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USMLE[®] STEP 1

2018

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**TAO LE ■ VIKAS BHUSHAN ■ MATTHEW SOCHAT
YASH CHAVDA ■ ANDREW ZUREICK**

FIRST AID FOR THE®

USMLE STEP 1 2018

TAO LE, MD, MHS

Associate Clinical Professor
Chief, Section of Allergy and Immunology
Department of Medicine
University of Louisville School of Medicine

VIKAS BHUSHAN, MD

Boracay

MATTHEW SOCHAT, MD

Fellow, Department of Hematology/Oncology
St. Louis University School of Medicine

KIMBERLY KALLIANOS, MD

Assistant Professor, Department of Radiology and Biomedical Imaging
University of California, San Francisco

YASH CHAVDA, DO

Resident, Department of Emergency Medicine
St. Barnabas Hospital, Bronx

ANDREW ZUREICK

University of Michigan Medical School
Class of 2018

MEHBOOB KALANI, MD

Resident, Department of Internal Medicine
Allegheny Health Network Medical Education Consortium



New York / Chicago / San Francisco / Athens / London / Madrid / Mexico City
Milan / New Delhi / Singapore / Sydney / Toronto

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Dedication

To the contributors to this and past editions, who took time to share their knowledge, insight, and humor for the benefit of students and physicians everywhere.

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Contributing Authors

MAJED H. ALGHAMDI, MBBS

King Abdulaziz University College of Medicine

VIJAY BALAKRISHNAN

Emory University School of Medicine
Class of 2018

BRIAN BALLARD

Michigan State University School of Osteopathic Medicine
Class of 2018

HUMOOD BOQAMBAR

Royal College of Surgeons in Ireland
Class of 2018

TARUNPREET DHALIWAL

St. George's University School of Medicine
Class of 2018

RACHEL L. KUSHNER, MSc

Mercer University School of Medicine
Class of 2018

LAUREN N. LESSOR

St. George's University School of Medicine
MD/PhD Candidate, Class of 2018

JONATHAN LI

University of Michigan Medical School
Class of 2018

SCOTT MOORE, DO

Assistant Professor of Medical Laboratory Sciences
Weber State University

JUN YEN NG, MBBS

Princess Alexandra Hospital

CONNIE QIU

Lewis Katz School of Medicine at Temple University
MD/PhD Candidate, Class of 2021

KALLI A. SARIGIANNIS

Oakland University William Beaumont School of Medicine
Class of 2018

SARAH SCHIMANSKY, MB BCh BAO

Resident, Department of Ophthalmology
Gloucestershire Hospitals NHS Foundation Trust

JESSE D. SENGILLO

SUNY Downstate College of Medicine
Class of 2018

ISABELLA T. WU

Tulane University School of Medicine
Class of 2019

VAISHNAVI VAIDYANATHAN

University of Missouri-Kansas City School of Medicine
Class of 2018

IMAGE AND ILLUSTRATION TEAM

ARTEMISA GOGOLLARI, MD

PhD Candidate
University for Health Sciences, Medical Informatics, and Technology,
Austria

MATTHEW HO ZHI GUANG

University College Dublin (MD), Dana Farber Cancer Institute (PhD)
MD/PhD Candidate

VICTOR JOSE MARTINEZ LEON, MD

Central University of Venezuela

AIDA K. SARCON

St. George's University School of Medicine
Class of 2018

RENATA VELAPATIÑO, MD

San Martin de Porres University School of Medicine
Hospitalist, Clinica Internacional

Associate Authors

ANUP CHALISE, MBBS

Nepal Medical College and Teaching Hospital
Class of 2017

CATHY CHEN

University of Mississippi School of Medicine
Class of 2019

MATTHEW S. DELFINER

Resident, Internal Medicine
Temple University Hospital

RICHARD A. GIOVANE, MD

University of Alabama
Department of Family Medicine

JOSEPH G. MONIR

University of Florida College of Medicine
Class of 2018

ALEX MULLEN

University of Mississippi School of Medicine
Class of 2019

VASILY OVECHKO

Pirogov Russian National Research Medical University
Class of 2019

ERIKA J. PARISI

Frank H. Netter MD School of Medicine at Quinnipiac University
Class of 2018

JOHN POWER

Icahn School of Medicine at Mount Sinai
Class of 2018

MIGUEL ROVIRA

University of Michigan Medical School
Class of 2018

IMAGE AND ILLUSTRATION TEAM

BENJAMIN F. COMORA

Alabama College of Osteopathic Medicine
DO/MBA Candidate

NAKEYA KHOZEMA DEWASWALA, MBBS

Lokmanya Tilak Municipal Medical College
Class of 2016

ANTONIO N. YAGHY, MD

University of Balamand School of Medicine

Faculty Advisors

MEESHA AHUJA, MD

Psychiatrist
Rhode Island Hospital

DIANA ALBA, MD

Clinical Instructor
University of California, San Francisco

MARK A.W. ANDREWS, PhD

Lake Erie College of Osteopathic Medicine at Seton Hill
Greensburg, Pennsylvania

MARIA ANTONELLI, MD

Assistant Professor, Division of Rheumatology
MetroHealth Medical Center, Case Western Reserve University

HERMAN SINGH BAGGA, MD

Urologist, Allegheny Health Network
University of Pittsburgh Medical Center, Passavant

SHIN C. BEH, MD

Assistant Professor, Department of Neurology & Neurotherapeutics
UT Southwestern Medical Center at Dallas

PAULETTE BERND, PhD

Professor, Department of Pathology and Cell Biology
Columbia University College of Physicians and Surgeons

ANISH BHATT, MD

Clinical Fellow
University of California, San Francisco

SHELDON CAMPBELL, MD, PhD

Professor of Laboratory Medicine
Yale School of Medicine

BROOKS D. CASH, MD

Professor of Medicine, Division of Gastroenterology
University of South Alabama School of Medicine

SHIVANI VERMA CHMURA, MD

Adjunct Clinical Faculty, Department of Psychiatry
Stanford University School of Medicine

JAIMINI CHAUHAN-JAMES, MD

Psychiatrist
NYC Health + Hospitals

PETER V. CHIN-HONG, MD

Professor, Department of Medicine
University of California, San Francisco School of Medicine

BRADLEY COLE, MD

Assistant Professor
Loma Linda University School of Medicine

LINDA S. COSTANZO, PhD

Professor, Physiology & Biophysics
Virginia Commonwealth University School of Medicine

ANTHONY L. DeFRANCO, PhD

Professor, Department of Microbiology and Immunology
University of California, San Francisco School of Medicine

CHARLES S. DELA CRUZ, MD, PhD

Associate Professor, Department of Pulmonary and Critical Care Medicine
Yale School of Medicine

CONRAD FISCHER, MD

Associate Professor, Medicine, Physiology, and Pharmacology
Touro College of Medicine

JEFFREY J. GOLD, MD

Associate Professor, Department of Neurology
Assistant Professor, University of California, San Diego School of Medicine

RAYUDU GOPALAKRISHNA, PhD

Associate Professor, Department of Integrative Anatomical Sciences
Keck School of Medicine of University of Southern California

RYAN C.W. HALL, MD

Assistant Professor, Department of Psychiatry
University of South Florida

LOUISE HAWLEY, PhD

Immediate Past Professor and Chair, Department of Microbiology
Ross University School of Medicine

JEFFREY W. HOFMANN, MD, PhD

Resident, Department of Pathology
University of California, San Francisco School of Medicine

BRIAN C. JENSEN, MD

Assistant Professor of Medicine and Pharmacology
University of North Carolina Health Care

CLARK KEBODEAUX, PharmD

Clinical Assistant Professor, Pharmacy Practice and Science
University of Kentucky College of Pharmacy

MICHAEL R. KING, MD

Instructor, Department of Pediatric Anesthesiology
Northwestern University Feinberg School of Medicine

THOMAS KOSZTOWSKI, MD

Spine Instructor
The Warren Alpert Medical School of Brown University

KRISTINE KRAFTS, MD

Assistant Professor, Department of Basic Sciences
University of Minnesota School of Medicine

GERALD LEE, MD

Assistant Professor, Departments of Pediatrics and Medicine
Emory University School of Medicine

KACHIU C. LEE, MD, MPH

Assistant Clinical Professor, Department of Dermatology
Brown University, Providence, Rhode Island

WARREN LEVINSON, MD, PhD

Professor, Department of Microbiology and Immunology
University of California, San Francisco School of Medicine

PETER MARKS, MD, PhD

Center for Biologics Evaluation and Research
US Food and Drug Administration

J. RYAN MARTIN, MD

Assistant Professor of Obstetrics, Gynecology, and Reproductive Sciences
Yale School of Medicine

DOUGLAS A. MATA, MD, MPH

Brigham Education Institute and Brigham and Women's Hospital
Harvard Medical School

SOROUSH RAIS-BAHRAMI, MD

Assistant Professor, Departments of Urology and Radiology
University of Alabama at Birmingham School of Medicine

SASAN SAKIANI, MD

Fellow, Transplant Hepatology
Cleveland Clinic

ROBERT A. SASSO, MD

Professor of Clinical Medicine
Ross University School of Medicine

MELANIE SCHORR, MD

Assistant in Medicine
Massachusetts General Hospital

NATHAN W. SKELLEY, MD

Assistant Professor, Department of Orthopaedic Surgery
University of Missouri, The Missouri Orthopaedic Institute

SHEENA STANARD, MD, MHS

Assistant Professor, Department of Obstetrics and Gynecology
University of Rochester School of Medicine and Dentistry

HOWARD M. STEINMAN, PhD

Assistant Dean, Biomedical Science Education
Albert Einstein College of Medicine

MARY STEINMANN, MD

Assistant Professor, Department of Psychiatry
University of Utah School of Medicine

RICHARD P. USATINE, MD

Professor, Dermatology and Cutaneous Surgery
University of Texas Health Science Center San Antonio

PRASHANT VAISHNAVA, MD

Assistant Professor, Department of Medicine
Mount Sinai Hospital and Icahn School of Medicine

J. MATTHEW VELKEY, PhD

Assistant Dean, Basic Science Education
Duke University School of Medicine

BRIAN WALCOTT, MD

Clinical Instructor, Department of Neurological Surgery
University of California, San Francisco

TISHA WANG, MD

Associate Clinical Professor, Department of Medicine
David Geffen School of Medicine at UCLA

SYLVIA WASSERTHEIL-SMOLLER, PhD

Professor Emerita, Department of Epidemiology and Population Health
Albert Einstein College of Medicine

ADAM WEINSTEIN, MD

Assistant Professor, Pediatric Nephrology and Medical Education
Geisel School of Medicine at Dartmouth

ABHISHEK YADAV, MBBS, MSc

Associate Professor of Anatomy
Geisinger Commonwealth School of Medicine

KRISTAL YOUNG, MD

Clinical Instructor, Department of Cardiology
Huntington Hospital, Pasadena, California

Preface

With the 28th edition of *First Aid for the USMLE Step 1*, we continue our commitment to providing students with the most useful and up-to-date preparation guide for the USMLE Step 1. This edition represents an outstanding revision in many ways, including:

- 35 entirely new high-yield topics reflecting evolving trends in the USMLE Step 1.
- Extensive text revisions, new mnemonics, clarifications, and corrections curated by a team of more than 40 medical student and resident physician authors who excelled on their Step 1 examinations and verified by a team of expert faculty advisors and nationally recognized USMLE instructors.
- A new section on learning and memory science in Section I, Guide to Efficient Exam Preparation.
- Updated with 35+ new full-color photos to help visualize various disorders, descriptive findings, and basic science concepts. Additionally, revised imaging photos have been labeled and optimized to show both normal anatomy and pathologic findings.
- Updated study tips on the opening page of each chapter.
- Improved integration of clinical images and illustrations to better reinforce and learn key anatomic concepts.
- Improved organization of text, figures, and tables throughout for quick review of high-yield topics.
- Updated with 50+ new and revised diagrams and illustrations as part of our ongoing collaboration with USMLE-Rx (MedIQ Learning, LLC).
- Reorganized Rapid Review section to present high-yield concepts by topic and with page numbers to the corresponding text.
- Revitalized coverage of current, high-yield print and digital resources in Section IV with clearer explanations of their relevance to USMLE Step 1 review.
- Real-time Step 1 updates and corrections can be found exclusively on our blog, www.firstaidteam.com.

We invite students and faculty to share their thoughts and ideas to help us continually improve *First Aid for the USMLE Step 1* through our blog and collaborative editorial platform. (See How to Contribute, p. xvii.)

<i>Louisville</i>	Tao Le
<i>Boracay</i>	Vikas Bhushan
<i>St. Louis</i>	Matthew Sochat
<i>New York City</i>	Yash Chavda
<i>Ann Arbor</i>	Andrew Zureick
<i>Pittsburgh</i>	Mehboob Kalani
<i>San Francisco</i>	Kimberly Kallianos

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<i>Louisville</i>	Tao Le
<i>Boracay</i>	Vikas Bhushan
<i>St. Louis</i>	Matthew Sochat
<i>New York City</i>	Yash Chavda
<i>Ann Arbor</i>	Andrew Zureick
<i>Pittsburgh</i>	Mehboob Kalani
<i>San Francisco</i>	Kimberly Kallianos

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Each year we are fortunate to receive the input of thousands of medical students and graduates who provide new material, clarifications, and potential corrections through our website and our collaborative editing platform. This has been a tremendous help in clarifying difficult concepts, correcting errata from the previous edition, and minimizing new errata during the revision of the current edition. This reflects our long-standing vision of a true, student-to-student publication. We have done our best to thank each person individually below, but we recognize that errors and omissions are likely. Therefore, we will post an updated list of acknowledgments at our website, www.firstaidteam.com/bonus/. We will gladly make corrections if they are brought to our attention.

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How to Contribute

This version of *First Aid for the USMLE Step 1* incorporates thousands of contributions and improvements suggested by student and faculty advisors. We invite you to participate in this process. Please send us your suggestions for:

- Study and test-taking strategies for the USMLE Step 1
- New facts, mnemonics, diagrams, and clinical images
- High-yield topics that may appear on future Step 1 exams
- Personal ratings and comments on review books, question banks, apps, videos, and courses

For each new entry incorporated into the next edition, you will receive up to a **\$20 Amazon.com gift card** as well as personal acknowledgment in the next edition. Significant contributions will be compensated at the discretion of the authors. Also, let us know about material in this edition that you feel is low yield and should be deleted.

All submissions including potential errata should ideally be supported with hyperlinks to a dynamically updated Web resource such as UpToDate, AccessMedicine, and ClinicalKey.

We welcome potential errata on grammar and style if the change improves readability. Please note that *First Aid* style is somewhat unique; for example, we have fully adopted the *AMA Manual of Style* recommendations on eponyms (“We recommend that the possessive form be omitted in eponymous terms”) and on abbreviations (no periods with eg, ie, etc).

The preferred way to submit new entries, clarifications, mnemonics, or potential corrections with a valid, authoritative reference is via our website: **www.firstaidteam.com**.

This website will be continuously updated with validated errata, new high-yield content, and a new online platform to contribute suggestions, mnemonics, diagrams, clinical images, and potential errata.

Alternatively, you can email us at: **firstaidteam@yahoo.com**.

Contributions submitted by **May 15, 2018**, receive priority consideration for the 2019 edition of *First Aid for the USMLE Step 1*. We thank you for taking the time to share your experience and apologize in advance that we cannot individually respond to all contributors as we receive thousands of contributions each year.

▶ NOTE TO CONTRIBUTORS

All contributions become property of the authors and are subject to editing and reviewing. Please verify all data and spellings carefully. Contributions should be supported by at least two high-quality references.

Check our website first to avoid duplicate submissions. In the event that similar or duplicate entries are received, only the first complete entry received with valid, authoritative references will be credited. Please follow the style, punctuation, and format of this edition as much as possible.

▶ JOIN THE FIRST AID TEAM

The *First Aid* author team is pleased to offer part-time and full-time paid internships in medical education and publishing to motivated medical students and physicians. Internships range from a few months (eg, a summer) up to a full year. Participants will have an opportunity to author, edit, and earn academic credit on a wide variety of projects, including the popular *First Aid* series.

For 2018, we are actively seeking passionate medical students and graduates with a specific interest in improving our medical illustrations, expanding our database of medical photographs, and developing the software that supports our crowdsourcing platform. We welcome people with prior experience and talent in these areas. Relevant skills include clinical imaging, digital photography, digital asset management, information design, medical illustration, graphic design, and software development.

Please email us at firstaidteam@yahoo.com with a CV and summary of your interest or sample work.

How to Use This Book

CONGRATULATIONS: You now possess the book that has guided nearly two million students to USMLE success for over 25 years. With appropriate care, the binding should last the useful life of the book. Keep in mind that putting excessive flattening pressure on any binding will accelerate its failure. If you purchased a book that you believe is defective, please **immediately** return it to the place of purchase. If you encounter ongoing issues, you can also contact Customer Service at our publisher, McGraw-Hill Education, at <https://www.mheducation.com/contact.html>.

START EARLY: Use this book as early as possible while learning the basic medical sciences. The first semester of your first year is not too early! Devise a study plan by reading Section I: Guide to Efficient Exam Preparation, and make an early decision on resources to use by checking Section IV: Top-Rated Review Resources. Note that *First Aid* is neither a textbook nor a comprehensive review book, and it is not a panacea for inadequate preparation.

CONSIDER *FIRST AID* YOUR ANNOTATION HUB: Annotate material from other resources, such as class notes or comprehensive textbooks, into your book. This will keep all the high-yield information you need in one place. Other tips on keeping yourself organized:

- For best results, use fine-tipped ballpoint pens (eg, BIC Pro+, Uni-Ball Jetstream Sports, Pilot Drawing Pen, Zebra F-301). If you like gel pens, try Pentel Slicci, and for markers that dry almost immediately, consider Staedtler Triplus Fineliner, Pilot Drawing Pen, and Sharpies.
- Consider using pens with different colors of ink to indicate different sources of information (eg, blue for USMLE-Rx Step 1 Qmax, green for UWorld Step 1 Qbank).
- Choose highlighters that are bright and dry quickly to minimize smudging and bleeding through the page (eg, Tombow Kei Coat, Sharpie Gel).
- Many students de-spine their book and get it 3-hole-punched. This will allow you to insert materials from other sources, including curricular materials.

INTEGRATE STUDY WITH CASES, FLASH CARDS, AND QUESTIONS: To broaden your learning strategy, consider integrating your *First Aid* study with case-based reviews (eg, *First Aid Cases for the USMLE Step 1*), flash cards (eg, First Aid Flash Facts), and practice questions (eg, the USMLE-Rx Step 1 Qmax). Read the chapter in the book, then test your comprehension by using cases, flash cards, and questions that cover the same topics. Maintain access to more comprehensive resources (eg, *First Aid for the Basic Sciences: General Principles and Organ Systems* and First Aid Express videos) for deeper review as needed.

PRIME YOUR MEMORY: Return to your annotated Sections II and III several days before taking the USMLE Step 1. The book can serve as a useful way of retaining key associations and keeping high-yield facts fresh in your memory just prior to the exam. The Rapid Review section includes high-yield topics to help guide your studying.

CONTRIBUTE TO *FIRST AID*: Reviewing the book immediately after your exam can help us improve the next edition. Decide what was truly high and low yield and send us your comments. Feel free to send us scanned images from your annotated *First Aid* book as additional support. Of course, always remember that **all examinees are under agreement with the NBME to not disclose the specific details of copyrighted test material.**

Selected USMLE Laboratory Values

* = Included in the Biochemical Profile (SMA-12)

Blood, Plasma, Serum	Reference Range	SI Reference Intervals
* Alanine aminotransferase (ALT, GPT at 30°C)	8–20 U/L	8–20 U/L
Amylase, serum	25–125 U/L	25–125 U/L
* Aspartate aminotransferase (AST, GOT at 30°C)	8–20 U/L	8–20 U/L
Bilirubin, serum (adult)		
Total // Direct	0.1–1.0 mg/dL // 0.0–0.3 mg/dL	2–17 μmol/L // 0–5 μmol/L
* Calcium, serum (Total)	8.4–10.2 mg/dL	2.1–2.8 mmol/L
* Cholesterol, serum (Total)	Rec: < 200 mg/dL	< 5.2 mmol/L
* Creatinine, serum (Total)	0.6–1.2 mg/dL	53–106 μmol/L
Electrolytes, serum		
Sodium (Na ⁺)	136–145 mEq/L	136–145 mmol/L
Chloride (Cl ⁻)	95–105 mEq/L	95–105 mmol/L
* Potassium (K ⁺)	3.5–5.0 mEq/L	3.5–5.0 mmol/L
Bicarbonate (HCO ³⁻)	22–28 mEq/L	22–28 mmol/L
Magnesium (Mg ²⁺)	1.5–2 mEq/L	0.75–1.0 mmol/L
Gases, arterial blood (room air)		
P _{O₂}	75–105 mm Hg	10.0–14.0 kPa
P _{CO₂}	33–45 mm Hg	4.4–5.9 kPa
pH	7.35–7.45	[H ⁺] 36–44 nmol/L
* Glucose, serum	Fasting: 70–110 mg/dL 2-h postprandial: < 120 mg/dL	3.8–6.1 mmol/L < 6.6 mmol/L
Growth hormone – arginine stimulation	Fasting: < 5 ng/mL provocative stimuli: > 7 ng/mL	< 5 μg/L > 7 μg/L
Osmolality, serum	275–295 mOsm/kg	275–295 mOsm/kg
* Phosphatase (alkaline), serum (p-NPP at 30°C)	20–70 U/L	20–70 U/L
* Phosphorus (inorganic), serum	3.0–4.5 mg/dL	1.0–1.5 mmol/L
Prolactin, serum (hPRL)	< 20 ng/mL	< 20 μg/L
* Proteins, serum		
Total (recumbent)	6.0–7.8 g/dL	60–78 g/L
Albumin	3.5–5.5 g/dL	35–55 g/L
Globulins	2.3–3.5 g/dL	23–35 g/L
* Urea nitrogen, serum (BUN)	7–18 mg/dL	1.2–3.0 mmol/L
* Uric acid, serum	3.0–8.2 mg/dL	0.18–0.48 mmol/L

(continues)

Cerebrospinal Fluid	Reference Range	SI Reference Intervals
Glucose	40–70 mg/dL	2.2–3.9 mmol/L
Hematologic		
Erythrocyte count	Male: 4.3–5.9 million/mm ³ Female: 3.5–5.5 million/mm ³	4.3–5.9 × 10 ¹² /L 3.5–5.5 × 10 ¹² /L
Erythrocyte sedimentation rate (Westergen)	Male: 0–15 mm/h Female: 0–20 mm/h	0–15 mm/h 0–20 mm/h
Hematocrit	Male: 41–53% Female: 36–46%	0.41–0.53 0.36–0.46
Hemoglobin, blood	Male: 13.5–17.5 g/dL Female: 12.0–16.0 g/dL	2.09–2.71 mmol/L 1.86–2.48 mmol/L
Hemoglobin, plasma	1–4 mg/dL	0.16–0.62 μmol/L
Leukocyte count and differential		
Leukocyte count	4,500–11,000/mm ³	4.5–11.0 × 10 ⁹ /L
Segmented neutrophils	54–62%	0.54–0.62
Band forms	3–5%	0.03–0.05
Eosinophils	1–3%	0.01–0.03
Basophils	0–0.75%	0–0.0075
Lymphocytes	25–33%	0.25–0.33
Monocytes	3–7%	0.03–0.07
Mean corpuscular hemoglobin	25.4–34.6 pg/cell	0.39–0.54 fmol/cell
Mean corpuscular volume	80–100 μm ³	80–100 fL
Partial thromboplastin time (activated)	25–40 seconds	25–40 seconds
Platelet count	150,000–400,000/mm ³	150–400 × 10 ⁹ /L
Prothrombin time	11–15 seconds	11–15 seconds
Reticulocyte count	0.5–1.5% of red cells	0.005–0.015
Sweat		
Chloride	0–35 mmol/L	0–35 mmol/L
Urine		
Creatine clearance	Male: 97–137 mL/min Female: 88–128 mL/min	
Osmolality	50–1,400 mOsmol/kg H ₂ O	
Proteins, total	< 150 mg/24 h	< 0.15 g/24 h

First Aid Checklist for the USMLE Step 1

This is an example of how you might use the information in Section I to prepare for the USMLE Step 1. Refer to corresponding topics in Section I for more details.

Years Prior

- Select top-rated review resources as study guides for first-year medical school courses.
- Ask for advice from those who have recently taken the USMLE Step 1.

Months Prior

- Review computer test format and registration information.
- Register six months in advance. Carefully verify name and address printed on scheduling permit. Call Prometric or go online for test date ASAP.
- Define goals for the USMLE Step 1 (eg, comfortably pass, beat the mean, ace the test).
- Set up a realistic timeline for study. Cover less crammable subjects first. Review subject-by-subject emphasis and clinical vignette format.
- Simulate the USMLE Step 1 to pinpoint strengths and weaknesses in knowledge and test-taking skills.
- Evaluate and choose study methods and materials (eg, review books, question banks).

Weeks Prior

- Simulate the USMLE Step 1 again. Assess how close you are to your goal.
- Pinpoint remaining weaknesses. Stay healthy (exercise, sleep).
- Verify information on admission ticket (eg, location, date).

One Week Prior

- Remember comfort measures (loose clothing, earplugs, etc).
- Work out test site logistics such as location, transportation, parking, and lunch.
- Call Prometric and confirm your exam appointment.

One Day Prior

- Relax.
- Lightly review short-term material if necessary. Skim high-yield facts.
- Get a good night's sleep.
- Make sure the name printed on your photo ID appears EXACTLY the same as the name printed on your scheduling permit.

Day of Exam

- Relax. Eat breakfast. Minimize bathroom breaks during the exam by avoiding excessive morning caffeine.
- Analyze and make adjustments in test-taking technique.

After the Exam

- Celebrate, regardless.
- Send feedback to us on our website at www.firstaidteam.com.

Guide to Efficient Exam Preparation

“I don’t love studying. I hate studying. I like learning. Learning is beautiful.”

—Natalie Portman

“Finally, from so little sleeping and so much reading, his brain dried up and he went completely out of his mind.”

—Miguel de Cervantes Saavedra, *Don Quixote*

“Sometimes the questions are complicated and the answers are simple.”

—Dr. Seuss

“He who knows all the answers has not been asked all the questions.”

—Confucius

“It’s what you learn after you know it all that counts.”

—John Wooden

“A goal without a plan is just a wish.”

—Antoine de Saint-Exupéry

“I was gratified to be able to answer promptly, and I did. I said I didn’t know.”

—Mark Twain

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▶ INTRODUCTION

Relax.

This section is intended to make your exam preparation easier, not harder. Our goal is to reduce your level of anxiety and help you make the most of your efforts by helping you understand more about the United States Medical Licensing Examination, Step 1 (USMLE Step 1). As a medical student, you are no doubt familiar with taking standardized examinations and quickly absorbing large amounts of material. When you first confront the USMLE Step 1, however, you may find it all too easy to become sidetracked from your goal of studying with maximal effectiveness. Common mistakes that students make when studying for Step 1 include the following:

- Starting to study (including *First Aid*) too late
- Starting to study intensely too early and burning out
- Starting to prepare for boards before creating a knowledge foundation
- Using inefficient or inappropriate study methods
- Buying the wrong resources or buying too many resources
- Buying only one publisher's review series for all subjects
- Not using practice examinations to maximum benefit
- Not understanding how scoring is performed or what the score means
- Not using review books along with your classes
- Not analyzing and improving your test-taking strategies
- Getting bogged down by reviewing difficult topics excessively
- Studying material that is rarely tested on the USMLE Step 1
- Failing to master certain high-yield subjects owing to overconfidence
- Using *First Aid* as your sole study resource
- Trying to prepare for it all alone

▶ *The test at a glance:*

- 8-hour exam
- Up to a total of 280 multiple choice items
- 7 test blocks (60 min/block)
- Up to 40 test items per block
- 45 minutes of break time, plus another 15 if you skip the tutorial

In this section, we offer advice to help you avoid these pitfalls and be more productive in your studies.

▶ USMLE STEP 1—THE BASICS

The USMLE Step 1 is the first of three examinations that you must pass in order to become a licensed physician in the United States. The USMLE is a joint endeavor of the National Board of Medical Examiners (NBME) and the Federation of State Medical Boards (FSMB). The USMLE serves as the single examination system for US medical students and international medical graduates (IMGs) seeking medical licensure in the United States.

The Step 1 exam includes test items drawn from the following content areas¹:

DISCIPLINE

Aging
Anatomy
Behavioral Sciences
Biochemistry
Biostatistics and Epidemiology
Genetics
Immunology
Microbiology
Molecular and Cell Biology
Nutrition
Pathology
Pharmacology
Physiology

ORGAN SYSTEM

Behavioral Health & Nervous
Systems/Special Senses
Biostatistics & Epidemiology/
Population Health/
Social Sciences
Blood & Lymphoreticular System
Cardiovascular System
Endocrine System
Gastrointestinal System
General Principles of Foundational
Science
Immune System
Multisystem Processes & Disorders
Musculoskeletal, Skin, &
Subcutaneous Tissue
Renal/Urinary System
Reproductive System
Respiratory System

How Is the Computer-Based Test (CBT) Structured?

The CBT Step 1 exam consists of one “optional” tutorial/simulation block and seven “real” question blocks of up to 40 questions per block with no more than 280 questions in total, timed at 60 minutes per block. A short 11-question survey follows the last question block. The computer begins the survey with a prompt to proceed to the next block of questions.

Once an examinee finishes a particular question block on the CBT, he or she must click on a screen icon to continue to the next block. Examinees **cannot** go back and change their answers to questions from any previously completed block. However, changing answers is allowed **within** a block of questions as long as the block has not been ended and if time permits.

What Is the CBT Like?

Given the unique environment of the CBT, it's important that you become familiar ahead of time with what your test-day conditions will be like. In fact, you can easily add up to 15 minutes to your break time! This is because the 15-minute tutorial offered on exam day may be skipped if you are already familiar with the exam procedures and the testing interface. The 15 minutes is then added to your allotted break time of 45 minutes for a total of 1 hour of potential break time. You can download the tutorial from the USMLE website and do it before test day. This tutorial interface is very similar to the one you will use in the exam; learn it now and you can skip taking it during the exam, giving you up to 15 extra minutes of break time. You can also gain experience

► *If you know the format, you can skip the tutorial and add up to 15 minutes to your break time!*

with the CBT format by taking the 120 practice questions (3 blocks with 40 questions each) available online or by signing up for a practice session at a test center.

For security reasons, examinees are not allowed to bring any personal electronic equipment into the testing area. This includes both digital and analog watches, iPods, tablets, calculators, cell phones, and electronic paging devices. Examinees are also prohibited from carrying in their books, notes, pens/pencils, and scratch paper. Food and beverages are also prohibited in the testing area. The testing centers are monitored by audio and video surveillance equipment. However, most testing centers allot each examinee a small locker outside the testing area in which he or she can store snacks, beverages, and personal items.

Questions are typically presented in multiple choice format, with 4–5 possible answer options. There is a countdown timer on the lower left corner of the screen as well. There is also a button that allows the examinee to mark a question for review. If a given question happens to be longer than the screen (which occurs very rarely), a scroll bar will appear on the right, allowing the examinee to see the rest of the question. Regardless of whether the examinee clicks on an answer choice or leaves it blank, he or she must click the “Next” button to advance to the next question.

The USMLE features a small number of media clips in the form of audio and/or video. There may even be a question with a multimedia heart sound simulation. In these questions, a digital image of a torso appears on the screen, and the examinee directs a digital stethoscope to various auscultation points to listen for heart and breath sounds. The USMLE orientation materials include several practice questions in these formats. During the exam tutorial, examinees are given an opportunity to ensure that both the audio headphones and the volume are functioning properly. If you are already familiar with the tutorial and planning on skipping it, first skip ahead to the section where you can test your headphones. After you are sure the headphones are working properly, proceed to the exam.

The examinee can call up a window displaying normal laboratory values. In order to do so, he or she must click the “Lab” icon on the top part of the screen. Afterward, the examinee will have the option to choose between “Blood,” “Cerebrospinal,” “Hematologic,” or “Sweat and Urine.” The normal values screen may obscure the question if it is expanded. The examinee may have to scroll down to search for the needed lab values. You might want to memorize some common lab values so you spend less time on questions that require you to analyze these.

The CBT interface provides a running list of questions on the left part of the screen at all times. The software also permits examinees to highlight or cross out information by using their mouse. There is a “Notes” icon on the top part of the screen that allows students to write notes to themselves for review at a later time. Finally, the USMLE has recently added new functionality including text magnification and reverse color (white text on black background). Being

▶ **Keyboard shortcuts:**

- *A, B, etc—letter choices*
- *Enter or spacebar—move to next question*
- *Esc—exit pop-up Lab and Exhibit windows*
- *Alt-T—countdown timers for current session and overall test*

▶ **Heart sounds are tested via media questions.**

Make sure you know how different heart diseases sound on auscultation.

▶ **Be sure to test your headphones during the tutorial.**

▶ **Familiarize yourself with the commonly tested lab values (eg, Hgb, WBC, platelets, Na⁺, K⁺).**

▶ **Illustrations on the test include:**

- *Gross specimen photos*
- *Histology slides*
- *Medical imaging (eg, x-ray, CT, MRI)*
- *Electron micrographs*
- *Line drawings*