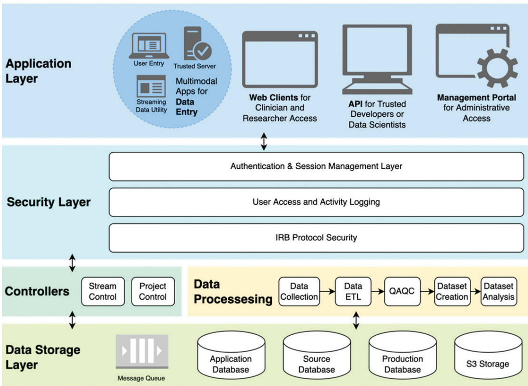

Figure 1: Overview of our AI-powered platform. The platform is built on scalable microservices architecture, which enables parallelized, fast, and resource-efficient data ingestion, processing, and model development. (IEEE JHBI, 2023)

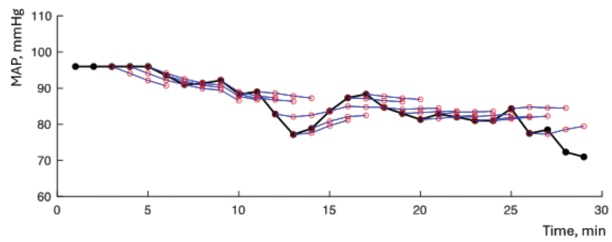

Figure 2: Blood pressure time-course and model prediction in a single patient undergoing cesarean delivery. The measured mean arterial blood pressure (MAP) is shown in black and the ARX model predictions, which are output 3 minutes in advance, are in red.

Automating Drug Administration: AI-powered Blood Pressure Management during Cesarean Delivery

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Optimizing drug administration holds the potential to significantly improve patient safety and outcomes. Continuous drug infusions are typically titrated to a monitored parameter, e.g., vasopressors to a target blood pressure. However, selecting the optimal dose to achieve the desired therapeutic effect while avoiding under- or over-treatment is crucial. This process can be automated by utilizing closed-loop infusion systems in which a controller monitors one or more patient parameters and adjusts the drug dose based on predefined rules. Compared to clinician-adjusted infusion rates, automated systems can reduce complications, aid faster recovery, and improve patient outcomes.

Cesarean delivery is the most common surgery in the world, with ~19M cases annually worldwide. Maternal and fetal safety depend on maintaining optimal maternal blood pressure; up to 75% of the patients are at risk for hypotension, a side effect of the anesthetic used. The current standard of care involves monitoring vital signs and prophylactic vasopressor (phenylephrine) infusion with rate adjustment every minute. There are different physician approaches, and the process is error-prone as individual patient responses to vasopressors vary.

We developed an AI-powered platform (Fig. 1) to process real-time data in the operating room. We collected highly dimensional time-series data with precise times, vital signs, and doses of drug administration events from 172 patients. Using that dataset, we developed a highly accurate, Autoregressive with Exogenous Input (ARX) model to predict blood pressure changes up to 3 minutes in advance, a period sufficient for physician intervention (i.e., vasopressor administration). The ARX model performed 48.9% better than a mean constant model for one-minute-ahead predictions of mean arterial pressure with a root mean square error (RMSE) of 3.6±1.3 mmHg. These results have been independently validated.

Next, we plan to implement machine learning to further enhance the ARX model's performance and personalize the results to individual patients. Further, integrating these models with a smart infusion pump can enable optimal blood pressure management and improve patient experience and outcomes. We have secured IP protection and are seeking partners for technology commercialization.