

# Perioperative Blood Management Technologist (PBMT) Certification Exam



## Development of the PBMT Exam

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Mayo Clinic and Mayo School of Health Sciences

CREF February 2009

# Disclosure

**No personal equity, patents, licensing, or consulting agreements with the medical device or pharmaceutical industry to disclose**

**Helping to construct the PBMT exam partially fulfills the requirements for JR's PhD dissertation project**

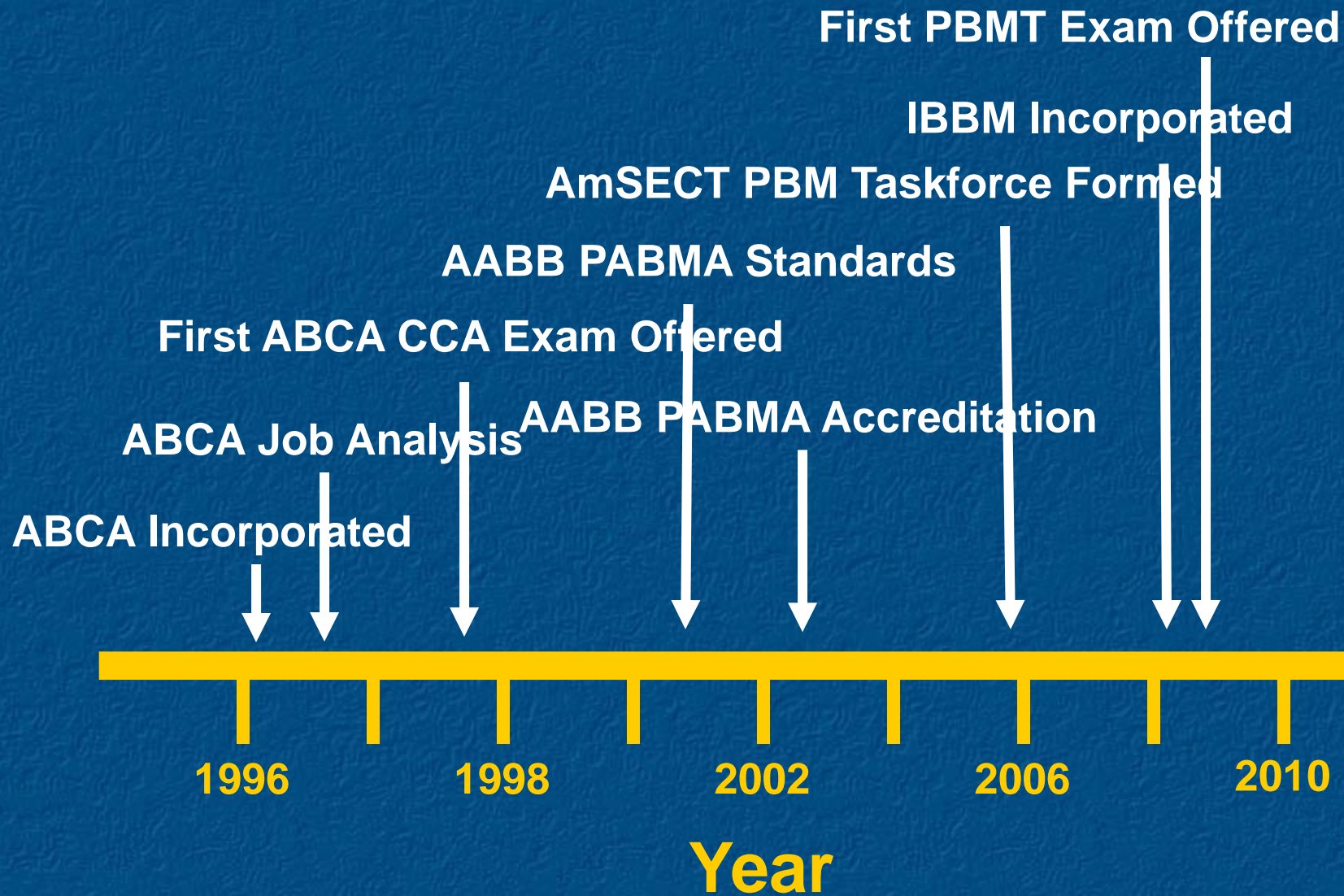
**JR does not represent or speak for the AABB, AmSECT or the IBBM**

# **Presentation Objectives**

## **PBMT Exam**

- ✓ **Outline the history of the PBMT exam**
- ✓ **Discuss the recent update to the PBMT exam**
- ✓ **Review challenges associated with the exam**
- ✓ **Give a glimpse of the exam's future**

# Time Line for PBMT Exam Process



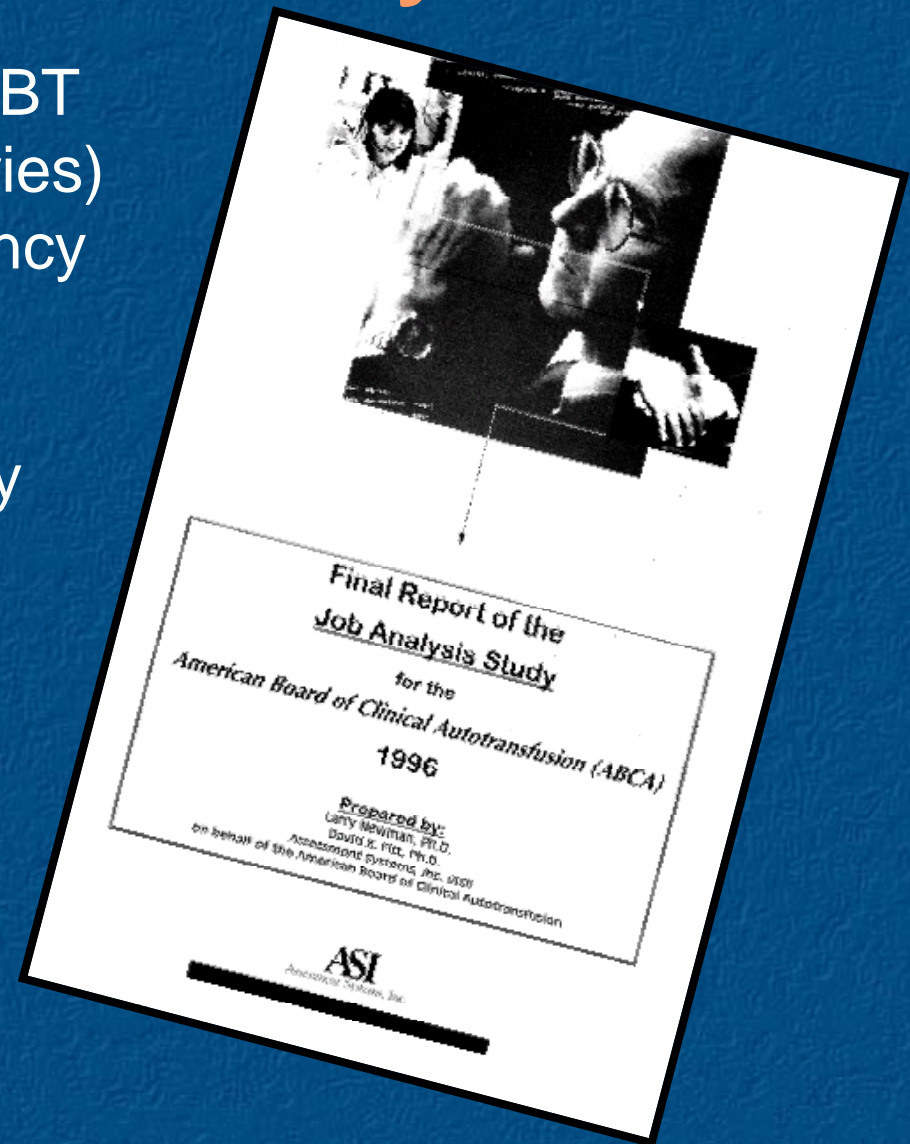
# 1990 ABCA Job Analysis

- 1996 demographics for PMBT
- Rating scales (task categories)
- Content areas for competency exam
- 56 tasks surveyed
- Task frequency vs. criticality
- 43 tasks both frequent and critical

## *Informed by:*

*American Psychological Association  
Standards for educational and psychological  
tests*

*Equal Employment Opportunity Commission  
Uniform guidelines on employee selection  
procedures*





January 2008

# AmSECT TODAY

Volume 11, Issue 1



*Al Stammers, MSA, CCP*

## **President's Message** **Perioperative Blood Management** **and the International Board** **of Blood Management**

**By Alfred H. Stammers, MSA, CCP**  
*AmSECT President*

"80% of success is showing up."  
- Woody Allen

There are few who would argue that perfusion is evolving into an entity that few who have been practicing since the '80's could have predicted. Back then the field was awash with a burgeoning caseload that led to huge shortages in practitioners and abundant opportunities for those in the field. So much so that Perfusionists found it difficult to support extracorporeal practices such as ECMO, ventricular assist and cell salvage. Indeed, these were 'given' to

ours has taken. "Times go by turns, and chances change by course, from foul to fair, from better hap to worse." However, this editorial is not written to reflect upon the negative, nor to document the factors that have led to the current state of cardiac surgery, and hence, perfusion. Instead, it is to look at opportunities for the continued advancement of our profession and describe what AmSECT is doing in pursuit of these.

No profession in medicine is better positioned to address the rapidly expanding field of blood management than perfusion. The comprehensive

# Designing a Test

- **What to test**
  - **Concerned with minimal KSAs**
  - **Must be job-related skills**
    - **Critical incident analysis**
  - **Legal issues**
    - **to avoid discriminatory practices, the test must be shown to be job-related**
- **How to test? Method?**
- **Sound instruments and procedures**
- **Integrity of testing process**
- **Use and interpretation of test**

Fortune, Jim C., and Associates. 1985. Chapter 2. Guidelines for developing and using a licensure test. In Understanding testing in occupational licensing. Jossey-Bass Publishers: San Francisco.

# Testing in Professional and Occupational Credentialing

- Testing information aids in personnel decision-making
- Content may cover various domains of knowledge, skills, abilities, traits, dispositions, and values
- Occupational tests may be used to “screen in” individuals
- On-going use of credentialing tests allows the accumulation of data within the test’s context
- Test users may wish to make an inference from test results to some future job behavior or outcome

# MAC

“Minimal acceptable candidate”

- Education?
- Training?
- Employment?
- Experience?
  - Caseload?
- Employment references?

# Exam Content Outline

## 1996-2001 Job Analysis

1. Basic science (5%): Terminology, principles
2. Hematology (12.6%): Terminology, principles, blood components, coagulation, sequestration
3. General knowledge (27.4%): Machines, disposables, components, circuits, set-up
4. Preoperative preparation (20.7%): Machines, disposables, components
5. Intraoperative (17.7%): Salvage, process, wash, QC, product, transfer, filtration, infuse, document
6. Postoperative (4.5%): Vacuum, termination, circuit, machines
7. Troubleshooting (4.6%)
8. Pheresis (7.6%)

## 2007 Proposed

1. Environmental factors ( % ): Sterility, vocabulary, team behaviors
2. Equipment and disposables ( % ): Machines, principles, disposables, operation, applications
3. Patient care procedures ( % ): Body of knowledge, AABB, FDA, JCAHO, OSHA, clinical guidelines, contraindications
4. Critical incidents ( % ): Body of knowledge, diagnose, troubleshoot, critical incident response, communication

# **KSAs**

## **Job domain analysis**

- **Knowledge**
- **Skills**
- **Abilities**
- **Critical incident theory**

## Perioperative Blood Management Technologist [PBMT]

# Job Domain Analysis

### *Theoretical Hierarchical Construct for K/S/A for Competency Exam*

Environmental Factors	Equipment / Disposables	Patient Care Procedures	Critical Incidents
Assertiveness, lead team when required [1.5]	Application and operation of equipment [2.5]	Suggest changes to and author clinical procedure guidelines [3.5]	Design and practice team drills for critical incidents [4.5]
Integration into surgical team and participate in care planning and quality management [1.4]	Follow manufacturer instructions-for-use and assembly [2.4]	Follow guidelines recognizing contraindications and exceptions [3.4]	Communication with team during critical incident and crisis management [4.4]
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Rules for sterile environment: OSHA, CDC training [1.1]	Hardware and device technical knowledge [2.1]	Body of medical knowledge: physiology, pharmacology [3.1]	Body of medical knowledge [4.1]

Increasing complexity, proficiency and difficulty

Riley: April 2008

# Critical incidents in perioperative autologous blood management (PABM)

## Contamination of sterile field and circuit components

- Set-up contamination
- Contamination during cell processing
- Bacteremia (1)

## Record keeping errors

- Record entry error
- Record entry omission
- Mis-label autologous blood product
- Quality indicator failure (2)

## Hemolysis

- Wrong cell wash solution
- Wrong heparin drip solution

## Inadequate de-airing of anesthesia red cell infusion bag

- Accidental venous air infusion

## Medication errors

- Wrong anticoagulant drug
- Wrong anticoagulant drug dose
- Wrong anticoagulant drip solution

## Allergic reactions

- Anaphylactic reaction (3)

## Equipment failure

- Cell washing devices
- Platelet concentration devices
- Rapid infusion devices
- Blood warming devices

## Circuit disposable component failure

- Shed blood reservoir
- Cell washing bowl or chamber

## Circuit blood line separation

- Blood spray
- Blood loss

## Special patient management requirements

- Partial cell washing bowl volume (2, 4)
- Massive red blood cell and platelet loss (5)
- Massive plasma protein and clotting factor loss
- Pediatric patients (6)
- Jehovah Witness (7)
- Cancer patient (8)
- Cesarean patient (9, 10)
- Liver transplant patient

# Critical incidents in perioperative autologous blood management (PABM)

## Reference

1. Shindo S, Matsumoto H, Kubota K, Kojima A, Matsumoto M. Temporary bacteremia due to intraoperative blood salvage during cardiovascular surgery. *Am J Surg.* 2004;188(3):237-239.
2. Hansen E, Bechmann V, Altmeyen J, Wille J, Roth G. [Quality assurance in blood salvage and variables affecting quality][Article in German]. *Anesthesiol Intensivmed Notfallmed Schmerzther.* 2004;39(9):569-575.
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# Testing for Credentialing

- Certification is widely used to indicate that a person has certain specific skills or knowledge which are only part of their occupation
- Certification tests provide the public with a dependable mechanism for identifying practitioners who have met particular strict standards: educational requirements, supervised experience and other specific criteria
- Validation of credentialing tests depends mainly on content-related evidence – **often on the judgments that the test adequately represents the content domain of the occupation**
- Defining the minimum level of knowledge and skill required for licensure or certification is one of the most important difficult tasks facing the credentialing board

# **SMEs**

## **Subject matter experts**

- **Are qualified and their credentials are known**
- **Role in processes: SMEs**
  - **Define the context and content for the employment exam**
  - **Write test items**
  - **Evaluate test items**
  - **Maintain the test item data bank**

# Reliability vs. Validity

- **Exam reliability**

- Exam will yield same results when given repeatedly
  - Item discrimination, difficulty, distraction, Cronbach  $\alpha$ , K-R 21, Rasch analysis methods

- **Exam validity [Cureton, 1951]**

- How well the test serves the purpose for which it is designed
  - Correlation between test scores and “true criterion” scores



# Exam Reliability and Validity

It is NOT about the exam

“Before pursuing the discussion of reliability and validity, two points need to be made:

1. Examinations are neither reliable nor valid; **scores** from examinations may be reliably or validly interpreted.
2. Examination scores are used to make decisions; the **decisions** may be reliable and/or valid.

Note that it is possible for scores and decisions to be reliable without being valid.”

Fortune, Jim C., and Associates. 1985. Chapter 4. Determining reliability and validity of licensure examinations. In Understanding testing in occupational licensing. Jossey-Bass Publishers: San Francisco. p 66.

# Validation of PBMT Knowledge Exam

## Four C's of Validity

**CONTENT:** Review and update the job analysis or role delineation for the PBMT. The analysis should be revised every 4-5 years. The role of the PBMT is not relatively new and but is undergoing some change. The job analysis provides the basis for the exam specifications, and is essential to a legally-defensible exam.

**CRITERION:** Correlate performance on the certification - knowledge exam with available criteria of success, e.g. experience, education, and performance ratings.

**CONSTRUCT:** Examine and describe the nature of "competence" for a PBMT using factor analyses, or other construct analysis techniques.

**CONSEQUENCES:** What are the implications or outcomes of the current examination practices? Who does the exam select? Which, if any, PBMTs does the exam favor? Who are we keeping out of the profession or job?

## Perioperative Blood Management Technologist [PBMT]

# Job Domain Analysis

### *Theoretical Hierarchical Construct for K/S/A for Competency Exam*

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Increasing complexity, proficiency and difficulty

Riley: April 2008

## April 2008: Examination Plan

Section	Label	Items	Percent	Col	Percent
1.1	Sterile environment	4	0.04		
1.2	Social structure	1	0.01		
1.3	Communication	0	0.00		
1.4	Team integration	0	0.00		
1.5	Leadership	0	0.00	5	0.05
2.1	Device knowledge	2	0.02		
2.2	Equipment operation	9	0.08		
2.3	Disposable supplies	8	0.07		
2.4	Manufacturer's IFUs	5	0.05		
2.5	Equipment applications	5	0.05	29	0.26
3.1	Physiology, pharmacology	23	0.21		
3.2	Standards and guidelines	4	0.04		
3.3	Indications for use	11	0.10		
3.4	Contraindications and exceptions	6	0.05		
3.5	Author CPGs	1	0.01	45	0.41
4.1	Medical knowledge	8	0.07		
4.2	Diagnose and troubleshoot	11	0.10		
4.3	Critical incident response	11	0.10		
4.4	Team crisis management	1	0.01		
4.5	Design safety drills	0	0.00	31	0.28
Total		110	1.00	110	1.00

## Perioperative Blood Management Technologist [PBMT]

# Job Domain Analysis

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Increasing complexity, proficiency and difficulty

Riley: April 2008

# PBMS Certification Exam

- The AmSECT PBM Taskforce has also recommended that the IBBM provide a second higher level specialist certification designated the Perioperative Blood Management Specialist (PBMS).
- PBMS certification is directed at individuals who in addition to providing perioperative autotransfusion, would also be utilizing techniques of platelet pheresis for the production of platelet gel and other developing technologies.
- The specific criteria for the PBMS have yet to be developed with the anticipation of certification beginning in 2009 or 2010.

# Perioperative Blood Management Specialist [PBMS]

## Job Domain Analysis [Subject to Change]

*Theoretical Hierarchical Construct for K/S/A for Competency Exam*

Environmental Factors	Equipment / Disposables	Patient Care Procedures	Critical Incidents
Assertiveness, lead team when required [1.5]	Application and operation of equipment [2.5]	Suggest changes to and author clinical procedure guidelines [3.5]	Design and practice team drills for critical incidents [4.5]
Integration into surgical team and participate in care planning and quality management [1.4]	Follow manufacturer instructions-for-use and assembly [2.4]	Follow guidelines recognizing contraindications and exceptions [3.4]	Communication with team during critical incident and crisis management [4.4]
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Rules for sterile environment: OSHA, CDC training [1.1]	Hardware and device technical knowledge [2.1]	Body of medical knowledge: physiology, pharmacology [3.1]	Body of medical knowledge [4.1]

Increasing complexity, proficiency and difficulty

Riley: April 2008

# Pass Rates for Certification Tests

- Tests for credentialing need to be precise in the vicinity of the passing, or **cut** score
- The areas covered by the test should be defined and often test has section scores (scales)
- The test taker may be told only whether the decision was “pass” or “fail”
- Mastery tests are not designed to measure how well or how poorly a candidate performs on the exam (although P/F performance on certain sections of the exam may be useful to candidates)

**APA Standards for Educational and Psychological Testing**

# Page for every PBMT test item: Task force members validate items

http://www.surveymonkey.com - PABMT Exam Items - Group 01 - Microsoft Internet Explorer provided by SAMP Informa...

File Edit View Favorites Tools Help

Google G Go 17 blocked Check >> Settings lenovo

Y! Search Web Mail My Yahoo! Mobile >>

PABMT Exam Items - Group 01 [Exit this survey >>](#)

## 1. Introduction

The purpose for this survey is to present potential PABMT certification test items to a group of experts to collect their professional assessment of each item.

Each of the following pages contains a single potential certification test item. Please read the item stem and the distractors carefully. Then using your professional judgement, answer the questions about the test item.

Thank you for reviewing these items and for keeping these items confidential. First please answer these questions about your background.

You may leave and come back to the item analysis at any time without losing your input, as long as you use the same computer.

THANK YOU!

1. What is your professional education or training [check all that apply]?

MD

PhD

Internet

# Item is presented for validation; Correct answer?

PABMT Exam Items - Group 01

[Exit this survey >>](#)

## 2. Item # I00029

Please carefully read and answer the following questions regarding this test item:

I00029. What is the potential hazard of attaching a cell salvage instrument reinfusion bag directly to the patient's venous system?

- A. Clot in the line
- B. Air embolism
- C. Hemolysis
- D. Hemorrhage
- E. Infection

**ITEM to analyze and validate by experts**

1. In your professional opinion, what do you consider to be the **SINGLE-BEST** correct response to this question?

A.

B.

C.

D.

E.

2. In your professional opinion, what do you consider to be the **SECOND-BEST** correct response to this question?

A.

B.

C.

D.

E.

Comment on distractors, or suggest a distractor

# Establish Criticality v. Frequency

3. Considering the **MINIMAL** acceptable practice standards for a perioperative autologous blood management technologist (autotransfusionist), in your opinion please **RATE** this test item on the following scales.

	Extremely	Very	Not very	Not-at-all
The scientific principles employed in this item are _____ CRITICAL understanding to minimal PROFICIENT daily practice	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The item concepts and principles are employed _____ FREQUENTLY in typical practice situations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The item concepts and principles are _____ CRITICAL KNOWLEDGE that affects COMPETENCE and CLIENT OUTCOMES	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
For the examinee, selecting the CORRECT response to this item will be _____ DIFFICULT	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

4. Please estimate the probability that a hypothetical randomly selected **MINIMALLY** competent autotransfusionist / PABMT will answer this item correctly.

100    90    80    70    60    50    40    30    20    10    0

# Establish criticality versus frequency

This item content is frequently used is information that is critical to proficiency and outcomes, and the item is judged to be not very difficult

Considering the MINIMAL acceptable practice standards (autotransfusionist), in your opinion please RATE this tes					
<b>RESULTS</b>	Extremely	Very	Not very	Not-at-all	response Count
The scientific principles employed in this item are _____ CRITICAL understanding to minimal PROFICIENT daily practice	83.3% (5)	16.7% (1)	0.0% (0)	0.0% (0)	6
The item concepts and principles are employed _____ FREQUENTLY in typical practice situations	66.7% (4)	33.3% (2)	0.0% (0)	0.0% (0)	6
The item concepts and principles are _____ CRITICAL KNOWLEDGE that affects COMPETENCE and CLIENT OUTCOMES	100.0% (6)	0.0% (0)	0.0% (0)	0.0% (0)	6
For the examinee, selecting the CORRECT response to this item will be _____ DIFFICULT	0.0% (0)	33.3% (2)	50.0% (3)	16.7% (1)	6
	<i>answered question</i>				6
	<i>skipped question</i>				0



# Access to knowledge? Is item ready?

4. Please estimate the probability that a hypothetical randomly selected MINIMALLY competent autotransfusionist / PABMT will answer this item correctly.



5. Regarding the principles and knowledge required to respond correctly to this item, are the principles "COMMON KNOWLEDGE" and EASY to find in the educational literature?

cut-off score for item

input from five  
force members  
on item: Rewrite  
item if necessary

Please estimate the probability that a hypothetical randomly selected MINIMALLY competent autotransfusionist / PABMT will answer this item correctly.

	Response Percent	Response Count
100	0.0%	0
90	50.0%	3
80	33.3%	2
70	0.0%	0
60	0.0%	0
50	16.7%	1
40	0.0%	0
30	0.0%	0
20	0.0%	0
	0.0%	0
	0.0%	0
<i>answered question</i>		6

Probability of correct response rate on this item will be:  
 $Prob = (3 \cdot .9 + 2 \cdot .8 + .5) / 6 = 0.80$

# APA Standards Affecting the IBBM

**§ 14.1** Prior to development and implementation of an employment test, a clear statement of the objective of testing should be made. The subsequent validation effort should be designed to determine how well the objective has been achieved.

# APA Standards Affecting the IBBM

**§ 14.1** When evidence of validity based on test content is a primary source of validity evidence in support of the use of a test in selection or promotion, a close link between test content and job content should be demonstrated.

# APA Standards Affecting the IBBM

**§ 14.10** When evidence of validity based on test content is presented, the rationale for defining and describing a specific job content domain in a particular way (e.g., in terms of tasks to be performed or knowledge, skills, abilities, or other personal characteristics) should be stated clearly.

# APA Standards Affecting the IBBM

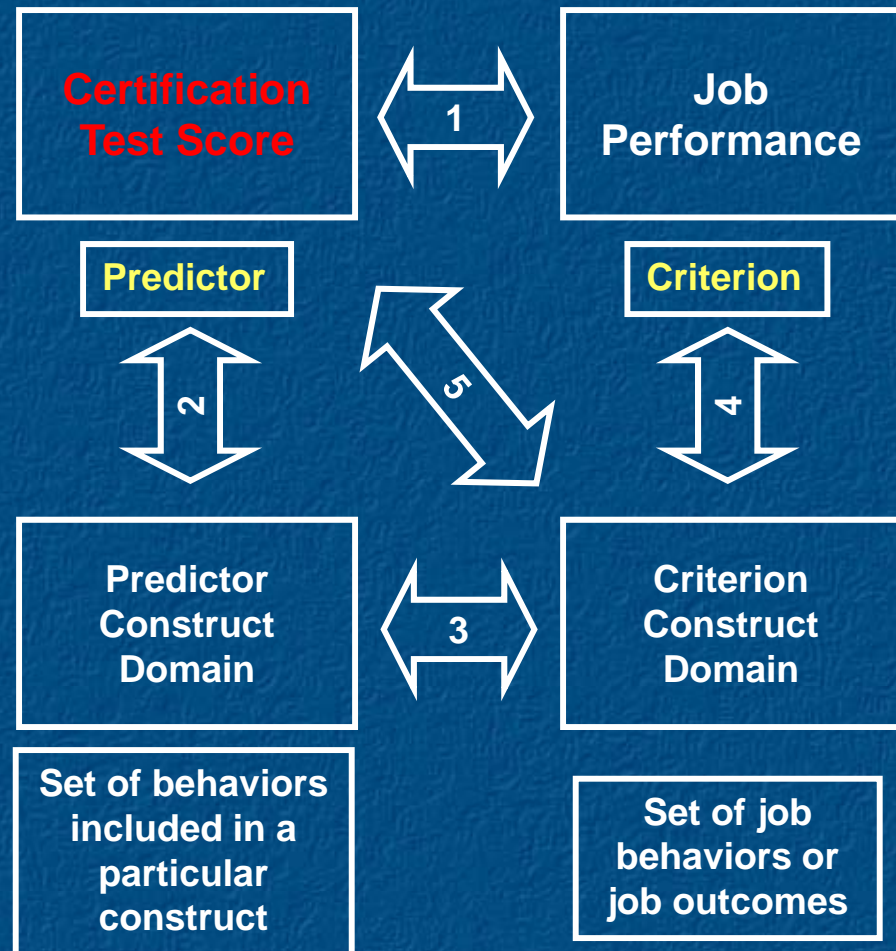
**§ 14.12** When the use of a given test for personnel selection relies on relationships between a predictor construct domain that the test represents and a criterion construct domain, two links need to be established. First there should be evidence of the relationship between the test and the predictor construct domain, and second, there should be evidence for the relationship between the predictor construct domain and major factors of the criterion construct domain.

# Validation in Employment Testing

Two domains for predictive inference:

- The predictor – the test score
- The criterion – job performance

**Linkages may be established by expert judgment** of the characteristics predictive of job success, analysis of critical incidents in effective job performance, interview and observation, and job analysis



# APA Standards Affecting the IBBM

**§ 14.14** The content domain to be covered by a credentialing test should be defined clearly and justified in terms of the importance of the content for credential-worthy performance in an occupation or profession. A rationale should be provided to support a claim that the knowledge or skills being assessed are required for credential-worthy performance in an occupation and are consistent with the purpose for which the licensing or certification program was instituted.

# APA Standards Affecting the IBBM

**§ 14.15 Estimates of the reliability of test-based credentialing decisions should be provided.**

**APA Standards for Educational and Psychological Testing**

# APA Standards Affecting the IBBM

**§ 14.17** The level of performance required for passing a credentialing test should depend on the knowledge and skill necessary for acceptable performance in the occupation or profession and should not be adjusted to regulate the number or proportion of persons passing the test.

# Rasch Item Analysis

## Rating Scales

**“In a rating scale that accurately and reliably represents the construct being measured, items should have a consistent and predictable hierarchical relationship to each other...**

**A range of such items should consistently categorize examinees as high, low or medium performers...**

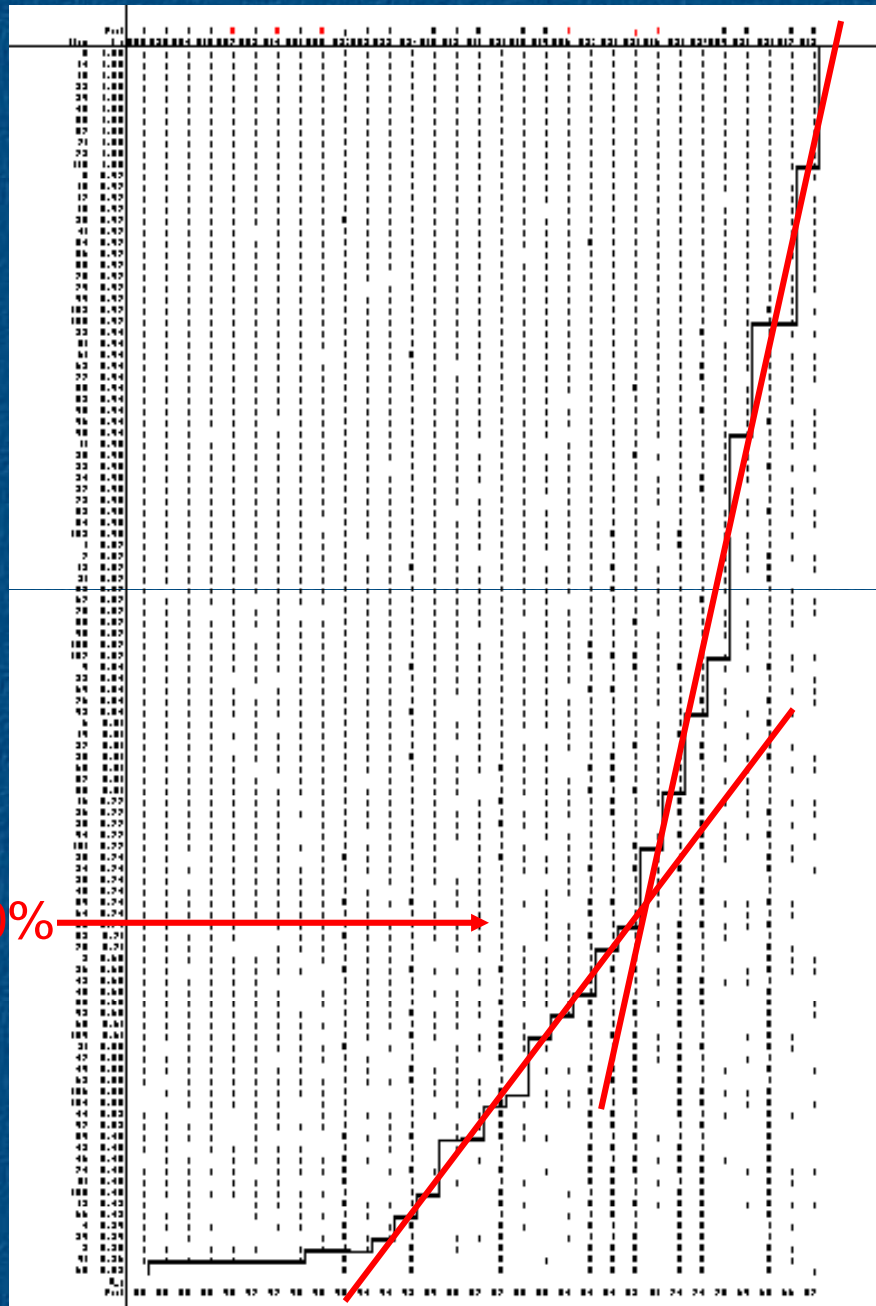
**Examinees that score high on the “harder” items should also score high on the “easier” items and on the scale overall, and vice versa.**

**Person and item reliability and separation are metrics that indicate the strength of these relationships.”**

Reference: Malec, Torsher, Dunn, et al., 2007; Wright & Masters, 2004; Bond & Fox, 2001; Anastasi, 1988

110 Item Scores Descending

70% →



31 Examinee Scores Ascending

International Board of Blood Management  
Exam Results Report

Perioperative Blood Management Technologist Certification Exam  
April 8, 2008

Examinee	E13	All Examinees
Exam #	804013	
Score	56	
Total Items	104	
Fraction	0.538	0.831
Rank	22	22
Status	Fail	

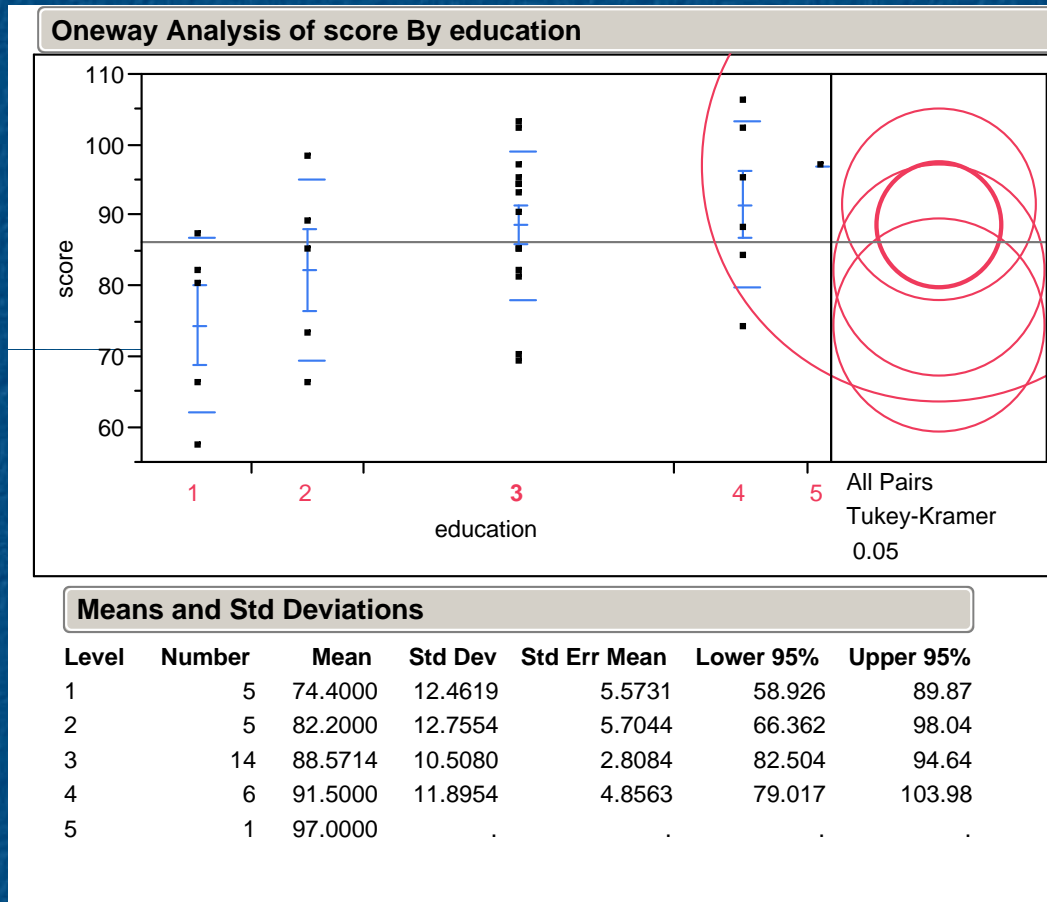
Score by Exam Plan Section <sup>1</sup>				All Examinees	
Exam Plan	# Items	Label <sup>1</sup>	Examinee 804013	Average	
1.1	4	Sterile environment	0.750	0.852	
1.2	1	Social structure	0.000	0.773	
2.1	2	Device knowledge	0.500	0.750	
2.2	9	Equipment operation	0.667	0.818	
2.3	8	Disposable supplies	0.571	0.844	
2.4	5	Manufacturer's IFUs	0.200	0.864	
2.5	4	Equipment applications	0.500	0.795	
3.1	22	Physiology, pharmacology	0.273	0.829	
3.2	3	Standards and guidelines	1.000	1.000	
3.3	10	Indications for use	0.500	0.832	
3.4	6	Contraindications and exceptions	1.000	0.826	
3.5	1	Author CPGs	0.000	0.955	
4.1	6	Medical knowledge	0.667	0.750	
4.2	11	Diagnose and troubleshoot	0.545	0.814	
4.3	11	Critical incident response	0.727	0.851	
4.4	1	Team crisis management	0.000	0.682	
<b>Total items</b>	<b>104</b>	* See <a href="http://www.intbbm.org/Certification/Certification-articles1.html">www.intbbm.org/Certification/Certification-articles1.html</a>			

Total exam and section scores are presented as fractions (i.e.: 0.850 = 85.0%).

Examinees may use the exam plan content section scores to compare themselves to the group and to identify areas of strength and areas for CME opportunity.

For more information, go to <http://www.intbbm.org/> or contact the IBBM office.

# Score v. Educational Level

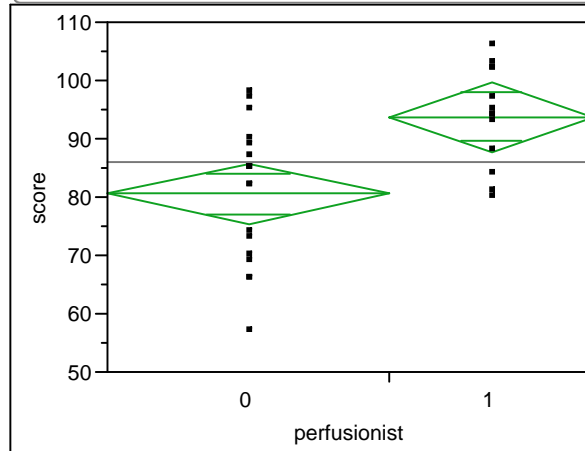


Scores increased with increasing educational level between levels 1-3 [ Level 1 is HS graduate, 2 is associate degree, 3 is BS, 4 is MS]

# Perf v. Non-Perf

The histograms for the perfusionists' (1) and non-perfusionists' (0) performance on the exam

## Oneway Analysis of score By perfusionist



## Oneway Anova

### Summary of Fit

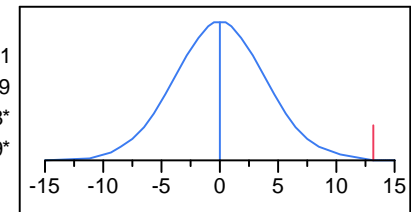
Rsquare	0.289361
Adj Rsquare	0.264857
Root Mean Square Error	10.56466
Mean of Response	86.09677
Observations (or Sum Wgts)	31

### t Test

1-0

Assuming equal variances

Difference	13.2137	t Ratio	3.436331
Std Err Dif	3.8453	DF	29
Upper CL Dif	21.0782	Prob >  t	0.0018*
Lower CL Dif	5.3492	Prob > t	0.0009*
Confidence	0.95	Prob < t	0.9991



### Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
perfusionist	1	1317.9575	1317.96	11.8084	0.0018*
Error	29	3236.7521	111.61		
C. Total	30	4554.7097			

### Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
0	18	80.5556	2.4901	75.463	85.648
1	13	93.7692	2.9301	87.776	99.762

Std Error uses a pooled estimate of error variance

# Summary

## The IBBM:

- updated the ABCA certification exam for the PBMT,
- designed the more modern exam to identify the minimally acceptable candidates, and
- followed the APA standards to provide a valid employment exam