PreCyte: personalizing perioperative care by predicting postoperative outcomes with novel machine learning and immune biomarkers discovery

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Objective of the technology



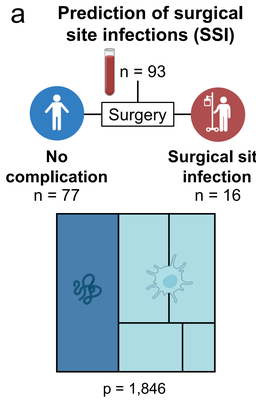
Annually, 63 million elective surgeries are performed in the U.S, with a 30% complication rate for major procedures. PreCyte aims to improve postoperative outcomes by predicting complications more accurately than existing clinical scales like the NSQIP score. It uses machine learning to identify biomarkers in blood samples and clinical data, creating a personalized risk score to guide treatment plans.

Technology and Method

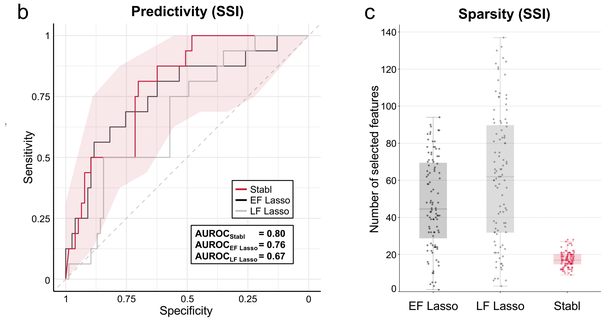
In a study involving 43 patients, a novel machine learning algorithm named Stabl was tested on three omic datasets for biomarker discovery, showing promising results. To further assess Stabl's capabilities, it was applied to a new multi-omic study aiming to identify biomarkers for predicting surgical site infections (SSI) from pre-operative blood samples in patients undergoing major abdominal surgery. A total of 274 patients were enrolled, with preoperative blood samples collected. From these, 93 patients were selected using a case-control design to minimize confounding factors. The analysis included single-cell mass cytometry and plasma proteomics.

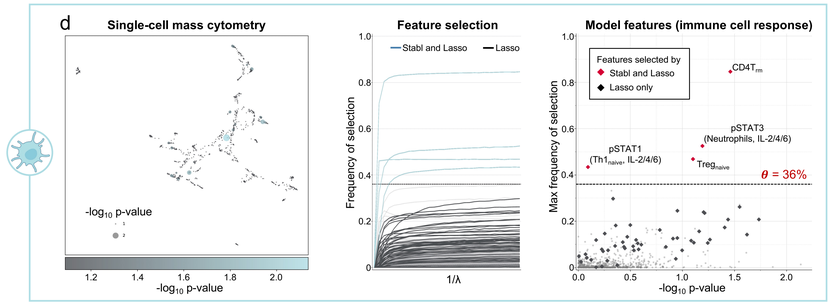
PreCyte, an in vitro diagnostic blood test, predicts surgical complications by simulating surgical stress on blood samples ex vivo and analyzing the immune response. It combines immune biomarkers with clinical data to generate a risk score for clinicians, aiding in personalized decision-making. PreCyte is useful for diagnosis, prognosis, and monitoring intervention efficacy, making complex data understandable through a risk score.

It targets major abdominal surgeries, including a blood processing kit (PreCyte Kit) and a software (PreCyte AI) for integrating immune and clinical data to produce a risk score.



Results





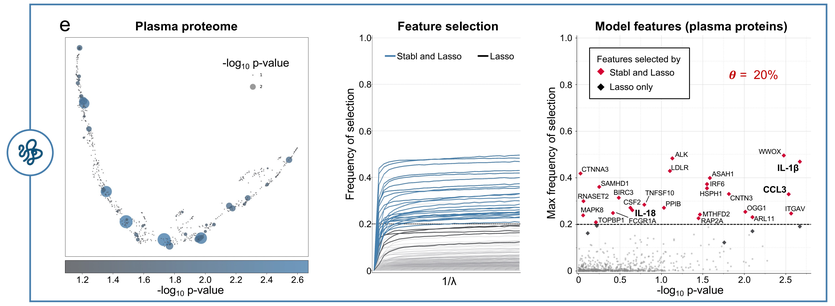


Figure 1. Stabl performance in selecting candidate biomarkers for the prediction of SSI.
1a. Among the 93 patients analysed, 16 suffered from SSI and 77 did not. **1b.** Stabl merged all omic datasets into a final model that accurately classified patients with and without SSI (AUROCStabl = 0.80 [0.69, 0.89]). When compared to early and late fusion Lasso, Stabl had comparable predictive performance yet superior sparsity (**1c.**)
1d.e. Stabl selected four mass cytometry and 25 plasma proteomic features that were combined into a biologically interpretable immune signature predictive of SSI. Examination of Stabl features revealed cell-type specific immune signaling responses associated with SSI that resonated with circulating inflammatory mediators. Notably, the STAT3 signaling response to IL-6 in neutrophils was increased before surgery in patients predisposed to SSI. Correspondingly, patients with SSI had elevated plasma levels of IL-1β and IL-18, two potent inducers of IL-6 production in response to inflammatory stress. CCL3 coordinates recruitment and activation of neutrophils, and the canonical stress response protein HSPH1. These findings are consistent with previous studies showing that heightened innate immune cell responses to inflammatory stress, such as surgical trauma can result in diminished defensive response to bacterial pathogens thus increasing a patient's susceptibility to infection.

Conclusions

STABL's analysis across omics data has shown promise in identifying biomarkers for surgical site infections (SSI), offering new insights into the immune response post-surgery. A trial with 283 patients has finished enrollment, with ongoing analysis expected to conclude by the end of 2023.

PreCyte's approach, using immune data and machine learning to predict postoperative complications, is being validated in a multicenter trial in France, with promising early results for major abdominal surgeries. Efforts are underway to refine the biomarker set for commercial development, facing challenges in standardization and clinical adaptation. The first commercial version of PreCyte, aiming for personalized care based on immune profiles, is anticipated by 2025.