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# Specifications Document

## Certified Clinical Transplant Nurse (CCTN) Examination

**A Program of the**

ABTC American Board for Transplant Certification

**Specifications Documented by**

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## Introduction

Applied Measurement Professionals, Inc., a PSI business (PSI/AMP) staff facilitated a job analysis in 2012 while under contract with the American Board for Transplant Certification (ABTC). Details about study methods and results are described within a report from the study. Results from the job analysis impacted the content of examinations that are assembled. Related details affecting each form of the examination are described within this specifications document.

## Objective behind the Examination

Candidates who take the examination for Certified Clinical Transplant Nurses (CCTN) will have prepared through work experience after becoming a registered nurse (RN). An eligible candidate must have become an RN at least 24 months before applying for the CCTN Examination. Additionally, an eligible candidate must have at least 12 months of work experience while directly caring for recipients who will receive or have received a transplanted solid organ. These nurses also care for persons who will donate and have donated a kidney or portion of a liver.

Solid organs (e.g., kidney, liver, heart) are distinct from other kinds of tissue (e.g., bone marrow) that can be transplanted. This distinction is made because the sources for a large volume of transplanted solid organs are persons who have recently expired.

It is legal and generally consistent with policies within hospitals for a nurse to care for donors and transplant recipients without a specialty credential beyond the RN. The objective behind the examination is to assess whether individuals who provide such care are sufficiently prepared to protect donors and recipients while facilitating optimal care during the time shortly before and after transplantation when they will be especially vulnerable to complications. The CCTN program recognizes the minimal competence of persons who voluntarily seek the certification from ABTC.

## Plan to Approve and Score Examination Items

The Examination will be assembled from items that are of the multiple-choice type. The ABTC has decided to deploy four options within each item. A typical item will have one option designated as the key, which will be worth one point when selected by a candidate. The remaining options will be worth zero points.

Persons who work as transplant nurses produce each new item. The procedure by which each new or revised item will be approved will involve an examination committee of about ten transplant nurses. Unanimous agreement must be observed about each of the following points for an item to be designated as approved within the item banking system:

- The item assesses a competency that is consequential to the program
- Content of the item links strongly to the competency described by a task classification within the detailed content outline
- The mental process by which a typical, competent candidate will arrive at the key is consistent with the cognitive level to which the item is classified
- The stem contains text that is clearly worded while efficiently presenting information that a competent candidate will need to select the key
- The best option of the four that are presented within the item is designated as the key
- Each distractor will be plausible to at least some from the candidate population

The intent behind the multi-step procedure is to promote protection of the public, encourage fairness to candidates, and minimize sources of measurement error that could negatively affect the first two goals.

Validation of the key of each new item that is subsequently implemented occurs without affecting candidates' test scores. One set of 25 items will be added to each new test form and designated as pretest items. Each pretest item is associated with a point value of zero, even when the key that had been approved by the examination committee is selected by a candidate. After a sufficient number of responses from candidates have accumulated, the key of each pretest item will be validated by members of the examination committee. Such validation is informed by a p and $r_{pb}$ value along with information about the frequency and percentage of respondents who selected each option plus the average score of each option group. Several items from a set are typically approved for inclusion on the scored-portion of a subsequent test form. A small subset of items are typically returned to the examination committee for revision.

Because of the pretesting system, items that are assembled into the scored portion of each test form must have had their keys validated by the process described above. Doing so permits delivery of results from each administration to each candidate as soon as he or she finishes the examination.

## Plan to Assess the Accuracy of Test Scores and Decisions

Because items will be dichotomously scored (1=correct, 0=incorrect), we use the Kuder-Richardson formula number 20 (KR 20) to produce an indicator of test score accuracy. KR 20 values indicate the proportion of variability in examination scores that can be attributed to variability in competence within the transplant nursing care domain. The degree to which observed scores are influenced by sources of measurement error will cause the value to fall below 1.00.

Estimates of the consistency of decisions about groups of candidates who pass and fail the examination are provided by indices that have been developed by Livingston[1] and Subkoviak[2]. Both indices estimate the proportion of a group taking a test form who would experience the same pass or fail outcome after a second attempt. Only those candidates who have scores near the cut score are associated with a detectable probability of experiencing the opposite outcome on a second attempt. The larger the measurement error, the larger is the subset of candidates who could experience an inconsistent set of decisions across two attempts. The further removed a decision consistency value falls below 1.00, the larger is the candidate subset who could experience inconsistent decisions.

We document a standard error value representing the average amount of error observed within candidates' scores plus a conditional standard error value that was observed at the cut score. The latter value particularly illuminates the amount of accuracy that was associated with test scores equal to the cut score.

[1] Livingston, S.A. (1972). Criterion referenced applications of classical test theory. **Journal of Educational Measurement**, 9, 13-26.

[2] Subkoviak, M. (1976). Estimating reliability from a single administration of a criterion-referenced test. **Journal of Educational Measurement**, 13(4), 7-10.

## Plan to Develop Examination Content over Time

Two test forms were released in 2014 to start the current cycle of test form assembly and release. We recommend that ABTC plan to conduct a job analysis as early as 2017 and no later than 2020. Anticipating that ABTC will continue to transition between testing cycles while perpetuating instant scoring for candidates, expect to start the next testing cycle two years after the year in which the job analysis is done. The intervening year will provide the opportunity to pretest items that will permit fulfillment of new test specifications after the keys of those items have been validated.

Once the current testing cycle is underway, ABTC releases one new test form each year and retires the oldest form. Hence, two test forms are maintained in the assessment center network. Examinations are solely administered by computer.

The creation of a new batch of items begins each year by comparing item frequencies in the bank to the test specifications. Assignments for new items are distributed among members of the CCTN examination committee as coordinated between the PSI/AMP test development specialist and the chairperson of the committee.

Critical to the development of quality examination content over time will be the influence of the approval procedure. Bullet points associated with item approval were described above in the section describing the Plan to Develop and Score Examination Items.

## Specifications for Test Form Assembly

A job analysis study yielded a set of task statements that were observed to be critical for transplant nurses in 2012. Refer to the study report for a description of each task and the methods by which tasks were labeled as critical.

The outline for organizing tasks that were observed to be critical by the job analysis is shown in Table 1. The first two characteristics associated with each item are as follows:

- Content domain – one of 21 domains
- Cognitive level – one of 3 levels

An item on an examination must link to a task organized under a content domain from the detailed content outline while being written to one of the three levels of cognition described in Table 1. Each form of the examination includes a set of 25 pretest items in addition to 150 scored items.

Some recipients are children, who present unique circumstances for transplant nurses. A second set of specifications affecting item assembly for each test form are described in Table 2, which holds constant a quantity of items involving pediatric patients on each test form.

Each group of recipients presents with unique issues depending on the organ that was transplanted. Remaining within the specifications and targets described in Table 3 helps to ensure standardized content among test forms when it comes to the types of cases that are described among the items on any given form. The values for minimums and maximums in Table 3 are not allowed to be exceeded or deficient for any test form. Values at the intersections of content domains and organ groups are considered targets that may fall short or be exceeded on a test form as long as the organ group minimum and maximum are satisfied for the whole test form.

In summary, examination content is controlled among test forms based on the following item characteristics:

- content domain
- cognitive complexity
- recipient age
- organ group

**Table 1. Specifications by Content Domains and Cognitive Complexities**

| ABTC Clinical Transplant Nurse | Items | | | |
|---|---|---|---|---|
| | Cognitive Level | | | |
| Content Area | Recall | Application | Analysis | Totals |
| **I. PRETRANSPLANTATION CARE** | **9** | **11** | **3** | **23** |
| A. Evaluate End-Stage Organ Failure | 1 | 1 | 1 | 3 |
| B. Monitor a Patient Awaiting Transplantation | 1 | 1 | 2 | 4 |
| C. Provide Education to a Patient Awaiting Transplantation | 2 | 5 | 0 | 7 |
| D. Provide Support for Psycho-Social Issues | 3 | 3 | 0 | 6 |
| E. Prepare Pre-Transplant Patient for Surgery | 2 | 1 | 0 | 3 |
| **II. CARE IMMEDIATELY POSTTRANSPLANTATION** | **7** | **9** | **16** | **32** |
| A. Evaluate Objective Criteria | 2 | 2 | 4 | 8 |
| B. Monitor Laboratory Results | 2 | 2 | 4 | 8 |
| C. Assess for Complications, Intervene, or Evaluate Response to Intervention | 2 | 4 | 7 | 13 |
| D. Care for the Living Donor | 1 | 1 | 1 | 3 |
| **III. TRANSPLANTATION MANAGEMENT** | **8** | **11** | **10** | **29** |
| A. Evaluate Graft Function | 2 | 2 | 3 | 7 |
| B. Recognize Signs and Symptoms of Infections | 1 | 4 | 0 | 5 |
| C. Prevent Infections | 2 | 1 | 0 | 3 |
| D. Monitor for Long Term Complications | 2 | 2 | 3 | 7 |
| E. Provide Support for Psycho-Social Issues | 1 | 2 | 4 | 7 |
| **IV. PHARMACOLOGICAL THERAPEUTICS** | **4** | **8** | **14** | **26** |
| A. Administer Immunosuppressive Drugs | 2 | 4 | 7 | 13 |
| B. Administer Transplant Related Non-Immunosuppressive Drugs | 2 | 4 | 7 | 13 |
| **V. EDUCATION AND DISCHARGE** | **6** | **17** | **2** | **25** |
| A. Discharge a Recipient Safely | 3 | 8 | 2 | 13 |
| B. Ensure the Recipient Understands the Long-Term Care Plan | 3 | 9 | 0 | 12 |
| **VI. PROFESSIONAL RESPONSIBILITIES** | **7** | **6** | **2** | **15** |
| A. Support Transplantation Research and Education | 3 | 2 | 0 | 5 |
| B. Act on Ethical/Legal Issues | 1 | 2 | 2 | 5 |
| C. Articulate Trends in Organ Donation | 3 | 2 | 0 | 5 |
| **Totals** | **41** | **62** | **47** | **150** |

**Table 2. Specifications by Recipient Ages**

| Recipient | Items |
|---|---|
| Pediatric | 10 |
| Adult or General | 140 |
| Total | 150 |

**Table 3. Specifications by Transplanted Solid Organs**

| Content Domain | Total Items | Limits on Items | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | General | Kidney | Liver | Heart | Lung | Pancreas | Intestine | Multi-Organ |
| I. PRETRANSPLANTATION CARE | 23 | 10-14 | 6-8 | 2-4 | 0-2 | 0-2 | 0-1 | 0-1 | 0-1 |
| II. CARE IMMEDIATELY POSTTRANSPLANTATION | 32 | 3-7 | 14-18 | 4-8 | 1-3 | 0-2 | 0-1 | 0-1 | 0-1 |
| III. TRANSPLANTATION MANAGEMENT | 29 | 8-12 | 10-14 | 2-6 | 0-2 | 0-2 | 0-1 | 0-1 | 0-1 |
| IV. PHARMACOLOGICAL THERAPEUTICS | 26 | 11-26 | 0-5 | 0-3 | 0-1 | 0-1 | 0-1 | 0-1 | 0-1 |
| V. EDUCATION AND DISCHARGE | 25 | 12-25 | 0-5 | 0-3 | 0-1 | 0-1 | 0-1 | 0-1 | 0-1 |
| VI. PROFESSIONAL RESPONSIBILITIES | 15 | 7-15 | 0-3 | 0-2 | 0-1 | 0-1 | 0-1 | 0-1 | 0-1 |
| Minimums | 150 | 51 | 30 | 8 | 1 | 0 | 0 | 0 | 0 |
| Maximums | 150 | 99 | 53 | 26 | 10 | 9 | 6 | 6 | 6 |

## Examination Administrations

Candidates have 180 minutes to take the examination. Test administration times are enforced by the computer system that presents items from a test form to candidates. The only exception to the testing time specifications is one that is consistent with the Americans with Disabilities Act in response to a request from a candidate who has documented the presence of a medically-recognized disability. The intent behind an accommodation is to equalize the opportunity to pass an examination for a person with a documented disability. Hence, no special notations are documented with results achieved by an accommodated candidate.

Each examination will be administered under standard procedures that are monitored by a proctor. The procedures are intended to keep the content of the examination secure, ensure that each administration occurs in an environment that is substantially similar to other administrations, and each person who takes the examination is the person who applied to take the examination. Each proctor verifies the identity of each candidate before admission to the testing center. Each candidate will capture a digital image of his or her face, which is printed on the score report that the candidate receives.

The sequence of items is scrambled within the group of candidates who take a test form. The ABTC has chosen to fix the sequence of options within each item.

## Establishing the Cut Score

The ABTC compares a cut score to the total examination score achieved by each candidate. The total examination score is the sum of each correct response to each scored item.

Although Table 1 illustrates that the examination will assess competencies across several domains, the cut score is of the compensatory type. The term *compensatory* acknowledges that it is possible for a candidate to compensate for scoring low in one content domain by scoring high in another domain. Passing will require a sufficiently high total score regardless of a candidate's score in each subdomain. The intent behind the CCTN credential is to document a sufficiently high level of competence across several subdomains, so a compensatory type of cut score is consistent with the program intent.

Methods associated with the criterion-referenced cut score study, including a description of the qualifications of the panel members and details about their deliberations were documented in a separate report that was produced in 2014. Form 9 and Form 10 began this cycle of test form assembly.

## Maintaining an Equivalent Challenge for Candidates across Test Forms

### Confidence in Item Information

Each scored item on each new test form has had its key validated and the measurement properties of each item are known at the point when assembly occurs because of the pretesting system. Confidence in the observed measurement properties for an item is linked to having included a sufficient number of cases when calculating statistics (p, $r_{pb}$) based on classic test theory. Between 50 and 100 candidates make their first attempts at the examination each year. Two test forms are maintained in the administration network, each of which has one set of pretest items. A typical new pretest item is expected to accumulate at least 75 responses from the population of first-time candidates because most forms are administered over a two-year period.

When each candidate becomes known to the system through the application process, the system randomly assigns a test form to the candidate from the list of available test forms. Because of the random assignment and adequate number of candidates responding to items on each test form, confidence in observed p and $r_{pb}$ statistics is sufficiently high. When those statistics are transferred into a spreadsheet to extrapolate test score characteristics (mean standard deviation, standard error of measurement, reliability, decision consistency), confidence in the extrapolated values is high as well.

We do not plan to aggregate candidate cases by the point in the year when the examination is taken because we expect that test administrations will occur on-demand the year around. Because the sequence of items will be scrambled when administered to different candidates, we do not plan to subsequently place an item at or near its "home" position relative to the beginning, middle, or end of the test form.

### Test Form Assembly Steps

The test form assembly plan involves satisfying the specifications without variation from what is displayed in Table 1 and Table 2. Target counts from Table 3 also influence test form assembly. When coupled with a plan to emulate the scale produced by the base form, we assert an intent to

assemble psychometrically parallel test forms that deserve the same cut score or a similar cut score as compared to the cut score that was used on the base form.

Verification of the cut score occurs by observing a linear equating result, which compares the scale characteristics and cut score from the base test form to the projected scale characteristics and cut score associated with the new test form. Form 10 was selected as the base form. Calculations built into an equating spreadsheet produce projections for the mean, standard deviation, standard error of measurement, reliability, and decision consistency that are expected to be associated with test scores from the new form. These projections are based on observed p and $r_{pb}$ values that are produced from accumulations of response information from all administrations of each item to candidates taking the examination for the first time. Such modeling within the spreadsheet assumes that candidates' abilities remain constant. The sufficient number of responses to each new item and the random assignment of test forms to candidates supports this assumption.

Items are often replaced by the examination committee as a test form progresses through the approval process. When an item is replaced on a new examination form, the person who is responsible for assembling the form must document the cut score result that is projected by the simplified linear equating formula[3]. (We have observed that the more familiar linear equating formula[4] produces the same result as the simplified formula.)

The old set of statistics is replaced with the new set within the equating spreadsheet for each item that is replaced. The same cut score that was used on the base test form is the observed result of the equating for some test forms in which case the same cut score is used for the new test form. The equated cut score may vary up or down on other occasions in which case ABTC has agreed to use a cut score for the new test form that is higher or lower than used on the base form in a magnitude that is indicated by the equating result. For example, if the equated cut value for a new test form was 107.8 and the cut score used on the base form was 107, then the cut score for the new form becomes 108.

[3] $Equated\ cut\ score = \left(\frac{Standard\ Deviation\ Y}{Standard\ Deviation\ X}\right)(Cut\ X - Mean\ X) + Mean\ Y$

Formula 20.1 in Crocker, L and Algina, J. (1986). Introduction to classical and modern test theory. Holt, Rinhart and Winston, Inc. Fort Worth, TX. p. 458-459.

[4] $Equated\ cut\ score = \left(\frac{Standard\ Deviation\ Y}{Standard\ Deviation\ X}\right) Cut\ X + [Mean\ Y - \left(\frac{Standard\ Deviation\ Y}{Standard\ Deviation\ X}\right) Mean\ X]$

Formula 2.5 in Kolen, MJ and Brennan, RL (1995). Test equating methods and practices. Springer, New York, NY. p. 30.

## Summary

The purpose of this document is to describe details associated with the assembly and use of the examination linked to the CCTN credential. The objective behind the credential is to recognize minimally competent clinical transplant nurses through a standardized examination that candidates voluntarily take. Examination forms are assembled from items of the multiple-choice type, which are dichotomously scored as correct or incorrect. A compensatory cut score is compared to each candidate's score to determine whether a candidate achieves the credential.

Each test form is assembled from items, some of which have a long legacy and other items that were recently validated. Each new item is approved while following a standard procedure, which is intended to promote public protection, encourage fairness to candidates, and minimize sources of measurement error.

Each test form is assembled according to specifications covering content domains, cognitive complexity, recipient age, and organ group. When coupled with a plan to closely reproduce the measurement scale of the base form within each new form, we assert that candidates experience an equivalent level of challenge among test forms as decisions to certify and do-not-certify are made.

## Index of Examination Features

| | Feature | Detail |
|---|---|---|
| **1.** | Job analysis year for current testing cycle | 2012 |
| **2.** | Start of current testing cycle | 2014 |
| **3.** | Forms released at start of cycle | CCTAB09A, CCTAB10A |
| **4.** | Number of forms released each year | 1 |
| **5.** | Number of forms maintained in the network | 2 |
| **6.** | Recommended time frame for next job analysis | 2017 to 2020 |
| **7.** | Recommended time frame for start of the next testing cycle | 2019 to 2022 |
| **8.** | Candidate eligibility | RN license |
| | | 24 months of nursing experience |
| | | 12 months of transplant nursing experience |
| **9.** | Objective behind examination | assess whether individuals who provide transplant nursing care are sufficiently prepared to protect donors and recipients while facilitating optimal care during the time shortly before and after transplantation when they will be especially vulnerable to complications |
| **10.** | Type of examination stimuli | multiple-choice items containing four options |
| **11.** | Examination content contributors | transplant nurses |
| **12.** | Number of members appointed to the examination committee | 10 |
| **13.** | Time between final item response submission and results delivery | 1 minute |
| **14.** | Minutes available to submit examination responses | 180 |
| **15.** | Number of scored test items | 150 |
| **16.** | Number of pretest items per set | 25 |
| **17.** | Number of pretest sets per form | 1 |
| **18.** | ADA accommodations | yes |
| **19.** | Examination administration tool | computer |
| **20.** | Item sequence scrambling for each candidate | yes |
| **21.** | Option sequence scrambling for each candidate | no |
| **22.** | Candidate response scoring scheme | dichotomous (0, 1) |
| **23.** | Reliability index | Kuder-Richardson Formula 20 |
| **24.** | Decision consistency index | Livingston |
| | | Subkoviak |

| | Feature | Detail |
|---|---|---|
| **25.** | Standard error value | Standard error of measurement |
| | | Conditional standard error of measurement |
| **26.** | Test form assembly specifications | 21 content domains |
| | | 3 cognitive levels |
| | | 10 pediatric; 140 adult or general |
| | | minimums and maximums by organ groups |
| **27.** | On-site proctor | yes |
| **28.** | On-site candidate authentication | yes |
| **29.** | Number of cut scores | 1 |
| **30.** | Cut score type | compensatory, criterion-referenced |
| **31.** | Candidate population on which Classic Test Theory item statistics are calculated | first-time |
| **32.** | Number of responses from first-time candidates last year | 57 between February 23, 2015 and February 22, 2016 |
| **33.** | Number of responses from first-time candidates expected for each pretest item | at least 50 |
| **34.** | Justification for releases of psychometrically-equivalent test forms | test form assembly specifications satisfied without variation |
| | | scale equivalence comparison between new form and base form through linear equating when scales are based on Classic Test Theory |


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