Mixed Effects Logistic Regression to Inform Component Weighting

for a Graduation Competency Exam

BY
Christopher D. Mattson
B.A., Indiana University, 2013
M.D., University of Chicago Pritzker School of Medicine, 2017

THESIS

Submitted as partial fulfilment of the requirements
for the degree of Master of Health Professions Education
in the Graduate College of the
University of Illinois at Chicago, 2021

Chicago, Illinois

Defense Committee:

Ara Tekian, Chair and Advisor
Yoon Soo Park
Rachel Yudkowsky
H. Barrett Fromme, University of Chicago

This thesis is dedicated to my parents, David and Theresa Mattson, who have offered tireless support and encouragement through all my academic, professional and personal endeavors.

ACKNOWLEDGEMENTS

I would like to thank my thesis committee - Drs. Ara Tekian, Yoon Soo Park, Rachel Yudkowsky and H. Barrett Fromme – for your guidance and wisdom throughout my thesis from first coming up with ideas through to final project completion. The knowledge and skills that I have gained thanks to you all are foundations upon which I will continue to build in the weeks, months and years to come.

I would also like to thank all my MHPE classmates. After having met and interacted with each of you, I will never completely understand the administrative error that must have occurred to allow me into the program and into your midst, but I am so grateful for having had the opportunity to learn with and from all of you. The memories and relationships I have formed I will carry with me forever.

CDM

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

CIS	COMMUNICATION AND INTERPERSONAL SKILLS
CS	CLINICAL SKILLS
GCE	GRADUATION COMPETENCY EXAMINATION
ICE	INTEGRATED CLINICAL ENCOUNTER
OSCE	OBJECTIVE STRUCTURED CLINICAL EXAMINATION
PE	PHYSICAL EXAMINATION
PN	PATIENT NOTE
SEP	SPOKEN ENGLISH PROFICIENCY
USMLE	UNITED STATES MEDICAL LICENSING EXAMINATION

SUMMARY

This study examines the relationship between medical student performance on a local Graduation Competency Examination (GCE) and national United States Medical Licensing Examination (USMLE) Step 2 Clinical Skills (CS) pass-fail results. An investigation was carried out to determine ideal weighting of GCE components that maximize predictive association with USMLE Step 2 CS pass-fail results.

The performance of 1,056 students over 6 academic years on both GCE and USMLE Step 2 CS was analyzed. Pearson correlation coefficients were calculated between GCE components and USMLE Step 2 CS pass-fail results. GCE Patient Note (PN) performance and GCE Communication and Interpersonal Skills (CIS) performance were significantly associated with USMLE Step 2 CS pass-fail result. GCE Physical Exam (PE) performance was not significantly associated with USMLE Step 2 CS pass-fail results.

Mixed effects logistic regression models were estimated with USMLE Step 2 CS pass-fail results as outcome, each individual GCE component as fixed effect and year as random effect. Better performance on each of PE, PN and CIS individually was associated with increased odds of USMLE Step 2 CS pass results. A mixed effects logistic regression model was estimated with USMLE Step 2 CS pass-fail results as outcome, all GCE components as fixed effects and year as random effect. Better performance on PN was associated with increased odds of USMLE Step 2 CS pass results.

Mixed effects logistic regression models were estimated with USMLE Step 2 CS pass-fail result as outcome, GCE Integrated Clinical Encounter (ICE) performance as fixed effect and year as random effect. Models were estimated using various PE and PN weighting combinations to comprise ICE score (e.g., 100%PE/0%PN, 90%PE/10%PN, 80%PE/20%PN). For all weighting combinations, better performance on ICE was associated with increased odds of USMLE Step 2 CS pass results. Maximum odds were obtained with weighting 20%PE/80%PN.

I. INTRODUCTION

A. Background

The decision was recently made to permanently discontinue administration of the United States Medical Licensing Examination (USMLE) Step 2 Clinical Skills (CS). This decision was the culmination of many years of conversation and debate in which people advocated for either reform to[1–3] or elimination of[4–6] the exam. However, despite the fact that the exam no longer exists, the need to rigorously assess the clinical skills of graduating medical students still remains. As the medical education community marches forward into the post-USMLE Step 2 CS world, the question of who will take on responsibility for this assessment remains open.

Individual medical schools have emerged as one likely answer. Many medical schools already have some form of comprehensive clinical skills examination that they administer to final year medical students. The University of Illinois at Chicago College of Medicine (UIC-COM) has been administering a local Graduation Competency Examination (GCE) to final year medical students for many years. The structure mirrors that of the USMLE Step 2 CS in that there are three score components: Physical Exam (PE), Patient Note (PN) and Communication and Interpersonal Skills (CIS). For the purposes of the USMLE Step 2 CS, there was also a Spoken English Proficiency (SEP) score that is omitted on UIC-COM GCE due to other curricular elements from which language fluency is known. Additionally, the USMLE Step 2 CS combined PE and PN scores to form an integrated clinical encounter (ICE) score. However, the precise way in which these scores were combined to arrive at overall ICE score was not known. In the absence of a national USMLE Step 2 CS, validity evidence for individual medical school assessments gains increased importance.

B. Statement of Problem

As the medical education community considers the possibility of local assessments taking the place of USMLE Step 2 CS, validity evidence for these local assessments is needed. With this in mind, the extent to which (if at all) locally developed GCE scores are associated with USMLE Step 2 CS results is not known. This is important information in investigating relations to other variables validity evidence for the GCE. Additionally, with any multicomponent examination, decisions regarding how scores are combined has implications for the validity of decisions made using the assessment. The way in which PE and PN scores should be combined to maximize relations to other variables validity evidence for the GCE is not known.

II. CONCEPTUAL FRAMEWORK

A. Conceptual Framework

Messick's unified validity framework is one of the primary frameworks used in organizing and discussing validity evidence for assessments in medical education. It is the framework recognized in the *Standards for Educational and Psychological Testing*[7] and is also presented in *Assessment in Health Professions Education*[8]. The framework describes 5 categories of validity evidence: content, response process, internal structure, relations to other variables and consequences. Gathering as much evidence from as many categories as possible adds to the confidence one has in decisions made using a given assessment.

B. Review of Related Literature

The UIC-COM GCE has abundant validity evidence that has already been enumerated. This includes validity evidence for the rubrics used in score generation[9] as well as for the PE[10], PN[10–12] and CIS[13] components specifically. There has also been work looking at internal structure and consequential validity evidence based on differential weighting of PE and PN to calculate ICE score[14]. There has not yet been a study of the UIC-COM GCE with regard to association with results on the USMLE Step 2 CS. This represents an opportunity for additional relations to other variables validity evidence.

This type of validity evidence has been explored for local clinical skills assessments at other institutions with mixed results. Berg et al described low correlations between elements of a medical school clinical assessment and elements of the older USMLE Step 2 CS scoring (Data Gathering and Documentation in place of PE and PN)[15]. Dong et al found associations

between performance on local objective structured clinical examinations (OSCE) completed by second and third year medical students and USMLE Step 2 CS ICE and CIS scores[16]. Finally, Torre et al showed an association between the score on an OSCE completed by medical students at the end of their internal medicine clerkship and USMLE Step 2 CS ICE score[17]. The present study offers an opportunity to add to this literature and additionally uses overall Step 2 CS pass- fail result in place of subcomponent scores which are not available to most institutions.

Additionally, Park et al analyzed PE and PN weighting through the lens of maximizing psychometric reliability and thus described internal structure validity evidence[14]. Utilization of relations to other variables validity evidence for purposes of informing component weighting has not previously been described.

III. METHODS

Medical student results from UIC-COM GCE PE, PN and CIS as well as USMLE Step 2 CS pass-fail information were obtained for the years 2013 through 2018. For the UIC-COM, students each complete 5 standardized patient encounters. PE, PN and CIS score for the examination are calculated by averaging PE, PN and CIS scores across all the stations. Cases are not the same every year, but the examination content is organized by the same faculty cohort following as assessment blueprint such that there is consistency over time. Students were only included for analysis if results were available for all assessments. Descriptive statistics for GCE score components by year were calculated. Pearson correlation coefficients between GCE PE, GCE PN, GCE CIS (hereafter referred to as PE, PN and CIS, respectively) and USMLE Step 2 CS pass-fail results were calculated. A mixed effects logistic regression model was estimated with PE as single fixed effect, year as random effect and USMLE Step 2 CS as outcome of interest. This process was repeated with PN as single fixed effect and then with CIS as single fixed effect. A mixed effects logistic regression model was estimated with PE, PN and CIS as fixed effects, year as a random effect and USMLE Step 2 CS as outcome of interest. GCE ICE (hereafter referred to as ICE) scores were calculated by combining PE and PN first with PE weighted 100% and PN 0% followed by 90%/10%, 80%/20% and so on to 0/100%. A mixed effects logistic regression model was estimated with each ICE score as a single fixed effect, year as a random effect and USMLE Step 2 CS as outcome of interest. Odds ratios for each ICE scoring combination were compared. All statistical analyses were completed using Stata/SE 16[18]. The study was granted exemption through the University of Illinois at Chicago Institutional Review Board (protocol #2020-1068).

IV. RESULTS

The performance of 1056 students across 6 years was analyzed. There were 1002 students that passed USMLE Step 2 CS and 54 students that failed USMLE Step 2 CS. Average PE score ranged from 31% in 2013 to 67% in 2017. Average PN score ranged from 54% in 2018 to 67% in 2016. Average CIS score ranged from 68% in 2017 to 73% in 2018 (table I).

Year	Students	USMLE Step 2 CS Fail	Physical Exam		Patient Note		Communication and Interpersonal Skills	
			Average	Standard Deviation	Average	Standard Deviation	Average	Standard Deviation
2013	178	9	34	9	65	7	72	6
2014	177	3	58	9	64	8	71	5
2015	185	6	41	10	57	7	70	6
2016	151	4	57	10	67	8	72	6
2017	183	13	67	10	61	8	68	6
2018	182	19	53	8	54	7	73	5
Total	1056	54						

TABLE I: NUMBER OF STUDENTS, USMLE STEP 2 CS RESULTS AND GCE COMPONENT AVERAGE AND STANDARD DEVIATION BY YEAR

There was no significant correlation between USMLE Step 2 pass-fail result and PE score. There were significant correlations between USMLE Step 2 pass-fail result and PN and CIS scores (table II).

	USMLE Step 2 CS Pass	PE	PN	CIS
USMLE Step 2 CS Pass	1.0000			
PE	0.0479	1.0000		
PN	0.2015**	0.1804**	1.0000	
CIS	0.0858*	0.0545	0.1716**	1.0000

TABLE II: CORRELATION BETWEEN RESULTS ON USMLE STEP 2 CS AND GCE COMPONENTS
* $p < 0.01$
** $p < 0.001$

In mixed effects logistic regression models with each individual GCE component in its own model as a fixed effect, better performance on each individual GCE component was significantly associated with better odds of passing USMLE Step 2 CS (Table III).

	Odds ratio (95% confidence interval)	p value
PE	1.04 (1.01-1.07)	0.012
PN	1.13 (1.08-1.17)	<0.001
CIS	1.07 (1.03-1.13)	0.002

TABLE III: MIXED EFFECTS LOGISTIC REGRESSION EXAMINING RELATIONSHIP BETWEEN INDIVIDUAL GCE COMPONENTS AND USMLE STEP 2 CS PASS-FAIL RESULT WITH INDIVIDUAL GCE COMPONENT AS FIXED EFFECT AND YEAR AS RANDOM EFFECT

In the mixed effects logistic regression model with all GCE components in the same model as fixed effects, better performance on PN was significantly associated with better odds of passing USMLE Step 2 CS while better performances on PE and CIS were not (Table IV).

	Odds ratio (95% confidence interval)	p value
PE	1.01 (0.99-1.04)	0.350
PN	1.12 (1.07-1.16)	<0.001
CIS	1.04 (0.99-1.09)	0.166

TABLE IV: MIXED EFFECTS LOGISTIC REGRESSION EXAMINING RELATIONSHIP BETWEEN GCE COMPONENTS AND USMLE STEP 2 CS PASS-FAIL RESULT WITH INDIVIDUAL GCE COMPONENT AS FIXED EFFECTS AND YEAR AS RANDOM EFFECT

For all possible PE/PN weighting combinations, better performance on ICE was significantly associated with better odds of passing USMLE Step 2 CS. Greatest odds of passing USMLE Step 2 CS were associated with weighting PE 20% and PN 80% (Figure I).

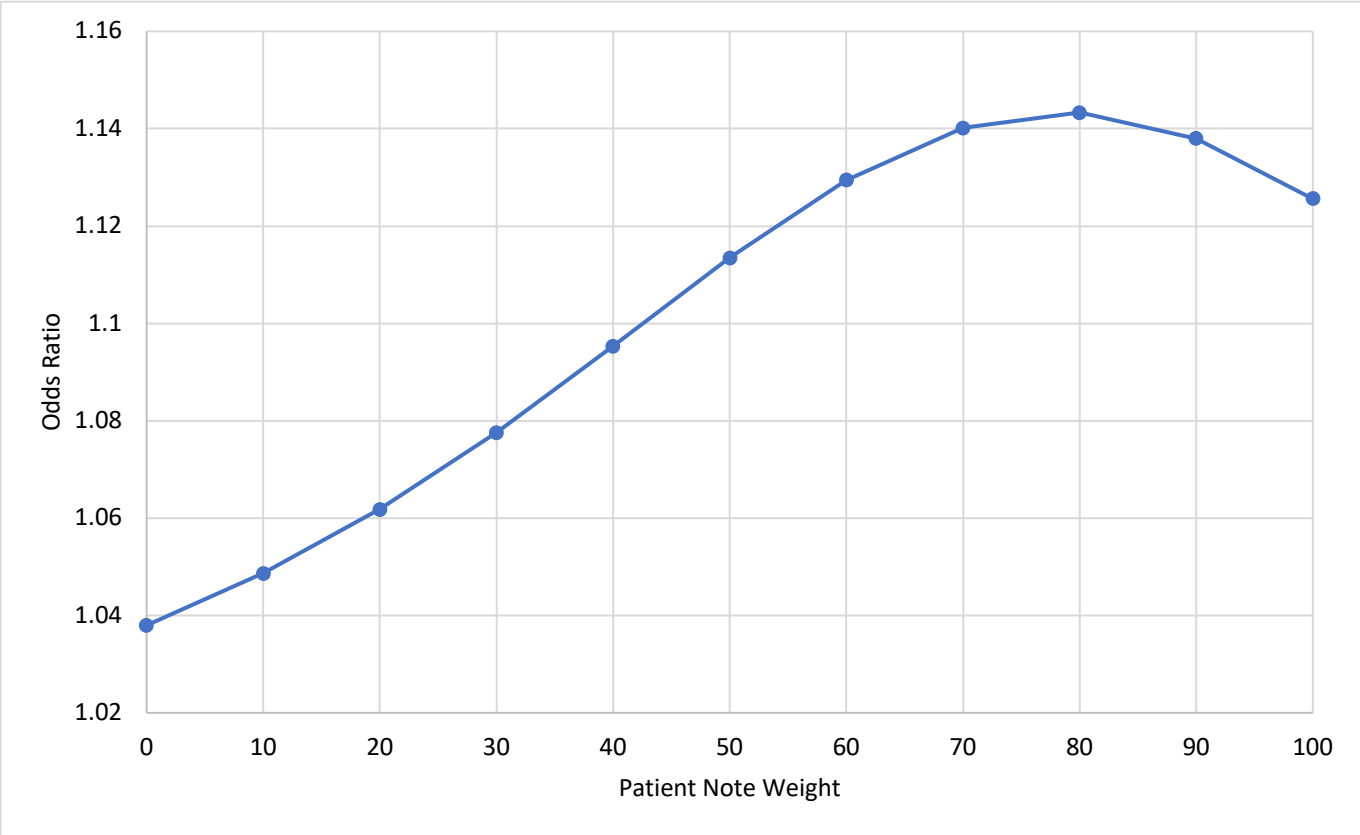

FIGURE I: Odds ratios for mixed effects logistic regression examining relationship between ICE scores with various weights and USMLE Step 2 CS pass-fail result with ICE score as fixed effect and year as random effect

V. DISCUSSION

The present study represents a significant contribution to the literature in the post-USMLE Step 2 CS world as the medical education community seeks to determine who will be responsible for high stakes assessment of medical student clinical skills and how this assessment will take place. It outlines important validity evidence that supports the ability of individual medical schools to carry out high quality and rigorous assessment in this domain. It is also based on analysis of results of over 1000 students which is larger than many similar studies. Analysis was significant for correlations between two out of three local examination components and USMLE Step 2 CS result. Multivariable mixed logistic regression models showed that a mere 1-point increase in student PN score was associated with 1.12 times increased odds of passing USMLE Step 2 CS. Finally, a series of mixed logistic regression models were used to inform component weighting for a multi-component examination. This offers valuable information both in thinking about scoring of GCE and other similar examinations, but also for literature around validity evidence for multi-component examinations more generally.

Pearson correlation coefficients were significant between PN and USMLE Step 2 pass as well as between CIS and USMLE Step 2 pass. The magnitude of these correlations was similar to those previously reported in the literature[15–17]. However, these previous studies focused on relationships between local examination elements and individual numeric scores for each USMLE Step 2 CS component. This component level numeric score information is not available to most medical schools who might seek to use such a method to gather validity evidence for their own local clinical skills assessment. The utilization of overall pass-fail result in place of these individual numeric scores in the present student highlights a possible model for

these schools and also demonstrates that it is reasonable to expect correlations even when using this overall USMLE Step 2 CS instead.

Interestingly, the three separate mixed effects logistic regression models with one individual GCE component as a fixed effect in each, year as random effect in all and USMLE Step 2 CS pass-fail result as outcome in all showed that better performance on any of the three GCE components was associated with better odds of passing USMLE Step 2 CS. However, when PE, PN and CIS were all included in the same mixed effects logistic regression, PN was the only component for which better performance remained associated with increased odds of passing Step 2 CS. The PN assesses more data interpretation and clinical reasoning. This is in contrast to the PE and CIS components which were more checklist-based and sought to confirm that students completed certain maneuvers or exhibited certain behaviors. This higher order interpretation and reasoning required for the PN may explain its enhanced differentiating power.

This is also relevant to consider in thinking about combining component scores for the purposes of calculating an ICE score. Given that PN was the component that remained significant in the mixed effects logistic regression model in which PE, PN and CIS were included, it stands to reason that this should be weighted more heavily when thinking about combining PE and PN to arrive at ICE. Consistent with this logic, analysis showed that maximization of odds ratio for passing USMLE Step 2 CS was achieved with weighting PE 20% and PN 80% to arrive at ICE. It is also significant to note that the odds ratio associated with this 20PE/80PN was greater in magnitude than any of the odds ratios for individual components in other mixed effects logistic regression models. Previous studies have shown that reliability and thus internal

structure validity is greater for composite scores than for individual scores when combining scores in a compensatory fashion[19]. The present study is the first to our knowledge that can make a claim to the increased relations to other variables validity evidence that can be achieved through combining scores. This is an idea that should continue to be investigated in future medical education studies.

The fact that weighting PE 20% and PN 80% was determined to be the best based on present analysis also warrants further discussion. To begin, Park et al report that, for the same GCE as is discussed in the present study, faculty preferred a weighting of PE 30% and PN 70%, but that psychometric reliability is maximized when PE weight was equal to or slightly greater than PN weight[14]. The fact that three different methods of determining weighting arrived at three different answers speaks to the challenging decisions that medical educators must make in determining score rules and making pass-fail decisions for examinations. There is no single answer in thinking about what the proper weighting should be for the GCE or for any other multi-component assessment. Instead, one must seek to provide as much validity evidence as possible for the decision made such that the results of the assessment can be trusted both by those scoring the examination and by those taking the examination.

There are some limitations that must be discussed regarding the present study. First, the results come from a single institution. However, analysis included over 1000 students across multiple years. Additionally, one purpose of the paper was to show that individual medical schools are able to carry out assessment of clinical skills with sufficient validity evidence. Thus, the analysis of single institution data was integral. Second, some might contend that the USMLE Step 2 CS pass-fail result is too crude a marker and that relationships should be

investigated at the level of USMLE Step 2 CS component results by numeric score as has been done in previous studies or at the level of USMLE Step 2 CS component pass-fail results. However, this level of detail is not routinely available to all medical schools and thus the present study highlights a method that can be broadly employed. Finally, there may also be some concerns about seeking to show association with USMLE Step 2 CS given the critiques and criticisms of the examination that existed over the years. However, the USMLE Step 2 CS exam was supported by robust validity evidence. Internal structure validity evidence[20,21] and relations to other variables validity evidence[22] were demonstrated for the communication and interpersonal skills (CIS) component. Internal structure validity evidence[23,24] and relations to other variables validity evidence[25] were demonstrated for combinations of elements similar to the USMLE Step 2 CS ICE. While there is certainly room to innovate and enhance the way in which clinical skills are assessed moving forward, the body of validity evidence for the former USMLE Step 2 CS positions it as a reasonable association to target at present.

In conclusion, it is known that there is a need for rigorous assessment of graduating medical student clinical skills now that USMLE Step 2 CS has been discontinued. The present study would suggest that individual medical schools can carry out such assessment in a way that is supported by robust validity evidence. Additionally, approaching weighting decisions with a focus on maximizing relations to other variables provides valuable information that medical educators can use in setting up assessment systems and establishing scoring rules.

CITED LITERATURE

1. Elder A. The Future of the USMLE Step 2 Clinical Skills Exam. *Acad Med*. 2018;93(11):1601. doi:10.1097/ACM.0000000000002408
2. Ecker DJ, Milan FB, Cassese T, et al. Step Up - Not On - The Step 2 Clinical Skills Exam: Directors of Clinical Skills Courses (DOCS) Oppose Ending Step 2 CS. *Acad Med*. 2018;93(5):693-698. doi:10.1097/ACM.0000000000001874
3. Kashaf MS. Clinical Skills in the Age of Google - A Call for Reform and Expansion of the USMLE Step 2 CS. *Acad Med*. 2017;92(6):734.
4. Kishore L. Jayakuma. The Limited Value of USMLE Step 2 CS. *Acad Med*. 2018;93(3):345.
5. Alvin MD. The USMLE Step 2 CS: Time for a change. *Med Teach*. 2016;38(8):854-856. doi:10.3109/0142159X.2016.1147539
6. Lehman IV EP, Guercio JR. The Step 2 Clinical Skills Examination - A Poor Value Proposition. *N Engl J Med*. 2013;368(10):889-891. doi:10.1056/NEJMp1300458
7. American Educational Research Association, American Psychological Association NC on M in E. *Standards for Educational and Psychological Testing*.; 2014.
8. Yudkowsky R, Park YS, Downing SM, eds. *Assessment in Health Professions Education*. 2nd Editio. Routledge; 2020.
9. Yudkowsky R, Park YS, Riddle J, Palladino C, Bordage G. Clinically Discriminating Checklists Versus Thoroughness Checklists: Improving the Validity of Performance Test Scores. *Acad Med*. 2014;89(7):1057-1062. doi:10.1097/ACM.0000000000000235
10. Park YS, Hyderi A, Heine N, et al. Validity Evidence and Scoring Guidelines for Standardized Patient Encounters and Patient Notes From a Multisite Study of Clinical

Performance Examinations in Seven Medical Schools. *Acad Med*. 2017;92(11):S12-S20. doi:10.1097/ACM.0000000000001918

11. Yudkowsky R, Park YS, Hyderi A, Bordage G. Characteristics and Implications of Diagnostic Justification Scores Based on the New Patient Note Format of the USMLE Step 2 CS Exam. *Acad Med*. 2015;90(11):S56-S62. doi:10.1097/ACM.0000000000000900
12. Park YS, Lineberry M, Hyderi A, Bordage G, Riddle J, Yudkowsky R. Validity Evidence for a Patient Note Scoring Rubric Based on the New Patient Note Format of the United States Medical Licensing Examination. *Acad Med*. 2013;88(10):1552-1557. doi:10.1097/ACM.0b013e3182a34b1e
13. Iramaneerat C, Myford CM, Yudkowsky R, Lowenstein T. Evaluating the effectiveness of rating instruments for a communication skills assessment of medical residents. *Adv Heal Sci Educ*. 2009;14:575-594. doi:10.1007/s10459-008-9142-2
14. Park YS, Lineberry M, Hyderi A, Bordage G, Xing K, Yudkowsky R. Differential Weighting for Subcomponent Measures of Integrated Clinical Encounter Scores Based on the USMLE Step 2 CS Examination - Effects on Composite Score Reliability and Pass-Fail Decisions. *Acad Med*. 2016;91(11):S24-S30. doi:10.1097/ACM.0000000000001359
15. Berg K, Winward M, Clauser BE, et al. The Relationship Between Performance on a Medical School's Clinical Skills Assessment and USMLE Step 2 CS. *Acad Med*. 2008;83(10):S37-S40. doi:10.1097/acm.0b013e318183cb5c
16. Dong T, Swygert KA, Durning SJ, et al. Validity Evidence for Medical School OSCEs: Associations With USMLE Step Assessments. *Teach Learn Med*. 2014;26(4):379-386. doi:10.1080/10401334.2014.960294

17. Torre DM, Hemmer PA, Durning SJ, et al. Gathering Validity Evidence on an Internal Medicine Clerkship Multistep Exam to Assess Medical Student Analytic Ability. *Teach Learn Med*. 2020:1-8. doi:10.1080/10401334.2020.1749635

18. StataCorp. Stata Statistical Software: Release 16. 2019.

19. Onishi H, Park YS, Takayanagi R, Fujinuma Y. Combining Scores Based on Compensatory and Noncompensatory Scoring Rules to Assess Resident Readiness for Unsupervised Practice: Implications From a National Primary Care Certification Examination in Japan. *Acad Med*. 2018;93(11S):S45-S51. doi:10.1097/ACM.0000000000002380

20. Cuddy MM, Swygert KA, Swanson DB, Jobe AC. A Multilevel Analysis of Examinee Gender, Standardized Patient Gender, and United States Medical Licensing Examination Step 2 Clinical Skills Communication and Interpersonal Skills Scores. *Acad Med*. 2011;86(10):S17-20. doi:10.1097/acm.0b013e31822a6c05

21. van Zanten M, Boulet JR, McKinley DW, DeChamplain A, Jobe AC. Assessing the Communication and Interpersonal Skills of Graduates of International Medical Schools as Part of the United States Medical Licensing Exam (USMLE) Step 2 Clinical Skills (CS) Exam. *Acad Med*. 2007;82(10):S65-S68. doi:10.1097/ACM.0b013e318141f40a

22. Winward ML, Lipner RS, Johnston MM, Cuddy MM, Clauser BE. The Relationship Between Communication Scores From the USMLE Step 2 Clinical Skills Examination and Communication Ratings for First-Year Internal Medicine Residents. *Acad Med*. 2013;88(5):693-698. doi:10.1097/ACM.0b013e31828b2df1

23. Clauser BE, Balog K, Harik P, Mee J, Kahraman N. A Multivariate Generalizability Analysis of History-Taking and Physical Examination Scores From the USMLE Step 2 Clinical Skills

Examination. *Acad Med*. 2009;84(10):S86-89. doi:10.1097/ACM.0b013e3181b36fda

24. Margolis MJ, Clauser BE, Swanson DB, Boulet JR. Analysis of the Relationship between Score Components on a Standardized Patient Clinical Skills Examination. *Acad Med*. 2003;78(10):S68-S71. doi:10.1097/00001888-200310001-00022

25. Cuddy MM, Winward ML, Johnston MM, Lipner RS, Clauser BE. Evaluating Validity Evidence for USMLE Step 2 Clinical Skills Data Gathering and Data Interpretation Scores - Does Performance Predict History-Taking and Physical Examination Ratings for First-Year Internal Medicine Residents? *Acad Med*. 2016;91(1):133-139. doi:10.1097/ACM.0000000000000908

VITA

NAME: Christopher David Mattson

EDUCATION: BA, Biochemistry and Spanish, Indiana University, Bloomington, Indiana 2013

MD, University of Chicago Pritzker School of Medicine, Chicago, Illinois, 2017

MHPE, University of Illinois at Chicago, Chicago, Illinois, 2021

TEACHING: University of Chicago Pritzker School of Medicine, Chicago, Illinois, Clinical Pathophysiology and Therapeutics – Pediatrics Unit, 2019

University of Chicago Pritzker School of Medicine, Chicago, Illinois, Clinical Skills 1B, 2017

University of Chicago Pritzker School of Medicine, Chicago, Illinois, Clinical Skills 1A, 2016

University of Chicago Pritzker School of Medicine, Chicago, Illinois, Personal and Professional Development, 2016

Indiana University, Bloomington, Indiana, Molecular Biology, 2011, 2013

Indiana University, Bloomington, Indiana, Genetics, 2012

Indiana University, Bloomington, Indiana, Honors Principles of Chemistry and Biochemistry, 2012

HONORS: Council on Medical Student Education in Pediatrics (COMSEP) Annual Meeting Best Trainee Poster, 2021

MHPE 505 Best Paper Award, University of Illinois at Chicago Department of Medical Education, Chicago, Illinois 2019

Pritzker Leadership Award, University of Chicago Pritzker School of Medicine, Chicago, Illinois, 2017

F. Howell Wright Award, University of Chicago Pritzker School of Medicine, Chicago, Illinois, 2017

University of Chicago Campus Life and Leadership Award, University of Chicago, Chicago, Illinois, 2017

Gold Humanism Honor Society, University of Chicago Pritzker School of Medicine, Chicago, Illinois, 2016

Phi Beta Kappa, Indiana University, Bloomington, Indiana, 2013

ABSTRACTS:

Mattson C, Wagner E, Kraft A, Mallick S, Cunningham P, Orlov N. "Leapfrog Rounds: Maximizing the Rounding Experience for Learners in Light of Social Distancing Restriction Imposed by the COVID-19 Pandemic". Society of Hospital Medicine Converge. Virtual Meeting. 2021.

Mattson C, Wolff L, Carter A, Fromme HB. "A Child Life Elective for Fourth Year Medical Students". Council on Medical Student Education in Pediatrics (COMSEP) Annual Meeting. Virtual Meeting. 2021.

Mattson C, Fromme HB, Tekian A, Park YS. "End-of-Rotation Assessment of Pediatric Residents: A Comparison of Reliability Across Rotations using Generalizability Theory". Pediatric Academic Societies Meeting. Philadelphia, PA. 2019. (Meeting cancelled due to COVID)

Mattson C, Wolff L, Carter A, Fromme HB. "Needs Assessment to Guide Development of a Child Life Elective for Fourth-Year Medical Students". University of Chicago Medical Education Day. Chicago, IL. 2019.

Caldwell H, Mattson C, Woodruff J, Lee WW. "Longitudinal Assessment of Personal and Professional Development Competencies at the Pritzker School of Medicine". Society of General Internal Medicine National Meeting, Washington, DC. 2019.

Mattson C, Farnan J, Woodruff J, Lee WW. "Comparison of Medical Student Self-Assessment and Faculty Assessment of Personal and Professional Development Skills" Society of General Internal Medicine National Meeting, Washington, DC. 2017.

Mattson C, Woodruff J, Lee WW. "Development of a Formal Personal and Professional Development Program for Undergraduate Medical Students" Society of General Internal Medicine National Meeting, Hollywood, FL. 2016.

Kastner K, Kocherginsky M, Garcia-Huerta K, Mattson C, Pinto N, Msall M. "Impact of PICU Admission on School Performance and Health Related Quality of Life" Society of Critical Care Medicine Critical Care Congress, Orlando, FL. 2016.

PUBLICATIONS:

LoRe D, Mattson C, Feltman D, Fry J, Brennan K, Arnolds M. “Physician Perceptions on Quality of Life and Resuscitation Preferences for Extremely Early Newborns”. American Journal of Perinatology. Accepted for Publication. 2021.

Mattson C, Farina E. “Application Phases Instead of Interview Caps to Decompress Residency Application”. Academic Medicine. Accepted for Publication. 2021.

Orlov N, Mattson C, Kraft A, Wagner E, Mallick S, Cunningham P, Arora V. “LEAPFROG Rounds: Maximizing the Rounding Experience for the Interprofessional Team During the COVID-19 Pandemic”. Academic Pediatrics. Online Ahead of Print. 2021.

Mattson C, Bushardt R, Artino A. “‘When a Measure Becomes a Target, It Ceases to be a Good Measure’”. Journal of Graduate Medical Education. 13(1) 2021: 2-5.

Caldwell H, Ham S, Mattson C, Woodruff J, Lee WW. “Longitudinal Assessment of Personal and Professional Development Competencies in Medical Students”. Journal of General Internal Medicine. 2020.

Mattson C, Park YS. “Toward Thoughtful Use of Shelf Exam Scores in Clerkship Assessment Systems”. Academic Medicine. 95(10) 2020: 1466-1467.

Holland AM, Martin JS, Mattson C, Lohse KR, Finn PR, Stager JM. “A cross-sectional study of physical activity and arterial compliance: the effects of age and artery size”. Journal of American Society of Hypertension. 11(2) 2017: 92-100.