Artificial intelligence and individualized optimal glycemic target in ICU patients

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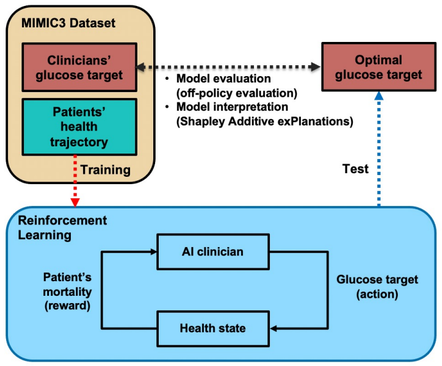
Background & Objective

- **Objective:** Suggesting individualized glucose target

- **Background**
  - Glycemic abnormalities are highly related to hospital complications and mortality
  - Current guideline suggests maintaining glycemic target between 140-180 mg/dL in general ICU patients
  - However, patient's clinical characteristics and disease progression are complex and diverse
  - We propose reinforcement learning-based glucose target recommendation AI

Method

- **Building computational model**
  - AI clinician: Learning glucose target policy based on patient's health trajectory
  - Defining reward(+100) and penalty(-100) depending on patient's mortality



- **Discretizing glucose level into 11 bins**

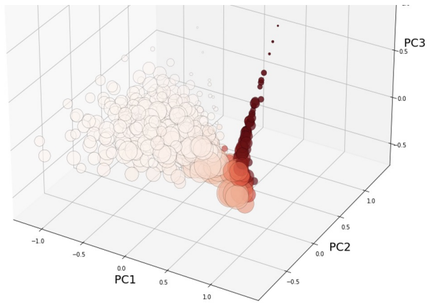
Discritized action (Bin of glucose target)	0	1	2	3	4	5	6	7	8	9	10
Glucose range	70 and less	70-99	100-119	120-139	140-159	160-179	180-199	200-219	220-239	240-269	270 or more

Hypoglycemic range (known as most dangerous glycemic range for ICU patients)

Normoglycemic range

Optimal glycemic range (recommended by current guideline)

Hyperglycemic range



- **Discretizing patient's health state**
  - K-means clustering
  - Resulting in k=400 mutually exclusive health state

- **Model evaluation and interpretation**
  - Weighted Importance Sampling
  - Shapley Additive exPlanations

Discussion

- Proposed AI agent that suggests individualized glucose target, supporting clinician's judgement
- Reinforcement learning enables to generate optimal strategy based on non-optimized training data
- Identifying patient-level target and underlying clinical factors might accelerate precision-medicine

Result

- **Model evaluation**
  - **Performance comparison between glucose target policies from clinician, guideline, and AI**
    - AI policy performed better than clinician's and guideline's
  - **Relationship between mortality rate and AI-estimated return**
    - Evaluating model calibration
- **Mode interpretation**
  - **AI preference**
    - Averaging Q-table across all states
    - AI suggested glucose target mostly in nomoglycemic range while preventing hypo- and hyperglycemic range
  - **Feature contribution to decision-making**
    - Identifying key factors: GCS, diabetes status, platelet count, urea nitrogen, and age