**Key Words**
Clinical Assessment, OSCE, Formative Feedback

**Abstract**
Across health profession education, assessment of learners' clinical skills is needed in addition to traditional written examinations. Clinical assessment methods are currently based on a testing format called Objectively Structured Clinical Examination (OSCE); a checklist-based assessment administered in a simulated environment with standardized patients. This assessment approach is currently paper-based, rendering tremendous amounts of administrative burden which, in turn, causes delayed feedback for learners. The purpose of our study is to develop an electronic clinical skills assessment system (ECSAS) for administering clinical skills assessment, such that: 1) learners can receive timely feedback, 2) faculty have tools to administer clinical skills assessment, and 3) effort intensive assessments such as an OSCE can be administered in an efficient manner. Such a solution is not only needed for all levels of training in medicine and dentistry, but also can be broadly applied to capture assessment data in other learning environments.

## Project/Research Description

**Background -** As demands on the functions of a physician increase, so do the expectations on the training of medical learners. In medical education, students are expected to master the knowledge and theories of medicine. They are also expected to translate the acquired theories and knowledge into clinical skills and competence and apply them appropriately in practical or patient settings. Assessing student medical knowledge can be captured by traditional methods such as written-responses and multiple-choice testing, but only one prominent method is available for assessing student clinical skills in a single sitting. This method is known as an Objective Structured Clinical Examination (OSCE).

While other methods exist for assessing student clinical skills across time (e.g., 360 evaluation), assessing students in one high-stake sitting is difficult because the variability of patient presentation and clinical signs or symptoms that examiners may expect students to look for varies. The OSCE method has the ability to control both aforementioned factors such that students can be fairly assessed in every examination. First, patient presentations are controlled through the use of standardized patients or actors that portray a given set of symptoms to ensure students are exposed to the same set of deductive outcome. Second, examiners assess students based on a checklist of clinically discriminating items that students are expected to reveal with the simulated patient during their encounter. Third, a collection of encounters, named stations, is administered to students to ensure adequate content coverage and reliability of reported scores. Taken together, these characteristics of OSCE allow students to be fairly and comprehensively assessed on their clinical skills all in one sitting.

Although OSCEs are broadly used across health profession education to assess student clinical performance in simulated settings, the main limitation of OSCE administration relates to the paper-based process. Currently, OSCEs are administered using specially prepared scanning paper and the data are input using scanning software. A typical administration of a 10 station OSCE with 160 students requires preparing, copying, disseminating, collecting and scanning 1600 sheets of paper. As students are identified through barcode labels, 1600 labels are also needed to organize the administration. An OSCE of ten stations currently requires at least five business days for preparation and five days to scan, score and process results. In the MD program alone, there are 5 clerkships and 4 courses each requiring administration of an OSCE to approximately 160 students per year. In addition, paper-based OSCE limits the ability to provide feedback to students. As paper scanning can only capture bubbled responses, written feedback cannot be captured or provided to students. With the OSCE score sheet considered secure exam material, students rarely receive any feedback throughout the process. With a flurry of score sheets reliant on barcode label for identification, the risk of human error, scanning error, and mislabeling can occur at each step of administration. Finally, with an abundance of preparation required prior to and after administration, faculty are required to submit cases well in advance of the OSCE. As a result, few changes can be made if an error is realized in the process, and students will not receive numeric feedback until well after the exam. A shift towards electronic-based administration of OSCE can address all concerns discussed.

The benefits of migrating paper-based to computer-based testing were recognized in our 2013 TLEF project in developing the University of Alberta computer-based testing system (UA-CBT). Electronic uploading of items allows for new and innovative response types to be developed. Electronic capturing of student responses allows for immediate scoring and instantaneous feedback. Computer-based administration allows for flexible administration to take place on an on-demand basis. As the Faculty of Education now uses the UA-CBT, we seek to extend these benefits to improve clinical assessment administration at the University of Alberta.

## Objectives

The purpose of our TLEF proposal is threefold. First, we will develop an Electronic Clinical Skills Assessment System (ECSAS) for administering clinical skills assessment under a web-based software platform. Second, we will implement ECSAS in three clinical skills assessment events, two of which would be OSCEs. Third, we will evaluate the feasibility, suitability and efficacy of using ECSAS for assessing clinical skills.

**Objective 1 - ECSAS Development** - To our knowledge, the University of Alberta currently does not possess any software for the administration of clinical skills assessment. Development of an ECSAS is ideal for many reasons. Although ECSAS solutions are commercially available, existing software does not meet the needs for a university as functions are either developed too robustly for testing agencies, or too simply as a paper replacement. Moreover, existing software requires a recurring cost in tens of thousands of dollars per year. All solutions either require an institution fee, or an annual site license fee with a per student fee. With existing solutions developed both by public and by members of our team in the past, functions can be reused to minimize development. For example, functions for integrating campus authentication and linking securely with student information databases are already implemented. Finally, with the expertise and experience of our team in educational assessment and developing assessment systems, ECSAS can be created to suit the assessment processes within our university without recurring cost.

ECSAS development will occur through four components using a rapid-prototype development framework. This framework was used with great success for development of the assessment platform in our 2013 TLEF project. The four components are: examiner interface, student interface, standardized patient interface and data storage/analytics. Each interface will be prototyped to refine user functionality throughout development. A web-based software framework, similar to our existing assessment system design, will guide user interaction on tablet and mobile devices. In addition to facilitating the comprehensive process of administering OSCE, ECSAS will also allow instructor submission and review of stations, formative report of student results through mapping of items, dashboard of administration process, and offline administration support. The total development time for ECSAS will require six months.

**Objective 2 - Pilot Implementation** - With the completion of ECSAS, the system will be used for trial in three clinical skills assessment administered in the year 1 and year 2 Physicianship course of the MD program led by Dr. Tan and Dr. Daniels. Each trial will be targeted to test a specific aspect of ECSAS. In the first trial, administered in September 2015,

students are presented with five simulated clinical stations that assess their communication skills using a checklist-based assessment along with written comments. In this low-stake testing environment, ECSAS will trial the examiner interface, student information capture, and student access to formative feedback. In the second trial, an OSCE from the Physicianship 1 course will use ECSAS to administer five of the ten stations. This trial will include testing the student interface, standardized patient interface, and parallel comparison on the efficacy of electronic and paper-based administration. In the final trial, an OSCE from the Physicianship 2 course will use ECSAS to administer all ten stations. Tests of system load, a personalized feedback station, and refinement of standardized patient interface will be evaluated in this trial. In all, a total of 3200 assessment forms will be created, disseminated and collected by ECSAS electronically.

**Objective 3 - Evaluation of ECSAS Development and Administration Process** – An evaluation process will be implemented throughout the development and pilot implementation of ECSAS. Evaluation data will be collected across a sample of examiners, students, and administrators to determine: 1) whether the use of ECSAS improved timeliness of student of feedback, 2) whether the availability of ECSAS allow clinical skills to be more readily assessed by instructors, 3) whether ECSAS improved the efficiency of an OSCE administration process. As a point of reference, evaluation data will also be collected in the paper-based administration for comparison. Such information as processing time, number of data-points not recorded in machine scoring, and time from administration to feedback reporting will be used for comparison with the use of ECSAS. Focus groups will also be held with involved stakeholders throughout this project to evaluate the development progress of ECSAS.

**Outcomes -** The outcome of this proposal is consequential for the students and faculty at the University of Alberta. Development of ECSAS can provide an open platform for instructors to securely administer clinical skills assessments in an efficient manner for all faculties of health professions. With student results electronically collected, debrief of student performance can occur immediately after examination, allowing timely and relevant feedback. The administrative burden for conducting clinical skills assessment is known to be problematic, ECSAS will minimize this unnecessary burden and allow faculty to focus on providing more relevant and authentic clinical learning and assessment experience.

## Justification for TLEF Mandates

**Innovation -** Aside from the migration into an electronic format and reducing a significant administrative burden, development of ECSAS is innovative in three ways. First, ECSAS allows for the availability of feedback to be disseminated to students in a timely and relevant manner. This is currently not possible with the paper-based process. Second, as information from OSCEs will be delivered in electronic format, more authentic information such as simulated electronic patient records, vitals and test results can now better resemble real clinical practice. As such, the use of ECSAS will improve and refine the authenticity of current assessment environments. Third, ECSAS can be used to improve many aspects of clinical assessment. Performance-based assessment methods are used to assess student competence in many clinical settings. ECSAS can

also be used to collect a variety of student assessment data administered through in the clinical learning environment.

**Collaboration -** Our research team consists of a collection of expertise that span across two faculties and four departments to provide a comprehensive solution applicable to different clinical skills assessment. Specifically, Dr. Daniels provides expertise in OSCE administration and how the process can be electronically migrated, Dr. Tan provides expertise in formative assessment of clinical skills and how feedback can be effectively provided to students, Dr. Gierl provides expertise in measurement and how assessment data can be best captured, Dr. Hillier provides expertise in curriculum integration while minimizing any risks for negative impact to student learning, and I provide the experience and expertise in assessment process design and managing software development. We will collaborate with students through existing channels to solicit feedback on ECSAS, and we will collaborate with administrative staff to ensure ECSAS is deployed in the most effective manner.

**Evaluation –** The evaluative criteria, evaluation questions and method of data collection are described in Objective 3.

**Sustainability/Impact on Students -** This project is leveraged on our previous research to produce an electronic clinical skills platform for OSCE administration across all health professions. Moreover, the platform can be used to modify and improve existing OSCE stations. The administration process, item types, and student feedback can all be modified and improved with the use of ECSAS. As OSCEs are currently being administered across all fields of health education, the potential for integrating this platform in other faculties are great. Resources required for sustaining ECSAS after development is minimal as only server hosting capacities are required to continue this system.

**Dissemination –** Dissemination of our project will focus on reporting the effectiveness of ECSAS as investigated in objective 3. Project findings will be presented in Faculty of Medicine's annual Celebration of Teaching and Learning event and university-wide event such as the Festival of Teaching. Moreover, as all health science educators may be able to benefit from the use of ECSAS, we will present our project findings to faculty stakeholders such as the Health Science Education Research Commons to promote accessibility. We expect the availability of an electronic clinical skills assessment system should benefit both instructors and faculty administrators within the health professions, hence we will focus our efforts on ensuring that ECSAS can be accessed across different faculties. As the ability to provide formative feedback within the ECSAS will be a novel innovation to the medical education research community, results on the effectiveness in providing feedback will be submitted to leading medical education conferences in North America.

## Co-Investigators

1. Dr. Tracey Hillier, Department of Radiology and Diagnostic Imaging
2. Dr. Amy Tan, Department of Family Medicine
3. Dr. Vijay Daniels, Department of Medicine
4. Dr. Mark Gierl, Department of Educational Psychology, Faculty of Education

## Timeline

| Date | Objective |
|---|---|
| April 2015 - September 2015 | ECSAS Development - Definition of Requirements, Hiring of Programmer, and First Development Phase |
| September 2015 | First Trial - Communication Skills Assessment<br>- Trial of Examiner Interface and Hosting Capacity<br>- Trial of Student Feedback Dissemination<br>- Trial of Student Scanning |
| October 2015 - December 2015 | Completion of ECSAS |
| January 2016 - March 2016 | Uploading of trial stations, refining student feedback and evaluation methods |
| April 2016 | Second Trial - Physicianship 1 OSCE (5 stations)<br>- Trial of Standardized Patient Interface<br>- Comparison with paper administration<br>- Refinement of Student Feedback Interface |
| May 2016 | Third Trial - Physicianship 2 OSCE (10 stations)<br>- Full test of ECSAS capabilities |
| May 2016 - July 2016 | Summer Student Projects |