Diagnosing and Managing Cutaneous Pigmented Lesions: Primary Care Physicians Versus Dermatologists

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BACKGROUND: Primary care physicians (PCPs) are often expected to screen for melanomas and refer patients with suspicious pigmented lesions to dermatologists.

OBJECTIVE: To assess whether there is a difference between dermatologists and PCPs in accurately diagnosing melanoma and appropriately managing (based on decisions to refer/biopsy) suspicious pigmented lesions.

DESIGN, PARTICIPANTS: A survey based on a random sample of 30 photographs of pigmented lesions with known pathology was administered to 101 dermatologists and 115 PCPs from October 2001 to January 2003.

MEASUREMENTS: Likelihoods that a photographed lesion was melanoma and that the lesion should be biopsied/referred were scored on a 1 to 10 scale. Accuracy of melanoma diagnosis and appropriateness of pigmented lesion management were compared between dermatologists and PCPs by using the areas under (AUC) the receiver operating characteristic (ROC) curves.

RESULTS: Dermatologists were superior to PCPs in diagnosing melanomas (AUC 0.89 vs 0.80, $P < .001$) and appropriately managing pigmented lesions (AUC .84 vs 0.76, $P < .001$). PCPs who tended to biopsy lesions themselves did better at managing pigmented lesions than PCPs who did not perform biopsies. Dermatology training during residency did not significantly improve the diagnostic accuracy of PCPs nor their management of pigmented lesions.

CONCLUSIONS: Dermatologists have both better diagnostic accuracy and ability to manage pigmented lesions than PCPs. Yet, there is a shortage of dermatologists to meet the demand of accurate melanoma screening. More innovative strategies are needed to better train PCPs and enhance skin cancer screening.

KEY WORDS: diagnosis; cancer; cancer screening; dermatology; primary care.

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Melanoma is a serious health concern representing the fifth most common invasive cancer in men and sixth in

women.¹ The incidence of melanoma continues to rise.^{2,3} Estimates for 2005 predicted 59,580 new cases of melanoma in the United States with 7,770 melanoma-related deaths.⁴ The early detection of melanoma is believed to dramatically improve survival since 5-year survival rates precipitously decline as the tumor thickness and stage increase. The 5-year survival for stage I melanoma is 91% to 95% versus 7% to 19% for stage IV.⁵

Currently, the standard screening method for preventing melanoma is a full-body skin examination by a health professional. Unfortunately, many medical professionals other than dermatologists may not be specifically trained in the early detection of melanomas. Primary care physicians (PCPs) are often expected to screen for melanomas and only refer to dermatologists when there is a high clinical suspicion of melanoma. However, if PCPs are not adept at diagnosing melanoma, then opportunities for early diagnosis and treatment could be missed. Conversely, the morphology of benign pigmented lesions can often mimic that of early melanomas, resulting in potentially unnecessary dermatology referrals, biopsies, and patient anxiety.

A few prospective studies have evaluated the diagnostic accuracy of fully trained PCPs and dermatologists for pigmented lesions,⁶⁻¹⁵ but they were limited by several features: calculating sensitivity only, not assessing appropriate management (biopsy or referral), and failing to account for random sampling error variability. This latter issue refers to the fact that the patients (or photos) and raters (physicians) in the study are drawn from a sample that can introduce sampling error and variability into diagnostic accuracy measurements. Most studies were also limited by small sample size and therefore lacked statistical power. Our recent meta-analysis showed that the cumulative data were insufficient to support the superiority of dermatologists or adequacy of PCPs for either accurately diagnosing or appropriately managing pigmented lesions.¹⁶

Our study was designed to address the limitations of previous studies and to more definitively answer whether there is a difference between dermatologists and PCPs in managing suspicious pigmented lesions and diagnosing melanoma. We

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used a series of photographs of pigmented lesions to evaluate both the diagnostic accuracy as well as the management skills of these 2 physician types using receiver operating characteristics (ROC) curves.

METHODS

Participants

From October 2001 to January 2003, we recruited dermatologists and PCPs from 4 sites: Atlanta (Emory University), Minneapolis (University of Minneapolis and the Minneapolis VA Medical Center [VAMC]), Dallas (University of Texas, Southwestern), and Chicago (Northwestern University). In all sites, physicians were recruited from the faculty of the respective academic departments as well as from community-based private practitioners. This was performed via personal contacts as well as from local, state, and regional physician group meetings. All participants were board-eligible or board-certified physicians in the appropriate specialty. The Institutional Review Board of each respective university approved the protocol and recruitment procedures.

Survey Development

The survey instrument consisted of a notebook containing 30 5×7 inch photos of pigmented lesions, 5 photos in each of the following categories: thin melanomas (≤ 0.75 mm Breslow thickness), medium thickness melanomas (1 to 4 mm), thick melanomas (>4 mm), compound nevi, seborrheic keratoses, and hemangiomas. We randomly selected these photos from a pool of 200 photos from the archives of the Dermatology Departments of Emory University, Minneapolis VAMC, and the University of Pennsylvania. At the time of selection, an acral lentiginous melanoma was included in the thin melanoma category. However, the thickness of the lesion was unknown so we did not include this photo in any of our subgroup analysis.

For each photo, dermatologists were asked the following 2 questions: (A) the likelihood that the lesion should be biopsied and (B) the likelihood that the lesion is a melanoma. Primary care physicians were asked the same questions except the first question was the likelihood the lesion should be referred to a dermatologist. Participants recorded their answer on a scale of 1 to 10. For part A, answering a "1" meant the physician would not biopsy or refer and a "10" meant they would definitely act. For part B, answering a "1" meant the lesion had the lowest likelihood of being a melanoma and a "10" meant the lesion had the highest likelihood.

Protocol

After providing verbal consent, the physician participants were given the photo survey and asked questions about their demographics, dermatology training, current practice, and comfort and frequency of screening for skin cancer. For PCPs, we also asked about their area of practice and tendency to biopsy lesions themselves.

We imputed missing data by averaging the participant's responses for similar type lesions. We imputed data for 20 PCPs (17%) and 19 dermatologists (18%). However, this accounted for only 1.1% and 1.5% of questions for PCPs and dermatologists, respectively. A total of 3 PCPs and 4 derma-

tologists were excluded for incomplete data that could not be imputed.

Statistical Methods

We compared the accuracy of melanoma diagnosis and appropriateness of lesion management for PCPs versus dermatologists by computing the area under the ROC curve. By comparing the participant's response on the 1 to 10 scale of agreement with the gold standard pathology report, we calculated the sensitivities and specificities for each response cut-point. We generated ROC curves for each physician by plotting "sensitivity" by "1 minus specificity" for each cut-point. For each ROC curve, we calculated an area under the curve (AUC), a standard measure of diagnostic accuracy, by the trapezoidal method.¹⁷ Our analysis compared the estimated mean AUC of all the ROC curves of the dermatologists to that of the PCPs.

Because the photos represent a random sample of patients, we applied a semiparametric method described by Dorfman et al.¹⁸ to account for the error variance in calculating the AUC. In the analysis, physician type (dermatologist or PCP) was the fixed effect. Because data were obtained from several study sites, physicians within study sites were also included as a random effect in the model. The *lme* routine in S-Plus¹⁹ was used to estimate and compare the AUCs of the 2 physician types. The same analysis was applied to PCPs with respect to residency training in dermatology.

Analysis of covariance (ANCOVA) was used to assess the relationship between diagnostic and management accuracy in order to account for the hierarchical structure of the data. Demographic data were analyzed by analysis of variance (ANOVA) for continuous data and logistic regression for dichotomous data to account for nesting of the physician type within sites.

RESULTS

Subject Demographics

A total of 223 physicians participated in the study; however, 4 dermatologists and 3 PCPs were excluded for incomplete data. Of the 216 physicians included in the final analyses, 47% (101) were dermatologists (Table 1). Among PCPs, the majority were Internists (56%) and family practitioners (37%). There were no statistically significant differences between PCPs and dermatologists for the following characteristics: gender, practice duration, number of days per week seeing patients, and proportion graduating from a U.S. medical school ($P > .2$ for all). Dermatologists were more comfortable with screening and more frequently screened their patients for skin cancer. None of the physician type $\times$ site interactions were statistically significant ($P > .05$). Sixty-nine percent of PCPs completed a dermatology rotation in medical school (45% had a 1 to 3 week exposure) and 50% during residency (78% had a 4 week exposure). Twenty-six percent of PCPs would biopsy lesions themselves rather than refer to a specialist.

Relationship Between Diagnostic Accuracy and Management Decisions

For dermatologists, the correlation between the perceived likelihood of melanoma and the decision to biopsy a lesion was 0.91 ($P < .001$). In other words, dermatologists chose to biopsy if they were more certain the lesion was melanoma, but did not

Table 1. Demographics – Dermatologists versus Primary care physicians (PCPs)

	Dermatologists (n=101)	Primary Care (n=115)	P Value
Site, no. (%)			
Atlanta	38 (39)	59 (61)	.05
Minneapolis	48 (51)	47 (49)	.33
Dallas	7 (88)	1 (13)	.02
Chicago	8 (50)	8 (50)	.80
Specialty, no. (%)			
Internal medicine		64 (56)	
Family practice		42 (37)	
Pediatrics		3 (3)	
Obstetrics-gynecology		2 (2)	
Geriatrics		1 (1)	
Unknown		3 (3)	
Male gender, no. (%)	59 (58)	66 (58%)	.93
Number of years in practice, mean (SD)	12.7 ± 9.1	13.5 ± 9.5	.50
Number of days per week seeing patients, mean (SD)	3.9 ± 1.1	4.0 ± 1.3	.68
Graduate of U.S. medical school, no. (%)	92 (92)	108 (96)	.27
Comfort screening patients for melanoma*	Agree (100%)	Agree (72%)	<.001
Frequency of screening patients for skin cancer†	Often (92%)	Often (59%)	<.001

*Answered “strongly agree” or “agree.”

†Answered “all the time” or “often.”

choose to biopsy if they thought the lesion was less likely to be melanoma. For PCPs, the correlation was also positive, but only 0.68 ($P<.001$), indicating less agreement between the perceived likelihood of the lesion being a melanoma and the decision to refer. The difference between the 2 correlations was statistically significant ($P<.001$).

ROC Curves

There is a greater variability among PCPs than dermatologists in diagnosing and managing pigmented lesions, demonstrated by the ratio of AUC variance in Table 2. Variance for the biopsy/refer question was 1.5 times greater for PCPs than for dermatologists, and over 2.5 times greater for the diagnosis question.

Figure 1 plots the average ROC curves for each physician type and each question. Table 2 lists the AUC for all melanomas as well as for the various thicknesses. For both questions, the AUC was significantly ($P<.001$) greater for dermatologists than PCPs. When looking at melanomas by thickness, the AUC remained significantly greater for dermatologists. However, for both dermatologists and PCPs, the AUC for the thin melanomas was substantially less than that for medium and thick melanomas.

PCP Analysis

We looked at whether certain characteristics of PCPs correlated with better diagnostic accuracy or more appropriate management. We found the AUC for the biopsy/refer question was significantly greater for those PCPs who tended to biopsy lesions themselves (AUC=0.85 vs AUC=0.74, $P=.002$), on par with dermatologists (AUC=0.84, $P=.67$). For the diagnosis question, the difference between the 2 groups of PCPs was not significant. In addition, dermatologists were superior to the PCPs who were inclined to biopsy (AUC=0.895 vs AUC=0.846, $P=.002$). Those PCPs who biopsied lesions themselves were more likely to have completed a dermatology rotation during residency (79% vs 31%, $P<.0001$), but not more likely to have done a rotation during medical school (61% vs 63%, $P=.55$). However, when we looked at dermatology training during residency for all PCPs, it was not a significant correlate of AUC for either question. Even when evaluating only the more subtle thin melanomas, dermatology training for PCPs did not significantly correlate with a greater AUC.

DISCUSSION

With the increasing incidence of melanoma in the United States, there is a need for accurate early diagnosis. While technologies are evolving in this effort, such as computerized dermoscopy,

Table 2. Estimated AUC for Physician and Melanoma Types

Melanoma	Question	Dermatologist AUC (95% CI)	PCP AUC (95% CI)	P Value	Ratio of PCP to Dermatologist AUC Variance
Thick	Biopsy/refer	0.92 (0.88 to 0.96)	0.84(0.76 to 0.93)	.005	2.20
	Diagnosis	1.00(0.98 to 1.00)	0.89(0.85 to 0.93)	<.001	5.56
Medium	Biopsy/refer	0.91(0.88 to 0.95)	0.84(0.76 to 0.92)	.004	2.22
	Diagnosis	0.99(0.97 to 1.00)	0.89(0.84 to 0.94)	<.001	4.53
Thin	Biopsy/refer	0.69(0.68 to 0.70)	0.61(0.56 to 0.66)	<.001	1.38
	Diagnosis	0.70(0.69 to 0.71)	0.62(0.56 to 0.68)	<.001	1.61
All	Biopsy/refer	0.84 (0.81 to 0.87)	0.76(0.69 to 0.83)	<.001	1.54
	Diagnosis	0.89(0.88 to 0.91)	0.80(0.75 to 0.84)	<.001	2.70

AUC, area under the curve; PCP, primary care physicians.

FIGURE 1. Average ROC curves for dermatologists and PCPs. Question A: likelihood the lesion should be biopsied/referred. Question B: likelihood the lesion is a melanoma.

the current gold standard remains a skin exam. This study suggests that given the trade-offs of sensitivity and specificity, dermatologists have better diagnostic accuracy and ability to manage pigmented lesions. Even with the more subtle thin melanomas, dermatologists still outperform PCPs for both diagnostic accuracy and appropriateness of management.

When we looked at the correlation between diagnostic accuracy and the management decision to biopsy or refer, dermatologists had a greater agreement between their assessment that the lesion was a melanoma and the likelihood they would biopsy the lesion. Conversely, even when PCPs had a lower suspicion for melanoma they were still inclined to refer the patient to a dermatologist. For PCPs this may be a good thing; along with the benign lesions, they may refer some of the thin melanomas that otherwise would have been missed. However, this also creates a larger volume of referrals and burden on dermatologists.

Compared with dermatologists, there was a greater amount of variance amongst PCPs in their diagnostic accuracy and ability to manage pigmented lesions. When we compared PCPs who tended to biopsy lesions themselves versus those who tended to refer, we found that those who biopsied had superior diagnostic accuracy and appropriate management, almost on par with dermatologists. These PCPs were more likely to have had dermatology training during residency, but that alone did not correlate with greater diagnostic accuracy. It may be that because these physicians often managed pigmented lesions on their own, they honed their clinical diagnostic skills.

This study has several limitations. First, the pigmented lesions were presented to physicians via photographs. Unlike dermatologists, PCPs are not trained and tested routinely with photographs. Lesions on live patients would be preferable since they are 3-dimensional and can be palpated. Another limitation is that we did not provide patient histories to accompany the photographs. Physicians may have been influenced in their decision to act upon a lesion if they knew about the duration of the lesion and the patient's melanoma risk factor profile. Additionally, the physicians completing our survey represent a convenience sample, which could have introduced

a selection bias. Our study is further limited because we did not have subjects commit to an action (refer or not refer, biopsy or not biopsy). Ultimately the management decision is a dichotomous one and can only truly be assessed when the physician is faced with a real patient. Finally, the management questions for the 2 physician types are different (biopsy vs refer). However, the aim of the question was to assess how well the physicians are managing suspicious lesions.

Despite the limitations of this study, our data provide valuable information for health policymakers. While dermatologists may have the most skill in performing full-body skin exams, the majority of early melanomas present to the PCP. Moreover, there is currently a shortage of dermatologists to meet existing demands.²⁰ Because of the increasing incidence of melanoma in the United States, it is unlikely that dermatologists will be able to supply the manpower to meet the demand of accurate melanoma screening. Therefore efforts to increase the early detection of melanoma must focus on improving PCPs' skill in performing skin cancer screenings as well as developing approaches that do not include PCPs.

Primary care physicians have a unique opportunity to provide skin cancer screening given the large number of patients seen for routine health examinations. Approximately 40% of office visits to physicians in the United States are to a family practitioner or internist²¹ and the majority of physician-detected melanoma is discovered by PCPs.²² One approach to improving the diagnostic skill of PCPs is to increase the amount of dermatology training in medical school and/or residency. However, our analyses demonstrated that 1 to 4 weeks of dermatology training does not impact PCPs' diagnostic accuracy of pigmented lesions.

Thus, other innovative strategies are needed to better train PCPs to manage pigmented lesions and to improve skin cancer screening. An internet CME program is 1 new approach that has been effective in training PCPs.²³ However, given PCPs have a limited time to manage a multitude of medical problems, early detection strategies need to be aimed outside the PCP setting. Some promising approaches include public education campaigns like that in Australia^{24,25} and genetic testing

for melanoma.^{26,27} All of these efforts promise to enhance the early detection of melanoma, thus improving survival from this devastating cancer.

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