахмат
Баярлалаа
teşekkür ederim
спасибо
faafetai lava
dank je
gracias
tapadh leat
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