# SIMULATING CLINICAL CONFIDENCE INTERVALS FOR BLACK-BOX ALGORITHMIC PREDICTIONS OF LIVER STEATOSIS

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#### INTRODUCTION

#### METHODS

Clinicians have begun using blood-serum biomarkers with artificial intelligence algorithms (AIAs) to assess the degree of liver steatosis without taking a liver biopsy. However, intra-patient and intra-lab variability could affect the inputs, and with >5 biomarkers used by an AIA, noise is compounded. Interpretable measures of an AIA's confidence are absent in the clinical workflow. We aim to resolve this gap in interpretability of non-invasive AIA with a stochastic noise injection method and interactive data visualization—allowing clinicians to a) observe steatosis predictions under simulated noise conditions and b) interactively simulate expected regression of steatosis with respect to changes in biomarkers through course of treatment.

LIVERFASt Steatosis, an AIA proprietary technology (Fibronostics, Orlando US), uses surrogate serum biomarkers to infer steatosis (0-1). Some of the serum biomarkers (e.g. cholesterol) are often targets for therapy. With data from a single use-case patient, we exhaustively injected uniform noise (from  $\pm$  1 to 64%) into one biomarker at a time (10,000 replicates per biomarker, cond.).



**Figure 1** a) Expected results of noise injection into apolipoprotein A1, a biomarker input into the AI-based LIVERFASt to produce a steatosis score b) linear noise equations for each biomarker, and c) steatosis with a parallel coordinate visualization.

Increasing noise in e.g. apolipoprotein A1 (the major protein component of highdensity lipoprotein (HDL) cholesterol in plasma) shows increasing probability of yielding a false positive S1 grade for steatosis (Fig 1a). Steatosis prediction variability increases linearly with noise injection across all biomarkers (R > 0.99; p < 0.001, Fig 1b); this behavior is visible in our interactive parallel coordinate visualization, which allows a clinician to interactively change the noise levels on all biomarkers to see the effect on the output steatosis scores (e.g. with BMI in Figure 1c and with Cholesterol in Figure 2c). Clinicians can identify the change in e.g. mean cholesterol or BMI which would yield a 10% decrease in the steatosis.

#### RESULTS



**Figure 2** a) Interactive parallel coordinate visualization of high dimensional noise distributions derived from a single patient. b) table of deidentified data, where the first row represents the original blood serum biomarker observations, and all other data are derived simulated patients. c) The clinician can raise the measurement of cholesterol to see the effect on the distribution of predicted liver condition scores (e.g. steatosis).

## CONCLUSION Noise injection allows for nuanced

tailoring and interpretation of results inferred by an AIA. We equip clinicians with an interactive tool to contextualize therapeutic expectations and aid in patient education towards adherence endpoints. In effect, we provide a new, nuanced view of how AI algorithms assess liver disease.

#### PIPELINE

If a patient will be undergoing a weight loss regimen, can we re-evaluate their liver steatosis score if they were to drop a score in BMI? Ultimately, using this tool prognostically will require the evaluation of these AIA's with multiple samples per patient, at a variety of inter-sampling intervals.

### REFERENCES

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