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Understanding the Impact of Medical Humanities on Internship Training and Performance

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Abstract

Medical humanities (MH) courses blend humanities with medical training to help students develop essential skills and empathy. Yet, how MH influences practical clinical performance during internships is not well established. This study investigated the effect of MH learning on internship outcomes. We analyzed the academic records of 1,364 medical students from eight admission cohorts. Student performance in basic sciences, clinical skills, and MH courses was evaluated, alongside internship grades. Machine learning models—including support vector machines, logistic regression, and random forests with ten-fold cross-validation—were applied to predict internship performance. Multiple regression was also used to determine MH's independent impact. MH was a significant predictor of internship performance. Removing MH variables from models notably reduced predictive accuracy (e.g., logistic regression AUC dropped from 0.781 to 0.742). Regression analyses revealed that MH had the most potent independent effect on internship grades (OR: 1.29, $P < 0.0001$), accounting for nearly 30% of the variance. Within MH, courses in Medical Sociology and Cultural Studies, and Communication Skills and Interpersonal Relationships, were particularly influential (AUC 0.710 and 0.705). Performance in MH courses is strongly associated with clinical competence during internships, even more so than basic medical science scores. These findings suggest that integrating the humanities into medical curricula can better prepare skilled and compassionate physicians. Further studies should explore the long-term benefits of MH engagement.

Keywords: Medical humanities, Medical education, Clinical competence, Internship performance, Machine learning

Introduction

In 1984, Eric Cassell highlighted the growing role of the humanities in medicine, extending beyond the domain of bioethics and underscoring the reciprocal relationship between health and the humanities. This convergence opened opportunities to examine philosophical, historical, and literary perspectives on illness and healing [1]. Originating in the United States in the 1960s, the field of medical humanities (MH) sought to re-establish the long-neglected bond between medicine and the arts [2]. Medical humanities curricula (MHC) now draw from a wide range of disciplines—including literature, philosophy, ethics, history, theology, anthropology, psychology, sociology, and the arts—to broaden the educational foundation of future healthcare professionals [3, 4]. Scholars have described four main rationales for MH: intrinsic, instrumental, critical, and epistemological [5]. Respectively, these emphasize the humanistic dimension of education, its practical value for clinical skills, its ability to critique medical and educational

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practices, and its recognition of the humanities as essential to medical knowledge and practice [6–10]. Collectively, these perspectives enable learners to engage with the complex human dimensions inherent in medical practice.

Historically, medical training prioritized scientific knowledge and technical competence, focusing on accuracy in diagnosis and effectiveness in treatment through rigidly structured programs [11–13]. While successful in some respects, this model often contributed to burnout, as students were burdened with rote memorization and little time for reflection [14, 15]. Over the past decades, MHC have gained recognition as vital components of comprehensive training, cultivating skills and values that extend beyond clinical procedures. These include critical thinking, ethical reasoning, cultural awareness, and the ability to manage ethical dilemmas. For instance, research has shown that art-based exercises can sharpen the observational skills of medical trainees [16]. Moreover, by drawing on historical and social perspectives, MHC invites learners to appreciate the varied experiences of patients, providers, and communities, ultimately nurturing empathy and a richer understanding of the human condition. When such humanistic approaches are neglected, empathy and compassion may decline during clinical practice, adversely affecting diagnostic accuracy, treatment adherence, patient satisfaction, and overall quality of care [17].

Integrating MH into medical education thus contributes to both personal and professional development. Physicians trained in these curricula demonstrate numerous benefits, such as improved communication, empathy, cultural competence, teamwork, reflective practice, observational acuity, stress management, and ethical reasoning [18, 19]. Yet, a persistent tension exists within contemporary medical training. While students are often exposed to MH during the preclinical phase to promote patient-centered values, these lessons are frequently undermined later by a culture that prizes efficiency, productivity, and performance metrics [20]. The inclusion of MH as a compulsory component of curricula remains debated. Critics argue that it is not essential and may even detract from mastery of core biomedical knowledge [21, 22]. Such arguments reflect a perception among many students that MH stands apart from the core of medical learning.

Although evidence indicates that positive experiences in medical humanities (MH) can support future success, research has yet to establish a direct relationship between the number of medical humanities courses (MHC) taken and students' later academic performance [23]. Consequently, little is known about how MHC influences clinical training and internship outcomes. In Taiwan, internship performance is measured through a comprehensive system that combines written exams on medical knowledge with practical evaluations. These include 360-degree feedback from interns, residents, and nursing staff, and in some departments, patient assessments as well. In addition, attending physicians evaluate students in outpatient settings across six key competencies: medical knowledge, communication, professionalism, teamwork, continuous learning, and patient care. Through these competencies and patient interactions, qualities such as cooperation and empathy are indirectly assessed, ensuring that both clinical ability and interpersonal skills are thoroughly evaluated.

Based on this background, the present study was designed with three aims:

1. To examine whether MH grades can predict medical students' internship performance.
2. To evaluate the independent contribution of MHC grades to internship outcomes.
3. If MH proves predictive, it will be used to identify which MH subfields have the most significant influence.

Material and Methods

Study participants and data collection

This cohort study involved medical students from the National Yang-Ming University School of Medicine, spanning eight enrollment years from 2011 to 2019. Academic data for each student were gathered across their 6–7 years of training. Most students had been admitted based on their scores in Taiwan's General Scholastic Ability Test (GSAT) and Advanced Subjects Test (AST), nationwide entrance exams held annually in January and July. Demographic information, including age, gender, residence, cumulative GPA, and individual course grades, was obtained through the registrar's office. The study received approval from the Institutional Review Board (IRB) at Taipei Veterans General Hospital (approval number 2023–08-008AC). It was conducted in line with IRB ethical standards, ensuring confidentiality, privacy, and responsible handling of participant data.

Categorization of the medical curriculum

Taiwan's medical program follows a structured pathway beginning with a four-year preclinical phase, which includes two years of liberal education and foundational medical sciences, followed by a two-year clinical phase. After this, students move into a clerkship or internship lasting two to three years. In this system, clerkship students are roughly equivalent to third- or fourth-year medical students in graduate-entry programs in Western countries.

For analysis, the curriculum was divided into four categories based on subject matter and sequence:

1. *Medical humanities (MH):* Courses such as medical ethics, philosophy of life, medical sociology, cultural studies, communication, interpersonal skills, psychology, mental health, and the integration of humanities with medicine.
2. *Basic medical sciences:* Subjects including anatomy, biochemistry, microbiology, embryology, pathology, physiology, and pharmacology.
3. *Clinical education:* Courses taken after basic sciences, covering specialties such as Internal Medicine, Surgery, Pediatrics, Obstetrics and Gynecology, Radiology, Ophthalmology, Dermatology, and Psychiatry.
4. *Internship performance:* Grades earned during 1–2 years of hospital-based rotations before graduation.

By comparing these four curriculum categories, this study aimed to clarify their respective roles in shaping medical training and student performance in Taiwan.

Data transformation and variable selection

To apply machine learning in predicting how different curriculum categories affect internship outcomes, internship grades were converted from continuous values into binary variables. Students whose grades were above the overall median were placed in one group, while those below the median formed the comparison group. To maintain data quality, courses with low enrollment—such as Traditional Chinese Medicine—were excluded from the analysis. In addition to curriculum-related factors, other independent variables were considered, including gender, age at admission, entry pathway (type of entrance exam), whether students had repeated a year, and the number of failed courses. This process enabled a more comprehensive examination of how both academic and demographic variables impact internship performance.

Statistical analysis and model selection

The analysis focused on the four curriculum domains: MH, basic medical sciences, clinical education, and internship performance. The complete workflow for data collection, categorization, and statistical modeling is presented in **Figure 1**. Internship performance grades were treated as the outcome variable, while the remaining three domains served as predictive features. Each domain was further subdivided according to course categories. Beyond academic grades, additional predictors, including gender, admission method, course repetition, and admission-exam retake status, were also incorporated into the model.

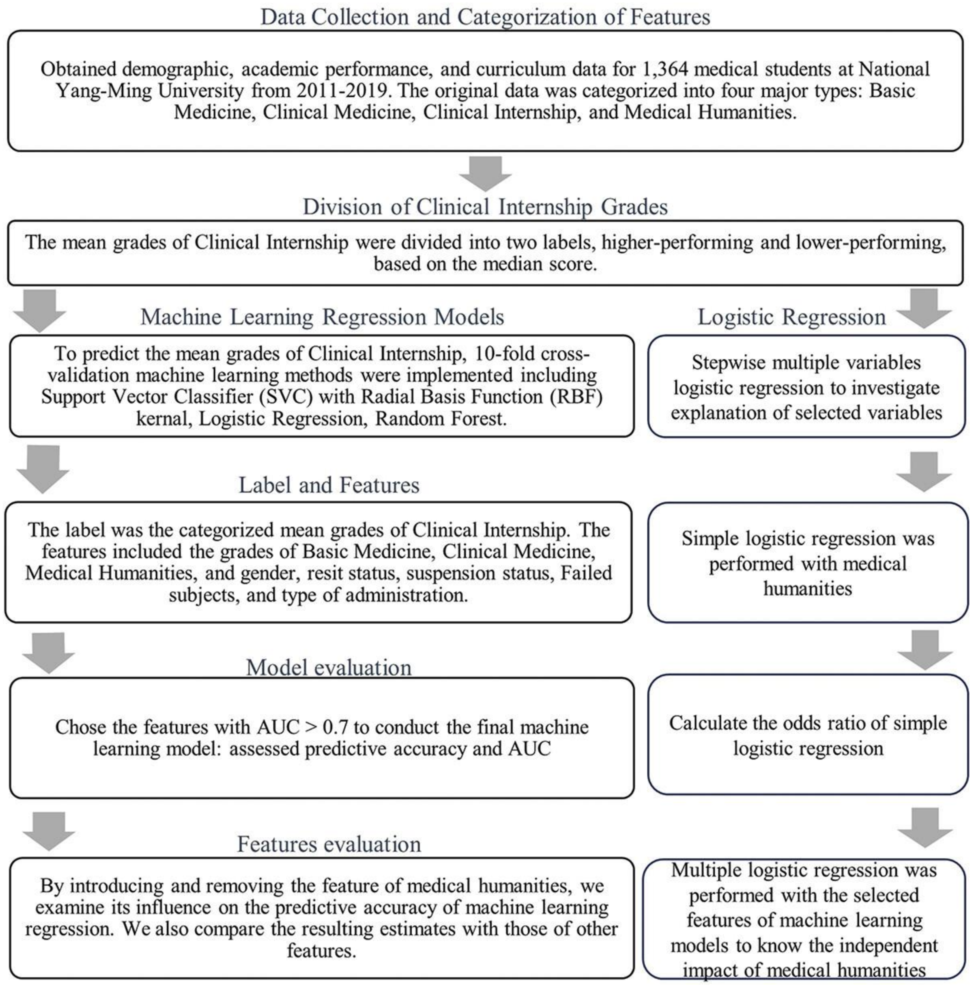

Figure 1. The flow chart of the analytical method

For the **first aim,** predicting students' academic performance, we applied three well-established machine learning classification models: logistic regression, support vector classification (SVC) with a radial basis function (RBF) kernel, and random forest (RF) [24]. These models were chosen due to their proven effectiveness in classification tasks. Logistic regression, a widely used binary classification method, offers both simplicity and interpretability. It is computationally efficient, avoids overfitting with moderate datasets, and provides clear insights through regression coefficients. The SVC with RBF kernel was selected for its ability to model complex, non-linear relationships by identifying an optimal separating hyperplane. SVM models, particularly those using RBF kernels, have consistently demonstrated strong predictive accuracy across diverse datasets [24]. Random forest, an ensemble method that aggregates multiple decision trees, was included for its robustness, high precision, and capacity to handle both linear and non-linear data. By averaging outputs from many decision trees, RF effectively reduces overfitting and is considered one of the top-performing classifiers in comparative studies [24]. Model performance was assessed using four metrics: accuracy, precision, recall, and the area under the receiver operating characteristic curve (AUC).

We evaluated models using a **10-fold cross-validation** strategy [25]. In each iteration, one fold served as the test set while the remaining nine were used for training. This process was repeated 10 times, and the results were averaged to provide overall model performance [26]. AUC was the primary evaluation metric, with a threshold of greater than 0.7 used to identify significant predictors. Variables exceeding this threshold were retained for further modeling. The final predictive models were refined through iterative inclusion and exclusion of

MHC, allowing us to determine their role in forecasting clinical internship performance. Descriptive statistical analysis was also conducted to identify differences between groups, and regression models were adjusted accordingly to account for potential confounders.

For the **second aim,** we examined the independent effect of MH on internship performance using both simple and multiple logistic regression analyses, implemented in SAS 9.4. In multivariate models, we controlled for confounders and incorporated significant predictors identified from machine learning (AUC > 0.7). Additionally, stepwise logistic regression was performed in SAS to compare results from traditional regression-based feature selection with those from machine learning.

For the **third aim,** subgroup analyses were carried out using machine learning to assess the effect of six specific MH subfields on internship performance. These subfields included: medical ethics and philosophies of life, medical sociology and cultural studies, communication skills and interpersonal relationships, psychology and mental health, integration of humanities and medicine, and others. This allowed us to identify which components of MH contributed most strongly when MH as a whole emerged as a significant factor.

Results and Discussion

A total of 1,364 students were included in the study. Participants were stratified into two groups based on MH performance: those scoring above the median (n = 682) and those scoring below the median (n = 682). Statistical analysis revealed significant group differences in gender, admission pathway, exam retake status, and the number of failed courses. The above-median group contained a higher proportion of female students compared to the below-median group (23.46% vs. 11.44%, P < 0.0001). Students in the above-median group were less likely to be admitted through the AST compared to the below-median group (20.53% vs. 29.33%, P < 0.0001). Furthermore, students in the above-median group had a lower proportion of failed subjects than those in the below-median group (32.48% vs. 46.41%, P < 0.0001) **(Table 1)**.

Table 1. Comparing the demographic and academic characteristics of students with better and poorer performance in medical humanities (above and below the median score in medical humanities)

Variable	Above median group		Below median group		P-value
	N	%	N	%	
Total	682	50%	682	50%	< 0.0001
Female	320	23.46%	156	11.44%	
Admission-exam retakers	140	10.26%	191	14.00%	< 0.01
Experiencing suspensions from studies	18	1.32%	26	1.19%	0.220
Never having failed a subject	633	46.41%	443	32.48%	< 0.0001
Admission by AST [a]	280	20.53%	400	29.33%	< 0.0001

[a]AST = advanced subjects test, university entrance examination in Taiwan for high school students, including medical programs.

The predictive performance of three machine learning models— support vector classification (SVC), logistic regression, and random forest—was examined in relation to internship outcome prediction. The evaluation was carried out under two conditions: incorporating medical humanities (MH) variables **(Table 2a)** and excluding them **(Table 2b)**. When MH variables were included, logistic regression emerged as the strongest overall predictor, yielding an accuracy of 0.689 and an AUC of 0.781. SVC also demonstrated robust predictive capability, achieving an accuracy of 0.688 with an AUC of 0.748. By comparison, random forest delivered weaker results, with an accuracy of 0.66 and the lowest AUC among the three models at 0.725.

Table 2. The machine learning prediction model of the impact of medical humanities on internship performance

	Accuracy	Precision	Recall	AUC
(a) Construction of machine learning models using subjects with an AUC > 0.7				
SVC with RBF	0.688	0.674	0.677	0.748
Logistic regression	0.689	0.678	0.680	0.781

Random forest	0.660	0.647	0.653	0.725
(b) Construction of machine learning models using subjects with AUC > 0.7, excluding medical humanities				
	Accuracy	Precision	Recall	AUC
SVC with RBF	0.681	0.666	0.667	0.698
Logistic regression	0.674	0.658	0.656	0.742
Random forest	0.628	0.599	0.603	0.660
(c) Construction of machine learning models using medical humanities only				
	Accuracy	Precision	Recall	AUC
SVC with RBF	0.641	0.662	0.677	0.756
Logistic regression	0.641	0.651	0.675	0.759
Random forest	0.562	0.572	0.585	0.645
(d) Construction of machine learning models using subjects with AUC > 0.7 and demographic variables (gender, never having failed a subject, admission by AST)				
	Accuracy	Precision	Recall	AUC
SVC with RBF	0.693	0.683	0.683	0.760
Logistic regression	0.662	0.652	0.667	0.739
Random forest	0.675	0.661	0.667	0.751

SVC = support vector classification, RBF: radial basis function, AUC: area under the curve.

Removing MH variables from the feature set led to a noticeable reduction in predictive accuracy across all models. Logistic regression remained the best-performing classifier, but its accuracy fell to 0.67. SVC showed a similar drop, reaching 0.681, while Random Forest experienced the most significant decline, with accuracy decreasing to 0.628.

When MH was modeled independently **(Table 2c)**, both Logistic Regression and SVC with an RBF kernel performed well, yielding accuracies of 0.641 and AUC values of 0.759 and 0.756, respectively. In contrast, random forest produced weaker results, with an accuracy of 0.562 and an AUC of 0.645. Adjusting for potential confounders—gender, absence of failed courses, and admission via AST—within the set of predictors that had an AUC > 0.7 resulted in reduced model performance. Specifically, the AUC declined from 0.781 to 0.739, while accuracy and precision dropped from 0.689 to 0.662 and from 0.678 to 0.652, respectively **(Table 2d)**. Findings from conventional logistic regression further reinforced the influence of MH on internship outcomes. When assessed as the sole predictor **(Table 3a)**, MH showed a strong coefficient estimate of 0.354. In the full model including all predictors **(Table 3b)**, MH continued to demonstrate the largest effect size (0.252). By comparison, coefficients for other domains were much smaller: biology and biochemical genetics (−0.008), microbiology and immunology (0.022), anatomy (0.0462), and clinical skills training (0.095).

Table 3. Simple and multiple logistic regression analyses examining the influence of medical humanities on internship performance

	OR	**95% confidence limits**		**P-value**
(a) Simple logistic regression				
Medical humanities	1.426	1.355	1.500	< 0.0001
(b) Multiple logistic regression				
Biology and biochemical genetics	0.992	0.958	1.027	0.639
Microbiology and immunology	1.022	0.979	1.067	0.326
Anatomy	1.047	1.017	1.079	< 0.005
Clinical skills	1.100	1.061	1.140	< 0.0001
Medical humanities	1.287	1.212	1.366	< 0.0001

OR = odds ratio.

In the stepwise logistic regression analysis, medical humanities (MH) was selected first, accounting for 29.49% of the variance in internship outcomes. Clinical skills emerged next, contributing an additional 12.81% to the explained variance. Other factors, including gender and basic sciences (1e), were incorporated later but had comparatively minor impacts on the model.

To explore the predictive value of specific aspects of MH, we assessed six medical humanities curriculum (MHC) categories using support vector classification (SVC), logistic regression, and random forest **(Table 4)**. Mirroring the earlier overall MH findings, logistic regression showed the strongest performance for two particular categories. For *medical sociology and cultural studies*, it achieved an AUC of 0.710, and for *communication skills and interpersonal relationships*, an AUC of 0.705. SVC also produced meaningful predictions, with AUCs of 0.706 and 0.678 for the respective categories. By comparison, Random Forest demonstrated lower predictive ability, with AUCs of 0.662 for *medical sociology and cultural studies* and 0.641 for *communication skills and interpersonal relationships*.

Table 4. The machine learning prediction model of the impact of subgroup medical humanities on internship performance

	Accuracy	Precision	Recall	AUC
(a) Medical ethics and philosophies of life				
SVC with RBF	0.580	0.599	0.603	0.664
Logistic regression	0.593	0.606	0.617	0.667
Random forest	0.560	0.573	0.577	0.589
(b) Medical sociology and cultural studies				
SVC with RBF	0.629	0.628	0.635	0.706
Logistic regression	0.631	0.620	0.631	0.710
Random forest	0.623	0.611	0.621	0.662
(c) Communication skills and interpersonal relationships				
SVC with RBF	0.673	0.625	0.631	0.678
Logistic regression	0.678	0.639	0.631	0.705
Random forest	0.641	0.583	0.581	0.641
(d) Psychology and mental health				
SVC with RBF	0.568	0.558	0.571	0.606
Logistic regression	0.541	0.556	0.568	0.637
Random forest	0.577	0.541	0.554	0.587
(e) Integration of humanities and medicine				
SVC with RBF	0.569	0.586	0.595	0.655
Logistic regression	0.577	0.591	0.600	0.664
Random forest	0.574	0.571	0.579	0.603
(f) Others				
SVC with RBF	0.573	0.495	0.526	0.552
Logistic regression	0.554	0.515	0.512	0.512
Random forest	0.594	0.568	0.548	0.617

SVC = support vector classification, RBF = radial basis function.

This study highlights the significant role of medical humanities curricula (MHC) in predicting the internship performance of medical students. Analyzing data from 1,364 students across eight cohorts, covering four curriculum categories—basic sciences, clinical skills, internship performance, and humanities—revealed that MHC demonstrated the strongest association with internship grades within machine learning models. When MH variables were excluded, both support vector machines and logistic regression showed reduced predictive performance. For example, the AUC for logistic regression decreased from 0.781 to 0.742 upon removing humanities. This decline suggests that other factors, such as gender, subject failures, and admission pathways, may act as confounders affecting the predictive relationships. Further research is needed to clarify the mechanisms through which these confounders influence model accuracy and to optimize predictive adjustments accordingly.

Regression analyses further reinforced the prominent influence of MH on internship outcomes. Logistic regression coefficients indicated that humanities exerted a stronger effect than other variables, including core basic sciences and clinical skills. Following multivariable adjustment, the coefficient for humanities was 0.252, notably higher than the coefficients for biology and biochemical genetics, microbiology and immunology, anatomy, and clinical skills training. Even when considered as the sole predictor, MH retained substantial predictive power, accounting for a considerable portion of the variance that can be explained. Stepwise regression confirmed this pattern, with humanities emerging as the primary predictor, explaining 29.49% of variance in internship grades, whereas clinical skills added only 12.81% after humanities were included. Collectively, these results underscore the integral contribution of MHC to the development of clinical competencies during the internship period.

Among the various humanities domains, curricula in medical sociology, cultural studies, and communication skills, as well as interpersonal relationships, were particularly influential. Incorporating medical sociology into training equips students with a comprehensive understanding of holistic healthcare models, the evolution of Taiwan's medical culture, and community-based care systems [27]. Beyond theoretical knowledge, these courses offer experiential learning through volunteer activities, enabling students to engage with diverse communities and deepen their sociological awareness. Such immersion not only strengthens clinical competencies but also promotes essential communication skills grounded in empathy and mutual understanding [28, 29]. Likewise, developing clinical communication skills is critical, as effective communication is widely recognized as a core competency for healthcare practitioners [30, 31]. Our findings reinforce the value of MHC in cultivating these essential skills, with particular emphasis on medical sociology and communication-focused curricula.

Several limitations should be acknowledged. The single-institution design limits generalizability, and inclusion of multiple medical schools could provide a more representative view of MHC benefits. The observational nature of the study also precludes definitive causal conclusions; experimental designs manipulating human exposure would better establish direct effects. Self-selection bias may exist, as students opting for humanities electives might already possess relevant interests or aptitudes. However, the mandatory structure of many MHC courses mitigates this concern. Lastly, the study primarily assessed academic outcomes such as GPA. Expanding the scope to include measures of empathy, teamwork, and communication could reveal additional benefits of humanities education beyond scholastic performance.

Conclusion

Overall, the findings of this study support the integration of the humanities as an essential element of medical education, highlighting its critical contribution to the development of clinical competencies in future physicians. Humanities curricula foster a broad set of skills—including observation, critical thinking, ethical judgment, self-reflection, and communication—that enhance performance during the intensive clinical experiences of internships. Consequently, the medical humanities deserve increased attention and investment within medical school programs globally, promoting the growth of compassionate and well-rounded healthcare professionals. Future research should extend these findings by exploring long-term outcomes across multiple institutions, employing experimental designs, and examining a broader spectrum of competencies influenced by engagement with the humanities.

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