

**A** National  
Assessment  
**C**ollaboration

NAC  
ANNUAL  
TECHNICAL  
REPORT **2019**



MEDICAL COUNCIL  
OF CANADA

LE CONSEIL MÉDICAL  
DU CANADA

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## OVERVIEW

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In response to the 2004 *Report from the Canadian Task Force on Licensure of International Medical Graduates* (IMGs; Federal/Provincial/Territorial Advisory Committee on Health Delivery and Human Resources, 2004), the Medical Council of Canada (MCC) began a series of related initiatives to support the assessment and training of IMGs in Canada. A steering committee was created and convened from 2005 to 2009 to develop a framework and governance structure for a National Assessment Collaboration (NAC).

The NAC is an alliance of Canadian organizations that are streamlining the evaluation process for international medical graduates (IMGs) seeking a licence to practise medicine in Canada. A significant development of the NAC program is the pan-Canadian Objective Structured Clinical Examination (OSCE), known as the NAC Examination. The purpose of the NAC Examination (hereinafter referred to as “exam”) is to assist Canadian medical school clinical residency programs in selecting IMGs into the first year of postgraduate training. The intent of this national exam is to avoid duplication of assessments performed by provincial IMG assessment programs. Residency program directors are able to use candidate results to assist in making decisions about which IMG candidates are best qualified for entry into their programs. In 2019, the NAC exam was delivered in Alberta, British Columbia, Manitoba, Nova Scotia, Ontario, Saskatchewan, and Quebec, and was mandatory for application to the Canadian Resident Matching Service (CaRMS) in all provinces.

The National Assessment Central Coordinating Committee (NAC<sup>3</sup>) is the governing body responsible for the oversight and function of the NAC exam and reports to the MCC Executive Board.

The NAC Examination Committee (NEC), reporting to the NAC<sup>3</sup>, oversees the creation and maintenance of the NAC exam content. The NEC ensures that all content adheres to the NAC exam Blueprint, and that the overall

exam content and format meet NAC guidelines. In addition, the NEC approves the release of results, and adjudicates on issues identified in scoring and quality assurance.

Policies and procedures have been established to ensure comparability of results from year to year, faster release of results over time and uniform quality control as well as quality assurance across exam dates and jurisdictions. To this end, the MCC has developed and continues to update a library of structured procedures that help maintain uniformity in administration across regions and sites, as well as provide the basis for support materials for Standardized Patients (SPs) and Physician Examiners (PEs). The standardization of procedures is necessary to support the validity argument that differences in test scores are due to differences in candidates' abilities as assessed by the NAC exam and not to site differences. Additionally, these policies and procedures are necessary for high-volume testing programs such as the NAC where the exam sessions may be geographically distributed and results must be comparable and uniform in quality.

This report summarizes exam administration aspects as well as key psychometric properties of all test forms for the NAC exam that took place in 2019.

## 1. EXAM DEVELOPMENT

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This section describes the Blueprint and test specifications for the NAC exam, the format of the exam, how exam content is developed, and the scale and criteria used to rate competencies.

### **Blueprint and test specifications**

The NAC Blueprint was drafted over a series of meetings between 2009 and 2010 by a group of assessment experts and ratified by the NAC Steering Committee in 2010. From 2011 to 2018, the steering committee's successor group, the NEC, maintained the original blueprint except for the testing of therapeutic knowledge. In 2013, the NAC Therapeutics Exam (a written exam) was removed from the Blueprint, and the testing of this knowledge was incorporated into the testing of clinical management skills to create a revised Management & Therapeutic competency. In 2015, the NEC struck a subcommittee to consider and recommend updates to the NAC exam, and in 2019 those changes, which include the removal of Language Fluency and Organization as measured competencies, the use of key featured checklist items and a more streamlined scoring process, took effect. See Table 1 for the updated Blueprint and test specifications.

Test specifications were developed for the NAC exam and approved by the NEC to meet the Blueprint and ensure that similar content is measured on each of the test forms. Adhering to a blueprint and test specifications ensures that candidates are measured on similar content across different test forms of the exam. All exam test forms are constructed by selecting OSCE cases/stations to best represent NAC test specifications.

**Table 1** outlines the test specifications for the NAC exam and provides a summary of the required content and skills to be assessed in a test form, including clinical competencies, systems, disciplines and patient age groups. An additional constraint of gender is also included to ensure the proportional distribution of patient gender across stations.

*Table 1: Test specifications for 2019 NAC exam*

CLINICAL COMPETENCY	Recommended # of stations	SYSTEM	Recommended # of stations
History Taking	6-7	Respiratory	min 1
Physical Examination	1	Cardiovascular	min 1
Combined Hx/Px	2-3	GI	min 1
Communication Skills	min 6	MSK	2-3
Diagnosis	min 3	GU	
Data Interpretation	min 3	Endocrine	
Investigations	min 3	Neuro	
Management	min 3 Up to 20% must be TPx-specific	Mental Health	2-3
		Reproductive Health	
		Multi-system	
DISCIPLINE	Recommended # of stations	AGE <i>(age of actual patient, not necessarily SP's age)</i>	Recommended # of stations
Medicine	2-4	Newborn	1-2
Surgery	2-4	Infant 2-23 months	
Psychiatry	1-2	Child (preschool) 2-5 yrs	
OBGYN	1-2	Child (school age) 6-12 yrs	
Pediatrics	1-2	Adolescent 13-17 yrs	1-2
Geriatric Medicine	1-2	Young adult 18-44 yrs	4-5
Urgent Care	1	Adult 45-64 yrs	
		Older adult 65+ yrs	2-3
<b>GENDER</b> <i>(Gender of SP, not necessarily actual patient's gender)</i>			

The ratio of M/F cases should be no greater than 6:4

### Exam format

For each administration, the NAC exam test forms were composed of 10 operational 11-minute OSCE stations. The overall exam is designed to assess seven clinical competencies: communication skills, data interpretation, diagnosis, history taking, investigations, physical examination, and management.

In addition to completing ten operational stations, candidates completed two pilot stations that did not count towards the final score.

In each station, an SP portrayed the clinical scenario, and each candidate's performance was evaluated by a PE. Each station measured up to seven clinical competencies.

Standardized procedures, including training for PEs and SPs and data analyses, were followed to ensure that the NAC exam results were comparable across test forms for all candidates.

### **Exam content**

NAC exam content is developed by a panel of clinical subject matter experts along with experts in medical education and assessment. In this reporting year, there were several content development workshops where OSCE cases/stations were written, peer-reviewed and approved for piloting.

The NAC exam contains both operational and pilot stations. The operational stations, each including multiple items, are the basis for the candidates' reported score. Each exam also contains "blind" pilot stations that are completed under normal exam conditions but for which no score is reported to the candidates. Data obtained from these pilot stations are reviewed and analyzed after the exam. Feedback from PEs, SPs and SP trainers regarding pilot stations is also reviewed, and, if necessary, adjustments are made to the stations as a result. If significant adjustments are made to a station, the station is piloted a second time before it is used operationally.

To ensure that all NAC exams are comparable, each test form or iteration of the exam must meet specific testing criteria (see **Table 1** for test specifications).

### **Content validity**

Measuring how well a test form matches the test specifications is one piece of evidence supporting the validity of score interpretations for the intended



purpose of the examination (Kane, 2006; 2013). This section highlights the test specifications and how well each test form measures the required content and skills.

The NEC works with MCC staff to select and approve the stations for a given test form. The test forms are drafted by the NAC Test Development Officer (TDO) in accordance with the test specifications. The NEC then reviews the test forms, including individual stations, to ensure that test specifications are met and that content is at the appropriate assessment level, that of a recent graduate from a Canadian medical school. The NEC approves the final version of the content for each test form. For security reasons, each exam sitting uses a different test form.

**Table 2** shows the sampling of test specification characteristics, clinical competencies, and number of stations for each of the three forms administered. The *Recommended* column specifies the desired number of stations for each test form for each clinical competency, discipline, gender, system and age group. There was one test form administered in March (Form 1) and two test forms administered in September (Forms 2 and 3).

*Table 2: Sampling of OSCE content  
by test specifications per test form for 2019*

CLINICAL COMPETENCIES	Recommended # of stations	MARCH	SEPTEMBER	
		Form 1	Form 2	Form 3
History Taking	6-7	6	6	6
Physical Examination	1	1	1	1
Combined Hx/Px	2-3	3	3	3
Communication Skills	min 6	9	9	9
Diagnosis	min 3	7	8	7
Data Interpretation	min 3	3	4	3
Investigations	min 3	5	5	8
Management	min 3	9	7	8

DISCIPLINE	Recommended # of stations	MARCH	SEPTEMBER	
		Form 1	Form 2	Form 3
Medicine	2-4	4	5	5
Surgery	2-4	2	2	2
Psychiatry	1-2	3	1	2
OBGYN	1-2	1	2	1
Pediatrics	1-2	2	2	1
Geriatric Medicine	1-2	2	1	1
Urgent Care	1	2	2	3
<b>GENDER</b> of SP, not necessarily actual patient's gender		<b>Form 1</b>	<b>Form 2</b>	<b>Form 3</b>
The ratio of M/F cases should be no greater than 6:4		M = 5	M = 6	M = 5
		F = 4 E = 2	F = 4	F = 5

*Table 2 (cont.): Sampling of OSCE content by test specifications per test form for 2019*

SYSTEM	Recommended # of stations	Form 1	Form 2	Form 3
Respiratory	min 1	1	2	1
Cardiovascular	min 1	1	1	2
GI	min 1	1	2	2
MSK	2-3	3	3	2
GU				
Endocrine				
Neuro				
Mental Health	2-3	6	5	5
Reproductive Health				
Multi-system				
AGE*	Recommended # of stations	Form 1	Form 2	Form 3
Newborn	1-2	1	1	1
Infant 2-23 months				
Child (preschool) 2-5 years				
Child (school age) 6-12 years				
Adolescent 13-17 years	1-2	1	2	1
Young adult 18-44 years	4-5	5	5	6
Adult 45-64 years				
Older adult 65+ years	2-3	3	2	2

\* Age of actual patient, not necessary SP's age.

## Scoring candidate performance

PEs rated candidate performance relative to the standard of *a recent graduate from a Canadian medical school*. The scoring tools use a combination of short, key featured checklists and rating scales.

The key features methodology gives score points to only the critical or “key” steps a physician must take in order to manage the patient’s problem effectively. Both the patient interaction component and the oral question component (if applicable by station) are scored in this key featured format.

PEs also scored the candidates’ proficiency on a number of competencies on a five-point Likert-type scale. The five rating points, along with a description of the acceptable performance level for each competency, are described in **Table 3**.

Orientation and training materials were given to PEs to provide more specific context for these scoring tools.

Each station had one PE and, by the conclusion of the exam, each candidate had been evaluated by twelve PEs in ten operational and two pilot stations. The scores from the ten operational stations provided by each PE were used to calculate all scores as described in the *Exam Scoring* section.

**Table 3: NAC exam competency ratings**



**COMPETENCY RATINGS**

Based on this interaction, please rate **this candidate's performance in the following competencies** as compared to a recent Canadian graduate accepted into postgraduate training (for rating scale anchors, refer to RATING SCALE CRITERIA page).

**QUALITY OF HISTORY TAKING**

UNACCEPTABLE	BORDERLINE UNACCEPTABLE	BORDERLINE ACCEPTABLE	ACCEPTABLE	ABOVE
○	○	○	○	○

Acquires from the patient, family or other source a chronologic, medically logical description of pertinent events, including questioning about onset, location, duration, character, severity, etc., as appropriate to the case. Gathers information efficiently in sufficient breadth and depth to permit a clear definition of the patient's problem(s).

**DIAGNOSIS**

UNACCEPTABLE	BORDERLINE UNACCEPTABLE	BORDERLINE ACCEPTABLE	ACCEPTABLE	ABOVE
○	○	○	○	○

Discriminates important from unimportant information and reaches a reasonable differential diagnosis and/or diagnosis.

**MANAGEMENT**

UNACCEPTABLE	BORDERLINE UNACCEPTABLE	BORDERLINE ACCEPTABLE	ACCEPTABLE	ABOVE
○	○	○	○	○

Discusses therapeutic management, including but not limited to pharmacotherapy, adverse effects and patient safety, disease prevention and health promotion when appropriate. Selects appropriate treatments (including monitoring, counselling, follow-up); considers risks and benefits of therapy and instructs the patient accordingly. Identifies medication classes, except when specific drugs and dosages would reasonably be expected in the context of the clinical problem.

**COMMUNICATION SKILLS**

UNACCEPTABLE	BORDERLINE UNACCEPTABLE	BORDERLINE ACCEPTABLE	ACCEPTABLE	ABOVE
○	○	○	○	○

Uses a patient-centred approach: establishes trust and respect and shows sensitivity to the patient's needs. Provides clear information and confirms patient's understanding; encourages questions and uses repetition and summarizing to confirm and/or reinforce understanding. Respects confidentiality when appropriate. Avoids use of jargon/slang and uses tone and vocabulary appropriate to the patient. Demonstrates appropriate non-verbal communication (e.g., eye contact, gesture, posture and use of silence).

**QUALITY OF PHYSICAL EXAMINATION**

UNACCEPTABLE	BORDERLINE UNACCEPTABLE	BORDERLINE ACCEPTABLE	ACCEPTABLE	ABOVE
○	○	○	○	○

Elicits physical findings in an efficient logical sequence that documents the presence or absence of abnormalities and supports a definition of the patient's problem(s). Demonstrates sensitivity to the patient's comfort and modesty; explains actions to the patient.

**INVESTIGATIONS**

UNACCEPTABLE	BORDERLINE UNACCEPTABLE	BORDERLINE ACCEPTABLE	ACCEPTABLE	ABOVE
○	○	○	○	○

Selects suitable laboratory or diagnostic studies to elucidate or confirm the diagnosis; takes into consideration associated risks and benefits.

**DATA INTERPRETATION**

UNACCEPTABLE	BORDERLINE UNACCEPTABLE	BORDERLINE ACCEPTABLE	ACCEPTABLE	ABOVE
○	○	○	○	○

Interprets investigative data appropriately in the context of the patient's problem(s).

## NAC exam competency descriptors



### COMPETENCY DESCRIPTORS

Based on this interaction, please rate **THE QUALITY OF THIS CANDIDATE'S PERFORMANCE IN THE FOLLOWING COMPETENCIES** as compared to a recent Canadian graduate accepted into post-graduate training (for rating scale anchors, refer to RATING SCALE CRITERIA page).

UNACCEPTABLE as compared to a recent Canadian graduate accepted into postgraduate training	BORDERLINE UNACCEPTABLE as compared to a recent Canadian graduate accepted into postgraduate training	BORDERLINE ACCEPTABLE as compared to a recent Canadian graduate accepted into postgraduate training	ACCEPTABLE as compared to a recent Canadian graduate accepted into postgraduate training	ABOVE the level expected of a recent Canadian graduate accepted into postgraduate training
○	○	○	○	○

**QUALITY OF HISTORY TAKING**

Acquires from the patient, family or other source a chronologic, medically logical description of pertinent events, including questioning about onset, location, duration, character, severity, etc. as appropriate to the case. Gathers information efficiently in sufficient breadth and depth to permit a clear definition of the patient's problem(s).

**DIAGNOSIS**

Discriminates important from unimportant information and reaches a reasonable differential diagnosis and/or diagnosis.

**MANAGEMENT**

Discusses therapeutic management, including but not limited to pharmacotherapy, adverse effects and patient safety, disease prevention and health promotion when appropriate. Selects appropriate treatments (including monitoring, counselling, follow-up); considers risks and benefits of therapy and instructs the patient accordingly. Identifies medication classes, except when specific drugs and dosages would reasonably be expected in the context of the clinical problem.

**COMMUNICATION SKILLS**

Uses a patient-centered approach: establishes trust and respect and shows sensitivity to the patient's needs. Provides clear information and confirms patient's understanding: encourages questions and uses repetition and summarizing to confirm and/or reinforce understanding. Respects confidentiality when appropriate. Avoids use of jargon/slang and uses tone and vocabulary appropriate to the patient. Demonstrates appropriate non-verbal communication (e.g., eye contact, gesture, posture and use of silence).

**QUALITY OF PHYSICAL EXAMINATION**

Elicits physical findings in an efficient logical sequence that documents the presence or absence of abnormalities and supports a definition of the patient's problem(s). Sensitive to the patient's comfort and modesty; explains actions to the patient.

**INVESTIGATIONS**

Selects suitable laboratory or diagnostic studies to elucidate or confirm the diagnosis; takes into consideration associated risks and benefits.

**DATA INTERPRETATION**

Interprets investigative data appropriately in the context of the patient's problem(s).

## 2. EXAM ADMINISTRATION

This section describes procedures to standardize exam administration, including candidate orientation, responsibilities of exam administration staff, Standardized Patient training, role of Chief Examiners (CEs), and PE recruitment and training.

### Candidate orientation

The MCC provides detailed information about the NAC exam for candidates on the MCC website. Topics include what to expect on exam day, scoring and results, as well as registration information.

### Exam sites and candidate numbers

The exam sites and the number of candidates for each test form are depicted in **Table 4**.

*Table 4: NAC candidate numbers by test form 2019*

		SITES	Total # of candidates	# of first-time test takers	# of repeat test takers
<b>MARCH</b>	Form 1	AB-Edmonton, BC, MB, ON-Ottawa, ON-Toronto, SK	414	344	70
<b>SEPT.</b>	Form 2	AB-Calgary, AB-Edmonton, MB, ON-London, ON-Ottawa, ON-Sudbury, ON-Toronto, QC, SK	679	512	167
	Form 3	AB-Calgary, BC, NS, ON-London, ON-Ottawa, ON-Toronto, QC, SK	615	428	187
<b>TOTAL</b>			<b>1708</b>	<b>1284</b>	<b>424</b>

## **Exam administration staff**

Each exam site is responsible for recruiting and supervising exam administration staff. These individuals in turn work with the MCC to ensure the security of exam materials and the quality of performance of all people involved in the exam (SP Trainers, SPs, CEs, PEs, exam day staff, caterers). NAC policies and procedures provided by the MCC ensure the standardization of the exam administration. MCC staff oversees site staff, either in person or via electronic communication, on exam days across the country in addition to offering an assistance line.

## **Standardized Patient training**

Each site is responsible for hiring and supervising the SP Trainers who, in turn, oversee the SPs and assure the quality of their standardized performance on exam day(s). SPs are trained at each site using standardized NAC training material provided by the MCC. Training support is provided centrally to SP Trainers by MCC staff, primarily by the NAC Training Officer.

## **Chief Examiners**

All NAC exam sites employ physicians as CEs. The role of the CE depends on exam site size and on how the Site Administrator chooses to delegate tasks.

Each CE is responsible for:

1. Assisting with PE recruitment and training, if needed.
2. Assisting with the dry runs of SPs prior to exam day, including a final assessment of SPs' readiness to perform in a standardized manner according to their patient scripts on exam day.
3. Overseeing examiners and candidates on exam day.
4. Addressing, where appropriate, candidates' questions, concerns and complaints on exam day.

5. Reviewing and signing all incident reports recorded on exam day.

**Note:** One exam site (Nova Scotia) also hires a deputy registrar to share responsibilities with the CE.

### **Common PE recruitment requirements for all MCC exams**

- PEs or markers must be registered and in good standing with a Medical Regulatory Authority (MRA) in Canada.
- PEs or markers may be retired, but they must have an active licence with an MRA in Canada.
- PEs or markers must be practising in Canada, or they must have practised in Canada within the last 5 years.
- All PEs and markers must adhere to the MCC Code of Business Conduct.
- PEs or markers must have the ability and stamina to complete the task (e.g., uncorrected hearing loss is a serious handicap).

All exceptions must be approved by the examination manager.

### **NAC exam PE recruitment requirements**

PEs must meet ALL of the Common PE Recruitment Requirements for all MCC exams. Additionally, PEs for the NAC exam must meet the following requirements:

1. Physicians must have the Licentiate of the Medical Council of Canada (LMCC) and must provide their LMCC registration number. Physicians who DO NOT have their LMCC will be accepted as examiners under the following conditions:
  - Non-licentiate examiners must be faculty members (e.g., faculty lecturer, assistant professor, associate professor or professor).

#### **AND**

- Non-licentiate examiners must be certified by one of the following organizations and must provide their certification number:



- Royal College of Physicians and Surgeons of Canada (RCPSC)
- Collège des Médecins du Québec (CMQ)
- College of Family Physicians of Canada (CFPC)

**AND**

- Non-licentiate examiners must sign a waiver indicating that they have no intention of taking the NAC examination.
2. Physicians must have recent experience supervising clerks and/or PGY1s, and/or they must have experience as an examiner at this level of training.
  3. Physicians may be community physicians (i.e., they do not need to be faculty members if all other criteria are met).
  4. Physicians must be currently practising medicine in Canada; if they are a resident physician, they must be PGY4 or higher OR have CCFP certification at the time of the examination.
  5. If retired, physicians must be within three years of practising in Canada.

The MCC provides training to standardize PE scoring to the exam standard using a scoring exercise with guided discussions. It provides a pre-exam, online training for all new and returning PEs, and an exam-day PE training delivered by the exam sites' CEs and senior site staff.

### 3. EXAM SCORING

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In this section, we describe the quality assurance (QA) and quality control (QC) procedures related to the scoring of the NAC exam as well as what scores are reported and how they are calculated.

#### **Standard QA and QC procedures**

To ensure the accuracy and integrity of the candidates' exam day electronic records, a number of data QA steps are performed as outlined below.

PEs complete a score sheet for every candidate seen in their OSCE station. These score sheets are scanned at the exam sites and transmitted securely to the MCC. The MCC staff import the score sheets into Teleform (a Cardiff Software Inc. program) where they are reviewed. Scanning anomalies are identified (for example, a non-readable candidate barcode, PEs' pencil marks that are too faint) and corrections are made. The data are then exported electronically into a scoring application for preliminary scoring and the results are used to generate a list of candidates who fall within ten points above and below the pass score. Once the paper copies of the score sheets arrive at MCC, all the sheets for this candidate group are reviewed by staff for discrepancies against the electronic data reports. Although rare, any differences are corrected in the electronic data files to reflect the paper score sheets. The updated electronic files are then re-imported into the scoring application for final scoring and scale score transformation for all candidates. All scores are also calculated independently in parallel using the *Statistical Analysis System* (SAS®) and compared to the results from the scoring application. All values must match before results are released to candidates.

#### **Exam result approval**

The results for each administration of the NAC exam are reviewed by the NEC. The NEC approves the release of results after each administration, including special cases. Once the results have been approved by the NEC, they are imported to physiciansapply.ca and released to candidates.

When an incident occurs during the exam that may impact a candidate's performance, it is presented to the NEC as a special case. The NEC determines the severity of the impact and decides if any changes should be made to the candidate's exam results. Depending on the nature of the incident (e.g., illness, fire alarm, SP misportrayal, or a candidate's inappropriate behaviour), the NEC may decide to remove a station from a candidate's exam, award a candidate a "No Standing", or a "Denied" result.

A "No Standing" result indicates that procedural irregularities in the examination process may have seriously affected the performance of the candidate and/or may have prevented a reliable assessment of the candidate's knowledge and abilities. A "No Standing" result does not count towards a candidate's number of attempts.

A "Denied" result indicates that a candidate has been found to have committed an infraction related to the MCC's examination process and/or breached confidentiality of the examination. A "Denied" result counts as an attempt towards a candidate's total number of attempts. Additionally, candidates that are given a "Denied" result may be denied eligibility to one or more future examinations of the MCC for a specified period of time.

### **Exam result reporting**

Approximately one week after results are released to candidates, the MCC issues a Statement of Results (SOR) and a Supplemental Information Report (SIR) to each candidate through their [physicianapply.ca](https://physicianapply.ca) account (see Appendices A and B for SOR and SIR samples). The SOR includes the candidate's final result and total score, as well as the pass score. The SIR includes the candidate's final result, total score and additional information in graphic display about the candidate's domain subscores and comparative information.

The total score is reported on a standard-score scale ranging from 300 to 500. In contrast, the score profile in Figure 1 of the sample SIR displays a candidate's domain subscores in terms of a percentage. As a result, total

scores cannot be compared to domain subscores in the SIR as they are reported on different scales. Additionally, it is important to note that, because subscores have fewer items than total scores, subscores have less measurement precision. Subscores are provided to individual candidates for feedback only and are not meant to be used by organizations for selection.

The following sections outline the steps in creating the results reported to candidates, IMG programs and the CaRMS.

### Scale scores

The scale score is a candidate's total score reported on a scale that ranges from 300 to 500 (as opposed to a candidate's total raw score that is on a percentage metric). In general, there are two steps in deriving scale scores. The first step involves computing candidates' total raw scores. The second step involves transforming the total raw scores into scale scores.

#### Step 1: Calculate total raw scores

The first step in deriving a total raw score is to calculate the station score for each OSCE station with the following formula:

$$\text{station score} = \frac{\text{sum of a candidate's item scores}}{\text{sum of maximum possible item scores}} * 100$$

where the numerator is the sum of each candidate's scores on each item *i* for that station and the denominator is the sum of the maximum possible score for each item for that station. For example, a station with several checklist items, oral questions, and competency rating scales could result in the following score:

$$\text{station score} = \frac{1 + 0 + 1 + 1 + 4 + 0 + 3 + 2 + 3}{1 + 1 + 1 + 1 + 4 + 4 + 4 + 4 + 4} * 100 = \frac{15}{24} * 100 = 62.5$$

The station scores are then used to calculate the total raw score for each candidate using the following formula:

$$\text{total score} = (\text{sum of 10 station scores})/10$$

Since station scores are based on the sum of the candidate's item scores for that station, missing data needs to be taken into account so that it does not negatively impact a candidate's score. Missing data occurs when the PE does not provide a score for an oral question or does not provide a rating for a competency for a given candidate on the score sheet. When this happens, the station score is based only on the item scores provided by the PE.

In the above example, if the last item is missing from a candidate's score sheet, it is excluded from both numerator and denominator when calculating this candidate's station score as shown below.

$$station\ score = \frac{1 + 0 + 1 + 1 + 4 + 0 + 3 + 2}{1 + 1 + 1 + 1 + 4 + 4 + 4 + 4} * 100 = \frac{12}{20} * 100 = 60$$

The station score would have been 50 per cent if the missing item were treated as zero and the adjustment not applied. However, to be fair to the candidate, we exclude the missing item from the calculation of the station score and would use a station score of 60 per cent instead.

## **Step 2: Linking and scaling**

### **2a: Establishing the score scale**

Form 1 from the March 2019 exam session was the base form used for setting the pass score and establishing the new reporting scale. Once step 1 above is completed, the total raw scores are transformed into scale scores ranging from 300 to 500 for reporting purposes. Using the March 2019 session results, the new scale was established to have a mean of 400 and a standard deviation of 25. The transformation formula is as follows:

$$ScaleScore_x = (slope)(Score_x) + (intercept)$$

where

$ScaleScore_x$  is defined as the linear function to calculate the scale score for candidate X,

$slope$  is equal to 2.48 (established using form 1 candidate performance data),

*intercept* is equal to 275.30 (established using form 1 candidate performance data), and

$Score_x$  is the total raw score for candidate X.

After these transformations, all scale scores are rounded to a whole number between 300 and 500. The reported scale scores as seen by candidates and IMG programs are this rounded value. For example, a linked score of 62.5 would result in the following scale score:

$$ScaleScore_x = (2.48) * (62.5) + (275.30) = 430.3 \text{ rounded to } 430$$

For subsequent exam forms in 2019 (i.e., forms 2 and 3) and future years, the process for obtaining a scale score can be divided into two steps. The first step (2b) is to link through common stations the scores from the September 2019 exam session (forms 2 and 3) to scores from the March 2019 exam session (form 1) that was used for setting the pass score and establishing the scale. The second step (2c) is to convert the linked total scores for forms 2 and 3 to scale scores that are reported to candidates and IMG programs.

## **2b: Linking**

As described in the *Exam Development* section, for security reasons, multiple test forms are used each year. All test forms are assembled based on the same blueprint and test specifications and efforts are made to ensure they are as similar as possible in terms of content coverage. However, they inevitably differ in difficulty due to variations in clinical scenarios and tasks sampled on each test form.

The process of linking total scores statistically takes into account small differences in test form difficulty and adjusts total scores for the test form being linked so that all scores are on the same metric and can be compared. Linking also provides a way to apply the same pass score to candidates who take different test forms.

One method to link test forms is to have a subset of content appear identically across test forms. This is a common-item non-equivalent group design. The subset of content that is presented identically is called an anchor set and it is used to statistically estimate the overall ability of candidates that took each test form and the test form difficulty. For the 2019 NAC exam test forms, anchor sets were included across the three test forms and used to link candidates' total scores. Test form 1 in 2019 was selected as the base form to which all subsequent test forms in 2019 were linked. The Tucker observed score method (Kolen & Brennan, 2004) was used to link scores between NAC exam test forms starting in 2019.

### **2c: Scale score transformation**

Once total scores are calculated and linked to the base test form, the linked scores are transformed into scale scores ranging from 300-500 for reporting purposes. As described in section 2a, the new scale was established using the March 2019 session results to have a mean of 400 and a standard deviation of 25. This final transformation ensures that any differences in scale score means and standard deviations on the current test forms can be directly compared to test form 1 of 2019. For example, a mean increase from 400 to 410 or decrease from 400 to 390 would indicate that the general performance of the candidate group who took the subsequent test forms was higher or lower, respectively. The final transformation formula for forms 1 through 3 scores is as follows:

$$ScaleScore_x = (slope)(LinkedScore_x) + (intercept)$$

where

*ScaleScore<sub>x</sub>* is defined as the linear function to calculate the scale score for candidate X,

*slope* is equal to 2.48 and is applied to all test forms (based on the initial transformation of form 1, 2019),

*intercept* is equal to 275.30 and is applied to all test forms (based on the initial transformation of form 1, 2019), and

*LinkedScore<sub>x</sub>* is the linked score for candidate X.

The transformed scale score is then rounded to a whole number between 300 and 500. The reported scale scores as seen by candidates and IMG programs are this rounded value.

### **Pass/Fail status**

The pass score for this exam was set by a panel of 21 physicians from across the country, representing various specialties, demographics, and years of experience supervising students and residents. The panel recommended the pass score of 398 through a rigorous standard-setting exercise in April 2019. It was subsequently approved for implementation by the NEC in May 2019. Test form 1 from March 2019 was used to establish the pass score, and a contrasting group method was used for standard setting. Full details of the standard-setting exercise can be found in the “Technical Report on the Standard-Setting Exercise for the NAC Examination” ([mcc.ca/media/Technical-Report-on-the-Standard-Setting-Exercise-for-the-NAC-Examination-2019.pdf](http://mcc.ca/media/Technical-Report-on-the-Standard-Setting-Exercise-for-the-NAC-Examination-2019.pdf)). The established pass score of 398 was used to assign each candidate from the 2019 administration either a pass or fail status.

### **Domain subscores**

The domain subscore is a percentage score and its calculation is similar to that of a station score (i.e., the sum of a candidate’s item scores divided by the sum of maximum possible item scores multiplied by 100) except that the items associated with each domain are pulled from multiple stations. There are three subscores (reflecting three broad domains of physician activities) that are presented to candidates in their SIRs: Assessment & Diagnosis, Management, and Communication. Domain subscores are used to create the graphical displays in the candidates’ SIRs. They are not used to calculate the total score or scale scores (as outlined above); therefore, domain subscores cannot be directly compared to the candidates’ scale scores. Domain subscores are only intended to provide general feedback to candidates on their relative strengths and weakness in their performance on the NAC exam.



## 4. PSYCHOMETRIC RESULTS

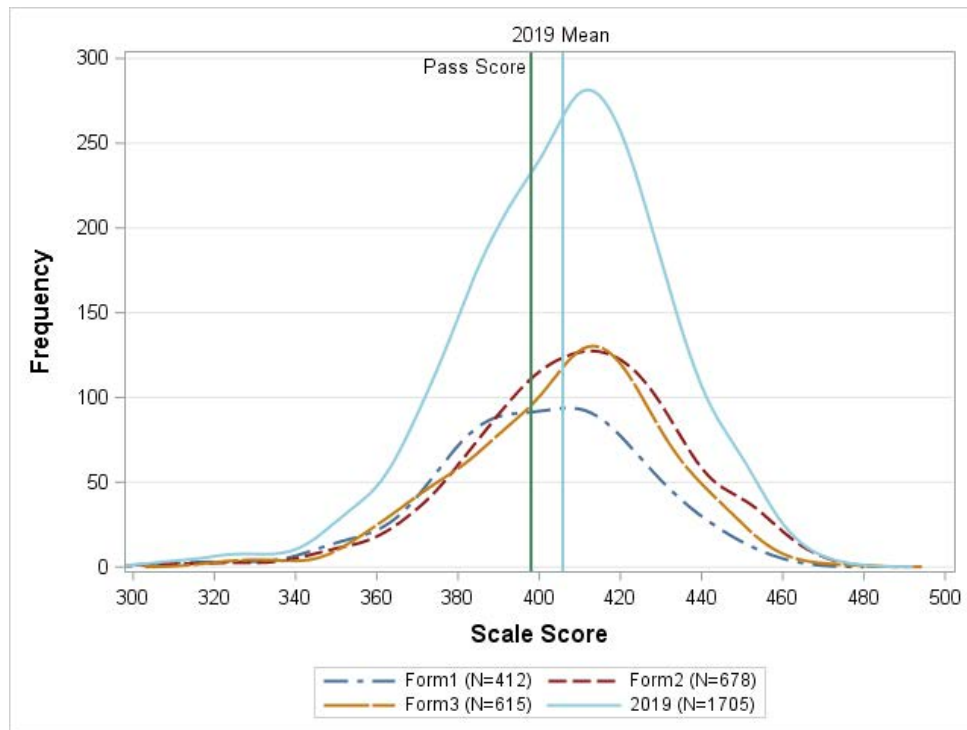
In this section, summary statistics for scale scores and pass rates are provided, as well as estimates of reliability and classification decisions, and a summary of station quality and domain subscore profiles. Results reviewed and approved by the NEC following the March and September 2019 administrations are used in this section, excluding candidates whose status is “No Standing” or “Denied” or who missed more than one station.

### Scale scores

Summary statistics and pass rates from each test form are presented in **Table 5**. The score distributions by test form and for the whole year are displayed in Figure 2. These statistics are based on the scale scores reported to candidates. The minimum, maximum, and standard deviation are indicators of the variation in scale scores.

*Table 5: Summary statistics of scale scores by form for each 2019 administration*

Administration		N	Min.	Max.	Mean	Median	SD	Pass Rate
<b>MARCH</b>	Form 1	412	310	460	400.0	401	25.0	54.9%
<b>SEPT.</b>	Form 2	678	300	471	409.0	410	25.9	68.7%
	Form 3	615	320	477	406.2	409	24.6	67.2%
<b>TOTAL</b>		<b>1705</b>	<b>300</b>	<b>477</b>	<b>405.8</b>	<b>408</b>	<b>25.5</b>	<b>64.8%</b>



**Figure 1.** Score distribution by test form and for the whole year

### Estimates of score reliability and classification decisions

**Table 6** shows the reliability estimates, the Standard Error of Measurement (SEM), the decision consistency and decision accuracy estimates along with the associated false positives and false negatives by test form. The estimated false positives indicate the expected proportion of candidates who passed based on their observed score, but who should fail based on their true ability. The estimated false negative rate indicates the expected proportion of candidates who failed based on their observed score, but who should pass based on their true ability.

#### Cronbach's alpha

Cronbach's alpha was used to estimate score reliability for the NAC exam. This reliability estimate is described in *Educational Measurement* by Haertel

in section 2.4.4 (Haertel, 2006). The formula for Cronbach's alpha is:

$$\alpha\rho_{XX'} = \frac{n}{n-1} \left( 1 - \frac{\sum \sigma_{X_i}^2}{\sigma_X^2} \right)$$

where  $n$  is the number of stations,  $\sigma_{X_i}^2$  is the score variance for station  $i$ , and  $\sigma_X^2$  is the variance of the total scores (Haertel, 2006, p. 74). A score reliability estimate indicates the desired consistency (or reproducibility) of exam scores across replications of measurement (Crocker & Algina, 1986; Haertel, 2006). Cronbach's alpha for each form is included in **Table 6**. The reliability estimate in conjunction with the total exam SEM can provide further evidence of the reliability of the candidate's scale score.

### **Standard error of measurement (SEM)**

The SEM provides a value that can be used to construct a confidence range (for example, +/- 1 SEM and +/- 2 SEM represent 68 per cent and 95 per cent, respectively) within which a candidate's observed score is expected to fluctuate if the candidate was to repeat the exam over and over again. The SEM value should be as small as possible so that the measurement of the candidate's ability contains as little error as possible. The SEM is calculated as follows:

$$SEM = \sigma_X \sqrt{1 - \alpha\rho_{XX'}}$$

where  $\sigma_X$  is defined as the standard deviation for the total score (square root of the variance), and  $\alpha\rho_{XX'}$  is defined as the reliability estimate as shown above. The SEM on the scale score for each form is listed in **Table 6**.

### **Decision accuracy and decision consistency**

A critical concern for a high-stakes exam such as the NAC exam is the reliability of a pass/fail decision. This can be assessed by examining the consistency and accuracy of pass/fail decisions based on exam scores. Decision consistency and decision accuracy can be estimated using the Livingston and Lewis (1995) procedure. Decision consistency is an estimate of the agreement between the pass/fail classifications on potential parallel

forms of the exam. Decision accuracy is an estimate of the agreement between the pass/fail classifications based on observed exam scores and those that would be made based on their true scores (i.e., observed score  $\pm$  measurement error).

**Table 6** includes the decision consistency and decision accuracy estimates for each form. Ideally, both of these values should be high, such as 0.80 and above, suggesting reliable and valid pass/fail classifications. A value of 0.80 indicates that either the accuracy or the consistency of the decision is being met for 80 per cent of the candidates. It should be noted that reliability is impacted by both the amount of variability in candidate scores and the number of items or stations included in any given exam. Other things being equal, reliability increases with the increase in the number of items or stations. For an OSCE such as the NAC exam, given the limited number of stations that can be realistically administered in any test form, it is more difficult to obtain high reliability estimates.

*Table 6: Reliability estimate, SEM, decision consistency and decision accuracy by form for each 2019 administration*

	MARCH	SEPTEMBER	
	Form 1	Form 2	Form 3
<b>Reliability estimate</b>	0.68	0.75	0.65
<b>SEM</b> (scale score)	14.24	13.01	14.50
<b>Decision consistency</b>	0.75	0.82	0.77
False positive	0.12	0.09	0.12
False negative	0.13	0.09	0.11
<b>Decision accuracy</b>	0.82	0.87	0.84
False positive	0.07	0.05	0.06
False negative	0.11	0.08	0.10

## OSCE station statistics

Summary statistics for each of the OSCE stations by administration and form are provided in **Table 7**. The percentages of missing data, average station scores (p-values), standard deviation and station total correlations (STCs) are presented.

P-values are the average proportion of correct scores that candidates achieved on each of the stations. In general, p-values indicate station difficulty. P-values range between 0 and 1. Station p-values that are low ( $< 0.20$ ) indicate a difficult station and those that are high ( $> 0.90$ ) indicate an easy station. P-values are sample dependent, i.e., they are influenced by both the size and the overall ability of the sample. Therefore, p-values should not be overinterpreted or used as the only indicator of difficulty. Rather, p-values provide a general sense of the range of difficulty of stations on a particular test form.

Standard deviations indicate the general variability of station scores. The STCs are indicators of discrimination between low- and high-ability candidates for a given station. A low or negative STC ( $< 0.30$ ) indicates that there is a weak or negative relationship between the station score and the overall exam score and the station is not adequately discriminating between low- and high-ability candidates. This may lead to high-ability candidates not scoring as well as expected, and low-ability candidates scoring better than expected. This information, along with p-values, is useful in flagging stations that should be reviewed by content experts and possibly removed from scoring. A moderate to high STC ( $\geq 0.30$ ) indicates that high-ability candidates are performing well on a given station. Stations with STCs that are below 0.30, as well as those with negative values are flagged for review. Flagged stations are retained for scoring if their content is deemed acceptable by physician experts.

*Table 7: Summary statistics for OSCE stations by form for each 2019 administration*

MARCH								
FORM 1								
Station	% Missing	p-value	SD	STC				
1	0.24	0.61	0.19	0.42				
2	1.18	0.53	0.16	0.39				
3	0.44	0.56	0.16	0.39				
4	0.25	0.45	0.23	0.33				
6		0.56	0.24	0.31				
7	0.24	0.32	0.19	0.27				
8	0.26	0.49	0.24	0.32				
10		0.50	0.18	0.34				
11	0.24	0.48	0.20	0.24				
12		0.53	0.20	0.35				
<b>Mean</b>	<b>0.41</b>	<b>0.50</b>	<b>0.20</b>	<b>0.34</b>				

SEPTEMBER								
FORM 2					FORM 3			
Station	% Missing	p-value	SD	STC	% Missing	p-value	SD	STC
1		0.63	0.19	0.39	0.36	0.43	0.20	0.32
2	0.44	0.58	0.17	0.43	0.52	0.49	0.18	0.37
3		0.52	0.17	0.43	0.22	0.60	0.18	0.34
4	0.66	0.54	0.24	0.37	0.49	0.55	0.20	0.17
6	0.27	0.66	0.21	0.47	0.04	0.54	0.29	0.32
7	0.57	0.54	0.21	0.36		0.44	0.19	0.28
8	0.27	0.63	0.19	0.42	0.13	0.59	0.17	0.39
10	0.15	0.48	0.23	0.40	0.04	0.53	0.18	0.33
11	0.41	0.52	0.20	0.46	0.33	0.64	0.20	0.36
12	0.15	0.59	0.20	0.41	0.33	0.58	0.21	0.35
<b>Mean</b>	<b>0.36</b>	<b>0.57</b>	<b>0.20</b>	<b>0.41</b>	<b>0.27</b>	<b>0.54</b>	<b>0.20</b>	<b>0.32</b>

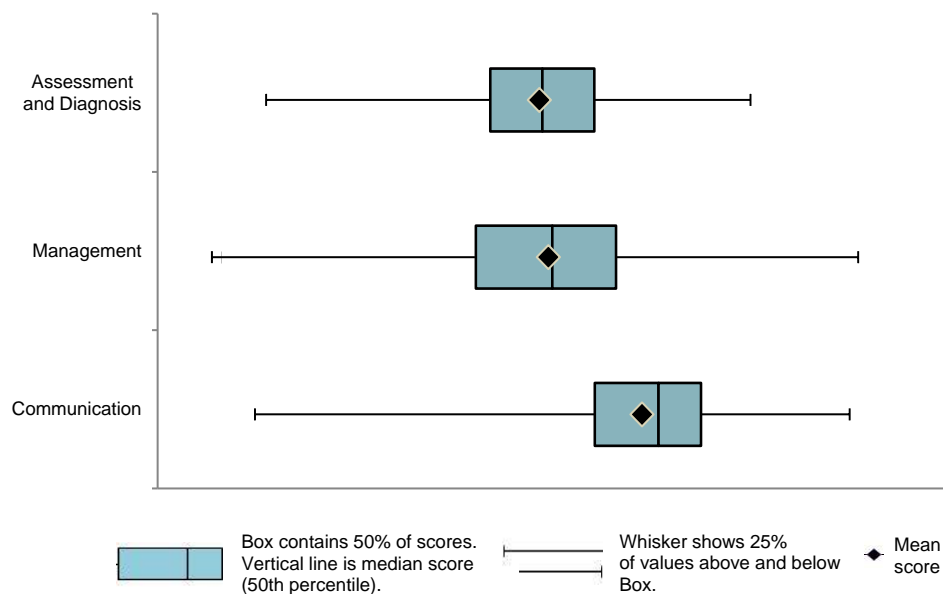
### Domain subscore profiles

The purpose of the domain subscore profile is to provide general feedback to candidates by highlighting their relative strengths and weaknesses on three broad categories of physician activities assessed by the NAC exam. A

domain subscore profile is presented in the form of a graph to each candidate in the SIR (see Appendix B for a sample SIR). The graph shows the domain subscore for each of the three domains and the SEM around the domain subscore. The calculation of the domain subscores for each candidate is outlined in the section 3 in this report.

This section provides domain subscore profiles for each of the three test forms in 2019. The range of domain subscores for each test form is shown graphically in **Figures 2 through 4**. The boxes for each domain indicate the range for 50 per cent of candidates' domain subscores. The vertical line represents the median or 50th percentile domain subscore. The remaining 25 per cent of domain subscores are shown to the right or left of the box as a line. The mean domain subscore is indicated by the diamond.

Note that domain subscore profiles cannot be compared across test forms as they are created for individual test forms and they are not linked statistically across forms like the total exam scores.



*Figure 2. Domain subscore profile for test form 1, 2019*

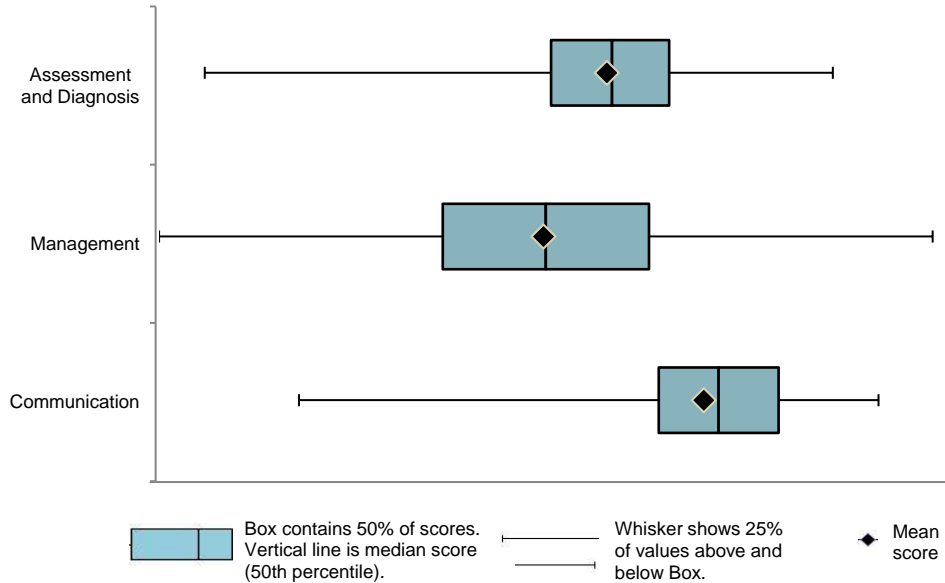


Figure 3. Domain subscore profile for test form 2, 2019

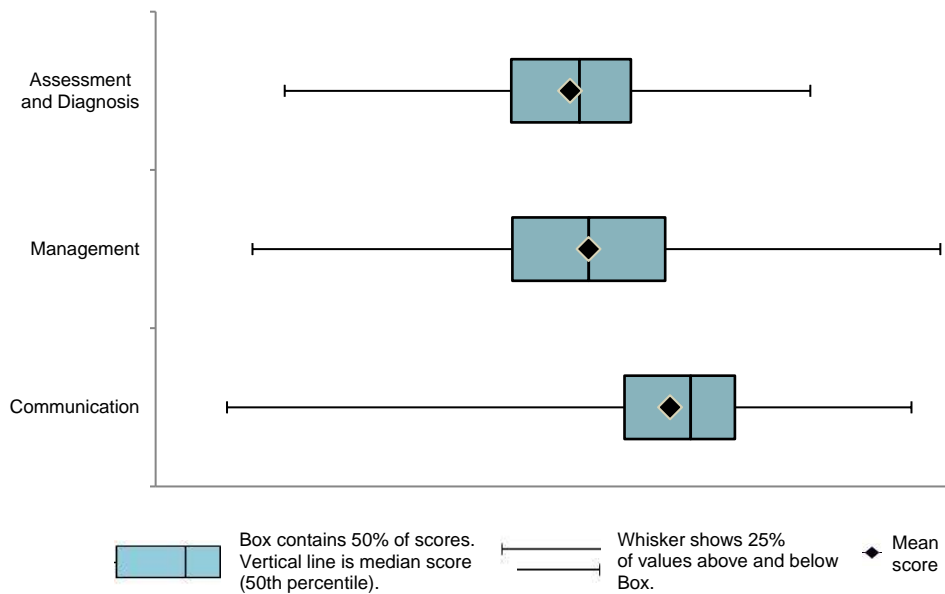


Figure 4. Domain subscore profile for test form 3, 2019



## Historical comparisons

**Table 8** presents candidate performance data for the total group, first-time test takers and repeat test takers. Only the data from 2019 are presented since this was the first year that the NAC exam based on a new blueprint was implemented. Data prior to 2019 are not included as the previous NAC exam was very different in terms of blueprint, format, scoring approach, pass score, and score scale. The 2019 data will be included in the technical report in future years for historical comparisons. For historical data on the previous NAC exam prior to 2019, please see “2018 NAC Annual Technical Report” ([mcc.ca/media/2018-NAC-Annual-Report.pdf](http://mcc.ca/media/2018-NAC-Annual-Report.pdf)).

*Table 8: Candidate performance data for 2019*

Year	Session	TOTAL		First-time test takers		Repeat test takers	
		# Tested	Pass rate	# Tested	Pass rate	# Tested	Pass rate
2019	Total	1705	64.8%	1281	63.9%	424	67.5%
	March	412	54.9%	342	53.5%	70	61.4%
	Sept.	1293	68.0%	939	67.7%	354	68.6%

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## APPENDIX A:

### NAC Examination Statement of Results (SOR)

	<b>National Assessment Collaboration Examination Statement of Results</b>
<b>Candidate name:</b> XXXXXXXXXXX, XXXXX	
<b>Candidate code:</b> 11111111111	
<b>Examination session:</b> March 2019	<b>Your final result:</b> Pass
<b>Pass score:</b> 398	<b>Your total score:</b> 450
May 24, 2019	
We are writing to inform you of your final result on the National Assessment Collaboration Examination.	
Your total score is reported as a scaled score ranging from 300 to 500 with a mean of 400 and a standard deviation of 25. The mean and standard deviation were set using the results from the March 2019 session.	
Your final result is based on your total score relative to the pass score.	
For more information, please visit the exam's Scoring web page on our website, <a href="http://mcc.ca">mcc.ca</a> .	
Supplemental information on your examination performance is reported to you in a separate document within your <a href="http://physiciansapply.ca">physiciansapply.ca</a> account.	
 <a href="http://mcc.ca">mcc.ca</a> <a href="http://physiciansapply.ca">physiciansapply.ca</a> <a href="http://inscriptionmed.ca">inscriptionmed.ca</a>	

# APPENDIX B:

## NAC Examination Supplemental Information Report (SIR)



National Assessment  
Collaboration Examination  
Supplemental Information Report

**Candidate name:** Aaaaaaaaaa, Zzzzzzzzzzz-Zzzzz  
**Candidate code:** 1111111111      **Your final result:** Pass  
**Examination session:** March 2019      **Your total score:** 456

This report provides you with supplemental information on your performance on the National Assessment Collaboration (NAC) Examination.

The NAC Examination assesses core abilities to apply medical knowledge, demonstrate clinical skills, develop investigational and therapeutic clinical plans, as well as demonstrate communication skills at a level expected of a medical graduate entering into postgraduate training in Canada.

The exam assesses your performance across three broad domains that reflect a physician's scope of practice as indicated in the following table. Each domain is assigned a weighting on the exam and the content weights are expressed as percentages.

Domains	Weighting (%)
Assessment and Diagnosis	70 ± 5
Management	15 ± 5
Communication Skills	15 ± 5

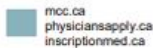
See p. 2 of this report for the domain definitions.

Figure 1 displays your performance in each domain. We provide your subscores along with the mean subscore of first-time takers who passed the same exam. We also provide the standard error of measurement (SEM) for each of your subscores. It represents the expected variation in your subscore if you were to take this exam again with a different set of questions covering the same domains.

Small differences in subscores or overlap between SEMs indicate that performance in those domains was somewhat similar. Overlap between the SEM and the mean score of first-time takers who passed signifies that performance is similar to the mean.

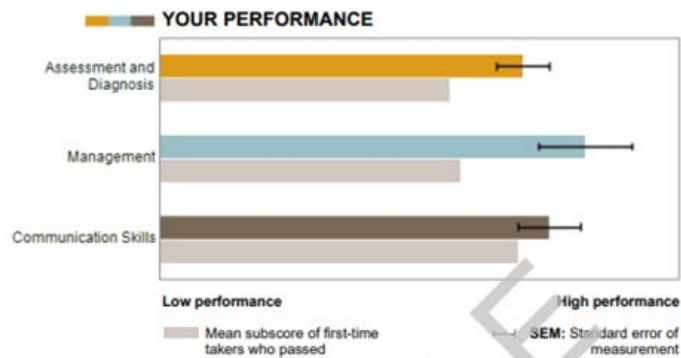
**Subscores are based on less data than the total score and have less precision. Your total score and subscores cannot be compared as they are calculated differently. The pass score cannot be applied to Figure 1.**

For more information, please visit the exam's Scoring web page on our website, [mcc.ca](http://mcc.ca).



mcc.ca  
physiciansapply.ca  
inscriptionmed.ca

Figure 1: NAC Examination score profile



The following defines the three domains assessed by the exam:

- **ASSESSMENT AND DIAGNOSIS** covers the following physician activities:
  - **History Taking:** Acquires from the patient, family or other source a chronologic, medically logical description of pertinent events; gathers information in sufficient breadth and depth to permit a clear definition of the patient's problems.
  - **Physical Examination:** Elicits physical findings in an efficient logical sequence that documents the presence or absence of abnormalities, and supports a definition of the patient's problems; sensitive to the patient's comfort and modesty; explains actions to the patient.
  - **Diagnosis:** Discriminates important from unimportant information and reaches a reasonable differential diagnosis and/or diagnosis.
  - **Data Interpretation:** Interprets investigative data appropriately in the context of the patient's problems.
  - **Investigation:** Selects suitable laboratory or diagnostic studies to elucidate or confirm the diagnosis; takes into consideration associated risks and benefits.
- **MANAGEMENT:** Discusses therapeutic management, including but not limited to pharmacotherapy, adverse effects and patient safety, disease prevention and health promotion, when appropriate; selects appropriate treatments (including monitoring, counseling, follow-up); considers risks and benefits of therapy and instructs the patient accordingly.
- **COMMUNICATION SKILLS:** Uses a patient-centered approach; establishes trust and respect, and shows sensitivity to the patient's needs; provides clear information; confirms patient's understanding (encourages questions, and uses repetition and summarizing to confirm and/or reinforce understanding); respects confidentiality when appropriate; speaks clearly (volume and rate); avoids use of jargon/slang and uses vocabulary appropriate to the patient; demonstrates appropriate non-verbal communication (e.g., eye contact, gesture, posture and use of silence).