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ASAP (Acute Support Assessment and Prioritizing) vid akut strokesjukvård

Stefan Candefjord, Docent
Hoor Jalo, Doktorand

Strokeforskningsdag *“Den vetenskapliga utvecklingen inom strokeområdet”*

Hjärtats aula, SU Sahlgrenska
2023-10-24

Care@Distance – Our team

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(Part-time)

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Mattias Seth
Ph.D. Student

Hoor Jalo
Ph.D. Student

Xxx Yxx
Assistant Professor
(in recruitment)

Xxx xxx
Ph.D. Student
(to be recruited 2023)

Xxx xxx
Ph.D. Student
(to be recruited 2023/24)

Utbildning

- Masters Program Course since 2007
  (Initiated by B A Sjöqvist 2007; 2020 S Candefjord)
  ≈ 40 students/year
- Bachelor Program Course start 2021
  (S Candefjord)
  ≈ 60 students/year

Collaboration; examples

- Chalmers
  - Technology Management and Economics
  - Center for Healthcare Architecture (CVA)
  - Physical Resource Theory
  - CHAIR (AI Research)
- Sahlgrenska University Hospital (SU)
  - Ambulance service
  - Neurology/Stroke
  - Trauma
  - Cardiology
- Region of Västra Götaland (VGR)
  - Sjukvårdens Larmcentral (SvLc; Dispatch)
  - Ambulance services
  - Primary Care (Närhälsan)
- Region of Uppsala
- Region of Kronoberg
- City of Gothenburg (Göteborgs stad)
- Tre Stiftelser (Elderly Care)
- University of Borås/Prehospen
- VTI
- Norway
  - Oslo Met University
  - Östfold Univ.
- Industry
  - InterSystems
  - Nuance
  - Dedalus
  - Aweria
  - Camanio
  - Cuviva
  - Raytelligence
  - Medfield Diagnostics
  - Autoliv Development
  - Volvo Cars
  - Consat
  - Detecht
  - SOS International

Medicinteknik, civilingenjör

300 hp

Genom medicinteknik kan du rädda liv och förbättra framtidens hälsa med avancerad teknik och artificiell intelligens. Vården står inför stora utmaningar med en åldrande befolkning och din innovationskraft kommer att bidra till lösningarna i en globalt växande framtidsindustri. Den tvärvetenskapliga utbildningen är unik genom ett tätt samarbete med Sahlgrenska akademin och Sahlgrenska universitetssjukhuset.

Översikt

Antal platser
65

Utbildningsområde
Elektroteknik

Examen
Civilingenjör/Masterexamen

Språk
Svenska

Anmälningskod
CTH-73000

Studieplats
Johanneberg

Stängt för anmälan

Programmets sida på antagning.se

Få mer information om våra utbildningar

CHALMERS

https://www.chalmers.se/utbildning/hitta-program/medicinteknik-civilingenjor/

https://www.chalmers.se/aktuellt/kalender/soh-exjobbs-och-kandidatarbetesmassa-inom-halsa-och-teknik/

Exjobbs- och kandidatarbetesmässa inom hälsa och teknik

Vårt motto & vision

Öka beslutsprecisionen
&
Inga fel i bedömning, prioritering och hantering!

Vårt teknikfokus

Förbättra distans- och prehospital vård med:

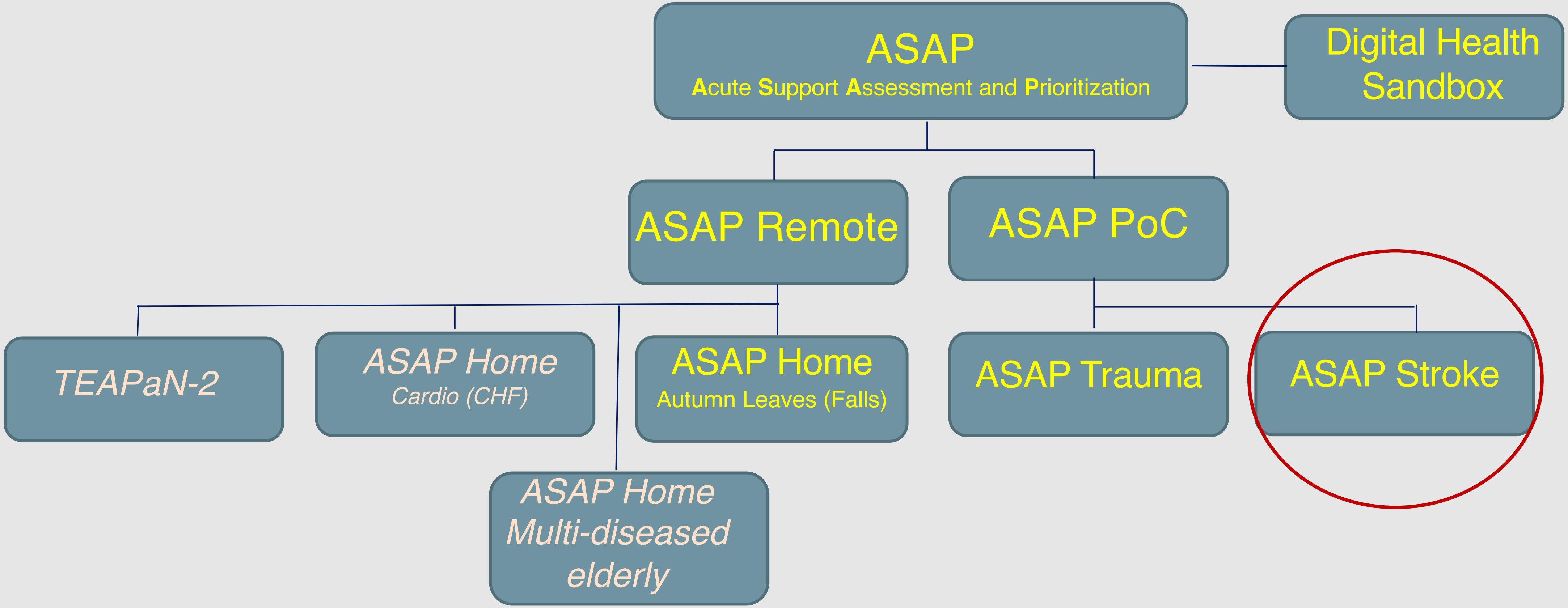
- Datafusion
- Kliniska beslutsstöd
- AI/ML
- Telemedicin
- Innovativ användarinteraktion

ASAP

Acute **S**upport **A**ssessment and **P**rioritizing

- ett generiskt koncept för att stödja datafusion, kliniska beslutsstöd, AI, telemedicin och innovativ användarinteraktion i hälso- och sjukvårdstillämpningar

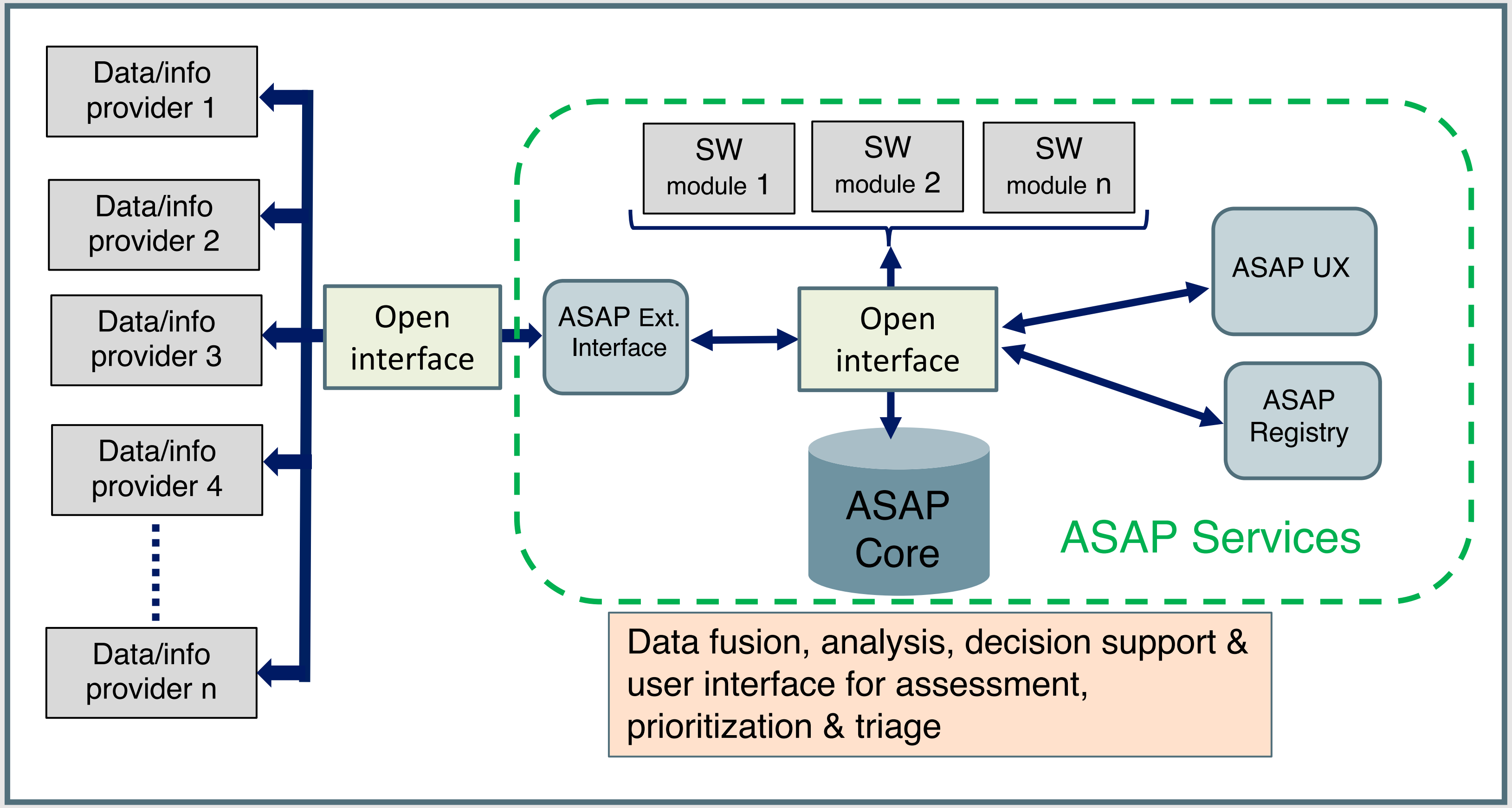
ASAP Familjeträd



ASAP Konceptet (Acute Support Assessment & Prioritizing)

Stöd för datafusion, AI/ML och kliniskt beslutsstöd

General structure ASAP & ASAP Services



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ASAP PoC (Point of Care) Stroke

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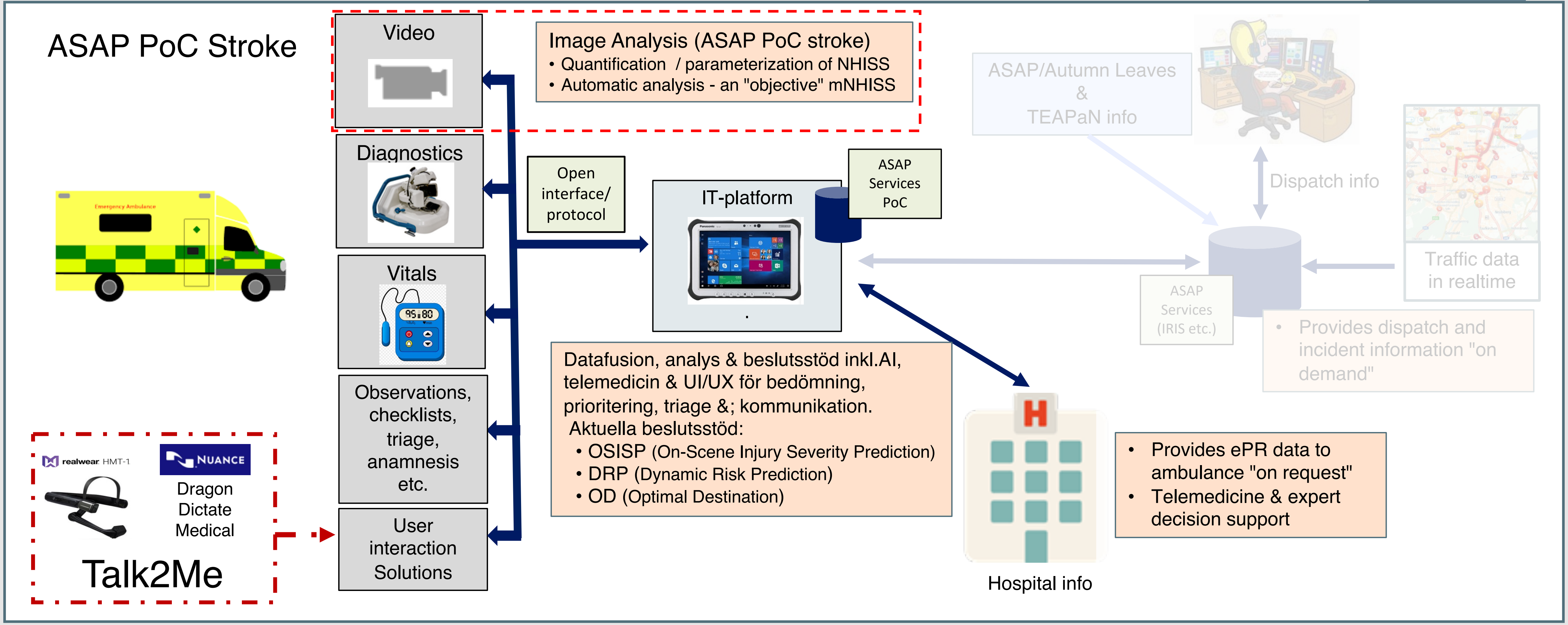
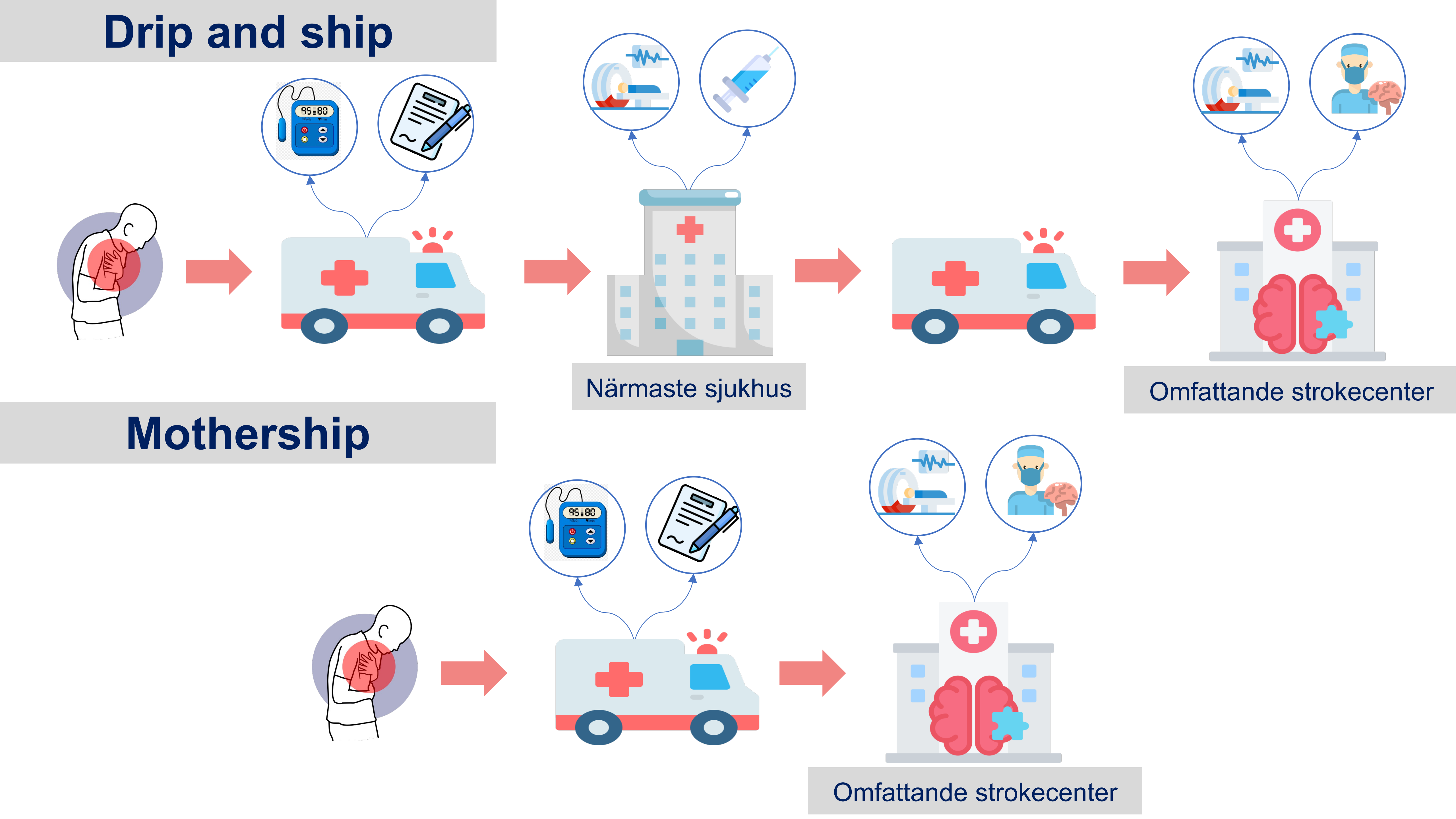
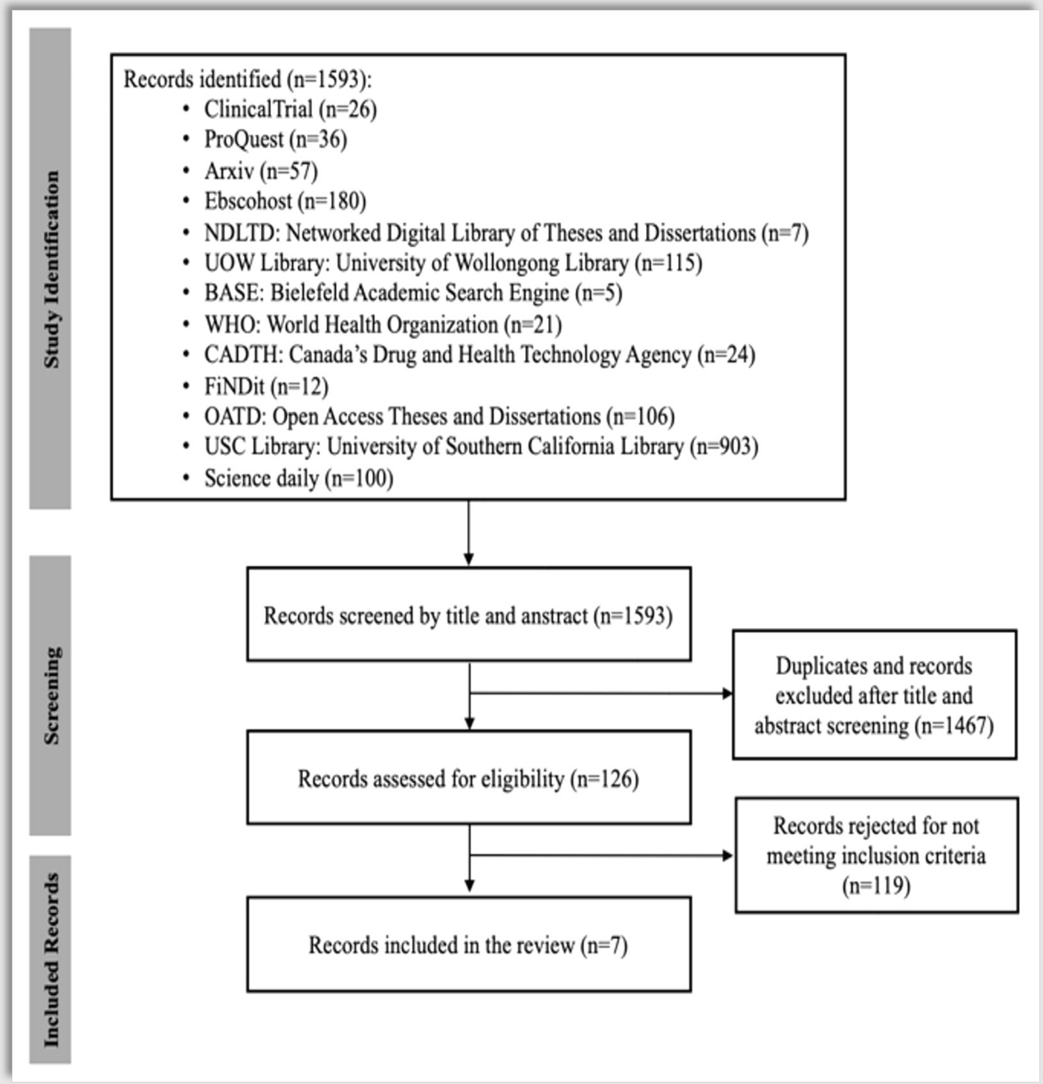



Drip and ship
95 80
Närmaste sjukhus
Omfattande strokecenter
Mothership
95 80
Omfattande strokecenter

ASAP PoC/Stroke

Scoping review in the stroke decision making in prehospital assessment – Grey literature.

- ***3 clinical trials***
- ***2 mobile applications***
- ***1 master's thesis***
- ***1 PhD dissertation***

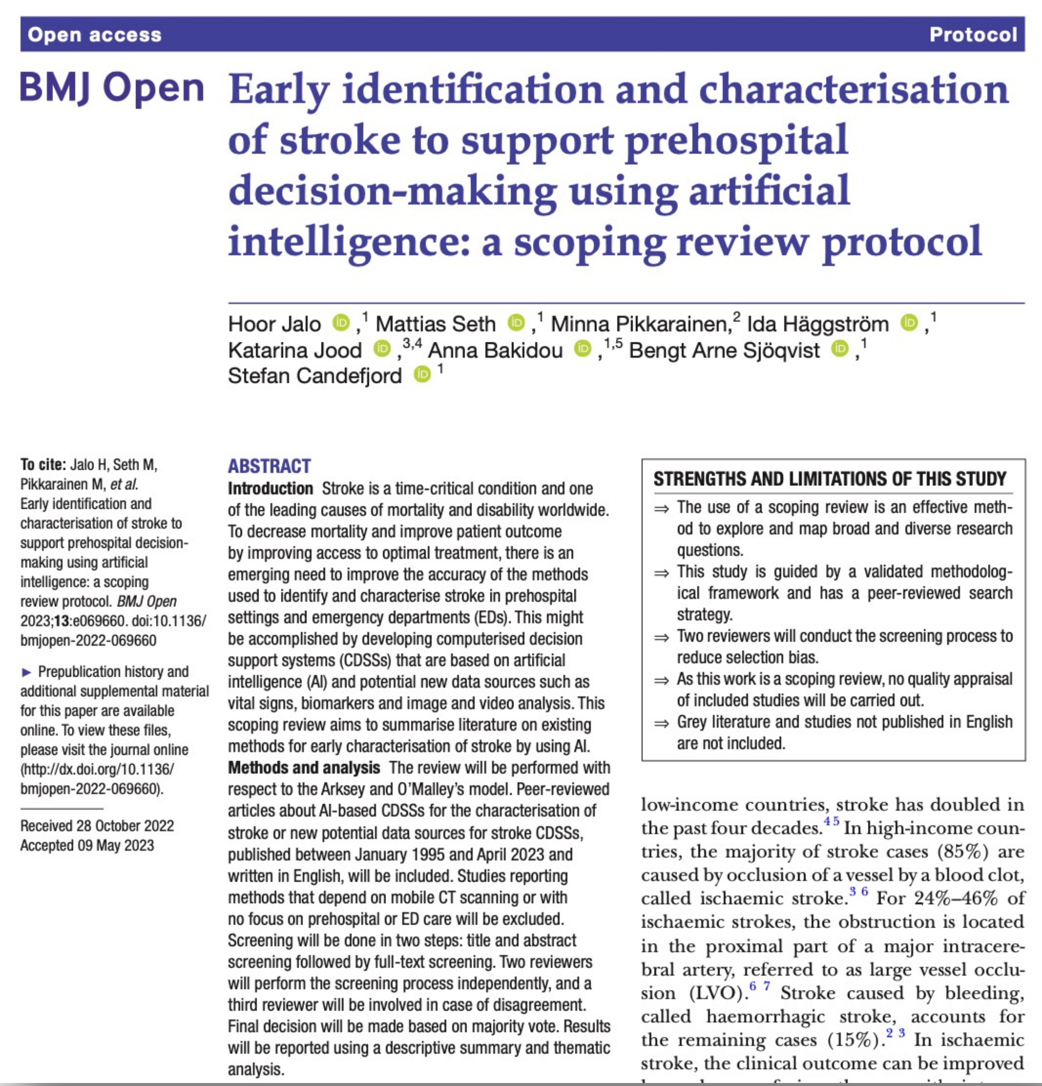


ASAP PoC/Stroke

Scoping review in the stroke decision making in prehospital assessment – Peer-reviewed literature.

Aims of scoping review:

- To highlight the promising methods in early stroke characterization and investigate the possibility of using them as decision support systems for stroke, especially LVO.
- To compare the accuracy of AI-based decision support systems with the accuracy of clinical stroke scales based on evidence available in the literature.
- To identify new data sources and variables that could be used in the early characterization of stroke, e.g., vital data, observations by paramedics, biomarkers, sensors, video analysis, etc.



Open access Protocol

BMJ Open

Early identification and characterisation of stroke to support prehospital decision-making using artificial intelligence: a scoping review protocol

Hoor Jalo [1], Mattias Seth [1], Minna Pikkarainen,[2] Ida Häggström [1], Katarina Jood [3,4] Anna Bakidou [1,5] Bengt Arne Sjöqvist [1], Stefan Candefjord [1]

To cite: Jalo H, Seth M, Pikkarainen M, *et al.* Early identification and characterisation of stroke to support prehospital decision-making using artificial intelligence: a scoping review protocol. *BMJ Open* 2023;**13**:e069660. doi:10.1136/bmjopen-2022-069660

► Prepublication history and additional supplemental material for this paper are available online. To view these files, please visit the journal online (http://dx.doi.org/10.1136/bmjopen-2022-069660).

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ABSTRACT

Introduction Stroke is a time-critical condition and one of the leading causes of mortality and disability worldwide. To decrease mortality and improve patient outcome by improving access to optimal treatment, there is an emerging need to improve the accuracy of the methods used to identify and characterise stroke in prehospital settings and emergency departments (EDs). This might be accomplished by developing computerised decision support systems (CDSSs) that are based on artificial intelligence (AI) and potential new data sources such as vital signs, biomarkers and image and video analysis. This scoping review aims to summarise literature on existing methods for early characterisation of stroke by using AI.

Methods and analysis The review will be performed with respect to the Arksey and O'Malley's model. Peer-reviewed articles about AI-based CDSSs for the characterisation of stroke or new potential data sources for stroke CDSSs, published between January 1995 and April 2023 and written in English, will be included. Studies reporting methods that depend on mobile CT scanning or with no focus on prehospital or ED care will be excluded. Screening will be done in two steps: title and abstract screening followed by full-text screening. Two reviewers will perform the screening process independently, and a third reviewer will be involved in case of disagreement. Final decision will be made based on majority vote. Results will be reported using a descriptive summary and thematic analysis.

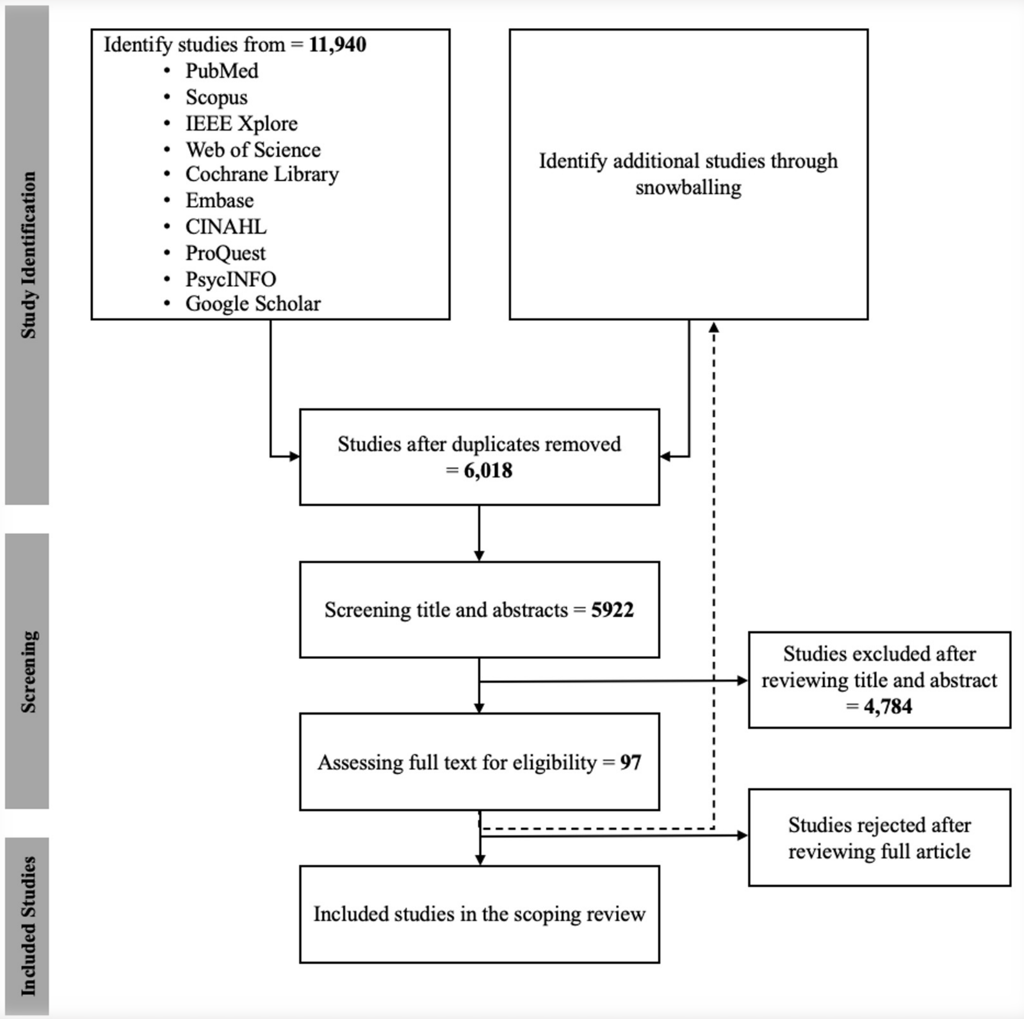
STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ The use of a scoping review is an effective method to explore and map broad and diverse research questions.
- ⇒ This study is guided by a validated methodological framework and has a peer-reviewed search strategy.
- ⇒ Two reviewers will conduct the screening process to reduce selection bias.
- ⇒ As this work is a scoping review, no quality appraisal of included studies will be carried out.
- ⇒ Grey literature and studies not published in English are not included.

low-income countries, stroke has doubled in the past four decades.[4 5] In high-income countries, the majority of stroke cases (85%) are caused by occlusion of a vessel by a blood clot, called ischaemic stroke.[3 6] For 24%–46% of ischaemic strokes, the obstruction is located in the proximal part of a major intracerebral artery, referred to as large vessel occlusion (LVO).[6 7] Stroke caused by bleeding, called haemorrhagic stroke, accounts for the remaining cases (15%).[2 3] In ischaemic stroke, the clinical outcome can be improved

ASAP PoC/Stroke

Scoping review in the stroke decision making in prehospital assessment – Peer-reviewed literature.



	Inclusion criteria	Exclusion criteria
Patient	Patients with suspected stroke.	Phases of stroke care not related to initial diagnosis and treatment, e.g., rehabilitation.
Intervention	AI-based CDSS.	The early characterization method depends on mobile CT scanning. Stroke detection image techniques that cannot be used or adapted to the prehospital setting.
Outcomes	Study reports accuracy and/or qualitative evaluation.	No results for stroke characterization are reported.
Publication type	Peer-reviewed articles and peer-reviewed conference papers.	Book reviews, editorial articles, conference abstracts and commentaries.
Study design	Qualitative and quantitative studies.	Cost effectiveness and acceptability studies.
Publication date	January 1995 – April 2023.	Full article cannot be obtained.
Language	English.	Articles not written in English.

ASAP PoC/Stroke

Scoping review in the stroke decision making in prehospital assessment – Peer-reviewed literature.

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Clinical Decision Support for Stroke Using Multi–view Learning Based Models for NIHSS Scores

Vaibhav Rajan[1](✉), Sakyajit Bhattacharya[1], Ranjan Shetty[2], Amith Sitaram[3], and G. Vivek[2]

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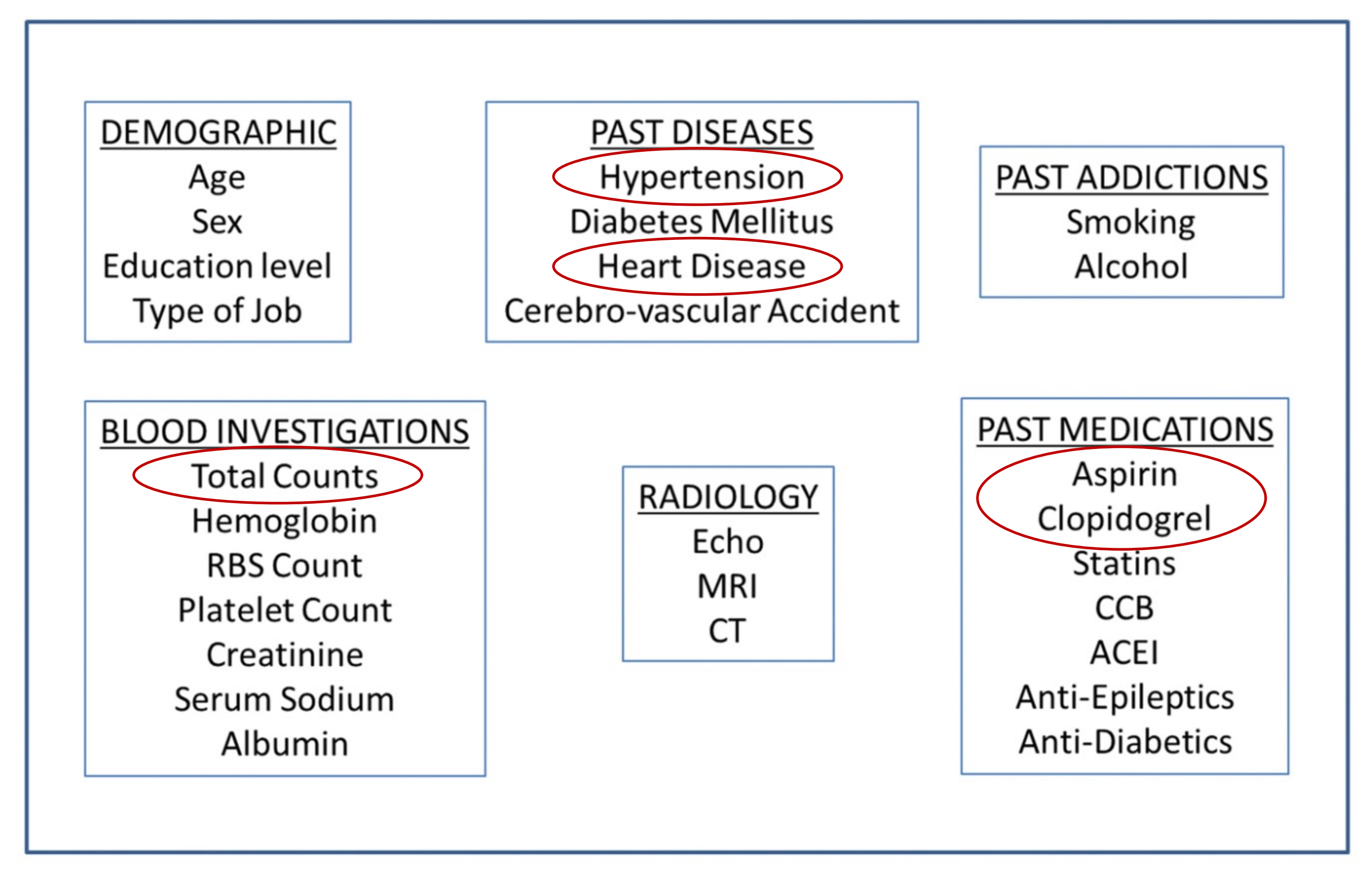
vaibhav.rajan@xerox.com
[2] Kasturba Medical College, Manipal University, Manipal, India
[3] University Hospital, Zurich, Switzerland

Abstract. Cerebral stroke is a leading cause of physical disability and death in the world. The severity of a stroke is assessed by a neurological examination using a scale known as the NIH stroke scale (NIHSS). As a measure of stroke severity, the NIHSS score is widely adopted and has been found to also be useful in outcome prediction, rehabilitation planning and treatment planning. In many applications, such as in patient triage in under–resourced primary health care centres and in automated clinical decision support tools, it would be valuable to obtain the severity of stroke with minimal human intervention using simple parameters like age, past conditions and blood investigations. In this paper we propose a new model for predicting NIHSS scores which, to our knowledge, is the first statistical model for stroke severity. Our multi–view learning approach can handle data from heterogeneous sources with mixed data distributions (binary, categorical and numerical) and is robust against missing values – strengths that many other modeling techniques lack. In our experiments we achieve better predictive accuracy than other commonly used methods.



ASAP PoC/Stroke

Scoping review in the stroke decision making in prehospital assessment – Peer-reviewed literature.

frontiers | Frontiers in Neurology

BRIEF RESEARCH REPORT
published: 01 July 2022
doi: 10.3389/fneur.2022.878282

Check for updates

Human vs. Machine Learning Based Detection of Facial Weakness Using Video Analysis

Chad M. Aldridge[1†], Mark M. McDonald[1†], Mattia Wruble[1], Yan Zhuang[2], Omar Uribe[1], Timothy L. McMurry[3], Iris Lin[4], Haydon Pitchford[1], Brett J. Schneider[1], William A. Dalrymple[1], Joseph F. Carrera[5], Sherita Chapman[1], Bradford B. Worrall[1,3], Gustavo K. Rohde[2,6] and Andrew M. Southerland[1,3]*

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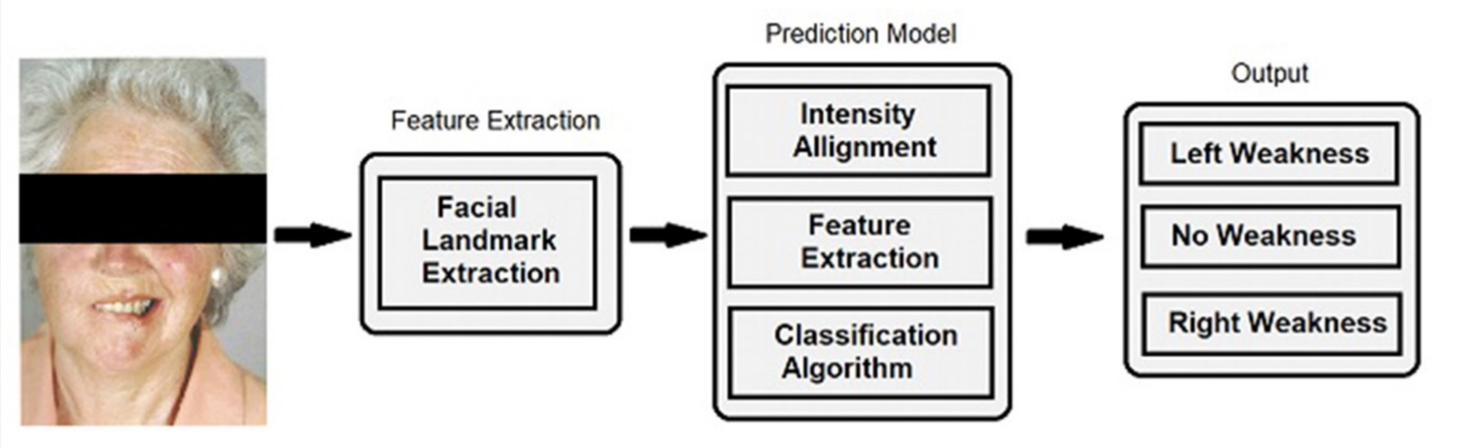
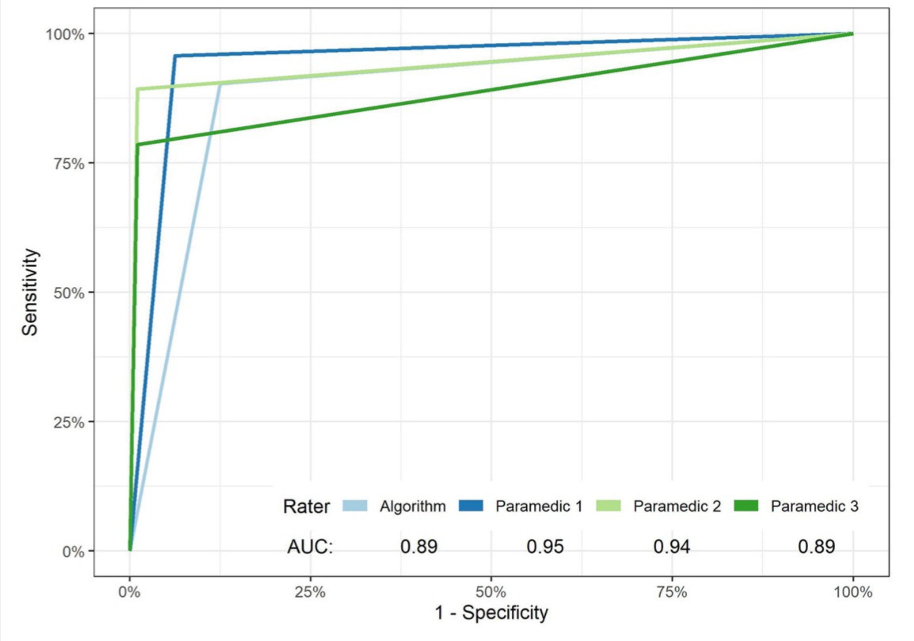
Aldridge CM, McDonald MM, Wruble M, Zhuang Y, Uribe O, McMurry TL, Lin I, Pitchford H, Schneider BJ, Dalrymple WA, Carrera JF, Chapman S, Worrall BB, Rohde GK and Southerland AM (2022) Human vs. Machine Learning Based Detection of Facial Weakness Using Video Analysis.

Background: Current EMS stroke screening tools facilitate early detection and triage, but the tools' accuracy and reliability are limited and highly variable. An automated stroke screening tool could improve stroke outcomes by facilitating more accurate prehospital diagnosis and delivery. We hypothesize that a machine learning algorithm using video analysis can detect common signs of stroke. As a proof-of-concept study, we trained a computer algorithm to detect presence and laterality of facial weakness in publically available videos with comparable accuracy, sensitivity, and specificity to paramedics.

Methods and Results: We curated videos of people with unilateral facial weakness (n = 93) and with a normal smile (n = 96) from publicly available web-based sources. Three board certified vascular neurologists categorized the videos according to the presence or absence of weakness and laterality. Three paramedics independently analyzed each video with a mean accuracy, sensitivity and specificity of 92.6% [95% CI 90.1–94.7%], 87.8% [95% CI 83.9–91.7%] and 99.3% [95% CI 98.2–100%]. Using a 5-fold cross validation scheme, we trained a computer vision algorithm to analyze the same videos producing an accuracy, sensitivity and specificity of 88.9% [95% CI 83.5–93%], 90.3% [95% CI 82.4–95.5%] and 87.5 [95% CI 79.2–93.4%].

Conclusions: These preliminary results suggest that a machine learning algorithm using computer vision analysis can detect unilateral facial weakness in pre-recorded videos with an accuracy and sensitivity comparable to trained paramedics. Further research is warranted to pursue the concept of augmented facial weakness detection and external validation of this algorithm in independent data sets and prospective patient encounters.

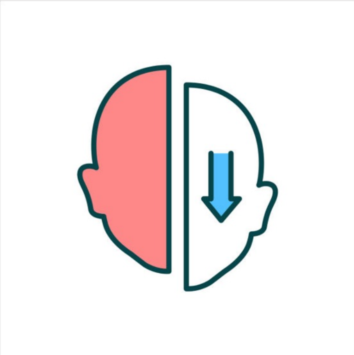




Första studien på AI-baserad analys av video på strokesymtom

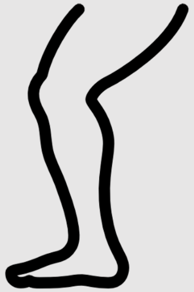
Early characterisation of stroke using video analysis and machine learning

Mål att utvärdera potentialen för maskininlärning (ML) och videoanalys för tidig karakterisering av stroke genom att digitalisera delar av NIHSS skalan



Facialispares

Pares i arm



Pares i ben

Ataxi

Dysartri

Metod

- Samla in data (video- och ljuddata)
  - Friska frivilliga som efterliknar strokesymtom (n = 6)
  - Filmerna granskades och godkändes av två seniora strokespecialister (Petra Redfors, Annika Nordanstig)
  - Datasetet bestod av 888 video- och 90 ljudinspelningar (156 för ansiktsförlamning, 246 armpares, 247 benpares, 119 finger-näsataxi, 120 häl-knäataxi och 90 dysartri)
- Bearbeta videorna med hjälp av att detektera landmärken
- Träna ML-klassificeringsmodeller
- Binärt klassificeringsproblem: stroke jämfört med icke-stroke
- Data delades upp som 75 % tränings- och 25 % testdata
- Utvärdering av modellernas prestanda
  - Noggrannhet, sensitivitet och specificitet

Första studien på AI-baserad analys av video på strokesymtom

Early characterisation of stroke using video analysis and machine learning

Facialispares

Ingen pares

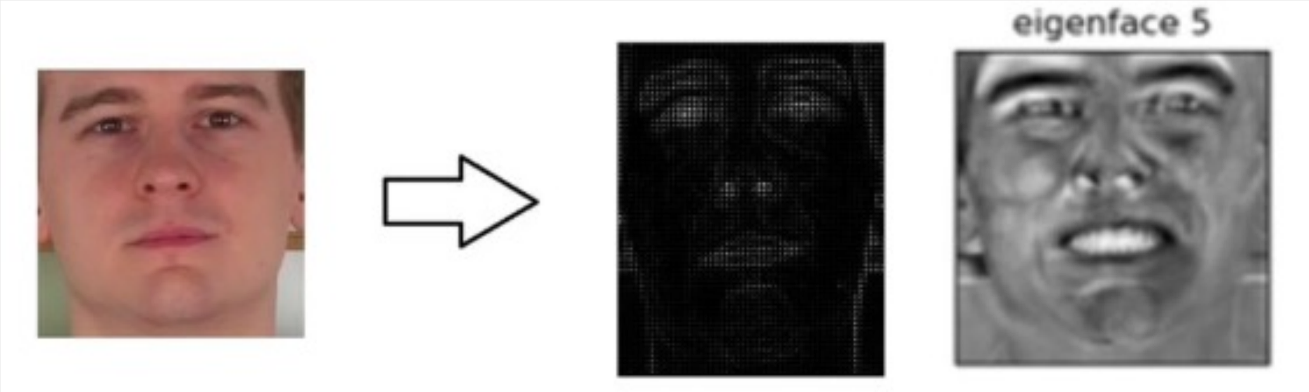
Pares

Ansiktsigenkänning

Förbehandling gjordes med MediaPipe för att skära ut ansiktsregionen och ta bort onödig information

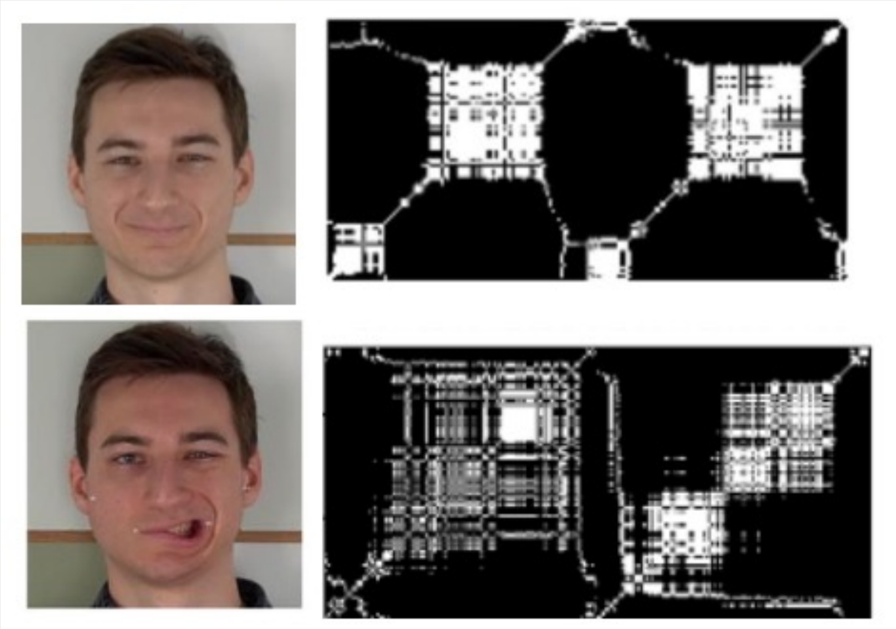
Extrahering av ansiktslandmärken

Histogram of Oriented Gradients (HOG) och Eigenface-algoritmer användes för extraktion av ansiktsdrag



HOG Eigenface

Recurrent plots (RP) testades på ansiktsförlamning på övre och nedre halvan av ansiktet



Första studien på AI-baserad analys av video på strokesymtom

Early characterisation of stroke using video analysis and machine learning

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Modellens prestanda

Algorithm	Classifier	Accuracy (%)	Sensitivity (%)	Specificity (%)
HOG	AdaBoost	97.8	98.0	97.0
	CNN	94.3	97.0	91.0
	DNN	97.8	98.0	96.0
	SVM	97.6	98.0	95.0
Eigenface	AdaBoost	96.6	97.0	95.0
	DNN	96.2	97.0	92.0
	SVM	96.0	97.0	91.0
RP	CNN	94.1/88.2	96.2/88.9	92.0/87.5
	DNN	80.4/70.6	80.8/75.0	80.0/69.2
	RestNet	84.3/66.7	84.6/33.3	84.0/66.7

Första studien på AI-baserad analys av video på strokesymtom

Early characterisation of stroke using video analysis and machine learning

Arm och ben pares

NIHSS = 1

NIHSS = 2

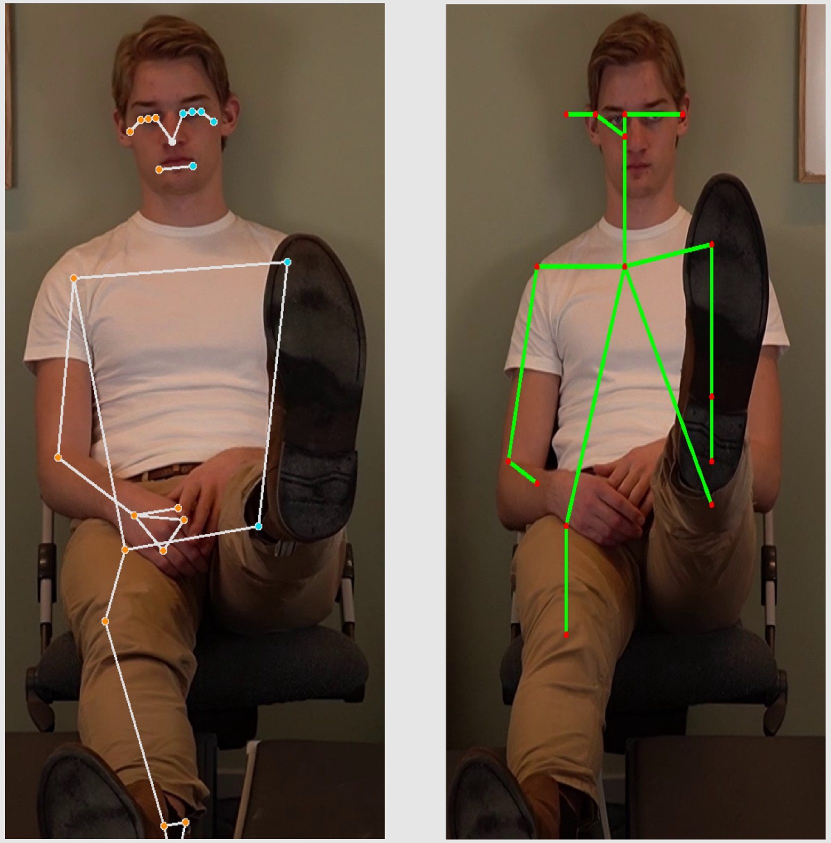
NIHSS = 3

Modellens prestanda (armpares)

Algorithm	Classifier	Accuracy (%)	Sensitivity (%)	Specificity (%)
OpenPose	DNN	88.1	95.7	61.5
	SVM	93.0	97.0	77.0
	RestNet	78.3	100	0
MediaPipe	DNN	91.0	97.7	22.2
	SVM	100	100	100
	RestNet	82.7	100	0

Modellens prestanda (benpares)

Ben identifierades inte av MediaPipe (vänster) och OpenPose (höger) för benpares.



Första studien på AI-baserad analys av video på strokesymtom

Early characterisation of stroke using video analysis and machine learning

Ataxi

Ataxi finger mot näsa

Häl-knä-ataxi

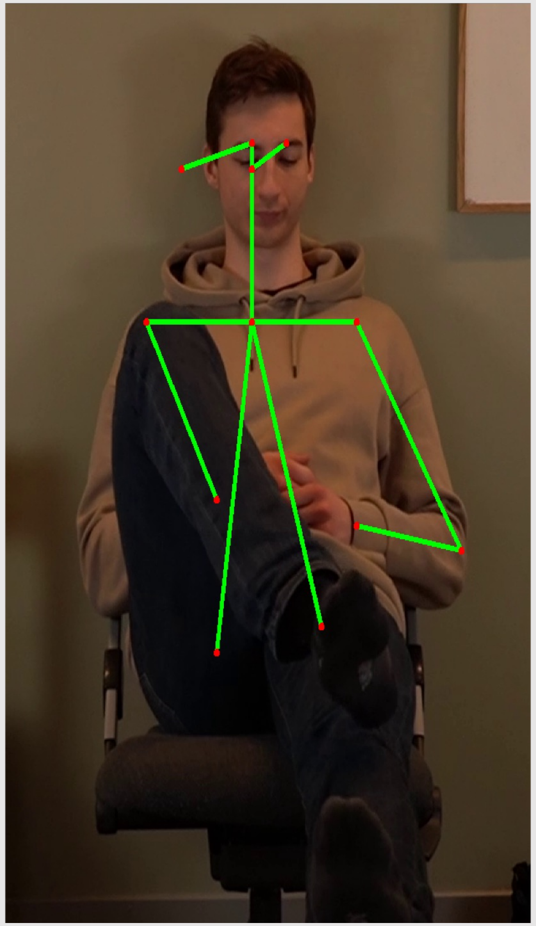
Modellens prestanda (finger-näsa-ataxi)

Algorithm	Classifier	Accuracy (%)	Sensitivity (%)	Specificity (%)
OpenPose	DNN	76.7	64.3	87.5
	SVM	47.0	100	0
	RestNet	53.3	0	100
MediaPipe	DNN	86.6	71.4	93.8
	SVM	47.0	100	0
	RestNet	60.0	0	100

Modellens prestanda (häl-knä-ataxi)

- OpenPose misslyckades med att upptäcka benet i häl-knä-ataxi.

Algorithm	Classifier	Accuracy (%)	Sensitivity (%)	Specificity (%)
MediaPipe	DNN	90.0	85.7	93.8
	SVM	47.0	100	100
	RestNet	70.0	14.3	0

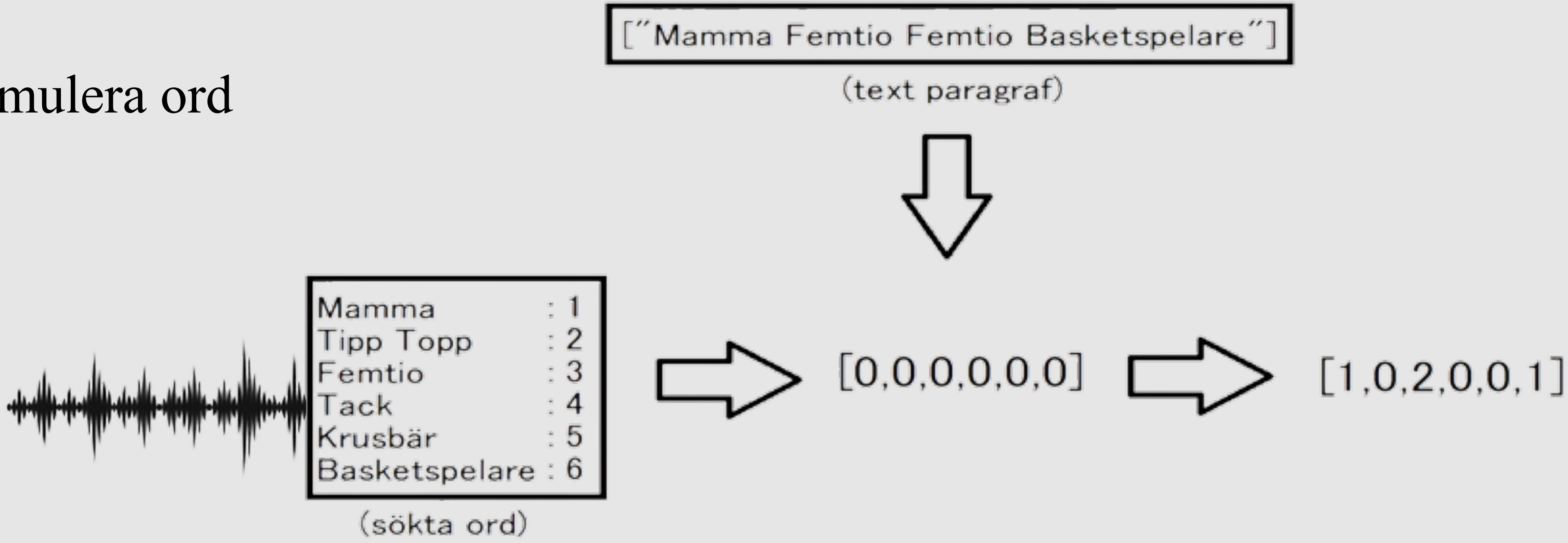


Första studien på AI-baserad analys av video på strokesymtom

Early characterisation of stroke using video analysis and machine learning

Dysartri

Symtom på dysartri efterliknades i tre steg:
normalt tal
sluddrigt tal
oförmåga att formulera ord



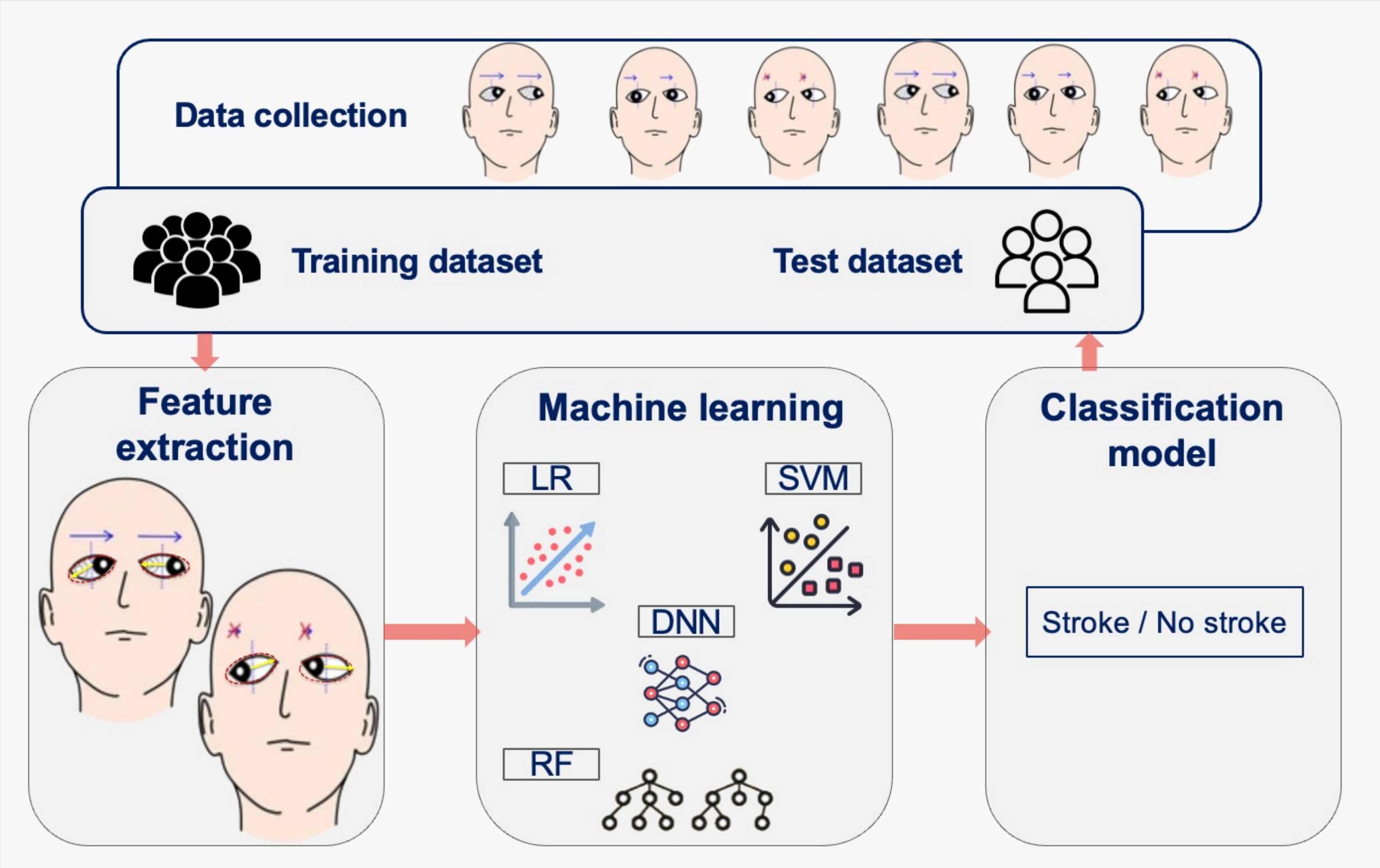
Modellens prestanda

Algorithm	Classifier	Accuracy (%)	Sensitivity (%)	Specificity (%)
Google Speech-to-Text	DNN	100	100	100
	SVM	100	100	100
	RestNet	100	100	100

ASAP PoC/Stroke

Early characterisation of stroke using video analysis, machine learning and eye tracking

Kandidatarbete som fokuserar på digitalisering av partiell blick från NIHSS-skala



ASAP PoC/Stroke

Utveckling av ett AI-beslutsstöd för prehospital strokebedömning baserat på de svenska strokeregistren.

CHALMERS

VÄSTSTROKE
ett kvalitetsregister för hela strokevårdkedjan

RIKSSTROKE
The Swedish Stroke Register

EVAS
REGISTRET FÖR ENDOVASKULÄR BEHANDLING AV STROKE

- Vilken typ av data finns i varje register?
- Vilka är de viktigaste variablerna för detektion av LVO i prehospital miljö?
  - Ålder
  - On-set tid
  - Transporttid till omfattande strokecenter
  - NIHSS poäng
    - Ögonrörelser
    - Motorisk funktionsnedsättning
  - Komorbiditet

Bakidou *et al.*
BMC Medical Informatics and Decision Making (2023) 23:206
https://doi.org/10.1186/s12911-023-02290-5

BMC Medical Informatics and Decision Making

RESEARCH — Open Access

Check for updates

On Scene Injury Severity Prediction (OSISP) model for trauma developed using the Swedish Trauma Registry

Anna Bakidou[1,2*], Eva-Corina Caragounis[3], Magnus Andersson Hagiwara[2], Anders Jonsson[2], Bengt Arne Sjöqvist[1] and Stefan Candefjord[1]

Abstract

Background Providing optimal care for trauma, the leading cause of death for young adults, remains a challenge e.g., due to field triage limitations in assessing a patient's condition and deciding on transport destination. Data-driven On Scene Injury Severity Prediction (OSISP) models for motor vehicle crashes have shown potential for providing real-time decision support. The objective of this study is therefore to evaluate if an Artificial Intelligence (AI) based clinical decision support system can identify severely injured trauma patients in the prehospital setting.

Methods The Swedish Trauma Registry was used to train and validate five models – Logistic Regression, Random Forest, XGBoost, Support Vector Machine and Artificial Neural Network – in a stratified 10-fold cross validation setting and hold-out analysis. The models performed binary classification of the New Injury Severity Score and were evaluated using accuracy metrics, area under the receiver operating characteristic curve (AUC) and Precision-Recall curve (AUCPR), and under- and overtriage rates.

Results There were 75,602 registrations between 2013–2020 and 47,357 (62.6%) remained after eligibility criteria were applied. Models were based on 21 predictors, including injury location. From the clinical outcome, about 40% of patients were undertriaged and 46% were overtriaged. Models demonstrated potential for improved triaging and yielded AUC between 0.80–0.89 and AUCPR between 0.43–0.62.

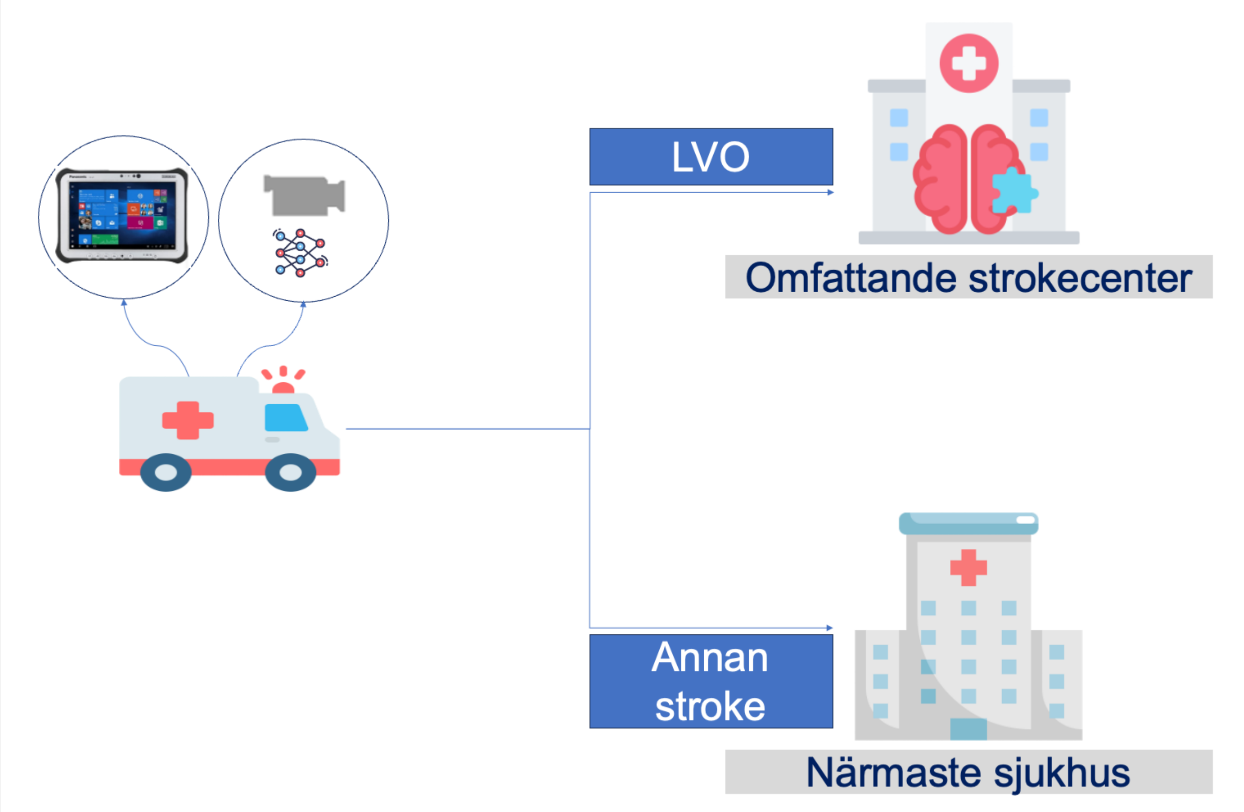
Conclusions AI based OSISP models have potential to provide support during assessment of injury severity. The findings may be used for developing tools to complement field triage protocols, with potential to improve prehospital trauma care and thereby reduce morbidity and mortality for a large patient population.

Keywords Artificial Intelligence (AI), Clinical Decision Support System (CDSS), On Scene Injury Severity Prediction (OSISP), Prehospital care, Trauma, Field triage

ASAP PoC/Stroke

Kliniska studier

- Första retrospektiv studie i samarbete med SA/GU (Katarina Jood).
- Prospektiva studier i ambulans (först blindade studier så att vi eliminerar risker för patienterna)
- Kan vi öka andelen patienter som får trombektomi och/eller korta tiden till behandling?



Slutsatser

- Resultaten indikerar att digitalisering av delar av NIHSS är genomförbart, och att videoanalys och ML har potential för tidig upptäckt av strokesymtom.

- Kommande studier kommer utvärdera om AI-baserade beslutsstöd har potential att komplettera dagens beslutsstöd.

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Tack för att du lyssnade!

Frågor?

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