This thesis covers studies on continuous glucose and exhaled breath analysis in the ICU. It is divided into three parts. First, we aimed to compare and test different (continuous) blood glucose measurement methods (part I). Second, we aimed to predict blood glucose levels by analysis of exhaled breath in intubated and ventilated ICU patients (part II). Finally, we aimed to investigate further development of exhaled breath analysis techniques and data analysis methods (part III). We hope that the results of the research in this thesis will enhance the understanding of (continuous) blood glucose measurements and exhaled breath analysis in ICU patients.
Continuous glucose and exhaled breath analysis in the Intensive Care Unit

Author: Jan Hendrik Leopold
Lay-out and cover design: Stephan Achterberg, www.vanlennep.eu
Print: Brill, www.brill.com
Continuous glucose and exhaled breath analysis in the Intensive Care Unit

ACADEMISCH PROEFSCHRIFT

ter verkrijging van de graad van doctor
aan de Universiteit van Amsterdam
op gezag van de Rector Magnificus
prof. dr. ir. K.I.J. Maex
ten overstaan van een door het College voor Promoties ingestelde commissie,
in het openbaar te verdedigen in de Agnietenkapel
op donderdag 26 oktober 2017, te 14.00 uur
door Jan Hendrik Leopold
geboren te Leiden
Promotiecommissie:

Promotores:  prof. dr. M.J. Schultz  AMC-UvA
             prof. dr. A. Abu-Hanna  AMC-UvA

Copromotor:  dr. L.D.J. Bos  AMC-UvA

Overige leden:  prof. dr. N.P. Juffermans  AMC-UvA
                prof. dr. E.H.D. Bel  AMC-UvA
                prof. dr. A.H. Zwinderman  AMC-UvA
                prof. dr. T. Bein  Universität Regensburg
                dr. M.C. Schut  AMC-UvA
                dr. A.W. Boots  Universiteit Maastricht

Faculteit: Faculteit der Geneeskunde
Chapter 1  General introduction and outline of this thesis ........... pag 5

Part 1
Chapter 2  Continuous Glucose Monitoring–devices for Use in Intensive Care Units ....................................................... pag 15
Chapter 3  Point Accuracy and Reliability of an Interstitial Continuous Glucose Monitoring Device in Critically Ill Patients: A Prospective Study ........................................ pag 31
Chapter 4  Point and Trend Accuracy of a Continuous Intravenous Microdialysis–based Glucose–monitoring Device in Critically Ill Patients – a Prospective Study ........................................... pag 55

Part 2
Chapter 5  Glucose Prediction by Analysis of Exhaled Metabolites – a Systematic Review ................................. pag 79
Chapter 6  Factors influencing continuous breath signal in intubated and mechanically–ventilated intensive care unit patients measured by an electronic nose ................................................................. pag 99
Chapter 7  Non-invasive breath monitoring with eNose does not improve glucose diagnostics in critically ill patients in comparison to Continuous Glucose Monitoring in blood ......................................................... pag 119

Part 3
Chapter 8  Comparison of classification methods in breath analysis by electronic nose .............................................. pag 133
Chapter 9  Volatile organic compound profiles in outlet air from extracorporeal life-support devices differ from breath profiles in critically ill patients ............................... pag 157
Chapter 10 Summary and General Discussion ................................................................. pag 173
Chapter 11 Nederlandse Samenvatting ................................................................. pag 181

Appendices
Author Contributions
Portfolio