The Role of Standardized, Performance-based Examinations for Licensure: A Pandemic View from Optometry

Brooke Houck, Ph.D.
National Board of Examiners in Optometry
June 14, 2021

During 2020, the United States experienced a pandemic unlike any other in modern history, comparable only to the Spanish influenza outbreak of 1918-1920. During COVID-19 pandemic, governmental orders were issued at the federal, state, and local level to help protect public health. As these orders and directives rolled out, the National Board of Examiners in Optometry (NBEO) made the difficult decision to temporarily suspend testing at the National Center for Clinical Testing in Optometry (NCCTO), beginning on March 17, 2020.

Of the three-part series of licensure examinations that NBEO administers, the NCCTO in Charlotte, NC is the only testing location over which the organization can make decisions about opening or closing based on public health. Part III Clinical Skills Testing is administered at the NCCTO; however, Part I Applied Basic Science (ABS) and Part II Patient Assessment and Management (PAM), inclusive of the Treatment and Management of Ocular Disease (TMOD) exam are administered at Pearson VUE Professional centers across North America. Both Part I ABS and Part II PAM are typically scheduled for administration during March and April every spring. During the onset of the pandemic in the U.S., and without prior warning to NBEO, Pearson VUE also made the decision to close testing centers. Like most businesses in the nation, closures were abrupt and disruptive, yet necessary to ensure the safety of public health and to comply with governmental regulations. In short, the temporary suspension of testing at the NCCTO as well as the cancellation of exams at Pearson VUE Professional centers disrupted the testing schedule for many optometry candidates.

This paper explores the implications of the decisions made due to the pandemic. The experiences of the pandemic have opened a window for reflection on the role of clinical skills testing in licensure examinations.

Different Decisions for Different Organizations

Pearson VUE centers began reopening at partial capacity as regulations about social distancing shifted across the states. NBEO was able to reschedule candidates whose test were canceled by Pearson VUE for Part I ABS and Part II PAM over the course of the summer and fall of 2020. The NCCTO reopened on May 18, 2020, and all candidates in the class of 2020 had the opportunity to complete the Part III CSE by the end of June 2020.

However, other medical licensing entities made different choices in response to the pandemic. The American Board of Surgery (ABS) elected to offer their General Surgery Qualifying Exam, a 300 question, multiple choice exam that takes approximately 8 hours, through a remote proctored administration (*ABS Update Regarding the July 16-17 General Surgery Qualifying Exam*, 2021). The United States

Medical Licensing Examination® (USMLE®) closed administration of their Step 2 Clinical Skills examination in May 2020 (*United States Medical Licensing Examination | Announcements*, 2021). Similarly, the National Board of Osteopathic Medical Examiners (NBOME) also suspended the administration of the Comprehensive Osteopathic Medical Licensing Examination of the United States® (COMLEX-USA®) Level 2 Performance Evaluation (PE) in March 2020 (*Timeline — NBOME*, 2021).

Figure 1. Balancing Alternative Test Delivery Methods

As early as April 2020, NBEO began looking at alternative test delivery options. In August of 2020, Association of Regulatory Boards of Optometry (ARBO), in conjunction with NBEO, commissioned a task force to examine possible alternatives to NBEO's historical testing modalities (at Pearson Professional Centers and at the NCCTO). Figure 1, taken from the work of the task force, illustrates the challenge at hand – balancing exam validity, reliability, & security with the safety of candidates and testing staff. The Task Force ultimately recommended the following guidance to the NBEO Board of Directors:

1. Examination integrity, reliability, and validity must be maintained,
2. Any changes to testing should be able to be implemented within a 3-month time frame,
3. NBEO should make accommodations in the Part III CSE testing schedule to accommodate group travel for students from the schools and colleges of optometry,
4. NBEO should further investigate the feasibility of a temporary testing site on the west coast,
5. Consider outreach for potential advocacy efforts by other organizations,
6. NBEO should continue to negotiate scheduling options for the computer-based examinations with Pearson VUE.

Different Outcomes for Different Decisions

The NCCTO was closed temporarily for cleaning and the implementation of safety protocols with regards to the pandemic. After reopening, optometry candidates in the class of 2020 had an opportunity to complete the Part III CSE by June 25, 2020. The NCCTO remained open and resumed the regular testing schedule for the 2020-2021 academic year, without interruption. The decisions of the NBEO during the pandemic led to a scenario where no optometry candidate was blocked from seeking licensure because of the inability to test due to testing center closure.

In contrast, the American Board of Surgery experienced tremendous setbacks and technical problems in the implementation of the remote proctored administration of the General Surgery Qualifying Exam. The issues were severe enough that testing was stopped mid-administration, with the ABS issuing the following statement,

> "The attempted administration of the virtual 2020 American Board of Surgery General Surgery Qualifying Exam was a failure. There is no way to sugarcoat it, and there is nothing that we, as an organization, can say right now to make those who were affected feel any better… While we cannot give you back the time that you spent studying, away from your family, in the midst of the worst public health crisis that we have seen in a century, we can and will refund exam fees

> starting immediately" (*ABS Issuing Refunds, Launching Security Investigation for Virtual 2020 General Surgery QE*, 2021).

Similarly, it was announced on May 15, 2020 that the NBME was conducting research to explore the use of remote proctoring for the USMLE® Step 2 Clinical Skills examination, and that the exam should be ready in 3-6 months. Eleven days later, it was announced that the USMLE® Step 2 Clinical Skills was being suspended for 12-18 months due to the complexity of transitioning from an in-person OSCE to an online format. By the end of January 2021, USMLE® announced that the work to relaunch the Step 2 Clinical Skills was being discontinued, and that there were "no plans to bring back Step 2 CS" (*United States Medical Licensing Examination | Announcements*, 2021).

Lastly, NBOME formed the Special Commission on Osteopathic Medical Licensure Assessment, whose first goal was the review and endorsement of temporary pathways for the Class of 2021 and 2020 to be eligible for the COMLEX-USA Level 3, given that the COMLEX-USA® Level 2 Performance Evaluation (PE) was suspended (*Pathway for Classes 2020 and 2021 — NBOME*, 2021). The final report of the Commission is expected to be released in July 2022 (*Timeline — NBOME*, 2021). Until then, the national testing centers that administered the COMLEX-USA® Level 2 Performance Evaluation (PE) remain closed, and the staffing positions necessary to support them have been eliminated.

Context

In the wake of the decisions by NBME and NBOME, national, standardized OSCEs and other performance-based exams have come under scrutiny. This report highlights the importance of clinical skills testing, particularly in the field of optometry, and more generally for public protection against medical incompetence and / or malpractice.

Competency

Traditionally, clinical competency assessment was "based on a general impression derived from repeated student-teacher interactions" (Rossel & Kakta, 1990, p. 17). This general definition covers all medical professions; the notion of clinical competency – that some physicians seem to be more competent than others, naturally led to the need to assess clinical competency. The first widely-used, broadly accepted method for assessing clinical competency was the bedside clinical examination, which was considered a milestone in healthcare education (Harden et al., 2015). Historically, a candidate would spend roughly an hour with a single "long" case, after which they would meet with examiners to discuss the case, telling the examiners the details of the patient's history, symptoms and physical signs, possible diagnoses, and a plan for management of the problem (Harden et al., 2015). This kind of assessment of clinical skills was considered the most important assessment for determining a student's competence to begin to practice independently or under supervised practice (Stokes, 1974).

However, the bedside examination approach received criticism for its low reliability and limited validity (Harden et al., 2015; Krichbaum et al., 1994; Rossel & Kakta, 1990; Sloan, Donnelly, Drake, et al., 1995). Assessments were often idiosyncratic to institutions, and even varied among clinical instructors within institutions. For example, Krichbaum, Rowan, et al. (1994) discuss the bedside examination in the field of nursing:

> "Faculty have not agreed on expectations for performance. Rather, depending on tacit values of individual teachers or of the school of nursing, faculty have employed a variety of evaluation

> strategies to determine the quality of students' clinical performance…Personal traits were measured subjectively by the instructor, who decided which students met the expectations and which did not. This approach to the process of evaluating clinical performance… is highly subject to bias" (1994, pp. 395–396).

Specifically, overall exam reliability -- the ability of an exam to repeatedly yield similar results for similarly competent examinees -- for these kinds of assessments was highly problematic due to their varied structure and content (Ballister, 2018; Burke, 2020; Harden et al., 2015). It became clear that in order to uniformly measure clinical competency, it was necessary to adhere to a uniform understanding of the components of clinical competency.

Defining Clinical Competency

In optometry in the United States, there is currently a minimal requirement of clinical competency in order to be granted a license to practice. Licenses are granted by State Boards of Optometry, who rely on one unified, national exam series that indicates candidate competency. State boards of optometry typically require candidates to (1) have graduated from an Accreditation Council on Optometric Education (ACOE) accredited optometry degree program and (2) pass the NBEO "entry-level licensure exam administered by the [NBEO]" (*ARBO FAQ*, 2021).

An optometrist who is minimally competent to enter into independent practice has sufficient knowledge of…
Anatomy
Biochemistry / Physiology
Immunology / Microbiology / Pathology
Optics
Pharmacology,

is sufficiently able to…
Review clinical presentations and synthesize clinical data in order to correctly diagnose, treat, and manage optometric patients within standards of ethics, and knowledge of public health,

and has demonstrated competency in…
Patient Communication
Affective Skills
Psychomotor Skills
Clinical Observation & Reporting Skills

Figure 2. Competency in the practice of optometry.

The rationale for optometric licensing processes given by ARBO is as follows,

> "Assembling a quality optometrist population to meet the needs of the public begins with licensure…the state ensures all practicing optometrists have appropriate education and training, and they abide by *recognized standards* (emphasis added) of professional conduct while serving their patients….Candidates for licensure must also complete a rigorous examination, designed to assess an optometrist's ability to apply knowledge, concepts and principles that are important in health and disease and that constitute the basis of safe and effective patient care" (*ARBO FAQ*, 2021).

That is, the process of obtaining a license to practice optometry rests upon determining if a candidate is minimally competent to enter into independent practice, based upon a codified understanding of competency.

Measuring Competency

Given the psychometric challenges of the bedside clinical examination, a new process for measuring clinical competency was needed. The advent of the *Objective Structured Clinical Examination* (OSCE) presented an innovative approach in gauging clinical competency (Harden et al., 1975; Harden & Gleeson, 1979). The OSCE evolved out of the need to control for biases that are inherent in other modes of assessment for clinical skills (Benett, 1993). In performance-based assessment, there are 3 primary variables that must be accounted for, shown in Figure 3, reproduced from (Harden et al., 2015, p. 4) – the student, the patient / standardized patient, and the examiner.

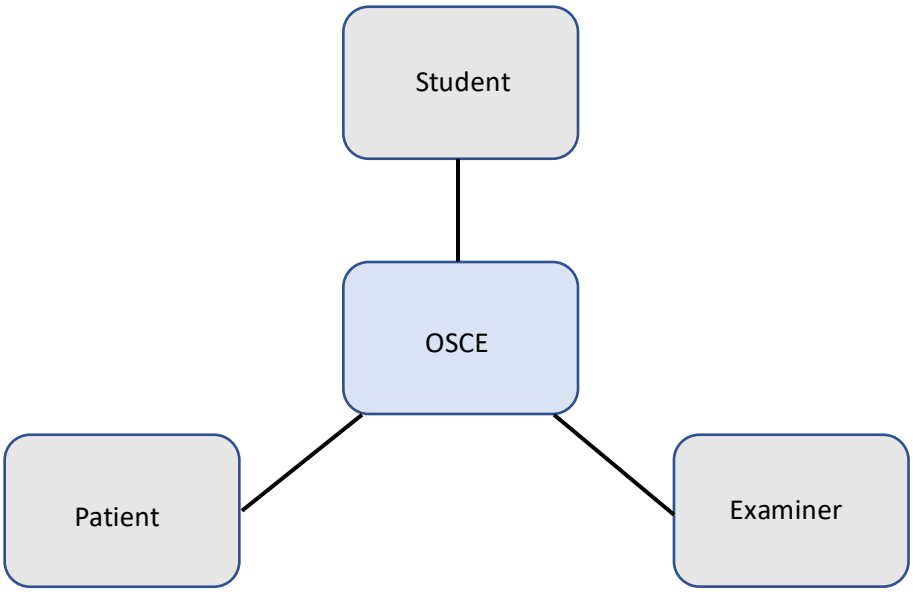

Figure 3. Three variables present in a performance-based exam. Reproduced from (Harden et al., 2015, p. 4).

Whereas previous methods of clinical skills assessment did not adequately control for differences among patients and examiners, the OSCE format reduces measurement error by providing, to the greatest extent possible, standardized, homogenous patients and examiners. By standardizing those two variables, the extent to which scores on the exam vary among students can be attributed to differences in student performance or ability, rather than to random differences between patients and examiners.

Additionally, the OSCE format is an improvement upon other performance-based assessment structures because it increases exam reliability by providing multiple opportunities for students to demonstrate mastery, the OSCE format yields higher reliability than previous forms of skills assessment; the number of stations in an OSCE is positively related to exam reliability (Joorabchi, 1991), often statistically

represented by Cronbach's alpha (Cronbach, 1951). Studies of validity and reliability of OSCE exams demonstrate the psychometric advantages of using this method of assessment, essentially making it the "gold standard" for a standardized assessment of clinical skills (Benett, 1993; Fink et al., 2021; Schuwirth & Van der Vleuten, 2003; Schwartzman et al., 2021; Sloan, Donnelly, Schwartz, et al., 1995; Sloan et al., 1993; Wallace et al., 2002).

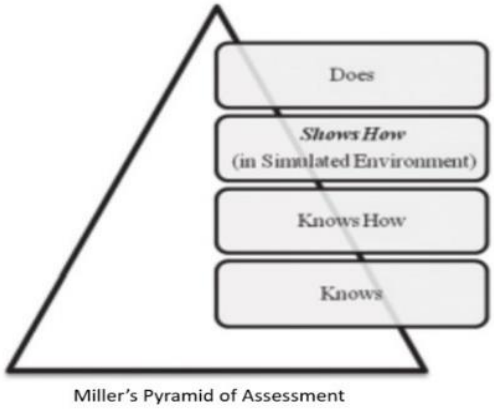

Figure 4. Miller's pyramid adapted from Khan et. al., 2013.

In their review of performance-based assesments, Swanson, Norman, & Linn (1995) provided a broad overview of the strengths and challenges of the four primary approaches to performance-based assessment in the health professions – *Patient Management Problems* (PMPs), *Computer-Based Clinical Simulations, Oral Examinations, and Standardized Patients* (SPs). The Standardized Patient aproach to which the authors refer is the OSCE format (1995, p. 6). They conclude that, "Neither traditional testing nor performance-based assesments are a panacea….Performance-based test, used well, can clearly assess skills that cannot be measured with traditional written tests" (1995, p. 11). In fact, the authors conclude that the use of a group of testing methods (i.e. clinically oriented multiple choice tests and performance-based assessment of clinical skills) will provide a better, more comprehensive, measurement of an examinee's competency than using one single method (Swanson et al., 1995). This conclusion supports the most common conceptual framework for assessing clinical competency. Miller (1990) suggested a framework for assessment of clinical competency, which became known as Miller's pyramid. At the bottom, he placed *know/knowledge*, "required in order to carry out professional functions effectively." He also said that many believe that this knowledge is all that needs to be tested to establish competency. In the next level on the pyramid, he placed *knows how/competence*, "know how to use the knowledge [students] accumulated. The top two levels are probing shows how/performance and does/action aspects of the evaluation" (Miller, 1990, p. S63).

Measuring Competency in Optometry

Considering the parameters of competency shown in Figure 2, the NBEO series of licensure exams consists of three separate parts. Part I ABS is a multiple-choice, computer-based exam that assesses candidates' mastery of the underlying basic science concepts necessary for entry into optometric practice. The exam consists of 370 questions, 20 of which are unscored, pre-test items, and is administered in two sessions of 4 hours each. Part II PAM examination assesses clinical thinking and decision-making, along with knowledge of diagnosis and treatment. The Part II PAM exam is also a computer-based, multiple-choice exam. It contains 350 items and is administered over two sessions of 3.5 hours each. Part II PAM questions frequently are shown as part of an overall case wherein candidates are given clinical information, sometimes including diagnostic images. The questions for the case follow a sequence that mimics clinical thinking and decision-making; however, examinees are able to select from a list of possible answers while thinking through the case and appropriate treatment steps. Lastly, Part III CSE is a performance-based exam wherein examinees are required to perform optometric clinical skills that reflect practice. These skills are performed at 4 different stations; all stations rely on standardized patients on whom the examinee performs the skills for each station. Candidates stay at each station for 30 minutes, making the total testing time 2 hours not including time for check-in, orientation, and checkout. Each station is located in an examination room that is designed to simulate real-life optometric exam rooms. The equipment, placement of materials, and room dimensions are standardized, and the NBEO follows a multilayered protocol for quality assurance throughout the examination process.

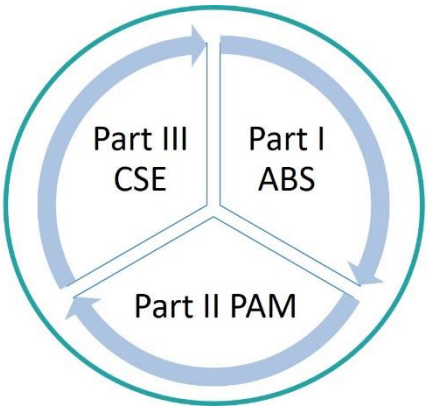

Figure 5. Three-part series of optometric licensure exams, when combined, measure overall optometric competency.

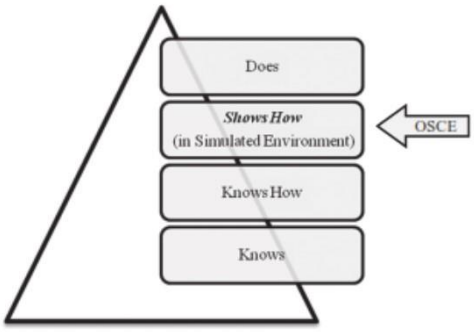

Figure 6. OSCE relative to Miler's Pyramid.

Given that every knowledge, skill, and ability necessary for entry into the independent practice of optometry cannot be tested in the same format, the examination series provides a scaffolded path for the assessment of overall competency. Figure 5 provides a graphical representation of this holistic assessment. Each exam within the series covers an aspect of optometric competency, but it is the combination of the series of exams that represents overall competency.

Within the context of health professions licensure exams, a performance-based exam or an OSCE can be mapped onto Miller's pyramid as shown in Figure 6 (Khan et al., 2013). An OSCE inherently requires the examinee to show an examiner that she or he has mastered specific clinical skills. Whereas previously the examinee needed only to have applicable knowledge (Part I ABS) and how to theoretically apply that knowledge

(Part II PAM) (see Figure 7), the performance-based exam extends mastery to include physical performance.

When considering the content of the exams in light of each's role in the holistic assessment of competency in optometry, the top of the pyramid, "Does," is truncated. The final assessment of competency is at the "Shows How" level because examinees are able to, after completing this level of assessment, apply for and receive a license to practice independently. In some other healthcare professions, examinees similarly progress through a series of licensure examinations to determine competency, but then must also undergo a period of supervised practice. The period of supervised practice, or, residency, falls within the category "Does" on the pyramid. Supervised practice operates as an additional layer to the overall assessment of clinical competency.

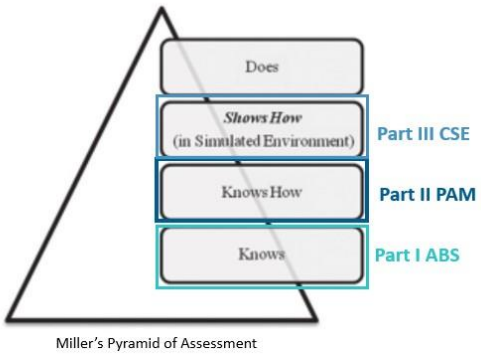

Figure 7. NBEO exam series as mapped onto Miller's pyramid.

Of note, NBEO is currently undergoing a major restructure of the Part III CSE and released both a blueprint and model for the restructured Part III exam, which, when implemented, will become the NBEO Part III Patient Encounters and Performance Skills (PEPS) exam. The starting date of the Part III PEPS is as yet undetermined (*Part III PEPS Restructure Blueprint & Model*, 2020, p. 4). Restructuring the Part III examination will change the nature of the exam from one in which the focus is on the performance of specific, optometric clinical skills to an exam that focuses on broader clinical skills, including standard features of OSCE examinations such as taking a case history, determining a treatment plan, and composing a SOAP note[1].

Evolution of Regulatory Testing in Optometry

Historically, optometry has been a strongly regulated profession. Before the separation of optometry from medical practice, there existed only "eye physicians" – medical doctors who focused on the eye -- ophthalmologists. As the need for clear vision became increasingly known, the need for optometrists took hold. Ophthalmologists recognized the public need for optometry in 1929 in an article from *The Commonwealth of Optometrist*, stating, "…the number of competent eye physicians is of course totally and hopelessly insufficient" (Lancaster, 1928, p. 3). However, though conceding the need for optometrists to serve the public, sentiment among "eye physicians" remained that optometrists were not sufficiently trained. In the same article referenced above, the author goes on to state, "It is out of the question to eliminate the optometrist….To give the optometrist a training that would make him competent would be to eliminate the optometrist by making him an eye physician" (Lancaster, 1928, p. 3). The author ends with a call for optometrists to organize a group of members to set and maintain

[1] SOAP is an acronym for subjective, objective, assessment, and plan. The SOAP note is a common method of documentation for writing notes in patients' medical charts.

professional standards for optometrists to pave the way for collaboration between optometrists and ophthalmologists (p. 4). Essentially, the medical community felt that optometry was not regulated enough to ensure full, essential training and high standards of care.

The first state law to recognize and regulate the practice of optometry occurred in 1901 in Minnesota; by 1921 all states had adopted laws governing the practice of optometry (*Fall 2019 Greensheet*, 2019). The early part of the 20th century was marked by the increasing organization, regulation, and raising of standards within optometry. By 1915, with the ruling of the Pennsylvania Supreme Court in Martin V. Baldi that optometry "is a separate profession from medicine and cannot be properly regulated by the state board of medicine as a branch of that profession" (*Fall 2019 Greensheet*, 2019, p. 8), optometry became more unified and standardized. This is evidenced by a resolution in 1931 by the Examination Committee of the International Board of [Optometry] Boards (IBB)[2], known now as the Association of Regulatory Boards of Optometry (ARBO), defining the minimum standard eye examination.

Standardized, Performance-Based Exams and the Public

The chief role of governmental, regulatory policies regarding the profession of optometry is to uphold standards of care intended to protect the public from any harm that may come from being treated by a practitioner who is not at least "minimally competent" to practice independently. As discussed previously, the mode through which optometric candidates demonstrate competence to state regulatory boards as part of an application for licensure to practice is the NBEO three-part exam series.

Public Protection

Licensing boards within health professions are tasked with determining if a candidate is minimally competent, and therefore which candidates qualify for a license to practice. This role of the licensing board is but one of several that position licensing boards as the guardians of public protection within the health profession in which they serve. For example, licensing boards also investigate complaints about physicians, and have the authority to impose a variety of disciplinary actions such as: requiring continuing education training, imposing fines, imposing restrictions on practice, and revoking licenses to practice.

Within the field of optometry, regulatory boards have similar obligations. The Association of Regulatory Boards of Optometry states,

> "The duty of the board goes beyond the licensing and re-registration of optometrists. The board is charged with the responsibility of evaluating when an optometrist's professional conduct or ability to practice optometry warrants modification, suspension or revocation of the license to practice optometry. Board members devote a great deal of time and attention to overseeing the practice of optometrists by reviewing complaints from consumers, malpractice data, information from hospitals and other health care institutions, and reports from government agencies…When a board receives a complaint about an optometrist, and there is reason to

[2] The Association of Regulatory Boards of Optometry (ARBO) was founded in 1919 under the organizational name of IBB. The organization's name changed to the International Association of Boards of Examiners in Optometry (IAB) in 1954. The acronym ARBO began to be used in 1999 when the group's name changed to The Association of Regulatory Boards of Optometry (*ARBO History*, 2021).

> believe the optometrist has violated the law, the board has the power to investigate, hold hearings, and if necessary, imposes some form of discipline" (ARBO FAQ, 2021).

In their first task of determining whether or not to issue a license to practice, regulatory boards rely on licensure exams to provide information on candidates' knowledge, skills, and abilities within the field. It is then logical to question whether or not licensure exams, which are used to determine minimal competency, have a relationship with state boards' other primary task of investigating complaints and issuing disciplinary actions.

Review of the Research

Research has been conducted to investigate the role of licensure exams in the context of public protection. For example, Tamblyn et al. investigated whether or not licensing exam scores predict performance in practice in medicine, specifically in primary care (2002). Researchers used linked databases of physicians' performance within Québec, Canada over the course of 4-7 years, along with physicians' scores on the Québec family medicine certification exam (QLEX). Using this longitudinal data, Tamblyn et al. examined physicians along 5 annual measures of performance already established within the national health system of Québec. Analysis of the data was conducted using multiple linear regression for repeated measures with generalized estimating equations showed statistically significant relationships between exam scores and positive performance measures. The authors also investigated the extent to which the associations found decreased over time by testing interactions between exam scores and years of experience in practice. An autoregressive first-order correlation structure for residuals was used to account for the interdependence of performance measures for physicians over time (i.e., a performance outcome for year 2 is interdependent on the same performance outcome for year 1). Findings showed that exam scores taken during the final year of medical school were statistically significant predictors of future performance in practice. Additionally, and perhaps most significantly, the authors demonstrated that the relationship between licensure exam scores and performance was sustained throughout the first 4-7 years of independent practice. That is to say, Tamblyn et al. found that licensure examination scores not only were accurate predictors of how well a physician would perform in independent practice, but also that this prediction was accurate for a significant period of time – between 4 and 7 years after entering practice. While the generalizability of these findings to the practice of optometry in the United States is as yet undetermined, the research strongly suggests that licensing examinations likely work as intended – candidates with higher scores tend to exhibit better performance in practice than candidates who score lower (i.e., closer to the cut score for minimal competency).

Research within the context of the United States shows similar findings about the relationship of licensure exams with performance in practice. The Comprehensive Osteopathic Medical Licensing Examination of the United States (COMLEX-USA) is a 3-level examination series that all state licensing boards within the U.S. utilize for licensure decisions for osteopathic physicians. The Level 2 exam has, heretofore, consisted of two parts – the Level 2 Cognitive Exam (CE) and the Level 2 Performance Exam (PE). The Level 2 PE is further categorized into the following two domains: Biomedical/Biomechanical Domain (BD) and the Humanistic Domain (HD). Using retrospective data for physicians who completed osteopathic medical college between 2004 and 2013, Roberts et al. (2020) analyzed the relationship between scores on various parts of the COMLEX-USA and disciplinary actions against osteopathic physicians. Their analysis compared physicians who received licensing board actions against them to those who did not. Using a retrospective cohort approach, researchers used multinomial logistic

regression (MLR) where the outcome categories were (1) license revocation, (2) imposed limitations to practice, and (3) other board action as compared to the outcome of no board action received. Their findings showed a statistically significant relationship with physician scores on the Level 2-PE exam in the biomedical/biomechanical domain with the odds of receiving an adverse licensure board action in 2 outcome categories. The analysis showed, "…higher COMLEX-USA Level 2-PE BD scores showed significantly lower odds in receiving a board action revoking a physician's license and imposing limitations to practice, controlling for scores at other levels [COMLEX-USA exam levels 1, 2-CE, and 3], years in practice, and gender" (Roberts et al., 2020, p. 928).

Additionally, Cuddy et al. (2017) investigated the relationship of scores on the United States Medical Licensing Examination (USMLE) with physician practice after receiving a medical license. The authors utilized a non-nested multi-level logistic regression model to uncover the relationship between exam scores and receiving an adverse board action across time. Similar to the COMLEX-USA, the USMLE consists of several parts: Step 1, Step 2 Clinical Knowledge (CK), Step 2 Clinical Skills (CS, recently discontinued), and Step 3. Cuddy et al. (2017) examined scores from the USMLE Step 1 and Step 2 Clinical Knowledge exams. Findings showed a statistically significant relationship between Step 2-CK scores and board disciplinary action. An increase of 1 standard deviation in Step 2-CK exam scores was associated with an approximately 25% decrease in the odds of a physician receiving disciplinary action (odds ratio = 0.75, $p<0.05$, CI given in paper).

This study did not analyze scores on a performance-based exam (the now discontinued Step 2-CS). The authors cite Tamblyn et al.'s (2002) finding that scores on communication and clinical decision-making showed a negative association with patient complaints. Both the heavy emphasis of the USMLE Step 2-CS exam on communication, alongside this citational context and the failure of Cuddy et al. to mention the Step 2-CS exam at all, suggests that the performance-based exam did not adequately cover those aspects of practice that are most strongly associated with the odds of receiving or not receiving disciplinary action. To date, no research is publicly available on the relationship of the performance-based portion of the USMLE with physician performance.

Despite not addressing the connection between exam scores on a performance-based exam, Cuddy et al.'s (2017) findings are in line with the overall findings of Tamblyn et al. (2002) and Roberts et al. (2020). All three studies find empirical, statistically significant relationships between licensure exams and physician performance in practice. These findings lend further support to the concept of the licensure examination *as* a public protection measure; licensure exams operate like a barricade, holding back aspiring physicians who have not yet demonstrated competency from interacting with, and possibly harming, patients.

The "Last Gatekeeper" Before Licensure

Optometry differs from other health professions in a critical aspect -- state boards of optometry generally do not require that candidates for licensure undergo a period of supervised practice. That is, candidates who complete optometry school and pass NBEO examinations, can immediately apply for a license from most states. State boards of optometry issue licenses to practice independently, based chiefly on an applicant's completion of optometry school and passage of the NBEO licensure series[3]. This is a strong difference from other medical professions wherein candidates are required to complete a period of supervised practice / residency.

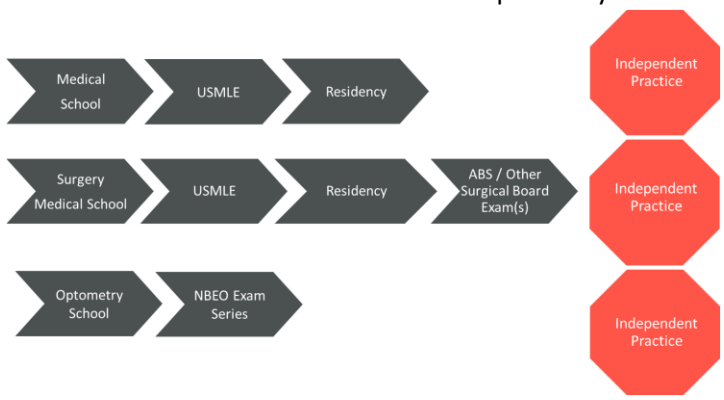

Figure 8. Pathways to independent practice in various health professions.

During residency, students have hands-on practice under supervision; they are not solely responsible for patient care and safety. Residency presents another window of opportunity for the assessment of clinical competency, as denoted previously (see discussion of Figure 7). This suggests that the assessment of clinical competency in optometry ends earlier than in other health professions, highlighting the ongoing need for a standardized examination of clinical competency. A standardized examination of clinical competency provides state licensing boards with critical information about potential licensee competency that would otherwise be unavailable.

Future Directions: Part III PEPS

Beyond Psychomotor Skills

Adequate medical care necessitates physicians have all of the requisite knowledge, skills, and abilities to care for patients. One critical area of knowledge necessary for adequate patient care is the ability to correctly diagnose and treat patients, which requires skills and abilities in patient communication, documentation, and other diagnostic activities. The ability to apply professional knowledge in a problem-solving framework is crucial for developing and demonstrating diagnostic competencies (Heitzmann et al., 2019).

As previously stated, the NBEO is currently restructuring the Part III, performance-based examination. Part III PEPS will focus on broader clinical skills, such as taking a case history, determining a treatment plan, and composing a SOAP note, in addition to assessing candidates' performance of specific, optometric skills, sometimes referred to as psychomotor skills. Examples of psychomotor skills include: (1) holding a gonio lens up to the eye, positioning it properly in order to view the angle, (2) using a tonometer probe correctly to measure corneal mires, or (3) using a biomicroscope to evaluate ocular

[3] Some states require an examination administered by the state board of optometry in addition to the NBEO licensure exams.

structures by maneuvering the instrument to properly obtain views of various anatomical structures to inspect for abnormalities. Each of these involves technical optometric knowledge along with the ability to *physically* perform the procedure correctly. Grounded in both research and practice analyses, Part III PEPS is being developed to measure candidates' holistic ability to practice optometry. This includes both psychomotor skills (see examples given previously), communication and documentation skills, and diagnostic competency.

Diagnostic Competency

Research in medical education suggests that "the qualitative entanglement of biomedical and clinical knowledge" are critical for the development of diagnostic expertise (Heitzmann et al., 2019, p. 6). That is, the knowledge base of the profession undergoes changes through the development of diagnostic expertise. Whereas an early optometry student learns the biomedical knowledge necessary and later on learns the clinical knowledge necessary, her or his diagnostic expertise begins to expand at the crux of applying the knowledge in such a way that the biomedical knowledge become enmeshed with the clinical knowledge (Boshuizen & Schmidt, 1992).

Mamede et al. (2012) states, "Through repeated confrontation with clinical cases, biomedical knowledge gets 'encapsulated.' That these two types of knowledge are encapsulated means that biomedical knowledge gets interconnected and integrated with clinical features" (p. 6). Through this encapsulation process, students make connections between the biomedical mechanisms and the symptoms of a disease, along with frequent patient characteristics and usual circumstances in which certain diseases emerge. The connections students make, or the synthesis of biomedical, clinical, and contextual knowledge, generates "illness scripts" (Charlin et al., 2007; Schmidt & Rikers, 2007). Specifically, an illness script is defined as containing, "knowledge of the relations between different diseases as well as of cases of a disease the physician has previously encountered" (Heitzmann et al., 2019, p. 6). Illness scripts accelerate progress towards diagnostic competency as they function as shorthand, cognitive markers that a physician can use to access their knowledge in the pursuit of a correct diagnosis and an adequate treatment plan.

Clinical Authenticity

It is clear that applying both content and clinical knowledge in an encounter with a patient is complex. It is much easier to assess clinical knowledge with case scenarios with tidy questions and provided answer choices from which candidates may choose, just as it is easier to assess content knowledge with well-crafted multiple-choice questions as compared to assessing overall diagnostic competency or the components therein. However, the lived experience of optometrists in practice is not tidy, with clear answer choices provided to them. In fact, practitioners can expect to encounter a variety of complex conditions and patients and must draw on their diagnostic expertise in addition to their ability to complete specific optometric tasks. Thus, it is logical that the assessment of holistic diagnostic expertise is warranted to determine if an optometric candidate has met the threshold for minimum competency to enter into independent practice. Assessing this requires candidates to demonstrate their diagnostic expertise for review. But how can we assess this in a fair and standardized manner?

Research indicates that the clinical authenticity of an exam that is intended to measure clinical competency is important; Chernikova et al. (2020) found that simulations with higher clinical authenticity are associated with increased positive learning outcomes. Research knowledge of the role of authenticity in clinical assessment has informed the action of the NBEO in restructuring the Part III

exam. The restructure will result in a performance-based exam with greater clinical authenticity than the current exam. Whereas Part III CSE requires candidates to demonstrate proficiency in some optometric skills, it does not require proficiency in diagnostic expertise and the components therein. The restructured exam, Part III PEPS, however, requires candidates to demonstrate their knowledge, skills, and abilities in both the performance of optometric, psychomotor skills, but also in their overall clinical and diagnostic competency. Throughout the "Patient Encounters" portion of the Part III PEPS examination, candidates rotate through rooms, as if in clinic, encountering different patients with different diagnoses. Candidates must engage in history-taking, order further tests, interpreting findings, diagnosing the patient, documenting the encounter via a SOAP note, and communicating the diagnosis and treatment plan to the patient. This closer adherence to clinical authenticity allows exam scores to provide a more complete depiction of a candidates' ability to enter into independent practice.

Conclusion

In summary, NBEO Parts I, II, and III licensure examination series constitute a comprehensive assessment of competency in optometry. A standardized measurement of minimal competency is warranted to ensure public safety, and research has demonstrated the significant relationship licensure exams have with future physician performance.

In the context of the pandemic that began in earnest in the United States in early 2020, the NBEO weighed various options for fulfilling their obligation to provide access to the pathway for licensure while simultaneously maintaining exam integrity in conjunction with the need to attend to the safety of candidates and staff during a pandemic. Other medical professions moved in a different direction, by either delaying or canceling performance-exams altogether. However, the stakes are high for optometry when it comes to making sudden changes to the licensure testing protocol because optometry candidates move directly to independent practice after completing NBEO exams.

Prior to the onset of the pandemic, the NBEO had already begun working on a major restructuring of the Part III performance-based examination. The restructured exam, Part III PEPS, is being developed in such a way as to elevate the examination and what it assesses in terms of optometric competency.

References

ABS Issuing Refunds, Launching Security Investigation for Virtual 2020 General Surgery QE. (2021). https://www.absurgery.org/default.jsp?news_virtualgsqe07.17

ABS Update Regarding the July 16-17 General Surgery Qualifying Exam. (2021). https://www.absurgery.org/default.jsp?news_virtualgsqe07.16

ARBO FAQ. (2021). Association of Regulatory Boards of Optometry, Inc. https://www.arbo.org/faq.php#licensure

ARBO History. (2021, March 26). ARBO About Us. https://www.arbo.org/aboutus.php

Ballister, M. M., DNP, CRNA, APRN, CHSE. (2018). Basics of the Objective Structured Clinical Exam. *AANA Journal*, *86*(2), 60–63. ProQuest Central.

Benett, Y. (1993). The validity and reliability of assessments and self-assessments of work-based learning. *Assessment & Evaluation in Higher Education*, *18*(2), 83–94.

Boshuizen, H. P., & Schmidt, H. G. (1992). On the role of biomedical knowledge in clinical reasoning by experts, intermediates and novices. *Cognitive Science*, *16*(2), 153–184.

Burke, D. (2020). Assessment and Appraisal. In D. Burke (Ed.), *How Doctors Think and Learn* (pp. 65–74). Springer International Publishing. https://doi.org/10.1007/978-3-030-46279-6_9

Charlin, B., Boshuizen, H. P., Custers, E. J., & Feltovich, P. J. (2007). Scripts and clinical reasoning. *Medical Education*, *41*(12), 1178–1184.

Chernikova, O., Heitzmann, N., Stadler, M., Holzberger, D., Seidel, T., & Fischer, F. (2020). Simulation-Based Learning in Higher Education: A Meta-Analysis. *Review of Educational Research*, *90*(4), 499–541. https://doi.org/10.3102/0034654320933544

Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika*, *16*(3), 297–334. https://doi.org/10.1007/BF02310555

Cuddy, M. M., Young, A., Gelman, A., Swanson, D. B., Johnson, D. A., Dillon, G. F., & Clauser, B. E. (2017). Exploring the relationships between USMLE performance and disciplinary action in practice: A validity study of score inferences from a licensure examination. *Academic Medicine*, *92*(12), 1780–1785.

Fall 2019 Greensheet. (2019). Association of Regulatory Boards of Optometry, Inc. https://www.arbo.org/greensheets/Greensheet_Spring_2019.pdf

Fink, M. C., Reitmeier, V., Stadler, M., Siebeck, M., Fischer, F., & Fischer, M. R. (2021). Assessment of Diagnostic Competences With Standardized Patients Versus Virtual Patients: Experimental Study in the Context of History Taking. *Journal of Medical Internet Research*, *23*(3), e21196. https://doi.org/10.2196/21196

Harden, R. M., & Gleeson, F. A. (1979). Assessment of clinical competence using an objective structured clinical examination (OSCE). *Medical Education*, *13*(1), 39–54. https://doi.org/10.1111/j.1365-2923.1979.tb00918.x

Harden, R. M., Lilley, P., & Patricio, M. (2015). *The Definitive Guide to the OSCE: The Objective Structured Clinical Examination as a performance assessment.* Elsevier Health Sciences.

Harden, R. M., Stevenson, M., Downie, W. W., & Wilson, G. M. (1975). Assessment Of Clinical Competence Using Objective Structured Examination. *The British Medical Journal*, *1*(5955), 447–451. JSTOR.

Heitzmann, N., Seidel, T., Hetmanek, A., Wecker, C., Fischer, M. R., Ufer, S., Schmidmaier, R., Neuhaus, B., Siebeck, M., Stürmer, K., Obersteiner, A., Reiss, K., Girwidz, R., Fischer, F., & Opitz, A. (2019). Facilitating Diagnostic Competences in Simulations in Higher Education A Framework and a Research Agenda. *Frontline Learning Research*, 1–24. https://doi.org/10.14786/flr.v7i4.384

Joorabchi, B. (1991). Objective structured clinical examination in a pediatric residency program. *American Journal of Diseases of Children*, *145*(7), 750–754.

Khan, K. Z., Ramachandran, S., Gaunt, K., & Pushkar, P. (2013). The Objective Structured Clinical Examination (OSCE): AMEE Guide No. 81. Part I: An historical and theoretical perspective. *Medical Teacher*, *35*(9), e1437–e1446. https://doi.org/10.3109/0142159X.2013.818634

Krichbaum, K., Rowan, M., Duckett, L., Ryden, M. B., & Savik, K. (1994). The Clinical Evaluation Tool: A measure of the quality of clinical performance of baccalaureate nursing students. *Journal of Nursing Education*, *33*(9), 395–404.

Lancaster, W. B. (1928). The Optometry Problem. *Journal of the American Medical Association*, *91*(24), 1847–1848. https://doi.org/10.1001/jama.1928.02700240001001

Mamede, S., van Gog, T., Moura, A. S., de Faria, R. M., Peixoto, J. M., Rikers, R. M., & Schmidt, H. G. (2012). Reflection as a strategy to foster medical students' acquisition of diagnostic competence. *Medical Education*, *46*(5), 464–472.

Miller, G. E. (1990). The assessment of clinical skills / competency / performance. *Academic Medicine*, *65*(9), S63-67.

Part III PEPS Restructure Blueprint & Model. (2020). National Board of Examiners in Optometry. https://www.optometry.org/media/documents/part3/Part_III_PEPS_Resctructure_Blueprint_&_Model.pdf

Pathway for Classes 2020 and 2021—NBOME. (2021). https://www.nbome.org/special-commission-on-osteopathic-medical-licensure-assessment/temporary-pathway-for-classes-2020-and-2021/

Roberts, W. L., Gross, G. A., Gimpel, J. R., Smith, L. L., Arnhart, K., Pei, X., & Young, A. (2020). An Investigation of the Relationship Between COMLEX-USA Licensure Examination Performance and State Licensing Board Disciplinary Actions. *Academic Medicine*, *95*(6), 925–930.

Rossel, C. L., & Kakta, B. A. (1990). Clinical evaluation of nursing students: A criterion-referenced approach to clinical evaluation based on terminal characteristics. In C. F. Waltz & O. L. Strickland (Eds.), *Measurement of Nursing Outcomes* (Vol. 3, pp. 17–30). Springer.

Schmidt, H. G., & Rikers, R. M. (2007). How expertise develops in medicine: Knowledge encapsulation and illness script formation. *Medical Education*, *41*(12), 1133–1139.

Schuwirth, L. W., & Van der Vleuten, C. P. (2003). The use of clinical simulations in assessment. *Medical Education*, *37*, 65–71.

Schwartzman, E., Lee, S., Chung, E. P., & Law, A. V. (2021). Assessing communication skills in student pharmacists—Psychometric validation of Global Communication Rubric. *Patient Education and Counseling*, *104*(3), 649–653. https://doi.org/10.1016/j.pec.2020.08.036

Sloan, D. A., Donnelly, M. B., Drake, D. B., & Schwartz, R. W. (1995). Faculty sensitivity in detecting medical students' clinical competence. *Medical Teacher*, *17*(3), 335–342.

Sloan, D. A., Donnelly, M. B., Johnson, S. B., Schwartz, R. W., & Strodel, W. E. (1993). Use of an Objective Structured Clinical Examination (OSCE) to measure improvement in clinical competence during the surgical internship. *Surgery*, *114*(2), 343–350.

Sloan, D. A., Donnelly, M. B., Schwartz, R. W., & Strodel, W. E. (1995). The Objective Structured Clinical Examination. The new gold standard for evaluating postgraduate clinical performance. *Annals of Surgery*, *222*(6), 735.

Stokes, J. F. (1974). *The clinical examination: Assessment of clinical skills*. Association for the Study of Medical Education.

Swanson, D. B., Norman, G. R., & Linn, R. L. (1995). Performance-based assessment: Lessons from the health professions. *Educational Researcher*, *24*(5), 5–11.

Tamblyn, R., Abrahamowicz, M., Dauphinee, W. D., Hanley, J. A., Norcini, J., Girard, N., Grand'Maison, P., & Brailovsky, C. (2002). Association between licensure examination scores and practice in primary care. *Jama*, *288*(23), 3019–3026.

Timeline—NBOME. (2021). https://www.nbome.org/special-commission-on-osteopathic-medical-licensure-assessment/timeline/

United States Medical Licensing Examination | Announcements. (2021). https://www.usmle.org/announcements/?ContentId=309

Wallace, J., Rao, R., & Haslam, R. (2002). Simulated patients and objective structured clinical examinations: Review of their use in medical education. *Advances in Psychiatric Treatment*, *8*(5), 342–348.