

A Novel Teaching and Assessment Tool Utilizing A Cloud-based Simulation Platform to Evaluate How Medical Students Learn to Use Antimicrobials

I. SPECIFIC EDUCATIONAL AIMS: 1) To implement a cloud-based virtual patient simulation platform to provide education, allow practice and evaluate medical students on the biology, pharmacology, and proper clinical use of antimicrobial medications. 2) To create an online longitudinal assessment portfolio to track the growth of students' competencies in antimicrobial concepts from pre-clinical to clinical years, which can serve as a foundation for a new innovative assessment model at Stanford School of Medicine.

II. PROJECT RATIONALE: With increasing antibiotic resistance, appropriate use of antimicrobials is essential, and teaching future doctors the fundamental concepts of appropriate antimicrobial use seems obvious. But, it is not effectively done. A recent survey showed that 90% of fourth-year US medical students would like more education on appropriate use of antimicrobials and only one-third felt prepared to apply principles of appropriate antimicrobial use[1]. We need to do better.

Ideally, to enable real learning about these fundamental concepts, we should start with early medical students and continue their longitudinal learning process to their clinical clerkships [2]. Students would have multiple opportunities to practice applying their new skills in a format that was linked from preclinical to clinical years. Students and instructors would have a strong assessment system with a variety of instruments to track a student's growth [3]. This ideal scenario is challenging.

III. APPROACH: We aim to address these challenges by using a cloud-based virtual patient simulation platform. First, the online platform will provide students multiple opportunities to practice applying concepts of antimicrobial use in clinical cases. The online platform would be the same for preclinical students and students in clinical clerkships in order to emphasize longitudinal learning and start students early. Only the content in the clinical cases would change, with increasing case complexity as the student progressed to clerkships. For students in clinical rotations, the online platform would enable extra practice to mitigate the variability of patient cases they encounter on rotation.

Second, the online platform would allow students and instructors to track a student's growth in applying the concepts of antimicrobial use throughout the student's training. The online platform will track all student interactions with the virtual patient, including the student's articulated rationale and thought-process for their decision. Although attending physicians commonly provide feedback on a student's thought-process, it is based on the available patient case, likely not longitudinal with knowledge of the student's past abilities, and the student's articulated rationale is rarely captured in a formal way to review later. We hypothesize our online platform used in a longitudinal learning process will provide an effective real-time and longitudinal assessment tool for students and instructors to track a student's growth in learning fundamental concepts of antimicrobial use.

We will partner with Med2Lab, Inc. and adapt their core product, PBLCloud, to create a cloud-based simulation platform. We have received the 2018 Stanford EdTech Mini Grant to work with the EdTech team to fully integrate the platform into Canvas, and to pilot the use of the platform as a summative evaluation tool in the 2018 fall quarter Microbiology and Infectious Disease II course (INDE 265). Our goal for this proposal is to complete the design and customization of the platform with creation of a full series of clinical cases with increasing complexity. In each clinical case, students will be asked to use a web/mobile-based interface to gather history information, form differential diagnoses, make diagnostic and antimicrobial treatment decisions and importantly be prompted to articulate their thought-process for each decision as free-text. The interface will show the virtual patient's clinical changes at later time points, reflecting the student's assessment and decisions.

Students' interactions with the virtual patient will be continuously captured, and a detailed analytic report of the student's performance can be created after each virtual patient interaction. Longitudinal tracking of a student's performance and her thought-process is achieved by a

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“tagging” system. We will tag each activity in the clinical case with one or more corresponding knowledge, skill or attitude important to learning fundamental concepts of antimicrobial use.

We plan on implementing the online platform for separate student cohorts. One cohort will be pre-clinical students in the Microbiology & Infectious Diseases Course in Winter quarter 2019. The other student cohort will be students in Pediatric Clerkships starting in Spring quarter 2019. Although not the same students, evaluation of both of these student cohorts will allow us to assess the effectiveness of the online platform for its increasing complexity and its ability to effectively track longitudinal growth.

IV - V. TIMELINE AND PLAN FOR IMPLEMENTATION:

Period	Implementation Plan & Milestones
Oct'18 - Dec'18	Design the complete set of patient cases, scoring rubrics, and appropriate knowledge, skills and attitudes for tagging. Enter into system.
Oct'18 - Dec'18	Develop and customize the system to assess student's performance based on designed rubrics; the tagging system; the report / feedback system & interface
Jan'19 - Mar'19	Students in different levels of training will use the system at multiple time points. Students will use the system for individual practice, additional practice after feedback with instructors, and as summative evaluation. Scoring rubrics and longitudinal reports are tested simultaneously.
Jan'19 - Jun'19	Data are continuously collected and monitored. Iterative changes are made if needed.
Jun'19 - Jul'19	Data from student's performances, system performances, student surveys and faculty debriefs will be analyzed to evaluate the effectiveness of the system.

V. ANTICIPATED WORK PRODUCT: (1) a full case-based curriculum on antimicrobials that span different levels of training, with associated educational materials and scoring rubrics (2) a cloud-based system that provide practice with virtual patient cases while tracking the student's growth in meeting competencies for learning fundamental concepts of antimicrobial use.

VI. EVALUATION PLAN: Success for Specific Aim 1 will be defined by complete implementation of the patient simulation in a longitudinal fashion linking the preclinical years (Microbiology/Infectious Diseases Course) to clinical years (Pediatric Clerkship) resulting in student and instructor satisfaction and evidence of student growth. We will measure in pre-clinical and clinical years: 1. Survey feedback from students using the platform. 2. Immediate debriefs of the instructors teaching the in-class sessions. 3. Student scores from the simulation based on a number and on sophistication of their articulated thought-process, tracking at initial encounter, after instructor feedback and as summative evaluation.

Success for Specific Aim 2 will be defined as complete creation of effective knowledge, skills and attitudes (competencies) specific to antimicrobial concepts that are embedded in clinical reasoning concepts, which can differentiate pre-clinical abilities from clinical abilities (in order to track growth over time). We will measure: 1. Student scores from the simulation based on a number and on complexity and sophistication of their thought-process. We would compare pre-clinical students to clinical students using mixed methods approach. 2. Debriefs with stakeholders including Directors for Practice of Medicine and for the Pediatric Clerkship.

VII. DISSEMINATION OF RESULTS: Our online platform will be available for use at all Stanford-affiliated educational programs. The developed software and tools can be further incorporated into Stanford training for topics beyond antimicrobial use. Effectiveness of our online platform will be presented at appropriate education meetings and published in appropriate academic journals.

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References:

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3. Van der Vleuten CP, Schuwirth LW, Driessen EW, et al. A model for programmatic assessment fit for purpose. *Med Teach*. 2012;34:205-214