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Greater Objective and Perceived Competence for Clinics is Associated with Reduced Stress but No Change in Impostorism in Medical Students [a]

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Abstract

Impostorism is prevalent in medical students and negatively impacts wellness, contributing to stress and burnout. Perceived competence is noted as one attribute underlying impostorism. A curricular change that resulted in improved United States Medical Licensing Examination (USMLE) Step 1 scores and student self-perceptions of preparedness for clinical training was used as a natural experiment to assess the effects higher competence/preparedness, based on an objective indicator and self-perceptions, on impostorism, stress, and burnout during early clinical training. Third-year medical students in the last class of the old "Legacy"

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curriculum and the first class of the revised "ACE" curriculum completed a voluntary, anonymous survey that included the Clance Impostor Phenomenon Scale, the Perceived Stress Scale, and the abbreviated Maslach Burnout Assessment. USLME Step 1 scores and data on students' self-perception of their preparedness for clinics were collected as part of routine curricular monitoring. Both groups of students had highly similar entering demographics. Compared to Legacy students, ACE students had higher USMLE Step 1 scores ($p < 0.001$) and perceived themselves to be better prepared for clinical clerkships ($p < 0.001$). Stress scores were 15% lower in ACE students ($p < 0.05$). However, impostor scores were nearly identical between these groups and the proportions of students endorsing burnout were not different. This suggests that impostorism and burnout during the transition to clinical training are not attenuated by improved competence and are not directly related to stress.

Keywords
Impostor phenomenon; stress; burnout; medical student; competence; preparedness; clinical training; undergraduate medical education

1. Introduction

Impostorism is the distrust of one's abilities and achievements, despite conflicting evidence, and the fear of being exposed as an "impostor" [2, 3]. Although first described in women and believed to be a fixed trait, impostorism is now recognized to affect both genders and to be an affective response to specific situations such as periods of transition (e.g., beginning or moving between career phases) [4-7]. Sufficiently intense impostor feelings, sometimes termed "impostor phenomenon" [8], can lead to higher levels of stress, lower motivation, less assertive behavior, diminished job satisfaction, reduced self-acceptance, and decreased ability to enjoy successes [9, 10]. It is associated with psychological characteristics such as perfectionism, anxiety, neuroticism, low or unstable high self-esteem, the tendency to attribute success to chance, and lower self-discipline, self-determination, conscientiousness, resilience, and perceived competence [11-19].

Psychological distress in medical students is an increasing concern with significant potential impact on career progression, longevity, and satisfaction; professionalism, and quality of care [20-22]. Medical trainees identify impostorism as a cause of stress and believe it negatively impacts their professional development [23]. Roughly one-fourth of male and half of female medical students meet the criterion for impostor phenomenon [24-28]. Compared to non-impostors, these students exhibit greater psychological distress, which can lead to depression, anxiety, burnout, impaired identity formation as physicians, consideration of dropping out of medical school, and, in extreme cases, suicide [28-31]. The transition between the preclinical to the clinical phases of medical training, when students begin to take on patient care responsibilities that have the potential for dire consequences, is a challenging period when medical students are likely to be particularly stressed and experience decreased confidence in their abilities [32-35]. Impostor feelings, which can be driven by low self-perceptions of competence [12], are notably high in both male and female students, and correlated with stress levels during this transition [36].

Fostering student wellness is an increasingly important goal for schools of medicine, which includes initiatives addressing impostorism. Of the characteristics associated with impostorism, low self-perceived competence, defined by Bernard et al. [12], as "feeling inadequate or unprepared for one's occupational role", is a factor that may potentially be mitigated by educational experiences that produce superior preparedness and competence. The impact of competence on impostorism, however, has not been assessed experimentally.

In this study, a curricular change was used as a natural experiment to assess the impact of improvement in competence/preparation for entry into the clinical phase of medical training on indices of wellness as the students began the clinical phase of training. We hypothesized that students in the revised curriculum, who had better objective and self-perceived competence, would have lower levels of impostorism, stress, and burnout than students in the old curriculum.

2. Materials and Methods

This study is a natural experiment examining the effects of improved indices of students' objective and self-perceived competence on wellness parameters in two initially similar groups of medical students. Two indices of competence/preparation for entry into the clinical phase of medical training were used: (1) the United States Medical Licensing Examination (USMLE) Step 1 scores, a standardized, objective measure of academic pre-clinical competence, and (2) students' self-reported perceived preparedness for clinical training, a subjective measure of self-perceived competence, completed at the end of the preclinical phase. Effects on impostorism, stress, and burnout were examined using validated instruments.

This study was reviewed and monitored by the University of Kansas Medical Center Office of Research Compliance (STUDY #00142155). The Self-perception of Preparation for Year 3 Clinical Clerkships Survey was performed for routine monitoring for educational program evaluation, development, and quality improvement, and was thus exempt from institutional research oversight.

2.1 Participants

The subjects were medical students in the University of Kansas School of Medicine classes of 2020(n = 215) and 2021(n = 214). These students were the last and first classes of the "Legacy" and "ACE" curricula (see below) and began the clinical phase (third year) of medical training in the Fall semesters for 2018 and 2019, respectively. Demographic parameters, obtained from the University of Kansas School of Medicine Office of Medical Education are presented in Table 1.

Table 1 Demographic parameters of the total classes in the Legacy and ACE curricula.

	Legacy Mean/n (%)	**ACE** Mean/n (%)	t/χ^2	**df**	**p**	**Effect Size**
Total	215	214				
Gender			$\chi^2 = 0.479$	1	0.49	0.06
Male	110(51%)	116(54%)				
Female	105(49%)	95(44%)				
Age	25.7 ± 3.0	26.1 ± 2.8	t = 1.427	427	0.15	0.14
Race			$\chi^2 = 5.461$	3	0.14	0.19

Caucasian	172(80%)	154(72%)				
African American	7(3%)	14(7%)				
Asian	24(11%)	27(12%)				
Other	9(4%)	16(7%)				
Hispanic	13(6%)	19(9%)	$\chi^2 = 0.870$	1	0.35	0.11
Composite MCAT score	507 ± 6.1	508 ± 5.5	t = 1.783	427	0.075	0.17
USMLE Step 1 score	225 ± 19	231 ± 18	t = 3.357	427	**0.0009**	**0.32**
Assigned Campus						
Preclinical			$\chi^2 = 0.290$	2	0.87	0.05
Kansas City	175(81%)	178(83%)				
Wichita	32(15%)	28(13%)				
Salina	8(4%)	8(4%)				
Clinical			$\chi^2 = 0.761$	2	0.68	0.06
Kansas City	140(65%)	133(62%)				
Wichita	67(31%)	73(34%)				
Salina	8(4%)	8(4%)				

Data are the mean ± SD or frequencies with percentages. Legacy students received the old curriculum; ACE students, the revised curriculum. Statistical testing employed Student's-t test (two-tailed) or Chi-square test. Cohen's d or h were used to determine effect size. Abbreviations: MCAT-Medical College Admission Test, USMLE – United States Medical Licensing Examination.

The University of Kansas School of Medicine is a public medical school in the United States. Students are located on three campuses in Kansas City, Wichita, and Salina. Most students finish all four years on one campus; however, roughly 16% of the class underwent the preclinical phase in Kansas City and the clinical phase in Wichita. Educational experiences were designed to be nearly identical on all campuses.

The University of Kansas School of Medicine underwent a comprehensive curricular revision that incorporated a variety of student-centered approaches intended to improve academic outcomes, student wellness, and foster the development of skills and behaviors required in 21st-century medical practice (described in detail in: [37]). The Active-learning, Competency-based, Excellence-driven, "ACE", curriculum was initiated for incoming medical students in the fall of 2017. The ACE curriculum replaced the "Legacy" curriculum. Both the Legacy and ACE curricula were of 4 years duration, with 2 years of preclinical and 2 years of clinical training. The Legacy preclinical curriculum consisted of lecture-based integrated foundational science instruction with some clinical skills experiences. In contrast, the ACE preclinical curriculum was delivered in an integrated hybrid format organized around clinical cases incorporating foundational sciences and clinical practice using a variety of active learning approaches including problem-based learning (PBL) [38], case-based collaborative learning (CBCL) [39], and flipped classroom [40]. Immersive clinical experiences, including standardized patients and simulations, enabled learners to better integrate classroom learning with patient care. To foster student wellness, ACE students were organized into learning communities, had an individual faculty coach to provide advising, and enhanced mechanisms for students to provide feedback to faculty and administration.

For both curricula, students took USMLE Step 1 at the end of Year 2. A passing score on USMLE Step 1 was required to enter clinical training. Clinical training commenced with six required, sequential eight-week rotations, which were randomly assigned. Admissions criteria and procedures were the same for both curricula.

2.2 Self-Perception of Preparation for Year 3 Clinical Clerkships Survey

2.2.1 Data Collection

An anonymous, voluntary survey was administered by the Office of Medical Education at the beginning of the 2018 and 2019 Spring semesters as part of routine program evaluation and quality improvement processes. The survey was distributed to all third-year students electronically via OASIS, a web application for medical school education management including program evaluation. The survey was available for 20 days and required roughly 20 minutes to complete. Reminders were sent twice a week until students completed the survey, or the survey closed.

2.2.2 Instrument

The survey consisted of 49 items. Students were asked to rate how well they believed the preclinical curriculum had prepared them for various aspects of clinical clerkships (31 items, plus a single item assessing "Overall preparation for clinical clerkship"), as well as the preparatory value of specific preclinical courses (17 items – not used in this analysis). Items were rated on a 5-point Likert scale where 1-5 indicated poor, fair, good, very good, excellent, respectively. An additional response option was "Not Applicable/Don't Recall", which had no numerical value. Demographic data collected was limited to gender.

2.3 Impostorism, Stress, and Burnout Survey

2.3.1 Data Collection

Data were collected in October-November of 2018 and 2019. During this time period, students would have completed at least one clinical rotation but still be early in their clinical training. The survey, which consisted of 60 items, was voluntary and anonymous. It required about 20 minutes to complete. The survey was composed of validated instruments assessing impostorism, stress, and burnout (see below), as well as demographic items. Students were incentivized to participate by a monetary contribution to their respective class funds if the specified response rate was achieved. Informed consent was obtained prior to completion of the survey.

Data were collected and managed by the authors using REDCap (Research Electronic Data Capture) tools [41]. REDCap sent an e-mail to all third-year medical students containing a link to the on-line survey. Weekly reminders were sent by REDCap to students who had not completed the survey until the close of the survey period.

2.3.2 Instruments

Clance Impostor Phenomenon Scale (CIPS). The CIPS [2] is a 20-item instrument using a 5-point Likert scale to indicate endorsement of impostorism feelings with 1-5 indicating not at all true,

rarely, sometimes, often, or very true, respectively. Responses to individual items were added to produce a score ranging from of 20 to 100, with a higher score signifying stronger and more frequent impostor feelings. The severity of impostor feelings was classified as low (score 20-40), moderate (41-60), frequent (61-80), or intense (≥81). A score of 62 or higher was interpreted to indicate meeting criterion for "impostor phenomenon", as verified by clinical interview [8]. Previous studies report high instrument reliability (Cronbach's α = 0.87-0.92 [8, 18, 42]).

Perceived Stress Scale (PSS). The PSS [43-45] is a 10-item instrument using a 5-point Likert scale (0-4) to indicate the frequency of stress-related feelings in the last month from never, almost never, sometimes, fairly often, or very often, respectively. Responses were scored according to the instrument instructions and added to yield a total score. Scores ranged from 0 to 40, with 0-13 indicating low stress; 14-26, moderate stress; and 27-40, high stress. Reported instrument reliability is good (Cronbach's α = 0.71-0.86 [44, 46, 47]).

Abbreviated Maslach Burnout Assessment. Burnout was evaluated using a single item designed for, and validated in, physicians [48, 49]. An affirmative response indicated burnout. In medical professionals, responses to this item were strongly correlated with the domain score for emotional exhaustion of the full Maslach Burnout Inventory (MBI) [50] (Spearman *r* = 0.76-0.83) [48] and had a predictive value of 88-89% [48, 51].

2.4 Data Analysis

SAS (v. 9.4), GraphPad Instat (v.3), and GraphPad StatMate (2.0) were used to analyze the data. Data are presented at the mean ± SD or as frequencies with percentages for categorical data. Differences between groups were considered significant at $p < 0.05$. Effect sizes were interpreted as small (0.20-0.49), medium (0.50-0.79), and large (≥ 0.8).

2.4.1 Demographic Data

Demographic attributes between classes or between respondents and the total class were compared using Student's-t or Chi-Square tests. Effect sizes were calculated using Cohen's d or h for independent samples or proportions, respectively. Medical College Admissions Test (MCAT) scores reported using the pre-2015 scoring scale were converted to the 2015 scoring scale based on the score percentile.

2.4.2 Self-Perception of Preparation for Year 3 Clinical Clerkships Survey

Responses from the 30 individual items related to specific skills were aggregated into six factors: (1) medical knowledge (9 items), (2) patient care (10 items), (3) sensitive exams (3 items), (4) interpreting labs/test (3 items), (5) upper body exams (4 items), and (6) using medical literature (2 items) based on a principal component analysis with varimax rotation. Each item was associated with a single factor. Responses to these items were averaged to generate factor scores. Due to the highly granular nature of these items, only the factor scores are presented here. Responses to the item "Overall preparation for clinical clerkship" were analyzed as a single item.

These ordinal data were analyzed for differences between class years using the Mann-Whitney U test. Effect sizes were calculated using Cohen's d.

2.4.3 Impostorism, Stress, and Burnout Survey

In the Legacy cohort, responses to a single item on the CIPS were omitted by eight individuals (a different item for each respondent). The impostor score for these individuals was normalized for 19, rather than 20, responses by multiplying the score 1.05263(i.e., 1 + 1/19) and rounding to the nearest whole number.

A preliminary analysis determined no interaction of gender with curriculum and no effect of campus. Accordingly, gender and campus were not used as variables in this analysis.

Differences in responses between curricula were assessed using Student's-t or Chi-Square tests, as appropriate. Effect sizes were determined using Cohen's d or h, respectively.

3. Results

3.1 Student Demographics

The Legacy (class of 2020) and ACE (class of 2021) curricula classes were similar with respect total class size, gender distribution, age, race distribution, and composite MCAT score (Table 1). The ACE total class had somewhat higher proportions of males and non-Caucasian students, but this difference was not statistically significant ($\chi^2(1) = 0.479$, $p = 0.49$ and $\chi^2(3) = 5.461$, $p = 0.14$, respectively).

3.2 USMLE Step 1 Performance

The mean USMLE Step 1 score was 6 points higher for all ACE students compared to all Legacy students ($t(427) = 3.357$, $p < 0.001$) with a small effect size ($d = 0.32$) (Table 1). Among the respondents to the Impostorism, Stress, and Burnout Survey, mean USMLE Step 1 score for ACE students was 9 points higher than Legacy students ($t(213) = 3.997$, $p < 0.001$) with a medium effect size ($d = 0.54$) (Table 2).

Table 2 Demographic parameters of respondents to the Impostorism, Stress, and Burnout survey.

	Legacy		**ACE**					**Effect**
	n	Mean/n (%)	n	Mean/n (%)	***t/χ²***	**df**	**p**	**Size**
Total	112		112					
Gender	112		111		$\chi^2 = 0.215$	1	0.64	0.08
Male		46(41%)		50(45%)				
Female		66(59%)		61(55%)				
Age	110	25.9 ± 3.1	107	25.6 ± 2.3	t = 0.808	215	0.42	0.11
Race	112		112		$\chi^2 = 1.764$	3	0.62	0.10
Caucasian		94(84%)		90(80%)				
African American		2(2%)		3(3%)				
Asian		8(7%)		13(12%)				
Other		8(7%)		6(5%)				
Hispanic	112	9(8%)	112	5(5%)	$\chi^2 = 0.686$	1	0.41	0.12

Composite MCAT score	105	508 ± 5.5	106	509 ± 5.2	t = 1.357	209	0.18	0.19
USMLE Step 1 score	109	228 ± 18	106	237 ± 15*	t = 3.997	213	**<0.0001**	**0.54**
Assigned Campus								
Preclinical	111		112		χ^2 = 4.126	2	0.13	0.03
Kansas City		94(84%)		93(83%)				
Wichita		17(15%)		15(13%)				
Salina		0(0%)		4(4%)				
Clinical	111		112		χ^2 = 3.949	2	0.14	0.04
Kansas City		71(64%)		70(62%)				
Wichita		37(34%)		38(34%)				
Salina		0(0%)		4(4%)				

Data are the mean ± SD for continuous variables or frequencies with percentages. Legacy students received the old curriculum; ACE students, the revised curriculum. Statistical testing employed Student's-t test (two-tailed) or Chi-square test. Cohen's d or h were used to determine effect size. *Different than ACE class mean (t(318) = 2.960, p < 0.0033, d = 0.36) (see Table 1). Abbreviations: MCAT-Medical College Admission Test, USMLE – United States Medical Licensing Examination.

3.3 Self-Perception of Preparation for Year 3 Clinical Clerkships Survey

In the Legacy sample, 161 of 215(75%) students surveyed responded with 158 providing data relevant to this analysis. In the ACE sample, 116 of 214(54%) students surveyed responded with 114 providing relevant data. The percentages of male and female respondents were not significantly different.

The six factors (Table 3) accounted for 70% of the variance. The Cronbach's α for the factors was 0.93, 0.91, 0.88, 0.84, 0.89, and 0.88, respectively.

Table 3 Student perceptions of preparation for clinical clerkships in the Legacy and ACE curricula.

Exam/Skill	**Legacy** Mean (n)	**ACE** Mean (n)	**U**	**p**	**Effect Size**
Factor 1: Medical knowledge	3.44 ± 0.89 (158)	3.77 ± 0.73 (114)	6940	**0.0013**	**0.41**
Factor 2: Patient care	3.18 ± 0.90 (158)	3.39 ± 0.77 (114)	7833	0.067	0.23
Factor 3: Sensitive exams	3.02 ± 1.04 (151)	3.07 ± 0.91 (111)	8364	0.98	0.05
Factor 4: Interpreting labs/tests	2.91 ± 0.90 (155)	3.35 ± 0.83 (114)	6276	**<0.0001**	**0.47**
Factor 5: Upper body exams	3.32 ± 0.97 (157)	3.56 ± 0.76 (114)	7881	0.094	0.28
Factor 6: Using medical literature	3.24 ± 1.05 (157)	3.38 ± 0.97 (111)	8123	0.34	0.14
Overall preparation for clerkship	3.11 ± 0.96 (158)	3.58 ± 0.90 (113)	6709	**0.0005**	**0.51**

Data are the mean ± SD. Items were rated on a 5-point Likert scale with 1-5 ranging from poor to excellent. Factors scores are the average of multiple individual survey items, each associated with a single factor. Legacy students received the old curriculum; ACE students, the revised curriculum. Statistical testing employed the Mann-Whitney U test. Effect size was determined using Cohen's h.

Students in the ACE curriculum rated their preparedness for clinical clerkships higher than Legacy students for medical knowledge ($U = 6940$, $p < 0.01$), and interpreting labs/tests ($U = 6276$, $p < 0.001$). Overall preparation for clerkship was rated at 3.11 ± 0.96 and 3.58 ± 0.90 for Legacy and ACE students, respectively ($U = 6709$, $p < 0.001$), where 3 and 4 denote good and very good preparation, respectively. The effect sizes for these differences were small-to-medium ($d = 0.41$, 0.47, and 0.51, respectively). ACE students also rated their preparedness for patient care higher than Legacy students, but this did not quite meet significance criteria ($U = 7833$, $p = 0.067$). Students' perceptions of preparedness for clerkship in the Legacy and ACE curricula were similar with respect to sensitive exam, upper body exams, and using the medical literature.

3.4 Impostorism, Stress, and Burnout Survey

3.4.1 Respondent Characteristics

Characteristics of respondents are presented in Table 2. In the Legacy sample, 127 of 215(59%) students surveyed responded with 112 completing at least one instrument. One hundred and eleven students completed all three instruments. The respondents were not different from the Legacy total class. Respondents were primarily Caucasian (84%) with a mean age of 25.9 ± 3.1 years.

In the ACE sample, 120 of 214 (56%) students responded. One hundred and twelve students completed at least one instrument, and 111 students completed all three instruments. The respondents were not different from the ACE total class or from Legacy respondents with the exception of mean USMLE Step 1 score, which was 6 points higher in ACE respondents than in the total ACE class ($t(318) = 2.960$, $p < 0.01$). Compared to the Legacy respondents, the ACE and respondents had somewhat a higher proportion of non-Caucasians and a smaller percentage of reported Hispanic ethnicity, but this was not significant.

The proportions of students on the three KUSOM campuses were similar for both classes and were not different from the total classes during either phase of training.

3.4.2 Impostorism

The CIPS had excellent validity (Cronbach's $\alpha = 0.92$).

Mean CIPS scores for Legacy and ACE students (63.1 ± 15 and 63.4 ± 14, respectively) were not different ($t(222) = 0.155$, $p = 0.88$) (Table 4). The proportions of respondents meeting impostor phenomenon criterion (score ≥62) were 61% in ACE (61%) and 51% in Legacy and were also not different ($\chi^2(1) = 1.810$, $p = 0.18$). Likewise, the distribution of students with CIPS scores in the low (20-40), moderate (41-60), frequent (61-80) and intense (81-100) ranges did not differ between curricula ($\chi^2(3) = 3.724$, $p = 0.29$).

Table 4 Impostorism, stress, and burnout in Legacy and ACE curricula students.

	Legacy Mean (n)/n (%)	**ACE** Mean (n)/n (%)	***t*/χ^2**	**df**	**p**	**Effect Size**
Impostorism						
Clance Impostor Score	63.1 ± 15(112)	63.4 ± 14(112)	t = 0.155	222	0.88	0.02
Score ≥62	57(51%)	68(61%)	χ^2 = 1.810	1	0.18	0.20

Distribution						
Score 20-40	6(5%)	6(5%)	$\chi^2 = 3.724$	3	0.29	0.24
Score 41-60	47(42%)	37(33%)				
Score 61-80	42(38%)	56(50%)				
Score 81-100	17(15%)	13(12%)				
Perceived Stress Score	17.9 ± 6.9(111)	15.6 ± 6.8(111)	t = 2.501	220	**0.013**	**0.34**
Distribution						
Score 0-13	34(30%)	44(40%)	$\chi^2 = 2.795$	2	0.25	0.10
Score 14-26	66(59%)	61(54%)				
Score 27-40	12(11%)	7(6%)				
Burnout	43(39%)	38(34%)	$\chi^2 = 0.311$	1	0.58	0.10

Data are the mean ± SD for continuous variables or frequencies with percentages. Legacy students received the old curriculum; ACE students, the revised curriculum. Statistical testing employed Student's-t test (two-tailed) or Chi-square test. Cohen's d or h were used to determine effect size.

Post hoc analysis indicated that the study had 75% power to detect a difference between means of 5.13 with a significance level (alpha) of 0.05 (two-tailed).

3.4.3 Stress

The PSS had excellent validity (Cronbach's $\alpha = 0.90$).

The mean PSS score was 15% higher for Legacy students compared to ACE students (17.9 ± 6.9 and 15.6 ± 6.8, respectively; $t(220) = 2.501$, $p < 0.05$). The effect size was small ($d = 0.34$). The largest proportion of students in both curricula had PSS scores in the moderate range (59% and 54%, respectively) and the distribution of students with PSS scores in the low (0-13), moderate (14-26), and high (27-40) ranges did not differ between curricula ($\chi^2(2) = 2.795$, $p = 0.25$) (Table 4).

3.4.4 Burnout

The proportions of students endorsing burnout were 39% and 34% in the Legacy and ACE curricula, respectively, which were not different between curricula ($\chi^2(1) = 0.311$, $p = 0.58$) (Table 4).

4. Discussion

Among other characteristics, impostorism is associated with low perceived competence, defined as "feeling inadequate or unprepared for one's occupational role" [12], and is a contributor to stress and burnout [52]. In this natural experiment, students entering medical school with highly similar demographics (Table 1), but with differing objective and self-perceived competence for starting clinical training (Tables 1 and 3), were used to evaluate the impact of competence on impostorism, stress, and burnout. The present data indicate that the improved objective and self-perceived competence of the ACE students was associated with decreased stress, but nearly identical levels of impostorism and burnout. Importantly, all data were collected prior to the COVID pandemic, and are thus not confounded the impact of that unprecedented event.

Self-assessment of abilities may overestimate actual ability [53]; however, ACE students also had higher USMLE Step 1 scores, an objective indicator of mastery of foundational sciences (Table 1), providing external validation of their academic competence. Moreover, in the subset of ACE students who responded to the Impostorism, Stress, and Burnout survey, the mean USMLE Step 1 score was 6 points higher than in the ACE class as a whole (Table 2) and thus provided a more stringent test of the hypothesis. It is possible that higher USMLE Step 1 scores, which students tend perceive as a critical factor in their residency prospects [54], contributed to the ACE student's higher self-perceived competence for clinics (Table 3). However, the relationship between USMLE Step 1 score and impostorism is complex and may affect only certain subsets of individuals. Notably, one study found that USMLE Step 1 scores were inversely correlated with CIPS scores in male, but not female, third-year medical students [36], whereas another study of students in all four years of medical training failed to find a relationship [55]. Furthermore, these studies did not assess whether low USMLE Step 1 score stimulates impostorism, if pre-existing impostorism impacts USMLE Step 1 performance, or both.

Although stress scores were lower in ACE students (Table 4), impostor scores were nearly identical in Legacy and ACE students, with both groups having mean impostor scores just above the threshold score for impostor phenomenon (≥62) (Table 4). The 75% power to detect a 5-point difference between groups afforded by the sample size indicates that the study was sufficiently powered to identify meaningful differences. The proportions of students meeting impostor phenomenon criterion also did not differ between curricula, and variation between groups in the proportion of impostors was most likely due to the scores being clustered around the criterion score. Likewise, consistent with the reported association between impostorism and burnout [28], the proportion of students reporting burnout was also not different between classes. The lack of association between measures of competence and impostorism observed in this study suggests that factors other than competence are the significant drivers of impostorism, at least among third-year medical students.

A recent argument has been made emphasizing the importance of the context in which impostor feelings occur [56]. Accordingly, medical students, who, as a group, may be more academically capable, highly motivated, and somewhat older than the undergraduate subjects in most studies, and who are taking on uniquely challenging new responsibilities, may manifest impostorism in distinct ways. Most analyses of the CIPS suggest that impostor beliefs cluster into three factors that relate to self-doubt and concerns about ability, the attribution of successes to luck, and the tendency to discount success and praise [8, 18, 57]. Another study of professionals and trainees in science, technology, engineering, mathematics, and medicine (STEMM) indicated slightly different factors (self-doubt, fear of evaluation, and luck) and suggested that subtypes of impostors may be notably high in one factor and low in another [58]. Analysis of third-year medical students' responses on the CIPS indicated that this specific population is unlikely to attribute their past accomplishments to luck. Instead, impostorism was driven primarily by unfounded fear of failure, worrying about future challenges, tending to remember past failures rather than successes, and for women, comparing themselves to others [59]. Personality traits associated with impostorism specifically in medical students have not been examined.

Stress correlates strongly with impostor score in medical students [36], and students with impostorism have more psychological distress and burnout [28, 29]. Interestingly, students in the ACE curriculum had lower stress scores than Legacy students without a concomitant decrease in

impostor score or incidence of burnout. This suggests that the relationship between stress, impostorism, and burnout is complex, and that stress may be more affected by the types of changes incorporated into the ACE curriculum than impostorism or burnout.

The lack of relationship between objective and perceived competence and impostorism observed in this study suggests that mitigating impostorism may require a specifically targeted approach beyond providing a sound academic program. Recommendations for alleviating impostorism focus on providing education about impostorism, helping impostors see themselves more objectively, decreasing reliance on external approval, and addressing any associated perfectionism, depression, and anxiety [7, 60-63]. Coaching and mindset interventions, which emphasize continuous improvement and skill development [64, 65], were found to be effective in several studies [66-68]. Mindfulness practices have also shown efficacy [68], although support from colleagues and mentors was found to be more effective than reflection and mindfulness in another study [69].

4.1 Limitations

Despite the lack of significant differences between the demographics of the entire classes and the survey respondents, respondents may have had different characteristics from non-respondents. Likewise, the Self-perception of Preparation for Year 3 Clinical Clerkships Survey and Impostorism, Stress, and Burnout Survey may have been completed by different subpopulations of students. Because these surveys were performed separately and without an identifier, it was not possible to make correlations between these data.

The proportion of non-Caucasian respondents was too small to enable the detection of any effects of minority status.

The design used two classes at a single medical school with data collected at specific time points in the academic program. Accordingly, these findings may not generalize to other schools, educational programs, types of students, or time points. The analyses did not examine or control for any effects of which clinical rotation was completed before administration of the Impostorism, Stress, and Burnout survey.

Finally, the data is insufficient to draw any conclusions, establish causal relationships, or identify which aspects of the ACE curriculum may have contributed to the observed effects.

5. Conclusions

Third-year medical students who had better objective and self-perceived competence were less stressed but had no difference in feelings of impostorism or burnout during their early clinical training. This suggests that drivers of impostorism in medical students during the transition to clinics are complex and appear to be unrelated to perceived competence. This finding highlights the complexity of the relationship between perceptions of competence and impostorism, as well as other important indices of wellness such as stress and burnout. Greater understanding of this relationship may inform student wellness initiatives to aid medical students as they transition into clinical training.

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Author Contributions

BL conceptualized the study and obtained funding. BL and JAV designed the study. BL, AMM, and EN collected and analyzed the data. All authors contributed to the interpretation of the data, and the drafting, critical revision, and final approval of the manuscript.

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Competing Interests

The authors have no competing interests.

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