



(NEJM)
Knowledge+ | **AACC**
Learning Lab

FOR LABORATORY MEDICINE

NEJM
Knowledge⁺ | **AACC**
Learning Lab



THE LEADING AUTHORITY IN
LABORATORY MEDICINE



GLOBAL PARTNER IN
EDUCATION TECHNOLOGY



PUBLISHER OF THE
*NEW ENGLAND
JOURNAL OF MEDICINE*

AACC Learning Lab for Laboratory Medicine on NEJM Knowledge+ is an adaptive e-learning product for preparation for certification, competency assessment, and continuing medical education. The program is sectioned into the following six major pillars in Laboratory Medicine*.

1 CLINICAL CHEMISTRY

Covers principles in laboratory medicine, analytical techniques and instrumentation, pathophysiology of various organ systems and the corresponding analytes.

2 MOLECULAR DIAGNOSTICS

Covers principles of molecular biology, nucleic acid techniques and applications, pharmacogenetics, forensic testing, molecular tumor markers, monogenic and polygenic basis for common and rare diseases.

3 TRANSFUSION MEDICINE

Covers testing in the blood bank, transfusion service techniques, indications for transfusion, blood products and modifications, adverse events associated with transfusion of blood products, and transfusion reactions.

4 HEMATOLOGY AND COAGULATION

Covers analytical techniques and instrumentation, hematopoiesis, iron metabolism (including hemoglobin, iron, bilirubin, anemia), red and white blood cell disorders, platelet disorders, porphyrins and porphyrias, hematologic neoplastic disorders, hemostasis and coagulation.

5 MICROBIOLOGY

Covers microbes (bacteriology, mycobacteriology, virology, mycology, parasitology, prions) and associated infectious diseases, anti-infectives, antiparasites, infection control, and diagnostics as well as infection control and disease surveillance.

6 CLINICAL IMMUNOLOGY

Covers primary immunodeficiencies, allergic diseases, organ-specific and systemic autoimmune diseases, and monoclonal gammopathies.

*A listing of the curricula of the six sections is included in the Appendix.

The screenshot displays the 'YOUR SELF-ASSESSMENT DASHBOARD' for Laboratory Medicine. The dashboard shows overall progress at 12%. A dropdown menu is open for 'Clinical Chemistry', listing sub-topics like Transfusion Medicine (100%), Molecular Diagnostics (79%), Hematology and Coagulation (0%), Microbiology (0%), and Clinical Immunology (0%). The main dashboard lists 16 sub-topics with their respective progress bars and percentages.

| Sub-topic | Progress |
|---|----------|
| Clinical Chemistry | 12% |
| Transfusion Medicine | 100% |
| Molecular Diagnostics | 79% |
| Hematology and Coagulation | 0% |
| Microbiology | 0% |
| Clinical Immunology | 0% |
| Thyroid | 31% |
| Tumor markers | 0% |
| Liver disease | 30% |
| Kidney disease | 0% |
| Clinical toxicology, drugs of abuse | 0% |
| Immunochemical techniques | 0% |
| Vitamin D | 0% |
| Vitamins other than vitamin D | 31% |
| Test for diagnosis and management of diabetes | 0% |
| Basic laboratory analytical techniques | 100% |
| Pharmacogenetics | 0% |
| Nucleic acid isolation | 64% |
| Mycobacteriology | 0% |
| Therapeutic drugs and their management II | 0% |

Recharge your learning

NEJM Knowledge+ creates a personalized review program to help you maintain your mastery based on your performance and on how long it has been since you last reviewed content.

[RECHARGE NOW](#)

When completed in 3 years, this program will consist of approximately 120 courses spanning across all disciplines of laboratory medicine thus becoming the *de facto* backbone of all training programs and the main source for providing continuing education credits in the field.

UNIQUENESS OF AACC LEARNING LAB



COLLABORATIVE EFFORT

AACC Learning Lab is a collaborative effort between NEJM Group, the most trusted and respected name in medical science, AACC, a recognized leader in laboratory medicine, and Area9, a global leader in education technology.



ADAPTIVE LEARNING

AACC Learning Lab utilizes adaptive learning. Through a series of questions while timing the learner and asking about the level of confidence in the answer, sophisticated algorithms identify the areas in which the learner is not proficient and provides targeted learning materials.



MICRO LEARNING

AACC Learning Lab enables learning in small blocks of time since most professionals are not always able to find the time needed to read long review articles.



MOBILE

AACC Learning Lab enables learning wherever you are as the program can be accessed on mobile devices.



PEER COMPARISON

AACC Learning Lab allows the learners to monitor their progress and provides comparison to peer groups.



LIFE-LONG LEARNING

AACC Learning Lab is a life-long learning companion.

WHAT IS A COURSE?

Courses for the six sections are based on curricula that are used by experienced and board-certified professionals from the various disciplines in laboratory medicine and approved by the NEJM Knowledge+ group. Each course consists of three separate components: learning objectives, probes, and learning resources.



LEARNING OBJECTIVES

Learning objectives are granular and utilize Bloom's taxonomy. They range in complexity from *describe* or *define* to *deduce* and *analyze*. Each course contains 100-150 learning objectives to cover the topic of interest.



PROBES

There are nine different types of questions to choose from including multiple choice, fill in the blank, matching, and a clinical case. Morphologies, chromatograms, tables, electrophoretic patterns and other images can be used in these questions. There are at least two questions for each learning objective. Based on continuous analyses of how learners are responding, more depth will be developed.



LEARNING RESOURCES

They provide explanation for the answer in the form of a video, image, pathway, text (possibly read by a professional reader) and they also include a reference to support the explanation. There is at least one learning resource for each learning objective. Based on continuous analyses of how learners are responding, more depth will be developed where appropriate.

TARGET AUDIENCE



Primary Audience

LABORATORY MEDICINE PROFESSIONALS

Laboratory medicine professionals at all levels (MD, PhD, and MT). Approximately 20% of the courses are defined as easy, 60% intermediate, and 20% difficult.



Secondary Audience

CLINICIANS

Because of the granular nature of each course and the richness of available materials, specific courses targeting clinicians of certain specialties or general practitioners can be constructed from existing courses. For example, NEJM Knowledge+ Internal Medicine Board Review contains one course in endocrinology and another in infectious disease. AACC Learning Lab contains 6 courses in endocrinology and 21 courses in microbiology.



NADER RIFAI, PHD

EDITOR-IN-CHIEF, *CLINICAL CHEMISTRY*
CO-EDITOR, AACC LEARNING LAB

CHRISTINA ELLERVIK, MD, PHD

CO-EDITOR, AACC LEARNING LAB



FACULTY

The program is created under the editorship of
Nader Rifai and Christina Ellervik

Each of the six sections has two editors, with the exception of Clinical Chemistry which has three, and Clinical Immunology which has one. Currently, over 90 practicing professionals, primarily from academia, from the US, UK, Canada, Iceland, Denmark, Norway, Australia, Croatia and Singapore are participating in this project.

CREATION OF A COURSE

After the identification of an author by one of the editors and a 45 minute phone call with Nader Rifai to explain the program and the vision, the following steps take place:

- 1** **OUTLINE**

Author develops a detailed outline of the course for review by editors.
- 2** **TRAINING**

Author is trained on the platform and the writing style.
- 3** **MONITORING**

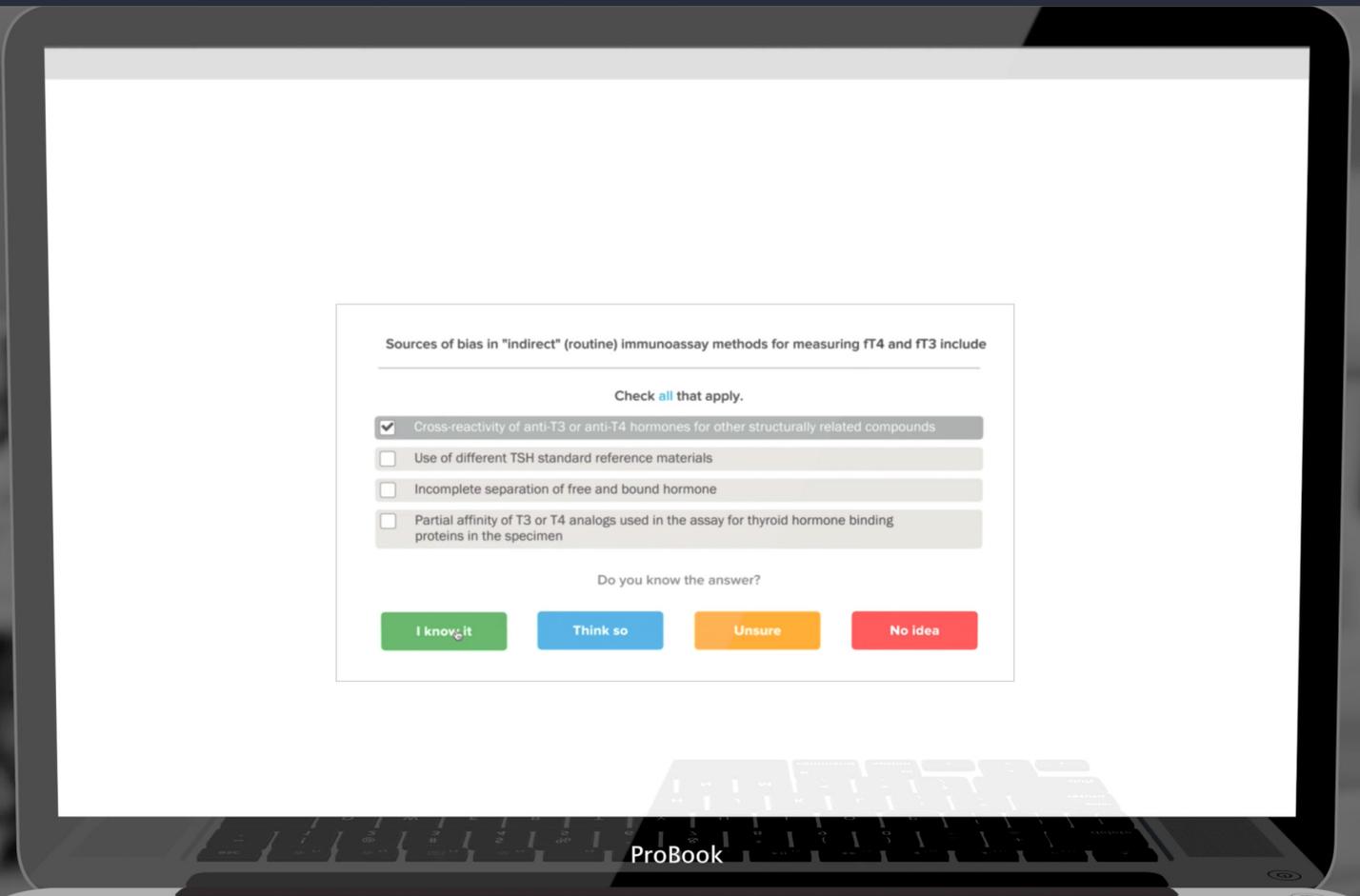
Author's progress is monitored by the Area9 editorial specialist and editors. Approximately 15 one-hour conferences usually take place during the development of a course.
- 4** **REVIEW**

When the course is completed, it is reviewed by the Area9 editorial specialist, the editors involved, and an external reviewer, if needed.
- 5** **BETA TESTING**

After the author responds to the reviewers comments, the course undergoes beta testing by 3-5 individuals.
- 6** **SUBMISSION**

Finally, the course is submitted to NEJM Knowledge+ for review.

It takes about 300 hours to complete a course (4-6 months) by an author. The review process takes approximately 2 months. This program follows the same review process developed for other NEJM Knowledge+ programs.



The Area9 adaptive learning platform is recognized as the most advanced in the world and is used by millions of learners yearly.



UTILITY OF AACC LEARNING LAB

The AACC Learning Lab was built with two major goals:

- To be used by all laboratory medicine professionals
- To be used by laboratory medicine professionals in the three entities:
 - Hospital labs
 - Commercial labs
 - IVD industry

This program is useful in:

- Preparing for certification exams
- Assessing competency on a personal and institutional level

Employers will find the program not only useful in teaching their employees various aspects of laboratory medicine, but also in providing them with an assessment of their employees' knowledge level and competency.
- Maintaining certification by obtaining the required CE and CME credits

Employers may find this program as the most cost effective means for their employees to obtain the desired credits since they will be able to use the program when workload is low or on their own time.
- Staying current in an ever expanding and fast moving field
- Providing a life-long learning companion

APPENDIX

| CLINICAL CHEMISTRY COURSES | |
|---|--|
| Management | Laboratory safety |
| | Laboratory management |
| Variability assessment | Statistical methodologies in laboratory medicine |
| | Biological and preanalytical variability |
| | Quality control of the examination process |
| Analytical principles | Basic laboratory analytical techniques |
| | Chromatography |
| | Mass spectrometry |
| | Proteomics |
| | Immunochemical techniques |
| | Point of care testing |
| | Calculations |
| Proteins | Protein electrophoresis |
| | Serum enzymes |
| | Tumor markers |
| | Amino acids, peptides, and proteins |
| Nutrition | Vitamin D |
| | Vitamins other than vitamin D |
| | Metals: Trace and toxic |
| | Nutrition |
| Therapeutic drugs management and toxicology | Therapeutic drugs and their management I |
| | Therapeutic drugs and their management II |
| | Clinical toxicology: Drugs of abuse |
| | Clinical toxicology: Other than drugs of abuse |
| Body fluids | Body fluids |
| Endocrinology | Bone and mineral metabolism |
| | Catecholamines and serotonin |
| | Pituitary function and pathophysiology |
| | The adrenal cortex |
| | Thyroid |
| | Tests for diagnosis and management of diabetes |
| | Reproductive endocrinology and pregnancy and its disorders |
| Cardiovascular | Lipids and lipoproteins |
| | Cardiac biomarkers |
| Kidney | Kidney disease |
| | Disorders of water, electrolytes and acid-base metabolism |
| Gastroenterology | Liver disease |
| | Exocrine pancreas |
| Newborn screening | Inborn errors of metabolism I |
| | Inborn errors of metabolism II |

HEMATOLOGY AND COAGULATION COURSES

| | |
|----------------------------------|--|
| General | Automated hematology and general approach to the peripheral blood smear |
| | Normal and abnormal peripheral blood and bone marrow morphology |
| | Lymph node pathology: normal, reactive, malignant and metastatic |
| | Spleen and thymus: neglected organs in hematopathology |
| Red cells | Anemia (microcytic/normocytic/macrocyclic and hemolytic/hypoproliferative) |
| | Hemoglobin electrophoresis/HPLC |
| | Hemoglobinopathies, thalassemias, and RBC cytoskeletal and enzyme defects |
| White cells | White blood cell abnormalities (quantitative and qualitative) |
| Hemostasis/coagulation/platelets | Laboratory diagnosis of disorders of bleeding including platelets |
| Coagulation | Laboratory diagnosis of disorders of bleeding and thrombosis including platelets |
| Neoplastic | Acute myeloid leukemia |
| | Myelodysplastic syndromes, myeloproliferative neoplasms, and hybrid disorders |
| | Precursor lymphoid neoplasms (B and T lymphoblastic leukemia/lymphoma) |
| | Mature B-cell neoplasms |
| | Mature T-cell and NK-cell neoplasms |
| | Hodgkin lymphoma |
| | Lymphoproliferative disorders associated with primary and iatrogenic immune deficiency |
| | Histiocytic and dendritic cell disorders (not just neoplasms) |
| Ancillary diagnostic techniques | Flow cytometry immunophenotyping principles and applications to diagnosis, prognosis, therapy and monitoring of leukemias, lymphomas, and primary and acquired immune deficiencies |
| | Cytogenetics and molecular genetics of hematolymphoid disorders, both benign and malignant |

MOLECULAR DIAGNOSTICS COURSES

| | |
|----------------------------------|--|
| Foundational genomics | Principles of molecular biology |
| | Genomes and variants |
| Molecular diagnostics techniques | Nucleic acid isolation |
| | Resolution and detection of nucleic acids (non-sequencing based) |
| | Sequencing-based techniques |
| | Cytogenomics |
| Molecular oncology | Cancer genetics concepts and laboratory testing |
| | Solid tumor genomics |
| | Familial Cancer Syndromes |
| | Genomics of hematopoietic and lymphoid malignancies |
| | Blood-based cancer detection |

MOLECULAR DIAGNOSTICS COURSES CONTINUED

| | |
|-----------------------------|--|
| Genomics | Molecular detection of Mendelian inherited disorders |
| | Non-Mendelian disorders |
| | Mitochondrial genetics |
| | Pharmacogenetics |
| Hereditary disorders | Hereditary pulmonary disorders |
| | Hereditary cardiovascular disorders |
| | Hereditary dermatologic disorders |
| | Hereditary endocrine disorders |
| | Congenital hearing loss |
| | Hereditary hematologic disorders |
| | Hereditary neurologic disorders |
| | Hereditary neuromuscular disorders |
| | Hereditary skeletal disorders |
| | Hereditary renal disorders |
| Immunology | Molecular immunology |
| Prenatal screening | Circulating fetal nucleic acids |
| Human identification | Molecular determination of identity |

MICROBIOLOGY COURSES

| | |
|---|--|
| Infectious diseases and preanalytical considerations | Infectious syndromes |
| | Microbiology specimens |
| Microbiology and antimicrobials | Bacteria |
| | Bacterial diagnostics |
| | Bacterial infections |
| | Antibacterials |
| | Mycobacteria & diagnostics |
| | Mycobacterial infections & antimycobacterials |
| | Viruses |
| | Viral diagnostics |
| | Viral infections & antivirals |
| | Fungi & diagnostics |
| | Fungal infections |
| | Antifungals |
| | Parasites |
| | Parasitic diagnostics |
| | Parasitic infections and antiparasitics |
| Antimicrobial susceptibility | |
| Biosafety and infection surveillance | Biosafety |
| | Infection surveillance |
| Laboratory management | Management of the clinical microbiology laboratory |

TRANSFUSION MEDICINE COURSES

Blood donation

Blood groups and pre-transfusion compatibility testing

Red blood cell transfusion

Platelet transfusion

Plasma components and derivatives

Hemolytic Disease of the fetus and the newborn

Acute transfusion reactions

Therapeutic apheresis

Delayed transfusion reactions

Transfusion support for hematopoietic stem cell and solid organ transplantation

CLINICAL IMMUNOLOGY COURSES

Primary immunodeficiencies

Allergic disease

Organ-specific autoimmune diseases

Systemic autoimmune diseases

Monoclonal gammopathies



[AACC.ORG/LEARNINGLAB](https://aacc.org/learninglab)