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Prognosticating fetal growth restriction and small for gestational age by medical history

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Prognosticating fetal growth restriction and small for gestational age by medical history

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FGR/SGA

Fetal growth restriction (FGR)

Intrauterine growth restriction (IUGR)

Small for gestational age (SGA)

estimated fetal weight <10th percentile

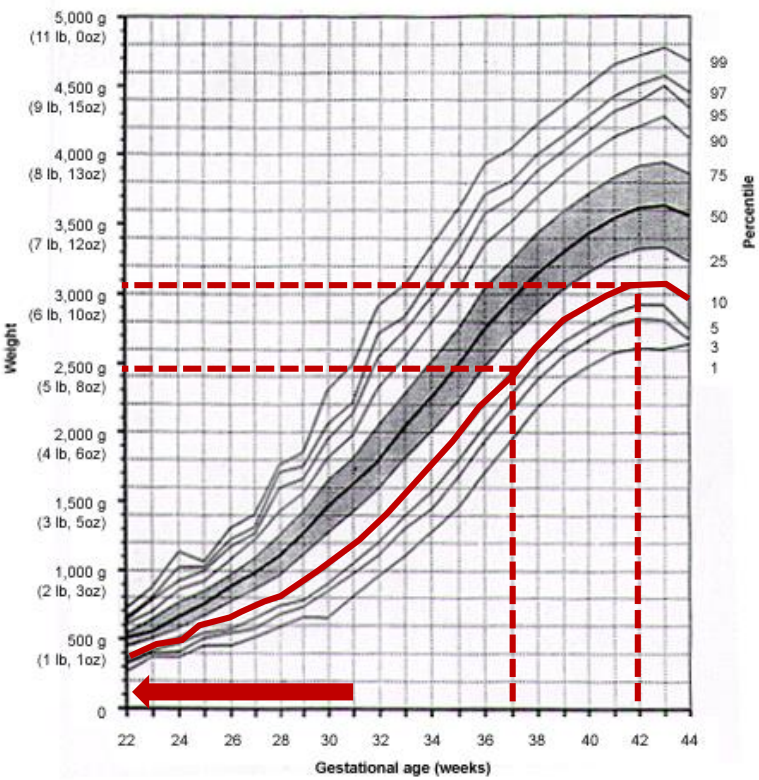

Image courtesy of Peleg, Kennedy, Hunter (1998)

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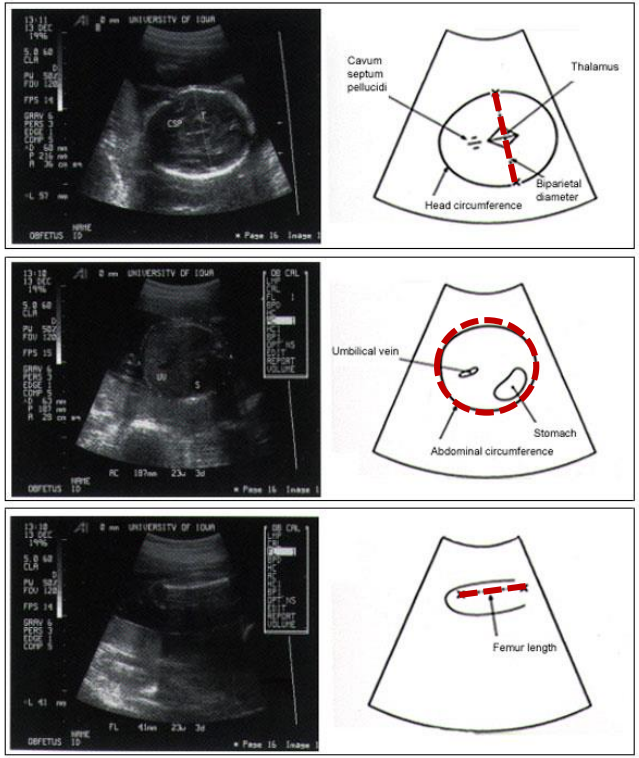


Image courtesy of Peleg, Kennedy, Hunter (1998)

Effective prevention needs accurate screening[3]

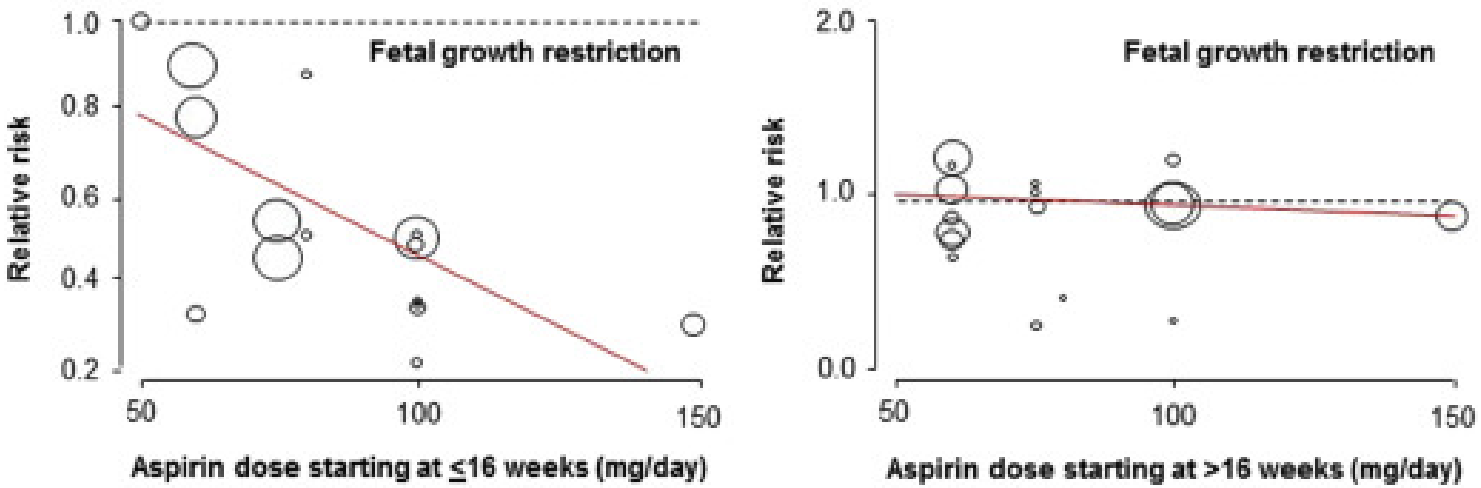


Image courtesy of Roberge, Nicolaides, Demers, Hyett, Chaillet, and Bujold. (2017).[3]

The most accurate method is mostly inaccessible[4,5]

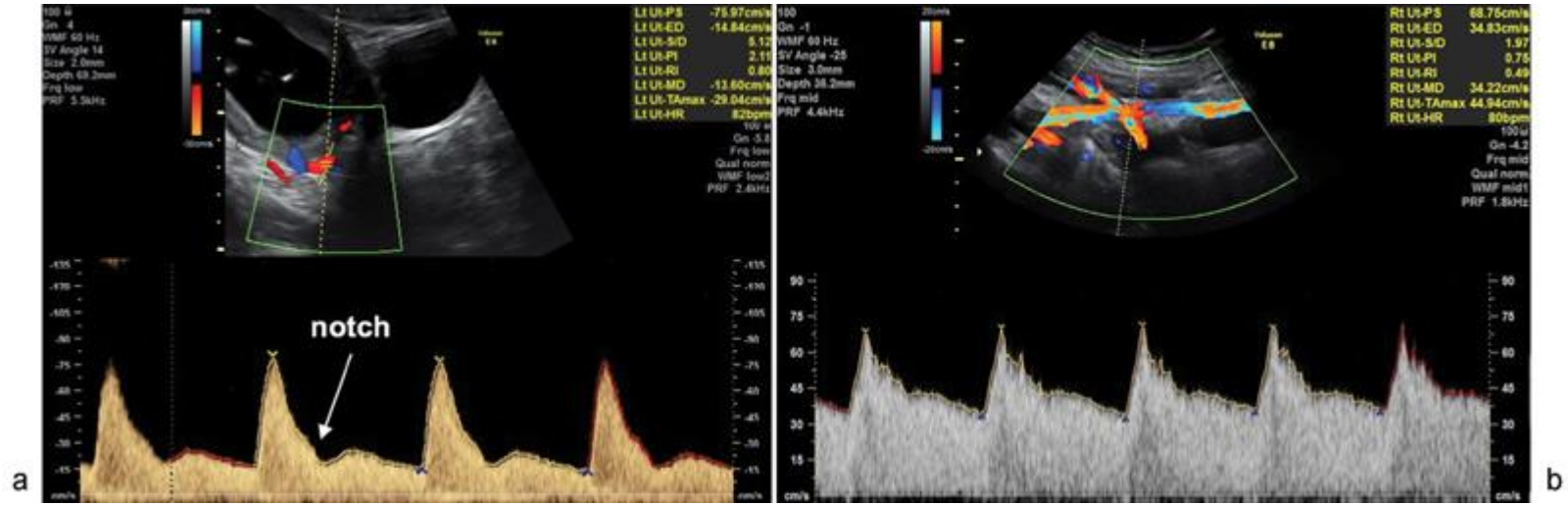


Image courtesy of Roberge, Nicolaides, Demers, Hyett, Chaillet, and Bujold. (2017)

Medical histories to predict FGR/SGA

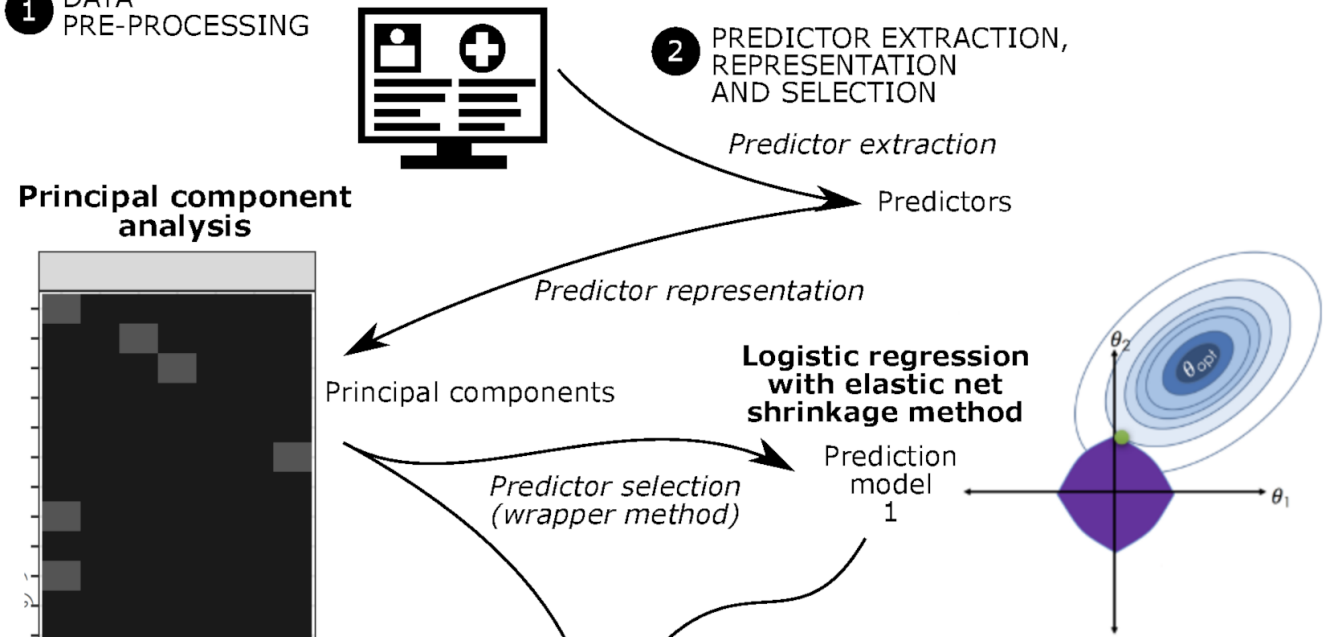
Medical histories could predict pregnancy outcome.[8,9]

- Only 19.5% of women with ≥1 major *risk factor for FGR* had evidence of serial third trimester ultrasound assessments.[6]
- A health insurance claim database abundantly records *medical history*; thus, it allows its proactive screening, particularly in countries with universal health coverage.[7]

Predictive modeling pipeline

Following a pre-registered protocol[10]

Image courtesy of Susanty, Sufriyana, Su, Chuang. (2023).



Predictive modeling pipeline (2)

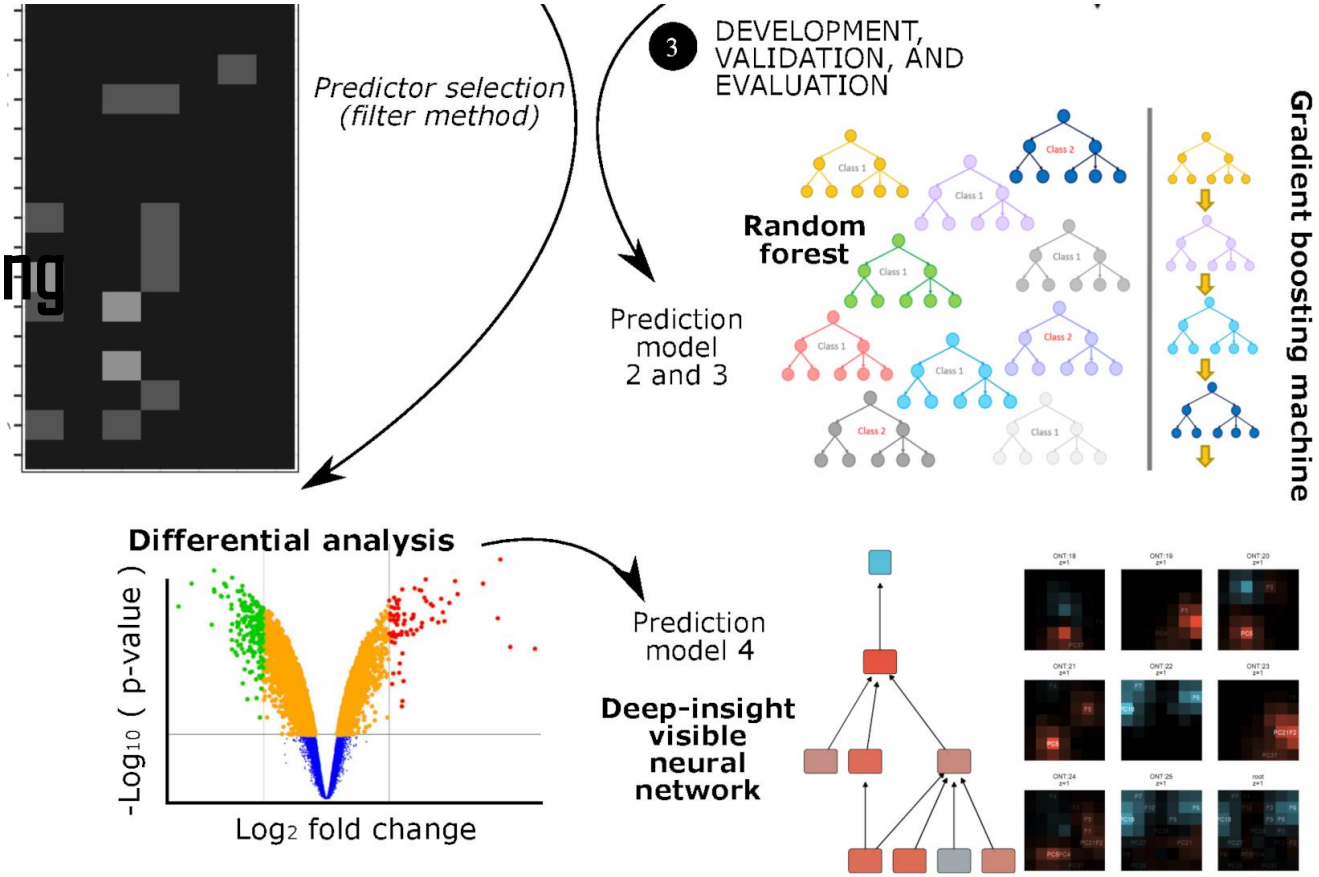


Image courtesy of Susanty, Sufriyana, Su, Chuang. (2023).

Deep-insight visible neural network (DI-VNN)

> Neural Netw. 2023 May;162:99-116. doi: 10.1016/j.neunet.2023.02.020. Epub 2023 Feb 24.

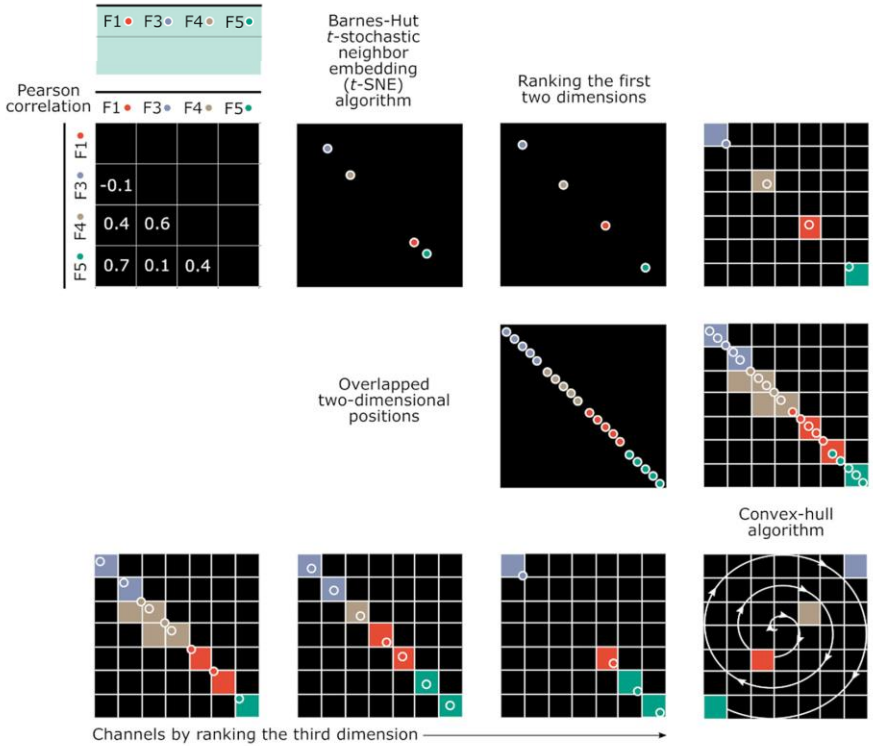
Human-guided deep learning with ante-hoc explainability by convolutional network from non-image data for pregnancy prognostication

Herdiantri Sufriyana [1], Yu-Wei Wu [2], Emily Chia-Yu Su [3]

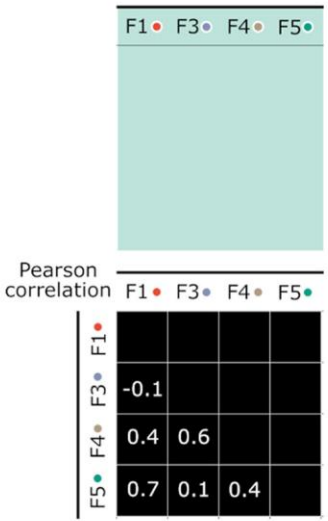
Affiliations + expand

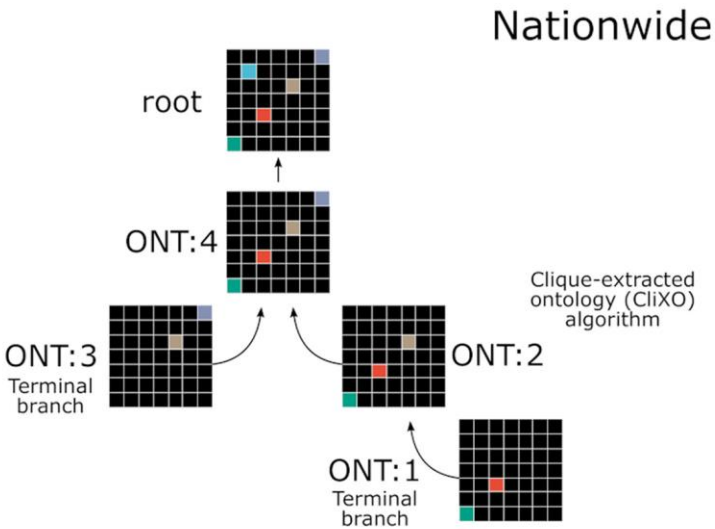
PMID: 36898257 DOI: 10.1016/j.neunet.2023.02.020

Feature map

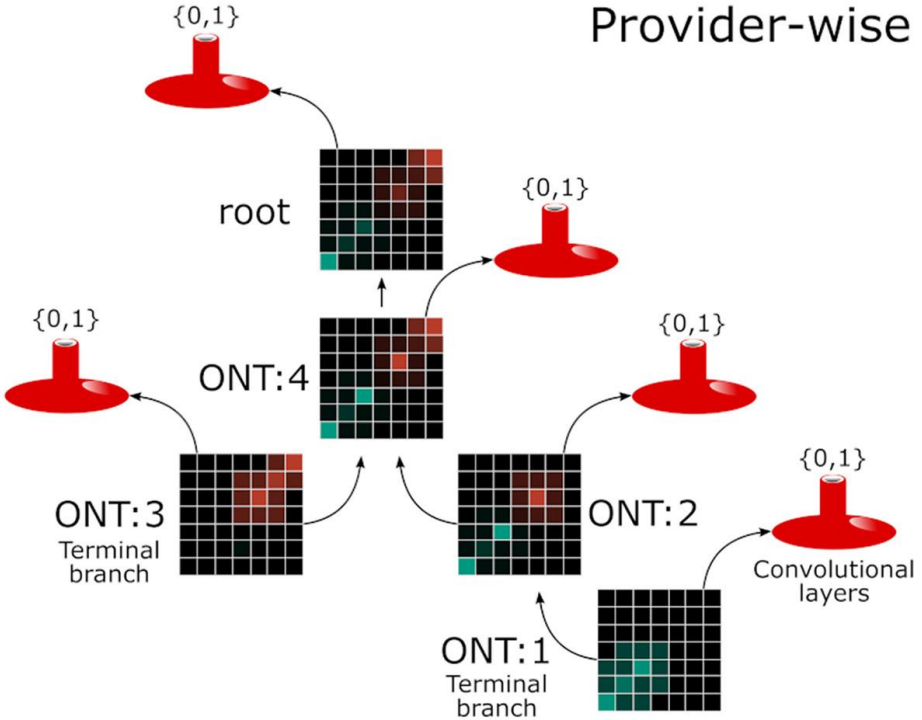

F1 F3 F4 F5
Pearson correlation
F1 F3 F4 F5
F1
F3 -0.1
F4 0.4 0.6
F5 0.7 0.1 0.4
Barnes-Hut t-stochastic neighbor embedding (t-SNE) algorithm
Ranking the first two dimensions
Overlapped two-dimensional positions
Convex-hull algorithm
Channels by ranking the third dimension

Neural network macroarchitecture

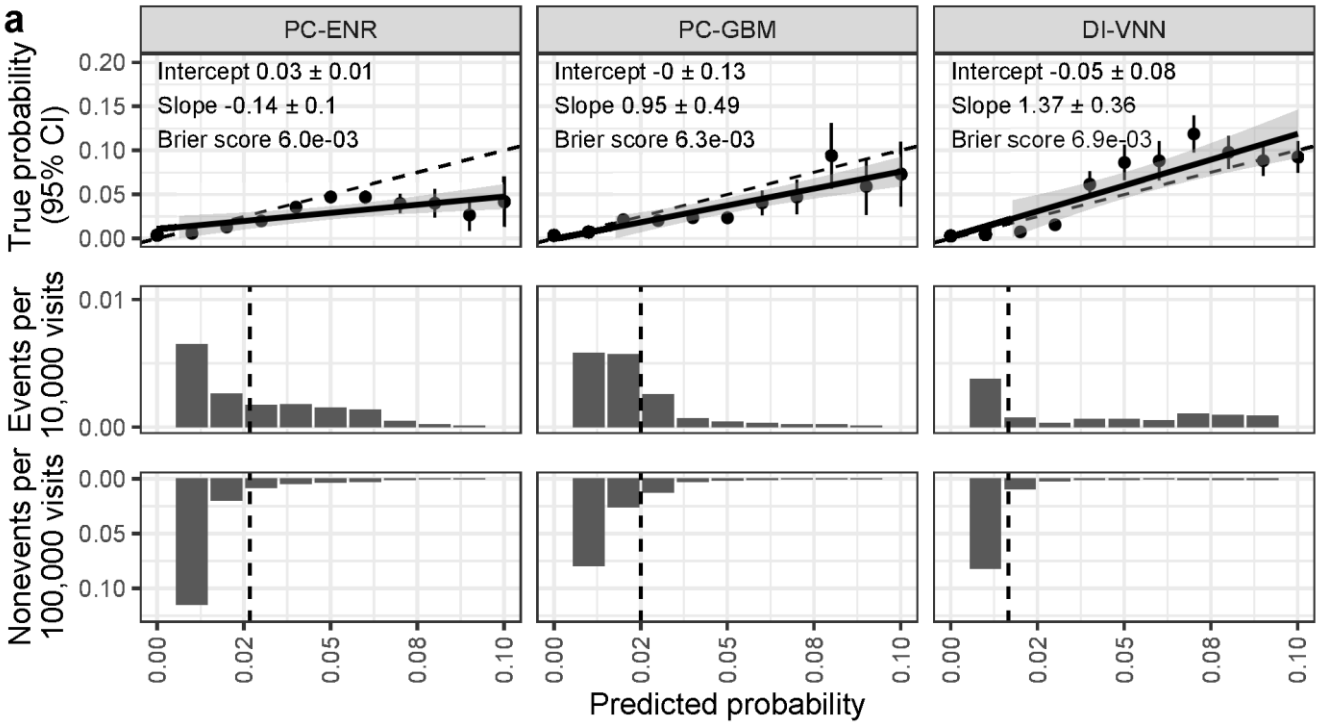




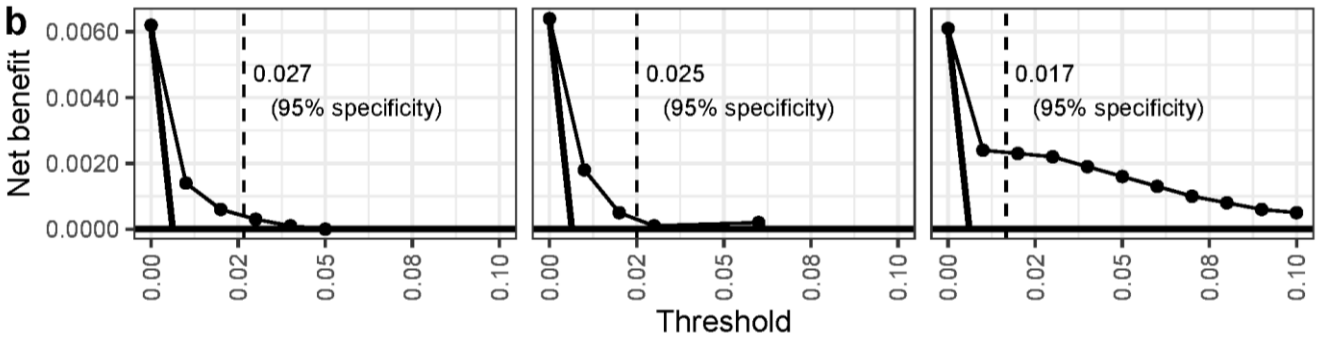
Representation learning



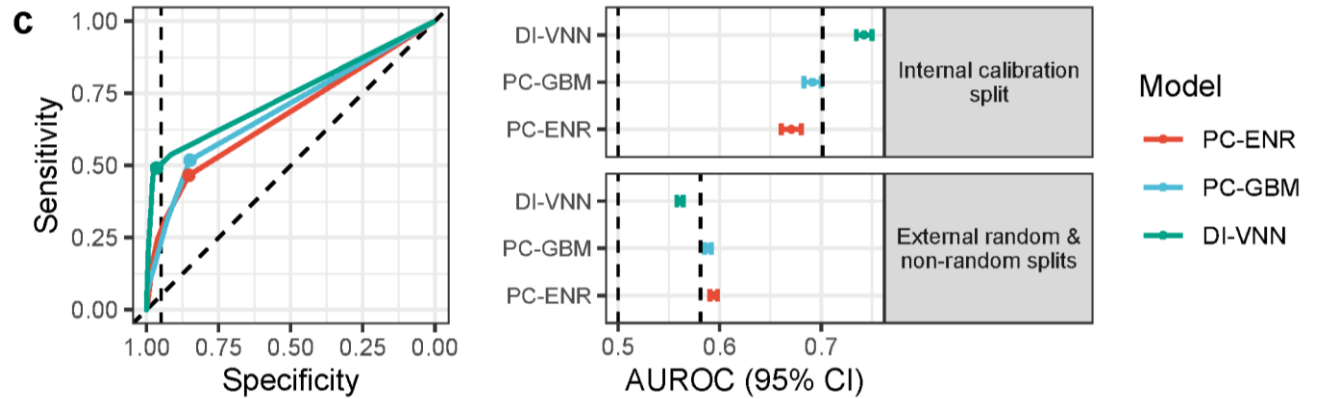
Calibration



Clinical utility



Discrimination ability and robustness



Previous studies

- Required ultrasound or biomarkers and a specific range of gestational age: (1) 25~42 weeks [12]; (2) 10~14 weeks [13]; and (3) 30~35 weeks [14]
- The DI-VNN were competitive to those models.
- **External validation** also estimated the DI-VNN to outperform the previous model [13].
- Evaluation of the previous models [12, 13, 14] also used **training set only**, which might be overoptimistic.

Strength

- No requirement for ultrasound or biomarkers.
- A general population of pregnant women without a specific gestational age range
- Unlike the previous studies, we conducted external validation to estimate the future performance of the DI-VNN.

Limitations

- The accuracy of DI-VNN was only moderate.
  - However, similar accuracies were achieved by the previous models,
  - Although they should be systematically reviewed to ensure all comparable models are included (currently under reviewed).
- The impact of DI-VNN on patient outcomes is also still unclear.
  - Yet, many previous studies in medicine have yet to evaluate the impacts of their prediction models [15].

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