Neural ordinary differential equations for ICU glycaemic control

Presenter
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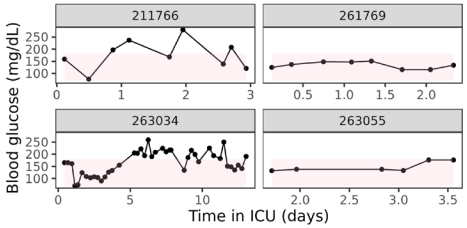
CENTRE FOR BIG DATA RESEARCH IN HEALTH

BACKGROUND

Hyperglycaemia is a marker for poor intensive care unit (ICU) outcomes. **10-30%** of ICU patients suffer from poor control (<70 mg/dL or >180 mg/dL). Treatment is insulin and other hypoglycaemic agents.



METHOD

Challenges:

- Irregular time intervals
- Probabilistic forecasts

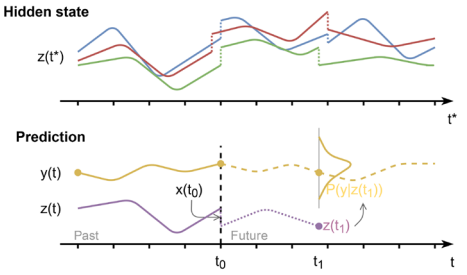
Solution: latent neural ODE

f_θ, μ_θ and σ_θ are **neural networks**, x_t is our measurements/exogeneous inputs at time t

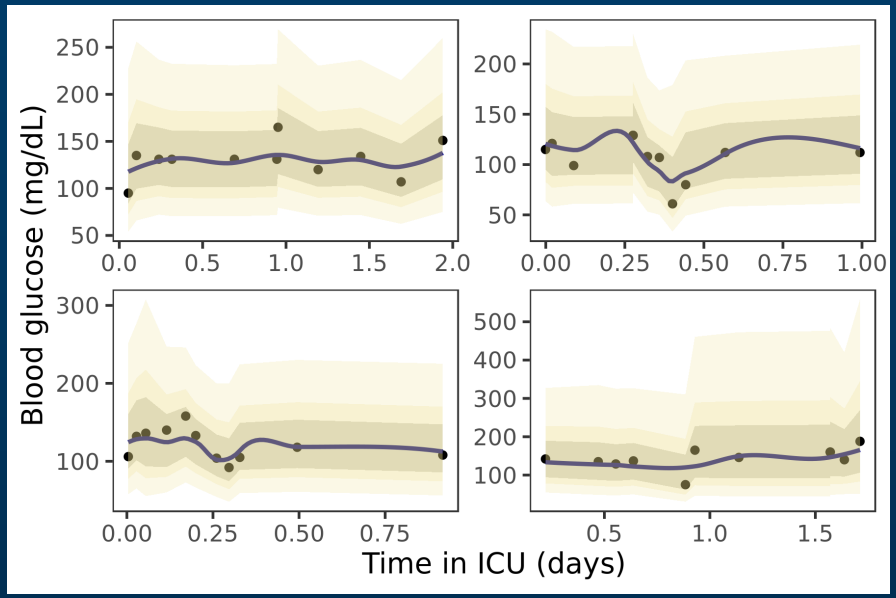
$$\text{glucose}_{t_1} \sim \text{Normal}(\mu_\theta(z_t), \sigma_\theta(z_t))$$

$$z_{t_1} = ODESolve(f_\theta, t_0, t_1)$$

$$\frac{dz}{dt} = f_\theta(x, z)$$



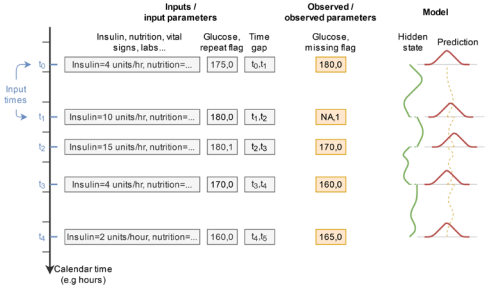
We develop accurate models of patient glucose-insulin dynamics from observational data



The model has applications in clinical decision support tools aimed at reducing hyperglycaemia

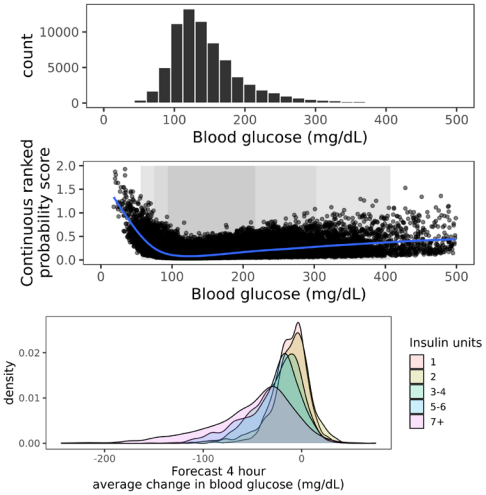
DATA and TRAINING

Our dataset was constructed from the MIMIC-III dataset. It contains 12,047 ICU stays and 571,063 blood glucose measures. It was trained using mini-batch gradient descent (maximum likelihood) over 30 epochs. Coded using *pytorch* and *torchdiffeq*.



RESULTS

The 95% predictions achieve near nominal coverage at 94.8% with the continuous ranked probability score demonstrated best performance in the range 100-200 mg/dL (0.10) with average of 0.13 across the whole test dataset.



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