Using a Massive Open Online Course Format to Engage Health Professions Students Regarding Health Systems Science and the U.S. Healthcare System

by

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DEDICATION

       This dissertation is dedicated to two important people in my life. To my grandfather Dr. Maxwell Nadis who was a constant source of strength for our family during difficult times and always kept a positive attitude throughout his long life of 96 years. On the first day of this journey he and my grandmother said, *"When you keep your mind going, you'll make your own luck"*. I carry these words with me in all parts of my life.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

LIST OF ABBREVIATIONS, ACRONYMS, SYMBOLS

AAMC – Association of American Medical Colleges

ACA – Affordable Care Act

AMA – American Medical Association

ANOVA – Analysis of Variance

CHAT – Choosing Healthplans All Together

CDMI – Midwestern University College of Dental Medicine – Illinois

DiD – Difference-in-Differences

HIT – Health Information Technology

HSS – Health Systems Science

IPE – Interprofessional Education

MOOC – Massive Open Online Course

NBME – National Board of Medical Examiners

SBP – Systems-Based Practice

UMCOP – University of Michigan College of Pharmacy

UMMS – University of Michigan Medical School

UMSOD – University of Michigan School of Dentistry

UMSPH – University of Michigan School of Public Health

ABSTRACT

As the U.S. healthcare system undergoes significant transformation, providers who have been traditionally viewed as the nexus of care delivery inside the healthcare system, are struggling to effectively participate in system-wide reform due to challenges related to their ability to navigate the complexities of the system beyond the delivery of individual patient care. In this new era, healthcare providers must become oriented around systems-based practice (SBP) and be more adequately equipped to consider these issues in their patient care decision making. To achieve this goal, they require competencies in contextualizing and operationalizing their role in order to effectively navigate the larger U.S. healthcare system.

Medical educators have proposed transforming the health professions school curricula by introducing a "third pillar" of medical education, termed *Health Systems Science* (HSS) to address knowledge, attitudes, and skills in SBP. The field of HSS is particularly nascent but quickly advancing. While learning about HSS and the U.S. healthcare system is increasingly being acknowledged as an essential part of health professions education, large proportions of graduating health professions students report it is insufficiently addressed in their curricula. Lack of training regarding healthcare systems may put recent health professions school graduates at a disadvantage as they enter their respective professional workforces, often requiring them to spend time and effort learning the health care system as they transition to their role as practicing clinicians. These findings suggest that efforts to amplify the HSS curriculum in health professions education can be an important way to improve student knowledge and confidence regarding health policy and health care systems.

To address these challenges, we developed a 6-week HSS massive open online course (MOOC) for interprofessional learners entitled, "Understanding and Improving the U.S. Healthcare System". Learners engage with material predominantly in an asynchronous, learner-determined setting using short-form videos (each ≤ 15 minutes) with a variety of pedagogical techniques.

The aim of my dissertation is to understand how HSS can be more readily integrated into health professions education through the use of a MOOC based curriculum. <u>My primary hypothesis is that delivering HSS curriculum in this flexible format provides students with the opportunity to increase objective knowledge of the healthcare system, increase confidence in healthcare system-related knowledge, and become more optimistic about opportunities to improve the healthcare system in the future</u>. In Chapters 1 and 2, I assess associations of exposure to this curriculum with students' objective knowledge of the healthcare system, confidence in healthcare system-related knowledge, and optimism about opportunities to improve the healthcare system in the future for those who participated in the course and by comparing outcomes to a control group. In Chapter 3, I assess how students applied knowledge they obtained from the HSS MOOC through an analysis of participation in CHAT (Choosing Healthplans All Together), a simulation game designed to provide them with the opportunity to design an insurance plan as an individual and then on behalf of a stakeholder group.

In toto, my research contributes to the growing need for health professions schools to identify ways to more effectively integrate HSS into their curricula and evaluate outcomes related to HSS curricular inclusion as HSS education and training has the potential to impact individual and population health by giving future providers a greater ability to contextualize their roles as central stakeholders in the larger U.S. healthcare system.

INTRODUCTION

The Triple Aim framework introduced by the Institute for Healthcare Improvement focuses on transforming the experience of health care including quality and satisfaction, improving population health, and reducing the per capita cost of health care (1). Guided by this framework, the U.S. healthcare system is facing a new era in the way patients receive care and how providers in medicine, dentistry, pharmacy, and public health facilitate the delivery of care (2) to address challenges related to fragmentation, high cost and inefficiency, medical errors, and disparities impacting vulnerable patient populations (3). This transformation is occurring through policy initiatives such as the Affordable Care Act (ACA), payment reform designed to incentivize adherence to quality benchmarks, interprofessional team-based care approaches that streamline care delivery, and the use of electronic health records and health information technology (HIT) to help patients, providers, and payers better understand how health care services are being delivered.

As the U.S. healthcare system undergoes this transformation, providers who have been traditionally viewed as the nexus of care delivery inside the healthcare system, are struggling to effectively participate in system-wide reform due to challenges related to their ability to navigate the complexities of the system beyond the delivery of individual patient care (2). This leads to a reduction in provider satisfaction and an increase in burnout (4). Providers are becoming more frustrated as they are required to take direction from and yield authority to more system literate administrators and policymakers. In contrast to the patient focused decision making orientation that providers have been accustomed to following, administrators and policymakers are being

encouraged to make decisions that impact patient care in order to adhere to policy initiatives, minimize financial consequences for health delivery systems, operationalize health care delivery innovation, and ultimately leverage HIT (5). In this new era, healthcare providers must become oriented around systems-based practice (SBP) (6–9) and be more adequately equipped to consider these issues in their patient care decision-making. To achieve this goal, they require competencies in contextualizing and operationalizing their role in order to effectively navigate the larger U.S. healthcare system.

To train providers to meet these important competencies, curricula in U.S. health professions schools must be transformed to better integrate them into undergraduate and graduate health professions education. While transforming curricula may appear daunting, health professions schools have successfully evolved curricula before to respond to changes in the U.S. healthcare system. Over the last century, medical education has been focused on training physicians through curricula that address basic science and clinical science (2). This structure was in response to a system-wide need for medical practice to be more grounded in biological sciences and scientific theory. In 1910, Abraham Flexner's seminal review of American and Canadian medical education, established a framework that was anchored to biological sciences and scientific theory, emphasizing the need for physicians in training to practice scientifically and engage in rigorous research (10). At the time of the release of Flexner's review, the framework he outlined provided structural standardization and rigor in medical training that was not previously present in U.S. and Canadian medical education (6). As a result, this framework led to a new structure for medical school curriculum that is still in use – two years of preclinical learning in the basic and clinical sciences and two years of clinical education and apprenticeships (2). U.S. medical schools continue to evolve medical school curriculum related to basic and

clinical sciences. In 2013, the American Medical Association (AMA) formed the *Accelerating Change in Medical Education Consortium*, to stimulate innovation in U.S. medical schools, to enhance the traditional curricular structure (11).

Evolution of health professions school curriculum was not only taking place in medical schools. In 1926, William Gies argued that to improve oral health across the United States, dentistry should be recognized as a specialty of medicine and that dental schools should be centered in universities with large research portfolios and faculties dedicated to teaching and research (12). His report also called attention to the need for dental students to receive the same foundation in basic and clinical sciences as medical students (12). Since the release of this report, dental education has been transformed through accredited academic programs. As a result, there have been significant improvements in the training of dentists contributing to a reduction in the prevalence and severity of dental caries and periodontal disease (13, 14). In pharmacy education, transformation has taken place since 1821 when the first college delivering pharmacy education in the United States was founded (15). Since then, pharmacy school curricula have expanded beyond a 2-year academic degree (Graduate in Pharmacy, PhG) to the PharmD which is currently required as the entry level degree by the Accreditation Council for Pharmacy Education. This evolution is attributed to changes in drug delivery and the need for clinical pharmacy services such as patient consultation and drug education in the mid to late 20th century (15).

THE FIELD OF HEALTH SYSTEMS SCIENCE

As the U.S. healthcare system continues to evolve, medical educators have proposed transforming the health professions school curricula by introducing a "third pillar" of medical education, termed *Health Systems Science* (HSS) (16) to address knowledge, attitudes, and skills

in SBP (8, 17–20). HSS is defined as "the principles, methods, and practice of improving quality, outcomes, and costs of health care delivery for patients and populations within systems of medical care" (16). The field of HSS is particularly nascent but quickly advancing. While learning about HSS and the U.S. healthcare system is increasingly being acknowledged as an essential part of health professions education (21–23), large proportions of graduating health professions students report it is insufficiently addressed in their curricula (24). While HSS curricula are present in some health professions schools and colleges, the type of curriculum in each school is highly variable and often fragmented (25). A prior cross-sectional survey of U.S. medical school deans to assess the state of health policy learning in their institutions found substantive variation across schools over the level of health policy training provided (26). While 94% of schools indicated that there was some form of health policy education present in the curriculum, 58% indicated that there was "too little" health policy education (26).

Even when present, training in health policy often is delivered in isolated parts of curricula that limit interprofessional exposures to HSS content. Moreover, many health professions schools have few faculty with the requisite subject matter expertise in health policy and healthcare systems to develop and provide engaging content. Training regarding the principles, processes and performance of the U.S. healthcare system is also generally insufficient, compared with other curricular elements. In a prior analysis of respondents to the Association of American Medical Colleges (AAMC) Medical School Graduation Questionnaire, investigators found that 90% of graduating students reported appropriate training in clinical decision making, while only 40% reported appropriate training in the business practices of medicine – including healthcare systems, medical economics, managed care, practice management, and medical record-keeping (24). On the other hand, students in the first year of

medical school who were exposed to a higher-intensity curriculum in healthcare (13 required lectures and 13 required discussion sections over a four-month period), reported higher satisfaction than students who experienced a lower-intensity curriculum (3 required two-hour small-group sessions during the first and third years of medical school), while also experiencing no decrement in their perception of adequate training in other key domains of instruction (24).

A growing number of textbooks have been released that explore some aspects of HSS and SBP including the first edition of *Health Systems Science*, a textbook (released in 2016) developed by a working group of the original 11 U.S. medical schools that were funded by the AMA's Accelerating Change in Medical Education Consortium to address ways to revolutionize undergraduate medical education (11). In addition, *Health Systems Science Review* was released in 2019 as a companion to the 2016 textbook designed to provide faculty with assessment tools and cases to apply the principles of HSS along with a series of online modules provided by the AMA that address core domains of HSS.

While more resources continue to be released, inclusion of HSS is not mandated and many barriers impede adoption into the curriculum. Some barriers include the perception that HSS is better learned in practice, limited space available in the undergraduate medical education curriculum, deficits in faculty able to teach HSS, and student perceptions that HSS is not a priority because it is not mandatorily evaluated (27). Lack of training regarding healthcare systems may put recent health professions school graduates at a disadvantage as they enter their respective professional workforces, often requiring them to spend time and effort learning the health care system as they transition to their role as practicing clinicians (28). These findings suggest that efforts to amplify the HSS curriculum in health professions education can be an important way to improve student confidence and knowledge regarding health policy and health

care systems. However, introducing new formalized didactic content into already-established health professions curricula remains a challenge. Therefore, formalizing a health care systems curriculum with a flexible format is critical.

DEFINING THE HEALTH SYSTEMS SCIENCE CURRICULUM

HSS curriculum is composed of three <u>central curricular domains</u> including *Core*, *Cross-Cutting*, and *Linking* Domains. Table A.1 defines the different domains and Figure A.1 illustrates the relationships between the domains.

Core Curricular Domain

The *Core Curricular Domain* includes areas directly related to principles of HSS. There are six core curricular domains: 1) Health Care Structures and Processes; 2) Health Care Policy, Economics, and Management; 3) Clinical Informatics/Health Information Technology; 4) Population Health; 5) Value-Based Care; and 6) Health System Improvement (25). *Health Care Structures and Processes* incorporates principles related to health care system organizations and institutions that define the U.S. healthcare system including the impact of fragmentation and coordination on the delivery of care. *Health Care Policy, Economics, and Management* includes history of health care reform and health policy, financing models, insurance, and provider incentives. *Clinical Informatics/Health Information Technology* encompasses how HIT is leveraged in the U.S. healthcare system, electronic health records, and health information exchange. *Population Health* relates to public health and preventive care as well as health disparities and social determinants of health. *Value-Based Care* incorporates issues related to health system performance and how quality is measured and factored into payment in the U.S. healthcare system. Finally, *Health System Improvement* relates to processes used to implement reforms to health care delivery and policy levers that impact system function (16).

6

Cross-Cutting Domains

There are five *Cross-Cutting Domains* that include knowledge and skills related to patient-care competencies that also impact HSS topics (16). These domains include: 1) Leadership and Change Agency; 2) Teamwork and Interprofessional Education; 3) Evidence-Based Medicine and Practice; 4) Professionalism and Ethics; and 5) Scholarship. *Leadership and Change Agency* encompasses the principles of team-based care delivery, approaches to quality improvement, and how to align personal and institutional values. *Teamwork and Interprofessional Education* incorporates principles of interprofessional collaboration and communication. *Evidence-Based Medicine and Practice* includes how to use decision support resources in health systems, the role of clinical guidelines, and biostatistical methods for identifying health disparities. *Professionalism and Ethics* relates to framing professionalism in the field, issues of trust, and how to properly utilize social media. Finally, *Scholarship* incorporates principles related to developing quality and safety reports, population health research, and the role research plays in catalyzing changes related to SBP (25).

Linking Domain

The *Linking Domain* that connects the domains described above is *Systems Thinking* – designed to create a linkage between the core and cross-cutting domains of HSS, and other non-HSS domains (related to the basic and clinical sciences) that are impacted by HSS (16). Applying *Systems Thinking* to the HSS curricular framework provides students with the opportunity to connect all the different domains together. For example, when learning about the history of the passage of Medicare, students can contextualize how an individual patient's adherence to a care plan relates to their ability to rely on Medicare for hospital, physician, and pharmacy benefits provided by the federal government. This can be compared to the challenges

that individual patients might have faced prior to Medicare's passage. At the same time, the student can better appreciate how Medicare's passage catalyzed hospitals across the country to capitalize new facilities and improve access to care for adults age 65 and older. Understanding these differences provides the student with the opportunity to appreciate all the levels of the healthcare system that an HSS topic impacts in both SBP and the clinical encounter.

THE HEALTH SYSTEMS SCIENCE MASSIVE OPEN ONLINE COURSE

To address the challenges health professions schools face when attempting to implement an HSS curriculum, we developed a 6-week HSS massive open online course (MOOC) for interprofessional learners entitled, "Understanding and Improving the U.S. Healthcare System". The course enables learners to engage with material predominantly in an asynchronous, learner-determined setting using short-form videos (each ≤ 15 minutes) with a variety of pedagogical techniques based on growing evidence in the literature that flipped classroom approaches and MOOCs in medical education increase learner motivation and engagement (29). The flipped classroom design is defined by an approach in which the tasks completed inside and outside of the classroom are "flipped" to what occurs in a traditional classroom. The traditional classroom design is focused on foundational knowledge transfer through instructor delivered lectures (29). In a flipped classroom design, foundational knowledge is obtained by students through self-paced learning prior to class to allow for knowledge application and problem solving to take place as part of instructor facilitated activities and exercises (30).

The course was structured into five asynchronous learning modules: 1) illustrated didactics related to the four main stakeholder groups in the U.S. healthcare system (patients, providers, payers, and public health); 2) brief documentaries about the history of healthcare reform, compiled from the audio-visual archives of 10 U.S. presidential libraries; 3) interviews

with faculty experts related to the roles and activities of public and private payers in the U.S. healthcare system; 4) an adaptation of CHAT® (31) - a simulation exercise designed to instruct students on how insurance plans are designed (31, 32); 5) a panel discussion with nationally recognized health policy experts focusing on the future of the U.S. healthcare system and healthcare reform. Each module was divided into a series of 4-6 segments ($\leq$ 15 minutes per segment). All video content was updated each year prior to course delivery to reflect current events in health policy. Students were provided a weekly course agenda instructing them on how to view content and participate in online discussions and reflections. In addition to delivering the asynchronous video content to students online, students were required to attend a 6th course element – a one-time, small-group (<20 students each), integrated discussion facilitated by faculty from the University of Michigan Institute for Healthcare Policy and Innovation in which medical and dental students were mixed into each small group. These discussions were designed to embed an interprofessional flipped classroom element into the course and enhance student engagement (29).

The HSS MOOC was first offered globally through the online learning platform Coursera (Palo Alto, CA) in October 2013 and June 2014 with over 5,000 learners enrolling in the course. In January 2015, the University of Michigan Medical School (UMMS) and the University of Michigan School of Dentistry (UMSOD) first required the course for all first-year undergraduate medical and dental students; students in older cohorts were also welcome to participate. In January 2016, the University of Michigan School of Public Health (UMSPH) offered the course to graduate students in public health and undergraduate students interested in pursuing a career in health professions and in January 2017, the University of Michigan College of Pharmacy (UMCOP) first required the course for all first-year undergraduate pharmacy students.

The nascent and evolving field of HSS was conceptualized in the last five years and as a result, the more defined HSS curricular framework had not been developed when we originally launched the HSS MOOC. Nonetheless, the learning modules contained in the HSS MOOC relate directly to the core, cross-cutting, and linking domains of HSS curriculum. All five learning modules contain introductory level content related to the six core HSS curricular domains. Table A.2 describes the primary learning objectives for each learning module and the HSS core curricular domains that are related. In addition to the HSS core curricular domains, throughout the HSS MOOC, students also engage in activities that allow them to apply content they learn according to the five cross-cutting HSS curricular domains. The Leadership and Change Agency cross-cutting domain is applied during two modules: *The Main Players* and *U.S. Presidents and the History of U.S. Healthcare Reform*. During these modules, students reflect on the history of health care reform and their role as one of the four main players (patients, providers, payers, and public health) as they articulate their core values and how they would approach leading efforts to reform the U.S. healthcare system. The Teamwork and Interprofessional Education cross-cutting domain is applied during two modules: *Private and Public Payers in the U.S. Healthcare System* and *Designing Benefits in a Health Plan – the CHAT® Simulation Game.* In these modules, students are presented with the dynamic between different professions in the healthcare system and apply what they have learned to consider how different professions and teams would approach the design of a health insurance plan for an individual and a stakeholder group. During the one-time, small-group integrated discussion, students come together across disciplines to explore how they would approach health insurance design and collaborate around establishing a health insurance plan. This simulation game also provides students with the opportunity to apply principles related to the Professionalism and

10

Ethics cross-cutting curricular domain and the Evidence-Based Medicine and Practice cross-cutting curricular domain as students grapple with the evidence that informs these types of decisions and the ethics that play a role in making trade-offs during insurance plan design. Finally, during *The Future of the U.S. Healthcare System* module, students return to applying the Leadership and Change Agency cross-cutting curricular domain and explore the Scholarship domain as they consider how they can continue to be leaders in shaping reform and identify future scholarly work and research they can participate in, related to HSS. It is important to note that the HSS MOOC was designed for learners at the early stage of their health professions education. As such, material is intentionally foundational and meant to provide all health professions students with a common understanding of the core domains of HSS so that they are better equipped to engage in future and more advanced learning about HSS.

DISSERTATION AND CONTRIBUTION

The aim of my dissertation is to understand how HSS can be more readily integrated into health professions education through the use of a MOOC based curriculum. My primary hypothesis is that delivering HSS curriculum in this flexible format provides students with the opportunity to increase objective knowledge of the healthcare system, increase confidence in healthcare system-related knowledge, and become more optimistic about opportunities to improve the healthcare system in the future. In Chapter 1, I assess associations of exposure to this curriculum with students' objective knowledge of the healthcare system, confidence in healthcare system-related knowledge, and optimism about opportunities to improve the healthcare system in the future across several schools. In Chapter 2, I assess the associations of exposure to this curriculum with students' objective knowledge of the healthcare system, confidence in healthcare system-related knowledge, and optimism about opportunities to

improve the healthcare system in the future for dental students who participated in the course by comparing outcomes to a control group. Finally, in Chapter 3, I assess how students applied the knowledge they obtained from the HSS MOOC through an analysis of their participation in CHAT (Choosing Healthplans All Together), a simulation game designed to provide them with the opportunity to design an insurance plan as an individual and then on behalf of a stakeholder group and prioritize the essential health benefits mandated by the Affordable Care Act. In toto, my research contributes to the growing need for health professions schools to identify ways to more effectively integrate HSS into their curricula and evaluate outcomes related to HSS curricular inclusion as HSS education and training has the potential to impact individual and population health by giving future providers a greater ability to contextualize their roles as central stakeholders in the larger U.S. healthcare system.

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Table A.1 Core, Cross-Cutting, and Linking Domain Definitions for a Health Systems Science (HSS) Curricular Framework

Curricular domain	Working definition for curricular content
Core domains[b]	
Health care structures and processes[55]	All issues related to the organization of individuals, institutions, resources, and processes for delivery of health care to meet the needs of patients or populations of patients. This domain includes the processes of collaboration and coordination required for the delivery of health care.
Health care policy, economics, and management[56]	All issues related to the decisions, plans, and actions undertaken to achieve specific health care goals and the issues related to efficiency, effectiveness, value, and behavior in the production and consumption of health care. These sciences are used to promote health through the study of all components of the health care system and managed care.
Clinical informatics and health information technology[57]	All issues related to the application of informatics and information technology to deliver health care services, including clinical decision support, documentation, electronic medical records, and the utilization of data to improve health.
Population and public health[58]	All issues related to traditional public health and preventive medicine, including the full range of health determinants affecting the entire population rather than just those individuals who are sick. Content includes the organized assessment, monitoring, or measurement to prevent disease and injury, promote health, prolong life, or improve any other health outcome for a group of individuals (e.g., geographic populations such as nations, communities, ethnic groups, or any other defined group), including the access to and distribution of such outcomes within the group, and the dynamic interrelationships among various personal, socioeconomic, and environmental factors that relate to health outcomes or prevention.
Value-based care[4]	All issues related to the performance of a health system as it relates to quality of care delivery, cost, and waste. From the quality perspective, issues relate to the six Institute of Medicine dimensions of quality (patient safety, effectiveness, patient-centeredness, timeliness, effectiveness, and equitability). From the cost perspective, all issues relate to the cost of health care, waste components, and service requirements. The domain includes the epidemiology of, as well as seeing and classifying, gaps in care and care delivery.
Health system improvement[59]	All issues related to processes of identifying, analyzing, or implementing changes in policy, health care delivery, or any other function of the health care system to improve the performance of any component of the health care system. Issues herein include quantifying and closing gaps (action), variation and measurement (specifically related to quantifying and closing gaps, not to health care measures in general), analysis of data, and interventions.
Cross-cutting domains[c]	
Leadership and change agency[60]	All issues related to the ability to inspire motivation in others to create goals toward a desirable vision. In the context of undergraduate medical education, leadership pertains to team-based care, quality improvement projects, etc.
Teamwork and interprofessional education	All issues related to collaboration and team science, specifically through the process of individuals working together on specified tasks to achieved shared goals.
Evidence-based medicine and practice[61]	All issues related to the conscientious, explicit, and judicious use of current best evidence in making decisions about the care of individual patients, populations of patients, or interventions in health care delivery improvement.
Professionalism and ethics	All issues related to ethical behavior and professionalism, including conduct, congruent with generally accepted moral principles and values and with professional guidelines based on those principles and values. This definition includes general leadership ethics, such as honesty and responsibility, as well as ethics and professionalism specific to the HSS domains.
Scholarship[62]	All issues related to scholarship of HSS content and/or health services research that investigates any HSS domain. Scholarship is defined as (1) discovery, which is consistent with traditional research; (2) integration, which makes connections across disciplines and places specialties in a larger context; (3) application, which demonstrates the vital interaction between research and practice; and (4) teaching (educational scholarship), which emphasizes the creation of new knowledge about teaching and learning in the presence of learners.
Linking domain[d]	
Systems thinking[63]	All issues related to the attention of a complex web of interdependencies; an awareness of the "whole," not just of the parts; and the ability to recognize multidirectional cause–effect relationships with all causes emerging as the effect of another system dynamic.

[a]Citations listed after each domain refer to the references from which the authors modified definitions for the purposes of this work.
[b]Core curricular domains are content areas that align directly with HSS.
[c]Cross-cutting domains refer to content areas that may have been traditionally included in an undergraduate medical education curriculum, but in this analysis, these domains were emphasized within the context of the HSS.
[d]The linking domain refers to content that unifies or links the core curricular or cross-cutting domains to other core curricular or cross-cutting domains (internal linking) and to other areas of the curriculum, such as the basic and clinical sciences (external linking).

Figure A.1 Core, Cross-Cutting, and Linking Domains for a Health Systems Science (HSS) Curricular Framework.

Core curricular domains are content areas that align directly with HSS. The cross-cutting domains are content areas that traditionally may have been included in undergraduate medical education curricula, but have a new context in the HSS. The one linking domain, systems thinking, unifies or links the core curricular or cross-cutting domains to other core curricular or cross-cutting domains (internal linking, depicted in this figure) and to other areas of the curriculum, such as the basic and clinical sciences (external linking, not depicted in this figure).
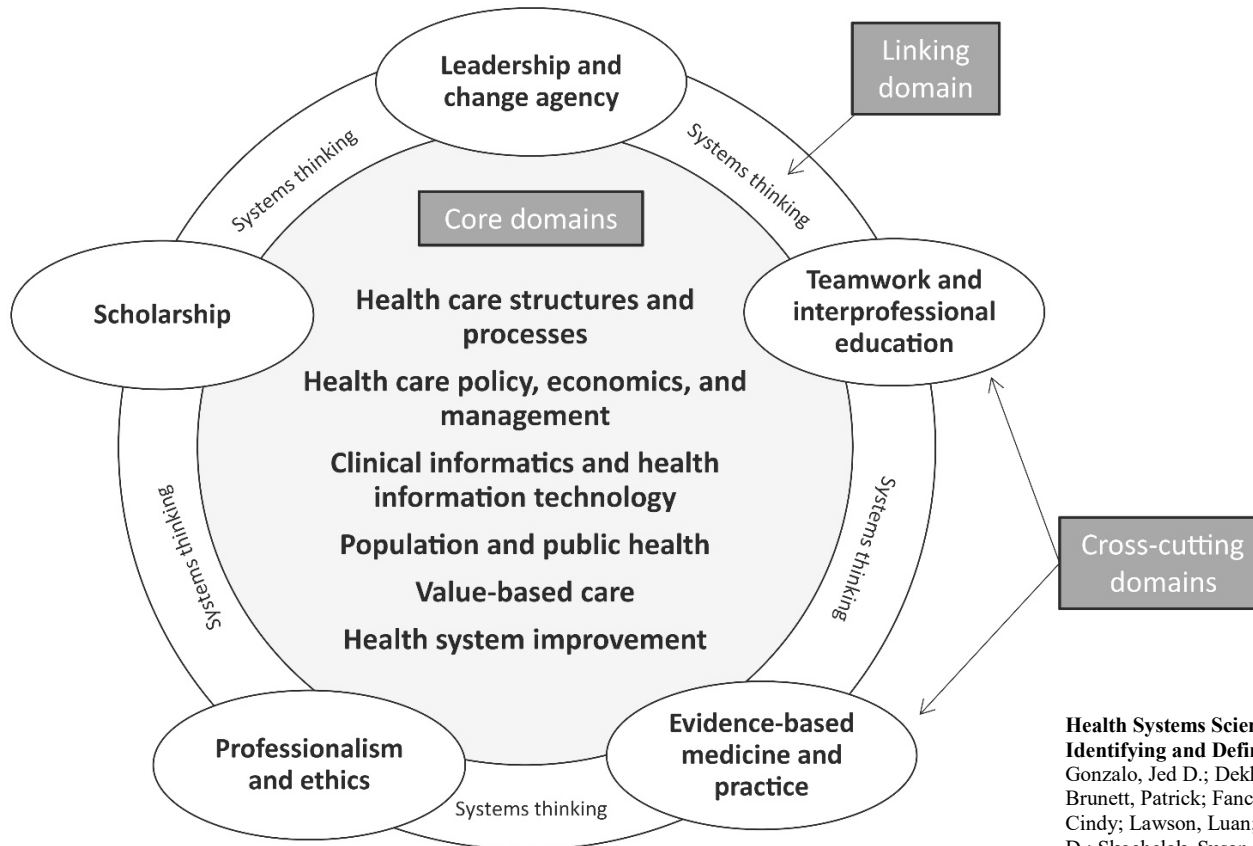
Table A.2 HSS MOOC Modules, Learning Objectives, and Curricular Domains

MODULE	LEARNING OBJECTIVES	HSS CURRICULAR DOMAIN
The Main Players	• Identify each student's learning agenda for the course • Ability to recognize four main stakeholders ("players") in the U.S. healthcare system • Understand how patients, providers, payers, and public health interact in the U.S. healthcare system • Recognize the role of interprofessional collaboration in achieving outcomes • Understand the role of health services research and "big data" and how it relates to achieving the Triple Aim	• Health Care Structures and Processes • Clinical Informatics and Health Information Technology • Population and Public Health
U.S. Presidents and the History of U.S. Healthcare Reform	• Understand principle contributions of U.S. Presidents from Truman to Trump with respect to healthcare reform • Reflect on the four main stakeholders in the U.S. healthcare system and how healthcare reform efforts impacted each of them • Reflect on individual experiences in the U.S. healthcare system and how it has been impacted by reform	• Health Care Policy, Economics, and Management
Private and Public Payers in the U.S. Healthcare System	• Recognize key similarities and differences between private and public payers • Understand employer sponsored health plans, government sponsored health coverage, quality measures, health disparities, public health approaches to care delivery, and value-based purchasing • Understand how the history of payers in private and public domains parallels the history of healthcare reform in the U.S. healthcare system	• Health Care Policy, Economics, and Management • Value-Based Care • Population and Public Health
Designing Benefits in a Health Plan – the CHAT® Simulation Game	• Understand the interplay of benefit options in designing a health plan related to Essential Health Benefits • Deliberate on essential health benefits for yourself in a health insurance plan with a spending constraint • Deliberate on essential health benefits for a stakeholder group in a health insurance plan with a spending constraint	• Health Care Policy, Economics, and Management • Value-Based Care • Health System Improvement
The Future of the U.S. Healthcare System	• Consider contrasting perspectives about future evolution of the U.S. healthcare system • Contemplate how you may be able to influence functioning and performance of the U.S. healthcare system as an individual • Contemplate how you may be able to influence functioning and performance of the U.S. healthcare system as a member of a stakeholder group	• Health System Improvement • Health Care Structures and Processes • Health Care Policy, Economics, and Management • Population and Public Health • Value-Based Care

CHAPTER 1
Using a Massive Open Online Course Format to Engage Medical and Dental Students
Regarding Health Systems Science and the U.S. Healthcare System

INTRODUCTION

As the U.S. healthcare system continues to evolve, medical educators have proposed transforming the health professions school curricula by introducing a "third pillar" of medical education, termed *Health Systems Science* (HSS) (1) to address knowledge, attitudes, and skills in SBP (2–6). HSS is defined as "the principles, methods, and practice of improving quality, outcomes, and costs of health care delivery for patients and populations within systems of medical care" (1). The field of HSS is particularly nascent but quickly advancing. While learning about HSS and the U.S. healthcare system is increasingly being acknowledged as an essential part of health professions education (7–9), large proportions of graduating health professions students report it is insufficiently addressed in their curricula (10). While HSS curricula are present in some health professions schools and colleges, the type of curriculum in each school is highly variable and often fragmented (11). A prior cross-sectional survey of U.S. medical school deans to assess the state of health policy learning in their institutions found substantive variation across schools over the level of health policy training provided (12). While 94% of schools indicated that there was some form of health policy education present in the curriculum, 58% indicated that there was "too little" health policy education (12).

Even when present, training in health policy often is delivered in isolated parts of curricula that limit interprofessional exposures to HSS content. Moreover, many health

professions schools have few faculty with the requisite subject matter expertise in health policy

and healthcare systems to develop and provide engaging content. Training regarding the

principles, processes and performance of the U.S. healthcare system is also generally

insufficient, compared with other curricular elements. In a prior analysis of respondents to the

Association of American Medical Colleges (AAMC) Medical School Graduation Questionnaire,

investigators found that 90% of graduating students reported that they believed they received

appropriate training in clinical decision making, while only 40% reported that they believed they

received appropriate training in the business practices of medicine – including healthcare

systems, medical economics, managed care, practice management, and medical record-keeping

(10). On the other hand, results from this analysis indicate that students in the first year of

medical school who were exposed to a higher-intensity curriculum in healthcare systems (13

required lectures and 13 required discussion sections over a four-month period) reported higher

satisfaction with learning about healthcare systems than students who experienced a more

standard lower-intensity curriculum (3 required two-hour small-group sessions during the first

and third years of medical school), while also experiencing no decrement in their perception of

adequate training in other key domains of instruction (10).

A growing number of textbooks have been released that explore some aspects of HSS and

SBP including the first edition of *Health Systems Science* a textbook (released in 2016)

developed by a working group of 11 U.S. medical schools that were funded by the American

Medical Association (AMA) in 2013 to address ways to revolutionize undergraduate medical

education (13). In addition, *Health Systems Science Review* was released in 2019 as a

companion to the 2016 textbook designed to provide faculty with assessment tools and cases to

apply the principles of HSS along with a series of online modules provided by the AMA that address core domains of HSS.

While more resources continue to be released, inclusion of HSS is not mandated and many barriers impede adoption into the curriculum. Some barriers include: the perception that HSS is better learned in practice, limited space available in the undergraduate medical education curriculum, deficits in faculty able to teach HSS, and student perceptions that HSS is not a priority because it is not mandatorily evaluated (14). Several solutions to addressing these barriers include: partnering with licensing and accrediting bodies to incorporate HSS into licensure requirements, standardizing assessments related to HSS, increasing faculty awareness of HSS and incentivizing faculty to deliver HSS curriculum, and investigating how increasing HSS knowledge impacts quality outcomes (7). As the field of HSS continues to grow, important progress is being achieved. For example, together with the National Board of Medical Examiners (NBME) the medical schools that formed the AMA Accelerating Change in Medical Education Consortium developed a standardized HSS examination that measures student competence in HSS (15).

Many of the priority areas being identified in the literature are designed to address a critical issue – lack of training regarding healthcare systems may put recent health professions school graduates at a disadvantage as they enter their respective professional workforces, often requiring them to spend time and effort learning the health care system as they transition to their role as practicing clinicians (16). These findings suggest that efforts to amplify the HSS curriculum in health professions education can be an important way to improve student confidence and knowledge regarding health policy and health care systems. However, introducing new formalized didactic content into previously established health professions

21

curricula remains a challenge. Therefore, formalizing a health care systems curriculum with a flexible format is critical.

To address these issues, we developed a 6-week HSS massive open online course (MOOC) for interprofessional learners entitled, "Understanding and Improving the U.S. Healthcare System". The course enables learners to engage with material predominantly in an asynchronous, learner-determined setting using short-form videos (each $\leq$ 15 minutes) with a variety of pedagogical techniques based on growing evidence in the literature that flipped classroom approaches and MOOCs in medical education increase learner motivation and engagement (17). The flipped classroom design is defined by an approach in which the tasks completed inside and outside of the classroom are "flipped" to what occurs in a traditional classroom. The traditional classroom design is focused on foundational knowledge transfer through instructor delivered lectures (17). In a flipped classroom design, foundational knowledge is obtained by students through self-paced learning prior to class to allow for knowledge application and problem solving to take place as part of instructor facilitated activities and exercises (18).

In January 2016 and in September 2017, the University of Michigan Medical School (UMMS) and the University of Michigan School of Dentistry (UMSOD) required the course of all first-year undergraduate medical and dental students; students in older cohorts were also welcome to participate. In this report, we assess the associations of exposure to this curriculum with students' objective knowledge of the healthcare system, confidence in healthcare system-related knowledge, and optimism about opportunities to improve the healthcare system in the future for those who participated in the course.

METHODS

Course Content

Based on growing evidence in the literature that flipped classroom approaches and MOOCs in medical education increase learner motivation and engagement (17), we developed a 6-week course using the MOOC format that also employed elements of a flipped classroom design. The course was structured into five asynchronous learning modules: 1) illustrated didactics related to the four main stakeholder groups in the U.S. healthcare system (patients, providers, payers, and public health); 2) brief documentaries about the history of healthcare reform, compiled from the audio-visual archives of 10 U.S. presidential libraries; 3) interviews with faculty experts related to the roles and activities of public and private payers in the U.S. healthcare system; 4) an adaptation of CHAT®(22) - a simulation exercise designed to instruct students on how insurance plans are designed (22, 23); 5) a panel discussion with nationally recognized health policy experts focusing on the future of the U.S. healthcare system and healthcare reform. Each module was divided into a series of 4-6 segments ($\leq$ 15 minutes per segment).

All video content was updated each year prior to course delivery to reflect current events in health policy. Students were provided a weekly course agenda instructing them on how to view content and participate in online discussions and reflections. In addition to delivering the asynchronous video content to students online, students were required to attend a 6th course element – a one-time, small-group (<20 students each), integrated discussion facilitated by faculty from the University of Michigan Institute for Healthcare Policy and Innovation in which medical and dental students were mixed into each small group. These discussions were designed to embed an interprofessional flipped classroom element into the course and enhance student engagement(17).

23

Pre-Course and Post-Course Self-Assessments

We developed a 43-item survey instrument that was used as a pre-course and post-course self-assessment to evaluate students' objective knowledge of the healthcare system structure regarding patients, providers, payers, and public health, confidence in understanding the U.S. healthcare system, and optimism about opportunities for system improvement. In addition to our team of investigators, faculty at UMMS and UMSOD and a group of three non-first-year medical students independently piloted the instrument prior to fielding to provide feedback. We delivered the pre-course self-assessment electronically to all students enrolled in the course using the online Canvas platform (Instructure, Salt Lake City, Utah). Students were required to complete the pre-course self-assessment prior to accessing the first module. Upon completion of the course, students were required to complete the post-course self-assessment electronically. We report below on 28 of the 43 items; the remaining items related to learning process measures, unrelated to the U.S. healthcare system.

Knowledge: We asked students 13 objectively verifiable, multiple-choice questions related to health policy and healthcare system topics, including adverse selection, definitions of Medicare and Medicaid, electronic health records, presidential healthcare reform efforts, functions of health insurance, employer sponsored health insurance, and the Affordable Care Act. We divided knowledge questions into domains that related to the overall course's structural presentation – patients, providers, payers, public health, and healthcare system history. Overall knowledge gained from the course was measured as the difference in the mean proportion of correct answers pre-course versus post-course.

Confidence: We asked seven questions related to learners' ability to identify main stakeholders and groups in the U.S. healthcare system, their ability to identify examples of programmatic success in the healthcare system, problem areas that need improvement, history of

healthcare reform efforts, key differences between private and government health insurance programs, and ways to control the growth of healthcare costs. Confidence was measured on a four-point discrete continuous scale ("Not confident" [assigned a value of -1], "Unsure" [0], "Somewhat confident" [+1], "Very confident" [+2]).

Optimism: We asked learners a series of four questions related to their personal optimism that the U.S. healthcare system will be improved 1 year, 5 years, or 10 years from now, and their attitudes surrounding their own ability to improve the U.S. healthcare system in the future (i.e., as future healthcare professionals). Optimism was measured on a four-point scale (Not optimistic [-1], Unsure [0], Somewhat optimistic [+1], Very optimistic [+2]).

To ensure internal consistency among the items combined into each of the three measures (knowledge, confidence and optimism), we validated each using a principal components exploratory factor analysis of responses to the items in each scale. Each scale had just one factor, with a standardized Cronbach's coefficient for each above .70 ($\alpha = .72$ for knowledge; $\alpha = .81$ for confidence; and $\alpha = .71$ for optimism).

Analyses

Descriptive and inferential statistics and cross-tabulation were generated for the survey data. We performed analysis of variance (ANOVA) to assess differences between medical and dental students on all measures. We found no differences between medical and dental students, with the exception of one knowledge-related question. Thus, we elected to combine medical and dental students for subsequent analyses, unless otherwise indicated.

In order to assess associations of sociodemographic characteristics with students' confidence, optimism, and knowledge in the pre-course and post-course assessments, we fit multivariable regression models with students' field of study (medical or dental), decade of birth

25

(1990-1999 versus earlier), whether they had any prior formal exposure to education in healthcare systems or health policy (any versus none), and whether they had ever previously been uninsured as covariates. We assessed statistical significance using Bonferroni's adjustment for multiple comparisons. A two-tailed P < .003 was considered statistically significant for measures of knowledge, confidence, and optimism based on starting with a P < .05 and then applying Bonferroni's adjustment for multiple comparisons. All statistical analyses were performed using Stata IC 14.2 for Windows (Stata Corp, College Station, Texas).

The study was determined to be exempt from ongoing human subjects review by the University of Michigan Institutional Review Board (Study #HUM00132240).

RESULTS

The healthcare system MOOC was delivered from January 18 – February 26, 2016, and October 9 – November 17, 2017. All 537 medical and dental students enrolled during these periods completed paired pre- and post-course self-assessments; 332 (62%) were preclinical medical students and 205 (38%) were first-year dental students.

Table 1.1 presents student-reported exposure to, prior health systems science training, and previous uninsured periods by school affiliation. More than two-thirds (n=456, 85%) students were born between 1990-1999. About one-fifth (n=104, 19%) of students reported that they had previously been uninsured, and the majority of students reported that they had either little (n=285, 53%) or no (n=121, 23%) prior formal education regarding the U.S. healthcare system or health policy. We hypothesize that students with prior health systems science training would have a lower increase in knowledge, confidence, and optimism as a result of participating in the course. We also hypothesize that being previously uninsured may be associated with

greater knowledge and confidence surrounding issues related to payers in the U.S. healthcare system.

Knowledge

Students demonstrated significant increases in their objective knowledge of health policy topics post-course (Table 1.2). Overall student knowledge of the healthcare system increased by a mean proportion of correct answers of .17 (P < .001). Students' knowledge prior to the course was generally higher regarding providers and patients than regarding payers, public health, and history of the healthcare system. For the question regarding eligibility criteria for Medicaid, there was no significant increase in knowledge post-course, but over three-quarters of students (n=417, 78%) had already answered the question correctly on the pre-course self-assessment. There were other topics (e.g., key challenges for providers; function of the Affordable Care Act) for which accurate pre-course knowledge was also fairly common, but student knowledge still increased significantly post-course on these items.

In multivariable regression models with Bonferroni corrections for multiple comparisons, students' levels of confidence pre-course were positively associated with prior formal exposure to education in health policy and the healthcare system (+0.41; P<.001). Otherwise, there were no associations of the measured student factors related to the pre-course or post-course measures. Exposure to the course materials was the only measured factor associated with post-course student measures of confidence, optimism, and knowledge.

Confidence and Optimism

Table 1.3 shows significant increases in overall student confidence along the seven separate confidence item measures. Mean student confidence pre-course in two of the seven separate confidence item measures are negative (history of health care reform efforts and

27

controlling the growth of healthcare costs) and only one pre-course confidence measure is greater than 1 (examples of problem areas that need improvement). This as compared to all confidence item measures post-course which are greater than 1. Mean overall reported confidence among students was 0.32 pre-course, as compared to 1.44 post-course (P < .001). Of particular note, students became markedly more confident in their ability to describe the history of reform efforts in the U.S. healthcare system (+1.59; P < .001). In addition, mean student confidence improved related to their ability to identify ways to control the growth of healthcare costs in the U.S. healthcare system (+1.23; P < .001) and to their understanding of reasons behind the benefits included in U.S. health insurance plans (+1.17; P < .001).

Students also became more optimistic about the U.S. healthcare system improving one, five, and ten years in the future (Table 1.3). The largest mean difference was observed in increased optimism that the U.S. healthcare system would be improved in ten years (+0.25; P < .001). Students also reported post-course (1.04) that they were more optimistic about their own ability to improve the U.S. healthcare system as healthcare professionals, as compared to their pre-course self-assessment responses (.93; P=.008).

DISCUSSION

We have developed, and rigorously evaluated, what we believe is the first MOOC-based comprehensive curriculum for undergraduate health professions students related to understanding the U.S. healthcare system. The primary objective of the healthcare system MOOC was to provide a flexible and engaging curriculum that would facilitate interprofessional learning about HSS and the U.S. healthcare system. Our curricular design targeted the needs of the majority of preclinical medical and dental students, who self-reported little or no formal education on the U.S. healthcare system prior to this course. Our curriculum blended engaging

and accessible didactics, faculty interviews and a panel discussion with experts, brief documentary films, and an adaptation of an evidence-based insurance plan simulation game (22) to provide students with a multi-faceted presentation of the U.S. healthcare system and help them understand how key stakeholders interact.

While there is an emerging body of literature about the effectiveness of using MOOCs and other forms of flipped classroom approaches in clinical education (17), we focused on understanding how MOOCs contribute to addressing the large gap in undergraduate health professions education related to HSS and health policy. We are encouraged by our findings indicating that, after participating in the course, student knowledge markedly improved, student confidence related to understanding the U.S. healthcare system increased significantly, and so did student optimism about healthcare system improvement and improved self-efficacy for students' abilities to implement change in the U.S. healthcare system. While confidence and optimism were measured via self-report, knowledge items offered a more objective metric. Relevant to interprofessional curricular aims, improvements in all factors were statistically indistinguishable for all but one item across medical and dental students.

Limitations

As a pre-post assessment of students enrolled in two offerings of the healthcare system MOOC at two health professions schools at a single university, this study has limitations. Results may not be generalizable to other U.S. health professions schools that have other components of their curricula focused on the U.S. healthcare system. We deliberately focused on early health professions learners, for whom this curriculum would be largely foundational. A more rigorous study design would utilize a concurrent control group to assess the impact of the healthcare system MOOC on students' knowledge, confidence, and optimism. Another potential

29

limitation is that we developed the pre-course/post-course self-assessment surveys *de novo* to evaluate this course and did not conduct formal pilot-testing. Nevertheless, we found high levels of internal validity on the subscales.

In addition, a limitation is that our study focuses only on health professions students' attitudes and knowledge about the healthcare system, and (given the pre-clinical stage of the students) was not designed to assess how these attitudes and knowledge may impact care delivery, quality, and outcomes for patients. While our study provides evidence that the MOOC format is effective for communicating key information about the healthcare system to health professions students, development of future MOOCs related to health policy topic areas would offer more opportunities for currently practicing providers to become more effective stakeholders in the perpetually challenging and increasingly complex U.S. healthcare system. Future MOOCs may offer opportunities to assess how provider engagement with, and knowledge about, the U.S. healthcare system may affect practice and clinical outcomes.

Conclusions

HSS education and training has the potential to impact individual and population health by providing future providers with a greater ability to contextualize their roles as central stakeholders in the larger system. However, significant barriers to delivering this type of interprofessional education exist in traditional classroom settings due to curricular structure, logistical support, and cross-school coordination required to deliver interprofessional education. With substantial volatility and increasing fragmentation in the U.S. healthcare system, health professions schools may find it difficult to deliver up-to-date curriculum that incorporates the diverse perspectives of interprofessional stakeholders.

The MOOC format permits rapid exposure for medical and dental students to multiple core themes of the U.S. healthcare system in a predominantly asynchronous learning environment, through an approach that can be incorporated with other established curricular elements. With demonstrable increases in student knowledge, confidence, and optimism for improvements in the healthcare system in the future, the MOOC structure provides a curricular approach that health professions schools across the country could employ to intensify HSS training in a manageable and sustainable way.

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Table 1.1 Responses, by School Affiliation, to Questions to Assess Exposure to Major Health Policy Events, Prior Health Policy Knowledge, and Previous Uninsurance, for Students Taking a Healthcare System Massive Open Online Course (MOOC)

Question and response choices	Number (%) responding, by academic affiliation		
	All **n = 537**	**Medical** **n = 332**	**Dental** **n = 205**
What year were you born?			
Before 1970	1 (.2)	1 (.3)	—
1970-1979	3 (.6)	3 (.9)	—
1980-1989	77 (14.3)	51 (15.4)	26 (12.7)
1990-1999	456 (84.9)	277 (83.4)	179 (87.3)
Missing responses	—	—	—
How would you describe the extent of your prior formal education regarding the US healthcare system and health policy?			
None	121 (22.5)	64 (19.3)	57 (27.8)
Little	285 (53.1)	189 (57.0)	96 (46.8)
Some	106 (19.7)	65 (19.6)	41 (20.0)
Extensive	25 (4.7)	14 (4.2)	11 (5.4)
Missing responses	—	—	—
Have you ever been uninsured in the US healthcare system?			
Yes	104 (19.4)	61 (18.4)	43 (21.0)
No	419 (78.0)	266 (80.1)	153 (74.6)
Missing responses	14 (2.6)	5 (1.5)	9 (4.4)

Table 1.2 Change in Medical and Dental Students' Knowledge Regarding Health Policy after Taking a Healthcare System Massive Open Online Course (MOOC)

Knowledge	N	Mean Correct Pre	Mean Correct Post	Difference Correct (Post-Pre)	95% CI Difference	P Value[1]
Overall	536	.55	.71	.17	.15 — .18	<.001
Overall						
Patients	535	.49	.64	.15	.10 — .20	<.001
Rate of Infant Mortality in the US						
Providers	532	.64	.78	.14	.09 — .18	<.001
Benefits of Electronic Health Records for Providers	532	.87	.93	.06	.03 — .09	<.001
Unequal Distribution of Providers						
Payers	534	.65	.83	.18	.14 — .22	<.001
Relationship between Health Insurance and Improved Health	535	.78	.81	.03	-.01 — .07	.18
Defining Medicaid	533	.52	.76	.24	.20 — .29	<.001
Defining Adverse Selection	530	.52	.78	.26	.21 — .30	<.001
Primary Advantages for Employer Based Health Insurance	530	.12	.42	.30	.25 — .34	<.001
Identifying the Oregon Health Insurance Experiment	532	.54	.74	.20	.15 — .25	<.001
Benefits of Value-Based Insurance Design						
Public Health and System History	536	.26	.55	.29	.24 — .33	<.001
US Presidential Reforms to Medicare	532	.79	.85	.06	.02 — .10	.002
Defining the Functions of the ACA	534	.15	.36	.22	.17 — .26	<.001
History of US Presidential Appeals for Universal Health Insurance	534	.77	.85	.08	.04 — .12	<.001

[1] We assessed statistical significance using Bonferroni's adjustment for multiple comparisons. P<.003 was considered statistically significant for measures of knowledge.

Table 1.3 Change in Attitudes of Confidence and Optimism Regarding Health Policy Reported by Medical and Dental Students Taking a Healthcare System Massive Open Online Course (MOOC)

Attitude	N	Mean Pre	Mean Post	Difference (Post-Pre)	95% CI Difference	P Value[2]
Confidence						
Overall	537	.32	1.44	1.12	1.07 — 1.18	< .001
Identifying the <u>main players or groups</u> in the US healthcare system	537	.52	1.70	1.18	1.09 — 1.26	< .001
Identifying <u>examples of success</u> in the US healthcare system	537	.52	1.48	.96	.87 — 1.04	< .001
Identifying <u>examples of problem areas that need improvement</u> in the US healthcare system	537	1.02	1.67	.65	.58 — .73	< .001
Describing the <u>history of reform efforts</u> in the US healthcare system	537	-.35	1.23	1.59	1.50 — 1.68	< .001
Understanding key <u>differences between</u> private health insurance and government programs that provide coverage in the US healthcare system	537	.36	1.43	1.08	.98 — 1.17	< .001
Understanding <u>reasons for the benefits that are included in health insurance plans in the US</u>	537	.27	1.44	1.17	1.07 — 1.27	< .001
Identifying ways to <u>control the growth of healthcare costs in the US healthcare system</u>	537	-.12	1.11	1.23	1.14 — 1.33	< .001
Optimism						
Overall	529	.51	.69	.18	.13 — .24	< .001
The US healthcare system will be improved 1 year from now	516	-.44	-.29	.15	.05 — .24	.002
The US healthcare system will be improved 5 years from now	513	.53	.75	.22	.14 — .31	< .001
The US healthcare system will be improved 10 years from now	513	1.06	1.31	.25	.19 — .31	< .001
Your potential to improve the US healthcare system in the future	510	.93	1.04	.11	.03 — .19	.008

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[2] We assessed statistical significance using Bonferroni's adjustment for multiple comparisons. P <.003 was considered statistically significant for measures of confidence and measures of optimism.

CHAPTER 2
Evaluating the Effectiveness of the Health Systems Science MOOC Among Dental Students

INTRODUCTION

A 1926 report by William Gies, PhD, argued that, to improve oral health across the United States, dentistry should be recognized as a specialty of medicine and that dental schools should be centered in universities with large research portfolios and have faculties dedicated to teaching and research (1). The report also called attention to the need for dental students to receive the same foundation in basic and clinical sciences as medical students (1). Since the release of the Gies report, dental education has been transformed through accredited academic programs and, as a result, there have been significant improvements in the training of dentists and a reduction in the prevalence and severity of dental caries and periodontal disease (2, 3). At the same time, increasing evidence indicates that periodontal disease is associated with negative systemic health outcomes in patients with chronic conditions such as type 2 diabetes, rheumatoid arthritis, cerebral vascular disease, and adverse pregnancy outcomes (4) and studies have demonstrated that improved outcomes coupled with lower medical costs and hospitalizations can be achieved for patients with these chronic conditions who receive periodontal treatment as compared to patients who do not receive periodontal care (5). These outcomes motivate the need for dental and medical care delivery systems to be more integrated (6) so that improved outcomes in both oral health and comprehensive health care can be achieved (7, 8).

The health care system in which dentists are practicing today is considerably different from the one that Gies wrote about in 1926. This changing environment requires dentists to have

broader knowledge of health care systems and updated skills related to managing care delivery (6). Dentists are increasingly playing many roles in the U.S. health care system beyond traditional practice as clinicians, including the roles of researcher, manager, team leader, communicator, and advocate (9). While there is an overall decrease in the prevalence of dental caries and periodontal disease at the population level, health disparities in the U.S. produce unfavorable trends in periodontal disease among high-risk populations (10). Vulnerable populations also face more limitations in accessing care that impede the dental care delivery system from addressing their needs (6).

In addition to changes in patterns of prevalence of oral health diseases, practice patterns among U.S. dentists are evolving. In the U.S., over $110 billion is spent on oral care annually, with the majority of this spending occurring in private practices that are isolated from other health care providers (11). In recent decades, there has been a transition away from solo private practices to dental service organizations that manage large numbers of practices as the solo private practice model has become financially unsustainable for providers (6). Similar to patterns occurring in medical care delivery, these challenges facing solo private practices are related to the high costs associated with the implementation of electronic health records and other technologies and the need for graduating dental students to find stable practice environments that allow them to retire student debt (6). As a result, new models are emerging that integrate dental services into the larger health care system including dentists integrated into hospitals and teledentistry (6, 12). Graduating dental students require more skills to navigate the U.S. healthcare system and require more education on practice management, communication, and leadership (9). Broader training and skill development will enable dental professionals to advance oral health of the public and communicate, manage, and lead intraprofessional dental

teams and become highly contributing members of interprofessional teams with other clinicians such as physicians, pharmacists, and nurses (13).

Dental students currently receive education on the knowledge and skills related to the scientific basis of diseases, diagnoses, and treatments. In addition, U.S. dental schools are increasingly implementing curricula that provide interprofessional education (IPE) (14) to dental students, allowing them to more effectively understand the role of different health care team members in making integrated decisions for patients and communities (6). Basic science and clinical science allow dental students to understand how to provide care to patients, and interprofessional education allows dental students to understand their role in coordinating care. However, these domains do not provide them with the knowledge they need to navigate the U.S. healthcare system and develop a professional identity in the evolving landscape of health care delivery (15).

To address this gap in education, medical educators have proposed a "third pillar" of medical education, termed *Health Systems Science* (16) (HSS). HSS is composed of six core curricular domains: 1) health care structures and processes; 2) health care policy, economics, and management; 3) clinical informatics/health information technology; 4) population health; 5) value-based care; 6) health system improvement (17). Learning about HSS and the U.S. healthcare system is an essential part of health professions education, but large proportions of graduating health professions students report it is insufficiently addressed in their curricula (18). While HSS curricula are present in some health professions schools and colleges, the type of curriculum in each school is highly variable and often fragmented (17). A prior cross-sectional survey of U.S. medical school deans to assess the state of health policy learning in their institutions found substantive variation across schools over the level of health policy training

provided (19). While 94% of schools indicated that there was some form of health policy education present in the curriculum, 58% indicated that there was "too little" health policy education (19).

Even when present, training in health policy is often delivered in isolated parts of curricula that limit interprofessional exposures to health policy content. Moreover, many health professions schools have few faculty with the requisite subject matter expertise in health policy and healthcare systems to develop and provide engaging content. For example, in U.S. dental and dental hygiene schools, a prior survey indicated that 68% of these schools have a department or division with public health dentistry or community dental health (20). However, the median number of curricular hours devoted to dental public health topics (4.0 - 8.0 hours) among these schools was less than 1% of their overall dental curricula (on average 4,942 hours) (21, 22).

Training regarding the principles, processes and performance of the U.S. healthcare system is also generally insufficient, compared with other curricular elements. In a prior analysis of respondents to the Association of American Medical Colleges (AAMC) Medical School Graduation Questionnaire, investigators found that 90% of graduating students reported that they believed they received appropriate training in clinical decision making, while only 40% reported that they believed they received appropriate training in the business practices of medicine – including healthcare systems, medical economics, managed care, practice management, and medical record-keeping (18). On the other hand, results from this analysis indicate that students in the first year of medical school who were exposed to a higher-intensity curriculum in healthcare systems (13 required lectures and 13 required discussion sections over a four-month period) reported higher satisfaction with learning about healthcare systems than students who experienced a more standard lower-intensity curriculum (3 required two-hour small-group

sessions during the first and third years of medical school), while also experiencing no decrement in their perception of adequate training in other key domains of instruction (18). Lack of training regarding HSS may put recent dental school graduates at a disadvantage, requiring them to spend time and effort learning the health care system as they transition to their role as practicing clinicians (23). These findings suggest that efforts to amplify the health care systems curriculum in health professions education can be an important way to improve student knowledge and confidence regarding health policy and health care systems. However, introducing new formalized didactic content into already-established health professions curricula remains a challenge. Therefore, delivering a substantive health care systems curriculum with a flexible format is critical.

To address these issues, we developed a 6-week health policy massive open online course (MOOC) for interprofessional learners entitled, "Understanding and Improving the U.S. Healthcare System". The course enables learners to engage with material predominantly in an asynchronous, learner-determined setting using short-form videos (each ≤ 15 minutes) with a variety of pedagogical techniques (see Methods). In October 2017, the University of Michigan School of Dentistry (UMSOD) delivered the course to all first-year undergraduate dental students. In this report, we assess the associations of exposure to this curriculum with students' objective knowledge of the healthcare system, confidence in healthcare system-related knowledge, and optimism about opportunities to improve the healthcare system in the future for those who participated in the course by comparing outcomes to a control group of first-year undergraduate dental students at Midwestern University College of Dental Medicine – Illinois (CDMI) who were not exposed to the curriculum.

METHODS

Course Content

Based on growing evidence in the literature that flipped classroom approaches and MOOCs in medical education increase learner motivation and engagement (24), we developed a 6-week course using the MOOC format that also employed elements of a flipped classroom design. The flipped classroom design is defined by an approach in which the tasks completed inside and outside of the classroom are "flipped" compared with content in a traditional classroom. The traditional classroom design is focused on foundational knowledge transfer through instructor-delivered lectures (24). In a flipped classroom design, foundational knowledge is obtained by students through self-paced learning prior to class to allow for knowledge application and problem solving to take place as part of instructor facilitated activities and exercises (25).

The course was structured as five asynchronous learning modules: 1) illustrated didactics related to the four main stakeholder groups in the U.S. healthcare system (patients, providers (including dentists), payers, and public health); 2) brief documentaries about the history of healthcare reform, compiled from the audio-visual archives of 10 U.S. presidential libraries; 3) interviews with faculty experts related to the roles and activities of public and private payers in the U.S. healthcare system; 4) an adaptation of CHAT® (26) - a simulation exercise designed to instruct students on how insurance plans are designed (26, 27); 5) a panel discussion with nationally recognized health policy experts focusing on the future of the U.S. healthcare system and healthcare reform. Each module was divided into a series of 4-6 segments (≤ 15 minutes per segment).

All video content was updated prior to course delivery to reflect current events in health policy. Students were provided a weekly course agenda instructing them on how to view content

and participate in online discussions and reflections. In addition to delivering the asynchronous video content to students online, students were required to attend a 6th course element – a one-time, small-group (<20 students each), integrated discussion facilitated by faculty from the University of Michigan Institute for Healthcare Policy and Innovation in which medical, dental, pharmacy, and public health students were mixed into each small group. These discussions were designed to embed an interprofessional flipped classroom element into the course and enhance student engagement (24).

Pre-Course and Post-Course Self-Assessments

We developed a 43-item survey instrument that was used as a pre-course and post-course self-assessment to evaluate students' objective knowledge of the healthcare system structure regarding patients, providers, payers, and public health, confidence in understanding the U.S. healthcare system, and optimism about opportunities for system improvement. In addition to our team of investigators, faculty at the University of Michigan Medical School (UMMS) and UMSOD and a group of three non-first-year medical students independently piloted the instrument prior to fielding to provide feedback and inform minor edits to the questions to enhance clarity.

For the intervention group, we delivered the pre-course self-assessment electronically to all students using the online Qualtrics platform (Qualtrics, Seattle, Washington). Students were required to complete the pre-course self-assessment prior to accessing the first module. Upon completion of the course, students were required to complete the post-course self-assessment electronically. For the control group we delivered the pre-course self-assessment electronically to all students using the online Qualtrics platform (Qualtrics, Seattle, Washington). Students in the control group completed the pre-course self-assessment the same week as students in the

intervention group and completed the post-course self-assessment electronically during the same week as students in the intervention group. We report below on 28 of the 43 items; the remaining items related to learning process measures, unrelated to the U.S. healthcare system.

Knowledge: We asked students 13 objectively verifiable, multiple-choice questions related to health policy and health systems science topics, including adverse selection, definitions of Medicare and Medicaid, electronic health records, presidential healthcare reform efforts, functions of health insurance, employer sponsored health insurance, and the Affordable Care Act. Overall knowledge gained from the course was measured as the individual difference in the mean proportion of correct answers pre-course versus post-course.

Confidence: We asked seven questions related to learners' ability to identify main stakeholders and groups in the U.S. healthcare system, their ability to identify examples of programmatic success in the healthcare system, problem areas that need improvement, history of healthcare reform efforts, key differences between private and government health insurance programs, and ways to control the growth of healthcare costs. Confidence was measured on a four-point discrete continuous scale. Overall pre and post confidence was measured as the mean of the seven questions related to students' confidence.

Optimism: We asked learners a series of four questions related to their personal optimism that the U.S. healthcare system will be improved 1 year, 5 years, or 10 years from now, and their attitudes surrounding their own ability to improve the U.S. healthcare system in the future (i.e., as future healthcare professionals). Optimism was measured on a four-point discrete continuous scale. Overall pre and post optimism was measured as the mean of the seven questions related to students' optimism.

44

To ensure internal consistency among the items combined into each of the three measures (knowledge, confidence and optimism), we validated each using a principal components exploratory factor analysis of responses to the items in each scale. Each scale had just one factor, with a standardized Cronbach's coefficient for each above .70 ($\alpha = .72$ for knowledge; $\alpha = .81$ for confidence; and $\alpha = .71$ for optimism).

Study Design

Our study followed a quasi-experimental design, with a non-randomized intervention group and a control group. Students in the control group did not receive a formal HSS curriculum as Midwestern University CDMI did not have HSS formally structured into the undergraduate dental student curriculum. Students in both the control and intervention groups took the pre- and post-course self-assessments on the same Qualtrics platform (Qualtrics, Seattle, Washington). Students in the control group completed their self-assessments concurrent to students in the intervention group to ensure the same overall policy environment (i.e. policies being debated, media headlines). All students were made aware that they were participating in the study and that it was exempt from ongoing human subjects review by the University of Michigan Institutional Review Board (Study #HUM00132240) and the Midwestern University Institutional Review Board.

Analyses

Descriptive and inferential statistics and cross-tabulation were generated for the survey data. An intent to treat approach was used with a difference-in-differences (DiD) model to assess whether student knowledge, confidence, and optimism about healthcare systems and health policy changes as a result of receiving the MOOC curriculum. For the DiD analysis, we used two binary indicators to identify students who participated in the Health Systems Science

MOOC. The first binary indicator is a "treatment" variable with a value of (1) if the student participated in the Health Systems Science MOOC at UMSOD versus (0) if the student was at CDMI and did not participate in the course. The second binary indicator is a "Pre/Post" variable that relates to whether the response is from the pre-course self-assessment (0) or post-course self-assessment (1). Students with a value of (1) for both binary indicators participated in the Health Systems Science MOOC and completed the post-course self-assessment.

Equation 1. Difference-in-Differences Model Specification

$$Y_{it} = \beta_0 + \beta_1 G_i + \beta_2 T_t + \beta_3 [G * T]_{it} + \beta_4 X_{it} + \varepsilon_{it}$$

The quasi-experimental DiD analysis includes estimates for the two indicators described above: a group indicator for whether a student (*i)* participated in the Health Systems Science MOOC (G_i) and a time indicator for whether the student completed a pre- or post-course self-assessment (T_i). The marginal effect of the interaction term ($[G*T]_{it}$) estimates the change in likelihood of increased knowledge, confidence, or optimism for students who participated in the Health Systems Science MOOC, before and after receiving the curriculum, *net* of the change in knowledge, confidence, or optimism during the same period for students who did not participate in the Health Systems Science MOOC.

To verify if there are dissimilar changes in knowledge, confidence, and optimism of healthcare systems and health policy among students who participated in the Health Systems Science MOOC and those who did not participate (and received standard curriculum) that would violate the parallel trends assumption of DiD, we examined the mean overall reported knowledge, confidence, and optimism for other dental students participating in the Health Systems Science MOOC at UMSOD in January 2016 and January 2017. While we did not have

comparable data for the control group at CDMI, we examined mean overall reported knowledge, confidence, and optimism for dental students who also did not participate in the Health Systems Science MOOC at CDMI six months following completion of the post-course self-assessment. We performed analysis of variance (ANOVA) to assess differences between the control and intervention groups prior to the delivery of the Health Systems Science MOOC. Figure 2.1 illustrates that there were parallel trends between the intervention and control groups in the absence of participation in the Health Systems Science MOOC. While the trend for overall knowledge does not appear to be flat over time, it would bias against our principal hypotheses.

Figure 2.1 Mean Overall Reported Student Knowledge, Confidence, and Optimism for Students in the Intervention and Control Groups from 2016-2018

47
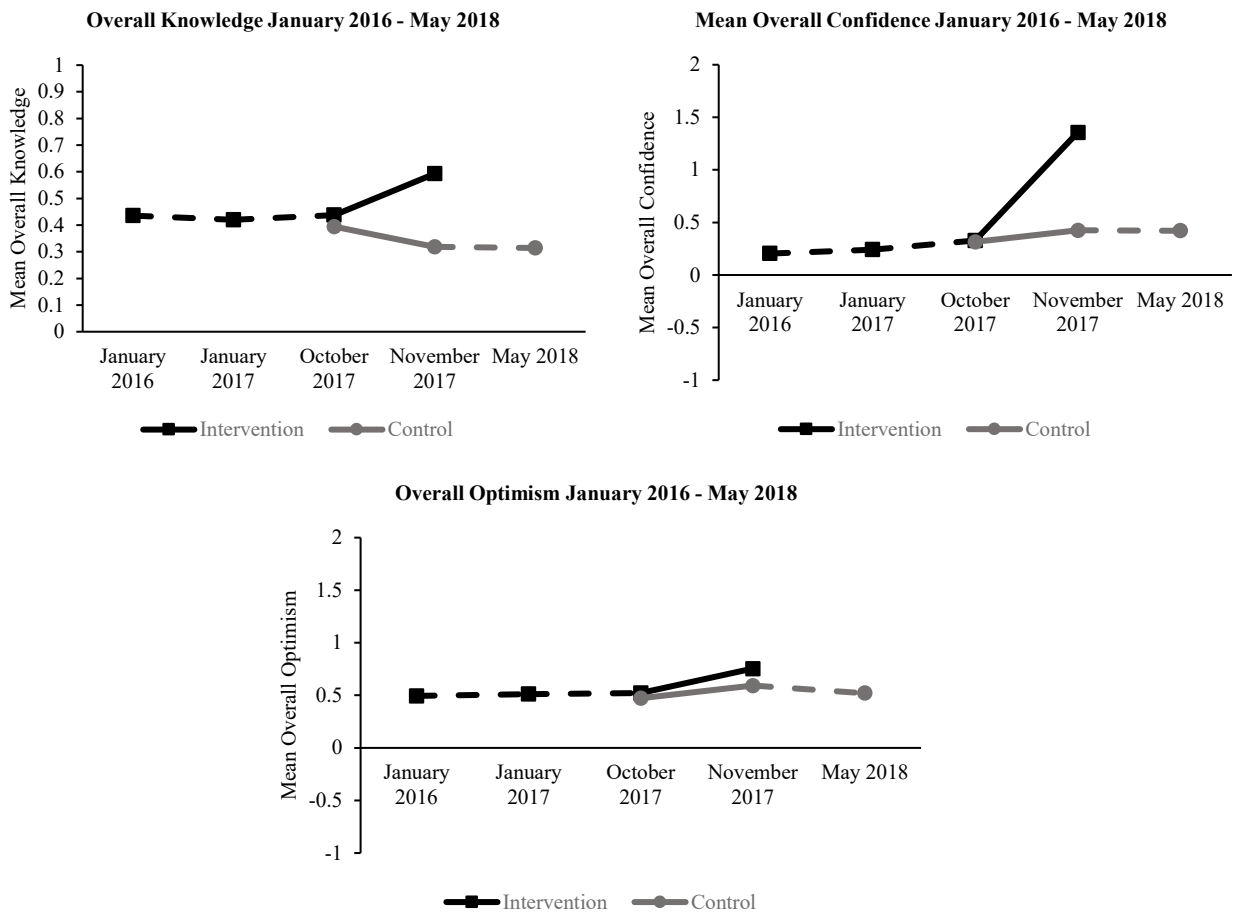
In order to assess associations of sociodemographic characteristics with students'
knowledge, confidence, and optimism in the pre-course and post-course assessments, we fit
multivariable regression models with decade of birth (1990-1999 versus earlier), whether they
self-reported any prior formal exposure to education in healthcare systems or health policy (any
versus none), and whether they had ever previously been uninsured as covariates. We
hypothesized that students with prior formal exposure to healthcare systems or health policy
education would be more knowledgeable and confident prior to participating in the course. We
hypothesized that students with prior formal exposure to healthcare systems or health policy
education would be less optimistic about the potential for improvements in the U.S. healthcare
system. However, we also acknowledge the equipoise that exists with optimism as increased
optimism could be associated with greater engagement in achieving positive change. We also
hypothesized that students who had been previously uninsured would be more confident and
knowledgeable due to their need to navigate the U.S. healthcare system as an uninsured patient
in the past.

We assessed statistical significance using Bonferroni's adjustment for multiple
comparisons. A two-tailed $P < .003$ was considered statistically significant for measures of
knowledge, confidence, and optimism based on starting with a $P < .05$ and then applying
Bonferroni's adjustment for multiple comparisons. All statistical analyses were performed using
Stata IC 14.2 for Windows (Stata Corp, College Station, Texas).

The study was determined to be exempt from ongoing human subjects review by the
University of Michigan Institutional Review Board (Study #HUM00132240) and the Midwestern
University Institutional Review Board.

RESULTS

The Health Systems Science MOOC was delivered from October 9 – November 17, 2017. All 107 dental students in the intervention group enrolled during these periods completed paired pre- and post-course self-assessments at Week 1 and Week 6 respectively; 101 dental students out of 130 in the control group completed paired pre-and post-course self-assessments during the comparable Weeks 1 and 6 respectively.

Table 2.1 presents student-reported, prior health systems science training and previous uninsured periods in the control and intervention groups. The vast majority of students in the control (n=90, 89%) and intervention (n=100, 94%) groups were born between 1990-1999. About one-quarter of the students in the control (n=24, 24%) and intervention (n=31, 29%) groups reported that they had previously been uninsured, and the majority of students in the control group reported that they had either little (n=49, 49%) or no (n=31, 31%) prior formal education regarding the U.S. healthcare system or health policy. This was similar to the majority of students in the intervention group who reported that they had either little (n=17, 16%) or no (n=83, 78%) prior formal education regarding the U.S. healthcare system or health policy.

Knowledge

Table 2.2 presents the results from DiD analyses on knowledge of healthcare systems and health policy. The estimated marginal probability impact of the "Group*Time" interaction term – indicates the change in average likelihood of increased knowledge, confidence, and optimism from participating in the Health Systems Science MOOC. The DiD interaction term was significant for overall knowledge and for five of the separate knowledge item measures. Figure 2.2 and Appendix A illustrate that students in the intervention group demonstrated significant increases in their objective knowledge of health policy topics post-course compared to students

49

in the control group. Overall student knowledge of the healthcare system increased by a mean proportion of correct answers of .16 (P < .001).

Confidence and Optimism

Table 2.3 shows the results from DiD analyses on confidence and optimism. It is significant in overall student confidence along the seven separate confidence item measures. Figure 2.3 and Appendix A illustrate the change in mean reported confidence for the control vs. intervention groups. Mean overall reported confidence among students in the intervention group was 0.33 pre-course, as compared to 1.36 post-course (P < .001). Of particular note, students became markedly more confident in their ability to describe the history of reform efforts in the U.S. healthcare system (+1.10; P < .001). In addition, mean student confidence improved related to their ability to identify ways to control the growth of healthcare costs in the U.S. healthcare system (+.72; P < .001) and to their ability to understand the key differences between private health insurance and government programs that provide coverage in the U.S. healthcare system (+1.00; P < .001).

The largest point estimates for differences in optimism were observed in increased optimism that the U.S. healthcare system would be improved in five years (+.42; P=.22) and ten years (+.17; P =.86). However, the DiD interaction term was insignificant for all optimism measures – students did not become more optimistic about the U.S. healthcare system improving one, five, and ten years in the future (Table 2.3). Students also reported post-course (1.07) that they were more optimistic about their own ability to improve the U.S. healthcare system as healthcare professionals, compared to their pre-course self-assessment responses (.88; P=.14). However, these results were not statistically significant. Figure 2.4 and Appendix A illustrate the difference in change in attitudes of optimism for the control vs. intervention groups.

In evaluating the individual student factors using the multivariable regression models with Bonferroni corrections for multiple comparisons, students' levels of confidence pre-course were positively associated with prior formal exposure to education in health policy and the healthcare system (+0.41; P<.001). Otherwise, there were no associations of the measured student factors related to the pre-course or post-course measures. Exposure to the course materials was the only measured factor associated with post-course student measures of knowledge, confidence, and optimism.

DISCUSSION

We have developed, and rigorously evaluated, what we believe is the first MOOC-based comprehensive curriculum for undergraduate health professions students related to understanding the U.S. healthcare system and the emerging HSS pillar of medical education. The primary objective of the Health Systems Science MOOC was to provide a flexible and engaging curriculum that would facilitate interprofessional learning about HSS and the U.S. healthcare system. Our curricular design targeted preclinical dental students, the majority of who self-reported little or no prior formal education on the U.S. healthcare system prior to this course. Our curriculum blended engaging and accessible didactics, faculty interviews and a panel discussion with experts, brief documentary films, and an adaptation of an evidence-based insurance plan simulation game (26) to provide students with a multi-faceted presentation of the U.S. healthcare system and help them understand how key stakeholders interact. We compared the students at UMSOD who participated in this MOOC with students at CDOM who were receiving standard preclinical dental curriculum at the same time. Our findings suggest that formally introducing HSS curriculum into undergraduate dental education increases knowledge and confidence regarding the U.S. healthcare system among future dental providers. This

addresses the growing need to help graduating dental students better contextualize their role in the U.S. healthcare system as they are faced with practice patterns that require a greater understanding of how to navigate the system. This broader training may enable these future dental professionals to become active stakeholders in advancing oral health improvements and may provide greater self-efficacy to advocate for positive changes in U.S. health policy.

While there is an emerging body of literature about the effectiveness of using MOOCs and other forms of flipped classroom approaches in clinical education (24, 28), we focused on understanding how MOOCs contribute to addressing the large gap in undergraduate health professions education related to healthcare systems and health policy. We are encouraged by our findings indicating that, after participating in the course, student knowledge markedly improved and student confidence related to understanding the U.S. healthcare system increased significantly. While confidence and optimism were measured via self-report, knowledge items offered a more objective metric and also improved. UMSOD has continued to require the course for all first-year dental students. Midwestern University CDMI was offered the opportunity to integrate the course into their curriculum following the study period.

Limitations

As a pre-post assessment of students enrolled in one offering of the healthcare system MOOC at two dental schools in the Midwestern U.S., this study has limitations. Results may not be generalizable to other U.S. health professions schools that have other components of their curricula focused on the U.S. healthcare system. We deliberately focused on early health professions learners, for whom this curriculum would be largely foundational. While our study design utilizes a concurrent control group to assess the impact of the Health Systems Science MOOC on students' knowledge, confidence, and optimism, it was only delivered in two dental

schools. This introduces the need to further assess the impact of the course among students in other health professions schools. However, we are encouraged by our findings from our previous analysis, in which improvements in all factors were statistically indistinguishable for all but one item across medical and dental students providing some limited evidence that our findings would be similar in other health professions schools. Another potential limitation is that we developed the pre-course/post-course self-assessment surveys *de novo* to evaluate this course and did not conduct formal pilot-testing. Nevertheless, we found high levels of internal validity on the subscales.

In addition, a limitation is that our study focuses only on health professions students' knowledge, confidence, and optimism about the healthcare system, and (given the pre-clinical stage of the students) was not designed to assess how these may impact care delivery, quality, and outcomes for patients. While our study provides evidence that the MOOC format is effective for communicating key information about the healthcare system to health professions students, development of future MOOCs related to health policy topic areas would offer more opportunities for currently practicing providers to become more effective stakeholders in the perpetually challenging and increasingly complex U.S. healthcare system. Future MOOCs may offer opportunities to assess how provider engagement with, and knowledge about, the U.S. healthcare system may affect practice and clinical outcomes.

Conclusions

Health systems science education and training has the potential to impact individual and population health by providing future providers with a greater ability to contextualize their roles as central stakeholders in the larger system. However, significant barriers to delivering this type of interprofessional education exist in traditional classroom settings due to curricular structure,

logistical support, availability of faculty, and cross-school coordination required to deliver interprofessional education. In addition, there is a recognized deficit of validated assessment methods targeting HSS domains (17). With substantial volatility and increasing fragmentation in the U.S. healthcare system, health professions schools may find it difficult to deliver up-to-date curriculum that incorporates the diverse perspectives of interprofessional stakeholders and when these curricula are delivered it may be difficult to robustly evaluate their effectiveness.

The MOOC format permits rapid exposure for dental students to multiple core themes of the U.S. healthcare system in a predominantly asynchronous learning environment, through an approach that can be incorporated with other established curricular elements. In addition, it allows students to receive curriculum that can be rigorously assessed allowing for more self-regulated learning (29). With demonstrable increases in student knowledge and confidence about the healthcare system, the MOOC structure provides a curricular approach that health professions schools across the country could employ to intensify HSS training in a manageable and sustainable way.

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Table 2.1 Responses, by Experimental Group, to Questions to Assess Exposure to Major Health Policy Events, Prior Health Policy Knowledge, and Previous Uninsurance, for Students Taking a Healthcare System Massive Open Online Course (MOOC)

Question and response choices	Number (%) responding, by experimental group		
	All n = 208	Control n = 101	Intervention n = 107
What year were you born?			
Before 1970	—	—	—
1970-1979	1 (.5)	1 (1)	—
1980-1989	10 (8.2)	10 (9.9)	7 (6.5)
1990-1999	456 (91.3)	90 (89.1)	100 (93.5)
Missing responses	—	—	—
How would you describe the extent of your prior formal education regarding the US healthcare system and health policy?			
None	114 (54.8)	31 (30.7)	83 (77.6)
Little	66 (31.7)	49 (48.5)	17 (15.9)
Some	17 (8.2)	17 (16.8)	—
Extensive	4 (1.9)	4 (4.0)	—
Missing responses	7 (3.4)	—	7 (6.5)
Have you ever been uninsured in the US healthcare system?			
Yes	55 (26.4)	24 (23.8)	31 (29.0)
No	121 (58.2)	72 (71.3)	49 (45.8)
Missing responses	32 (15.4)	5 (5)	27(25.2)

Table 2.2 Differences in Change in Knowledge Regarding Health Systems Science Reported by Dental Students Who Did Not Participate in the Health Systems Science Massive Open Online Course (MOOC) (NC) and Dental Students Who Did Participate in the Health Systems Science MOOC (C)
(N=208)

Knowledge	CONTROL			INTERVENTION			CHANGE	
	Mean Pre (SD)	Mean Post (SD)	Difference (Post-Pre)	Mean Pre (SD)	Mean Post (SD)	Difference (Post-Pre)	Difference in Differences (SE)	P Value[3]
Overall	.39 (.17)	.32 (.23)	-.08	.44 (.19)	.59 (.20)	.16	.23 (.04)	< .001
Patients								
Rate of Infant Mortality in the US	.22 (.42)	.16 (.36)	-.05	.33 (.47)	.48 (.50)	.15	.21 (.09)	.02
Providers								
Benefits of Electronic Health Records for Providers	.59 (.49)	.54 (.50)	-.05	.63 (.49)	.70 (.46)	.07	.13 (.10)	.20
Unequal Distribution of Providers	.65 (.48)	.51 (.50)	-.15	.77 (.42)	.84 (.36)	.07	.22 (.09)	.02
Payers								
Relationship between Health Insurance and Improved Health	.57 (.50)	.44 (.50)	-.13	.52 (.50)	.73 (.45)	.21	.33 (.10)	.001
Defining Medicaid	.54 (.50)	.39 (.49)	-.15	.65 (.48)	.69 (.46)	.05	.20 (.10)	.04
Defining Adverse Selection	.34 (.47)	.3 (.46)	-.04	.40 (.49)	.64 (.48)	.23	.27 (.10)	.005
Primary Advantages for Employer Based Health Insurance	.32 (.47)	.38 (.49)	.06	.46 (.50)	.66 (.47)	.21	.15 (.10)	.13
Identifying the Oregon Health Insurance Experiment	.03 (.17)	.04 (.21)	.01	.04 (.19)	.20 (.40)	.16	.15 (.05)	.006
Benefits of Value-Based Insurance Design	.41 (.49)	.31 (.47)	-.09	.33 (.47)	.56 (.50)	.23	.33 (.10)	.001
Public Health and System History								
US Presidential Reforms to Medicare	.15 (.36)	.12 (.33)	-.03	.15 (.36)	.43 (.50)	.28	.31 (.08)	< .001
Defining the Functions of the ACA	.62 (.49)	.44 (.50)	-.19	.66 (.48)	.78 (.42)	.12	.30 (.09)	.001
History of US Presidential Appeals for Universal Health Insurance	.09 (.29)	.11 (.32)	.02	.11 (.32)	.26 (.44)	.15	.13 (.07)	.07
Uninsurance Remaining after Implementation of ACA	.59 (.49)	.41 (.50)	-.18	.64 (.48)	.74 (.44)	.10	.29 (.10)	.003

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[3] We assessed statistical significance using Bonferroni's adjustment for multiple comparisons. P <.003 was considered statistically significant for measures of confidence and measures of optimism.

58

Table 2.3 Differences in Change in Attitudes of Confidence and Optimism Regarding Health Systems Science Reported by Dental Students Who Did Not Participate in the Health Systems Science Massive Open Online Course (MOOC) (NC) and Dental Students Who Did Participate in the Health Systems Science MOOC (C)

N = 208	CONTROL			INTERVENTION			CHANGE	
Attitude	Mean Pre (SD)	Mean Post (SD)	Difference (Post-Pre)	Mean Pre (SD)	Mean Post (SD)	Difference (Post-Pre)	Difference in Differences (SE)	P Value[4]
Confidence								
Overall	.32 (.65)	.43 (.80)	.11	.33 (.68)	1.36 (.45)	1.03	.92 (.129)	< .001
Identifying the main players or groups in the US healthcare system	.45 (1.04)	.48 (1.08)	.03	.37 (1.03)	1.49 (.60)	1.11	1.08 (.19)	< .001
Identifying examples of success in the US healthcare system	.72 (1.04)	.69 (1.01)	-.04	.51 (.96)	1.42 (.57)	.91	.94 (.18)	< .001
Identifying examples of problem areas that need improvement in the US healthcare system	1.16 (.86)	.86 (.99)	-.30	.99 (.85)	1.47 (.66)	.48	.78 (.17)	< .001
Describing the history of reform efforts in the US healthcare system	-.34 (.99)	-.02 (1.07)	.32	-.23 (1.02)	1.19 (.65)	1.42	1.10 (.19)	< .001
Understanding key differences between private health insurance and government programs that provide coverage in the US healthcare system	.23 (1.14)	.36 (1.09)	.14	.26 (1.09)	1.40 (.58)	1.14	1.00 (.20)	< .001
Understanding reasons for the benefits that are included in health insurance plans in the US	.28 (1.11)	.34 (1.01)	.07	.49 (1.03)	1.39 (.58)	.91	.84 (.19)	< .001
Identifying ways to control the growth of healthcare costs in the US healthcare system	-.29 (1.00)	.23 (1.09)	.52	-.09 (1.03)	1.15 (.74)	1.24	.72 (.19)	< .001
Optimism								
Overall	.47 (.67)	.59 (.70)	.12	.52 (.59)	.75 (.57)	.23	.11 (.13)	.37
The US healthcare system will be improved 1 year from now	-.42 (.94)	-.14 (1.05)	.28	-.34 (.93)	-.16 (1.03)	.18	-.10 (.20)	.61
The US healthcare system will be improved 5 years from now	.49 (1.0)	.68 (.96)	.19	.46 (.93)	.88 (.77)	.42	.22 (.18)	.22
The US healthcare system will be improved 10 years from now	.92 (.86)	1.07 (.80)	.14	1.07 (.67)	1.25 (.67)	.17	.03 (.15)	.86
Your potential to improve the US healthcare system in the future	.90 (.96)	.85 (.85)	-.05	.88 (.85)	1.07 (.67)	.20	.25 (.17)	.14

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[4] We assessed statistical significance using Bonferroni's adjustment for multiple comparisons. P <.003 was considered statistically significant for measures of confidence and measures of optimism.

Figure 2.2 Change in Knowledge Regarding Health Systems Science Reported by Dental Students Who Did Not Participate in the Health Systems Science Massive Open Online Course (MOOC) and Dental Students Who Did Participate in the Health Systems Science MOOC
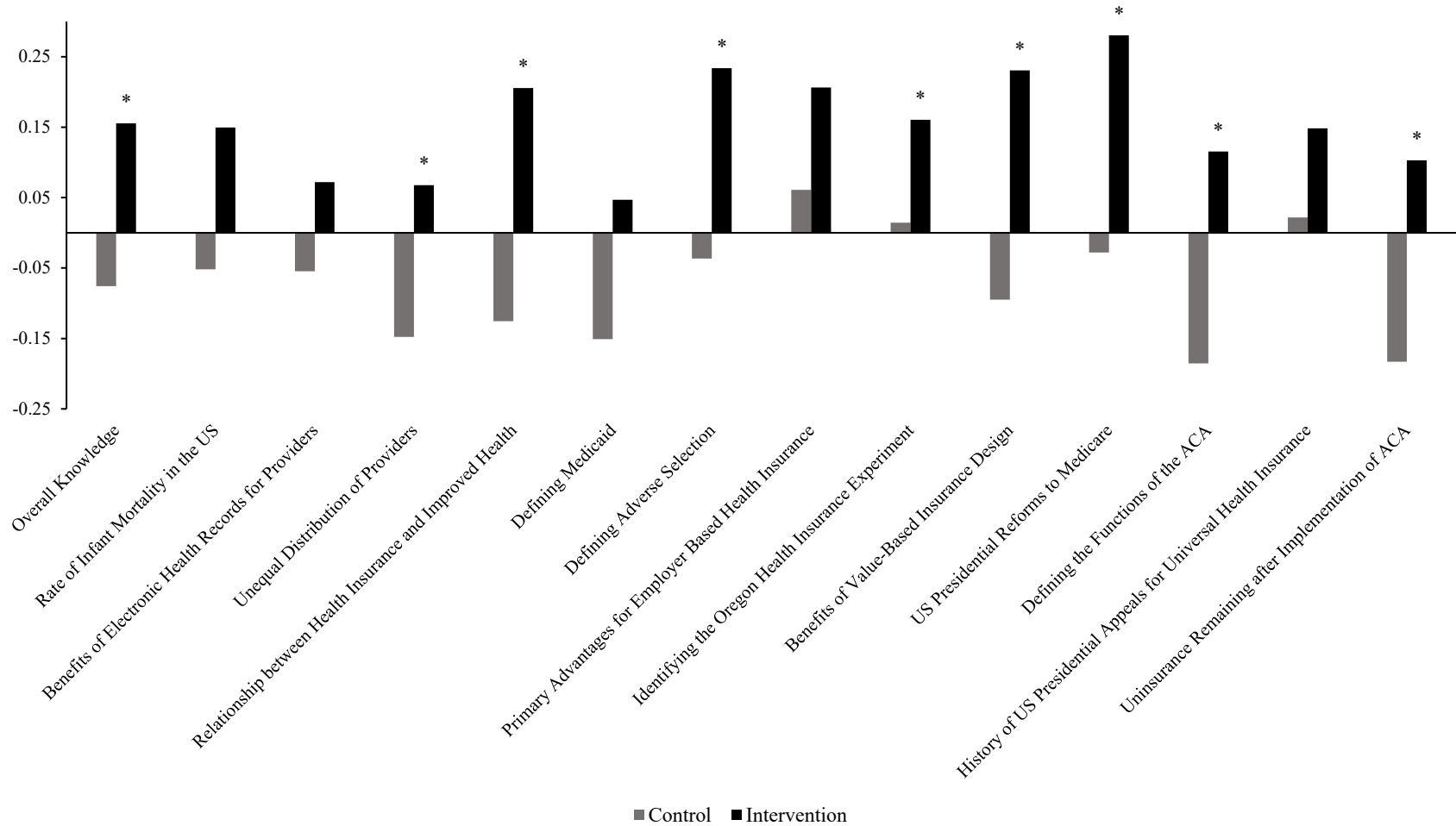
Figure 2.3 Change in Attitudes of Confidence Regarding Health Systems Science Reported by Dental Students Who Did Not Participate in the Health Systems Science Massive Open Online Course (MOOC) and Dental Students Who Did Participate in the Health Systems Science MOOC
(N = 208)
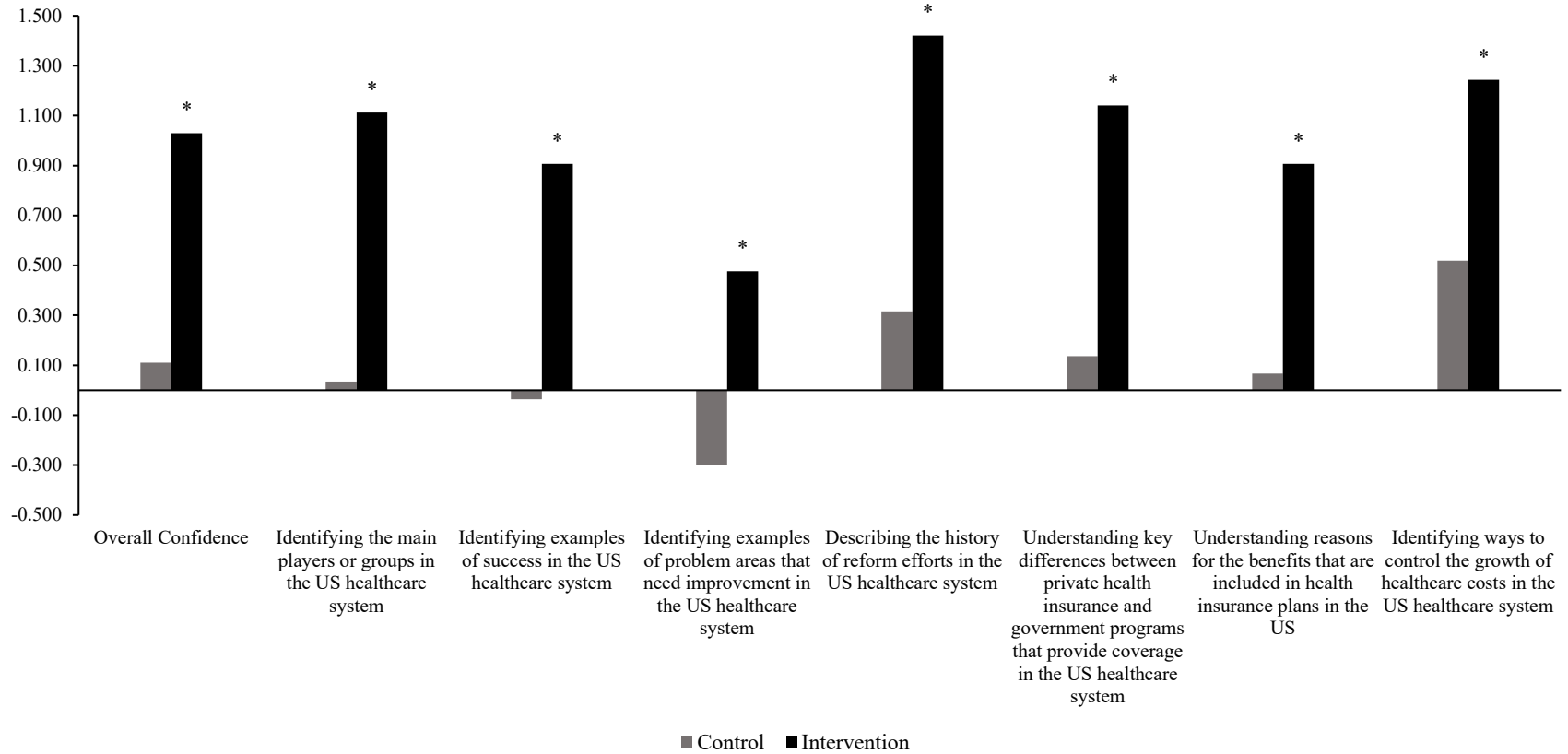
Figure 2.4 Change in Attitudes of Optimism Regarding Health Systems Science Reported by Dental Students Who Did Not Participate in the Health Systems Science Massive Open Online Course (MOOC) and Dental Students Who Did Participate in the Health Systems Science MOOC
(N = 208)
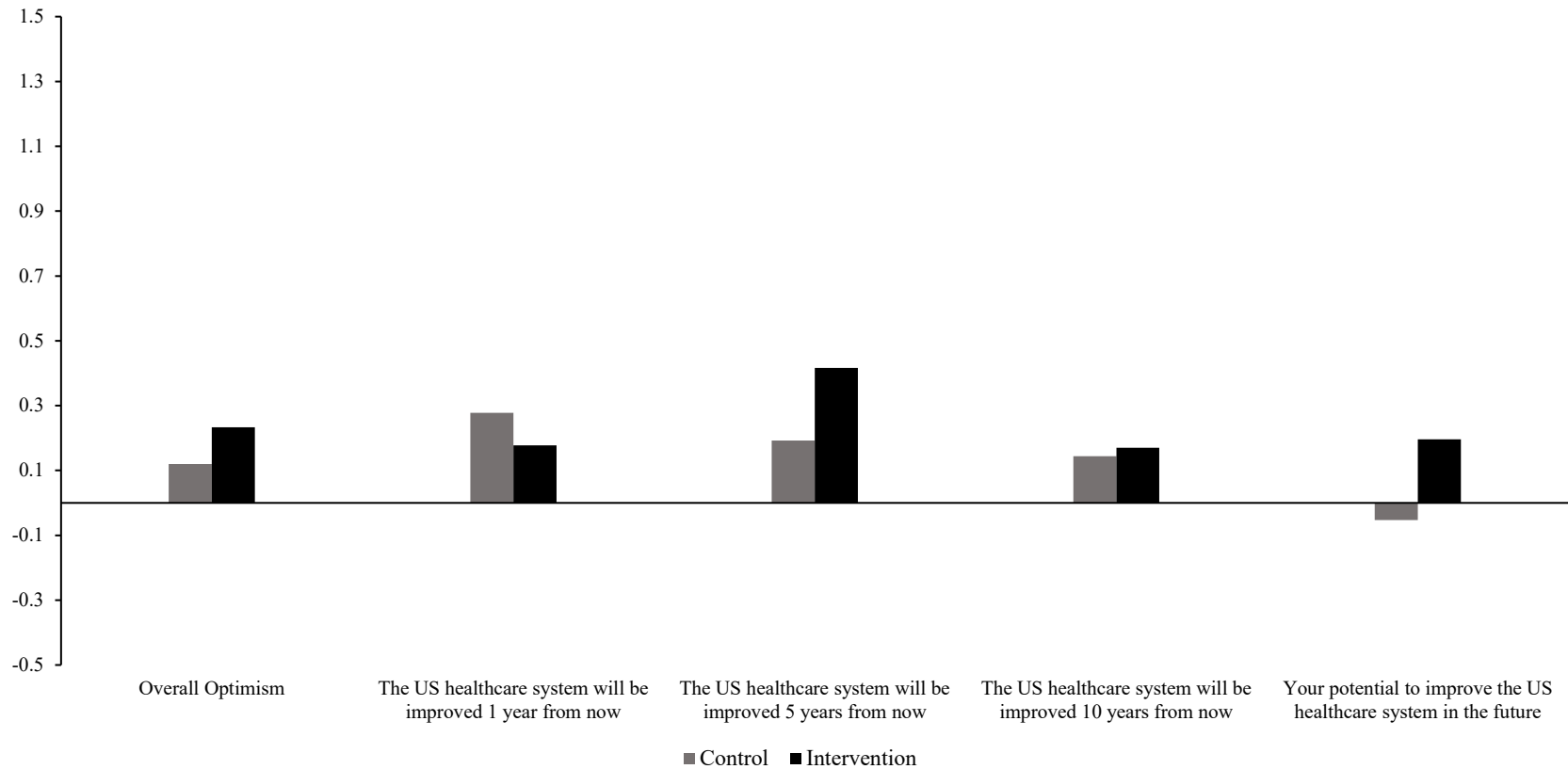
CHAPTER 3
Deliberating on Essential Health Benefits Among Future Health Professionals

INTRODUCTION

Medical educators have proposed a "third pillar" of medical education, termed *Health Systems Science* (1) (HSS). Health systems science is composed of six core curricular domains: 1) health care structures and processes; 2) health care policy, economics, and management; 3) clinical informatics/health information technology; 4) population health; 5) value-based care; 6) health system improvement (2). Learning about HSS and the U.S. healthcare system is an essential part of health professions education, but large proportions of graduating health professions students report these topics are insufficiently addressed in their curricula (3). While HSS curricula are present in some health professions schools and colleges, the type of curriculum in each school is highly variable and often fragmented (2). A prior cross-sectional survey of U.S. medical school deans to assess the state of health policy learning in their institutions found substantive variation across schools over the level of health policy training provided (4). While 94% of schools indicated that there was some form of health policy education present in the curriculum, 58% indicated that there was "too little" health policy education (4).

Even when present, training regarding the principles, processes and performance of the U.S. healthcare system is also generally insufficient, compared with other curricular elements. In a prior analysis of respondents to the Association of American Medical Colleges (AAMC) Medical School Graduation Questionnaire, investigators found that 90% of graduating students

reported that they believed they received appropriate training in clinical decision making, while only 40% reported that they believed they received appropriate training in the business practices of medicine – including healthcare systems, medical economics, managed care, practice management, and medical record-keeping (3). On the other hand, results from this analysis indicate that students in the first year of medical school who were exposed to a higher-intensity curriculum in healthcare systems (13 required lectures and 13 required discussion sections over a four-month period) reported higher satisfaction with learning about healthcare systems than students who experienced a more standard lower-intensity curriculum (3 required two-hour small-group sessions during the first and third years of medical school), while also experiencing no decrement in their perception of adequate training in other key domains of instruction (3).

Lack of training regarding HSS may put recent health professions school graduates at a disadvantage, requiring them to spend time and effort learning the health care system as they transition to their role as practicing clinicians (5). These findings suggest that efforts to amplify the HSS curriculum in health professions education can be an important way to improve student knowledge and confidence regarding health policy and health care systems. However, introducing new formalized didactic content into already-established health professions curricula remains a challenge. Therefore, delivering a substantive HSS curriculum with a flexible format is critical.

Increasing knowledge about high-value, cost-conscious care delivery among physicians and medical students has been associated with a reduction in the delivery of unnecessary health care services (6). However, the majority of interventions designed to address this knowledge are focused on increasing awareness of price and the fundamentals of health economics (6) with minimal focus on the structure and design of health insurance plans. From the perspective of

health care consumers, since the majority of patients rely on health insurance plans to pay for their health care needs (7), training for health professions students about practical aspects of health insurance in the U.S. healthcare system and how to prioritize limited healthcare resources may prepare future clinicians to help their patients more effectively (8) – especially since consumers rely on providers to make the majority of health care decisions for them, trusting that the services required to treat illness will be readily available (9).

Essential Health Benefits

Since health insurance uses pooled resources to pay for individual healthcare utilization and relies on balancing current needs of one group of consumers with future needs of another group of consumers (8), stakeholders require an understanding of how health insurance plans are designed and who is involved in the process. For many of these stakeholders, including clinicians and consumers, questions such as "Who decides what is covered by health insurance?" and "How do they decide?" may be difficult to answer – especially as it relates to the way plans must be structured in order to comply with the Affordable Care Act (ACA). Beginning in 2014, the ACA required private insurance plans sold in the individual and small-group marketplace to cover a range of *essential health benefits* (10). The statute outlining this (section 1302) outlines ten different categories of services that must be covered: 1) ambulatory patient services; 2) emergency services; 3) hospitalization; 4) maternity and newborn care; 5) mental health and substance use disorder services, including behavioral health treatment; 6) prescription drugs; 7) rehabilitative and habilitative services and devices; 8) laboratory services; 9) preventive and wellness services and chronic disease management; and 10) pediatric services, including oral and vision care (10). While the ACA emphasized many federally mandated standards, the process for determining what qualifies as an essential health benefit was delegated to the states in a

bulletin announcement from the Department of Health and Human Services in 2011 (10). This decision left states with wide authority to deliberate around what would and would not be qualified as essential health benefits reducing standardization of health insurance plans across states. This non-centralized approach differed from the customarily centralized standard that characterized the ACA and as a result, states definitions of essential health benefits significantly varied (11). For example, only 51% of states considered Autism Spectrum Disorder Services an essential health benefit and only 10% considered Weight Loss Programs an essential health benefit creating large disparities across states around different health and medical services (11, 12).

Deliberative Democratic Decision Making

In order to ensure that states can adequately address the essential health benefits in health insurance policies, deliberative procedures must be implemented and rigorously evaluated to identify trade-offs that determine the ultimate structure of benefits and cost-sharing – even though this process is rarely visible to plan holders. To help the public understand this process and its implications for their health insurance plans, deliberative democratic decision making has been proposed and used to engage citizens in policy-related objectives (13–19). While this approach can be effective, several conditions should be met in order to achieve an effective outcome: 1) a representative sample of individuals should participate in the process; 2) participants should understand the material and topic being deliberated; and 3) vulnerable populations should be represented during the deliberation (8).

These conditions are especially difficult to meet when implementing this process for a health policy issue such as health insurance design. While a representative group of stakeholders can be identified, recruiting these individuals for a discussion about health insurance encounters

obstacles that create biases impeding the deliberation from taking all voices into account (8). For example, those working in the healthcare system who have an interest in the outcome are more likely to be able to participate, but they are only one stakeholder group impacted by the deliberation. While the voices of these health care workers are considered in the process, patients with chronic illnesses who may not be physically able to participate in the deliberation may not have their needs addressed. Furthermore, healthy individuals who are not necessarily in need of healthcare at the time that the deliberation takes place may not be represented in the discussions at all.

With HSS curriculum lacking in many health professions schools, newly graduating health professionals are unlikely to have the health systems science literacy level needed to understand how to make complex decisions about health insurance benefits. Furthermore, consumers may rely on their providers to understand the healthcare system and do not have the literacy level necessary to actively participate. Finally, individuals who are more vulnerable to the decision outcomes or who have less social and political power to become involved in the decision making process may not have their interests considered in the deliberations (15). Large stakeholders such as health professionals are often represented by associations or advocacy organizations, whereas vulnerable populations may not have the comparable organizational capacity to advocate for themselves.

The outcomes of deliberations are characterized by the final product or policy impact that the deliberative process has on the target issue undergoing scrutiny (8). The impact on individual participants or on the larger community can be characterized by improvement in individual understanding or collective awareness (13), greater political activation and participation (20), changes in individual views about the issue being debated, or changes in

67

attitudes, perceptions, behaviors, or knowledge related to the policy issue (8). In health care

policy prioritization decisions, the influence of deliberations can be seen in the way benefits

distributions across health insurance plans change following a deliberation, increased public

knowledge about health care financing, or whether the public changes their attitudes around the

relative priority of certain health care services (8). For example, the deliberation around the

passage of the ACA resulted in changes to the mandatory benefits insurers were required to

provide to consumers. Following the passage of the ACA, citizens became engaged in

deliberations around whether the ACA should be repealed and through this deliberative process,

they became more aware of health care financing. As a result, public perceptions surrounding

the role of the federal government in financing healthcare services changed. Prior to the passage

of the Affordable Care Act, 46% of Americans supported a policy in which insurance would be

provided from a single government plan compared to 56% of Americans supporting the same

policy nearly ten years later (21).

CHAT (Choosing Healthplans All Together)

To address the need to understand consumers' informed preferences related to health

insurance and overcome some of the obstacles related to representation in deliberations, the

CHAT (Choosing Healthplans All Together) exercise was developed in 1998 as a decision-

making tool designed to promote inclusive, deliberative, and accessible decision making for a lay

audience (8, 22). We integrated CHAT into our 6-week health policy massive open online

course (MOOC) for interprofessional learners entitled, "Understanding and Improving the U.S.

Healthcare System" to help students apply the knowledge they gained about health systems

science during the course to the decision-making process on health insurance design. Students in

our course deliberate in two phases as a learning community through making individual choices

that are designed to provide them with the opportunity to initiate the process of deliberation (phase one) and through working together in small groups to achieve consensus around a common health insurance plan (phase two). The course enables learners to engage with material in a predominantly asynchronous, learner-determined setting using short-form videos (each ≤ 15 minutes) with a variety of pedagogical techniques (see Methods). In October 2017, the University of Michigan Medical School (UMMS), School of Dentistry (UMSOD), College of Pharmacy (UMCOP), and School of Public Health (UMSPH) delivered the course to all first-year undergraduate medical and dental students, first year pharmacy students, and graduate public health students. In this report, we focus on the outcomes related to students' participation in phase one of the CHAT exercise as they individually deliberated about how to design a health insurance plan for themselves and then for a public stakeholder group they represented.

METHODS

Course Content

Based on growing evidence in the literature that flipped classroom approaches and MOOCs in medical education increase learner motivation and engagement (23), we developed a 6-week course using the MOOC format that also employed elements of a flipped classroom design. The flipped classroom design is defined by an approach in which the tasks completed inside and outside of the classroom are "flipped" to what occurs in a traditional classroom. The traditional classroom design is focused on foundational knowledge transfer through instructor delivered lectures (23). In a flipped classroom design, foundational knowledge is obtained by students through self-paced learning prior to class to allow for knowledge application and problem solving to take place as part of instructor facilitated activities and exercises (24).

The course was structured into five asynchronous learning modules: 1) illustrated

didactics related to the four main stakeholder groups in the U.S. healthcare system (patients,

providers, payers, and public health); 2) brief documentaries about the history of healthcare

reform, compiled from the audio-visual archives of 10 U.S. presidential libraries; 3) interviews

with faculty experts related to the roles and activities of public and private payers in the U.S.

healthcare system; 4) an adaptation of CHAT® (25) - the simulation exercise described earlier

that instructs students about how insurance plans are designed (25, 26); 5) a panel discussion

with nationally recognized health policy experts focusing on the future of the U.S. healthcare

system and healthcare reform. Each module was divided into a series of 4-6 segments ($\leq$ 15

minutes per segment).

Each semester that the course was offered, all video content was updated prior to course

delivery to reflect current events in health policy. Students were provided a weekly course

agenda instructing them on how to view content and participate in online discussions and

reflections. In addition to delivering the asynchronous video content to students online, students

were required to attend a 6th course element – a one-time, small-group (<20 students each),

integrated discussion facilitated by faculty from the University of Michigan Institute for

Healthcare Policy and Innovation in which medical, dental, pharmacy, and public health students

were mixed into each small group. These discussions were designed to embed an

interprofessional flipped classroom element into the course and enhance student engagement

(23).

CHAT Simulation Structure

CHAT was designed to reflect key tenets of democratic deliberation (13, 14, 27)

including: 1) being designed and pretested to ensure accessibility for a wide range of participants

by requiring only a sixth-grade reading level and using various techniques to simplify the complexities of health insurance design material; 2) providing each participant the opportunity to voice health care priorities that affect everyone and training the facilitator to actively solicit input from everyone engaged in the exercise; 3) providing a transparent deliberative process designed to expose trade-offs that address ethical and rational priorities; and 4) balancing communal values with personal autonomy by providing participants with the opportunity to express individual and group preferences (8, 13, 14, 28). CHAT is structured as a game or simulation exercise to address the complexity of health insurance design decision making (8, 25). It was created primarily for groups of nine to fifteen laypersons, however, our implementation of CHAT was dramatically larger including over 450 participants.

The CHAT board (Figure 3.1) is circular and similar to a pie chart. It contains a wedge for each health service benefit category chosen by participants minimizing any presentation of a hierarchical relationship between categories that might influence selections (as might be portrayed with a list). Benefit categories are color-coded to match the board. The relative sizes of the wedges in the board visually reflect the approximate relative costs. CHAT can be implemented to reflect various scenarios including decision making on Medicare and Medicaid coverage priorities (29), healthcare decision-making outside of the U.S. (30) and decisions related to health research (31, 32). For the purpose of educating future health care professionals about health insurance design and policy, we designed Essential Health Benefits CHAT to illustrate decisions about the essential health benefits required by the Affordable Care Act to qualify a health plan from avoiding individual or employer penalties or to be considered a Medicaid managed care plan.

There were 13 categories of benefits or indicators with varying levels of coverage (Level 1, Level 2, Level 3) that represent different types of insurance coverage (Table 3.3) and can be chosen by selecting markers on the wedges of the board. Milliman (Seattle, WA) was engaged to provide actuarial estimates which were then used to develop relative costs for each level of benefits. Nine categories had three levels of coverage: 1) *outpatient*; 2) *emergencies*; 3) *hospitals*; 4) *maternity*; 5) *mental health*; 6) *pharmacy*; 7) *rehab*; 8) *labs*; and 9) *vision and dental*. Two categories – *child health* and *preventive and chronic illnesses* – had two levels of coverage. Two categories – *costs for care* and *premiums* were indicators (rather than benefits) of the costs of the plan borne by the consumers to have the health plan with the benefits selected. Students received 100 markers which allowed them to fill in about 70 percent of the spaces on the CHAT board (Figure 3.1).

Marker requirements were additive – each student had to fill in Level 1 first before adding markers to choose Level 2 or Level 3. Level 1 coverage provided the most basic coverage while Level 3 provided the most comprehensive coverage with the exception of the two indicator categories, *costs for care* and *premiums*. In these categories, electing Level 3 required more markers but reduced out of pocket costs and monthly premium costs respectively. These categories were each required to be selected at least at Level 1. No other category was a required selection. Leaving a category (e.g., hospitals) completely out of the insurance plan indicated that the type of service in that category (e.g., inpatient care) would not be required to be covered at all for plans qualifying as covering essential health benefits.

Essential Health Benefits CHAT is designed to approximate the essential health benefits included in health insurance plans available in the Health Insurance Marketplace established by the Affordable Care Act. The Marketplace includes four different plans: 1) bronze (lowest

monthly premium); 2) silver; 3) gold; and 4) platinum (highest monthly premium) (33). The

premium used, $336 per member per month ($4,032 annually), was based on the estimated cost

in 2017 of an individual's standardized silver plan and, by default, either Level 2 or, less often

Level 1, reflected the description of a standardized silver plan for that category, with higher and

lower levels approximating coverage in standardized bronze and gold plans. Since the 100

markers represented the resources available, each marker's value was $3.36. Dollar amounts

assigned to each category and level were omitted to minimize numeracy requirements and avoid

issues related to price interpretation (8).

We provided students with 4 video segments including an introduction to CHAT and a

description of the 13 benefit categories, the levels available to choose for each benefit category,

and the cost (in markers) of those choices. We also provided students with a worksheet that

allowed them to record their selections for each of the benefit categories. As part of the course,

CHAT is used to provide students with the opportunity to engage in two different phases of

democratic deliberation. In phase one, students deliberate individually, voicing health care

priorities and balancing trade-offs – a critical part of the deliberative process. In phase two,

students build on their individual deliberation as they balance communal values with personal

autonomy in a group deliberation. For the phase one individual deliberation, students use the

board, benefits schedule, video segments, and 100 markers, to engage in two rounds of CHAT.

First, they choose which benefit categories to include in a health plan designed for

themselves and at what level (none, Level 1, Level 2, Level 3) to include them. Second, students

are randomly assigned to one of five stakeholder groups: 1) *Adults 65 years old and older who

are in generally good health for their age*; 2) *Non-Elderly adults (18-64) with chronic health

conditions*; 3) *Young adults (18-40) with partners in generally good health*;

4) *Young families (adults 18-40 and children) in generally good health*; and 5) *Young Single Adults (18-40) living in poverty*. Students individually choose which benefits categories to include in a health plan designed for their stakeholder group and what level (none, Level 1, Level 2, Level 3) of benefit to include for their stakeholder group.

For the phase two group deliberation, students participated in one-time, small-group (<20 students each), integrated discussions facilitated by faculty from the University of Michigan Institute for Healthcare Policy and Innovation in which medical, dental, pharmacy, and public health students were mixed into each small group. During this session, students deliberated on behalf of their stakeholder groups to create a communal insurance policy that would reflect the needs of all the stakeholder groups in aggregate. We report below on the phase one individual CHAT deliberations in which students prioritize benefits for themselves and on behalf of a stakeholder group. The phase two group deliberations that took place during the in-person sessions were more exploratory than definitive. Therefore, these results were not analyzed.

Pre-Course and Post-Course Self-Assessments

We developed a 43-item survey instrument that was used as a pre-course and post-course self-assessment to evaluate students' objective knowledge of the healthcare system structure regarding patients, providers, payers, and public health, confidence in understanding the U.S. healthcare system, and optimism about opportunities for system improvement. In addition to our team of investigators, faculty at UMMS and UMSOD and a group of three medical students independently piloted the instrument prior to fielding to provide feedback. We delivered the pre-course self-assessment electronically to all students enrolled in the course using the online Canvas platform (Instructure, Salt Lake City, Utah). Students were required to complete the pre-course self-assessment prior to accessing the first module. Upon completion of the course,

74

students were required to complete the post-course self-assessment electronically. We report below on 28 of the 43 items; the remaining items related to learning process measures, unrelated to the U.S. healthcare system.

Knowledge: We asked students 13 objectively verifiable, multiple-choice questions related to health policy and health systems science topics, including adverse selection, definitions of Medicare and Medicaid, electronic health records, presidential healthcare reform efforts, functions of health insurance, employer sponsored health insurance, and the Affordable Care Act. We divided knowledge questions into domains that related to the overall course's structural presentation – patients, providers, payers, public health, and healthcare system history. Overall knowledge gained from the course was measured as the difference in the mean proportion of correct answers pre-course versus post-course.

Confidence: We asked seven questions related to learners' confidence in their ability to identify main stakeholders and groups in the U.S. healthcare system, their ability to identify examples of programmatic success in the healthcare system, problem areas that need improvement, history of healthcare reform efforts, key differences between private and government health insurance programs, and ways to control the growth of healthcare costs. Confidence was measured on a four-point discrete continuous scale ("Not confident" [assigned a value of -1], "Unsure" [0], "Somewhat confident" [+1], "Very confident" [+2]).

Optimism: We asked learners a series of four questions related to their personal optimism that the U.S. healthcare system will be improved 1 year, 5 years, or 10 years from now, and their attitudes surrounding their own ability to improve the U.S. healthcare system in the future (i.e., as future healthcare professionals). Optimism was measured on a four-point scale (Not optimistic [-1], Unsure [0], Somewhat optimistic [+1], Very optimistic [+2]).

75

To ensure internal consistency among the items combined into each of the three measures (knowledge, confidence and optimism), we validated each using a principal components exploratory factor analysis of responses to the items in each scale. Each scale had just one factor, with a standardized Cronbach's coefficient for each above .70 ($\alpha = .72$ for knowledge; $\alpha = .81$ for confidence; and $\alpha = .71$ for optimism).

Analyses

For the pre-course and post-course self-assessments, descriptive and inferential statistics were generated. We performed analysis of variance (ANOVA) to assess differences among medical, dental, pharmacy, and public health students. We found no differences among medical, dental, pharmacy, and public health students. Thus, we elected to combine all students for subsequent analyses related to confidence and knowledge, unless otherwise indicated.

Participant characteristics were described using proportions for categorical variables and means and standard deviations for continuous variables. We describe students' benefits selections for their individual insurance plan using proportions and calculated the percentage of students selecting each benefit category. We also generated a mean and standard deviation of markers spent per student in each category.

To describe the difference between how students prioritized benefits in their individual insurance plan as compared to the plan they designed on behalf of a stakeholder group, we used proportions and calculated the percentage of students within each stakeholder group who chose benefits at Level 1, Level 2, or Level 3 for their individual plan and their plan on behalf of a stakeholder group. The difference between students' individual and stakeholder group insurance plans was assessed using Chi-Square tests (or Fisher's Exact Test for cells with fewer than 10

observations). A two-tailed P < .05 was considered statistically significant for the difference between the levels selected for an individual plan and a stakeholder group plan.

To assess the magnitude of change between student selections for their individual plan and their stakeholder group plan, we created a benefits change score that was the difference between the level chosen for each benefit category in the student's stakeholder group plan and the level chosen for each benefit category in the student's individual plan. For example, a score of -2 indicates that a student selected Level 1 when choosing on behalf of a stakeholder group and Level 3 when choosing the same benefit category for their individual plan.

To describe how students' benefits selections related to whether they considered them essential health benefits or not, we used aggregated proportions by stakeholder group and calculated the percentage of students selecting at least Level 1, at least Level 2, and Level 3 for each benefit category in their respective stakeholder groups. We compared across stakeholder groups, the percentage of students who selected at minimum Level 1 with the percentage of students who selected at minimum Level 2 or Level 3.

In order to assess associations of sociodemographic characteristics and stakeholder group assignment with students' benefits change score, we fit multivariable regression models with standardized beta coefficients with students' field of study (medical, dental, pharmacy, other health professions, undergraduate) using non-health professions as the reference category, decade of birth (1990-1999 versus earlier), whether they had any prior formal exposure to education in healthcare systems or health policy (any versus none), their overall knowledge and confidence in the post-course self-assessment, and their stakeholder group assignment using young adults 18-40 with partners in generally good health as the reference category as covariates. A two-tailed P < .05 was considered statistically significant. All statistical analyses

were performed using Stata IC 14.2 for Windows (Stata Corp, College Station, Texas). The study was determined to be exempt from ongoing human subjects review by the University of Michigan Institutional Review Board (Study #HUM00132240).

RESULTS

The healthcare system MOOC was delivered from October 9 – November 17, 2017. There were 454 health professions students enrolled during this period who completed paired pre- and post-course self-assessments at Week 1 and Week 6 respectively and participated in CHAT during Week 4 and Week 5; 155 (34%) were preclinical medical students, 106 (23%) were first-year dental students, 85 (19%) were first-year pharmacy students, 58 (13%) were graduate health professions students, and 44 (10%) were undergraduates with plans to pursue health professions careers.

Table 3.1 presents student-reported, prior health systems training, previous uninsured periods, and stakeholder group assignment by school affiliation. The vast majority (n=405, 88%) were born between 1990-1999. About one-fifth (n=98, 20%) of students reported that they had previously been uninsured, and the majority of students (n=342, 75%) reported that they had little or no prior formal education regarding the U.S. healthcare system or health policy. Each of the five stakeholder groups was assigned to approximately one-fifth of the students, with similar proportions of students from each of the different school affiliations represented in each of the stakeholder groups.

Table 3.2 shows overall student confidence along the seven separate confidence item measures. Mean overall reported confidence among students was 0.32 pre-course, as compared to 1.51 post-course (P < .001). Table 3.2 also shows overall student knowledge of health policy

topics. Overall student knowledge of the healthcare system increased by a mean proportion of correct answers of .19 (P < .001).

CHAT: Individual and Stakeholder Group Selections

Table 3.4 describes students' benefits selections for their individual insurance plan, using proportions and percentages of students selecting each benefit category. Nearly all students selected coverage in each of the 13 categories, with the exception of child health (n=259, 57%) and rehab (n=356, 78%). These selections reflect the fact that the majority of students were born after 1990 and are unlikely to have children or require rehabilitation services. Mean markers spent per student were generally aligned with Level 2 (Figure 3.2), with the exception of costs for care in which students typically chose benefits higher than Level 2 in order to further reduce out-of-pocket costs.

Table 3.6, Table 3.7, Table 3.8, Table 3.9, and Table 3.10 describe the differences between how students prioritized benefits in their individual insurance plan as compared to the plan they designed on behalf of a stakeholder group. Students prioritized benefits differently between their individual plan and stakeholder group plan in the majority of categories. This general finding suggests that students were able to take another person's perspective sufficiently well to change their decision-making about benefits for a stakeholder group. For example, when representing adults 65 years old and older who are in generally good health for their age, significantly more students invested in Level 3 for hospital coverage (n=31, 28%) compared to the number of students who invested in Level 3 for hospital coverage for their individual plan (n=18, 17%; P < .001). When representing young families (adults 18-40 and children) in generally good health, almost all students invested in Level 1 or Level 2 for child health (n=95, 97%) compared to the number of students who invested in Level 1 or Level 2 for child health for

their individual plan (n=54, 55%; P=.04). When representing young single adults (18-40) living in poverty, more students invested in reducing out of pocket costs, investing in Level 3 for costs for care (n=45, 57%) compared to the number of students who invested in Level 3 for costs for care for their individual plan (n=22, 28%; P < .001).

We performed multivariable regression models assessing the magnitude of change in the different benefit category investments between a student's individual insurance plan and the student's plan for a stakeholder group. The change in investment was statistically significantly associated with the stakeholder group that students were assigned and in the premiums category with students who had experience with being uninsured previously.

With students representing young adults (18-40) with partners in generally good health as a reference group, students representing adults 65 years old and older who are in generally good health for their age increased (from their individual plan) the monthly premium of the policy (-.27; P < .001) and reduced investments in coverage for maternity care (-.33; P < .001) and child health (-.25; < .001), while increasing coverage for hospital care (+.26; P < .001), pharmacy benefits (+.30; P < .001), and rehab (+.23; P < .001).

Students representing non-elderly adults (18-64) with chronic health conditions, increased (from their individual plan) the monthly premium of the policy (-.18; P < .05) and reduced investments in coverage for maternity care (-.26; P < .001), preventive and chronic illness (-.12; P < .05), child health (-.16; P < .01), and vision and dental (-.34; P < .001) while increasing coverage for outpatient visits (+.14; P < .05), hospital care (+.21; P < .001) and pharmacy (+.37; P < .001).

Students representing young families (adults 18-40 and children) in generally good health increased investments (from their individual plan) in coverage for maternity care (+.14; P < .05)

and child health (+.21; P < .001).   Finally, students representing young single adults (18-40)

living in poverty reduced (from their individual plan) investments in coverage for maternity

(-.17; P < .01), labs (-.19; P < .01), child health (-.12; P < .05), and vision and dental

(-.25; P < .001) and reduced out-of-pocket costs for their stakeholder group's policy

(+.17; P < .01).

In addition, students who reported that they had previously experienced a period of

uninsurance in their life were willing to reduce other benefits in exchange for a reduction in

monthly premiums for their stakeholder group (+.11; P < .05). Otherwise, there were no

associations of the measured student factors related to the magnitude of change in the different

benefit category investments between a student's individual insurance plan and the student's plan

for a stakeholder group.

CHAT: Essential Health Benefits

Table 3.11 describes the aggregate levels of benefits prioritized for students' insurance

plans on behalf of a stakeholder group. At least 70% of students in each stakeholder group

selected a minimum of Level 1 coverage for outpatient, emergency, hospitals, mental health,

pharmacy, rehab, labs, preventive and chronic illness, and vision and dental. The only benefits

that students could not achieve consensus on for at least Level 1 coverage, were maternity and

child health. Less than 20% of students representing older adults prioritized at least Level 1 for

maternity and child health and less than 60% of students representing young single adults in

poverty prioritized at least Level 1 for maternity and child health. The distribution for the

different levels of coverage was most uniform in mental health. Approximately 80% of students

in each of the five stakeholder groups prioritized a minimum of Level 1 coverage, about 50%

prioritized a minimum of Level 2 coverage and about 20% prioritized Level 3 coverage. This

contrasted with pharmacy benefits where approximately 95% of students in each of the five stakeholder groups selected a minimum of Level 1 coverage compared to a more variable selection for Level 3 ranging from 5% for young adults (18-40) with partners in generally good health to 46% for non-elderly adults (18-64) with chronic health conditions. For the indicators of costs for care and premiums, students were required to select at least Level 1. Students demonstrated uniformity between a minimum of Level 2 and Level 3 for costs for care while making more variable choices in premiums – 41% of students representing young single adults in poverty favored Level 3 compared to only 8% of students representing older adults favoring Level 3 for premiums.

DISCUSSION

Over 450 health professions students deliberated in two phases about priorities related to health insurance plans for themselves and on behalf of a stakeholder group as part of our MOOC-based comprehensive curriculum for undergraduate health professions students related to health systems science. In phase one of CHAT, they first prioritized benefits for themselves that approximate a silver plan on the Health Insurance Marketplace while indicating a preference for trading off coverage for healthcare services in exchange for a reduction in out of pocket costs. During this phase, when deliberating on behalf of a stakeholder group, students also significantly changed several of their benefits priorities and cost-sharing to reflect the perceived needs of their assigned stakeholder group.

The differences between priorities for their own insurance plan and their stakeholder group were most pronounced in the way they invested in hospital benefits, maternity care, pharmacy benefits, rehab services, child health, and vision and dental benefits. Students representing seniors were most likely to prioritize increased investments in hospital care and

82

pharmacy benefits while reducing the benefits for maternity and child health. This tradeoff is expected, and in a key respect illustrates that the exercise was working as pedagogically intended. In another respect, this tradeoff indicates how national dialogue about single-plan benefit considerations inherent in the Essential Health Benefits of the ACA or "Medicare-for-All" can pit population subgroups against one another.

While students were routinely cost-conscious in their prioritization behavior, they prioritized more benefits with the consequence of a more costly monthly policy premium for their stakeholder group. For example, students representing adults living in poverty traded off coverage for vision and dental services for a reduction in out-of-pocket costs. Students representing young families reduced investments in vision and dental services in order to invest in maternity care and child health benefits. As compared to students representing young adults with partners in generally good health, students were most likely to reduce vision and dental benefits across all stakeholder groups in order to increase coverage or further reduce out-of-pocket costs and premiums reflecting their perception that vision and dental services are not as high of a priority in overall health and wellness as other healthcare services. This is somewhat surprising, given that nearly one-quarter of students participating in the exercise were dental students and they did not prioritize differently than the non-dental students.

We found few associations between demographic characteristics including field of study, decade of birth, prior exposure to health policy education and the difference in their priorities for their own plan and their stakeholder group plan. Dental students were surprisingly not statistically significantly more likely to prioritize vision and dental services, while pharmacy students were not more likely to prioritize pharmacy benefits. In addition, medical students or public health students were not more likely to prioritize preventive and chronic illness coverage.

However, it is important to note that students who reported that they had previously experienced a period of uninsurance in their life were more willing to reduce other benefits in exchange for a reduction in the cost of their insurance plan. This may be motivated by their deeper understanding of the financial hardship facing patients who have no coverage.

The most consistent behavior pattern in benefits prioritization related to out-of-pocket costs and monthly premiums. Students demonstrated that they are a group of young adults that is very price-sensitive for themselves and for a stakeholder group most closely aligned with their age group. When representing older adults who were either in generally good health or have a chronic condition, students were willing to trade off this price sensitivity in order to prioritize greater coverage. Furthermore, while students demonstrated a price sensitivity, most notably in their individual plan, they did not elect to reduce the total number of markers spent to lower the monthly cost of their insurance plan. If they had elected all benefits in Level 1, their plan would have most closely approximated a bronze plan in the Health Insurance Marketplace. The results of this deliberation indicate that even though they may not require many of the services covered under their individual plan, they still demonstrated that they were most inclined to be covered under a silver plan with slightly lower out-of-pocket costs. This could be attributable to the fact that these students are future health professionals who understand that even young adults require a certain basic level of coverage, but it is notable that when given the opportunity to spend less every month they still did not prioritize a less expensive plan approximating a bronze plan on the Health Insurance Marketplace – instead favoring an insurance plan with more comprehensive coverage.

Finally, students demonstrated agreement about the value of each of the essential health benefits but differed in their perceptions of how robust they wanted those benefits to be, given

the trade-offs across the full spectrum of benefits. With the exception of child health and maternity, the majority of students representing the five different stakeholder groups selected at least Level 1 coverage for the remaining essential health benefits. This demonstrates a preference for spreading coverage across the essential health benefits rather than choosing to exclude coverage on one benefit category to provide more generous coverage for other benefit categories. Students also demonstrated that they were able to achieve consensus on how to prioritize certain benefits. For example, mental health coverage had a uniform distribution at the different aggregated levels across the stakeholder groups. This is an important finding as mental health services are currently one of the essential health benefits that do not have uniform coverage between different states. Demonstrating how to achieve consensus among future providers around mental health coverage may contribute to providing policy makers with a clearer understanding of why disparities between states on essential mental health benefits need to be eliminated.

Limitations

As a simulation game meant to provide health professions students with the opportunity to deliberate on health insurance plans and decide on their priorities for a stakeholder group, this study has limitations. We deliberately focused on early health professions learners, so results may not be generalizable to other groups of future young professionals who are not working in the health care delivery system. Early learners in business, finance, government, or education might prioritize differently. These future young professionals would likely be involved in deliberating on health insurance benefits in the future as part of a large employer or a governmental agency. Furthermore, we did not incorporate graduate health professions students who might have a more advanced understanding of care delivery and prioritize health insurance

benefits differently. Another potential limitation is that we did not analyze the results of the phase two deliberations in which students deliberated on a communal plan together.   Finally, students were not making actual trade-offs with their own money which may bias their decision making toward electing more generous coverage for both their individual plans and their stakeholder group plans.

Conclusions

Health systems science education and training has the potential to impact individual and population health by giving future providers a greater ability to contextualize their roles as central stakeholders in the larger system. A critical component of this training is providing future healthcare professionals the opportunity to understand how health insurance is designed and how rationing of health services takes place in the U.S. healthcare system. Significant barriers to delivering this type of interprofessional education exist in traditional classroom settings due to curricular structure, logistical support, and cross-school coordination required to deliver interprofessional education. With substantial volatility and increasing fragmentation in the U.S. healthcare system, health professions schools may find it difficult to deliver up-to-date curriculum that incorporates the diverse perspectives of interprofessional stakeholders and allows them to actively take part in the decisions related to health insurance that they will most likely not encounter at any other time in their undergraduate or graduate professional training.

The MOOC format permits rapid exposure for health professions students to multiple core themes of the U.S. healthcare system in a predominantly asynchronous learning environment, through an approach that can be incorporated with other established curricular elements. This format allows large numbers of students to engage in deliberation around health insurance for both themselves and on behalf of a stakeholder group. With demonstrable changes

in the way students prioritized benefits for themselves and for a stakeholder group, the CHAT exercise provides a curricular approach that health professions schools across the country could employ to intensify HSS training and provide students with practical experience around health insurance deliberation in a manageable and sustainable way.

Our findings provide evidence that CHAT has the ability to support HSS education by providing students with the opportunity to take the perspective of population subgroups dissimilar to themselves and make choices about health plan benefits that are measurably different than the choices they make for themselves. This perspective-taking exercise may provide new opportunities for health professions students to gain a deeper understanding of how plan benefits are designed and the challenges of prioritizing coverage of specific health care utilization within a spending constraint. As states continue to deliberate around what should and should not be considered an essential health benefit, stakeholders including providers will need to engage in prioritizing different health and medical services in order to advocate for inclusion of these services under the essential health benefits. The emergence of disparities across states regarding health services such as autism care, weight loss programs, and mental health treatment necessitates that future providers understand how essential health benefits are prioritized so that they can become more actively engaged in advocacy surrounding what services are incorporated into the various essential health benefits provisioned by each state. Even though students were not spending their own money, they exhibited decision-making and preferences that suggest they were responding to the rules of the simulation in ways that forced them to make these important trade-offs. Moreover, students were exposed to nuances of national dialogue about common benefits (e.g. in "Medicare for All") that may help them serve as more deeply informed health care professionals in the future.

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Figure 3.1 Essential Health Benefits CHAT Board used in the CHAT Exercise
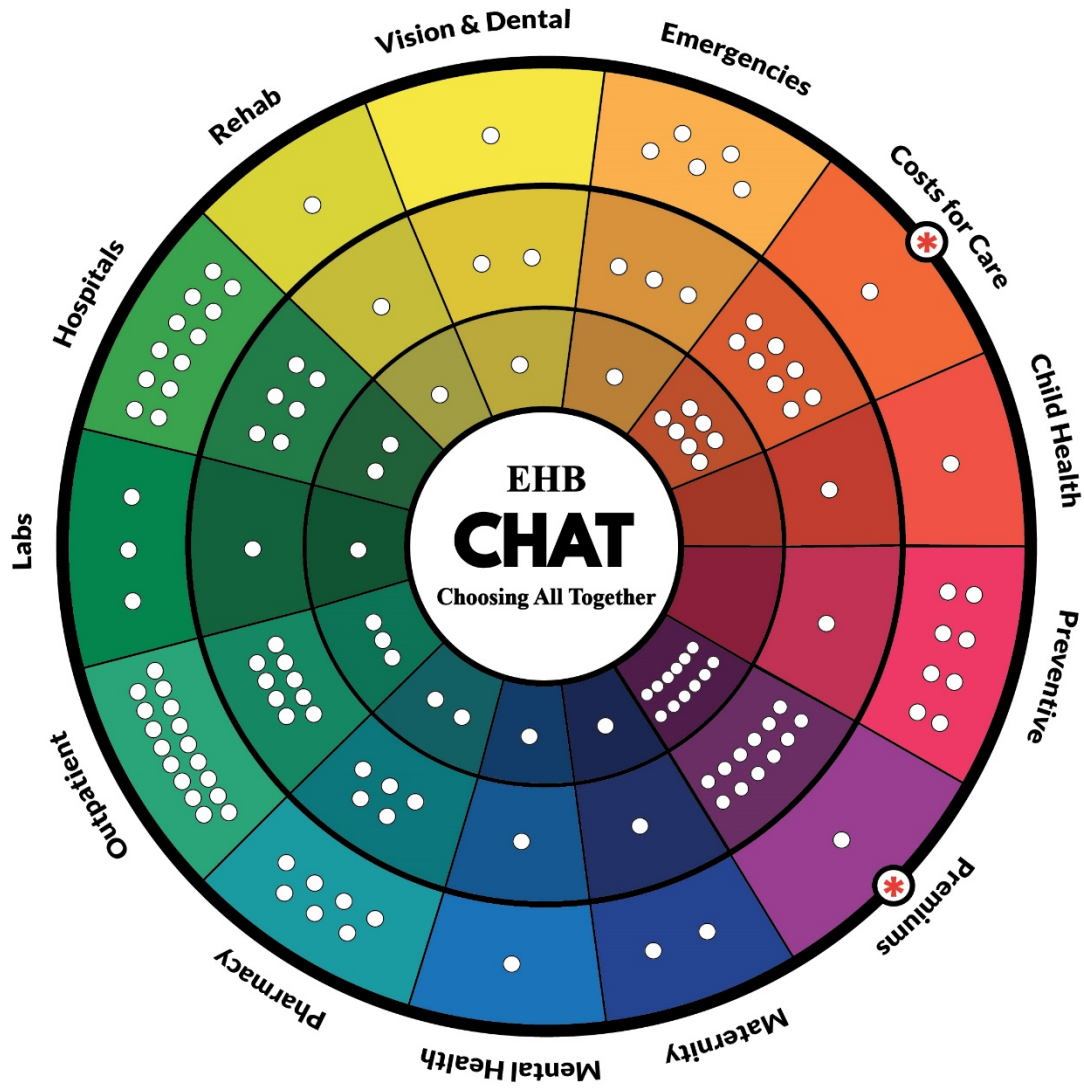
Table 3.1 Responses, by School Affiliation, to Questions to Assess Exposure to Major Health Policy Events, Prior Health Policy Knowledge, and Previous Uninsurance, for Students Participating in CHAT in October 2017

Question and response choices	Number (%) responding, by school affiliation						
	All n = 458	**Medical** n = 155	**Dental** n = 106	**Pharmacy** n = 85	**Other Health Professions** n = 58	**Undergraduate** n = 44	**Non-Health Professions** n = 6
Year Born							
Before 1990	49 (10.7)	26 (16.8)	7 (6.6)	4 (4.7)	11 (19.0)	—	1 (16.7)
After 1990	405 (88.4)	129 (83.2)	99 (93.4)	81 (95.3)	47 (81.0)	44 (100.0)	5 (83.3)
Missing responses	4 (.9)	—	—	—	—	—	—
Stakeholder Group Represented							
Adults 65 years old and older who are in generally good health for their age	108 (23.8)	38 (24.5)	19 (17.9)	19 (22.4)	16 (27.6)	16 (36.4)	—
Non-Elderly adults (18-64) with chronic health conditions	81 (17.8)	29 (18.7)	22 (20.8)	14 (16.5)	10 (17.2)	5 (11.4)	1 (16.7)
Young adults (18-40) with partners in generally good health	88 (19.4)	33 (21.3)	21 (19.8)	16 (18.8)	8 (13.8)	7 (15.9)	3 (50.0)
Young families (adults 18-40 and children) in generally good health	98 (21.6)	33 (21.3)	21 (19.8)	21 (24.7)	16 (27.6)	7 (15.9)	—
Young Single Adults (18-40) living in poverty	79 (17.4)	22 (14.2)	23 (21.7)	15 (17.7)	8 (13.8)	9 (20.5)	2 (33.3)
Previously been uninsured in the US healthcare system							
Yes	98 (21.4)	35 (22.6)	17 (16.0)	19 (22.4)	22 (37.9)	3 (6.8)	2 (33.3)
No	356 (77.7)	120 (77.4)	89 (84.0)	66 (77.7)	36 (62.1)	41 (93.18)	4 (66.7)
Missing responses	4 (.9)	—	—	—	—	—	—
Prior formal education regarding the US healthcare system and health policy							
None	98 (21.4)	22 (14.2)	30 (28.3)	23 (27.1)	6 (10.3)	16 (36.4)	1 (16.7)
Little	244 (53.3)	93 (60.0)	49 (46.23)	47 (55.3)	33 (56.9)	19 (43.2)	3 (50.0)
Some or Extensive	112 (24.5)	40 (25.8)	27 (25.5)	15 (17.7)	19 (32.8)	9 (20.5)	2 (33.3)
Missing responses	4 (.87)	—	—	—	—	—	—

Table 3.2 Student Overall Knowledge and Confidence about the U.S. Healthcare System

Question and response choices	Mean (SD), by school affiliation						
	All n = 454	**Medical** n = 155	**Dental** n = 106	**Pharmacy** n = 85	**Other Health Professions** n = 58	**Undergraduate** n = 44	**Non-Health Professions** n = 6
Confidence							
Overall Pre-Course	.35 (.67)	.42 (.74)	.33 (.69)	.36 (.64)	.25 (.61)	.30 (.47)	.17 (.63)
Overall Post-Course	1.51 (.45)	1.48 (.41)	1.36 (.46)	1.48 (.58)	1.71 (.35)	1.75 (.26)	1.55 (.40)
Knowledge							
Overall Pre-Course	.53 (.20)	.63 (.17)	.44 (.19)	.48 (.20)	.54 (.20)	.51 (.16)	.53 (.09)
Overall Post-Course	.72 (.19)	.77 (.17)	.59 (.20)	.80 (.17)	.72 (.14)	.74 (.14)	.77 (.08)

92

Table 3.3 Details of Essential Health Benefits CHAT Benefit Levels

BENEFIT CATEGORY	LEVEL 1	LEVEL 2	LEVEL 3
OUTPATIENT All medical services done on an outpatient basis. This includes doctor visits, X-Rays or other imaging tests, and some surgeries, unless they are Preventive or routine Chronic Illness services.	Members pay 50% of the cost for most services. Primary care visits have $45 copays. Specialist visits have $80 copays.	Members pay 20% of the cost for most services. Primary care visits have $30 copays. Specialist visits have $65 copays.	Members pay 10% of the cost for most services. Primary care visits have $20 copays. Specialist visits have $50 copays.
EMERGENCIES Ambulances and emergency room visits. An emergency is an injury or illness that could lead to death or permanent harm.	Members pay 50% of the cost for all emergency services.	Members have a $400 copay for emergency room visits. They have a $75 copay for urgent care visits. Members must pay 20% for observation and trips in an ambulance.	$150 copay per emergency room visit. $65 copay per urgent care visit. Members must pay 10% for observation and trips in an ambulance.
HOSPITALS The care that people receive when they are admitted to the hospital. Admission for mental illness is in the Mental Health category, not this one.	50% member cost sharing.	20% member cost sharing.	No member cost sharing.
MATERNITY Coverage for pregnant mothers and newborns.	50% member cost sharing.	20% member cost sharing.	No member cost sharing.
MENTAL HEALTH Identifying and treating mental illness and substance use. This includes inpatient and outpatient care.	50% member cost sharing.	20% member cost sharing.	No member cost sharing.
PHARMACY You can choose to cover prescription drugs.	Insurance has a strict formulary and works with few pharmacies. Members may have to take generic drugs, unless they aren't effective. Members pay: • $35 copay for generic drugs • 35% for preferred brands • 40% for non-preferred brands • 45% for specialty drugs	Insurance covers some drugs that aren't on its formulary, but members have to pay more. Insurance works with more pharmacies. Members may have to take generics, unless they aren't effective. They pay: • $15 copay for generics • $50 for preferred brands • $100 for non-preferred brands • 40% for specialty drugs	Insurance covers more drugs that aren't on its formulary, but the member has to pay more for those. Insurance works with most pharmacies. Members pay: • $10 copay for generics • $30 for preferred brands • $75 for non-preferred brands • 30% for specialty drugs
REHAB Health care services that help a person keep, learn, or improve skills and functioning for daily life. These may include physical, occupational, and/or speech therapy. It also includes equipment like slings, resistance bands, wheel chairs, etc.	50% member cost sharing.	20% member cost sharing.	10% member cost sharing.

BENEFIT CATEGORY	LEVEL 1	LEVEL 2	LEVEL 3
LABS Medical tests like blood and urine tests.	50% member cost sharing.	20% member cost sharing.	10% member cost sharing.
PREVENTIVE & CHRONIC ILLNESS Preventive care includes physicals, screenings for diseases like cancer and shots that help make people immune (vaccines). Chronic conditions include illnesses like asthma and diabetes that need more frequent care, often daily medicines and some monitoring at home.	Members pay 20% of the cost for preventive services. People with certain chronic conditions that put them at risk of going to the hospital get extra help. This may include education, support groups, case management, community health workers, and home visits.	Preventive services are covered with no member cost sharing. People with any serious chronic condition may get for extra help.	
CHILD HEALTH Health care coverage for children, including well-child visits. This also includes recommended vaccines. Dental and vision care are included in the "vision and dental" category.	Members pay 20% of the cost.	No member cost sharing.	
VISION & DENTAL This includes eye care services, like eye exams, refractions, and eye surgery. Also, this category covers prescription glasses and contact lenses and dental services.	Insurance covers vision and dental care for children. Both preventive and comprehensive dental care are covered.	Insurance covers vision care and preventive dental care for all members. It also covers comprehensive dental care for children.	Insurance covers vision care for all members. It also covers preventive and comprehensive dental care for all members.
COSTS FOR CARE Deductibles are the amount members must pay before insurance kicks in. Out-of-pocket maximums are the most members will have to pay (besides monthly premiums) for health care in a policy period or year.	Members have to pay $3,500 for a deductible before their insurance kicks in. The most they have to pay in a year is $7,150. This includes their $3,500 deductible but not their premiums.	Members have to pay $1,250 for a deductible before their insurance kicks in. The most they have to pay in a year is $4,750. This includes their $1,250 deductible but not their premiums.	Members do not have to pay anything before their insurance kicks in. The most they have to pay in a year is $2,500 plus premiums.
PREMIUMS How much members pay each month for health insurance. Members must pay monthly premiums whether or not they use any health care.	Average Nationwide Silver Plan Premiums. This can be about $350 per month for a 40-year-old who does not smoke. Depending on a person's household income and size, they may qualify for a subsidy to reduce these costs.	Members pay $50 less than they would if you chose level 1.	Members pay $100 less than they would if you chose level 1.

Table 3.4 Benefits Prioritized in Students' Individual Insurance Plan and Markers Allocated (N = 454)

| Category | Selected, n (%)[5] | Selected Level, n (%) | | | | Markers | |
		No Coverage	Level 1	Level 2	Level 3	Markers Needed to Select [Level 1, 2, 3]	Mean Markers Spent per Student (SD)
Outpatient	443 (96.9)	14 (3.1)	205 (44.9)	179 (39.2)	59 (12.9)	[17, 26, 29]	21.6 (6.2)
Emergencies	452 (98.9)	4 (.9)	129 (28.3)	177 (38.8)	146 (32.0)	[5, 8, 9]	7.4 (1.8)
Hospitals	448 (98.0)	9 (2.0)	198 (43.3)	171 (37.4)	79 (17.3)	[12, 18, 20]	15.4 (4.0)
Maternity	297 (65.0)	160 (35.0)	83 (18.2)	93 (20.4)	121 (26.5)	[2, 3, 4]	2.0 (1.6)
Mental Health	379 (82.9)	78 (17.1)	124 (27.1)	113 (24.7)	142 (31.1)	[1, 2, 3]	1.7 (1.1)
Pharmacy	450 (98.5)	7 (1.5)	184 (40.3)	198 (43.3)	68 (14.9)	[7, 12, 14]	10.1 (3.0)
Rehab	356 (77.9)	101 (22.1)	169 (37.0)	107 (23.4)	80 (17.5)	[1, 2, 3]	1.4 (1.0)
Labs	434 (95.0)	22 (4.8)	194 (42.5)	138 (30.3)	102 (22.4)	[3, 4, 5]	3.6 (1.1)
Preventive & Chronic Illness	427 (93.4)	30 (6.6)	175 (38.3)	252 (55.1)	—	[8, 9, —]	8.0 (2.2)
Child Health	259 (56.7)	198 (43.3)	66 (14.4)	193 (42.2)	—	[1, 2, —]	1.0 (.9)
Vision & Dental	444 (97.2)	13 (2.8)	85 (18.6)	168 (36.8)	191 (41.8)	[1, 3, 4]	3.0 (1.2)
Costs for Care	457 (100.0)	—	47 (10.3)	273 (59.7)	137 (30.0)	[1, 9, 16]	10.3 (4.4)
Premiums	457 (100.0)	—	108 (23.6)	280 (61.3)	69 (15.1)	[1, 13, 25]	12.0 (7.4)

[5] Percentages are calculated as students choosing the category out of total students participating

Figure 3.2 Mean (SD) Markers Spent per Student as Compared to Markers Needed to Select Level 2
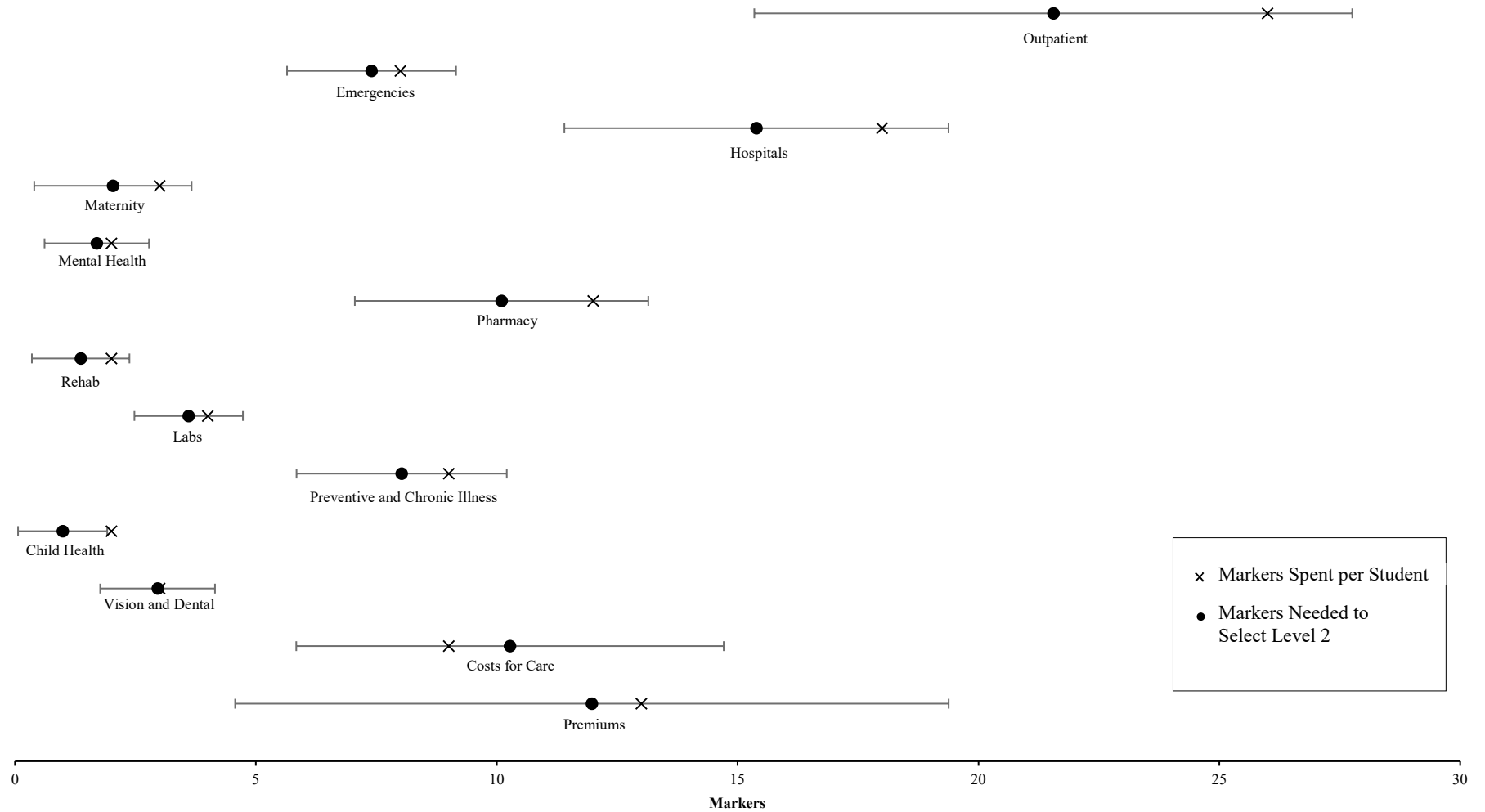
Table 3.5 Benefits Prioritized in Students' Individual Insurance Plan as Compared to Benefits Prioritized for Students' Insurance Plan on behalf of adults 65 years old and older who are in generally good health for their age (N = 109)

Category	Individual Selected Level, n (%)				Stakeholder Selected Level, n (%)				Difference	
	No Coverage	Level 1	Level 2	Level 3	No Coverage	Level 1	Level 2	Level 3	χ2	P Value
Outpatient	4 (3.7)	42 (38.5)	46 (42.2)	17 (15.6)	2 (1.8)	36 (33.0)	54 (49.5)	17 (15.6)	30.14	<.001
Emergencies	1 (0.9)	38 (34.9)	37 (33.9)	33 (30.3)	—	27 (25.0)	45 (41.7)	36 (33.3)	22.71	<.001
Hospitals	1 (0.9)	52 (47.7)	38 (34.9)	18 (16.5)	—	38 (38.9)	40 (36.7)	31 (28.4)	29.24	<.001
Maternity	48 (44.0)	19 (17.4)	24 (22.0)	18 (16.5)	90 (83.3)	12 (11.1)	4 (3.7)	2 (1.9)	14.39	.03
Mental Health	20 (18.4)	28 (25.7)	29 (26.6)	32 (29.4)	18 (16.5)	42 (38.5)	26 (23.9)	23 (21.1)	30.28	<.001
Pharmacy	2 (1.8)	41 (37.6)	47 (43.1)	19 (17.4)	3 (2.8)	16 (14.7)	47 (43.1)	43 (39.5)	37.15	<.001
Rehab	22 (20.2)	44 (40.4)	28 (25.7)	15 (13.8)	16 (14.8)	20 (18.5)	41 (38.0)	31 (28.7)	29.97	<.001
Labs	3 (2.8)	47 (43.1)	35 (32.1)	24 (22.0)	5 (4.6)	41 (37.6)	35 (32.1)	28 (25.7)	21.27	.01
Preventive & Chronic Illness	10 (9.2)	44 (40.4)	55 (50.5)	—	11 (10.1)	48 (44.0)	50 (45.9)	—	12.48	.01
Child Health	54 (49.5)	15 (13.8)	40 (36.7)	—	89 (81.7)	14 (12.8)	6 (5.5)	—	5.88	.13
Vision & Dental	4 (3.7)	21 (19.3)	38 (34.9)	46 (42.2)	6 (5.5)	16 (14.7)	42 (38.5)	45 (41.3)	53.71	<.001
Costs for Care	—	10 (9.2)	72 (66.1)	27 (24.8)	—	5 (4.6)	73 (67.6)	30 (27.8)	16.32	.01
Premiums	—	22 (20.2)	64 (58.7)	23 (21.1)	—	31 (28.4)	69 (63.3)	9 (8.3)	34.65	<.001

Table 3.6 Benefits Prioritized in Students' Individual Insurance Plan as Compared to Benefits Prioritized for Students' Insurance Plan on behalf of non-elderly adults (18-64) with chronic health conditions (N = 82)

Category	Individual Selected Level, n (%)				Stakeholder Selected Level, n (%)				Difference	
	No Coverage	Level 1	Level 2	Level 3	No Coverage	Level 1	Level 2	Level 3	χ2	P Value
Outpatient	3 (3.7)	36 (43.9)	32 (39.0)	11 (13.4)	3 (3.7)	26 (31.7)	32 (39.0)	21 (25.6)	34.07	<.001
Emergencies	1 (1.2)	23 (28.4)	29 (35.8)	28 (34.6)	—	29 (35.4)	26 (31.7)	27 (32.9)	7.79	.23
Hospitals	—	31 (37.8)	36 (43.9)	15 (18.3)	—	25 (30.5)	30 (36.6)	27 (32.9)	10.11	.04
Maternity	22 (26.8)	18 (22.0)	16 (19.5)	26 (31.7)	28 (34.2)	39 (47.6)	6 (7.3)	9 (11.0)	14.58	.08
Mental Health	13 (15.9)	20 (24.4)	20 (24.4)	29 (35.4)	9 (11.0)	31 (37.8)	24 (29.3)	18 (22.0)	22.71	.01
Pharmacy	—	38 (46.3)	35 (42.7)	9 (11.0)	2 (2.4)	10 (12.2)	32 (39.0)	38 (46.3)	11.28	.04
Rehab	20 (24.4)	33 (40.2)	14 (17.1)	15 (18.3)	25 (30.5)	27 (32.9)	12 (14.6)	18 (22.0)	17.60	.05
Labs	4 (4.9)	37 (45.1)	23 (28.1)	18 (22.0)	4 (4.9)	28 (34.2)	20 (24.4)	30 (36.6)	26.55	.05
Preventive & Chronic Illness	1 (1.2)	37 (45.1)	44 (53.7)	—	16 (19.5)	34 (41.5)	32 (39.0)	—	2.92	.62
Child Health	28 (34.2)	11 (13.4)	43 (52.4)	—	41 (50.0)	19 (23.2)	22 (26.8)	—	4.72	.33
Vision & Dental	—	18 (22.0)	29 (35.4)	35 (42.7)	14 (17.1)	31 (37.8)	22 (26.8)	15 (18.3)	14.71	.03
Costs for Care	—	9 (11.0)	41 (50.0)	32 (39.0)	—	6 (7.3)	42 (51.2)	34 (41.5)	10.04	.04
Premiums	—	20 (24.4)	52 (63.4)	10 (12.2)	—	26 (31.7)	49 (59.8)	7 (8.5)	28.49	<.001

Table 3.7 Benefits Prioritized in Students' Individual Insurance Plan as Compared to Benefits Prioritized for Students' Insurance Plan on behalf of young adults (18-40) with partners in generally good health
(N = 89)

Category	Individual Selected Level, n (%)				Stakeholder Selected Level, n (%)				Difference	
	No Coverage	Level 1	Level 2	Level 3	No Coverage	Level 1	Level 2	Level 3	χ^2	P Value
Outpatient	2 (2.3)	47 (52.8)	30 (33.7)	10 (11.2)	—	53 (59.6)	29 (32.6)	7 (7.9)	29.03	<.001
Emergencies	—	23 (23.8)	38 (42.7)	28 (31.5)	1 (1.1)	26 (29.2)	34 (38.2)	28 (31.5)	23.46	<.001
Hospitals	—	40 (44.9)	35 (39.3)	14 (15.7)	1 (1.1)	48 (53.9)	28 (31.5)	12 (13.5)	45.22	<.001
Maternity	28 (31.5)	16 (18.0)	20 (22.5)	25 (28.1)	17 (19.1)	22 (24.7)	20 (22.5)	30 (33.7)	18.20	.05
Mental Health	16 (18.0)	30 (33.7)	20 (22.5)	23 (25.8)	13 (14.6)	33 (37.1)	30 (33.7)	13 (14.6)	65.30	<.001
Pharmacy	—	37 (41.6)	45 (50.6)	7 (1.9)	1 (1.1)	47 (52.8)	37 (41.6)	4 (4.5)	30.46	<.001
Rehab	19 (21.4)	38 (42.7)	20 (22.5)	12 (13.5)	20 (22.7)	39 (44.3)	24 (27.3)	5 (5.7)	19.99	.01
Labs	3 (3.4)	40 (45.5)	31 (35.2)	14 (15.9)	2 (2.3)	43 (48.3)	33 (37.1)	11 (12.4)	38.69	<.001
Preventive & Chronic Illness	7 (7.9)	28 (31.5)	54 (60.7)	—	4 (4.5)	36 (40.5)	49 (55.1)	—	32.91	<.001
Child Health	38 (42.7)	14 (15.7)	37 (41.6)	—	34 (38.2)	23 (25.8)	32 (36.0)	—	17.54	<.001
Vision & Dental	3 (3.4)	23 (25.8)	35 (39.3)	28 (31.5)	3 (3.4)	16 (18.0)	35 (39.3)	35 (39.3)	26.57	<.001
Costs for Care	—	8 (9.0)	54 (60.7)	27 (30.3)	—	7 (7.9)	58 (65.2)	24 (27.0)	28.70	<.001
Premiums	—	17 (19.1)	57 (64.0)	15 (16.9)	—	6 (6.7)	61 (68.5)	22 (24.7)	39.03	<.001

Table 3.8 Benefits Prioritized in Students' Individual Insurance Plan as Compared to Benefits Prioritized for Students' Insurance Plan on behalf of young families (adults 18-40 and children) in generally good health
(N = 98)

Category	Individual Selected Level, n (%)				Stakeholder Selected Level, n (%)				Difference	
	No Coverage	Level 1	Level 2	Level 3	No Coverage	Level 1	Level 2	Level 3	χ^2	P Value
Outpatient	1 (1.0)	46 (46.9)	41 (41.8)	10 (10.2)	1 (1.0)	46 (46.9)	38 (38.8)	13 (13.3)	33.48	<.001
Emergencies	1 (1.0)	25 (25.5)	34 (34.7)	38 (38.8)	—	26 (26.5)	43 (43.9)	29 (29.6)	28.80	<.001
Hospitals	3 (3.1)	40 (40.8)	36 (36.7)	19 (19.4)	2 (2.0)	46 (46.9)	39 (39.8)	11 (11.2)	108.84	<.001
Maternity	35 (35.7)	16 (16.3)	20 (20.4)	27 (27.6)	5 (5.1)	14 (14.3)	26 (26.5)	53 (54.1)	11.91	.18
Mental Health	18 (18.4)	22 (22.5)	29 (29.6)	29 (29.6)	20 (20.4)	26 (26.5)	34 (34.7)	18 (18.4)	35.57	<.001
Pharmacy	2 (2.0)	41 (41.8)	37 (37.8)	18 (18.4)	1 (1.0)	42 (42.9)	42 (42.9)	13 (13.3)	46.62	<.001
Rehab	23 (23.5)	30 (30.6)	21 (21.4)	24 (24.5)	27 (27.6)	41 (41.8)	20 (20.4)	10 (10.2)	63.36	<.001
Labs	7 (7.1)	39 (39.8)	26 (26.5)	26 (26.5)	7 (7.1)	47 (48.0)	27 (27.6)	17 (17.4)	49.65	<.001
Preventive & Chronic Illness	8 (8.2)	36 (36.7)	54 (55.1)	—	3 (3.1)	38 (38.8)	57 (58.2)	—	31.89	<.001
Child Health	44 (44.9)	15 (15.3)	39 (39.8)	—	3 (3.1)	4 (4.1)	91 (92.9)	—	7.51	.04
Vision & Dental	2 (2.0)	10 (10.2)	34 (34.7)	52 (53.1)	1 (1.0)	12 (12.2)	40 (40.8)	45 (45.9)	88.64	<.001
Costs for Care	—	11 (11.2)	58 (59.2)	29 (29.6)	—	5 (5.1)	64 (65.3)	29 (29.6)	40.98	<.001
Premiums	—	25 (25.5)	64 (65.3)	9 (9.2)	—	27 (27.6)	64 (65.3)	7 (7.1)	40.53	<.001

98

Table 3.9 Benefits Prioritized in Students' Individual Insurance Plan as Compared to Benefits Prioritized for Students' Insurance Plan on behalf of young single adults (18-40) living in poverty
(N = 79)

Category	Individual Selected Level, n (%)				Stakeholder Selected Level, n (%)				Difference	
	No Coverage	Level 1	Level 2	Level 3	No Coverage	Level 1	Level 2	Level 3	$\chi2$	P Value
Outpatient	4 (5.1)	34 (43.0)	30 (38.0)	11 (13.9)	6 (7.6)	42 (53.2)	24 (30.4)	7 (8.9)	33.89	.02
Emergencies	1 (1.3)	20 (25.3)	39 (49.4)	19 (24.1)	2 (2.5)	29 (36.7)	21 (26.6)	27 (34.2)	44.34	.09
Hospitals	5 (6.3)	35 (44.3)	26 (32.9)	13 (16.5)	3 (3.8)	44 (55.7)	20 (25.3)	12 (15.2)	37.65	<.001
Maternity	27 (34.2)	14 (17.7)	13 (16.5)	25 (31.7)	32 (40.5)	19 (24.1)	12 (15.2)	16 (20.3)	20.27	.01
Mental Health	11 (13.9)	24 (30.4)	15 (19.0)	29 (36.7)	9 (11.4)	31 (39.2)	16 (20.3)	23 (29.1)	32.08	<.001
Pharmacy	3 (3.8)	27 (34.2)	34 (43.0)	15 (19.0)	4 (5.1)	37 (46.8)	25 (31.7)	13 (16.5)	23.38	<.001
Rehab	17 (21.5)	24 (30.4)	24 (30.4)	14 (17.7)	24 (30.4)	24 (30.4)	14 (17.7)	17 (21.5)	15.45	.08
Labs	5 (6.3)	31 (39.2)	23 (29.1)	20 (25.3)	11 (13.9)	49 (62.0)	13 (16.5)	6 (7.6)	40.78	<.001
Preventive & Chronic Illness	4 (5.1)	30 (38.0)	45 (57.0)	—	12 (15.2)	26 (32.9)	41 (51.9)	—	6.51	.17
Child Health	34 (43.0)	11 (13.9)	34 (43.0)	—	47 (59.5)	15 (19.0)	17 (21.5)	—	25.86	<.001
Vision & Dental	4 (5.1)	13 (16.5)	32 (40.5)	30 (38.0)	12 (15.2)	26 (32.9)	22 (27.9)	19 (24.1)	30.93	<.001
Costs for Care	—	9 (11.4)	48 (60.8)	22 (27.9)	—	10 (12.7)	24 (30.4)	45 (57.0)	23.00	<.001
Premiums	—	24 (30.4)	43 (54.4)	12 (15.2)	—	23 (29.1)	24 (30.4)	32 (40.5)	25.23	<.001

99

Table 3.10 Change in Benefit Selections between Benefits included in Students' Individual Insurance Plan and Benefits Selected for Students Insurance Plan on behalf of a Stakeholder Group
(N = 454)

Predictor Variables	Outpatient β (SE)	Emergencies β (SE)	Hospitals β (SE)	Maternity β (SE)	Mental Health β (SE)	Pharmacy β (SE)	Rehab β (SE)	Labs β (SE)	Preventive & Chronic Illness β (SE)	Child Health β (SE)	Vision & Dental β (SE)	Costs for Care β (SE)	Premiums β (SE)
Stakeholder Group													
Adults 65 years old and older who are in generally good health for their age	.09 (.10)	.08 (.11)	.26*** (.10)	-.33*** (.10)	-.03 (.11)	.30*** (.09)	.23*** (.11)	.07 (.10)	-.04 (.09)	-.25*** (.09)	-.08 (.09)	.06 (.09)	-.27*** (.08)
Non-Elderly adults (18-64) with chronic health conditions	.14* (.10)	-.01 (.11)	.21*** (.10)	-.26*** (.10)	-.04 (.11)	.37*** (.10)	.05 (.11)	.10 (.11)	-.12* (.10)	-.16** (.10)	-.34*** (.10)	.03 (.09)	-.18* (.09)
Young adults (18-40) with partners in generally good health	—	—	—	—	—	—	—	—	—	—	—	—	—
Young families (adults 18-40 and children) in generally good health	.05 (.10)	-.01 (.11)	.02 (.10)	.14* (.10)	-.06 (.11)	.05 (.09)	-.06 (.11)	-.10 (.10)	.04 (.10)	.29*** (.09)	-.13* (.09)	.04 (.09)	-.15 (.08)
Young Single Adults (18-40) living in poverty	-.04 (.10)	-.01 (.11)	.06 (.10)	-.17** (.11)	-.04 (.11)	.01 (.10)	.003 (.12)	-.19** (.11)	-.04 (.10)	-.12* (.10)	-.25*** (.10)	.17** (.09)	.02 (.09)
School Affiliation													
Medical School	-.25 (.28)	.25 (.31)	.03 (.27)	-.01 (.29)	-.26 (.30)	-.03 (.27)	-.27 (.31)	.14 (.29)	.01 (.27)	.08 (.26)	-.01 (.27)	.08 (.25)	.13 (.23)
Dental School	-.26 (.28)	.30 (.31)	.08 (.28)	-.09 (.30)	-.35 (.31)	.003 (.27)	-.26 (.31)	.05 (.29)	-.04 (.27)	-.10 (.26)	.05 (.27)	.05 (.26)	.12 (.24)
Pharmacy School	-.23 (.28)	.29 (.31)	.09 (.28)	.02 (.30)	-.12 (.31)	-.01 (.27)	-.15 (.31)	.15 (.29)	-.06 (.27)	.08 (.27)	.002 (.27)	-.009 (.26)	.11 (.24)
Other Health Professions	-.19 (.29)	.25 (.32)	.13 (.28)	-.04 (.30)	-.27 (.31)	-.07 (.28)	-.17 (.32)	.14 (.30)	-.08 (.28)	.05 (.27)	.03 (.28)	.09 (.26)	.11 (.24)
Undergraduate	-.18 (.29)	.13 (.32)	.07 (.29)	-.05 (.31)	-15 (.32)	-.02 (.28)	-.12 (.33)	.20 (.30)	-.05 (.28)	.02 (.27)	.10 (.28)	.06 (.27)	.10 (.25)
Non-Health Professions	—	—	—	—	—	—	—	—	—	—	—	—	—
Previously uninsured (Yes/No)	-.07 (.08)	-.07 (.09)	.04 (.08)	-.05 (.08)	-.06 (.09)	.01 (.08)	.04 (.09)	.03 (.08)	.05 (.08)	-.03 (.08)	-.02 (.08)	-.07 (.07)	.11* (.07)
Year born (>1990)	-.06 (.11)	.03 (.12)	-.02 (.10)	.01 (.11)	-.07 (.12)	.04 (.10)	-.03 (.12)	-.05 (.11)	-.04 (.10)	-.05 (.10)	-.06 (.10)	-.03 (.10)	.08 (.09)
Prior training in health policy	.03 (.05)	.01 (.05)	-.01 (.05)	-.01 (.05)	-.05 (.05)	-.03 (.05)	-.01 (.05)	-.01 (.05)	.001 (.05)	-.03 (.05)	.03 (.05)	-.02 (.04)	.02 (.04)
Overall Confidence Post-Course	-.01 (.07)	-.003 (.08)	-.07 (.07)	.02 (.08)	.04 (.08)	.03 (.07)	.10 (.08)	-.004 (.08)	.01 (.07)	.001 (.07)	-.14** (.07)	-.01 (.07)	.04 (.06)
Overall Knowledge Post-Course	.06 (.19)	.01 (.21)	.05 (.19)	-.02 (.20)	-.07 (.21)	-.05 (.18)	-.01 (.21)	-.10 (.20)	-.05 (.19)	-.03 (.18)	.01 (.18)	.03 (.18)	-.01 (.16)
N	454	454	454	454	454	454	454	454	454	454	454	454	454
Adjusted R^2	.01	.0001	.05	.18	.02	.13	.06	.06	.002	.23	.10	.01	.05

* P < .05   ** P < .01   *** P < .001

Table 3.11 Aggregate Levels of Benefits Prioritized for Students' Insurance Plan on Behalf of a Stakeholder Group for the Essential Health Benefits
(N = 454)

Benefits	Adults 65 years old and older in generally good health for their age (N = 109)				Non-Elderly adults (18-64) with chronic health conditions (N = 82)				Young adults (18-40) with partners in generally good health (N = 89)				Young families (adults 18-40 and children) in generally good health (N = 98)				Young Single Adults (18-40) living in poverty (N = 79)			
	None %	≥1 %	≥2 %	3 %	None %	≥1 %	≥2 %	3 %	None %	≥1 %	≥2 %	3 %	None %	≥1 %	≥2 %	3 %	None %	≥1 %	≥2 %	3 %
Outpatient	2	98	65	16	4	96	65	26	0	100	40	8	1	99	52	13	8	92	39	9
Emergencies	0	100	75	33	0	100	65	33	1	99	70	32	0	100	74	30	3	98	61	34
Hospitals	0	100	65	28	0	100	70	33	1	99	45	14	2	98	51	11	4	96	41	15
Maternity	83	17	6	2	34	66	18	11	19	81	56	34	5	95	81	54	41	60	35	20
Mental Health	17	84	45	21	11	89	51	22	15	85	48	15	20	80	53	18	11	89	49	29
Pharmacy	3	97	83	39	2	98	85	46	1	99	46	5	1	99	56	13	5	95	48	17
Rehab	15	85	67	29	31	70	37	22	23	77	33	6	28	72	31	10	30	70	39	22
Labs	5	95	58	26	5	95	61	37	2	98	49	12	7	93	45	17	14	86	24	8
Preventive & Chronic Illness	10	90	46	0	20	81	39	0	5	96	55	0	3	97	58	0	15	85	52	0
Child Health	82	18	6	0	50	50	27	0	38	62	36	0	3	97	93	0	60	41	22	0
Vision & Dental	6	95	80	41	17	83	45	18	3	97	79	39	1	99	87	46	15	85	52	24
Costs for Care	0	100	95	28	0	100	93	42	0	100	92	27	0	100	95	30	0	100	87	57
Premiums	0	100	72	8	0	100	68	9	0	100	93	25	0	100	72	7	0	100	71	41

CONCLUSION

As the U.S. healthcare system undergoes significant transformation, providers who have been traditionally viewed as the nexus of care delivery inside the healthcare system, are struggling to effectively participate in system-wide reform due to challenges related to their ability to navigate the complexities of the system beyond the delivery of individual patient care (1). Providers are becoming more frustrated as they are required to take direction from and yield authority to more system literate administrators and policymakers. In contrast to the patient focused decision making orientation that providers have been accustomed to following, administrators and policymakers are being encouraged to make decisions that impact patient care in order to adhere to policy initiatives, minimize financial consequences for health delivery systems, operationalize health care delivery innovation, and ultimately leverage HIT (2). In this new era, healthcare providers must become oriented around systems-based practice (SBP) (3–6) and be more adequately equipped to consider these issues in their patient care decision-making. To achieve this goal, they require competencies in contextualizing and operationalizing their role in order to effectively navigate the larger U.S. healthcare system.

To train providers to meet these important competencies, curricula in U.S. health professions schools must be transformed to better integrate them into undergraduate and graduate health professions education. Medical educators have proposed transforming the health professions school curricula by introducing a "third pillar" of medical education, termed *Health Systems Science* (HSS) (7) to address knowledge, attitudes, and skills in SBP (5, 8–11). While

the field of HSS is particularly nascent, it is quickly advancing. As a result, learning about HSS and the U.S. healthcare system is increasingly being acknowledged as an essential part of health professions education (12–14). Yet, large proportions of graduating health professions students report it is insufficiently addressed in their curricula (15). While HSS curricula are present in some health professions schools and colleges, the type of curriculum in each school is highly variable and often fragmented (16). To address the challenges health professions schools face when attempting to implement an HSS curriculum, we developed a 6-week HSS massive open online course (MOOC) for interprofessional learners entitled, "Understanding and Improving the U.S. Healthcare System". The course enables learners to engage with material predominantly in an asynchronous, learner-determined setting using short-form videos (each ≤ 15 minutes) with a variety of pedagogical techniques based on growing evidence in the literature that flipped classroom approaches and MOOCs in medical education increase learner motivation and engagement (17).

The aim of this dissertation is to contribute to the growing literature focused on integrating HSS into health professions education through the use of a MOOC based curriculum. In Chapter 1 we demonstrated that the MOOC format permits rapid exposure for medical and dental students to multiple core themes of the U.S. healthcare system in a predominantly asynchronous learning environment, through an approach that can be incorporated with other established curricular elements. Medical and dental students' exposure to this curriculum was associated with an increase in objective knowledge of the healthcare system, confidence in healthcare system-related knowledge, and increased optimism about opportunities to improve the healthcare system in the future. In Chapter 2, we demonstrated that exposure to this curriculum was associated with an increase in objective knowledge of the healthcare system and confidence

in healthcare system-related knowledge among dental students compared to a control group. Finally, in Chapter 3, we demonstrated that students were able to apply the knowledge they obtained from the HSS MOOC through their participation in CHAT (Choosing Healthplans All Together), a simulation game created to provide them with the opportunity to design an insurance plan as an individual and then on behalf of a stakeholder group. Not only were students able to successfully prioritize insurance benefits for themselves and for a stakeholder group, they were also able to prioritize essential health benefits and take the perspective of population subgroups dissimilar to themselves. This exposed them to nuances of the national dialogue about common benefits (e.g. in "Medicare for All") that may help them serve as more deeply informed health care professionals and advocates in the future. It is important to note that while our findings around optimism were inconclusive, we did not expect a definitive conclusion. Students who become more knowledgeable and confident in their ability to understand the U.S. healthcare system may become more optimistic as a result of this new knowledge and confidence as they can better appreciate the opportunities for reform. At the same time, they may become less optimistic as they confront the daunting and complex realities of navigating and reforming the U.S. healthcare system.

With demonstrable increases in student knowledge and confidence for improvements in the healthcare system in the future, the MOOC structure provides a curricular approach that health professions schools across the country could employ to intensify healthcare systems training in a manageable and sustainable way. While this intervention was only piloted in one institution, the results were objectively verified through several rigorous methods indicating that it may be a robust approach to HSS curricular transformation. Moving forward, we will need to conduct a more thorough longitudinal analysis of students who participated in the HSS MOOC to

investigate how the curriculum impacted them over the longer course of their health professions education. Nonetheless, the MOOC content provides an opportunity to standardize health systems science knowledge across health professions schools and ensure that a set of foundational competencies are achieved for all health professions school graduates. This approach to delivering and evaluating HSS curriculum addresses a growing need for health professions schools to identify ways to more effectively integrate HSS into their curricula and evaluate outcomes related to HSS curricular inclusion as HSS education and training has the potential to impact individual and population health by giving future providers a greater ability to contextualize their roles as central stakeholders in the U.S. healthcare system.

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APPENDICES

APPENDIX A: PRE AND POST-COURSE SELF-ASSESSMENT INSTRUMENT

Understanding and Improving the US Health Care System
Pre- and Post-Course Self-Assessment

Please answer the following questions.

For multiple-choice questions, please select the best answer for you; there are no right or wrong answers. We are simply trying to understand your perspectives and your learning goals for the course.

This self-assessment should take less than 15 minutes to complete.

(For journal readers: the values assigned to answer options are provided for your guidance. The values were not provided for the students.)

How confident are you that...

	Not confident (-1)	Somewhat confident (+1)	Very confident (+2)	Unsure (0)
you can identify the main players or groups in the US healthcare system	○	○	○	○
you can identify examples of success in the US healthcare system?	○	○	○	○
you can identify examples of problem areas that need improvement in the US healthcare system?	○	○	○	○
you can describe the history of reform efforts in the US healthcare system?	○	○	○	○

How confident are you that...

	Not confident (-1)	Somewhat confident (+1)	Very confident (+2)	Unsure (0)
you understand key differences between private health insurance and government programs that provide coverage in the US healthcare system?	○	○	○	○
you understand reasons for the benefits that are included in health insurance plans in the US?	○	○	○	○
you can identify ways to control the growth of healthcare costs in the US healthcare system?	○	○	○	○

Next, we will ask you about opportunities for improvement in the US healthcare system that you see.

How optimistic are you that the US healthcare system will be improved by <u>1 year from now</u>?

Not optimistic
(-1)   ○

Somewhat optimistic
(+1)   ○

Very optimistic
(+2)   ○

Unsure
(0)   ○

How optimistic are you that the US healthcare system will be improved by <u>5 years from now</u>?

Not optimistic
(-1)   ○

Somewhat optimistic
(+1)   ○

Very optimistic
(+2)   ○

Unsure
(0)   ○

How optimistic are you that the US healthcare system will be improved by <u>10 years from now</u>?

Not optimistic
(-1)   ○

Somewhat optimistic
(+1)   ○

Very optimistic
(+2)   ○

Unsure
(0)   ○

How optimistic are you about <u>your</u> potential to improve the US healthcare system in the future?

Not optimistic
(-1) ○

Somewhat optimistic
(+1) ○

Very optimistic
(+2) ○

Unsure
(0) ○

Please tell us a bit about yourself.

What is your primary school of study and campus within the University of Michigan? (choose one)

Engineering – Ann Arbor ○

University Library – Ann Arbor ○

College of Engineering and Computer Science – Dearborn ○

Dentistry – Ann Arbor ○

Music, Theater and Dance – Ann Arbor ○

Law – Ann Arbor ○

Pharmacy – Ann Arbor ○

School of Health Professions and Studies – Flint ○

Art and Design – Ann Arbor ○

Nursing – Ann Arbor ○

Social Work – Ann Arbor ○

Rackham – Ann Arbor ○

Literature, Sciences, and Arts – Ann Arbor ○

Kinesiology – Ann Arbor ○

College of Business – Dearborn ○

School of Education and Human Services – Flint ○

School of Management – Flint ○

Business – Ann Arbor ○

Medicine – Ann Arbor ○

Natural Resources and Environment – Ann Arbor ○

College of Arts and Sciences – Flint ○

Public Health – Ann Arbor ○

Architecture and Urban Planning – Ann Arbor ○

Public Policy – Ann Arbor ○

Education – Ann Arbor ○

College of Arts, Sciences, and Letters – Dearborn ○

Information – Ann Arbor ○

College of Education, Health and Human Services – Dearborn ○

How would you describe the extent of your prior FORMAL EDUCATION regarding the US healthcare system and health policy?

None (0) ○

Little (eg, attended a few lectures; small amount of reading) (1) ○

Some (eg, enrolled in at least one course with readings) (2) ○

Extensive (eg, major area of interest and focus in prior studies) (3) ○

What year were you born?

Before 1970   ○

1970-1974   ○

1975-1979   ○

1980-1984   ○

1985-1989   ○

1990-1994   ○

1995-1999   ○

Have you ever been uninsured in the US healthcare system?

Yes – I have been uninsured (1)   ○

No – I have always had health insurance (2)   ○

Unsure (3)   ○

Not applicable – I have not been a patient in the US (4)   ○

You're almost finished with this self-assessment!

To wrap up, we have some questions for you about the US healthcare system and the people it serves.

There is one best answer to each of the questions below. But we do NOT expect you to know all the answers.

Just answer the questions as well as you can. If you're not sure of the best answer, you can respond "I don't know."

Which of the following is the BEST description of patterns in infant mortality in the United States?

Infant mortality in the US is going up   ○

Infant mortality in the US is better than in most European countries   ○

African American infants have lower mortality rates than white infants in the US   ○

Improvements in infant mortality in the US have slowed in recent years (*)   ○

I don't know   ○

(For journal readers: the best answers (*) are provided for your guidance. The cues were not provided for the students.)

Which of the following is the BEST description of key challenges regarding providers in the US healthcare system?

There are more primary care physicians than subspecialty physicians ○

Providers are not distributed evenly across the US to ensure equitable access (*) ○

Too few providers accept private insurance plans ○

Dental and mental health providers more often serve rural areas than urban areas ○

I don't know ○

Why is having health insurance connected to having better health?

Having health insurance improves access to medical care ○

Having health insurance protects a person's household finances ○

Only people in better health have access to health insurance ○

Both (a) and (b) (*) ○

I don't know ○

Under the Affordable Care Act ("Obamacare"), why are some individuals still uninsured?

Some people won't want to pay for health insurance ○

Some people won't be eligible for government programs ○

Some people won't be aware that they are eligible for existing programs ○

All of the above (*) ○

I don't know ○

Which of the following government programs provides coverage predominantly for poor and low-income Americans, including children, pregnant women, and seniors?

Medicare ○

Medicaid (*) ○

Veterans Affairs ○

Affordable Care Act ○

I don't know ○

Which Republican president proposed that the US should have universal health insurance?

President Reagan ○

President Nixon (*) ○

President George H.W. Bush ○

None of the above ○

I don't know ○

The term "adverse selection" relates to which of the following ideas?

Patients don't have enough information to pick the best doctor ○

Surgeons and dentists have to take care of the sickest patients ○

People with a greater need for health care have a greater need for insurance (*) ○

Government health plans are poorly run ○

I don't know ○

The Affordable Care Act functions primarily to:

Expand Medicare for people under the age of 65 ○

Expand Medicaid eligibility for low-income individuals and provide subsidies for
others to buy health plans through an insurance marketplace (*) ○

Merge Medicare and Medicaid and provide universal health coverage ○

Provide health insurance to the uninsured by expanding Medicare ○

I don't know ○

The primary goal of value-based insurance design is to:

Encourage the use of high-value medical services at lower cost ○

Shift from a volume-based health care system to a system that emphasizes spending that is linked to patients' health benefits ○

Provide expensive services to patients without health insurance ○

Both (a) and (b) (*) ○

I don't know ○

What is a direct benefit of electronic health records (vs. paper charts) for healthcare providers, to help them work with patients to address unhealthy behaviors?

Automatically alert providers that a patient has unhealthy weight   ○

Allow providers to read notes about a patient's weight and eating behaviors   ○

Give providers an opportunity to research health behavior change strategies   ○

All of the above (*)   ○

I don't know   ○

Which of the following has demonstrated that providing health insurance improves people's health?

Kerr-Mills Act of 1960   ○

Ohio Health Care Experiment   ○

Oregon Health Insurance Experiment (*)   ○

Hill-Burton Act   ○

I don't know   ○

What are the main advantages for employers in providing health insurance to their employees?

Tax advantages provided by the Internal Revenue Service ⭘

Economies of scale that make group insurance more affordable for employers ⭘

Risk pooling across a group that did not come together for healthcare purposes ⭘

All of the above (*) ⭘

I don't know ⭘

Which of the following presidents enacted changes to Medicare?

President Reagan ○

President George W. Bush ○

President Truman ○

Both (a) and (b) (*) ○

I don't know ○

**APPENDIX B: PRE-POST CHANGE IN KNOWLEDGE, CONFIDENCE, AND
OPTIMISM FOR CONTROL VS. INTERVENTION GROUPS**

Figure B.1 Pre-Post Change in Knowledge for Control vs. Intervention Groups

139
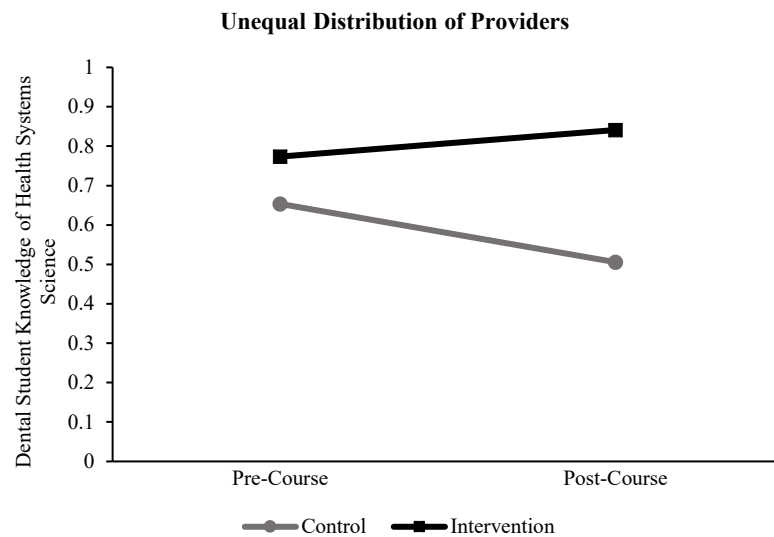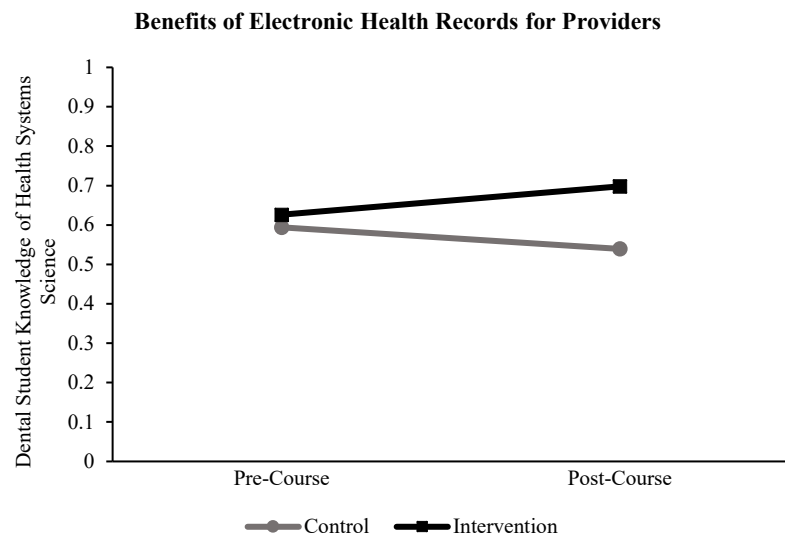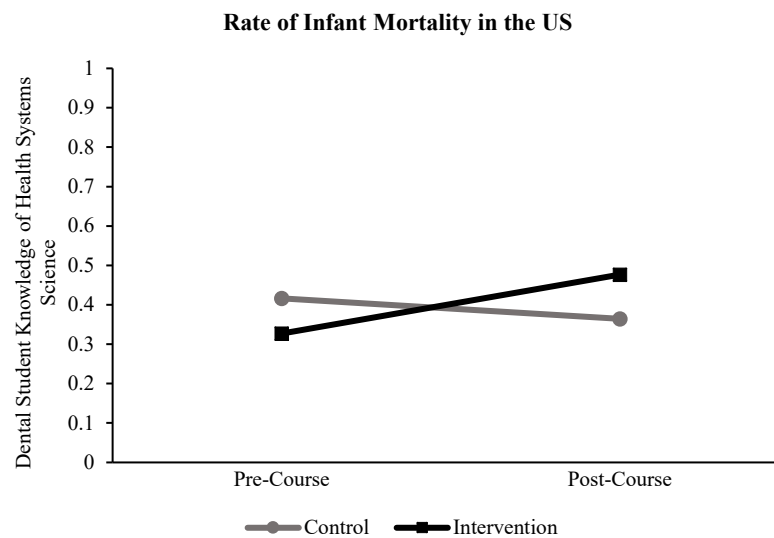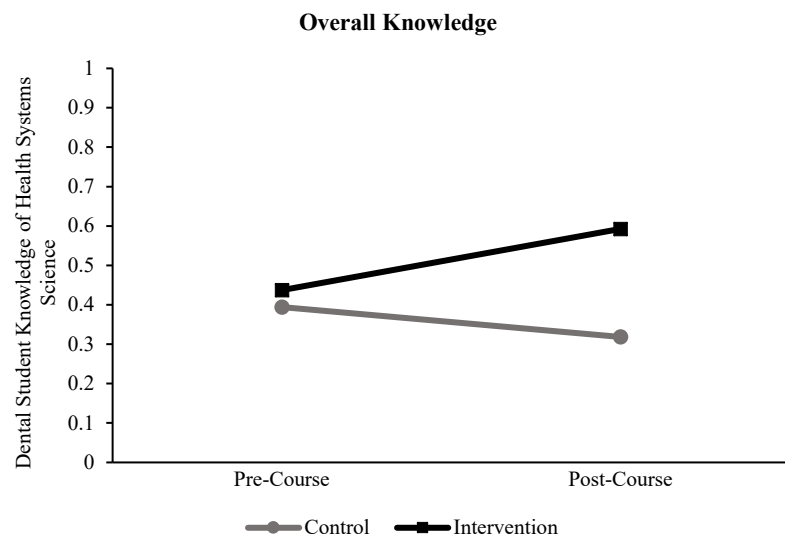
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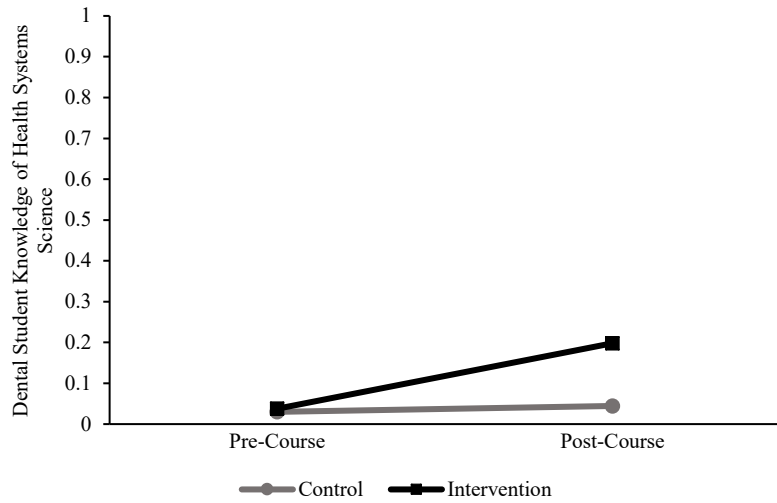
Benefits of Values-Based Insurance Design
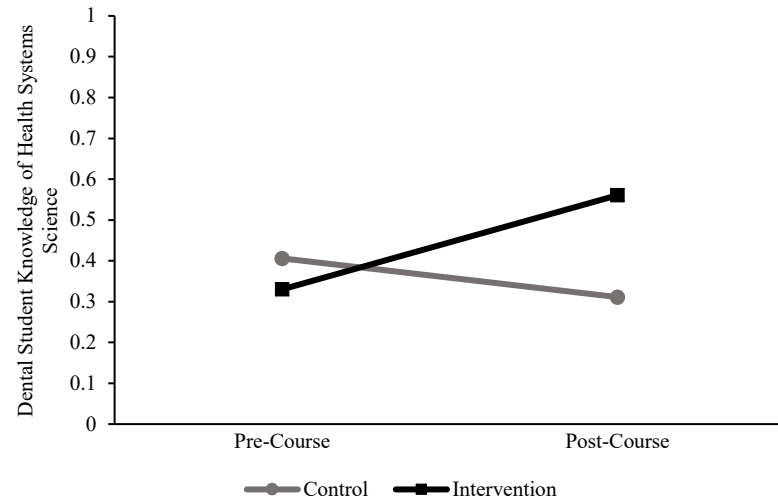
US Presidential Reforms to Medicare
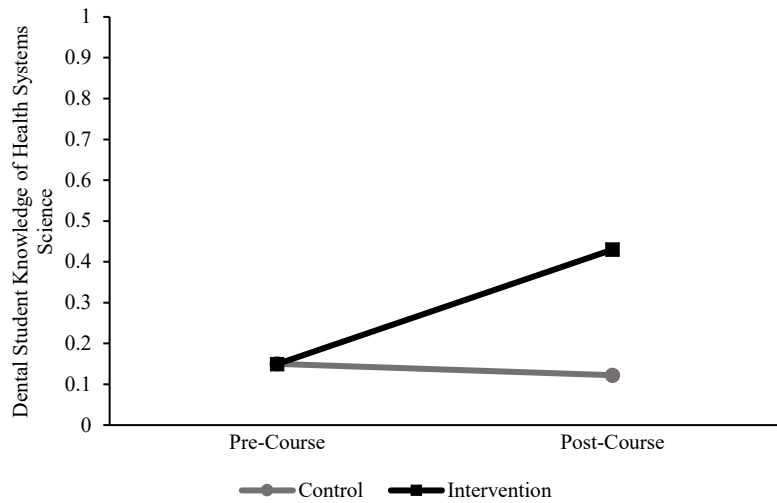
Defining the Functions of the ACA

140
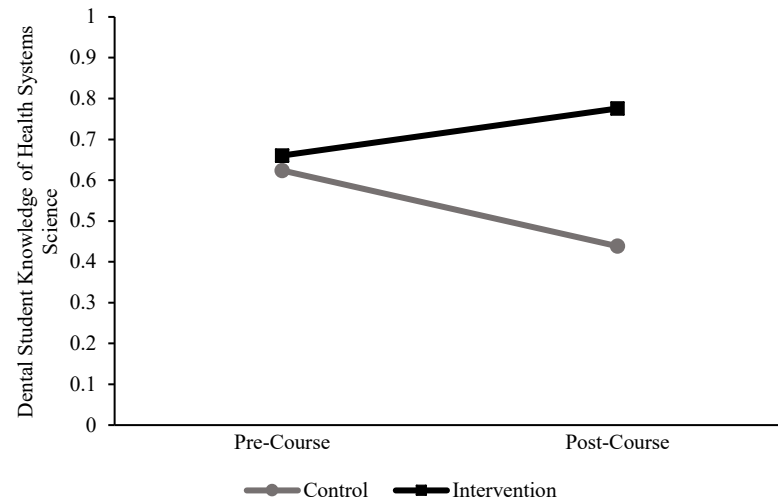
Relationship between Health Insurance and Improved Health
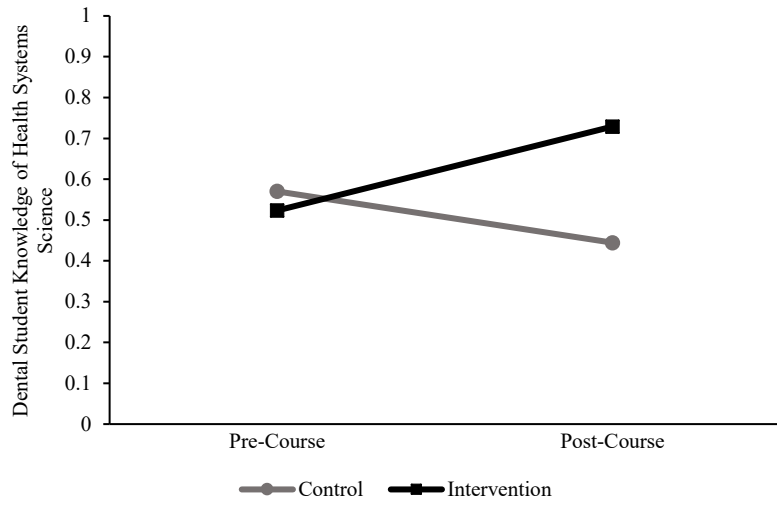
Defining Medicaid
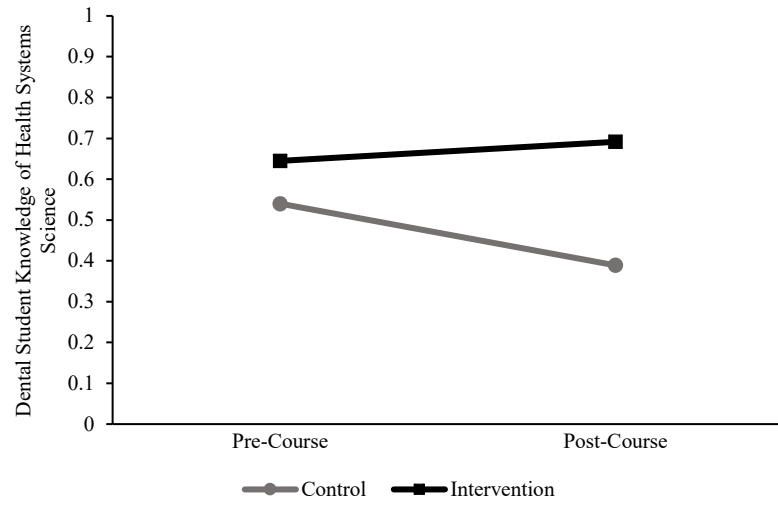
Defining Adverse Selection
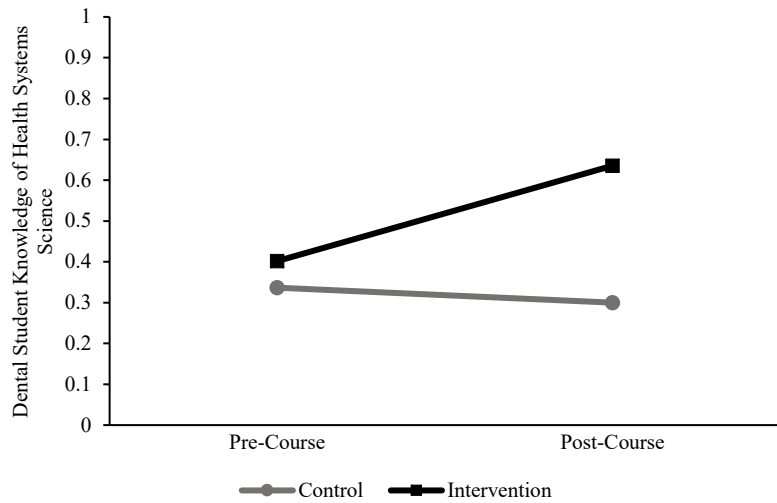
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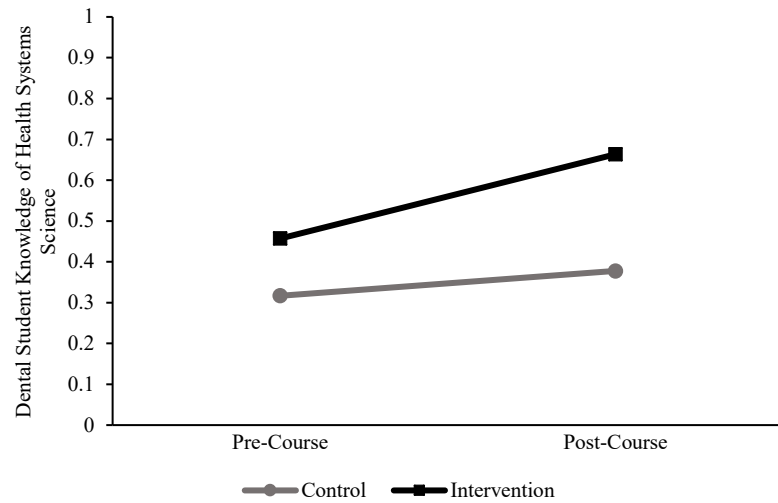
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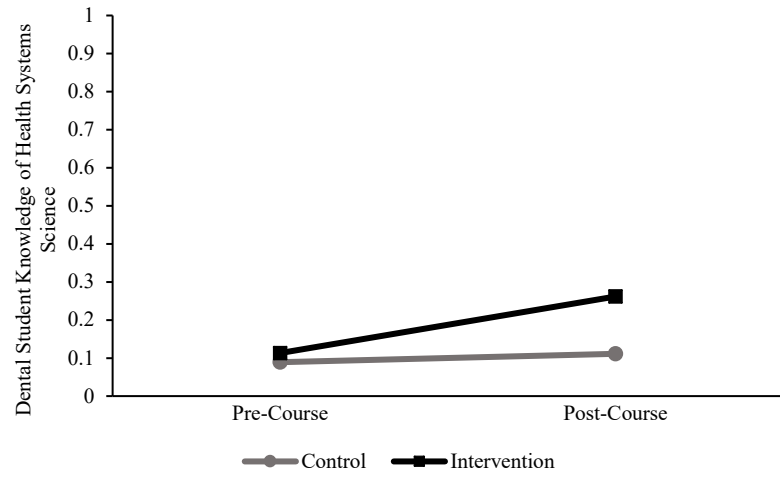
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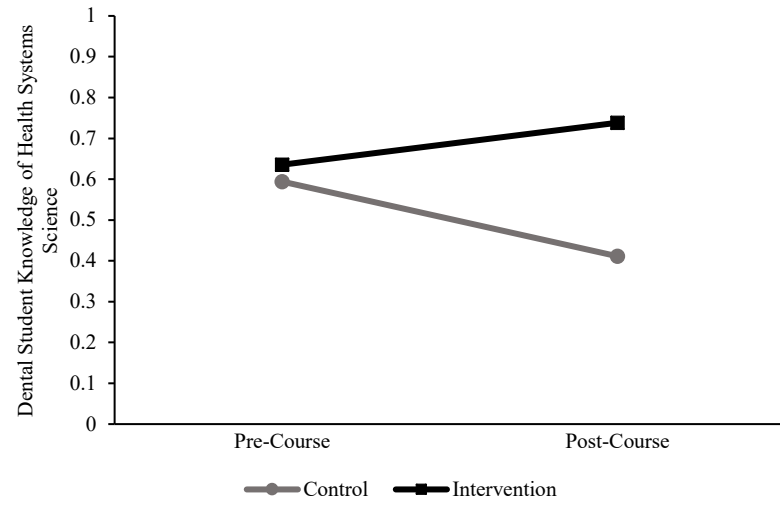
Figure B.2 Pre-Post Change in Confidence and Optimism for Control vs. Intervention Groups

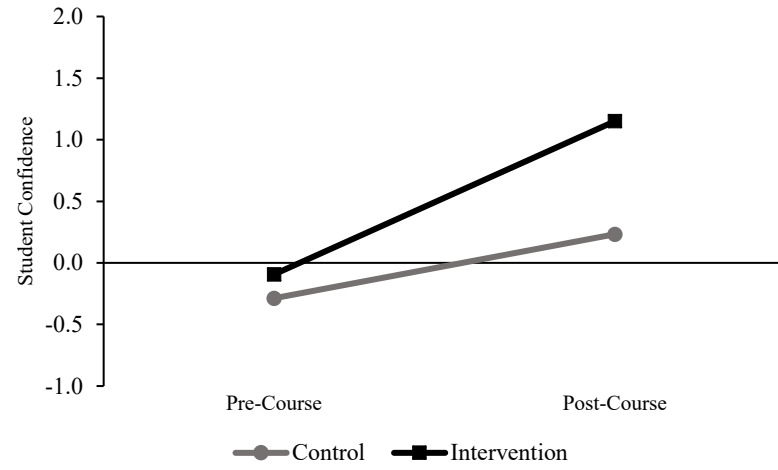143
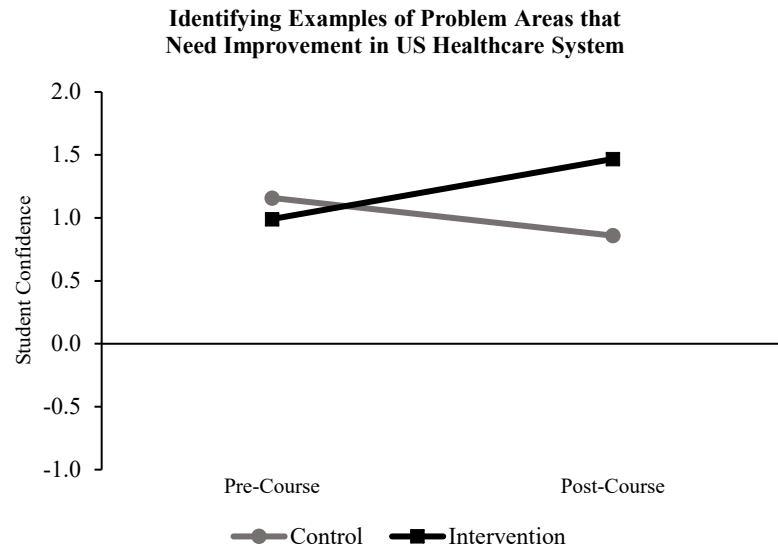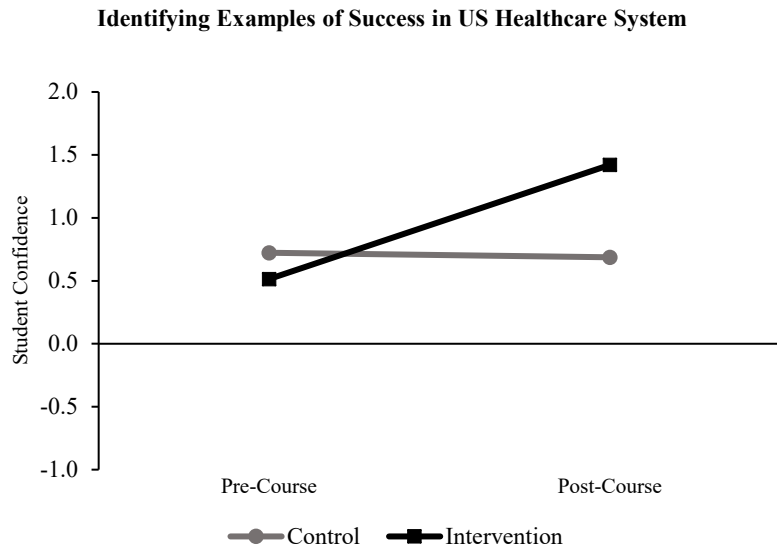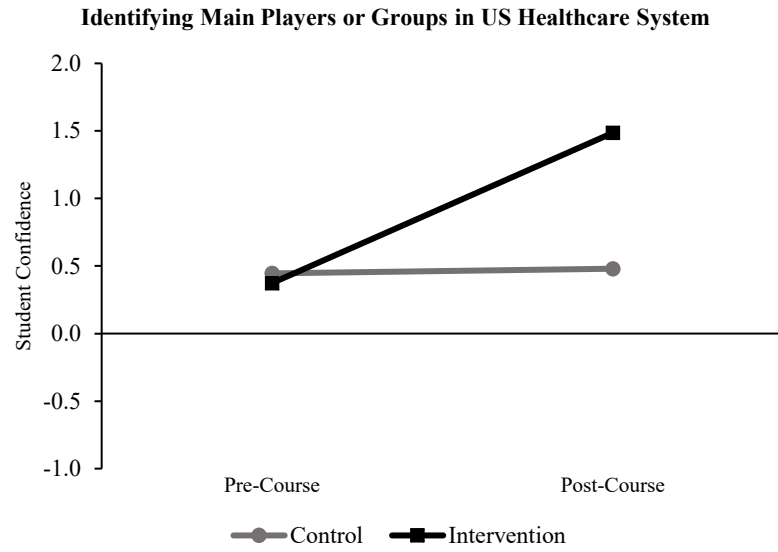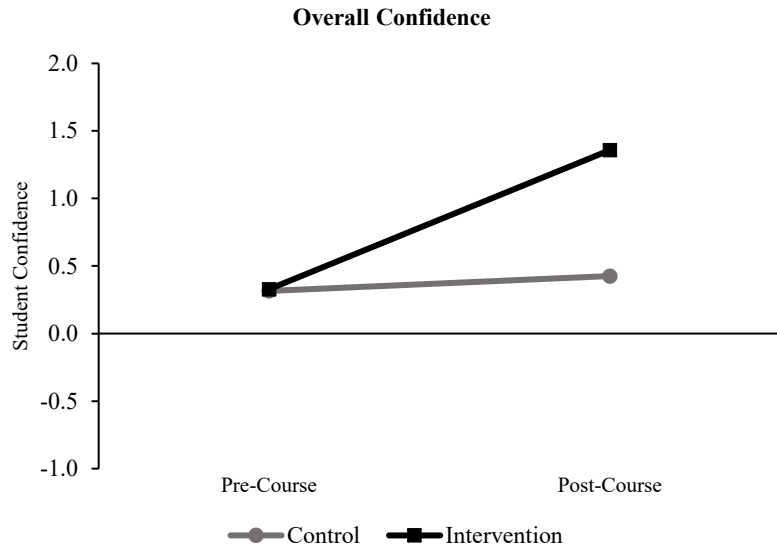
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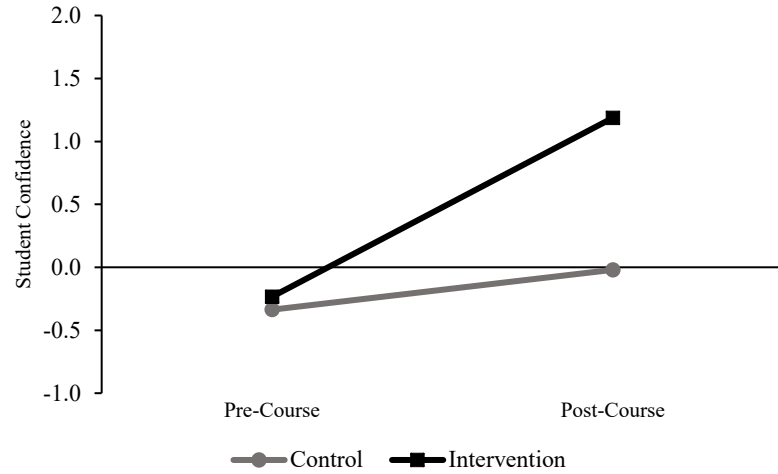
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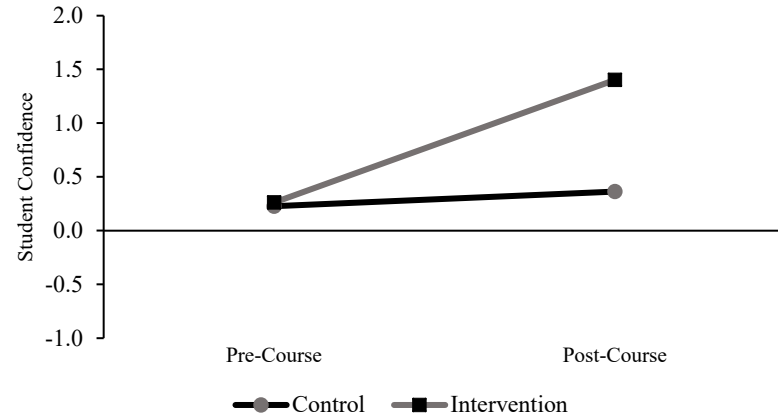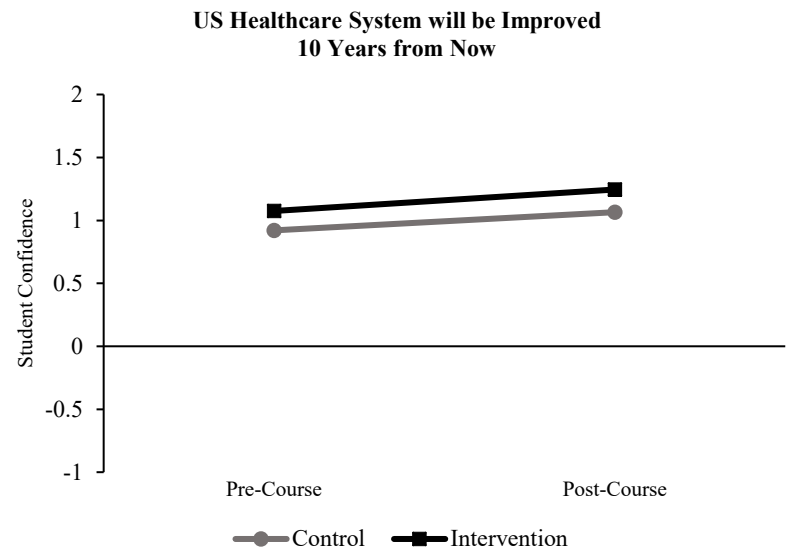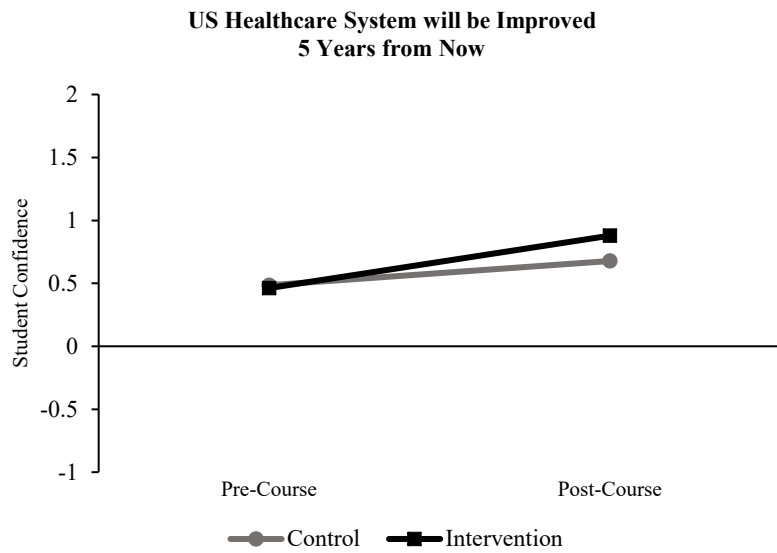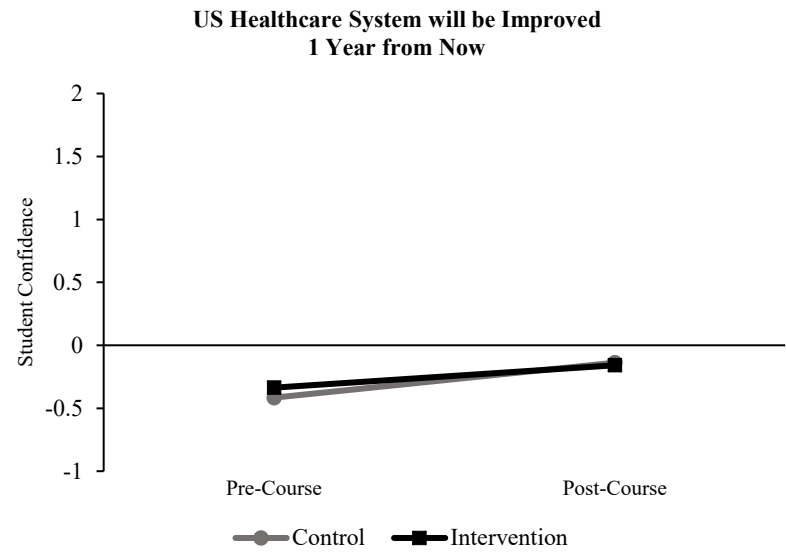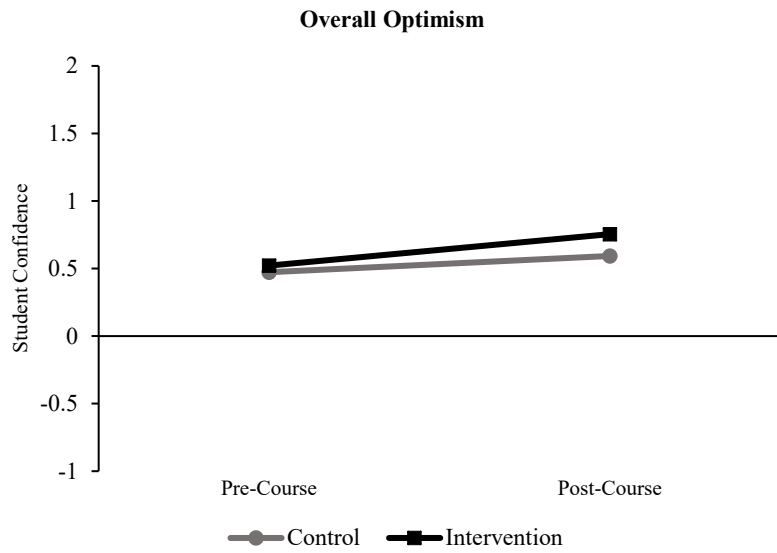
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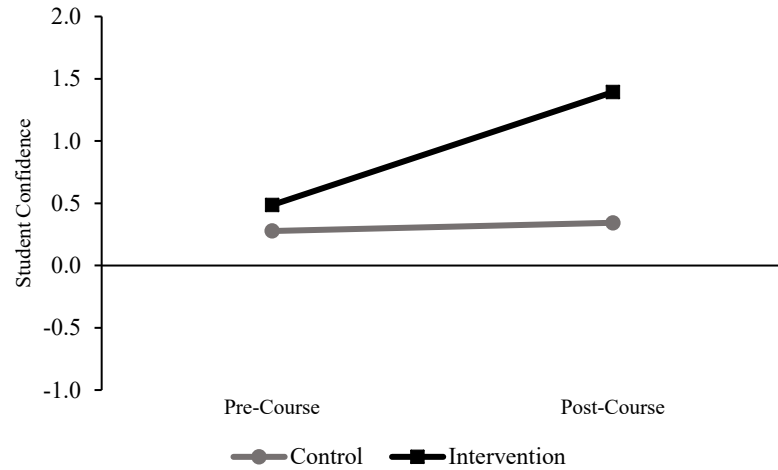
Identifying Ways to Control Growth of Healthcare Costs in US Healthcare System

144

Overall Optimism

**US Healthcare System will be Improved
1 Year from Now**

**US Healthcare System will be Improved
5 Years from Now**

**US Healthcare System will be Improved
10 Years from Now**

145

Your Potential to Improve US Healthcare System in Future