AMSMIC

ASSOCIATION OF MEDICAL SCHOOL MICROBIOLOGY AND IMMUNOLOGY CHAIRS

## *WELCOME*

On behalf of the Program Committee, I would like to welcome you to the 18th AMSMIC Workshop. This biennial workshop was developed and sponsored by the Association of Medical Schools Microbiology and Immunology Chairs (AMSMIC) in 1986. The focus of the meeting is sharing best practices in Microbiology and Immunology education in medical schools with the objective to help train the next generation of teachers and leaders in Microbiology and Immunology education.

The Workshop will enable the sharing of innovative strategies in Microbiology and Immunology teaching through facilitated group discussions, poster sessions, short oral presentations and informal networking.

We have assembled what we think is a fantastic program with Keynote talks from Dr. Claudia Kemper from the NIH and Dr. Alice Fornari from the Zucker School of Medicine. We are also very excited that the meeting includes 27 oral and poster presentations from our participants! We hope that this meeting format provides for robust discussion and the development of future collaborations and educational scholarship!

Julie Kerry, Chair AMSMIC Education Committee
Eastern Virginia Medical School

**Program Committee**
Tim Bauler, West Michigan University
Neal Chamberlain, A.T. Still University
Rebecca Greenblatt, Upstate
Brian Higgins, University of Kentucky

**www.amsmic.org**


## Monday July 18 - Welcome

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| **3:00 – 6:00 pm**<br>*Lobby II* | **AMSMIC Registration Desk Open**<br>Staff: Sheilah Jewart |
| **6:30 – 9:00 pm**<br>*Beach Tent* | **Welcome Reception & Dinner** |

## Tuesday July 19 – Emerging Topics

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| **8:00 - 5:00 pm**<br>*Lobby II* | **AMSMIC Desk Open** |
| **8:45 – 9:00 am**<br>*Beach/Gulf Room* | **Welcome & Introductions**<br>Julie Kerry |
| **9:00 – 10:00 am** | **Keynote: *The Complement System***<br>Claudia Kemper, PhD, Sr. Investigator<br>NIH National Heart, Lung & Blood Institute |
| 10:00 - 10:30 am | Break |
| **10:30 – 11:30 am** | **Facilitated Discussion: Defining Processes for Integrating Emerging Topics into the Curriculum**<br>Moderator: Tim Bauler |
| **12:00 – 1:30 pm**<br>*Beach Tent* | **Lunch** (Included) |

**1:30 - 3:15 pm**
*Beach/Gulf Room*

**Active Learning Strategies in Virtual, Live and Hybrid Environments**

Moderator: Kylie Watts

- ***TBL in the Age of COVID-19: Can we make it work? (13)***
  Kerstin Honer zu Bentrup

- ***Virtual Clerkship Practice Session (14)***
  Rebecca Greenblatt

- ***Teaching a Medical Microbiology Laboratory in a Virtual Environment (15)***
  Cindy Arvidson

- ***Comparison of Online vs In-Person Microbiology/Immunology Laboratories to Reinforce Learning Objectives and Promote Student Driven Discussion (18)***
  Noelle Thielman

- ***Igniting Children's Enthusiasm for Microbes with an Origami Paper Microscope (16)***
  Jorge Cervantes

- ***Using Team Based Learning to Solidify Microbiology and Immunology Concepts (17)***
  Holly Turula

**3:15 - 3:45 pm**

**Break / Poster Set-Up**

**3:45 - 5:45 pm**
*Beach/Gulf Room*

**Poster Session**

- ***Using Wiki Assignments in Medical School (08)***
  Erin McClelland

- ***Integration of basic biomedical and clinical sciences in a virtual environment (03)***
  Samina Akbar

- ***Evolution of a Microbiology and Immunology Curriculum: from separate courses and labs to subject integration (01)***
  Michael Volin

- ***Providing a resource for teaching microbiology laboratory techniques in a virtual environment (04)***
  Cindy Arvidson

- ***Use of Collaborative Self-Directed Learning in a Virtual COVID-19 Course (05)***
  Dwayne Baxa

- ***A Take-Home Immunology Wet Lab Exercise (02)***
  Melissa Stuart

- ***A Tale of Two Curricula: A comparison of immunology educational programs within one medical school (09)***
  Katharine Milani

- ***Drawing Exercises to Enhance Microbiology and Immunology Concept Understanding and Retention (12)***
  Robert Waters

- ***Transitioning POPS to Online Learning- the UMMC Experience (10)***
  Stephen Stray

- ***Spaced Retrieval: Using Email to Send Daily Practice Questions to Aid Student Exam Preparation in Infectious Disease (06)***
  Neal Chamberlain

- ***MicR0be Cards: Pandemic Project and Educational Opportunity (07)***
  Michael Conway

- ***Immunology Education in U.S. Undergraduate Medical Curriculum (11)***
  Yuan Zhao

- ***Inclusion of Diverse Skin Tones in Microbiology Lectures***
  Julie Kerry

**PM** **Evening Free**

## Wednesday July 20 – Integration

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|---|---|
| **9:00 - 10:30 am:**<br>*Beach/Gulf Room* | **Workshop: Cognitive Integration**<br>Julie Kerry |
| 10:30 - 11:00 am | Break |
| **11:00 - 12:00 pm:** | **Facilitated Discussion: Discipline Integration to Facilitate Deep Learning**<br>Facilitators: Julie Kerry and Kerstin Honer zu Bentrup |
| **12:00 - 1:30 pm**<br>*Beach Tent* | **Lunch** (included) |
| **1:30 - 2:30 pm** | **Short Talks: Discipline Integration, Adapting to Curriculum Innovations, Learning Objectives and Assessment, Getting Promoted on the Educational Track**<br>Moderator: Stephen Stray<br><br>• ***The Concept Synthesis Session: A Method for Integrating Foundational Microbiology and Immunology Content with Clinical Reasoning and Step 1 Preparation (25)***<br>Laura West<br><br>• ***Identifying Threshold Concepts Through Student Usage Data and Leveraging Those Concepts for Student Success (23)***<br>Amy Stone<br><br>• ***Developing a Medical Microbiology Education Doctorate Program for Pre-Clinical Educators: A Novel Doctorate Program to Meet the Growing Demand in Graduate-Level Medical Microbiology Education (24)***<br>Christopher Keller<br><br>• ***Defining and Building a Foundational Microbiology and Immunology Curriculum (26)***<br>Mark Wurth |
| 2:30 - 3:00 pm | Break |

| | |
|---|---|
| **3:00 - 5:00 pm** | **Short talks: Asynchronous and Independent Learning**<br>Moderator: Jolyne Drummelsmith<br><br>• ***Can We Engage Students in an On-Line Lab Session? A Preliminary Study Using Tailored Digital Content (21)***<br>Louise Lawson<br><br>• ***Club MICROBE: An extracurricular medical student interest group to promote distributed review of infectious disease content (27)***<br>Tim Bauler<br><br>• ***Self-directed learning: student written and reviewed MCQs (20)***<br>Dennis Arvidson<br><br>• ***Interrupted Asynchronous Learning Module in Immunology (19)***<br>Gabor Szalai<br><br>• ***Anime as a fun way to teach host-pathogen interactions in microbiology (22)***<br>Daven Devara |
| **7:00 - 9:00 pm**<br>*Island 2 Room* | **Optional Working Dinner:**<br>**Moving from Discussions to Deliverables**<br>Must be pre-registered |
| **PM** | **Evening Free** |

## Thursday July 21 – Faculty Development

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| **9:00 - 9:15 am** | **Introduction to Breakout Discussions** |
| **9:15 - 10:30 am** | **Breakout Discussions:**<br>***1.*** Learning Objectives and Assessments<br>Moderator: Cindy Arvidson<br><br>***2.*** Asynchronous and Independent Learning<br>Moderator: Tim Bauler<br><br>***3.*** Difficult Conversations with Students<br>Moderator: Julie Kerry<br><br>***4.*** Adapting to Curriculum Innovations<br>Moderator: Neal Chamberlain<br><br>***5.*** Demystifying the IRB<br>Moderator: Rebecca Greenblatt |
| **10:30 - 12:00 pm** | **Reports from Breakout Groups and General Discussion** |
| **12:00 - 1:30 pm**<br>*Beach Tent* | **Lunch** (included) |
| **1:30 - 2:45 pm** | **Keynote: *Turning Education into Scholarship***<br>Alice Fornari, EdD, RD<br>Associate Dean for Educational Skills Development,<br>Professor of Science Education, Occupational Medicine,<br>Epidemiology and Prevention, and Family Medicine<br>Zucker School of Medicine<br>Vice President, Faculty Development, Northwell Health |
| **2:45 - 3:45 pm** | **Facilitated Discussion: Getting Published and Promoted on the Education Track**<br>Facilitator: Rebecca Greenblatt |
| **3:45 - 4:00 pm** | **Closing Remarks**<br>Julie Kerry |
| **6:30 - 9:00 pm**<br>*Beach Tent* | **Farewell Dinner** (Included) |

# ABSTRACTS

**01**

***Evolution of a Microbiology and Immunology Curriculum: from separate courses and labs to subject integration***

Michael V Volin*, Michelle Swanson-Mungerson, and Richard Laddaga

Institution(s): Department of Microbiology and Immunology, College of Graduate Studies and Chicago College of Osteopathic Medicine, Midwestern University, Downers Grove, IL 60515

Curricula for teaching medical students Microbiology and Immunology are constantly evolving. Several factors play into this constant evolution including changes in technology, curricular time constraints, and increasing amounts of course content. In order to successfully address these issues, it is necessary to incorporate efficiencies into the curriculum. To make our Microbiology and Immunology curriculum more efficient we did the following. We converted our three separate courses taught over three quarters into two integrated courses taught over two quarters. Next, due to our school's curricular change to a symptom of-the-week aligned curriculum, we reordered topics within our courses to integrate and align with concordant courses and the symptom of the week. At the same time, we began converting our wet, hands-on laboratories to case-based, small group sessions. There were both positive and unexpected negative results of the curricular changes. Having larger courses with more exams gave students more opportunities to be successful. However, final exams were often triaged by students to study for other courses. Combining Microbiology and Immunology topics allowed for more thorough explanations of the immunological responses to specific microbes. However, students often had difficulty remembering immunological mechanisms later in the course. Also, the simultaneous teaching of the same topics with other courses allowed the students a greater

perspective of each topic, however the alignment of topics could not always be achieved. Finally, removing of the laboratory portion was missed by some hands-on learners, however the case-based small group activities aided their diagnosis development. Also, in response to Covid-19, the small group sessions were able to be temporarily converted to on-line group assignments in Canvas. Overall, our current course sequence is more efficient covering more topics while benefiting from student exposure to similar topics in parallel courses.

# 02

## A Take-Home Immunology Wet Lab Exercise

Melissa K. Stuart
A.T. Still University

Background:
The core learning styles are visual, auditory, and kinesthetic (hands-on). The immunology wet lab is a traditional venue for kinesthetic learning.

Objective:
When COVID-19 dictated a campus lock-out in Fall 2020, we devised a clinically relevant hands-on immunology lab exercise that could be done in the students' homes using their own biological specimens.

Methods:
Point-of-care (POC) tests in zip-top bags were distributed to students at an outdoor site. The kits contained an ABOD blood-typing agglutination assay and three lateral-flow immunoassays that tested for Group A strep in throat swabs, hCG pregnancy hormone in urine, and protein, glucose, nitrite, and leukocyte esterase in urine. Students read the laboratory handout and watched instructional videos before meeting with a lab instructor by Zoom. Students performed the assays while in their assigned Zoom rooms, photographed their results, and submitted the photos with their lab reports via email. Students were asked for voluntary, anonymous feedback on the exercise using a Canvas survey. The lab exercise and survey were IRB-exempt.

Results:
35/181 students completed the survey, 18 of whom indicated that hands-on learning was their preferred learning style. 100% of respondents agreed or strongly agreed that the lab was well organized, instructions were clear, assessments were fair, and that the exercise was enjoyable. 94.3% of respondents agreed or strongly agreed that having lab instructors available by Zoom was helpful and that the laboratory contributed to their training as future physicians. As a bonus, written comments indicated that the exercise provided a sense of connection among the students.

Conclusion:
The take-homeimmunology exercise served as a reasonable alternative to the traditional wet lab during the 2020 pandemic. By using their own biological specimens, students gained experience with POC tests without exposure to pathogens or heterologous human products.

# 03

## Integration of basic biomedical and clinical sciences in a virtual environment

*Samina Akbar, Ph.D. 1, *Minal Mulye, Ph.D. 2 , Medhane Cumbay, Ph.D. 1 , and T. Wilson, Ph.D. 3

1 Marian University, College of Osteopathic Medicine
2 Philadelphia College of Osteopathic Medicine
3 University of Kentucky College of Medicine

The COVID-19 pandemic presented a tremendous gap in clinical training of third- and fourth-year medical students due to discontinued in-person training in March 2020 to assure student safety. In the absence of traditional clinical rotations, we created a novel virtual course integrating basic biomedical and clinical sciences to guarantee continued training under these extraordinary circumstances. The overall goal of this course was to train students to respond to a case of emerging respiratory virus such as the novel coronavirus, identify a case once it occurs, compare and contrast patient management strategies, and properly implement infection prevention and control measures to mitigate transmission to healthcare workers or other patients. Week 1 of this two-week course was designed to promote online small group learning based on assigned articles and online learning modules. Week 2 included clinical case discussion with a team of clinicians and scientists. This approach provided student recall opportunities for basic principles covered in the pre-clinical years and emphasized their direct application in the current clinical setting and their day-to-day pandemic-influenced lives. Besides microbiology and immunology, the course provided relevant review of other basic biomedical disciplines including physiology, pharmacology, and public health. We covered the basics of the novel coronavirus (e.g., contagiousness, incubation period, immune response, vaccine development, and symptom management). Morbidity and mortality, screening, outbreak investigation, surveillance, evidence-based public health, and biosafety was also epidemiologically and clinically addressed. Students were provided an opportunity to discuss pandemic-related patient care practices with clinicians in a case-based manner. By employing a collaborative, investigative and integrative approach around a focal topic (COVID-19), we were able to foster meaningful learning and demonstrate seamless integrations between basic biomedical science knowledge and clinical application. This virtually delivered medical curriculum was timely, carried high student interest, and continued student training in a virtual setting during the pandemic.

**04**

# Providing a resource for teaching microbiology laboratory techniques in a virtual environment.

Cindy G. Arvidson*
Institution(s): Michigan State University College of Human Medicine

The Virtual Interactive Bacteriology Labs were developed in 2009 in response to the expansion of both MSU medical schools. This was necessary to maintain our bacteriology lab skills teaching in the Medical Microbiology and Immunology courses. These labs are still used in the new curricula in both CHM and COM, as well as in undergraduate courses at MSU.

The modules are freely available and are currently used by many institutions in the US and around the world, including medical schools, allied health programs, high schools, community colleges, and comprehensive colleges and universities. VIBL use skyrocketed when most institutions moved to on-line instruction at the start of the pandemic. The challenge we were faced with was that nine of the ten VIBL modules were based on Adobe Flash, which essentially disappeared at the end of 2020. To continue to provide this resource to the microbiology education community, it was necessary to convert the VIBL to a different format.

The MSU unit that oversaw their original development was dismantled in the 2010's and many of the team had moved on to other institutions. Due to the pandemic, MSU IT resources were not available since other university projects had higher priority. I was able to secure access to the original development materials (source files, graphical assets, logic and storyboards) from the original project producer, but the actual code had to be redone. This was accomplished by contracting with a local custom software company to convert the modules to HTML5.

Of the nine modules, seven were considered of highest priority. The conversion took several months of effort to complete, but modules were made available to the public through the same portal as each was completed. The response from the microbiology education community has been extremely appreciative and the use of these resources continued uninterrupted.

# 05

## Use of Collaborative Self-Directed Learning in a Virtual COVID-19 Course

Dwayne M. Baxa*, Kyeorda Kemp, Claudio Cortes
Oakland University William Beaumont School of Medicine, Rochester, MI 48309

Introduction
An online course was developed that focused on the current pandemic using a collaborative self-directed learning (CSDL) approach. The primary goal for the course was to identify what information students believed would be needed for them as practicing physicians in the context of COVID-19. A secondary goal was for students to gain a better appreciation for the CSDL process.

Methods
A 2-week synchronous, virtual elective was created that encouraged students to pursue topics they believed to be relevant to practice during the COVID-19 pandemic. Students were taught about self-directed learning and then prepared group presentations based on their research of the literature on these topics with the intent of teaching their peers. Class discussion followed each presentation and students gave feedback which was used to revise the work. Students submitted video reflections on their experience and therelevance of the material covered to their future training. Qualitative analysis of reflections and course Eva luations was conducted to determine the effectiveness of the CSDL framework, and to explore student perceptions of the course and its effectiveness at preparing them for practice. A survey regarding school-wide student perceptions of SDL was offered to M3 and M4 students in order to explore their experiences with SDL

Results
The course was attended by fifteen M3/M4 medical students. Students appreciated collaborating with their peers and reported gaining knowledge about the topics covered. The general survey offered to M3/M4s demonstrated that all students perceived that they employed SDL in medical school. However, many components of SDL beyond synthesizing and assessing were not utilized.

Conclusions
In this case study, we report that CSDL is an effective method for promoting self-directed learning as implemented in this course. Similarly designed courses can help students appreciate CSDL which will benefit them when they enter into the clinical practice.

**06**

## Spaced Retrieval: Using Email to Send Daily Practice Questions to Aid Student Exam Preparation in Infectious Disease

Neal R. Chamberlain, PhD
A.T. Still University/Kirksville College of Osteopathic Medicine

If students are quizzed frequently, their performance on the ensuing examination improves. In addition, if quizzes are spaced out students remember the content for a longer time. Spacing out quizzes makes knowledge retrieval to complete the quizzes difficult. Difficult retrieval of knowledge appears to improve long-term memory. Medical students oftentimes utilize practice questions to study. Does spacing of practice questions improve medical student performance on an infectious disease (IDIS) examination? Four days following the gastrointestinal (GI) IDIS lectures, a daily multiple-choice question was delivered by email for six days. Students were asked to email their response before the next email question arrived the following day. On day two through seven, feedback was sent to students with the correct and incorrect answers for the prior day's question. The exam was given five days after question G's feedback. Forty-four students (27.2%) emailed at least one response to the daily questions.

Responses decreased from question 1 to 6 (Ql= 34, Q2= 24, Q3= 20, Q4= 19, QS= 15, Q6= 14). The number of questions students responded to: 5 students- 6Q's, 7 students- SQ's, 3 students- 4Q's, 7 students- 3Q's, 6 students- 2Q's, 16 students- lQ. Incorrect responses to the questions were rare (Ql- 1, Q2- 0, Q3- 0, Q4-0, QS- 4 and Q6-1). The GI exam average was- 91.0%. The exam average for responders (91.8%) was higher but was not significantly higher than for non-responders (90.6%). The exam average was significantly higher (91.0%) than the exam average for three medical microbiology exams given to the same class in the previous semester (88.8%, 90.4%, and 87.2%). Spacing practice questions did not significantly improve student performance when comparing responders to non-responders but may have improved exam performance when the IDIS GI exam was compared with exams from the medical microbiology course.

## 07

### MicR0be Cards: Pandemic Project and Educational Opportunity

Michael J. Conway, Associate Professor
Foundational Sciences, Central Michigan University College of Medicine

The SARS-CoV-2 pandemic led to broad societal lockdowns and prolonged inactivity in non-essential research laboratories. The lack of in person activities also hindered progress in many scholarly activities. This shift in access led many academics to pursue novel projects. The pandemic revealed a large gap in knowledge of microbiology and public health concepts. Creative solutions were needed to communicate with students and the community to promote knowledge and appreciation of measures taken by public health authorities to mitigate the spread of infectious disease. To partially fill this gap, an online crowdfunding campaign was launched to raise money for a scientific illustrator – Alithographica – who helped create content for a new microbiology-based card and dice game. The game was printed, and then marketed using social media. It was given to M1/M2 medical students as an adjunct to their learning.

# 08

## Using Wiki Assignments in Medical School

Erin McClelland, PhD
Marian University College of Osteopathic Medicine

A wiki is a collection of pages that allow collaborative modification and management (eg, Wikipedia). First-year MUCOM medical students designed a Wiki that outlined the major concepts covered in Immunology during the Scientific Foundations of Medicine class. The first three deadlines were peer-reviewed where each student turned in their wiki and then anonymously reviewed another student's wiki content and suggested feedback. For the final deadline, all participating students were placed into groups that collaborated to collate the individual wikis into one. Thus, each student created and received peer feedback for their Immunology study guide for the Board Exam.

**09**

## A Tale of Two Curricula: A comparison of immunology educational programs within one medical school

Katharine Milani, PhD1*, Shyuan Wang, PhD2,3, Pamela Basehore, EdD2,3, Susan Muller-Weeks, PhD1

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Rowan University School of Osteopathic Medicine offers students a choice of curricular tracks. In the synergistic guided learning track (SGL), students engage in largely traditional classroom-based learning. In the problem-based learning track (PBL), students engage in independent study where clinical cases provide the stimulus for learning. Incoming students have the option of selecting either track. This study is a comparison of the immunology educational programs delivered in the two tracks. The SGL track is a single-pass approach. Students receive 21 hrs of immunology content during the Biomedical Foundations curriculum block which occurs during weeks 14 & 15 of the fall semester in year one. Active learning strategies are incorporated in the form of flipped classrooms and independent study with Q & A polling sessions. In contrast, the PBL track students work in small groups to progress through clinical cases that are related to the block content. The immunology block takes place in weeks 14 through 16 of the spring semester in the first year. During the block the students meet for a total of 18 hours of interaction with the group and a facilitator. The majority of the immunology content is absorbed during dedicated self-study time that takes place outside of the group sessions.

Here we will compare student experiences and outcomes utilizing internal and external exams. Both SGL and PBL blocks utilize internal exams for assessment of student progress. Additionally, all students are required to take the COMAT Foundations in Biomedical Sciences (FBS), prior to sitting for the COMLEX. Our analysis shows that student performance on internal exams has a moderate and significant correlation with COMAT FBS and COMLEX performance. Results also indicate there is no significant difference in student performance in immunology/microbiology between the two curricular tracks despite varied methods of content delivery.

# 10

## Transitioning POPS to Online Learning- the UMMC Experience

SJ Stray*, BJ Akerley, JT Bates, LE Keller, ME Marquart, LS McDaniel, R Tandon, JE Vidal, E Bengtén, M Wilson

Institution
Department of Microbiology and Immunology, University of Mississippi Medical Center

Patient-oriented Problem Sets (POPS) were developed to provide early-stage learners with a means of learning new material, contextualizing knowledge presented in lectures, and to allow students to practice communication skills such as presenting data to and obtaining information from peers. Due to COVID19 restrictions on gathering, we adapted POPS exercises to a real-time online format. Students were assigned to groups of either four or five plus one faculty facilitator, who facilitated up to four groups simultaneously. Students received the POPS pre-test the day before, but the remainder of the packet (not including the post-test) was not made available until immediately prior to the session to eliminate “Pre-work”. Meetings were held using Microsoft Teams. Facilitators were not available to any one group more than 25% of the time to encourage peer-to-peer interactions. Post-tests were deployed in the Learning Management System, with the answers and explanations from the POPS packet viewable once the student had taken the test.

Students and faculty enjoyed interacting virtually while student access to campus was severely limited. Some faculty reported fewer distractions due to other groups typically in the same room when given in person. Other faculty found that toggling between different meetings was time-inefficient and reduced opportunities to interact with students.

This method allowed us to maintain a level of interaction between students and faculty and among student during forced remote learning, and shows promise for adaptation for other remote learning scenarios, such as Medical Schools with multiple campus sites.

# 11

## IMMUNOLOGY EDUCATION IN U.S. UNDERGRADUATE MEDICAL CURRICULUM

Austin Reynolds, Ritvik Bhattacharjee, Yuan Zhao*

Sam Houston State University, College of Osteopathic Medicine, Conroe, TX 77304 U.S.A.

PURPOSE

Immunology is an integral component of undergraduate medical education (UME) because of its critical role in host defense and many disease processes. At the time of our study, no authoritative curriculum for immunology in UME exists. This project intends to determine the current status of immunology education in US medical schools in hopes to provide insight on curriculum design and delivery pertaining to this subject.

METHODS

In this study, curricular information for immunology education was collected from the curriculum webpage of 199 U.S. medical schools, including both allopathic and osteopathic programs, based on AACM and AACOM membership. Data pertaining to the setting of immunology education such as subject(s) that are co-taught with immunology, timing of course, credit hours, and integration level was recorded in Microsoft Excel for analysis.

RESULTS

Of 199 U.S. medical schools studied, 174 programs post the needed curriculum information online. Among them, 143 schools (71.9%) provide immunology education in year 1 of the undergraduate curriculum, 16 (9.2%) in year 2, and 9 (5.2%) integrated in both year 1 and 2. For course setting, 59 schools (33.9%) offer immunology with microbiology, 42 (24.1%) offer as part of foundational sciences course, 18 (10.3%) offer as stand-alone course. Ten programs (5.7%) have immunology fully integrated in system-based curriculum. Other subjects that are combined with immunology include hematology, pathology, oncology, etc. for other programs. Differences exist in MD versus DO Programs in immunology curriculum setting.

CONCLUSION

Our data suggests that immunology education in US colleges of medicine lacks consensus. Continued discussion on standardization of immunology education across US medical schools is recommended. Future direction includes surveying content experts from different programs on the pedagogy of immunology education and using Delphi method to develop authoritative learning objectives for immunology education in undergraduate medical curriculum.

**12**

## Drawing Exercises to Enhance Microbiology and Immunology Concept Understanding and Retention

Robert Waters, MS*, Delbert Abi-Abdallah, Ph.D., Nancy Carty, Ph.D.,
Christopher C. Keller, Ph.D., FNAOME

Lake Erie College of Osteopathic Medicine, Erie, PA

Medical students are required to learn copious amounts of foundational science concepts during their first two years of preclinical education. This information must be retained and added to over long periods. Every year students have difficulty retaining and comprehending some microbiology and immunology concepts. One area of current research has indicated that drawing out complex concepts increases student exam scores and retention. In order to help our students understand and retain difficult topics in microbiology and immunology, we added drawing workshops to the core curriculum for first year medical students and graduate students. During these workshops students are instructed to work in groups and draw out complex concepts such as immune cell function, exotoxin mechanism of action, and cell wall synthesis, among others. Our current data from graduate student surveys show that the students perceived these workshops to be helpful and engaging and most believe the workshops enhanced their exam performance. Therefore, a supplemental microbiology and immunology drawing companion is in development and will be added into our medical school curriculum. The drawing companion is part of a Doctoral dissertation project and will be used to determine if drawing exercises can enhance medical student outcomes on standardized exams.

**13**

## TBL in the age of COVID-19 – can we make it work?

Kerstin Höner zu Bentrup,PhD*1, Craig W. Clarkson, PhD2 & Guenevere Rae, MS, PhD3

Institution(s): Tulane Medical School, 1 Dept. of Microbiology and Immunology, 2 Dept. of Pharmacology, and 3 Office of Medical Education, 1430 Tulane Ave, New Orleans, LA 70112. Email: khonerzu@tulane.edu

PURPOSE

The COVID-19 pandemic has upended Medical Education. Moving lectures online was relatively easy, but how would one move Team-Based-Learning (TBL) exercises? A number of solutions were implemented since, including commercial software. Here we describe how we set out to use the resources we had on hand (Zoom, TurningPoint Technologies, Canvas) to adapt our in-person TBL concept to a modified online version, and provide a summary of initial student feedback.

METHODS

We devised our TBL for an online synchronous modality. The IRAT, GRAT and GAE were imported into an online polling software. Students were sent the hyperlinks, using the Zoom chat function. Progress on the students' submissions was monitored online in real-time. For the GRAT and GAE, students were divided into pre-defined breakout rooms to work within their steady TBL teams.

RESULTS

Our first online TBL took place in April 2020. Considering the stress the students experienced due to the pandemic, we initially decided to omit the IRAT during the in-class session and concentrated on the group exercises. Predictably, this format was more favorably received than the following online TBLs utilizing the three-part 'classic' structure. The ratings for the respective TBLs did not change significantly from previous years. Content analysis of the qualitative data revealed similar themes as well, independent of the online format. Students clearly appreciated the opportunity to work in their designated groups while being critical of technical glitches.

CONCLUSIONS

Results from this study support the hypothesis that an online TBL format is possible, even by using generic software tools that are available at most institutions. The format presented in this study demonstrates that faculty and students can be in a multitude of locations and still conduct a successful and effective Team-based Learning class session via streaming software, such as Zoom.

# 14

## Virtual Clerkship Practice Session

Muhammad Osman Arif MD, formerly Department of Medicine, Syed Bukhari MD, Department of Medicine, Amit Dhamoon MD/PhD, Department of Medicine, *Rebecca Greenblatt PhD, Department of Microbiology & Immunolog, Gary Johnson MD, Department of Emergency Medicine

SUNY Upstate Medical University, 750 East Adams Street, Syracuse NY 13210
(Dr. Arif is now in private practice in McKinney, Texas.)

We created the Clerkship Practice Session (CPS) in Fall 2019 in response to comments on the AAMC Graduation Questionnaire that third-year SUNY Upstate Medical students did not feel well-prepared to begin Clerkships. The CPS provides an opportunity for second-year students to practice interviewing a mock patient and presenting to a mock Attending during several time-limited high-impact cases (initially 8 per session). Anecdotal student feedback from the pilot CPS was positive, but the coronavirus pandemic necessitated major modifications for Fall 2020.
For 2020-2021, we reworked the CPS venue from a large-group classroom with physical stations to a Zoom session with Breakout Rooms. Because the previous year's clinical instructors were suddenly unavailable, we recruited fourth-year students to play the Patient and Attending roles. After the session, feedback from the students was positive (response rate 33/47, overall rating 8.17/10). Intriguingly, near-peer facilitation was the most popular feature of the exercise, with 52% of respondents Strongly Agreeing that "The MS4 students who facilitated the stations gave me an opportunity to display what I knew and helped me to learn more." (45% Agreed; 3% were Neutral.) Three respondents spontaneously commented that they preferred M4s to faculty for this role. For 2021-2022, we again recruited fourth-year facilitators and hosted the CPS on Zoom. Responding to comments from past students and facilitators, we reduced the number of cases to allow more time for discussion. Student response to the exercise remained positive (response rate 42/153, overall rating 7.7/10).

This year we also added a reflective question to the CPS closing discussion: the students were invited to self-assess their readiness to begin Clerkships. Responses were collected by anonymous free-response PollEverywhere polling. During the open self-assessment, two facilitators spontaneously responded to some student concerns, leading to a helpful conversation that we will attempt to duplicate in the future.

**15**

## Teaching a medical microbiology laboratory in a virtual environment.

Cindy G. Arvidson*, Dennis N. Arvidson, J. Patrick Bardill, and Kirstin Parkin

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The Shared Discovery Curriculum (SDC) at MSU-CHM is a completely integrated curriculum, with no discipline-specific courses. Assessment of student learning is through a progress suite of exams, which are taken twice each semester. Basic science knowledge is assessed, in part, by a comprehensive necessary science exam (CNSE) through the NBME. At the end of the first year, students who score in the lowest quintile in the microbiology and/or immunology subscores on the CNSE are required to participate in a 4-week, intensive intersession in Microbiology and Immunology.

The content covered in the intersession is primarily a review of Microbiology and Immunology material covered in the M1 curriculum, but in a more discipline-focused manner. As in the rest of the SDC, teaching methodologies are flipped-classroom models. Learning activities include a daily readiness assessment; a small group session where students work through a slide deck of content which includes questions for discussion and active learning activities; writing and presenting board-style questions; and hands-on bacteriology lab exercises. Small groups are led by M2s, post-docs, and graduate students, with support from faculty leaders.

Here, we describe the intersession and the approaches taken to flip the entire course, including the laboratory activity, to a virtual environment. Resources used to achieve this included a lock-down browser (within Desire2Learn) for assessments, Zoom for small and large group sessions, and Qualtrics for a case-based bacteriology lab exercise. Assessment data and student feedback on the intersession were comparable to pre-COVID iterations of the intersession and will be presented.

**16**

## Igniting children's enthusiasm for microbes with an origami paper microscope

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The current COVID-19 pandemic has evidenced the urgent need for microbiology literacy in society. Microbiology knowledge, and its dissemination, can help inform and increase the objectivity of important decisions, such as treatment or vaccination.

A microbiology learning experience, titled 'What you can't see can hurt you" was delivered as part of a larger outreach event (Medventure) where children are exposed to various aspects of medicine and health care fields. The activity involved an introduction to and discussion of bacteria of clinical importance, and the use of a smartphone-attachable paper-based foldable microscope.

To explore the impact of this activity on participants' interest in science and microbiology, a pre- and post- survey of 5 questions in an emoji-based Likert scale was completed by the participants before and after the activity.

A statistically significant increase in their interest in microbes, as well as in their curiosity on "where they can find microbes" was observed after the event.
Making microbes visible to children, and allowing them to capture images of microbes exposes them directly and personally to microscopy and microbiology. An affordable low-cost paper-based microscope can become an alternative approach to teaching and learning, and to deliver clinical microbiology information to a wide audience range.

**17**

## Using Team Based Learning to Solidify Microbiology and Immunology Concepts

Holly Turula, PhD

Western Michigan University Homer Stryker MD School of Medicine

This session/poster is geared toward future, current, and past microbiology and immunology educators who wish to explore the educational strategies involved in Team-Based Learning (TBL). TBL has been used in higher education since the 1970's yet is still an underused evidence-based approach for teaching microbiology and immunology concepts. TBL is broken down into three parts: before-class preparation, the in-class pre-quiz, and finally the group application exercise. To hold learners accountable for completing their independent pre-class work, the in-class pre-quiz (termed the readiness assurance test, or RAT) is performed first individually and then as a small group. To minimize misconceptions, questions are discussed as a class before moving on to the application exercise. Similar to immune cells, we work most effectively in collaboration. The in-class small group component of TBL simulates complex real-world situations allowing learners to participate in collaborative peer teaching while fostering mentorship and a sense of community. Learners are required to synthesize complex information from their pre-class learning and draw ideas together to answer questions in a way that stimulates higher order thinking. Not only that, but learners enjoy the process of TBL and find it beneficial!

In this seminar/poster session participants will engage in the steps of the TBL group application exercise in order to learn how to implement TBL in their classroom to better engage their learners.

**18**

## Comparison of Online vs In-Person Microbiology/Immunology Laboratories to Reinforce Learning Objectives and Promote Student Driven Discussion

Noelle R. J. Thielman PhD*, Robert Waters, MS, Nancy Carty, PhD, Christopher C. Keller, PhD, FNAOME

Lake Erie College of Osteopathic Medicine, Erie, PA

Without continual reinforcement, student retention of key concepts across pre-clinical curricula can be diminished. Reinforcement techniques used for medical education of microbiology/immunology were altered during the COVID-19 pandemic due to the online delivery of educational materials. Previously, we have found that in-person, hands-on, active group laboratories have aided medical students to integrate and retain key concepts in microbiology/immunology. Group laboratory sessions facilitate student collaboration in identifying critical information to formulate differentials and answer case-based questions through the analysis of laboratory tests, specimen slides, bacterial cultures, and high-definition visual components. While students do find alternative means of engaging the material, there is no substitution for spending quality time actively thinking about and discussing the information in a clinical frame of mind. During the 2020-2021 academic year, the laboratories were converted into an online platform using high-definition visual components. Students worked together via breakrooms on Zoom to answer the same case-based clinical scenario laboratories as students in previous years. Comparing online to in-person student experiences, we found overall student performance was similar; however, student collaboration and team-based discussions were reduced online compared to in-person. Online student interactions were limited, and most students completed the assignments alone and only interacted to check their results at the end of the session. Both the in-person and online platforms enhanced reinforcement of core information in microbiology/immunology, however we found drawbacks to online delivery of laboratory materials. Particularly, reduction in student driven discussions was seen online compared to in-person. Nevertheless, online microbiology/immunology laboratories still enabled an opportunity to reinforce core concepts necessary during pre-clinical medical education.

**19**

## Interrupted Asynchronous Learning Module in Immunology

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The COVID-19 pandemic has required the offering of asynchronous learning opportunities for medical students. In most cases, a video recording of a didactic lecture was provided, which is often viewed by students at increased speeds. Most learners today are accustomed to multitasking, looking up information, however at the same time their attention span is less than 15 minutes. In order to use the learners' need to disengage from the pre-recorded video, but keep them on the subject, a learning module in the topic of Immunology of the Gastrointestinal Tract was created with planned interruptions. During a 58 minutes long video, 13 times the playback was stopped and the students were instructed to look up a relevant information from previous lectures. Next, they had to take a quiz in order to continue viewing the video. The overall outline of the lecture, the outcome, the instructions and quiz questions will be presented.

# 20

## Self-directed Learning: Student Written and Reviewed MCQs

Dennis N. Arvidson

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ABSTRACT:
I developed a self-directed learning activity, using Eli Review http://app.elireview.com for Medical Microbiology students. This multistep optional activity required all students participating to work in synchrony. Each student prepared a multiple-choice question (board-style questions were encouraged), and submitted it to the Eli Review website. Next, students were randomly placed into groups of five; each student reviewed the questions written by four other students. In the third step the students reflected upon the feedback received and submitted a revision plan. Finally, students uploaded their revised question. The questions were compiled and posted in two online documents. One document contained only the questions, to be used as a practice exam. The second document contained the questions with answers and foils explained; each submission commented on why the question topic was chosen, included links to the literature cited, and comments on the articles chosen for citation.

**21**

## Can We Engage Students in an On-Line Lab Session? A Preliminary Study Using Tailored Digital Content

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Tulane University School of Medicine

ABSTRACT:
Our Basic Infectious Disease Module has included a wet-lab component for years. More recently, this has been offered as a voluntary lab designed to supplement the material presented in the classroom setting and providing an opportunity for students to perform routine microbiological assays. Our analysis of the impact of the lab session on student performance was published in 20201. Students who attended the voluntary lab sessions scored significantly higher on exam questions related to lab exercises than students who did not attend. In the current study, we seek to determine the impact of interactive digital content in a case-based active learning module as an alternative to a hands-on lab. This complementary active learning session allows us to supplement in-class learning but provides the flexibility needed in the case of interruptions to in-person learning as recently experienced due to the ongoing pandemic as well as weather impacts. Focusing on Health: Laboratory Exercises in Microbiology is a digital textbook designed to help students draw real-life connections with basic microbiological concepts using realistic examples. Individual licenses provide students with access to interactive content, including videos of lab techniques, quizzes to assess their preparation for class sessions or understanding of key concepts, and clinical correlates. The nature of the textbook allowed us to specifically tailor the content for our active learning session based on the respective clinical cases, prioritize specific topics of interest, and supplement the published material with custom notes, clinical case scenarios, videos, and quiz questions. Our hypothesis is that implementation of an adaptable commercial digital platform will enrich students' experience and improve comprehension and retention of in-class material, similar to our findings with hands-on labs.

1. L. Lawson, C. M. Lind, et al. 2020. "Impact of a voluntary laboratory-based active learning session on medical student knowledge retention". Medical Science Educator. 30:823-831.

**22**

## Anime as a Fun Way to Teach Host-pathogen Interactions in Microbiology

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There has been an increase in the diversification of backgrounds of students matriculating into medical school. We are seeing an increase in non-STEM backgrounds and students with minimal scientific backgrounds. Cartoons are effective in learning because the visual format effectively combines entertainment and knowledge, allowing readers to become engrossed in the story. Cartoons are popular in Japan, where they are known as anime, and cover a wide range of genres, including medical community settings.

To assist students in achieving a baseline level, we developed an anime detailing the pathogenesis of *Staphylococcus aureus* infection, with the aim of introducing medical microbiology concepts in a fun but informative manner.

Although we will touch upon the wide properties of all bacteria, we selected S. aureus as it is one of the first bacteria students learn during the first unit. Aspects covered include information such as shape, Gram-staining, and hemolytic ability. Pathogenesis covers how the bacteria enter the body, mechanism of virulence factors, and what diseases can arise from the infection. Treatment aspects were also included.

A storyboard on the progression of the story and what topic we want to cover was developed in Photoshop. Symbolism was utilized to relate technical terms with everyday objects, as well as the addition of cultural references with the aim of creating associations that are easier to remember. The developed storyboard was animated using Opentoonz and voiced.

A supplemental guide accompanying the anime was provided to not pollute the story with too many written text elements and make it more digestible.

Data on the effectiveness of the module was gathered through a survey and a pre/post-test to assess student understanding of the material. The goal is to create a fun and engaging module that covers the important topics in medical microbiology.

**23**

## Identifying Threshold Concepts Through Student Usage Data and Leveraging Those Concepts for Student Success

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ABSTRACT:
Threshold concepts (TCs) are foundational concepts that, when mastered, permanently change the way a student thinks about the material. Students will often answer questions on TCs incorrectly despite having been exposed to the material multiple times until the concept finally "clicks", indicating the mastery of a TC. Mastering a threshold concept moves a student from novice to expert and is demonstrated by increased performance on higher-order, critical-thinking (HOCT) exam questions. A key aspect of a TC is that the learner changes their perception of the material and cannot go back to their previous interpretations. For experts, this means that it is difficult to appreciate the thought processes occurring prior to mastery due to having made that change ourselves long before teaching the material. It is akin to trying to unlearn how to ride a bike. While TCs have been recognized as important for true mastery of foundational material, the methods of identifying TCs within a given field of study are not well-elucidated. Identifying and defining threshold concepts allows instructors to concentrate their efforts on these critical, but challenging, concepts. The goal of this project is to use assessment tools along with student survey data to identify TCs in immunology and microbiology. We hypothesized that threshold concepts can be identified through student usage data, and that performance on HOCT practice questions correlates with student performance on subsequent exam questions. Concepts that have high student usage time, but poor practice question performance are identified as potential TCs. We have identified TCs where students consistently perform poorly on HOCT exam and practice questions, despite multiple exposures to the concepts. HOCT questions distinguish levels of mastery of the material, and in particular, mastery of TCs. This method is applicable across multiple disciplines and is not limited to our areas of expertise.

**24**

# Developing a Medical Microbiology Education Doctorate Program for Pre-Clinical Educators: A Novel Doctorate Program to Meet the Growing Demand in Graduate-Level Medical Microbiology Education

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ABSTRACT:
Currently, there is a shortage of newly graduated medical microbiology educators who are trained and prepared to adequately fill faculty positions at teaching institutions. Most new microbiology and/or immunology doctoral graduates are well versed in their specific area of research, and have detailed background and experience in laboratory techniques and data analysis. However, they do not have the breadth of teaching experience to fill roles as teaching faculty in medical microbiology positions and are left to obtain these skills as on-the-job training. In addition, the scientific study of how people best learn new information, and how this understanding can improve educational outcomes, is well documented but rarely taught in doctoral programs. A current review of degree descriptions for most graduate-level microbiology degrees emphasizes laboratory research, with some programs offering at most several classes in education and/or teaching assistantships. With the expansion of medical and pre-medical programs, there is an increased need for well-qualified, doctorate-level microbiologists with a breadth of expertise in education. Therefore, we created a new 4-year doctoral degree program in medical microbiology education that includes a three-pronged approach to meet the needs of students excelling in medical microbiology education. The first component focuses on lecture-based, lab-based, and self-directed coursework in medical microbiology, immunology, and antimicrobial therapy of infectious diseases. The second component focuses on the theory of teaching and learning, including courses on innovative teaching techniques, didactics, and curriculum design and implementation. The third component focuses on application of the first two components by use of teaching practicums in various curricula, such as lecture-based, flipped classroom, and problem based learning. Thus we expect this program will help meet the demand for medical microbiology educators across various graduate-level programs, including medical schools.

(LCME standard 6.3 and COCA Element 6.7)

**25**

## The Concept Synthesis Session: A Method for Integrating Foundational Microbiology and Immunology Content with Clinical Reasoning and Step 1 Preparation

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ABSTRACT:

Effective teaching of microbiology and immunology to pre-clerkship medical students requires that this foundational content is integrated 1) with the clinical reasoning skills that will support students' future performance as clinicians and 2) into the "Step Climate," the idea that students constantly view undergraduate medical education through the lens of achieving the highest possible numerical score on USMLE Step licensing examinations (Chen et al., 2019). To achieve both, the Concept Synthesis Session (CSS) was developed as part of the Introduction to Disease pre-clerkship block at Texas A&M University College of Medicine. In these active learning sessions, which occur in each of the seven weeks of the block, students work through 10-12 Step 1-style clinical vignette questions, all of which focus directly on microbiology and immunology topics presented in the preceding week's lectures, and submit their answers in real-time using the classroom response system Poll Everywhere. The course instructor then provides feedback on each question, including a detailed analysis of correct and incorrect answers. The CSS therefore provides an opportunity for the development of clinical reasoning skills and high-yield review of microbiology and immunology foundational concepts, while explicit linking course content with Step 1 preparation. In the past four years since adoption of the CSS, student comments about this module have indicated strong satisfaction, consistent with studies that link similar cognitive integration exercises with positive student perception of pre-clerkship content (Classis et al., 2010; Maggi et al., 2012; Minhas et al., 2012).

In this talk, the CSS format and student feedback data will be presented, followed by a discussion of a step-by-step process that can be used to create a CSS focused on any foundational science topic.

**26**

## Defining and Building a Foundational Microbiology and Immunology Curriculum

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Transition towards system-based, integrated curriculum models in medical education have resulted in many challenges, and one many schools struggle to address is the integration of necessary foundational science material from diverse disciplines into the curriculum early in the course of medical education while simultaneously decreasing the time allotted to these topics. I will briefly describe the development of an immunology and microbiology curriculum as part of a 10-week foundational science course within the larger context of the University of Kentucky College of Medicine curriculum. I will review the challenges faced in terms of winnowing details to fit into the allotted instructional time, while preserving key concepts important to the development of students as physicians. Unique pedagogical strategies employed in the new curriculum allow for learner knowledge checks, and processes put in place ensure smooth transitions between instructors in the microbiology and immunology portions of the class. Specific examples of challenges and our solutions will provide jumping off point for larger inclusive discussion of challenges in implementing similar curriculum in other settings.

**27**

## Club MICROBE: An extracurricular medical student interest group to promote distributed review of infectious disease content

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ABSTRACT:
Medical students at our institution proposed a student interest group to develop infectious disease-related study materials to optimize their USMLE Step 1 performance. Students and a faculty facilitator created Club MICROBE (Med-students Immersed in Coordinated Review Of "Bug"-related Education) to promote distributed review of infectious disease content to enhance learning and retention.

Methods:
During each week of the M1 and M2 curriculum, 1-2 students wrote a patient vignette, practice question, and brief study card (1-2 pages maximum) for a pathogen of their choosing. Following review and comments by the faculty facilitator, the materials were emailed to all of the students in the Club.

Results:
79.3% of students report reviewing Club MICROBE materials soon after emails are sent (distributed review), rather than to prepare for exams (massed review). Students perceive Club MICROBE materials to be at least moderately well-done, and find them on average to be at least moderately useful. For those students who used Club MICROBE as a study aid, the majority wished they had used it more, suggesting the materials are useful. Participants in Club MICROBE perceived their microbiology/infectious disease knowledge at the end of their M2 year to be significantly greatly than non-participating students.

Discussion: Future directions may include to increase number of student-written practice questions, and move Club MICROBE materials to a website, thereby eliminating student need to download attachments, which was cited as a barrier. Unintentionally, Club MICROBE served as faculty development for the faculty facilitator, requiring rapid accumulation of the breadth of microbiology/infectious disease knowledge that medical students need to know, and further provided practice for writing dozens of USMLE-style questions.

**28**

## Inclusion of Diverse Skin Tones in Microbiology Lectures

Julie A. Kerry, Ph.D.

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**ABSTRACT:**
Many microbial infections impact the skin, either directly or indirectly, and physical examination of skin lesions can provide critical information for physicians as a component of their diagnostic assessment of a patient's illness. However, when teaching microbiology, the majority of available images demonstrate skin manifestations on Caucasian skin tones. Our school is making an active effort to enhance the diversity of patient representation throughout all aspects of the curriculum. As a part of that effort, the lecture on "Viral and Fungal Skin Infections" was modified to include as many images as possible of skin manifestations on diverse skin tones. This effort was challenging due to the relative lack of available images. Resources identified include a student generated online text book ("Mind the Gap") and a new feature on VisualDx that allows searches for a variety of infections on skin of color. Such efforts are important to enhance our student's ability to accurately diagnose infections for all potential future patients.