

Implementation of a dermatology skin of color educational module for medical students

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Abstract

Research in dermatology education highlights the lack of skin of color (SOC) instruction for medical students, leading to concerning healthcare outcomes. Because of the already limited opportunity for students to have dedicated teaching in pathophysiology, management, and treatment of dermatologic diseases in medical school, we developed an educational module that addresses these gaps. We created a one-hour virtual lecture for medical students focused on common skin diseases tested on the United States Medical Licensing Examination with visual images across all skin types. A questionnaire was administered before and after the educational module to assess outcomes comparing disease identification in lighter (Fitzpatrick scale I-III) versus darker (Fitzpatrick scale IV-VI) skin tones and to determine medical school student attitudes. An analysis of 43 examination scores before, and after attending the educational module determined rosacea, psoriasis, and basal cell carcinoma to be conditions in SOC patients that demonstrated the most significant improvement (47.3%, 54.9%, and 30.8%, respectively). Our results also highlighted worse performance outcomes for diseases in SOC in the pre-examination questionnaire. Thus, our study indicates that a concise education module focused on disease presentations inclusive of all skin types may efficiently increase students' ability to identify diseases commonly misdiagnosed in the clinical setting.

Keywords: dermatology, education, Fitzpatrick, skin of color, survey, USMLE

Introduction

The lack of skin of color (SOC) inclusion in medical education links to poorer dermatologic clinical outcomes in patients [1]. Medical literature often lacks representation of SOC imagery. One study found an overrepresentation of light skin in three of four commonly-used textbooks, with only 4.5% of overall imagery representing darker skin [2]. In addition, the First Aid 2020 resource for the United States Medical Licensing Examination (USMLE) Step 1 examination had no SOC representation for over 77% of conditions. Only 11% of images in the dermatology section were of SOC [3]. In addition, among other widely used preparatory resources like question banks for the STEP 1 exam, SOC comprised only 15% of all medical imagery [4]. Poor exposure to SOC conditions in medical training manifests in the clinical setting; studies have noted high rates of misdiagnosis and mismanagement in patients with darker skin [5,6]. Given the diversification of the US population and the increasing number of patients with SOC, the impacts of diagnostic disparities among patients with SOC will likely compound in the years ahead. Therefore, exposure to SOC dermatologic disease presentations represents a growing unmet need [7].

Previous studies implementing several month-long voluntary modules have demonstrated benefits in SOC diagnostic accuracy [8]. Although previous implementations have been effective, there may be a case for a more concise format, with a diagnostic focus comparing both SOC and non-SOC presentations. Thus, we believe that developing an

education module that addresses these needs will be successful in training future medical students to recognize common cutaneous skin conditions seen in the clinical setting.

Methods

To increase exposure to dermatologic conditions and their varied presentations in different populations and skin types, we designed and implemented an educational module delivered in a 1.5-hour virtual format over the Zoom digital conferencing platform during spring 2022. The module specifically consisted of a one-hour lecture and a 15-minute questionnaire before and after the lecture. The participants were medical students enrolled at the Icahn School of Medicine at Mount Sinai. The educational module was advertised through the student Email network and recruitment information emphasized the module as an educational opportunity to improve clinical familiarity with high-yield board examination dermatology topics, with a particular focus on cutaneous presentations in SOC. Lecture content was developed and structured after the published USMLE content [9]. The material chosen for the educational module was based on commonly misdiagnosed dermatologic conditions in SOC patients and underrepresented images in education resources for board examinations [10,11]. The educational module included images collected from VisualDx.com, Amboss.com, peer-reviewed published articles, and First Aid for the USMLE Step 1 2021 that in total represented over 30 common cutaneous conditions and nearly 70 clinical disease presentations across all skin types. Skin of color was defined as Fitzpatrick types IV-VI and non-SOC was defined as Fitzpatrick types I-III, in concordance with other educational studies in dermatology [10].

To assess the effectiveness of the educational module and improvement in clinical performance after implementation, students completed a pre-

and post-module questionnaire. Questionnaires included a series of twenty multiple choice questions with two images for each of the 10 different skin conditions. Each image was presented individually and randomized. One image for the skin condition was designated as representative of dermatologic disease found in SOC patients and the other of lighter tone. All images identified as SOC on the examination were of type IV-VI on the Fitzpatrick scale, whereas the dermatologic diseases found on lighter skin tones were of type I-III. Images used for the testing portion of the education module were collected from VisualDx.com for standardization purposes.

Demographic information and level of training were also requested, as well as attitudes towards dermatologic competency, comfort with SOC presentations, and views on existing medical school curricula, all of which were self-reported and analyzed on a 3-stage Likert scale (1=disagree/strongly disagree, 2=neutral, 3=agree/strongly agree). The post-module questionnaire was nearly identical, with the only modifications being revised phrasing on questions surrounding attitudes, competency, and comfort to better assess changes following the module. All statistical analyses were performed using a t-test.

Results

Of 46 participants who completed the pre-questionnaire and began the module, the response rate in the post-questionnaire was 43 (93.48%); therefore, the set of complete responses from 43 individuals was utilized in this analysis. Among clinical questions, scores were significantly higher in the post-questionnaire ($P < 0.001$), with mean post-test accuracy (53%) being over twice that of the pre-test (25%), (**Table 1**).

In the pre-questionnaire before lecture administration, participants were significantly more

Table 1. Overall pre- and post-test performance (N=43).

Variable	Mean % correct	Standard error (%)	Standard deviation (%)	95% Confidence interval
Pre-test	25	1	10	22-28
Post-test	53	3	19	47-59

Table 2. Pre- and post-test questionnaire data stratified by specialty interest, medical school year, sex, and race/ethnicity (N=43).

	Survey participants (N=43)	Pre-test % correct	Significance	Post-test % correct	Significance	Difference between pre- and post-test % correct	Significance
Specialty interest							
Other	35	23.1	P=0.0130	52.2	P=0.8032	29.1	P=0.1926
Dermatology	8	31.5		54.2		22.7	
Medical school year							
Year 1	9	19.0	P=0.1376	32.3	P=0.0070	13.3	P=0.0263
Year 2	26	25.8		57.1		31.3	
Year 3	8	27.4		60.7		33.3	
Sex							
Male	19	23.8	P=0.6025	49.6	P=0.3750	25.8	P=0.5234
Female	24	25.4		55.0		29.6	
Race/ethnicity							
White	17	24.4	P=0.3491	47.1	P=0.5235	22.7	P=0.3901
Black	8	28.0		56.5		28.5	
Latinx	1	9.5		57.1		47.6	
Asian	17	24.4		56.0		31.6	

likely to get non-SOC questions correct compared to SOC questions (P=0.001), and scores were significantly higher among students who indicated a professional interest in pursuing dermatology (P=0.013). Scores varied based on race/ethnicity or sex, though not significantly. However, both second- and third-year medical students scored significantly higher on the post-test than first-year medical students (P<0.003). Second-year medical students demonstrated a significantly greater improvement than first-year students (P=0.030). Post-questionnaire scores were found to be significantly higher in the case of non-SOC presentations when compared to SOC (P=0.042), but the scores did not vary by race/ethnicity or sex. The difference between pre- and post-test percent correct for non-SOC and SOC questions was similar and no significant differences in improvement were noted based on specialty interest, sex, or race (Table 2).

Significant performance improvements were noted among 9 SOC conditions and non-SOC conditions, with the exception of pityriasis rosea in non-SOC and tinea versicolor in SOC; the average percent improvement in accuracy was 4.53% greater in SOC presentations. The SOC conditions with the largest improvement were psoriasis (54.85%), rosacea (47.27%), and seborrheic keratosis (40.60%). Non-SOC conditions with the largest improvement were

tinea corporis (59.81%), basal cell carcinoma (37.61%), and seborrheic keratosis (32.05%), (Table 3).

Students expressed a need for medical school dermatology curricula as well as SOC disease education both before and after the module. Following the module, students reported feeling more comfortable diagnosing dermatology conditions in general and in SOC. Students also reported a greater understanding of the wide range of presentations that common dermatologic conditions can have in SOC and non-SOC and were more comfortable and confident with the dermatology content covered on the USMLE Step 1 or 2 examination after the module was complete (Table 4).

Discussion

Although nearly 30% of the United States (US) population seeks care for cutaneous conditions annually and over 5 to 8% of primary care visits involve dermatologic complaints, only 1% of medical schools require a third-year clinical rotation in dermatology [12,13]. Additionally, a survey completed by 137 allopathic US medical schools accredited by the Liaison Committee on Medical Education (LCME) identified only 12% of

Table 3. Percent improvement in post-test performance by dermatologic condition.

Condition	Skin of color (Fitzpatrick IV-VI)		Non-skin of color (Fitzpatrick I-III)	
	% Improvement	Significance	% Improvement	Significance
Basal cell carcinoma	30.84	P<0.001	37.61	P<0.001
Lichen planus	26.34	P<0.001	24.77	P<0.001
Pityriasis rosea	21.99	P<0.001	-5.51	P=0.407
Psoriasis	54.85	P<0.001	27.10	P<0.001
Rosacea	47.27	P<0.001	25.03	P=0.001
Seborrheic keratosis	40.60	P<0.001	32.05	P<0.001
Solar lentigo	16.08	P=0.012	19.46	P=0.024
Squamous cell carcinoma	19.67	P<0.001	12.84	P=0.028
Tinea corporis	28.97	P<0.001	59.81	P<0.001
Tinea versicolor	8.49	P=0.168	22.75	P<0.001
TOTAL				
% Improvement (P value)	27.96 (P<0.001)			
Skin of color % Improvement (P value)	30.12 (P<0.001)			
Non-skin of color % Improvement (P value)	25.59 (P<0.001)			

respondents to have a dedicated dermatology course in the preclinical curriculum. This discrepancy signals an opportunity for independent study by students to gain proficient knowledge in prevalent skin conditions seen in the clinical setting. U.S. Medical Licensing Examination also requires knowledge of diagnosis and skin pathology for medical students [9], thus reinforcing that these skills must be met during a student’s medical education. Reasons for reduced exposure in medical school include insufficient time within the regular curriculum, inability to incorporate relevant content within existing courses, and limited faculty capacity in teaching dermatology [12]. Increased exposure to foundational elements of dermatology in medical education represents an unmet need critical to improving the accuracy of future diagnoses by both general and specialized trainees [13].

Dermatology awareness among medical students is low, with diagnostic and treatment proficiency assessment scores below 50% in the literature [14]. In our study, we also observed similar findings, with students further indicating a need for dermatologic education. Our study reveals gaps in dermatologic knowledge in early medical training, which may continue into clinical practice, thereby potentially affecting patient care. For instance, less than 40% of primary care residents considered themselves

prepared to manage common dermatologic conditions due to a lack of medical school training received [15,16]. Approximately 47% of dermatologists and dermatology residents report that their prior training did not prepare them adequately in treating skin conditions seen in Black patients [17]. The lack of SOC education may lead to poor outcomes due to misdiagnosis or inappropriate treatment [10].

Additionally, students who self-indicated dermatologic interests scored significantly higher than others on the pre-test questionnaire, indicating the potential lack of sufficient exposure among those pursuing alternative specialties. These findings are particularly concerning due to the misalignment between limited dedicated instructional time and the growing prevalence of cutaneous conditions that future physicians will be exposed to in various fields [14].

Our educational module was implemented to address educational concerns surrounding dermatologic conditions with a particular focus on differences between SOC and non-SOC presentations in an efficient, informative, and accessible format for students of diverse clinical interests. The module was well-received, given that students generally were more comfortable with

Table 4. Pre- and post-test questionnaire attitudes data (N=43). All responses were on a 3-stage Likert scale (1=disagree/strongly disagree, 2=neutral, 3=agree/strongly agree).

	Mean	95% Confidence interval	Significance
Statement: "I now understand the wide range of presentations that common dermatology conditions can have in different skin types."			
Pre-test	1.58	1.36-1.81	P<0.001
Post-test	2.40	2.17-2.62	
Statement: "I now feel comfortable diagnosing dermatology conditions in general."			
Pre-test	1.26	1.10-1.41	P<0.001
Post-test	1.95	1.71-2.20	
Statement: "I now feel comfortable diagnosing dermatology conditions in skin of color patients."			
Pre-test	1.19	1.05-1.32	P<0.001
Post-test	1.93	1.70-2.16	
Statement: "I now feel comfortable about the dermatology content covered in the USMLE Step 1 or 2 exam."			
Pre-test	1.37	1.18-1.56	P<0.001
Post-test	2.21	1.99-2.43	
Statement: "There is an unmet need in medical school curricula to improve diagnosis of skin of color diseases."			
Pre-test	2.86	2.70-3.00	P=0.675
Post-test	2.81	2.67-2.95	

dermatologic conditions and standardized examinations following the course conclusion. The post-questionnaire revealed improvement in disease diagnostic accuracy, thus demonstrating the efficacy of the module. However, later-stage medical students saw greater improvement following the module, suggesting optimal implementation during more advanced years, when students' clinical knowledge bases are rooted in increased experience, in addition to a heightened incentive to learn in the context of more imminent board examinations. At the same time, post-questionnaire performance on non-SOC questions was more robust than on SOC questions, possibly related to a more substantial baseline knowledge derived from the ubiquity of similar-type images in medical school instructional materials. However, similar degrees of improvement from the pre- to post-questionnaires were seen in both non-SOC and SOC, indicating that our module may contribute meaningfully to a more diverse clinical repertoire.

The most significant improvements in identification of dermatologic conditions among SOC patients were seen in psoriasis and rosacea, both reportedly underdiagnosed in SOC populations within the clinical environment [18,19]. When comparing SOC and non-SOC patients, the largest improvement was seen in psoriasis and tinea corporis, respectively,

both among the top six contributors to the global burden of skin disease [20]. This suggests that if educational modules are designed carefully for cutaneous conditions of high impact and those with greater misdiagnosis rates among broad populations, diagnosis and treatment disparities can be mitigated among groups that already face barriers in accessing care and also the public at large [19].

There are several limitations to our study. The study was conducted at a single institution in a city in which dermatology is well represented due to multiple dermatology residency programs within close proximity. The sample size is limited, with smaller subgroups, and is composed of medical students who independently volunteered to participate in the module. The module was advertised as preparation for the USMLE licensing examination, thus possibly influencing the type of students seeking additional educational support. The module may be desirable to those who found their baseline dermatologic knowledge lacking or had an increased interest in the prospective field. Also, participants were at different stages in their medical school education, mostly year two, thus possibly skewing results in favor of increased interest to improve dermatologic education and identifying an existing lack of instruction in SOC disease from

year one. Further, the educational module does not assess long-term recall or retention, which is an important measure of education that extends beyond merely studying for an examination like the USMLE. Lastly, the use of Fitzpatrick skin type as a surrogate for pigmentary phenotype is a limitation as subjective determination of skin color does not accurately reflect the response to UV light and variation in skin color can be seen among racial and ethnic categories.

Conclusion

The overall findings of improved clinical proficiency in diagnosis suggest that the educational module's content and delivery were broadly informative for various dermatologic conditions across skin types,

received well by participants in its format, and reached educational goals. Educational modules like the one utilized here may have broader applications in enhancing clinical knowledge and appreciation of skin disease diversity among medical students.

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Potential conflicts of interest

The authors declare no conflicts of interest.

References

1. Yousuf Y, Yu JC. Improving Representation of Skin of Color in a Medical School Preclerkship Dermatology Curriculum. *Med Sci Educ.* 2021;32:27-30. [PMID: 34868730].
2. Louie P, Wilkes R. Representations of race and skin tone in medical textbook imagery. *Soc Sci Med.* 2018;202:38-42. [PMID: 29501717].
3. McNamara GP, To J, Chaudhry SB. Distribution of Skin of Color Representation in Medical Education Resources. *Dermatol Online J.* 2021;27. [PMID: 35130394].
4. Meckley AL, Presley CL, Szeto MD, et al. Skin of color representation in medical education: An analysis of National Board of Medical Examiners' self-assessments and popular question banks. *J Am Acad Dermatol.* 2022;86:e57-e59. [PMID: 34614435].
5. Adekun A, Onyekaba G, Lipoff JB. Skin color in dermatology textbooks: An updated evaluation and analysis. *J Am Acad Dermatol.* 2021;84:194-6. [PMID: 32335181].
6. Perlman KL, Klein EJ, Park JH. Racial Disparities in Dermatology Training: The Impact on Black Patients. *Cutis.* 2020;106:300-1. [PMID: 33471883].
7. Okoro U, Chau TQ, Kawaoka J, Wong V, Qureshi AA. Skin of Color in Preclinical Medical Education: A Cross-Institutional Comparison and A Call to Action. *Cutis.* 2021;108:204-9. [PMID: 34847000].
8. Slaughter C, Madu P, Chang AY, et al. Novel Education Modules Addressing the Underrepresentation of Skin of Color in Dermatology Training. *J Cutan Med Surg.* 2022;26:17-24. [PMID: 34340596].
9. USMLE Content Outline. 2022. https://www.usmle.org/sites/default/files/2022-01/USMLE_Content_Outline_0.pdf. Accessed on August 1, 2022.
10. Perlman KL, Williams NM, Egbeto IA, et al. Skin of color lacks representation in medical student resources: A cross-sectional study. *Int J Womens Dermatol.* 2021;7:195-6. [PMID: 33937492].
11. Al-Dabagh A, Davis SA, McMichael AJ, Feldman SR. Rosacea in skin of color: not a rare diagnosis. *Dermatol Online J.* 2014;20. [PMID: 25526008].
12. Cahn BA, Harper HE, Halverstam CP, Lipoff JB. Current Status of Dermatologic Education in US Medical Schools. *JAMA Dermatol.* 2020;156:468-70. [PMID: 32101260].
13. Murase JE. Understanding the importance of dermatology training in undergraduate medical education. *Dermatol Pract Concept.* 2015;5:95-6. [PMID: 26114062].
14. Ulman CA, Binder SB, Borges NJ. Assessment of medical students' proficiency in dermatology: Are medical students adequately prepared to diagnose and treat common dermatologic conditions in the United States? *J Educ Eval Health Prof.* 2015;12:18. [PMID: 25989840].
15. Buster KJ, Stevens EI, Elmets CA. Dermatologic health disparities. *Dermatol Clin.* 2012;30:53-9, viii. [PMID: 22117867].
16. Hansra NK, O'Sullivan P, Chen CL, Berger TG. Medical school dermatology curriculum: are we adequately preparing primary care physicians? *J Am Acad Dermatol.* 2009;61:23-9.e1. [PMID: 19409656].
17. Buster K, Yang L, Elmets C. Are dermatologists confident in treating skin disease in African-Americans. *J Invest Dermatol.* 2011;35.
18. Johnson SM, Berg A, Barr C. Recognizing Rosacea: Tips on Differential Diagnosis. *J Drugs Dermatol.* 2019;18:888-94. [PMID: 31524344].
19. Alexis AF, Blackcloud P. Psoriasis in skin of color: epidemiology, genetics, clinical presentation, and treatment nuances. *J Clin Aesthet Dermatol.* 2014;7:16-24. [PMID: 25489378].
20. Karimkhani C, Dellavalle RP, Coffeng LE, et al. Global Skin Disease Morbidity and Mortality: An Update From the Global Burden of Disease Study 2013. *JAMA Dermatol.* 2017;153:406-12. [PMID: 28249066].