Providing excellence in certification of laboratory professionals on behalf of patients worldwide.

A Closer Look at the BOC: Its Examination Committees and the Certification Examination

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Third session in the “A Closer Look at the BOC” series. This session is designed to explain the role of BOC certification exam committees and its exam development processes.

• Describe BOC examination committees.
• Explain the BOC certification exam processes of practice analysis and standard setting
• Describe how to write and review effective exam questions
Examination Committee Overview
Examination Committee Overview

At the heart of the BOC are the Examination Committees and Qualification Work Groups that function to:

• Develop and review certification exams and qualifications
• Ensure the validity of exams through practice analyses
• Set the pass score for exams and qualifications
Examination Committee Composition

Examination Committees and Qualification Work Groups are composed of:

- Technicians
- Technologists
- Laboratory Scientists
- Supervisors
- Educators
- Physicians

These dedicated volunteers are appointed based on their clinical competence, diverse geographic location and facility type and most of all, their desire to improve the profession through credentialing of laboratory professionals.
Examination Committee Composition

Recruitment for membership on an examination committee is based on committee’s vacancy needs for:

• Certification
• Job/Position Title
• Type and size of facility
• Area of Expertise
• Geographic Region
Geographic Distribution
2018 Phlebotomy Exam Committee

Chair
Tyler Anderson, DPT(ASCP)™

Vice Chair
Nicole Prociec, CMA(AAMA), PBT(ASCP)™

Board Liaison
Kathy Finnegan, MS, MT(ASCP) SH™

Laura Fucco, PBT(ASCP)

Lynne Steele, MS, MT(ASCP)

Teii McElhatten, MHA, CLA(ASCP) PBT™

Kourtney Kast, PBT(ASCP)™ DPT™

(C) 2019 ASCP BOC
Examination Committees

- Blood Bank
- Clinical Chemistry
- Cytogenetics
- Cytotechnology
- Cytometry
- Hematology
- Histotechnology
- Joint Generalist
- Laboratory Management
- Medical Laboratory Assistant
- Microbiology
- Molecular Biology
- Pathologists’ Assistants
- Phlebotomy
Exam Committee Responsibilities
Examination Committee Responsibilities

• Maintain item banks
• Utilize Practice Analysis to determine exam content
• Participate in the development and maintenance of item bank questions
• Review and edit item bank content
• Review and develop the exam eligibility requirements, examination content guidelines and reading lists
• Participate in all committee meetings and conference calls
## Committee Exam Responsibilities

<table>
<thead>
<tr>
<th>Exam Committee</th>
<th>Exam Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood Bank</td>
<td>BB, SBB, MLT &amp; MLS Blood Bank</td>
</tr>
<tr>
<td>Chemistry</td>
<td>C, SC, MLT &amp; MLS Chemistry</td>
</tr>
<tr>
<td>Cytogenetics</td>
<td>CG</td>
</tr>
<tr>
<td>Cytotechnology</td>
<td>CT, SCT</td>
</tr>
<tr>
<td>Hematology</td>
<td>H, SH, MLT &amp; MLS Hematology &amp; Urinalysis</td>
</tr>
<tr>
<td>Histotechnology</td>
<td>HT, HTL &amp; QIHC</td>
</tr>
<tr>
<td>Laboratory Management</td>
<td>DLM</td>
</tr>
<tr>
<td>Medical Laboratory Assistant</td>
<td>MLA</td>
</tr>
<tr>
<td>Microbiology</td>
<td>M, SM, MLT &amp; MLS Microbiology</td>
</tr>
<tr>
<td>Molecular Biology</td>
<td>MB, SMB</td>
</tr>
<tr>
<td>Pathologists’ Assistant</td>
<td>PA</td>
</tr>
<tr>
<td>Phlebotomy</td>
<td>PBT, DPT</td>
</tr>
</tbody>
</table>
# MLT & MLS Exam

<table>
<thead>
<tr>
<th>Exam Committee</th>
<th>Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood Bank</td>
<td>MLT &amp; MLS Blood Bank Exam Content</td>
</tr>
<tr>
<td></td>
<td>MLT &amp; MLS Practice Analysis Tasks for Blood Bank</td>
</tr>
<tr>
<td>Chemistry</td>
<td>MLT &amp; MLS Exam Chemistry Content</td>
</tr>
<tr>
<td></td>
<td>MLT &amp; MLS Practice Analysis Tasks for Chemistry</td>
</tr>
<tr>
<td>Hematology</td>
<td>MLT &amp; MLS Hematology &amp; Urinalysis &amp; Body Fluid Content</td>
</tr>
<tr>
<td></td>
<td>MLT &amp; MLS Practice Analysis Tasks for Hematology &amp; Urinalysis &amp; Body Fluid</td>
</tr>
<tr>
<td>Microbiology</td>
<td>MLT &amp; MLS Microbiology Content</td>
</tr>
<tr>
<td></td>
<td>MLT &amp; MLS Practice Analysis Tasks for Microbiology</td>
</tr>
<tr>
<td>Molecular Biology</td>
<td>MLT &amp; MLS Molecular Biology Content</td>
</tr>
<tr>
<td></td>
<td>MLT &amp; MLS Practice Analysis Tasks for Molecular Biology</td>
</tr>
<tr>
<td>Joint Generalist</td>
<td>Review/Edit MLT &amp; MLS Eligibility Routes</td>
</tr>
<tr>
<td></td>
<td>Review MLT &amp; MLS Practice Analysis Results</td>
</tr>
<tr>
<td></td>
<td>Review/Edit MLT &amp; MLS Content Guidelines</td>
</tr>
<tr>
<td></td>
<td>Set Standards for MLT &amp; MLS Exams</td>
</tr>
</tbody>
</table>
Exam Committee Meeting
Exam Committee Meeting Activities

- Review and accept previous meeting minutes
- Reports from the Chair of the Committee, Board Liaison and Executive Director.
- Cost analysis for the exam(s)
- Review/Edit Exam-related Documents:
  - Eligibility Requirements
  - Current Reading List
  - Content Guideline
- Review Examination Statistics
Exam Committee Meeting Activities cont.

- Item Bank review
- Review Goals and Objectives for the next year
- Discuss terms of members and guest needs
- Annual election of Chair and Vice Chair
- Select the next year’s meeting dates
- Item Bank Assignments
- Review/update committee member contact list
Exam & Item Statistics
### MLS 2017 Examination Statistics

Exam Pass Rate = 24501/32432 (75%)
Mean (SD) Scaled Score = 482 (116)
Mean (SD) Measure Mean (SD) = .56 (.77)
Standard Error Measurement = .21

<table>
<thead>
<tr>
<th>Year</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exams Given</td>
<td>3892</td>
<td>4298</td>
<td>4473</td>
<td>4635</td>
<td>4918</td>
<td>5222</td>
<td>4994</td>
</tr>
<tr>
<td>Mean (SD) Measure</td>
<td>.54 (.71)</td>
<td>.53 (.72)</td>
<td>.53 (.72)</td>
<td>.53 (.74)</td>
<td>.54 (.79)</td>
<td>.58 (.80)</td>
<td>.69 (.93)</td>
</tr>
<tr>
<td>Mean (SD) Scaled Score</td>
<td>487 (106)</td>
<td>485 (109)</td>
<td>485 (108)</td>
<td>486 (111)</td>
<td>469 (119)</td>
<td>474 (120)</td>
<td>491 (140)</td>
</tr>
<tr>
<td>Minimum</td>
<td>121</td>
<td>100</td>
<td>101</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Maximum</td>
<td>978</td>
<td>898</td>
<td>867</td>
<td>894</td>
<td>942</td>
<td>938</td>
<td>987</td>
</tr>
<tr>
<td>Total Pass (Pass Rate)</td>
<td>3078 (79%)</td>
<td>3370 (78%)</td>
<td>3504 (78%)</td>
<td>3613 (78%)</td>
<td>3533 (72%)</td>
<td>3784 (73%)</td>
<td>3619 (72%)</td>
</tr>
<tr>
<td>Total Fail (Fail Rate)</td>
<td>814 (21%)</td>
<td>928 (22%)</td>
<td>969 (22%)</td>
<td>1022 (22%)</td>
<td>1385 (28%)</td>
<td>1438 (26%)</td>
<td>1375 (28%)</td>
</tr>
<tr>
<td>Pass Rate for First Attempts</td>
<td>2798/3329 (84%)</td>
<td>3073/3679 (84%)</td>
<td>3161/3741 (84%)</td>
<td>3274/3905 (84%)</td>
<td>3198/4057 (79%)</td>
<td>3353/4202 (80%)</td>
<td>3179/4554 (70%)</td>
</tr>
<tr>
<td>Pass Rate - 1st Attempt NAACLS</td>
<td>2612/3044 (86%)</td>
<td>2864/3325 (86%)</td>
<td>2953/3440 (86%)</td>
<td>3043/3524 (86%)</td>
<td>2975/3661 (81%)</td>
<td>3100/3740 (84%)</td>
<td>2954/3567 (83%)</td>
</tr>
<tr>
<td>Pass Rate for Repeaters</td>
<td>280/563 (50%)</td>
<td>297/619 (48%)</td>
<td>343/732 (47%)</td>
<td>339/730 (46%)</td>
<td>335/861 (39%)</td>
<td>431/1020 (42%)</td>
<td>440/1000 (44%)</td>
</tr>
</tbody>
</table>

MPS = -.04
Candidate Separation Reliability = .93

MPS = .08
Candidate Separation Reliability = .94
Maintenance of Item Question Banks

• Develop new items including images on a continuing basis
• Review item performance
• Monitor the content task and cognitive skill distributions of items
• Monitor the content quality and difficulty of each item
• Review the statistical performance of each item
Wright Map provides a picture of the MLS exam.

- Organized as two vertical histograms.
- Left side shows the distribution of the measured ability of the candidates from most able (top) to least able (bottom).
- Right side shows the distribution of the items from most (top) to least (bottom) difficult.
- Pass point indicated by the gray bar.
- This map show that there is a sufficient number of items around the pass point to differentiate candidates who should pass or fail as accurately as possible.
### Item Statistics

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>AN: 171050</th>
<th>BP</th>
</tr>
</thead>
<tbody>
<tr>
<td>31</td>
<td>23</td>
<td>5</td>
<td>34</td>
<td>Answer = B</td>
<td></td>
</tr>
<tr>
<td>%</td>
<td>0.33</td>
<td>0.25</td>
<td>0.05</td>
<td>0.37</td>
<td>Dif = -0.28</td>
</tr>
<tr>
<td>Avg Ability</td>
<td>-0.2</td>
<td>-0.16</td>
<td>-0.32</td>
<td>-0.12</td>
<td>SE = .21</td>
</tr>
</tbody>
</table>

*Item difficulty has displaced significantly*

**Item does not adequately differentiate high and low ability examinees**

- Interpreting item statistics is usually more art than science.
- It is up to the content experts to decide the status of the exam item and appropriate next steps.
- This item has been “flagged” for a statistical issue.
- Committee needs to review the content of this item.
## Item Statistics for a flagged item

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>AN: 171050</th>
<th>BP</th>
<th>Answer</th>
<th>Dif</th>
<th>SE</th>
<th>Pt Meas</th>
<th>Displace</th>
</tr>
</thead>
<tbody>
<tr>
<td>Count:</td>
<td>31</td>
<td>23</td>
<td>5</td>
<td>34</td>
<td></td>
<td></td>
<td>Answer = B</td>
<td>-0.28</td>
<td>.21</td>
<td>.01**</td>
<td>1.26*</td>
</tr>
<tr>
<td>%</td>
<td>0.33</td>
<td>0.25</td>
<td>0.05</td>
<td>0.37</td>
<td></td>
<td></td>
<td>Dif = -0.28</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Avg Ability</td>
<td>-0.2</td>
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<td>-0.32</td>
<td>-0.12</td>
<td></td>
<td></td>
<td>SE = .21</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Item difficulty has displaced significantly

**Item does not adequately differentiate high and low ability examinees

- **Pt Measure** is the point-measure correlation between candidate responses to this item and candidate ability measures. Used to detect item discrimination.
- This item is not differentiating between low and high ability examinees.
- More candidates of higher ability chose “D” distractor rather than the correct answer of “B”.
- Committee may choose to rework the “D” distractor or the concept of this item.
Item Statistics for a flagged item

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>AN: 171050</th>
<th>BP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Count</td>
<td>31</td>
<td>23</td>
<td>5</td>
<td>34</td>
<td>Answer = B</td>
<td></td>
</tr>
<tr>
<td>%</td>
<td>0.33</td>
<td>0.25</td>
<td>0.05</td>
<td>0.37</td>
<td>Dif = -0.28</td>
<td></td>
</tr>
<tr>
<td>Avg Ability</td>
<td>-0.2</td>
<td>-0.16</td>
<td>-0.32</td>
<td>-0.12</td>
<td>SE = .21</td>
<td></td>
</tr>
</tbody>
</table>

*Item difficulty has displaced significantly

**Item does not adequately differentiate high and low ability examinees

- **Displace** is displacement and shows how item difficulty has drifted in the current calibration of this item from the initial calibration of this item.
- Positive values show item became more difficult and negative values show item became easier.
- This may indicate a concept that is becoming outdated or has been replaced by other methodologies.
- The committee may choose to delete this item or rewrite a new item to cover this concept.
Item Statistics for a functioning item

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>AN: 700291</th>
<th>BP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Count</td>
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<td>24</td>
<td>1</td>
<td>10</td>
<td>Answer = B</td>
<td></td>
</tr>
<tr>
<td>%</td>
<td>0.33</td>
<td>0.46</td>
<td>0.02</td>
<td>0.19</td>
<td>Dif = 1.30</td>
<td></td>
</tr>
<tr>
<td>Avg Ability</td>
<td>1.09</td>
<td>1.26</td>
<td>1.13</td>
<td>0.87</td>
<td>SE = .28</td>
<td>Pt Meas = .26</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>NULL!</td>
<td></td>
<td>Displace = .00</td>
<td></td>
</tr>
</tbody>
</table>
Exam Committee Volunteer Application

• The volunteer application form can be found on the ASCP BOC website

• The potential guest will need to send the Volunteer Application form and a full CV or resume for review
Exam Committee Volunteer Application

ASCP BOC website
Exam Committee Volunteer Application

- ASCP BOC website Volunteer Application online.
- Volunteer applications and recommendations from the exam committees & BOG will be reviewed by the committee chair when vacancies occur.
- Committee chair will contact individual(s) who meet qualifications of vacant position.
- Approved guests will receive invitation letter.
- After all guest positions are filled, volunteers not invited to be guests will be notified to see if they are interested in future consideration.

Composition of Committees and Work Groups

All BOC Examination Committees and Work Groups consist of laboratory professionals, including technicians, technologists, laboratory scientists, supervisors, educators, and physicians representing broad geographic regions of the United States and laboratory facilities of various types and sizes. As vacancies in Exam Committees and Work Groups occur, volunteers with appropriate characteristics are sought to complement the existing composition and ensure a diverse membership.

Requirements

Volunteers must meet at least one of the following criteria:

1. Be certified or qualified by the BOC, preferably with current CMP status.
2. Be a member of a BOG sponsoring, participating or collaborating society.
3. Have special expertise as required by the committee or work group.
Guests for Examination Committees

• The examination committee sends a Request a Guest form
• Guests are invited to serve on an examination committee when a vacancy or need arises
• A list of qualified volunteers are reviewed
• Guests are reviewed for ability, willingness and availability to serve on that committee
• The guest participates in a face to face meeting
• At the end of the meeting the guest is invited to be a member of the examination committee
Examination Committee Terms

• Each term is 3 years
• A member can serve two consecutive terms
• Terms are staggered for continuity
• A member of the BOC is the liaison between the committee and the BOC
MLT & MLS Practice Analyses
What is a Practice Analysis? (a.k.a. job analysis or job task analysis)

• A practice analysis is a formal process for determining the responsibilities of individuals in the job/profession, the knowledge individuals must possess; and the skills necessary to perform the job at a minimally competent level.

• The results of the practice analysis inform the specifications and content of the ASCP BOC certification examinations.

• The practice analysis process ensures that the examinations are reflective of current practices.
Practice Analysis Purpose

• A practice analysis provides the foundation of a certification examination by defining practice in a profession
• Provides evidence of content validation
• Considered best practices for high stakes examination development
• Ensures the certification examination is fair, valid, job-related and legally defensible
Practice Analysis Frequency

ASCP BOC conducts a practice analysis approximately every 5 years in accordance with:

- ASCP BOC Policy
- ANSI accreditation requirements under ISO17024
Practice Analysis Process

ASCP BOC conducted a practice analysis survey to inform the following certification examination categories:

• Medical Laboratory Technician (MLT)
• Medical Laboratory Scientist (MLS)
• Technologist in Blood Banking (BB) & Specialist in Blood Banking (SBB)
• Technologist in Chemistry (C) & Specialist in Chemistry (SC)
• Technologist in Hematology (H) & Specialist in Hematology (SH)
• Technologist in Microbiology (M) & Specialist in Microbiology (SM)
Practice Analysis Process

1. Survey Development
2. Demographics
3. Task Inventory – Knowledge and Skill Questions
4. Rating Criteria
5. Survey Construction
6. Pilot Testing and Revision
7. Survey Distribution
8. Survey Analysis
9. Committee Review and Discussion
10. Examination Content Guideline, Exam Publication and Standard Setting
Survey Development

During the ASCP Board of Certification (BOC) examination committee meetings, the five categorical examination committees (BB, C, H, M and MB) provided the input and discussion to develop the practice analyses surveys for the following certification examinations:

- MLT
- MT
- BB
- SBB
- C
- SC
- H
- SH
- M
- SM
Survey Development

- Each exam committee developed the tasks which would appear in the section of the survey corresponding to their respective disciplines.
- The Joint Generalist Committee (MLT & MLS) had final review and approval for the MLT & MLS survey.
- All committee members (subject matter experts) collectively discussed all aspects of their profession to design the survey tasks.
- The survey had two components:
  - Demographics
  - Task Inventory
Demographics

Demographic questions:

- Experience
- Education
- Gender
- Age
- Job Titles
- Work Shift
- Facility type
- Areas of lab work

The purpose of these questions was to provide analytic categories to refine the survey population and utilize those responses from individuals at the targeted level to inform specific exams.
## Demographics

The demographic data provides analytic categories to analyze the responses from individuals at the targeted professional level.

<table>
<thead>
<tr>
<th>Respondent</th>
<th>Experience</th>
<th>Department</th>
<th>Certification</th>
<th>Professional Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>20 years</td>
<td>Chemistry</td>
<td>MT(ASCP)</td>
<td>Specialist Level, Chemistry</td>
</tr>
<tr>
<td>2</td>
<td>2.5 years</td>
<td>Microbiology</td>
<td>M(ASCP)</td>
<td>Entry Level (M or MLS), Microbiology</td>
</tr>
<tr>
<td>3</td>
<td>1 year</td>
<td>Core Lab</td>
<td>MLT(ASCP)</td>
<td>Entry Level (MLT), Chemistry &amp; Hematology</td>
</tr>
</tbody>
</table>
Task Inventory

• Knowledge & Skills: The exam committees developed a series of knowledge areas and job-related task (skill) questions

• Major Survey Sections
  o Laboratory Operations
  o Blood Banking
  o Microbiology
  o Chemistry
  o Hematology/Coagulation
  o Molecular Biology
  o Immunology/Serology
  o Urinalysis
  o Body Fluids
  o Point-of-Care Testing
  o Management/Supervision
Task Inventory

• Respondents only rated the tasks within the major sections in which they work
• All respondents rated the tasks within the Laboratory Operations section
• For example, if a respondent indicated that they currently work in Chemistry and Hematology, they rated tasks within those two section and Lab Operations and did not see any other sections of the survey.
Survey Logistics

Rating Criteria – different rating scales were used to assess the knowledge and skills on the survey

- **Knowledge-only tasks** – asked respondents to assess the significance of having specific knowledge to perform their job.

- **Skill-related tasks** – asked respondents whether they performed the specific task in their jobs

- **Survey Construction** – survey created and delivered through Key Survey, electronic survey vendor.
Survey Logistics

Survey Distribution – The survey was sent to all current MLT & MT/MLS, categorical (BB/C/H/M) and specialist (SBB/SC/SH/SM) certificants.

• ASCP BOC staff encouraged exam committee members to disseminate the survey to their colleagues
• Links to the survey were posted on social media sites
• Worked with the Qualification in Apheresis committee and AABB to send the survey link to blood centers.
Survey Analysis

• Any individuals not currently practicing (e.g., retired, unemployed or not working as a lab professional) were removed from the practice analysis.

• The demographic data determined for which exam category and level (entry level or specialist level) the tasks and knowledge survey responses would be analyzed.
## Survey Analysis

The exam committees reviewed the survey responses within their area of expertise. The table below shows the criteria for retaining tasks on the exam.

<table>
<thead>
<tr>
<th>Respondent %</th>
<th>Exam Committee Review</th>
<th>Retain on Task List</th>
<th>Valid for Exam</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥40%</td>
<td>NA</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>≤40%</td>
<td>Determined the task was critical to patient care</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>≤40%</td>
<td>Task is up-and-coming in practice</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>≤40%</td>
<td>Task considered outdated</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>
MLT & MLS Practice Analysis Report

• The Joint Generalist Committee reviews and approves all decisions made by the categorical (BB/C/H/M) exam committees.

• The MLT and MLS Practice Analysis Report can be found: (https://www.ascp.org/boc/practice_analyses)

• This report contains the Final Task Lists for MLT & MLS which reflect current practice and are valid for the examination.
Exam Content Guideline & Publication

The exam committees revise the content guideline, set the content area percentages and review exam questions based on the practice analysis results.

During exam committee review of Exam Questions:

• Exam questions are reclassified according to the new content guideline.

• Current exam questions may be deleted or revised

• New questions will be written to fulfill the new content guideline
Standard Setting
Standard Setting

• To determine the standard considered capable to practice in a field

• Based on individual performance on content areas as represented by test items

• Individuals are measured against a criterion standard and not against one another
Criterion Standard

• The criterion standard distinguishes those who possess minimal competency to practice in a field from those who do not – pass or fail
• Pass/Fail decision ensures validity of the exam
• Individuals who pass this standard possess:
  • knowledge and skills relevant to their certification
  • the ability to exercise discernment and judgment within their certification
Establishing a Criterion Standard

• Each item (test question) represents a criterion for knowledge in a field
• Experts in the field evaluate each item
• Selected items and relevant statistics are used to determine the pass point for the exam
Minimally Competent Candidate

• Think of a practitioner who you know and who should be certified. This person has just attained the basic minimal knowledge and skill to practice in the profession.

• However, the practitioner is not outstanding in regard to knowledge and/or skill.

• Think of what differentiates this practitioner from those who surpass the standard in the field, and those who fail to meet the standard.
The Objective Standard Setting Model

• Stage 1: Criterion Development
• Stage 2: Ensuring Precision
• Stage 3: Constructing the Standard
Stage 1: Criterion Development

Examination Database

- Selectable pool of items
- Representative of the field content
- Follows the content outline

<table>
<thead>
<tr>
<th>MLS Exam Content Guideline</th>
<th>Exam Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood Banking</td>
<td>17-22%</td>
</tr>
<tr>
<td>Urinalysis &amp; Body Fluids</td>
<td>5-10%</td>
</tr>
<tr>
<td>Chemistry</td>
<td>17-22%</td>
</tr>
<tr>
<td>Hematology</td>
<td>17-22%</td>
</tr>
<tr>
<td>Immunology</td>
<td>5-10%</td>
</tr>
<tr>
<td>Microbiology</td>
<td>17-22%</td>
</tr>
<tr>
<td>Laboratory Operations</td>
<td>5-10%</td>
</tr>
</tbody>
</table>
Stage 1: Criterion Development

Each expert will determine whether the content presented in each item should be considered *essential for the MINIMALLY competent practitioner to understand*

- Yes, it is essential, a **criterion item**
- No, it is not essential
Stage 1: Criterion Development

• Each expert selects their own essential set of items that they think defines the content criterion

• A criterion point is established by taking the mean of item difficulties of the essential items that each expert selected
Determining Criterion Items

- Content of item is considered for the minimally competent practitioner to understand
- Candidates need to know the content for safe and effective practice

Things to consider:
- Importance of the content of the item in practice.
- Is content of the item essential for practice?
- Relevance of the content of the item to current practice.
Criterion Point

- The criterion is the foundation of the pass point
- Each expert selects an individual set of essential items – the criterion set
- Rasch analysis is used to obtain item difficulty for each criterion item
- The item difficulties of criterion items are averaged for each expert
- The criterion point is the grand mean of all experts’ criterion sets
## Items for Criterion Point Selection

<table>
<thead>
<tr>
<th>AN</th>
<th>Item Difficulty (in logits)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10010</td>
<td>-1.76</td>
</tr>
<tr>
<td>10020</td>
<td>-1.48</td>
</tr>
<tr>
<td>10030</td>
<td>0.05</td>
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<tr>
<td>10040</td>
<td>0.23</td>
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<td>10050</td>
<td>0.85</td>
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<tr>
<td>10060</td>
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<tr>
<td>10070</td>
<td>-1.25</td>
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<tr>
<td>10080</td>
<td>1.97</td>
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<tr>
<td>10090</td>
<td>-0.68</td>
</tr>
<tr>
<td>10100</td>
<td>1.32</td>
</tr>
</tbody>
</table>
### Example of Quantifying Criterion Point

<table>
<thead>
<tr>
<th>Expert 1</th>
<th>YES</th>
<th>NO</th>
<th>Mean Difficulty</th>
<th>Expert 2</th>
<th>YES</th>
<th>NO</th>
<th>Mean Difficulty</th>
</tr>
</thead>
<tbody>
<tr>
<td>AN</td>
<td></td>
<td></td>
<td></td>
<td>AN</td>
<td></td>
<td></td>
<td></td>
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<td>-0.68</td>
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<td></td>
<td></td>
</tr>
<tr>
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<td>X</td>
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<td>1.32</td>
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<tr>
<td>Criterion Point</td>
<td>7</td>
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<td>0.04</td>
<td>Criterion Point</td>
<td>5</td>
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<td>0.10</td>
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</tbody>
</table>
## Example of Quantifying Criterion Point

<table>
<thead>
<tr>
<th>AN</th>
<th>YES</th>
<th>NO</th>
<th>Mean difficulty</th>
<th>AN</th>
<th>YES</th>
<th>NO</th>
<th>Mean difficulty</th>
</tr>
</thead>
<tbody>
<tr>
<td>10010</td>
<td></td>
<td>X</td>
<td></td>
<td>10010</td>
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<tr>
<td>10100</td>
<td>X</td>
<td></td>
<td>1.32</td>
<td>10100</td>
<td>X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Criterion Point** 6 0.24 **Criterion Point** 8 0.08
## Example of Quantifying Criterion Point

Criterion point is the grand mean of the criterion sets.

<table>
<thead>
<tr>
<th>Expert</th>
<th>Average Item Difficulty</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.04</td>
</tr>
<tr>
<td>2</td>
<td>0.10</td>
</tr>
<tr>
<td>3</td>
<td>0.24</td>
</tr>
<tr>
<td>4</td>
<td>0.08</td>
</tr>
<tr>
<td><strong>Grand Mean</strong></td>
<td><strong>0.12 (Criterion Point)</strong></td>
</tr>
</tbody>
</table>
Stage 2: Ensuring Precision

Measurement error is the amount of uncertainty associated with an observed test score

• More concern with scores that fall within the error band of the pass point.

• *Protecting the public*: by providing confidence that no candidate who should fail would pass due to measurement error (higher pass point)

• *Protecting the candidate*: by providing confidence that no candidate who should pass would fail due to measurement error (lower pass point)
Stage 2: Ensuring Precision

Level of Confidence

- 85%: 1.00 logit x SEM
- 90%: 1.282 logits x SEM
- 95%: x 1.645 logits SEM
- 98%: 2.00 logits x SEM

Example:
Confidence 90%
SEM = 0.2
1.282 x 0.2 = 0.26 (90% level of confidence)

Example:
Confidence 95%
SEM = 0.2
1.645 x 0.2 = 0.33 (95% level of confidence)
Stage 3: Constructing the Standard

Determine the Pass Point

Pass Point = Criterion Point ± Confidence Level

- **Criterion Point**: grand mean of criterion item difficulties
- **Confidence Level**: selected level multiplied by SEM
Stage 3: Constructing the Standard

Examples:
Criterion Point: 0.12
90% Confidence Level 0.26
Pass Point = 0.12 ± 0.26 = -0.14* or 0.38**

Criterion Point: 0.12
95% Confidence Level 0.33
Pass Point = 0.12 ± 0.33 = -0.21* or 0.45**

**Protecting the public**: by providing confidence that no candidate who should fail would pass due to measurement error (higher pass point)

*Protecting the candidate**: by providing confidence that no candidate who should pass would fail due to measurement error (lower pass point)
Setting the Standard

- Review standard setting results against past examinee performance data.
- Determination of the final pass point for the new criterion standard.
- Application of new standard with administration of new exam.
Constructing Objective BOC Exam items
Item Writing

• Knowledge, skills, and judgment necessary for entry level practice

• Quality items minimize or erase construct-irrelevant factors
  • Construct-irrelevant factors are variables unrelated to the construct being measured but are present and affect the correct interpretation of exam scores

• Quality items are needed for a fair, reliable, and legally defensible exam

• Must adhere to rigorous standards
ASCP BOC Examinations

- Multiple Choice
- Four answer options
- Only one correct answer
- Independent items
Anatomy of a Multiple Choice Item

• **Stem (Problem statement):** the text that presents the problem to be answered

• **Distractors (Answer options):** the list of options that a test taker can choose from to answer the stem
  - One correct answer
  - Three distractors
Stem
(Problem Statement)
<table>
<thead>
<tr>
<th>Item stem SHOULD:</th>
<th>Item stem SHOULD NOT:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Be meaningful and directly describe the problem/situation</td>
<td>Have excess information; do not “teach” the test taker</td>
</tr>
<tr>
<td>Be free of irrelevant material</td>
<td>Use extremes (i.e. always, never) or ambiguous wording (i.e. may, usually, often)</td>
</tr>
<tr>
<td>Be positively stated – use negatively stated item stems only when significant learning outcomes are warranted</td>
<td>Contain language/wording that “tips-off” the correct answer</td>
</tr>
<tr>
<td>Be independent from other stems to avoid “cueing” answers</td>
<td>Be opinion-based where there is no best answer</td>
</tr>
<tr>
<td>Contain some novelty, but not too much</td>
<td>Contain personal pronouns</td>
</tr>
<tr>
<td>Employ correct grammar and spelling, especially in relation to the answer options</td>
<td>Contain sensitive/offensive language</td>
</tr>
<tr>
<td></td>
<td>Have verbatim wording from a textbook or study guide</td>
</tr>
</tbody>
</table>
In the form of a direct-question or incomplete-statement:

<table>
<thead>
<tr>
<th>Direct-Question Form</th>
<th>Incomplete-Statement Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>Which of the following glands regulates the calcium concentration in serum?</td>
<td>Serum calcium concentration is regulated by the:</td>
</tr>
<tr>
<td>A. Thyroid</td>
<td>A. Thyroid</td>
</tr>
<tr>
<td>B. parathyroid*</td>
<td>B. parathyroid*</td>
</tr>
<tr>
<td>C. Adrenal</td>
<td>C. adrenal gland</td>
</tr>
<tr>
<td>D. pituitary</td>
<td>D. pituitary gland</td>
</tr>
</tbody>
</table>
Stem should be meaningful

- Directly describe the problem
- Free of irrelevant material

**Poor**

Which of the following factor deficiencies is associated with either no bleeding, or only a minor bleeding tendency, even after trauma or surgery?

A. V  
B. X  
C. XII*  
D. XIII

**Better**

Which of the following factor deficiencies is associated with a negative bleeding history?

A. V  
B. X  
C. XII*  
D. XIII
### Poor

Which one of the following hormones is not produced in the liver?

A. Thrombopoietin
B. erythropoietin*
C. Angiotensinogen
D. hepcidin

### Better

Erythropoietin is produced in the:

A. Liver
B. Pituitary
C. kidney*
D. pancreas
**Poor**

Ten stockholders are each selling their shares for a price of more than $40. Ten potential buyers are each offering to buy one share for a certain price. Only three buyers would be willing to pay more than $40 for a share. The demand drops as share prices increase. Which economic model applies to this scenario?

A. Law of Scarcity and Demand  
B. Law of Supply and Demand*  
C. Law of Scarcity and Supply  
D. Law of Equilibrium

**Better**

A supermarket sets the price of its oranges to be sold for $3 each. Sale of the oranges has stagnated. The supermarket then lowered the price for the oranges to $2.00 each, and the sale has improved significantly, leading the supermarket to make a profit. Which economic model applies to this scenario?

A. Law of Scarcity and Demand  
B. Law of Supply and Demand*  
C. Law of Scarcity and Supply  
D. Law of Equilibrium
The presence of C-reactive protein in the blood is an indication of an:

A. recovery from a pneumococcal infection  
B. state of hypersensitivity  
C. recent streptococcal infection  
D. inflammatory response*

---

**Better**

The presence of C-reactive protein in the blood is an indication of:

A. recovery from a pneumococcal infection  
B. a state of hypersensitivity  
C. a recent streptococcal infection  
D. an inflammatory response*
Stem should not teach

- Do not have excess information in the stem
- Do not “teach” the examinee

**Poor**

Photosynthesis is the process by which plants and some bacteria convert energy from the sunlight to sugar. Which of the following is the equation for this process?

A. \( \text{C}_6\text{H}_12\text{O}_6 + 6\text{O}_2 \rightarrow \text{6CO}_2 + 6\text{H}_2\text{O} + \text{heat} \)

B. \( 6\text{H}_2\text{O} + 6\text{CO}_2 \rightarrow \text{C}_{12}\text{H}_6\text{O}_2 + 6\text{O}_2 \)

C. \( \text{H} + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O} + \text{energy} \)

D. \( 6\text{H}_2\text{O} + 6\text{CO}_2 \rightarrow \text{C}_6\text{H}_12\text{O}_6 + 6\text{O}_2 \)

**Better**

Which of the following is the equation of the energy conversion process in photosynthesis?

A. \( \text{C}_6\text{H}_12\text{O}_6 + 6\text{O}_2 \rightarrow \text{6CO}_2 + 6\text{H}_2\text{O} + \text{heat} \)

B. \( 6\text{H}_2\text{O} + 6\text{CO}_2 \rightarrow \text{C}_{12}\text{H}_6\text{O}_2 + 6\text{O}_2 \)

C. \( \text{H} + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O} + \text{energy} \)

D. \( 6\text{H}_2\text{O} + 6\text{CO}_2 \rightarrow \text{C}_6\text{H}_12\text{O}_6 + 6\text{O}_2 \)
Stem should not use ambiguous wording

Do not use extreme words like “always” or “never” (especially in medicine)
• There is no absolute certainty that something will always happen.
• Also, no absolute certainty that something would never happen.

Do not use ambiguity or ambiguous words like “usually” or “often”.
• This language confuses the examinee.
• Requires the examinee to use their own judgement and interpretation
Stem should not tip-off the correct answer

- Do not have excess information in the stem
- Do not “teach” the examinee

**Poor**

WBCs on a peripheral blood smear appear abnormal with hair-like projections of cytoplasm. This finding is consistent with:

A. acute lymphoblastic leukemia
B. primary myelofibrosis
C. hairy cell leukemia*
D. essential thrombocythemia

**Better**

The WBCs in the image (insert image of hairy cells) appear in a peripheral blood film. This finding is consistent with:

A. acute lymphoblastic leukemia
B. primary myelofibrosis
C. hairy cell leukemia*
D. essential thrombocythemia
Stem should not be opinion-based

Do not have an exam item where there is no definitively correct or best answer.

**Poor**

The best treatment for hemophilia A is:

A. Desmopressin  
B. recombinant VIII  
C. Cryoprecipitate  
D. gene therapy
Stem should not contain personal pronouns

**Poor**

You receive a refrigerated urine specimen for crystal identification that appears cloudy. Upon warming, the urine clears. This is due to the presence of:

A. urates*
B. phosphates
C. WBCs
D. bacteria

**Better**

A medical laboratory scientist observes clearing of a cloudy urine upon warming. This is due to the presence of:

A. urates*
B. phosphates
C. WBCs
D. bacteria
Do not introduce construct-irrelevant factors

Construct-irrelevant factors are variables that can threaten the validity of the examination and its outcome. These variables make it more difficult for the examinee to answer correctly or disadvantages certain examinees.

- Use of sensitive/offensive language can distract the examinee even if they have mastered the concept.
- Use of verbatim wording from a textbook or study guide benefits those with access to those resources.
- The goal of the examination is to prevent bias and protect the legitimacy of the pass/fail decisions made by challenging the examination.
Distractors (Answer Options)
Distractors should:

• Be grammatically consistent with the item stem
• Minimize excessive verbiage
• Be mutually exclusive of one another
• Avoid using “none of the above” or “all of the above”
• Be plausible
• Be parallel to one another
• Be of similar length so not to clue to the correct answer
• Be phrased positively
Distractors should minimize excessive verbiage.

**Poor**

Flammable and combustible liquids in containers > 5 gallons should be:
A. stored in a flammable safety cabinet
B. stored in a non-explosion proof refrigerator
C. stored in a fume hood
D. stored in an approved safety can

**Better**

Flammable and combustible liquids in containers > 5 gallons should be stored in a(n):
A. flammable safety cabinet
B. non-explosion proof refrigerator
C. fume hood
D. approved safety can
Distractors should be mutually exclusive.

<table>
<thead>
<tr>
<th>Poor</th>
<th>Better</th>
</tr>
</thead>
<tbody>
<tr>
<td>The normal range for fasting blood glucose is:</td>
<td>The normal range for fasting blood glucose is:</td>
</tr>
<tr>
<td>A. 100 – 130 mg/dL</td>
<td>A. 100 - 129 mg/dL</td>
</tr>
<tr>
<td>B. 70 – 100 mg/dL</td>
<td>B. 70 - 99 mg/dL</td>
</tr>
<tr>
<td>C. 50 - 70 mg/dL</td>
<td>C. 50 – 69 mg/dL</td>
</tr>
<tr>
<td>D. &lt; 50 mg/dL</td>
<td>D. &lt;50 mg/dL</td>
</tr>
</tbody>
</table>
Avoid using “K-type” distractors.

K-type distractors utilize multiple combination choices of answers.
- “All of the above”
- “None of the above”
- “Only A and B are correct”

Poor
The Vitamin K-dependent clotting factors include:
A. V
B. VII*
C. XI
D. All of the above

Better
The Vitamin K-dependent clotting factors include:
A. V
B. VII*
C. XI
D. XIII
Distractors should be equally plausible.

<table>
<thead>
<tr>
<th>Poor</th>
<th>Better</th>
</tr>
</thead>
<tbody>
<tr>
<td>Who succeeded the presidency after the assassination of John F. Kennedy?</td>
<td></td>
</tr>
<tr>
<td>A. George Washington</td>
<td>A. Dwight D. Eisenhower</td>
</tr>
<tr>
<td>B. Abraham Lincoln</td>
<td>B. Richard Nixon</td>
</tr>
<tr>
<td>C. Lyndon B. Johnson*</td>
<td>C. Lyndon B. Johnson*</td>
</tr>
<tr>
<td>D. Barack Obama</td>
<td>D. Jimmy Carter</td>
</tr>
</tbody>
</table>
Distractors should be parallel.

**Poor**

The state of Illinois borders on:
A. Lake Erie
B. Lake Michigan*
C. Minnesota
D. Indiana*

**Better**

The state of Illinois borders on:
A. Lake Erie
B. Lake Michigan*
C. Lake Huron
D. Lake Superior
Distractors should be similar in length.

- The answer should not be the longest distractor as it will be singled out.
- Longer distractors usually are adding information to make them definitively correct OR definitively incorrect.

**Poor**
The nanometer is a measurement of:
A. wavelength of radiant energy*
B. density
C. current
D. solubility

**Better**
The nanometer is a measurement of:
A. wavelength*
B. Density
C. Current
D. solubility
Present distractors in a logical order.

**Poor**
The normal range for fasting blood glucose is:
A. < 50 mg/dL
B. 70 - 99 mg/dL*
C. 100 – 129 mg/dL
D. 50 – 69 mg/dL

**Better**
The normal range for fasting blood glucose is:
A. 100 - 129 mg/dL
B. 70 - 99 mg/dL*
C. 50 – 69 mg/dL
D. <50 mg/dL
Item Taxonomy
Item Taxonomy

Knowledge
  • Recall/Remember

Comprehension
  • Interpretation
  • Understanding

Application or Analysis
  • Problem Solving
  • Justification

Bloom (1948)
Exam Item Review Checklist

• Item stems are concise and direct; free of irrelevant information.
• Item stems are worded positively.
• No clues or cues are given in the stems or across the test.
• Item stems should not “teach” the test taker.
• There is only one correct answer.
• Answer options are similar in length.
• Answer options are logically ordered.
• Distractors are feasible, but definitely incorrect.
• Items test facts, not opinions.
• Harder items are not “better” than easier items.
• Item content is equally relevant across groups of test takers and does not disadvantage any groups.
Summary

- Quality items reflect the underlying construct or trait that is being measured and minimize irrelevant factors that take away from the accurate measurement of the construct.

- To produce quality items that measure test takers’ knowledge and ability, item stems and answer options should be clear, concise, direct, and be of sound structure.

- The goal is to use these items to determine who possesses the minimally competent ability for certification and to practice in the field, not to “trick” test takers.
Thank you!