

Glucose Measurement of Intensive Care Unit Patient Plasma Samples Using a Fixed-Wavelength Mid-Infrared Spectroscopy System

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Abstract

Objective:

Glycemic control is a rapidly developing field in intensive care medicine with the aim of reducing mortality, morbidity, and cost. Current intensive care unit (ICU) glucose measurement technologies are susceptible to interference from medications, volume expanders, and other substances present in critically ill patients. We hypothesized that a fixed-wavelength mid-infrared (mid-IR) spectroscopy system would be accurate for measuring glucose levels of ICU patients.

Research Design and Methods:

This is a prospective investigation of plasma samples from two different institutions treating a heterogeneous population of ICU patients. The first 292 samples were collected from 86 patients admitted to Stamford Hospital, and the next 352 samples were collected from 75 patients from three ICUs at the University of Maryland. Plasma samples were measured on a Fourier-transform infrared or a proprietary spectrometer, with a glucose prediction algorithm to correct for spectral interference, which were compared with reference measurements taken using a YSI 2300 glucose analyzer.

Results:

Glucose values ranged from 24 to 343 mg/dl. Numerous medications and injury/disease states were observed in the patient populations, with metoprolol, fentanyl, and multiple organ failure the most prevalent. Despite these interferences, there was a high correlation ($r \geq 0.94$) and low standard error (≤ 12.8 mg/dl) between the predicted glucose values and those of the YSI 2300 STAT Plus reference instrument in the three studies. A total of 95.1% of the 644 values in the three studies met International Organization for Standardization 15197 criteria.

Conclusion:

These results suggest that a fixed-wavelength mid-IR spectrometer can measure glucose accurately in the plasma of ICU patients.

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Abbreviations: (APACHE) Acute Physiology And Chronic Health Evaluation, (FTIR) Fourier-transform infrared, (ICU) intensive care unit, (IRB) institutional review board, (ISO) International Organization for Standardization, (mid-IR) mid-infrared

Keywords: continuous glucose monitoring, intensive care unit, interference, spectroscopy

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