SKIN

ORIGINAL RESEARCH

Cost-Benefit Analysis of the Pigmented Lesion Assay When Introduced Into the Visual Assessment / Histopathology Pathway for Lesions Clinically Suspicious for Melanoma

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ABSTRACT

Objective: To evaluate the potential savings to health plans when the Pigmented Lesion Assay (PLA) is incorporated into the assessment of pigmented lesions clinically suspicious for melanoma.
Methods: A Return on Investment (ROI) model was developed from a US payor perspective to determine the per member per month (PMPM) net savings impact of incorporating PLA into the visual assessment/histopathology (VAH) pathway. Using 2019 claims data for patients with lesions suspicious for melanoma (N=239,854), use of PLA in year 1 was modeled and followed through subsequent years. Costs were assessed through the pathway of initial visual assessment, surgical procedure(s), histopathology, and subsequent management.
Results: The ROI model predicted annual net savings of $0.54 PMPM for commercial health plans over a three-year period with incorporation of PLA into the VAH pathway. In this analysis, 95.7% of surgically assessed lesions clinically suspicious for melanoma were diagnosed as benign, with 30.4% of patients with benign lesions undergoing a more advanced procedure (e.g., excision), either initially or following a biopsy. Melanoma diagnosis rates associated with biopsy only, excision only, and biopsy followed by excision procedures in the VAH pathway were 0.9%, 0.1%, and 17.9%, respectively.
Conclusion: Incorporation of the PLA into the VAH pathway for assessing suspicious pigmented lesions results in savings for commercial health insurance plans. Use of the PLA improves patient care by using genomic assessments to minimize avoidable surgical procedures on benign lesions, enrich the population of melanomas diagnosed, and decrease downstream costs of late-stage melanoma diagnoses.

INTRODUCTION

The current care pathway for evaluation of pigmented lesions is visual assessment, followed by surgical biopsy and histopathologic assessment (VAH).[1] However, the significant overlap in clinical and histopathologic features that exists between benign and malignant nevi make the classification of pigmented lesions a challenge for even highly experienced clinicians and pathologists.[2, 3] The VAH pathway relies on image and pattern recognition/interpretation, which is subjective in nature.[1, 3, 4] This, paired with concern regarding potential consequences of missing a melanoma, has resulted in a VAH pathway with a relatively low sensitivity (65% for up to stage pT1a – 84% for all

melanomas) and a negative predictive value (NPV) of 83%.[3, 5-7] These findings demonstrate the need for objective, cost-effective technologies to help improve the assessment, classification, and management of pigmented lesions.

The PLA is a noninvasive test that objectively measures genomic markers associated with melanoma within skin tissue samples collected via adhesive patches.[8-10] The PLA is used to identify high-risk lesions (severely dysplastic nevi as well as in situ and invasive melanomas)[6, 11-13] and guide management to either a) biopsy and histopathologic evaluation or b) clinical surveillance.[6, 14, 15] Use of the PLA is supported by the National Comprehensive Cancer Network (NCCN) Guidelines, which state that pre-diagnostic noninvasive patch testing may be helpful to guide biopsy decisions (category 2A recommendation).[16] The PLA has a 91% sensitivity for melanoma and an NPV of over 99%; a lesion clinically suspicious for melanoma that tests negative by PLA has a less than 1% probability of being diagnosed histopathologically as a melanoma.[8, 17] Previous studies have demonstrated that utilization of the PLA increases accuracy of pigmented lesion classification as either benign or malignant and thus dramatically reduces surgical procedures currently used to rule out melanoma.[14] The current study aims to build on the clinical value of the PLA by investigating the economic value of the PLA in the assessment of suspicious pigmented lesions.

Return-on-investment (ROI) modeling is a method used by actuaries to prioritize risks and determine the most cost-effective option for managing those risks. ROI models developed for healthcare payors estimate the potential incremental financial "investment" (costs) relative to the "return" (cost-offsets/savings) for specific cohorts of health plan members. ROI models incorporate net-cost, member churn, and medical-cost offset scenarios, leveraging proxy client data from claims databases with sensitivity testing of various population and assumption scenarios. In this study, an ROI model was developed to evaluate potential savings for commercial health insurance plans when the PLA is introduced into the VAH pathway to guide management of pigmented skin lesions clinically suspicious for melanoma.

METHODS

The ROI model was developed from a health plan perspective and designed to assess the per member per month (PMPM) net cost/savings impact of incorporating PLA into the VAH pathway. The model was built from claims data, financial factor inputs, costs associated with the VAH pathway, PLA investment costs, assumptions related to lesion progression in non-detected melanomas, and the number of target members for PLA in a plan. The inputs are modifiable, allowing the user to customize the PMPM net cost/savings impact calculation to their plan's data and extrapolate aggregate year-over-year cost/savings to the plan.

Claims Data and Member Cohorts

Data were sourced from proprietary databases that contain claims data for approximately 13.8 million commercially insured members across the United States who had a plan covering both medical and pharmacy benefits between January 1, 2019 and December 31, 2019.[18] A subset of these data relevant to skin lesions clinically suspicious for melanoma (N=239,854) was used to develop the ROI model. To account

Table 1. Member Cohorts

Cohort	Definition
1 Suspicious lesion	• D48.5/D49.2 diagnosis code but no further treatment related to the suspected lesion • Excludes nonmelanoma codes including, but not limited to, C44.XX, D04.XX, D23.XX, and L codes (except 'L98.9', 'L98.8')
2a Benign lesion with 1 surgical procedure	• Benign diagnosis (D22) with biopsy/pathology procedures • Benign diagnosis (D22) or suspicious lesion (D48.5, D49.2) + advanced procedure (i.e., excisions, sentinel node biopsies, MOHS surgery)
2b Benign lesion with 2 or more surgical procedures	• Benign diagnosis (D22) with biopsy/pathology procedures + excision procedures • Suspicious lesion (D48.5, D49.2) with biopsy/pathology procedures + excision procedures
3 Non-advanced melanoma (managed by biopsy/excision)	• Melanoma diagnosis (C43/D03) with biopsy/pathology procedures • Melanoma diagnosis + excision procedures
4 Advanced melanoma (metastatic and/or managed with advanced treatment)	• Melanoma diagnosis (C43/D03) + metastatic diagnosis (C79.2) • Melanoma diagnosis (C43/D03) with advanced cancer treatments

Each member was allocated to the cohort hierarchically. (Cohort 4 → 1)

for different levels of costs associated with suspicious skin lesions of various diagnoses/management and estimate cost to the plan, four cohorts of skin lesions clinically suspicious for melanoma were classified based on diagnosis codes and/or procedure codes (Table 1 and Appendices 1-3).

Cost Estimation Methodology

The health plan cost for diagnosis and management of melanoma through the VAH pathway was determined and then compared to a pathway incorporating PLA to help guide patient management decisions. Using trended 2019 claims data, a population using PLA in year 1 was modeled and followed through subsequent years.[18] Assessments were made through the pathway of initial diagnosis of lesions suspicious for melanoma and procedures for biopsy, pathology, and subsequent treatments. Several differences were noted and modeled: 1) The use of the PLA compared to standard biopsy/pathology; 2) The shift in cost to the plan when providers use the PLA to guide patient management decisions based on the genomic results of the PLA instead of performing surgical procedures on pathologically benign lesions; 3) The shift in cost from genomic assessment and treatment of future melanoma, through objective criteria, compared to late-stage cancer treatment in future years.

Future costs[1] to the plan were estimated by using the historic costs for these pathways and trending them forward by historical medical cost trend (4%). Member churn rate (15%), the percentage of members in a plan who will leave the plan each year, and plan cost share percentage (84%) were applied to the model to determine the true cost to the plan.[19] From this, the model aggregated

[1] Only directly related costs are considered. See Appendix 3 for the definition of 'direct' costs.

future years and discounted the cost by prevailing interest rates estimated from the 10-year U.S. Treasury T-Bill rate (1%) to arrive at the cost in terms of dollars today.[20] Inputs for cost trend, churn rate, and cost share were based on claims dated between January 1, 2017 and December 31, 2019.[19]

Estimating Return-on-Investment

Figure 1 includes visual representations of the ROI model calculations, including Final Savings, Genomic Assessment Savings, Procedure Avoidance Savings, PLA Costs, and Plan Net Cost Per Member Per Month. Each variable is further described below.

Genomic Assessment Savings is a measurement of the cost savings realized due to genomic assessment of pigmented lesions suspicious for melanoma through incorporation of the PLA into the VAH pathway. The PLA identifies lesions at high risk for melanoma based on the presence of genomic markers associated with melanoma.[8, 11, 13] With histopathology, cellular atypia is detectable, but PLA detects genomic atypia, which cannot be ascertained visually.[11, 13] The additional non-advanced melanoma (managed by biopsy/excision) and advanced melanoma (metastatic and/or managed with advanced treatment) cases included in the calculation are assumed to be melanomas that would not otherwise be detected by the VAH pathway during a particular office visit and were derived using biostatistics from sensitivity analyses comparing VAH and PLA pathways.[3, 8, 21] The non-advanced/advanced melanoma costs per patient represent the costs that would be incurred by the plan based on the likelihood that the melanomas missed by the VAH

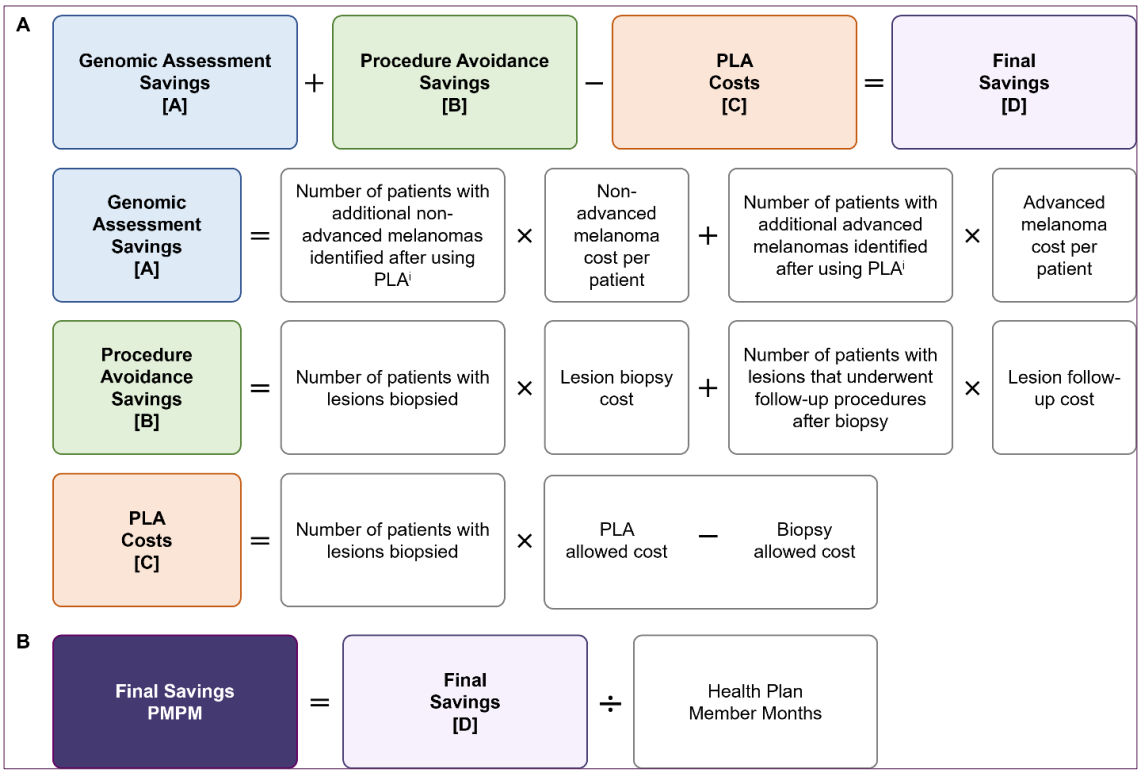

Figure 1. ROI Model Calculations
[i] Excludes melanomas detected via VAH pathway alone.
Non-advanced melanoma: managed by biopsy/excision
Advanced melanoma: metastatic and/or managed with advanced treatment

pathway during an office visit would be identified during the subsequent visit and how quickly the melanomas missed on the initial visit were likely to progress (Table 2).[22, 23] Financial factor inputs of cost trend, cost share, and interest rate were also used to calculate nonmelanoma/melanoma costs (Table 2).[19]

Procedure Avoidance Savings is a measurement of the cost savings realized due to not performing biopsies or follow-up treatments on non-malignant lesions as determined by the PLA. The number of patients with benign lesions that underwent biopsy with or without follow-up procedures and associated costs were based on 2019 claims data. A benign lesion follow-up procedure rate of 14.9% was used based on the claims data (Table 2).[18]

PLA Costs is a measurement of investment required for incorporating the PLA into the VAH pathway. The number of patients with lesions that underwent biopsy was based on 2019 claims data. PLA Allowed Cost inputs include the CMS allowable cost per PLA ($760)[24] as well as the average cost of an office visit to evaluate a suspected pigmented lesion ($190) and the average plan cost share (84%) based on 2019 claims data (Table 2).[18]

Figure 1B shows the calculation for plan net PMPM cost savings, calculated as the aggregate Final Savings divided by the Total Health Plan Member Months. Final Savings was calculated as Genomic Assessment Savings + Procedure Avoidance Savings – PLA Costs (Figure 1A). Total Health Plan Member Months is a direct measurement from experience data, which was derived from the 2019 claims data for the current study (Table 2).[18]

RESULTS

The demographics of the study population used for the ROI analysis and for the larger National Claims Database are summarized in Table 3. The study population subset included health plan members with a lesion clinically suspicious for melanoma (N=239,854). Claims associated with other dermatologic conditions (basal cell carcinoma, squamous cell carcinoma, actinic keratoses, warts, etc; see Table 1) were excluded from this analysis. The study population was 57.7% female; 95.7% of members were ≥18 years old. The proportion of lesions in Cohorts 1, 2a, 2b, 3, and 4 were 16.5%, 68.0%, 11.9%, 3.1%, and 0.5%, respectively (Table 4).

Return-on-Investment With PLA

The ROI model predicted the annual net cost/savings for commercial plans incorporating PLA into the VAH pathway. When using default values (Table 2), the ROI model predicted an annual net savings of $0.54 PMPM over a three-year period (aggregate savings of $5.66 million for a plan of 1 million members). Net savings were driven primarily by the increased sensitivity of genomic assessment compared to visual assessment (Genomic Assessment Savings).

Scenario and threshold testing was done to determine the sensitivity of the net PMPM savings at three years to various assumptions used within the Genomic Assessment Savings calculations of the ROI model (Table 2). The default value for additional melanomas identified by PLA was 26%, which was driven by sensitivity analyses comparing VAH and PLA pathways[3, 8, 21];

Table 2. Variables and Default Values

Variable Name	Variable Description and Assumptions	Default Values
Cost Trend	The annual trend applied to Medical and Pharmacy costs year-on-year changes[19,20]	Commercial: 4%
Interest Rate	Interest rate used for discounting, based on the 10-year U.S. Treasury T-Bill rate[20]	1%
Churn Rate	The percentage of members in a plan who will leave the plan each year[19,20]	15%
Cost Share	The percentage of plan's cost share[19,20]	Commercial: 84%
PLA Cost	Average allowed cost of PLA treatment[24]	$760
Suspicious Lesion Office Visit Cost	Cost of an office visit, based on the percentage of plan's cost share, to assess a lesion suspicious for melanoma.[18,20]	Commercial: $190
Benign Lesion with No Follow-up Procedure Cost	Direct cost (Medical + Rx) for benign lesion biopsy without follow-up procedure (subset of Cohort 2a)[18] *Represents total cost of receiving a biopsy.*	Commercial: $372
Benign Lesion with Advanced Procedure Only with No Follow-up Procedure Cost	Direct cost (Medical + Rx) for advanced procedure on a benign lesion, without follow-up procedures (subset of Cohort 2a)[18] *Represents total cost of receiving an advanced procedure instead of a biopsy.*	Commercial: $746
Benign Lesion with Follow-up Procedure Cost	Direct cost (Medical + Rx) for suspicious/benign lesion biopsy with follow-up procedure(s) (Cohort 2b)[18] *Represents total cost of receiving a biopsy and follow-up procedures.*	Commercial: $1,118
Benign Lesion Follow-up Procedure Rate	The number of patients with benign lesions that underwent biopsy with follow-up procedures (Cohort 2b) divided by the number of patients with benign lesions that underwent biopsy with or without follow-up procedures (subset of Cohort 2a + Cohort 2b)[18]	Commercial: 14.9%
Advanced Procedure Without Biopsy Rate	The percentage of cases in which the physician performed a more advanced surgical procedure without an initial biopsy (subset of Cohort 2a).[18]	Commercial: 15.5%
Additional Melanomas Caught by PLA	The percentage of additional melanoma patients identified through use of PLA among patients in "Melanoma with Biopsy/Excision" (Cohort 3) or "Advanced Melanoma" (Cohort 4)[3,20,21] multiplied by Market Share for PLA	26%
Progression to Melanoma	The percentage of patients who progress to melanoma from additional patients identified by PLA with no prior procedures/treatments (75%): 33% of lesions will be classified as nonadvanced melanoma (Cohort 3) and 67% will be classified as advanced melanoma (Cohort 4)[20,22,23]	Progression % = 75% Split Cohort 3 and 4 = 33% for Cohort 3 and 67% for Cohort 4
Total Health Plan Member Months	The sum of the number of months of coverage the population has over a full year[18]	145,134,689
Market Share for PLA	The percentage of patients who will receive PLA	100%

a 10% decrease in this rate (23.4%) resulted in $0.43 PMPM net savings (20% decrease), and a 10% increase in this rate (28.6%) resulted in $0.65 PMPM net savings (20% increase). The default value for progression to melanoma was 75%; a 10% decrease in this rate (67.5%) results in $0.48 PMPM net savings (9% decrease), and a 10% increase in this rate (82.5%) results in $0.59 PMPM net savings (9% increase). The default values for distribution in patients' progression to melanoma was 33%:67% for non-advanced to advanced melanoma; a 10% decrease in this rate for non-advanced melanoma (30%:70%) resulted in $0.58 PMPM net savings (9% increase), and a 10% increase in this rate for nonadvanced melanoma (36%:64%) results in $0.50 PMPM net savings (8% decrease).

Patient Outcomes

Surgical procedures and diagnostic outcomes were assessed in the study population. Of patients who received a diagnosis of "Neoplasm of uncertain behavior of skin" (D48.5) or "Neoplasm of unspecified behavior of bone, soft tissue, and skin" (D49.2), 83.5% received at least one surgical procedure to rule out melanoma (Table 4, Cohorts 2-4). Of these surgically assessed lesions, 4.3% were diagnosed as melanoma (number needed to biopsy: 23), and 95.7% were diagnosed as benign. In 15.5% of benign cases, the patient underwent a more advanced procedure (e.g., excision) instead of a biopsy for diagnosis. Another 14.9% of patients received additional advanced

Table 3. National Claims Database and Study Population Demographics (2019 Data)

	National Claims Database *Commercially insured members with a plan covering both medical and pharmacy benefits*		**Study Population Subset** *Subjects with lesions clinically suspicious for melanoma*	
	Counts[i] (N=13,822,351)	**Proportion of Total Count**	**Counts[i] (N=239,854)**	**Proportion of Total Count**
Region				
Northeast[ii]	2,250,823	16.3%	28,546	11.9%
Midwest[iii]	3,348,458	24.2%	53,907	22.5%
South[iv]	5,505,252	39.8%	108,128	45.1%
West[v]	2,717,818	19.7%	49,273	20.5%
Gender				
Male	6,997,655	50.6%	101,353	42.3%
Female	6,824,696	49.4%	138,501	57.7%
Age Band				
0-17	2,919,987	21.1%	10,241	4.3%
18-44	6,348,274	45.9%	94,743	39.5%
45-64	4,032,421	29.2%	116,808	48.7%
65-74	426,794	3.1%	14,451	6.0%
75-84	67,415	0.5%	2,685	1.1%
85+	27,461	0.2%	926	0.4%

[i] Unique Members
[ii] Northeast - CT, ME, MA, NH, RI, VT, NJ, NY, PA
[iii] Midwest - IL, IN, MI, OH, WI, IA, KS, MN, MO, NE, ND, SD
[iv] South - DE, DC, FL, GA, MD, NC, SC, VA, WV, AL, KY, MS, TN, AR, LA, OK, TX
[v] West - AZ, CO, ID, MT, NV, NM, UT, WY, AK, CA, HI, OR, WA

Table 4. Cohort Distribution of Study Population

Cohort		Counts[i]	Proportion of Total Count
1	Suspicious lesion	39,624	16.5%
2a	Benign lesion with 1 surgical procedure	163,006	68.0%
2b	Benign lesion with 2 or more surgical procedures	28,577	11.9%
3	Non-advanced melanoma (managed by biopsy/excision)	7,521	3.1%
4	Advanced melanoma (metastatic and/or managed with advanced treatment)	1,126	0.5%

[i] Unique members

surgical procedure(s) following a benign diagnosis, demonstrating a total advanced procedure rate of 30.4% for benign lesions.

Since the PLA is intended to be used for clinically suspicious pigmented lesions that are not overtly benign or malignant,[8] data from Cohorts 2 and 3 of the study population (Table 1) were used to determine the potential impact in both cost and quality of care that the PLA may provide. Each of these cohorts used one of three procedure categories to reach a diagnosis of benign (Cohort 2) or non-advanced melanoma (Cohort 3): A) biopsy only (N= 135,473); B) excision only (N= 28,086); and C) biopsy followed by excision (N= 34,818). Diagnosis rates of each procedural category are summarized in Table 5.

In category A, when a biopsy was the only procedure performed, 99.1% of patients received a diagnosis of benign (i.e., D22.XX), and 0.9% of patients received a diagnosis of nonadvanced melanoma (i.e., C43.XX, D03.XX). In category B, when an excision was the only procedure performed, 99.9% of patients received a diagnosis of benign, and 0.1% of patients received a diagnosis of nonadvanced melanoma (i.e., C43.XX, D03.XX). In category C, when a biopsy was performed followed by an excision, 82.1% of patients received a diagnosis of benign (i.e., D22), and 17.9% of patients received a diagnosis of nonadvanced melanoma (i.e., C43.XX, D03.XX). Categories B and C represent situations when the treating clinician decides to excise the lesion. When combining instances where a lesion is excised, 90.0% of patients receive a diagnosis of benign (i.e., D22), and 10.0% of patients receive a diagnosis of nonadvanced melanoma (i.e., C43.XX, D03.XX).

Table 5: Surgical Procedure Rates for Benign Lesions (Cohort 2) and Non-Advanced Melanomas (Cohort 3)

Procedure Category		Counts[i]	Benign Diagnosis[ii]	Non-Advanced Melanoma Diagnosis[iii]
A	**Biopsy only**	135,473	99.1%	0.9%
B	**Excision only**	28,086	99.9%	0.1%
C	**Biopsy followed by excision**	34,818	82.1%	17.9%
B+C	**Any excision**	62,904	90.0%	10.0%

Data are derived from 2019 claims data pulled in December 2021.
[i] Unique members
[ii] D22.XX
[iii] C43.XX, D03.XX

DISCUSSION

The PLA is a noninvasive genomic test used to guide patient management decisions for skin lesions clinically suspicious for melanoma; lesions that test positive are recommended for biopsy and histopathology, and those that test negative are recommended for clinical surveillance.[6, 8, 14, 15] A previous health economic analysis showed that routine use of PLA reduces cost compared to the VAH pathway in Medicare patients with suspicious pigmented lesions.[5] In agreement with these findings, the ROI model in this study indicates that incorporating the PLA into the VAH pathway can provide cost savings to commercial health insurance plans. This study also indicates where the PLA can improve outcomes of patients with lesions suspicious for melanoma.

The ROI model showed that adoption of PLA may result in savings of $0.54 PMPM over a three-year period. These cost savings were realized due to the use of genomic assessments to guide biopsy decisions for pigmented lesions clinically suspicious for melanoma. The performance metrics of the PLA (91% sensitivity, 99% NPV) improve upon those of the VAH pathway (65%-84% sensitivity, 83% NPV),[3, 5-8] resulting in more accurate classification of pigmented lesions based on genomics. Genomic aberrations precede visual changes in melanoma;[25] thus genomic assessments with the PLA are able to identify high-risk lesions for melanoma that may not otherwise be evaluated by the VAH pathway.[6, 11, 13] Using the PLA's genomic assessments to guide biopsy decisions could reduce overall treatment costs associated with VAH while improving patient outcomes.

In addition to cost savings, our study uncovered opportunities to improve upon the quality of care offered via the VAH pathway. Traditionally, clinicians have had to rely on image and pattern recognition to classify pigmented lesions as benign or malignant, which is a subjective and challenging exercise.[1-4] With the goal of never missing a melanoma, clinicians have exercised an abundance of caution when assessing pigmented lesions. For example, 83.5% of clinically suspicious pigmented lesions were surgically biopsied in this study, with 95.7% of those diagnosed as benign. Furthermore, the three procedural assessment pathways employed (biopsy only, excision only, and biopsy followed by excision) all yielded low rates of melanoma diagnoses (0.9%, 0.1%, and 17.9%). Though the approaches and outcomes above are understandable given the tools historically available, these data demonstrate the need for additional, reliable information that can more accurately classify pigmented lesions for enhanced decision making and improved outcomes.

NCCN Guidelines indicate that pre-diagnostic noninvasive patch testing may be helpful to guide biopsy decisions.[16] The PLA aligns with this guidance by noninvasively providing objective genomic information that indicates if a suspicious pigmented lesion is at high risk for melanoma.[8, 10, 11, 13] Improved outcomes for patients occur when they receive appropriate care for their condition, receive more effective care, and/or avoid unnecessary procedures/therapy or testing.[26] With the PLA, approximately 15% of lesions test positive and are recommended for biopsy and histopathologic evaluation, and the remaining 85% test negative and are recommended for clinical surveillance, thus avoiding a surgical procedure.[27] A separate analysis of PLA claims from 2020 independently validated these outcomes:

~20% of claims received a surgical procedure (i.e., presumed positive PLA result) and ~80% of claims did not receive a surgical procedure (i.e., presumed negative PLA result).[28] A recent long-term follow-up study demonstrated that clinical surveillance of PLA-negative lesions is appropriate; in this study, <1% of 1,535 PLA-negative lesions exhibited clinical changes leading to melanoma diagnoses (in situ or pT1a) during 24-36 months of follow-up.[17] Taken together, these data show that the PLA can improve patient outcomes by 1) identifying the small subset of clinically suspicious lesions at high risk for melanoma, and 2) avoiding surgical procedures of benign lesions.

CONCLUSION

Incorporation of the PLA into the VAH pathway enhances decision making for lesions clinically suspicious for melanoma, improves the quality of patient care, and drives lower overall costs to commercial health insurance plans.

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26. Blue Cross Blue Shield Association Policy 2.04.146.
27. Data on file. DermTech, Inc. La Jolla, California.
28. Optum, Inc. Commercial Claims Data, January 1, 2020 to December 31, 2020.

APPENDIX

Appendix 1. Advanced Cancer Treatment Codes

Chemotherapy (Advanced Cancer) NDC Codes
’00078068266’, ‘00173084608’, ‘00078068166’, ‘00173084708’, ‘00078066615’, ‘00173084913’, ‘00078066815’, ‘00173084813’, ‘50242009001’, ‘50242009002’, ‘50242071701’, ‘70255002001’, ‘70255002002’, ‘70255002501’, ‘70255002502’, ‘70255002503’, ‘70255002504’, ‘70255001002’
Advanced Cancer Procedure Codes
‘77401’, ‘77402’, ‘77407’, ‘77412’, ‘G6003’, ‘G6004’, ‘G6005’, ‘G6006’, ‘G6007’, ‘G6008’, ‘G6009’, ‘G6010’, ‘G6011’, ‘G6012’, ‘G6013’, ‘G6014’, ‘77385’, ‘77386’, ‘G6015’, ‘G6016’, ‘77417’, ‘77387’, ‘G6001’, ‘G6002’, ‘G6017’, ‘77014’, ‘77520’, ‘77521’, ‘77522’, ‘77523’, ‘77524’, ‘77525’, ‘77422’, ‘77423’, ‘77371’, ‘77372’, ‘77373’, ‘77600’, ‘77601’, ‘77602’, ‘77603’, ‘77604’, ‘77605’, ‘77606’, ‘77607’, ‘77608’, ‘77609’, ‘’77610’, ‘77611’, ‘77612’, ‘77613’, ‘77614’, ‘77615’, ‘77616’, ‘77617’, ‘77618’, ‘77619’, ‘77620’, ‘77778’, ‘77770’, ‘77771’, ‘77772’, ‘0394T’, ‘0395T’, ‘77424’, ‘77425’, ‘77789’, ‘77750’, ‘77761’, ‘77763’, ‘77790’, ‘77295’, ‘77300’, ‘77331’, ‘77301’, ‘77338’, ‘77306’, ‘77307’, ‘77316’, ‘77317’, ‘77318’, ‘77321’, ‘77332’, ‘77333’, ‘77334’, ‘77336’, ‘77370’, ‘J9271’, ‘J9299’, ‘J9228’, ’J9325’, ‘J9130’, ‘J9022’

Appendix 2. Procedure Codes Used to Define Cohorts for Biopsy, Pathology, Excision, and Destruction

Skin Biopsy
‘11100’, ‘11101’, ‘11102’, ‘11103’, ‘11104’, ‘11105’, ‘11106’, ‘11107’, ‘11300’, ‘11301’, ‘11302’, ‘11303’, ‘11305’, ‘11306’, '11307', '11308', '11310', '11311', '11312', '11313', '67810', '69100', '69105'
Pathology
'88300', '88301', '88302', '88303', '88304', '88305', '88306', '88307', '88308', '88309', '88312', '88313'
Excision *Exclusions: Excision claims that come with exclusion diagnosis codes (C44, D04, D23 or L codes except L98.9 or L98.8) as primary are not included.*
'17311', '17312', '17313', '17314', '17315', '21936', '22902', '22903', '23071', '23075', '24071', '24075', '25071', '25075', '26111', '26115', '27043', '27047', '27327', '27337', '27618', '27632', '28039', '28043', '69110', '69120', '69145', '69150', '69155', '38500', '38505', '38510', '38515', '38520', '38525', '38530', '11400-11446', '11600-11646'
Destruction
'17000', '17003', '17110', '17004', '17262', '17111', '17261', '17281', '17260', '17271', '17272', '17263', '17282', '17280', '17270' ,'17273', '17264', '17283', '17106', '17266', '17274', '17284'

Appendix 3. Direct Cost (Primary Condition Cost)

Direct Cost was estimated as follows:

- For biopsy claims: Claims with diagnosis codes C43, D03, D22, D48.5 or D49.2
- For other claims:
  - Benign or melanoma members' claims which come with destruct procedures[2] on the same day
  - Claims with diagnosis codes C43, D03, D22, D48.5 or D49.2 [*Note: An exclusion code (C44, D04, D23 or L codes except L98.9, L98.8) doesn't come as primary*]
  - Claims with procedures codes in excision/advanced cancer procedures/advanced melanoma NDCs[3]
  - Claims of advanced melanoma patients with advanced melanoma procedures, diagnosis code C79.2 or cancer DRGs (595, 596) or advanced melanoma NDCs

[2] See Appendix 2.
[3] See Appendix 1.