



# **AI-enabled decision support for spine surgery integrated in the EHR**

**- Innovation report from NORspine**

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# Conflicts of interest: none



## Minimally invasive decompression versus open laminectomy for central stenosis of the lumbar spine: pragmatic comparative effectiveness study

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### ABSTRACT

#### OBJECTIVE

To test the equivalence for clinical effectiveness between microdecompression and laminectomy in patients with central lumbar spinal stenosis.

#### DESIGN

Multicentre observational study.

#### SETTING

Prospective data from the Norwegian Registry for Spinal Stenosis

equivalence). Equivalence was confirmed by propensity matched cohort and full regression analyses. No difference in quality of life (EQ-5D) or in the number of patients with comorbidities was found between the laminectomy group (15.0%) and the microdecompression group (15.0%) but after propensity matching groups did not differ ( $P=0.23$ ) for single level decompression.

### BACKGROUND

In patients with lumbar spinal stenosis and degenerative spondylolisthesis, it is uncertain whether decompression surgery alone is noninferior to decompression with instrumented fusion.

### METHODS

We conducted an open-label, multicenter, noninferiority trial involving patients with symptomatic lumbar stenosis that had not responded to conservative management and who had single level spondylolisthesis of 2 mm or more. Patients were randomised to either microdecompression or laminectomy. The primary outcome was the proportion of patients achieving a clinically meaningful improvement in the Oswestry Disability Index (ODI) at 12 months. Secondary outcomes included the proportion of patients achieving a clinically meaningful improvement in the EuroQol-5D (EQ-5D) and the proportion of patients achieving a clinically meaningful improvement in the Visual Analogue Scale (VAS) at 12 months. The trial was registered at ClinicalTrials.gov (NCT01870155) on 10 October 2016.



## The NEW ENGLAND JOURNAL of MEDICINE

### ORIGINAL ARTICLE

## Decompression with or without Fusion in Degenerative Lumbar Spondylolisthesis

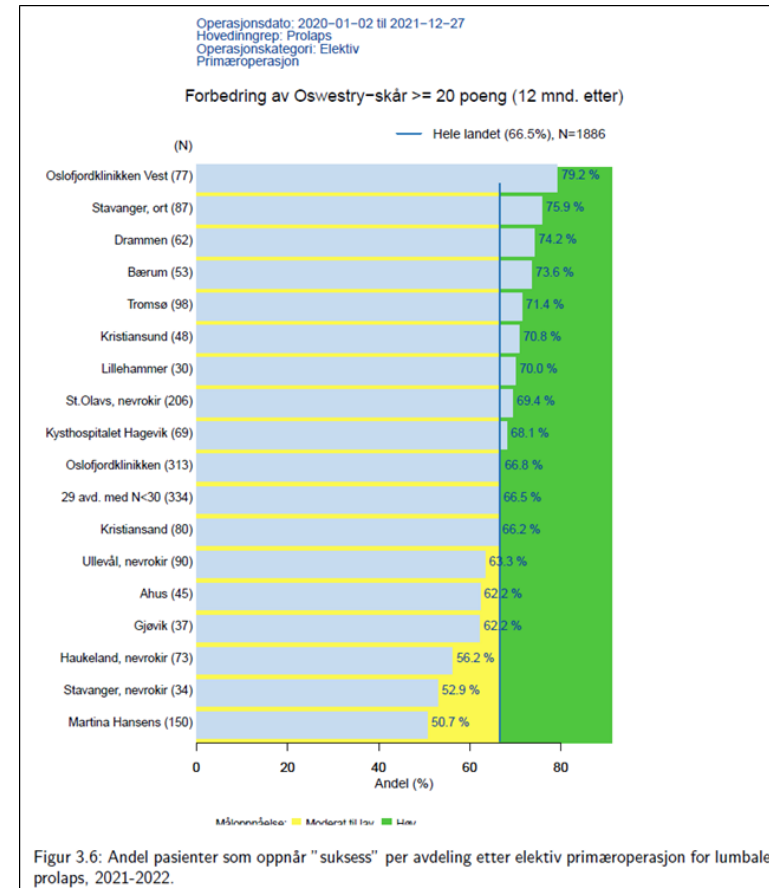
I.M. Austevoll, E. Hermansen, M.W. Fagerland, K. Storheim, J.I. Brox, T. Solberg, F. Rekeland, E. Franssen, C. Weber, H. Brisby, O. Grundnes, K.R.H. Algaard, T. Böker, H. Banitalebi, K. Indrekvam, and C. Hellum, for the NORDSTEN-DS Investigators\*

### ABSTRACT



# Background

- 30 % do not achieve substantial improvement
- 24 % undergo subsequent operations
- Geographic variation in
  - Surgical rates
  - Outcomes
- Hypothesis
  - Decision support integrated in the EHR will improve selection of patients for surgery, and thus outcomes





Journal of  
*Personalized  
Medicine*

Review

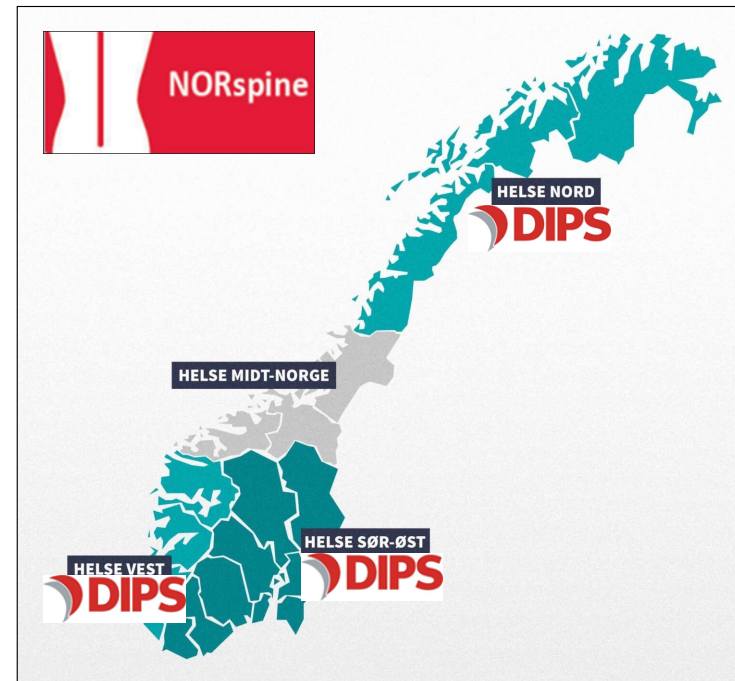
## Artificial Intelligence-Driven Prediction Modeling and Decision Making in Spine Surgery Using Hybrid Machine Learning Models

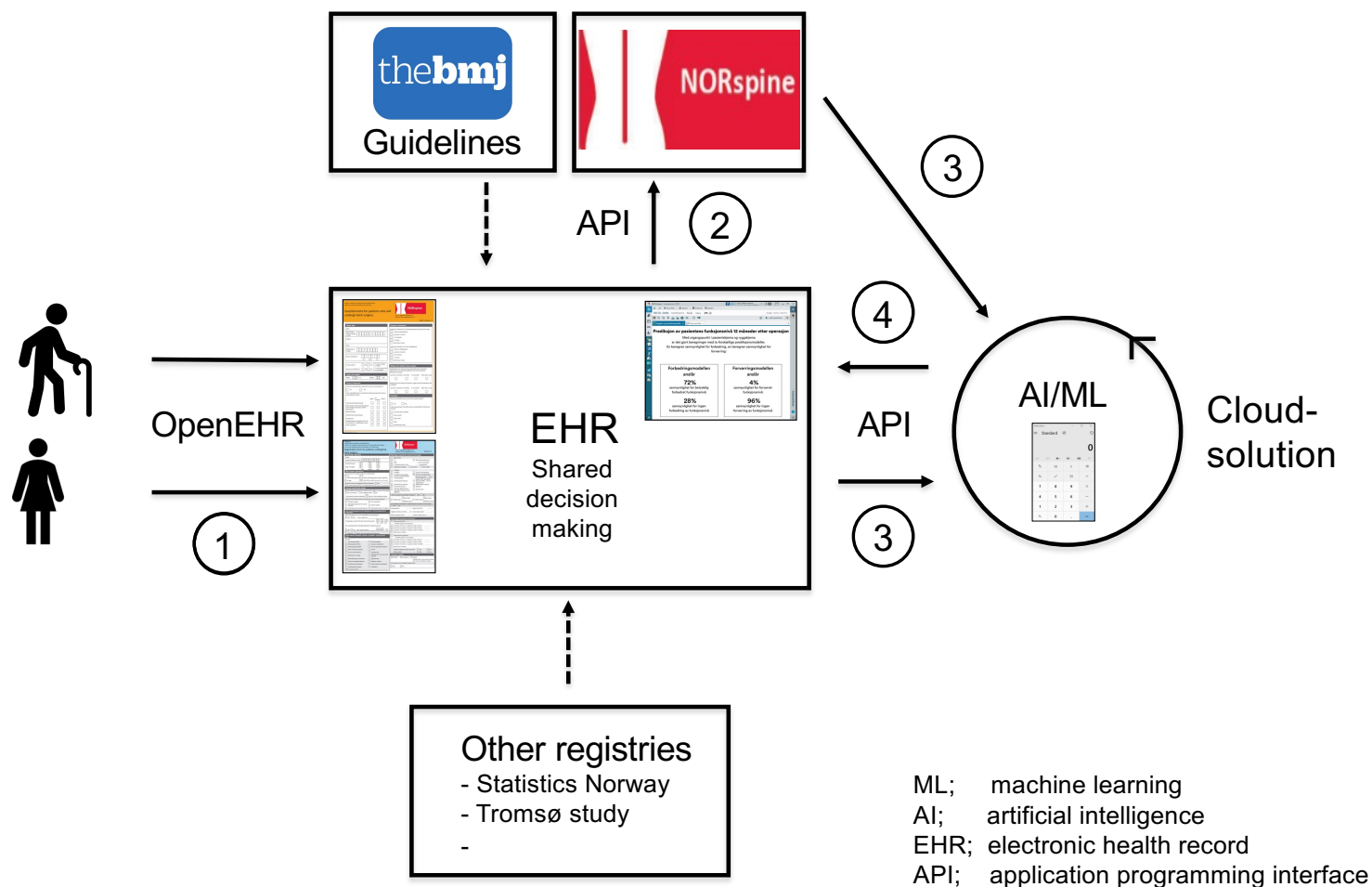
Babak Saravi <sup>1,2,3,\*</sup>, Frank Hassel <sup>2</sup>, Sara Ülkümen <sup>1,2</sup>, Alisia Zink <sup>2</sup>, Veronika Shavlokhova <sup>4</sup>,  
Sebastien Couillard-Despres <sup>3,5</sup>, Martin Boeker <sup>6</sup>, Peter Obid <sup>1</sup> and Gernot Michael Lang <sup>1</sup>

- 28 published models
  - AUCs 0.75 – 0.80, few externally validated
- Some use AI
  - Most trained on small samples
  - No RCTs or other well-designed effect-studies
  - None integrated in the EHR or implemented in routine clinical practice

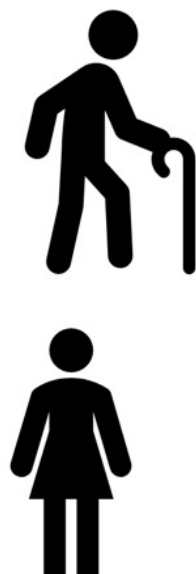
# Norway

- NORspine
  - >70,000 lumbar operations
  - 100 % coverage, 80 % capture
  - 350 variables
  - PROMs at baseline, 3 and 12 months
  - Collaboration with SweSpine and DaneSpine (external validation)
- One EHR-vendor in three of four health regions
  - 4.5 (86 %) million people









OpenEHR



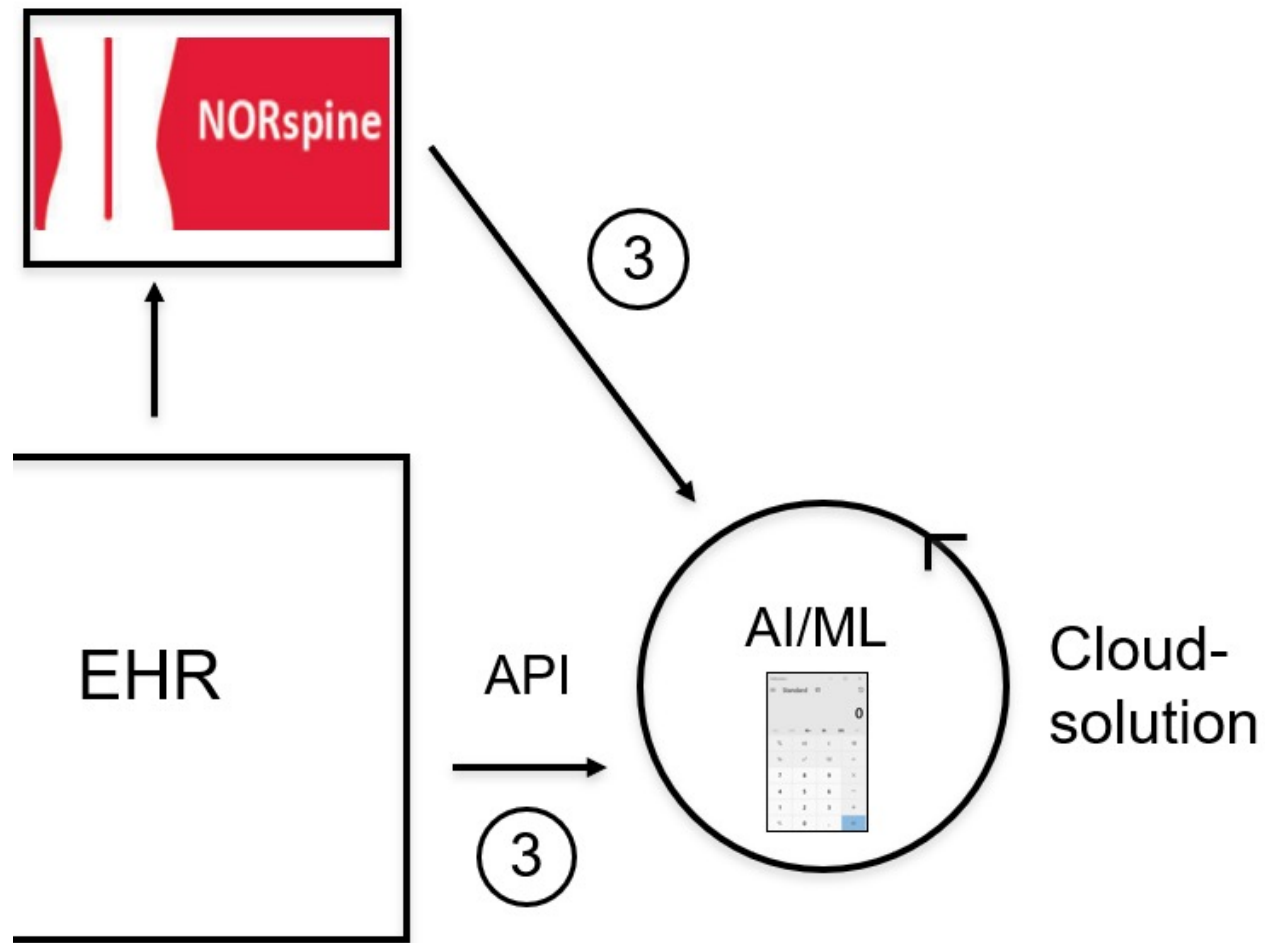
1

A screenshot of the EHR system interface, showing a patient's medical history and current status. The interface includes a header with the patient's name and date, followed by a table of medical history entries. The table has columns for 'Date', 'Event', and 'Status'. Below the table, there are sections for 'Current Status' and 'Next Steps'. The interface is designed for healthcare professionals to track patient care.

EHR







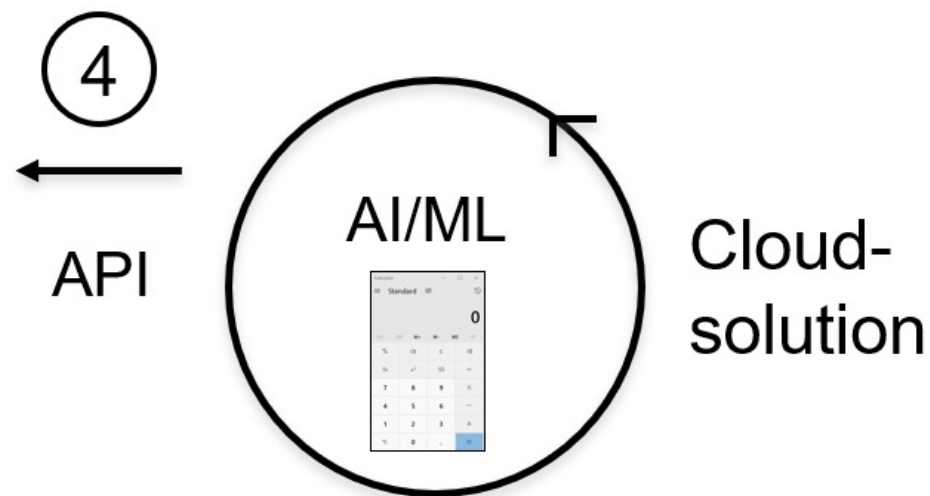
# EHR

Shared decision making

**Prediksjon av pasientens funksjonsnivå 12 måneder etter operasjon**

Med utgangspunkt i pasientskjema og ryggskjema er det gjort beregninger med to forskjellige prediksjonsmodeller. En beregner sannsynlighet for forbedring, en beregner sannsynlighet for forverring:

| Forbedringsmodellen anslår                                        | Forverringsmodellen anslår                                        |
|-------------------------------------------------------------------|-------------------------------------------------------------------|
| <b>72%</b><br>sannsynlighet for betydelig forbedret funksjonsnivå | <b>4%</b><br>sannsynlighet for forverret funksjonsnivå            |
| <b>28%</b><br>sannsynlighet for ingen forbedring av funksjonsnivå | <b>96%</b><br>sannsynlighet for ingen forverring av funksjonsnivå |



Success

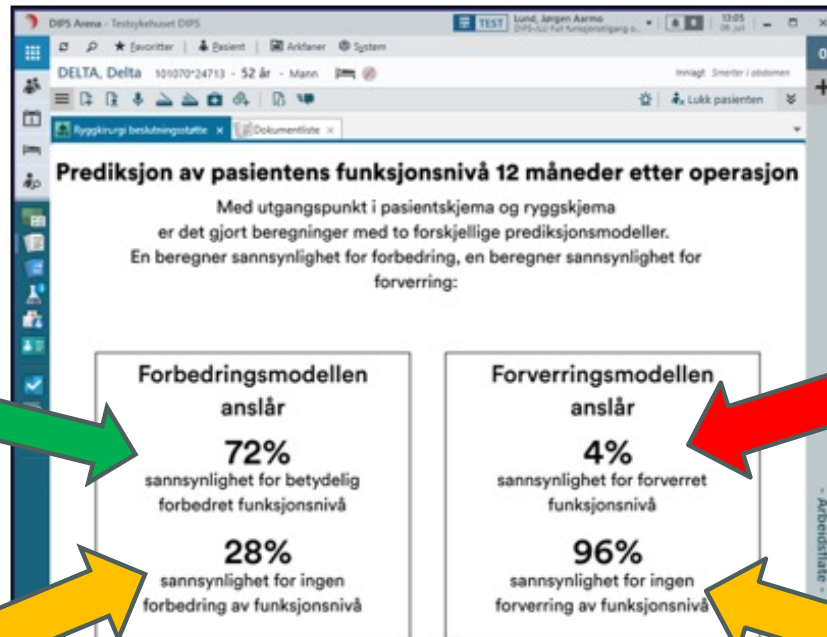
EHR

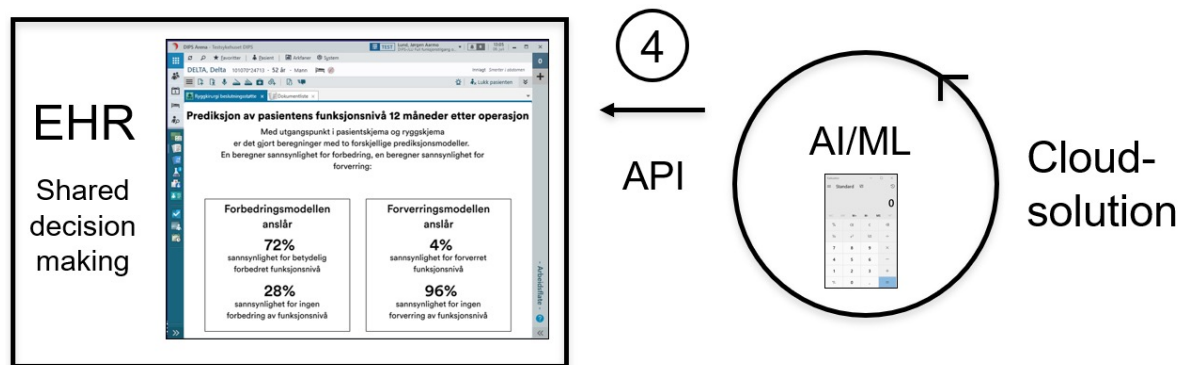
Shared  
decision  
making

Failure

Worsening

No worsening

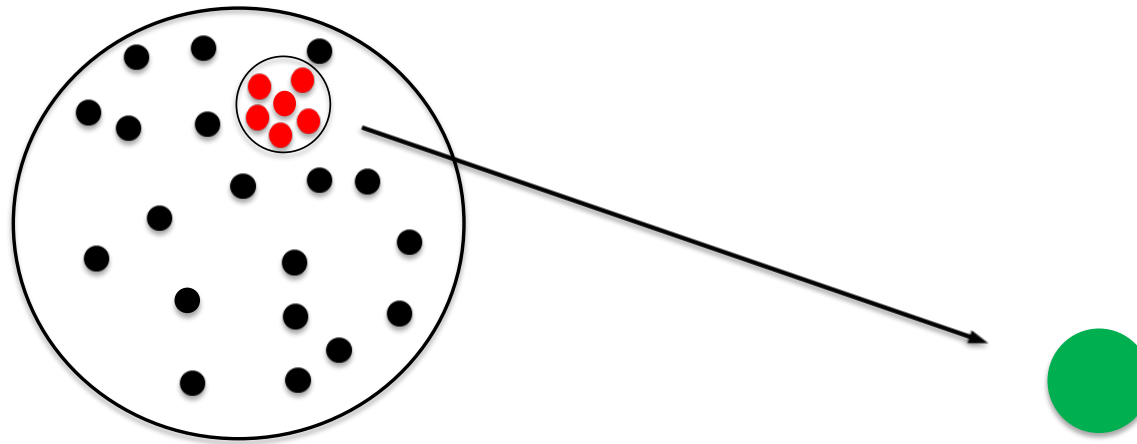




## Lumbar disc herniation model (preliminary)

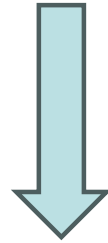
- Training / test n = 3426/857 (75% vs 25%)
- Minimum ODI baseline 22
- Success vs failure (ODI >22)
  - AUC 0.82 (95% CI 0.77-0.83)
- Worsening vs no worsening ( $\Delta\text{ODI} \leq -10$ )
  - AUC 0.79 (95% CI 0.73-0.81)

# How about the patients nearest me?



- Identify (clusters) of patients with a common set of label values predicting an outcome

**Non-operated patients can be followed**



**Better data in the future**



# Clinical studies

1. Mixed-methods feasibility study (2024)
2. Pilot prospective observational clinical trial (2024-25)
3. Prospective register embedded effect study (RCT or center-RCT)

