Decision Support for Clinical Neuroimaging

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- Decision support tools (CDS)
- Quantitative imaging tools (CQI)
- Computer aided detection (CADe)
- Computer aided diagnosis (CADx)
- Decision support tools (CDS)  
- Quantitative imaging tools (CQI)  
- Computer aided detection (CADe)  
- Computer aided diagnosis (CADx)

Alert  
Measure  
Find  
Complement
Life threatening emergency

3rd most frequent cause of death

16,000 strokes/y (CH)

1.9 million neurons every minute

Time-dependent therapy
...into computer science

Preprocessing

Machine Learning

Deep Learning

Representation

Decoding

Weighting

Matching

Meaning

Classification

Segmentation

Stroke

Seizure

Acute ischemic changes

Gray matter

Use case for CDS: Ischemic stroke

**Diagnostic markers**
- biological plausibility
- performance

**Prognostic markers**
- response to therapy
- guidance

**Predictive markers**
- individual fingerprints
- featurization

*Chaleta JA et al. Lancet 2007; 369 (9559): 293-8
Methods

Plain CT

CT Angiography

CT Perfusion

Image courtesy: OLEA Medical, with permission
Clinical application

2544 patients
139 hospitals
50% non-specialist centers
Large vessel occlusion

“...enables prompt review by stroke specialists...”

<table>
<thead>
<tr>
<th>Device performance</th>
<th>Value</th>
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<tbody>
<tr>
<td>Sensitivity</td>
<td>96.32% [0.9268, 0.9884]</td>
</tr>
<tr>
<td>Specificity</td>
<td>93.83% [0.9283, 0.9475]</td>
</tr>
<tr>
<td>Time-to-notification</td>
<td>Median = 5 minutes and 45 seconds</td>
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</table>

Golan D. et al. Translational Medicine 2020
AI optimized image quality of raw MRI data

Eligibility Criteria for DEFUSE 3

<table>
<thead>
<tr>
<th></th>
<th>Rater 1</th>
<th>Rater 2</th>
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<tbody>
<tr>
<td>Satisfied (CNN)</td>
<td>35</td>
<td>35</td>
</tr>
<tr>
<td>Satisfied (oSVD)</td>
<td>38</td>
<td>40</td>
</tr>
<tr>
<td>Disagreements (CNN vs oSVD)</td>
<td>5</td>
<td>5</td>
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</table>
AI outperforms fixed thresholds: The ISLES challenge

103 stroke pCT scans, 4 centers
DWI poststroke as reference
(mean delay 36 minutes, IQR 25–79)
Data diversity : Federated learning

Innosuisse project advanced stroke analytics platform
Siemens Research, Bern & Lausanne University Hospitals
Diploma of Advanced Studies

MAS/DAS Artificial Intelligence Techniques for Diagnostic Medical Systems
covers the necessary skills of analyzing a diagnostic problem and develop a solution with artificial intelligence

MAS/DAS Artificial Intelligence in Diagnostic Medical Systems
builds the bridge between development and integration

MAS/DAS Artificial Intelligence Translational Diagnostic Medical Systems
strong emphasis on the integration and deployment into a clinical workflow for patient care
AI impacts on Medical Imaging

Raphael Meier PhD
Richard McKinley PhD
PD Franca Wagner M.D.
Michael Rebsamen M.Sc.
Arsany Hakim M.D.
Johannes Kaesmacher M.D./PhD

ISLES 2018: Prof. Mauricio Reyes PhD / Prof. Greg Zaharchuk MD, PhD (UC Stanford)