Essential Equations for Anaesthesia

Key Clinical Concepts for the FRCA and EDA

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Authors

Dr Edward T. Gilbert-Kawai MBChB
Anaesthetic Registrar, Central London School of Anaesthesia, UK

Dr Marc D. Wittenberg MBChB, BSc (Hons), FRCA
Senior Anaesthetic Registrar, Central London School of Anaesthesia, UK

Foreword and contents editor

Dr Wynne Davies MBBCh, DRCOG, DCH, FRCA, FFICM
University College London Hospitals NHS Foundation Trust, UK

Statistical editor

Dr Rebecca Gilbert PhD
School of Social and Community Medicine, University of Bristol, UK

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Every effort has been made in preparing this book to provide accurate and up-to-date information which is in accord with accepted standards and practice at the time of publication. Although case histories are drawn from actual cases, every effort has been made to disguise the identities of the individuals involved. Nevertheless, the authors, editors and publishers can make no warranties that the information contained herein is totally free from error, not least because clinical standards are constantly changing through research and regulation. The authors, editors and publishers therefore disclaim all liability for direct or consequential damages resulting from the use of material contained in this book. Readers are strongly advised to pay careful attention to information provided by the manufacturer of any drugs or equipment that they plan to use.

To those nearest and dearest to me, to Ma for her omniscient advice, and above all to Grace for putting up with me.
Ned Gilbert-Kawai

To my parents for their unwavering love and support, to Eytan and Noa for showing me what life is about, and most of all to my rock, Dalya, without whom none of this would be possible.
Marc Wittenberg

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Foreword

Sitting examinations is a stressful time; answers are often all too apparent in the coffee room chat following the exit from the examination hall. The way we retrieve and process information has changed. The long evenings spent in the library browsing the *Index Medicus* are fortunately long gone, and have been replaced by much more instant online resources. The information revolution continues, and as wireless technology becomes universal, so access to information will become even more instant.

However, interpretation and emphasis is always going to need guidance. Deriving and remembering equations is a daunting task, particularly when trying to relate them to a clinical context; this book brings together many of the mathematical concepts in anaesthesia into one place. It is an invaluable reference guide to the equations used in anaesthesia today, with a brief explanation of units, and examples of each equation's relevance to clinical practice.

While the authors have attempted to include all equations relevant to post-graduate anaesthetic exams, it is not a panacea for all formulae, but a concise reference text for revision purposes. Succinct and clearly laid out, it enables candidates to build on their academic knowledge, and provides a fresh insight into the clinical applications of the mathematical concepts relevant to anaesthesia.

Doctors Gilbert-Kawai and Wittenberg's *Essential Equations for Anaesthesia* successfully complements other key medical texts as an equation reference guide that will be indispensable to all trainees in anaesthesia, and a refresher for those of us who took the examinations some time ago, before the advent of the information technology revolution.

Dr Wynne Davies MBBCh, DRCOG, DCH, FRCA, FFICM

Preface

One must divide one's time between politics and equations. Equations however are much more important to me, for whilst politics concerns the present, our equations are for eternity.

Albert Einstein (1879–1955)

As practising anaesthetic registrars, we are keenly aware of the challenges and pressures faced by all trainees taking the anaesthetic examinations. Among the seemingly insurmountable mountain of facts and figures that one is expected to know relating to physiology, pharmacology, physics and statistics, knowledge of equations and their derivation, use and application to anaesthetics is an absolute prerequisite.

Unfortunately, while commonly regarded by candidates as a 'nightmare exam question', this is often a favourite with examiners, particularly in the spoken *viva* exams. Easy marks to win if one can demonstrate their knowledge through a straightforward, clinically applied approach, or easy marks to lose if poorly answered. Learned by rote, attempts to derive and link their application to clinical practice can leave a candidate floundering – a huge forfeiture in an exam where every mark counts.

With this in mind, and having had to refer to nearly 20 books and multiple websites while undertaking our own revision, none of them contained a comprehensive list of the multitude of different equations that we were required to know. And thus it was, during a coffee break between theatre lists, that the idea of this book was born: a simple, handy, reference guide to all the equations required for the anaesthetics examination, with concise explanations and examples of their direct relevance to clinical practice.

The book is broadly divided into the four subject areas of physics, physiology, pharmacology and statistics. Each equation is explained, derived where necessary, and a worked or clinically relevant example provided to demonstrate its use. Units and relevant terms are given and, where required, clear, concise diagrams have also been provided to simplify understanding. For general interest, the historical background relating to an equation's nomenclature has also been given wherever possible. We expect readers to use it as a source of reference, and enablement to relate the equations to clinical anaesthesia and intensive care medicine.

Our hope is that a clearer understanding of the topic will significantly diminish the fear around this important aspect of the exam. Indeed, it is also hoped that this book will be of use not only to those preparing for examinations, but also to practising anaesthetists, as many of the equations in this book are directly relevant to clinical practice.

Because thorough preparation for any examination cannot be dependent on one text alone, this book is intended to complement, rather than supplant, other reference works, and is not a replacement for robust knowledge. Nor is there any substitute for hard work. Our intention is that using this book will smooth your passage towards successful completion of the examinations and we wish you good luck: if you are reading this, it means there is light at the end of the tunnel.

EG-K and MW
October 2013

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