

# **PEARLS FOR PRIMARY CARE**



# **PEARLS FOR PRIMARY CARE**

Integrating Biochemistry,  
Physiology and Clinical Skills  
to Optimize Outpatient Medicine

**Michael B. Jacobs, MD, PhD**  
**Board-Certified Internal Medicine**



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*Pearls for Primary Care:  
Integrating Biochemistry, Physiology, and Clinical Skills  
to Optimize Outpatient Medicine*

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上医医未病之病  
中医医将病之病  
下医医已病之病

—黄帝内经—

**SUPERIOR DOCTORS PREVENT DISEASE.**

**MEDIOCRE DOCTORS TREAT THE DISEASE BEFORE EVIDENT.**

**INFERIOR DOCTORS TREAT THE FULL BLOWN DISEASE.**

—Huang Dee: Nai-Ching  
(2600 BC:FIRST CHINESE MEDICAL TEXT).

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# ABOUT THE AUTHOR

**M**ichael B. Jacobs, MD, PhD, has an eclectic background. Before returning for post-graduate education in 1973, he had earlier experiences as a newspaper writer, high-school teacher and coach, and professional baseball player in the Detroit Tigers organization.

Dr. Jacobs completed his PhD in 1976 at the University of Toledo, Ohio, with a dissertation, *Antagonist EMG Temporal Patterns During Rapid Voluntary Movement*, which was published in the journal, *Neurology*, in January 1980. He then taught at the Universities of Utah and Texas before returning to medical school at the Medical College of Ohio at Toledo.

After completing his medical school education and residency in Internal Medicine in 1990, he practiced in Jacksonville, Florida, for 11 years while also having a concierge practice in New York City.

He currently has a private practice complemented by clinical research, medical-school teaching, and preceptorships for APRNs, PAs, and medical students in Las Vegas, Nevada, and NYC.

He is an assistant professor at Touro University Nevada and board-certified in Internal Medicine. His previous book, *Demystifying Medicine: A Guide for Adult Patients*, was published in 2010.





# ACKNOWLEDGMENTS

Interactions over the years with patients, students, and colleagues inspired this book. Also, my quest to be a better physician has motivated me to improve my knowledge base and impart accurate information to patients and students.

One of my professional charges is to educate patients and students to optimize care; hopefully, insights in this book will allow others to follow this precept. My medical training, continual study, and interactions with patients have accumulated knowledge acquisition for over 30 years. In addition, I am currently engaged in teaching of APRNs, PAs, and medical students/residents.

Special thanks to my Wellness Medical Group partner and former student, Abegail Concon, who has motivated me to think “outside the box” and aided the editing process with Michelle Trier.

Acknowledgments also to Spats, who helped me claw through this project.



This book was written during the 2020-2021 pandemic and reinforced the importance of science to advance medical progress and prevent future quarantines.

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Jim Severson



# PREFACE

As a practicing internist and teacher for over 30 years, I have recognized a chasm between information in standard textbooks and the reality of outpatient practice. Unfortunately, various diagnostic algorithms are not practical, as the tests are not easily obtainable in an outpatient setting. For example, how many arterial blood gases are completed as an outpatient?

Over my career, I have developed techniques and approaches that can aid the outpatient provider—physician, APRN, or PA—to be more efficient and effective. In this book, I have attempted to augment the providers' basic knowledge of diseases with additional insights to improve the patient-provider relationship.

This resource is not intended as a comprehensive overview of diseases and pathophysiology but presents practical approaches to common presentations in outpatient primary care.

I have attempted to supplement the information with pertinent physiological and biochemical precepts, allowing the provider to understand concepts that may aid in educating and treating patients. The education of patients is crucial.

Many of society's health issues can be mitigated if patients appreciate, understand, and follow healthy principles. Therefore, providers are vitally crucial in imparting sound and understandable knowledge.

It has been my experience that most patients appreciate the information more when supplemented with scientific principles. Unfortunately, there is a plethora of misinformation in the media about health, vitamins, supplements, and it is the primary care providers' role to be the arbiter. This book should improve interactions with patients and complement previous education and training.

Initially, all providers should appreciate and incorporate basic biochemical and physiological principles to improve their practice and the education of patients. Thus, **Part One** presents this information. However, it has been my experience that providers do not optimally utilize their biochemistry and physiology knowledge to make efficient decisions.

Providers can obtain crucial information by assessing a patient's vital signs and electrolytes, presented in the beginning chapters. However, there is no attempt to replicate the providers' information base but augment and synthesize this knowledge with additional insights (**PEARLS**).

**Part Two** introduces approaches for managing common office outpatient presentations. The goal is to improve patient care, prevent potentially unnecessary referrals, and obtain the appropriate information to make referrals more effective.

Using this text as a resource and reference, the provider can acquire more confidence to manage the discussed entities. It is essential for continuity of care and to mitigate healthcare expenses to be selective in utilizing specialists.

Primary care providers need to be a steward of healthcare costs. Likewise, the primary care provider can be a resource for providing facts when multiple conflicting reports are seen in the media.

There will be no attempt to present the various screening and treatment recommendations found in numerous sources. However, all primary care providers should know the current vaccine and screening guidelines.

Providers may be motivated by the information to pursue additional research about the various areas. Further research may indicate novel nuances about the presented information. As I have learned, I cannot master Internal Medicine, but the more I strive to, the better it is for my patients.

Michael B. Jacobs, MD PhD  
Board-Certified Internal Medicine  
December 2021

## **PART ONE**



# INTRODUCTION TO THE BODY

## Water Distribution

The human body has compartments to maintain the minerals and cellular activities in appropriate areas. Water ( $H_2O$ ) is the body's most abundant molecule. The total body water (TBW) accounts for 60 percent of the body weight in men and about 50 percent in women.

As we age, the percentage of fat often increases, decreasing the TBW. Of the total body water, two-thirds is intracellular (ICF) and one-third extracellular (ECE, outside the cell). This ECF includes the interstitial fluid (areas bathing cells) and the blood volume.

The blood volume is about one-quarter of the ECF and accounts for 4-5 liters of the 42 liters of fluid in an average 70-kilogram man (figure 1). The cell membrane acts as a barrier between the ECF and ICF.

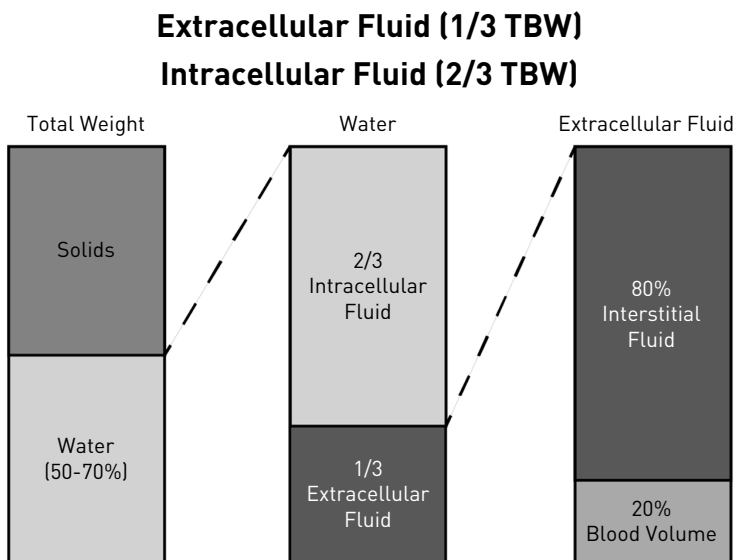


Figure 1

## Extracellular Fluid (ECF)

The blood volume flows through a series of conduits due to the forward push of the heart. Arterial elastic recoil, venous compression by skeletal muscles during movement, and the negative intrathoracic pressure during inspiration aid the movement.

The blood passes through arteries, arterioles, and capillaries where there is equilibrium with interstitial fluid. However, some fluid enters the lymphatics in the interstitium, draining lymph into the venous system. The lymph fluid contains clotting factors and proteins that escape the capillary walls and return to the blood.

The lymph's protein content is usually lower than that of blood. Also, some lipids from the intestine pass directly into lymphatics, and lymph fluid after a meal appears milky because of the high-fat content. Lymphocytes also enter the bloodstream through the lymphatics; additional serum lymphocytes can enlarge lymph nodes.

The capillaries connect with venules; the blood volume drains into the veins and back to the right atrium. The capillaries have one layer of endothelial cells, and some tissues have spaces that permit the passage of small molecules. However, large molecules like proteins are restricted. Vesicular transport (endocytosis), diffusion, and filtration are other mechanisms across the capillary wall.

Oxygen and glucose are in greater concentration in the capillaries, leading to their passage into the interstitial fluid, whereas carbon dioxide diffuses in the opposite direction. Thus, the transfer of oxygen and nutrients from the blood to the tissues occurs exclusively in the capillary beds.

The quantity of fluid in the interstitial spaces depends on the hydrostatic capillary pressure, interstitial pressure, extracellular volume, and oncotic pressure (primarily proteins). Decreased plasma proteins, demonstrated in nephrotic syndrome and cirrhosis, are examples of decreased capillary oncotic pressure control.

Increased interstitial fluid volume leads to edema. In addition, increased venous pressure (heart failure, incompetent venous valves, gravity) can cause edema. The gravity effect is demonstrated by ankle swelling when patients sit for prolonged periods. Therefore, decreasing the dependent position is essential in mitigating edema.

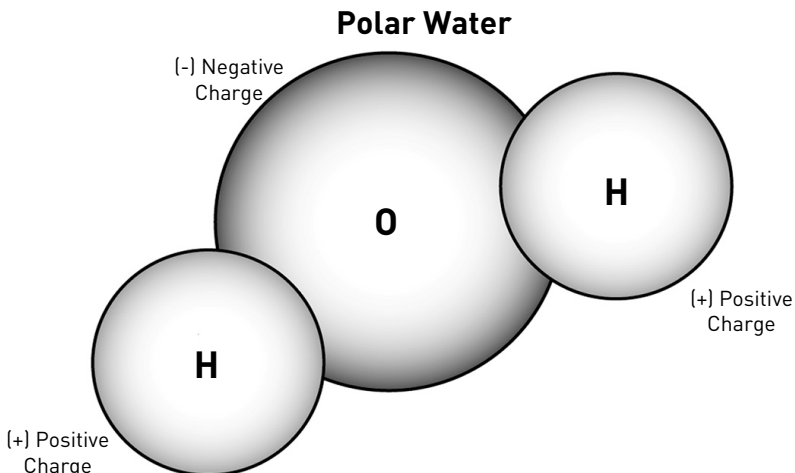


**PEARL:**

- **Water follows increased sodium retention. The combination of salt and water is distributed throughout the ECF, increasing the probability of pitting edema.**
- **Inadequate lymphatic drainage can lead to edema though less than from venous issues. This lymphedema from obstruction of the drainage channels has a higher protein content compared to venous-induced edema.**
- **Chronic edema, either from venous or lymph issues, can result in chronic inflammation with fibrosis in the skin and non-pitting edema when pressing over a bony surface.**
- **Chronic edema can also cause pigmentation changes in the skin, as the breakdown of the heme from hemoglobin releases biliverdin and iron.**
- **The liver processes biliverdin to bilirubin, while tissues store the released iron as hemosiderin. Additionally, iron is stored as ferritin, a soluble form.**

## Water Properties

Liquid water is the basis of life and is irreplaceable. Water is a polar molecule (unequal charges between the ions). This property forces polar molecules placed in water to separate into their ionized components (figure 2).



**Figure 2**