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Lindsay Buzzelli; Michael Flanagan, MD; John Gaspich III; Maryanne Neal, RN, BSN; Mark Stephens, MD

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Novel Methodology for Recruitment of High School Students to Health Professions

John Gaspich III; Lindsay Buzzelli; Maryanne Neal, RN, BSN; Mark Stephens, MD; Michael Flanagan, MD

Abstract

Medical schools are creating programs to introduce careers in healthcare to students at earlier stages in their education. At the Penn State College of Medicine University Park Regional Campus, we have created and implemented a novel improvisational, case-based, small-group learning curriculum for high school students to introduce integrative thinking in basic and clinical sciences and to cultivate an early interest in health profession careers. The program also includes elements of health systems science and humanities. A multidisciplinary team of educators with both secondary and post-secondary pedagogical expertise worked together to develop a longitudinal case-based curriculum suitable for high school students. This curriculum was administered to a group of 40 students in grades 9-12. At the start of each session, students were challenged to explore personal biases, reflect upon ethical dilemmas, and step outside of their comfort zones with "centering exercises." Through these activities, we strived to challenge the learners' preconceptions about their colleagues, medicine, and role within it. Students were then presented with a case as a large group. At critical junctures in the cases, students worked in small groups of 8-10 with 1-2 medical student facilitators to discuss questions and solve clinical dilemmas associated with the case. Early feedback from students and faculty advisors has been overwhelmingly positive. The authors have no conflicts of interest.

Background

The United States is experiencing a shortage of healthcare professionals. The Association of American Medical Colleges (AAMC) indicates a projected shortfall of nearly 105 000 physicians by 2030.[3] This shortage is not isolated to physicians. The aging population of the United States is expected to create a concurrent demand for more than 446 000 home health aides, 98 000 medical and laboratory technicians, 95 000 nursing assistants, and 29 000 nurse practitioners by 2025.[2] To address these shortages, medical schools have started to create programs for students in secondary schools to increase interest in health professions. Various models of education and recruitment including mini-medical schools, pipeline programs, and 3+3 integrated collegiate partnerships have been developed[5,6] to identify and recruit students for medical school. Rural communities have a particularly acute need for both physician and non-physician healthcare providers.[9]

In recent years, medical education has become more student-centered, interactive, and case-based. Early clinical exposure, case-based learning, and near-peer student-directed education are strategies used to increase engagement, knowledge retention, and enhanced problem-solving skills.[8] These strategies are designed to promote the growth of emotionally aware, resilient, and compassionate clinicians. One novel approach that has gained increased attention is the use of improvisational theater in medical education. Healthcare workers regularly face complex decision-making dilemmas. Employing techniques used in improvisational theater helps students to break down barriers, challenge preconceptions, and promote teamwork in the classroom with the hope that these skills may be applied in their future careers. Improvisational learning has also previously been implemented successfully in medical curricula to enhance well-being.[1] With this background in mind, we sought to design an innovative, case-based, improvisational curriculum to promote interest in health professions among high school students in our rural community.

Methods

At the Penn State College of Medicine University Park Regional Campus (UPRC), medical students and physician-educators are collaborators in a novel case-based curriculum with early clinical immersion. We specifically adapted this model to our pilot high school student curriculum. To do so, a multidisciplinary team of educators was assembled through a partnership between our regional medical campus and a local high school, State College Area High School (SCAHS). This team, led by 2 medical students, also included a registered nurse secondary education teacher, and 2 physician-educators. This team met regularly to develop a curriculum that would be feasible to implement in the high school environment.

Curriculum

The curriculum that was developed by this interdisciplinary team consists of 10 case-based, problem-focused sessions. We termed the curriculum the University Park-10 (UP-10) (Figure 1). Case selection was informed by medical students'

Lindsay Buzzelli, BS, MS2; The Pennsylvania State University College of Medicine
Michael Flanagan, MD; The Pennsylvania State University College of Medicine
John Gaspich III, BS, MS2; The Pennsylvania State University College of Medicine
Maryanne Neal, RN, BSN, Med; State College Area High School
Mark Stephens, MD, MS; The Pennsylvania State University College of Medicine

first year experiences during early clinical immersions. The UP-10 was designed to provide high school students with an entree into clinical decision making and the types of cases commonly seen in a community-based primary care clinic (Appendix).

Figure 1. UP-10 Curriculum Topics.

Condition/Concern:	Key Points:
Flu-like Illness	Bacterial vs. viral Mechanisms of Action of Antibiotics Vital signs and treatment implications
Heart Palpitations	Pathophysiology of Atrial Fibrillation Heart anatomy and physiology
Chronic Diarrhea	Types of diarrhea – taking a patient history Autoimmune, infection, cancer Gastrointestinal anatomy and physiology
Seizure	Neuronal signaling Seizure first aid Epilepsy, seizure disorders, and seizure types Lifestyle Impacts: Patient narratives
Nausea	Mechanism of Action of Medications Causes and physiology of nausea Humanities Focus: patient narrative
Diabetes	Insulin – production and function Demographics Signs/Symptoms of Crisis
Stroke	Recognition of signs/symptoms (stroke assessments) First aid
Trauma	Obtaining help Managing stress Adapting and acting quickly and judiciously Stop the Bleed
Asthma	Asthma pathophysiology Treatment and response
Wellness	Counseling about diet and exercise How, why, elements of modification as a component of disease management.

Improvisation

The UP-10 curriculum was designed to deliberately leverage improvisational theater techniques that would inspire students to embrace uncertainty, uncomfortable situations, and difficult conversations. Prior to each case, the group participated in an improvisational exercise that served as a paired discussion on personal development, compassion, ethics, shared decision making, and professional behavior. The exercises pushed students to think introspectively and challenged them to take on complex psychosocial situations in a manner that is similar to the daily challenges encountered by healthcare professionals in the workplace (Figure 4). Improvisational training requires individuals to take part in an activity previously unknown to them and adapt to the constraints of this activity. Oftentimes these activities take the form of simple exercises that increase in complexity until the system has reached a critical maximum requiring the group to adapt or continue to brush against the limits of the proscribed constraints. By providing students with a space in which to fail safely, embrace the difficulty of problem solving, and communicate with their peers, we challenged them to embrace both a humanistic approach and failure as a requisite for change, adaptation, and success.

Figure 2. Exemplar improvisational activities.

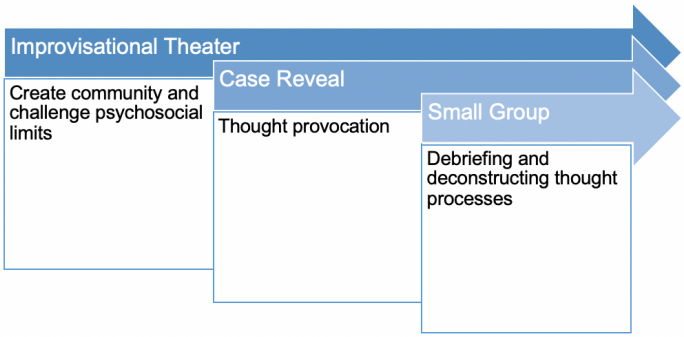
Improvisational Activity	Teaching Points
A group of 8-10 students are organized to stand in a circle. A facilitator starts off by saying the name of an animal and then holding out their hand to gesture to a student in the circle. That student then names a different animal and gestures to another student in the circle. This continues until the final student says the name of an animal and gestures back to a facilitator. Next, a small soft ball is added in and each person says the name of their animal and throws the ball to the person to whom they initially gestured. An outside facilitator then adds in more balls one at a time while those in the circle maintain the same pattern.	Students became increasingly willing to make mistakes at risk of embarrassment and social discomfort in front of peers and facilitators Students learn to take verbal and non-verbal cues from others in the circle to anticipate their actions and respond in turn. Students learn to remain calm in an increasingly demanding and chaotic setting.
Students were divided into 5 small groups, each paired with a facilitator. It was the students' task to find 2 meaningful interests, experiences, etc. common to all members of the group within 5 minutes time. A student from each group was then chosen to present these findings to the large group.	Students gained increasing comfort with the process of posing questions to their peers and facilitator. Students learned to find commonalities and connections with a seemingly dissimilar group of people. Students learned to unite the concepts of other and self.

Design

Four cases from the UP-10 curriculum were utilized as a proof-of-concept pilot. Sessions were held in partnership with and hosted by a local high school health-professions club. These sessions were held biweekly for 8 weeks, and lasted an average of 1.25 hours. The cases were presented by medical students using discussion, flipped classroom, small-group, and Socratic teaching methods. The medical students participating in the project also had prior teaching experience with high school and college students.

Sessions were open to any SCAHS student wishing to attend. Recruitment and advertising were facilitated by the school's chapter of the Health Occupations Students of America (HOSA). Between 20 and 40 students attended each session. Feedback was obtained from students via oral debrief in large-group format, and with individual students where possible. Elements for each session were deliberately chosen and organized to be complementary and sequential.

Figure 3. Breakdown of Session Elements.



Discussion

This proof-of-concept curriculum was successfully delivered to 20-40 students for a total of 4 sessions. While participants were from a variety of backgrounds and cultures due to the demographics of our suburban partner school, they included a limited number of individuals recognized as being underrepresented in medicine.

Students actively participated in both large- and small-group activities and learned to evaluate clinical scenarios. While we did not build a standardized, IRB-approved feedback mechanism into this pilot program, student feedback following each session was exclusively positive. Many students expressed the realization that the content they had previously learned in science courses was applicable to medical situations. They reported increased confidence and pride in appropriately using scientific and medical vocabulary. Several students stated that the cases helped them to explore an interest in fields of medicine they had not previously considered. Others felt that the cases helped them more fully recognize the role of the physician and the many considerations that go into formulating a diagnosis and offering the appropriate treatment. The HOSA faculty advisor noted increased attendance on days that UP-10 cases were presented, as well as an increase in engagement and participation. Both the students and their HOSA advisor requested that we extend and expand the partnership into the future.

There were several important lessons learned. First, we observed the need for near-peer mentorship of participating students. While many students were interested in the healthcare professions, several were unsure as to what specific path to take to meet their educational goals. Studies in science education outreach have shown that mentorship is particularly effective when it occurs between a mentor who has recently passed through the stage of training where the mentee currently resides, as it allows mentees to see themselves in the position of the mentor.[11] Our program presents a unique opportunity to facilitate this relationship between medical students and high school students as they approach their post-secondary schooling. Based on these observations and findings, we hope to grow a codified mentorship component within the program for future years by creating mentor-mentee groups/pairings and organizing mentorship events, such as open office hours and medical student panels.

As a proof of concept, our pilot program has demonstrated initial success. The program was easy to implement, was well-received by educators, students, and administrators and capably augmented the secondary school health education curriculum without adversely impacting prerequisites or previously scheduled activities. It would be prudent to create a standard feedback mechanism and an IRB approved protocol to better characterize the impact on students. While it is not possible to determine the long-term impact that this program had on student decision-making, or success with regard to entering a career in the health professions at this time, we plan to implement long-term follow-up mechanisms to determine how many participants subsequently pursue careers in the health professions. We plan to maintain our affiliation with this particular high school and expand to other high school students in future years.

This program represents a curriculum that is easily scaled and translated to different demographic populations. Our plan is to expand our relationships with both urban and rural students within the next academic year. To facilitate this, we have collaborated with the Office of Diversity, Equity, and Inclusion at the Penn State College of Medicine. We plan to deploy the UP-10 curriculum through interactive webinars to reach students in the more rural recesses of our county. In addition, we are currently modifying our curriculum to fit a one-day "mini-med school" intensive immersion that will be delivered to students from groups that are often underrepresented in health professions. Mini-med school concepts are not novel; however, we intend to integrate our innovative regional campus curriculum into this established approach. An initial session will be hosted at our regional medical campus in the fall of 2020. This will allow participants from more distant schools to participate in a health professions immersion that might otherwise be largely inaccessible. Following this event, we plan to introduce our program to urban area students thus enhancing established pipeline programs that familiarize students with both our regional campus and Penn State College of Medicine as a whole. The potential is great for this pilot program to continue evolving, while eventually helping to increase medical career awareness among rural and underrepresented

students. Ultimately, such programs may contribute toward meeting the nation's recognized need for more healthcare professionals.

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Appendix

Objectives and Case Summary:	**Key Points:**
Objectives: Students will be able to differentiate between a virus and a bacterial illness based on key signs/symptoms, appropriate treatments, and basic features of the microbes themselves. Students will be able to theorize a connection between natural selection, over-prescription of antibiotics, and antibiotic resistance. **Case Summary:** **CC:** Headache, cough, rhinorrhea, nausea, vomiting, and diarrhea **HPI:** Ms. X is 42-year-old female with a 2-day history of headache, cough, rhinorrhea, nausea, vomiting, and diarrhea. Two days ago, she came home from work feeling more tired than usual and went straight to bed. She slept soundly for about 4 hours, but then woke up to use the bathroom where she had an episode of watery diarrhea and vomited twice. At that time, she said her head felt 'heavy' and 'filled with mucus.' The pain in	**What:** Bacteria – Domain of unicellular prokaryotes that have cell walls containing peptidoglycan; produce an infection that is often associated with high fever, longer course, and white exudate. Virus – Particle made up of nucleic acid, protein, and often lipids that can replicate only by infecting living cells; produces an infection that is associated with a shorter course. Antibiotics – Compound that blocks the growth and reproduction of bacteria. Natural Selection – Process by which individuals that are better suited to their environment survive and reproduce most successfully. Resistance – An ability of a microorganism to withstand the impact of a medication that previously neutralized it. OPQRST – A mnemonic that can be used to remember the important questions to ask when taking a pain history: onset, provocation/palliation, quality, radiation, severity, and time. Differential Diagnosis – Process of differentiation a

her head was a 4 out of 10 and she took ibuprofen and went back to bed, both of which helped her feel better. She called off of work sick the following day and is out again today. She continues to have nausea, but has not vomited again since that time 2 days ago. She has continued to have diarrhea about 3 times each day and describes it as watery and brown in nature. She woke up with a cough today that she says comes and goes about every ten minutes, feels like a tickle in her throat and is partially relieved by cough drops and water. She does not endorse anorexia, night sweats, chills, blood in the stool, or sore throat. **PMHx:** Hypothyroidism (Levothyroxine) **PSHx:** None **FHx:** Father – DMII Maternal Grandmother – MI (age 87) **SHx:** Ms. X is a preschool teacher. She lives with her husband in State College, PA. She traveled to Puerto Rico about 2 months ago but does not endorse any other travel. She is insured through her school.	disease from others that are clinically similar. **How:** Students will be presented with a chief concern. They will then have to take a history from a mock patient, suggest physical exam skills, lab/imaging tests and adjust their mental models and differential diagnoses as they are presented with new information. **Why:** Flu-like symptoms are a common concern that medical students see in their family medicine clinics on a nearly daily basis. It is important to be familiar with a basic differential diagnosis and framework to approach this problem as a healthcare professional. Presenting this information as a case and having information slowly revealed allows students to engage in the process of taking a history, thinking about physical exam, and clinical decision making, something that they will be doing each day as future healthcare providers. A discussion around antibiotic resistance satisfies a review of evolution and natural selection but also offers an entrée into medical stewardship and effective and responsible use of resources.

She drinks 1 glass of wine every evening and does not endorse smoking or recreational drug use. **ROS:** None **Vitals:** **BP:** 124/84; **HR:** 80; **RR:** 16 (and regular); **SpO_2:** 98%; **Temp:** 99.1 F **Physical Exam:** **HEENT:** Some pain upon palpation of frontal sinuses; ears non-erythematous and non-edematous, tympanic membranes visualized bilaterally; mucus and erythema and edema visualized in nostrils bilaterally; throat appears erythematous, no exudate appreciated. **Pulm: –** Lungs clear bilaterally to auscultation. No rales, rhonchi, or wheezes heard. **Cardio:** Regular rate and rhythm with S1 and S2 present. No rubs, gallops, or murmurs. **Relevant Data:** Negative Rapid Strep Test	
Chief Concern, History Taking, and Physical Exam Findings	
Medical Student Facilitators: - Present chief concern to students. - Ask what the students would like to know about this patient (*one medical student acts as mock*	**Students:** - Formulate questions within the provided framework. - Have the opportunity to raise their hands and ask the mock patient questions about

patient using information above). - Present the OPQRST framework as well as the key categories involved in a patient history (history of present illness, medical/surgical history, family history, social history, and review of systems).	her medical history and physical findings.
Differential Diagnosis	
- Introduce the concept of a differential diagnosis. - Note a focus on most likely, unlikely but possible, and cannot miss diagnoses. - Cold call students and serve as scribe. - Challenge students to think about what makes each diagnosis more or less likely.	- Turn and talk to partner about which conditions fall into these categories and come up with a three-item differential diagnosis. - Share differential and reasoning with the group.
Bacterial vs. Viruses	
- Activate prior knowledge by asking students what they know about bacteria, viruses, their differences, and their similarities. - Call on students to share their insights.	- Mentally review concepts learned in biology about microbes (cellularity, nucleic acids, illnesses caused, etc.) - Share thoughts aloud with group.
Testing	
- Challenge students to think about what tests they would run based on the history they obtained,	- Provide examples of possible tests that would be helpful, quickly research possible
how the test would change their clinical course, and the costs associated with each test. *- Reveal a negative strep test.* - Ask students to revise their differential diagnosis with the information they now have.	costs, and share information with the group. - Defend to group why test would be helpful. - Come to the board and re-order the differential based on new information.
Treatment	
- Ask students to come up with a treatment plan with a partner. - Ask students to explain what they know about natural selection. - Challenge students to make a connection between natural selection and antibiotic resistance.	- Turn and talk with a partner about what treatments may be effective for a virus and why. - Think back to what they know about natural selection, identify selection pressures on bacteria, which bacteria survive and what the implications are. - Stop and jot thoughts in provided notebook.

Figure 4. Exemplar case discussion from the UP-10.