SKIN CANCER SCREENING IN PRIMARY CARE USING DERMOSCOPY

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ABSTRACT

Skin cancer rates continue to rise affecting millions of individuals annually. While cutaneous malignant melanoma comprises a fraction of total skin cancers diagnosed, melanoma is associated with a poor prognosis and higher mortality rate when compared to other forms of skin cancer. The greatest risk factor for skin cancer is the amount of ultraviolet light exposure making skin cancer the most common preventable form of cancer. In conjunction with primary prevention, part of secondary prevention measures involves performing routine skin examinations. According to data from the National Health Interview Survey, only 8% of individuals who had seen a primary care provider in the previous 12 months had a skin examination performed (Johnson et al., 2017). A low rate of skin examination can largely be attributed to current professional guidelines from the United States Preventative Services Task Force (2016) not supporting routine skin screening of all patients. Despite the recommendation, primary care providers are consistently faced with the need to evaluate skin lesions. Other barriers identified include lack of training and practical screening methods. Dermoscopy is a noninvasive technique for identifying skin lesions. Based on the need for improved screening practices and identified barriers, a brief educational session and resource on skin cancer and dermoscopy was presented to primary care providers at an urban family practice clinic in eastern North Dakota. Following the educational session, a three-month implementation period provided time for providers to implement their knowledge and dermoscopy skills in practice. The purpose of the project was to increase knowledge, improve accuracy of identifying skin lesions, and increase provider confidence using dermoscopy. Evaluation using a pre-implementation survey of providers in the clinic found the primary care providers felt comfortable with their baseline knowledge of skin cancer but did not feel confident in their ability to use a dermoscope. Most of

the participating providers deemed their level of knowledge regarding dermoscopy to be at a novice level. Results of the post-implementation found providers felt more comfortable using dermoscopy and knowledge in dermoscopy overall improved from novice to advanced beginner or competent.

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DEDICATION

I dedicate this dissertation to my family, John, Zoe, and Baby L.

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LIST OF ABBREVIATIONS

AAD	American Academy of Dermatology
ABCD	Asymmetry, Border sharpness, Colors, and Dermoscopic structures
ABCDE	Asymmetry, Border, Color, Diameter, and Evolving
ACS	American Cancer Society
AK	Actinic Keratosis
BCC	Basal Cell Carcinoma
CASH	Color, Architectural order verses disorder, Symmetry, and Homogeneity or Heterogeneity of structures
DOI	Diffusion of Innovations
DNA	Deoxyribonucleic Acid
EBP	Evidence Based Practice
FDS	Final Dermoscopic Score
HPV	Human Papilloma Virus
IRB	Internal Review Board
NCCN	National Comprehensive Cancer Network
NEE	Naked Eye Exam
NMSC	Nonmelanoma Skin Cancers
SCC	Squamous Cell Carcinoma
USPSTF	United States Preventative Services Task Force
UV	Ultraviolet (radiation)
UVA	Ultraviolet A light rays
UVB	Ultraviolet B light rays
UVC	Ultraviolet C light rays

CHAPTER ONE: INTRODUCTION

Despite advances in modern medicine, skin cancer has become one of the most common forms of cancer in the United States. Both the number of new cases and mortality rate continue to rise annually. The number of new skin cancer cases doubled between 1999 and 2015 (United States Cancer Statistics Working Group, 2019). The continued increase can be attributed to multiple factors. A rapidly growing and aging population in the United States has largely contributed to the increase in new cases along with improvements in screening, increased exposure to ultraviolet (UV) light, and increased human life expectancy (American Cancer Society [ACS], 2019).

The most common forms of skin cancer include melanoma, basal cell carcinoma, and squamous cell carcinoma. While melanoma has the highest mortality rate, basal cell and squamous cell carcinomas are far more common. In the United States, approximately 5.4 million basal cell and 3.3 million squamous cell cancers (SCC) are diagnosed annually. About 2,000 deaths occur annually from basal and squamous cell carcinomas (BCC) (ACS, 2019). In comparison, an estimated 192,310 individuals will be diagnosed with and 7,230 individuals will die from melanoma in 2019. Although the incidence of melanoma is less than basal and squamous cell carcinomas, the mortality rate for melanoma is much higher making melanoma a significant public health concern (American Academy of Dermatology, 2018).

Although skin cancer can be diagnosed in anyone regardless of skin color, several factors have been identified increasing an individual's predisposition to skin cancer. General non-modifiable risk factors include having fair skin, blonde or red hair, skin that burns or freckles easily, blue or green eyes, multiple large moles, and a personal or family history of skin cancer.

The greatest modifiable risk factor is exposure to UV light either in the form of sun light or tanning beds (United States Cancer Statistics Working Group, 2019)).

Background

Unlike many other forms of cancer or diseases, skin cancer is typically first assessed by a primary care provider via a naked eye exam (NEE) rather than a blood test or diagnostic imaging (ACS, 2018). However, the United States Preventative Services Task Force (USPSTF) does not recommend routine whole-body skin examinations on all adults by clinicians as the benefits do not outweigh the risks, particularly for melanoma (UPSTF, 2016). Skin cancer screening in adults regardless of known risk can lead to misdiagnosis, cosmetic disfigurement, unnecessary costs, and emotional distress for the patient (USPSTF, 2016). However, prognosis of a melanoma tumor is heavily dependent on early detection and thickness of tumor (Johansson, Brodersen, Gøtzsche, & Jørgensen, 2019). Research has shown that melanomas found by healthcare providers during periodic skin examinations are consistently thinner than those found by the patient (Geller & Swetter, 2019).

The USPSTF recommendation is among many barriers for performing skin examinations including lack of reimbursement (Holmes et al., 2018), lack of training, poor confidence, and time restraints (Oliveria, Heneghan, Cushman, Ughetta, & Halpern, 2011). In cancers like melanoma, which have a better prognosis when diagnosed early, breaking down these barriers can be crucial for timely and appropriate intervention (Lallas et al., 2015). While dermatologists have greater accuracy in detecting skin cancers, dermatologists also serve a much smaller portion of the population. Primary care providers have been shown to have less accuracy in correctly identifying skin lesions due to insufficient education and exposure in clinical practice. Utilizing

primary care providers, who see a larger portion of the population, is one way of breaking down some of the barriers to early skin cancer detection (Oliveria et al., 2011).

Using instruments to enhance a skin examination improves provider confidence and accuracy of identifying various skin lesions including melanoma. Dermoscopy is a well-documented, non-invasive practice for enhancing skin examinations. The practice involves a tool called a dermoscope or dermatoscope, which uses transillumination light and magnification to help a provider identify structures that are otherwise not able to be seen with the naked eye. Dermoscopy is currently primarily used by dermatologists and has been shown to improve the accuracy, specificity, and sensitivity of a skin cancer diagnosis. Knowing how dermoscopy has improved diagnostic abilities of dermatologists, there is potential for dermoscopy to be utilized by primary care providers with adequate training to improve detection of skin cancer (Marghoob, Usatine, & Jaimes, 2013).

While both incidence and mortality rate of skin cancer continue to rise, frequency of skin examinations performed remains low and inconsistent among primary care providers. According to data from the National Health Interview Survey, only 8% of individuals who had seen a primary care provider in the previous 12 months had a skin examination performed (Johnson et al., 2017). Low rate of skin examinations is likely due to lack of formal training and exposure in clinical practice (Curiel-Lewandrowski, Chen, Swetter, 2012). Familiarizing primary care providers with dermoscopy can break down barriers connected to skin cancer screening in primary care. Dermoscopy provides an evidence-based technique that providers can use to build upon their knowledge, increase their confidence in identifying lesions, and will remain in their skill set for the rest of their career. Educating primary care providers to use dermoscopy can

increase the number of individuals screened for skin cancer, improve the timeliness of diagnosing skin cancer, and lead to a better prognosis for the patient.

Purpose of the Project

According to the recommendation statement from the USPSTF (2016), insufficient evidence was found to support having a routine visual skin examination performed by a healthcare provider as a means of reducing skin cancer related deaths in all populations including individuals at a higher risk for skin cancer. A summary estimate of sensitivity increased from 71% for NEE to 90% with dermoscopy (Wolner et al., 2017). Specificity also increased from 81% to 90% with NEE and dermoscopy respectively but was not statistically significant (Wolner et al., 2017). Along with improvement in sensitivity and specificity, using dermoscopy decreased the number of unnecessary biopsies from 15.6% with NEE to 9% with dermoscopy. Tumors found with dermoscopy are thinner than NEE with a tumor thickness decreasing from 1.43mm with NEE to 0.77mm with dermoscopy (Wolner et al., 2017). However, without adequate training, use of dermoscopy can result in poorer accuracy compared to NEE (Marghoob et al., 2013). Educating primary care providers about dermoscopy was intended to increase provider knowledge, confidence, and identification of benign and malignant skin lesions during routine examinations. The purpose of the project was to increase primary care provider confidence in identifying skin lesions and increase application of skin cancer screenings in primary care by providing practitioners with an education module combined with time for clinical practice using dermoscopy.

Project Objectives

The objectives for this practice improvement project were directed toward designing an education plan, educating providers, and utilizing the knowledge and skill of dermoscopy in clinical practice. The objectives included:

1. Develop a comprehensive handout on dermatologic lesions for providers at an urban primary care clinic in eastern North Dakota to use in conjunction with dermoscope application by October 2019.
2. Increase knowledge of primary care providers in identifying both benign and malignant skin lesions using dermoscopy during a three-month implementation period.
3. Increase provider application and confidence using dermoscopy at the conclusion of the three-month implementation period.

CHAPTER TWO: LITERATURE REVIEW AND THEORETICAL FRAMEWORK

Literature Review

As previously discussed, exposure to ultraviolet (UV) radiation is the greatest risk factor for developing skin cancers making skin cancer the most common form of preventable cancer (CDC, 2018). There are two main types of UV light rays: UVA and UVB rays. UVC rays are absorbed by the ozone layer but could become a concern if the coverage of ozone layer decreases over time (Epstein & Wang, 2017).

While both UVA and UVB are a source of radiation contributing to DNA mutations that cause cancer, each type of UV radiation own characteristics. UVA rays also known as tanning rays are less intense, long waves that account for about 95% of UV radiation that reaches Earth. UVA rays are the type emitted by tanning beds. Risk for melanoma increases up to 75% after the first exposure to tanning beds as an adolescent. UVA can penetrate both the epidermis and dermis, which over time causes damage especially within keratinocytes of the basal layer. UVA rays also contribute to signs of aging such as wrinkles. Tanned skin from UVA rays is a result of damage to the skin's DNA and is the body's response to prevent further DNA damage (Epstein & Wang, 2017). UVB rays are short waves that typically only penetrate the epidermis causing sunburn or reddening of the skin. Like UVA rays, UVB is also responsible for contributing aging and increasing risk of skin cancer. UVB exposure can happen year-round. While UVB rays are strongest from 1000 to 1600 hours from April to October, double exposure can occur during the winter months as rays can reflect off snow or ice (Epstein & Wang, 2017).

Most forms of skin cancer can be prevented using multiple methods that can be implemented as early as initial well child visits and continue through adulthood. Prevention strategies can be divided into primary, secondary, and tertiary. Primary prevention consists of

methods for preventing initial presentation of disease, which for skin cancer is done by decreasing exposure to UV light. Some strategies for decreasing UV exposure include using a broad-spectrum sunblock, covering with clothing and hats, staying indoors or in the shade, and avoiding tanning beds. Secondary prevention of skin cancer involves screening and early detection. While recommendations currently do not favor routine skin examinations for all patients, healthcare providers should examine the skin when appropriate and educate patients to monitor their skin monthly to note any changes. Because thinner melanoma tumors are more likely to be found by healthcare providers than patients, providers should take the time to ask about changes in the skin or examine the skin if possible (Geller & Swetter, 2019). Tertiary prevention aims at prevention of reoccurring lesions by following with a dermatologist and having the skin examined on a more regular basis either by a primary care provider or dermatologist (Kornek & Augustin, 2013).

Forms of Skin Cancer

Basal Cell Carcinoma

In the United States, approximately eight out of ten of the 5.4 million nonmelanoma skin cancers (NMSCs) diagnosed annually are basal cell carcinomas (BCC) (ACS, 2019). BCC can be divided into six histologic subtypes: pigmented BCC, nodular BCC, superficial BCC, micronodular BCC, sclerosing BCC, and morphearform. Each subtype can vary in appearance and aggressiveness with nodular being the most common (Marzuka & Book, 2015).

BCC originates from progenitor cells in the basal layer or the bulge region of a hair follicle which is abundant with keratinocyte stem cells (Feller, Khammissa, Kramer, Altini, & Lemmer, 2016). Due to lack of blood and lymph supply in this region of the skin, basal cell carcinomas rarely metastasize. Approximately 0.003-0.1% of BCC cases have metastasized.

BCCs can be invasive of surrounding tissue structures leading to cosmetic and functional complications (Marzuka & Book, 2015). The most common areas a BCC can be found are on the head (scalp, face, ears) and neck followed by the upper back, chest, and arms (Habif, Campbell, Chapman, Dinulos, Zug, 2011).

UV exposure has been found to be the greatest risk factor for developing BCC. Previously, cumulative UV exposure was found to have a larger influence on risk for BCC. However, new research suggests childhood and adolescent sun exposure is more important than exposure as an adult. The frequency of UV exposure is also a factor. Consistent annual exposure seemed to have no influence on risk, whereas intense, intermittent exposures to UV rays increases risk for BCC (Marzuka & Book, 2015). BCC is more common in females, individuals age 55-75 years, and those with a history of using a tanning bed (Wu, 2019). Other factors that may contribute to increase risk for BCC include use of phototherapy, photosensitizing agents, chronic exposure to arsenic, ionizing radiation, immunosuppression, certain phenotypic traits, and having a personal history of BCC. Phenotypic traits include light skin, light eye color, and poor ability to tan. BCC is less common in Hispanic and Asian individuals, and rare in black individuals. About half of individuals who have developed a BCC will have another one within five years (Wu, 2019).

Although BCC lesions can vary in appearance, there are some general characteristics for providers to note. Providers familiar with these characteristics can typically diagnose a BCC based on the examination alone but will collect a biopsy sample to confirm diagnosis. BCC often appears as a pink or pearly-white papule or nodule. The surface is typically smooth with overlying telangiectasias. The papule/nodule grows slowly and has a central depression with a raised, rolled margin. Tumors commonly become symptomatic including bleeding, crusted, and

ulcerated in the center (Habif et al., 2011). Under dermoscopic examination, BCCs often lack a pigmented network (similar to melanoma) and have branching vessels and clusters of blue-gray ovals (Wu, 2019).

Figure 1. Smooth, pink papule with overlying telangiectasias representative of a basal cell carcinoma. Reproduced with permission from DermNetNZ.org (2019) (APPENDIX C).

Upon pathology confirmation, the goal for treating BCC is to remove the tumor while maintaining function and cosmesis at the lesion site. There are multiple forms of treatment depending on the location, size, and findings from pathology. Treatments include curettage and electrodesiccation, surgical excision, Mohs micrographic surgery, photodynamic therapy, cryotherapy, radiation therapy, and 5-fluoruorocil or imiquimod. Mohs surgery is a special method of surgical excision and has the highest cure rate. Topical medication like 5-fluoruorocil or imiquimod is used when there are multiple lesions in a large area or if surgical excision would pose a cosmetic or functional complication (Aasi, 2019).

Squamous Cell Carcinoma

Behind BCC, squamous cell carcinomas (SCC) are the second most common type of skin cancer in the United States comprising 20% of NMSCs (Habif et al., 2011). Squamous cells are in the outer portion of the epidermis. These cells are constantly shed as new cells form (ACS, 2016). SCC arises from the epidermal keratinocytes of the skin and adnexal structures (Kallini, Hamed, & Khachemoune, 2015). Similar to BCC, SCC rarely metastasize and up to 5% of reported cases have noted metastases into surrounding tissue or lymph and beyond (Lim & Asgari, 2017).

Actinic keratosis (AK) is a type of skin lesion that can precede the development of a SCC, but SCC can also occur without the presence of an AK (ACS, 2016). Individuals with AK have an approximated 6-10% lifetime risk of developing SCC (Kallini et al., 2015). SCC most commonly occurs on the face, scalp, neck, hands (elderly), and legs (females). SCC can also occur in the oral mucosa, periungual skin, and anogenital area which is related to high-risk human papilloma virus (HPV). Because SCC can arise by itself or from an AK, SCC can have a variety of presentations including papules, plaques, or nodules. SCC also can have a smooth hyperkeratotic, or ulcerative consistency. The type and location of the SCC influence the appearance. There are three types of SCC: SCC in situ (Bowen's disease), Erythroplasia of Queyrat, and invasive SCC. Bowen's lesions present as pink or erythematous well-demarcated scaly patches or plaques. Bowen's lesions are slow growing and are typically asymptomatic. Erythroplasia of Queyrat is a type of SCC occurring on the penis. Erythroplasia of Queyrat typically presents as an erythematous, well-defined plaque sometimes with a velvety appearance. Patients with Erythroplasia of Queyrat commonly have ulceration which can cause pain, itching, or bleeding. For invasive SCC, presentation of the lesion depends upon differentiation of the

tumor. Well-differentiated lesions appear as a firm, hyperkeratotic plaques, papules, or nodules ranging from 0.5cm to 1.5cm in diameter with or without ulceration. Poorly differentiated lesions appear soft, fleshy granulomatous papules, or nodules without hyperkeratosis. Poor differentiated tumors may also have ulceration, bleeding (hemorrhage), or necrotic areas (Lim & Asgari, 2017).

Figure 2. An erythematous, hyperkeratotic papule representative of cutaneous squamous cell carcinoma. Reproduced with permission from DermNetNZ.org (2019) (APPENDIX C).

Variants of SCC can include oral SCC and keratoacanthoma. Oral SCC lesions typically present as an ulcer, nodule, or firm plaque within the oral cavity. Common sites for oral SCC include the floor of the mouth and lateral or ventral aspects of the tongue. The lesions can arise in areas of erythroplakia (persistent red plaques) or leukoplakia (persistent white plaques). These lesions are commonly noted in individuals with a history of using chewing tobacco. Neurologic symptoms such as numbness, burning, paresthesia, or visual changes can also be associated with invasive SCC. Keratoacanthomas clinically and histologically resemble SCC and are keratocytic epithelial tumors. There is mixed evidence whether keratoacanthomas are a separate entity or

another subtype of SCC. Unlike most SCC lesions, keratoacanthomas initially have rapid growth and appear as a nodule in the shape of a dome or crateriform with a central keratotic core that develops within weeks of initial appearance (Lim & Asgari, 2017).

Risk for SCC is multifactorial including sun exposure, age, family history, and certain inherited disorders. For SCC, cumulative sun exposure is more important to consider when evaluating an individual's risk. Certain occupations such as farming or construction work have increased incidence of SCC (Kallini et al., 2015). SCC is also caused by more exposure to UVB rays than UVA. Like BCC, age is also important to consider. Individuals over 75 years are 50-300 times more likely to develop SCC than those under 45 years (Lim & Asgari, 2017). Historically SCC has had a higher incidence in males, SCC incidence on the legs in females is higher (Kallini et al., 2015). Phenotypic traits commonly associated with SCC include Caucasian or fair skin tone, light eyes, red hair, and Northern European ancestry. Individuals with darker skin tones are less likely to develop SCC, but when SCC occurs the lesion(s) tend to develop in non-sun exposed areas. The risk of individuals with a positive family history increases fourfold. Inherited disorders contributing to increased risk include xeroderma pigmentosum, epidermolysis bullosa, albinism, and epidermodysplasia. Other sources that can increase risk for SCC include tanning beds, chronic arsenic exposure, exposure to ionizing rays, immunosuppression, and areas of chronic inflammation from scars, burns, chronic ulcers, sinus tracts, or inflammatory dermatoses (lichen sclerosus & Marjolin's ulcer). Smoking and oral tobacco use is a possible factor especially for oral SCC, but research is conflicting (Lim & Asgari, 2017).

Treatment of a SCC lesion depends upon the extent of tumor progression, which is evaluated based on histologic examination using a biopsy sample. According to the National Comprehensive Cancer Network (NCCN), SCC tumors can be divided into low and high risk.

Low risk tumors are first incidence tumors. Characteristics of low risk tumors include well defined borders and histologic examination reveals moderate differentiation in cells, thickness is less than 2mm, and lack invasion of nearby nerves, lymph, or vascular tissue. The size of low risk tumors can vary depending on the location: less than 20mm for the trunk and extremities and less than 10mm for the cheeks, forehead, scalp, neck, and pretibial regions. High risk tumors are recurrent, poor tumor differentiation, thickness is greater than 2mm, and have invaded nearby nerve, lymph, or vascular structures. Size also plays a role in classifying a tumor as high risk. Lesions are considered high risk if greater than 10mm on the cheeks, forehead, scalp, neck, and pretibial regions, or greater than 20mm on the trunk and extremities. Lesions of any size on the eye lids; eyebrows; periorbital; temples; central face: nose, lips, chin; mandible; both pre- and post-auricular; hands; feet; and genitalia are all considered high risk (Aasi & Hong, 2018).

The choice of treatment will depend upon the classification of the tumor(s). For single low risk tumors with low risk for reoccurrence, surgical excision, Mohs micrographic surgery, curettage and electrodessication, cryotherapy, photodynamic therapy, and radiation for non-surgical candidates are all potential options. For multiple low risk tumors, cosmetic and function aspects must be taken into consideration (Aasi & Hong, 2018). Skin grafting or reconstructive surgery may be warranted for functional or cosmetic improvements when surgical excision is indicated (ACS, 2019). Typical treatment for multiple lesions consists of topical application of fluorouracil covered by an occlusive bandage. Fluorouracil is a topical chemo-type agent that elicits an inflammatory response causing rapidly growing abnormal cells to die, which can take days to weeks to occur depending on the patient. The medication can be used for both SCC and AK (Aasi & Hong, 2018).

Cutaneous Malignant Melanoma

While the previously mentioned forms of skin cancer are more common with a lower mortality rate, melanoma is more serious with a much higher mortality rate than SCC or BCC. The high mortality rate and continued increase in new cases make melanoma a public health concern and a priority for healthcare providers (AAD, 2018). Because of melanoma's higher mortality rate, clinicians should be aware of risk factors associated with melanoma. Risk factors include UV light exposure from both the sun and tanning beds, age, gender, and certain phenotypic traits. UV light exposure is by far the greatest risk factor for melanoma. Particularly, individuals who have a history of excessive sun exposure or have suffered multiple severe sunburns in childhood or adolescent years (Curiel-Lewandrowski, 2019). Historically, incidence of melanoma increases with age. Males are also more likely to get melanoma across all age groups (AAD, 2018). Family history is more associated with melanoma unlike the other skin cancer types previously mentioned. Other factors to keep in mind are chronic immunosuppression, UVA therapy, and cancer-prone conditions such as xeroderma pigmentosum. Phenotypic characteristics to note are fair complexion, blonde or red hair color, light colored eyes, and presence of multiple (>50) nevi. Although having multiple nevi is a risk factor for melanoma, most melanomas arise without the presence of an existing nevi (Curiel-Lewandrowski, 2019).

Most melanoma tumors originally appear as a superficial lesion confined to the epidermis. These lesions may remain in the epidermis for several years in the horizontal or radial growth phase. In the horizontal phase, melanomas are almost always curable with only surgical excision. Once a tumor has infiltrated the dermis, the tumor is considered in the vertical growth phase where the tumor increases in thickness. The probability of metastases is predicted by the

thickness of the tumor measured in millimeters. Other factors that influence metastases include ulceration, rate of cell division, presence of microsatellite lesions, and invasion to nerve, lymph, or vascular tissue.

Aside from the growth phases, melanoma has five stages based on clinical features and metastases. Stage 0 is melanoma in situ, which is a tumor in the original location and confined to the epidermis. Stage I is still confined to the skin by its thickness ranges up to 1mm. Stage II tumor thickness ranges from 1-4mm but has not yet spread to other areas. Stage III is regional nodal disease. In stage III, the tumor has either spread to surrounding tissue or nearby lymph node(s). Finally, stage IV involves distant metastases to other organs (AAD, 2018). Stages 0 or I are associated with the best prognosis and individuals typically are disease-free following treatment. Stages II-IV are considered a more advanced disease, have poorer prognosis, and are more likely to metastasize. Tumor thickness is the most important factor in prognosis. As tumor thickness increases, survival rates decline (Swetter & Geller, 2019).

Melanoma is divided into four sub-types: superficial spreading, nodular melanoma, lentigo maligna, and acral lentiginous. Superficial spreading melanoma is the most common subtype and is most likely to be linked to a pre-existing nevus. Superficial spreading accounts for 70% of melanomas. While superficial spreading melanoma can occur anywhere on the body, melanoma most commonly occurs on the lower extremities in both genders and the back in men. Superficial melanoma typically presents as a macule or thin plaque with variable pigmentation and irregular border. The diameter of a superficial melanoma ranges from a few millimeters to centimeters and color ranges from shades of black, gray, white, red, and blue. Nodular melanoma is the second most common subtype accounting for 15-30% of melanomas. Unlike the other subtypes, nodular melanomas do not appear to have a horizontal growth phase. Instead nodular

melanoma directly enters the vertical phase resulting in thicker tumors when initially diagnosed. Nodular melanomas arise as a papule or nodule with either dark pigmentation or an amelanotic pink coloration, symmetric boarders, and small diameter (Swetter & Geller, 2019).

Figure 3. Asymmetry, irregular border, and irregular distribution of pigmentation seen in superficial spreading melanoma. Reproduced with permission from DermNetNZ.org (2019) (APPENDIX C).

Lentigo maligna melanoma and acral lentigous melanoma are the lesser common subtypes. Lentigo maligna accounts for about 10-15% and acral lentigous comprise less than 5% of melanomas. Lentigo maligna originates as a brown macule on chronically sun-damaged skin. The macule slowly grows over years becoming darker and unevenly pigmented, asymmetric, and may have areas that are raised indicating vertical tumor growth. The incidence of lentigo maligna is rising, especially in older individuals due to chronic sun exposure. While acral lentigous is the least common melanoma overall, acral lentigous is the most common in individuals with darker skin who are typically at a lower risk for developing the other subtypes more commonly associated with chronic sun exposure. Acral lentiginous is most common on the palmar, plantar, and subungual areas. Acral melanoma originally appears as a macule or patch with dark brown to

black irregular pigmentation, raised areas, ulceration, and typically has a larger diameter. Acral melanoma can occasionally have an hypopigmented appearance which can mimic lesions such as warts, calluses, ulcer, ingrown toenails, or tinea pedis (Swetter & Geller, 2019).

Once a diagnosis has been made based on histologic findings of a biopsy, a patient can proceed with treatment. Treatment of melanoma depends upon the stage of the tumor. Stage 0 tumors can typically be removed via surgical excision or Mohs surgery. With thicker or metastasized tumors, further intervention is indicated. Such interventions include chemotherapy, radiation therapy, immunotherapy, targeted therapy, biological therapy, and lymphadenectomy (AAD, 2018).

Skin Cancer Screening Guidelines

The rationale for conducting routine cancer screening is because early detection of malignant lesions, particularly melanoma, has been associated with smaller tumor thickness. Smaller tumor thickness has been shown to be correlated with an improved prognosis and increased survival rate (Swetter & Geller, 2019). As of 2016, USPSTF published the most current recommendation stating there is insufficient evidence for reducing morbidity and mortality of skin cancer by having a routine visual total body skin examination completed by a clinician, including individuals with an increased risk of skin cancer. The report also notes that the benefits do not outweigh the risks of routine total body skin examinations. Due to insufficient evidence, the USPSTF does not recommend routine total body visual skin examinations in adolescents and adults regardless of risk level. Routine screening has been associated with negative implications such as overdiagnosis, unnecessary interventions, cosmetic complications, increased financial burden, and emotional challenges for the patient (Geller & Swetter, 2019).

Despite the USPSTF recommendation, clinicians are still faced with the dilemma of when to screen and how frequent examinations should be completed leaving a large gap for recommendations in clinical practice. Aside from the USPSTF, other agencies have provided information for patients and clinicians, but recommendations remain inconsistent. While the AAD and ACS do not explicitly recommend a frequency for examination, both organizations indicate the importance of self-skin examinations by patients to be able to report changes to the primary care provider. Any examination by clinician or patient can help find skin cancer early and can be important for individuals at higher risk. AAD also reports dermatologists can make their own recommendations based on an individual's risk factors (Geller & Swetter, 2019).

Current Skin Cancer Screening Techniques

Multiple methods have been designed to help clinicians distinguish malignant from benign skin lesions. The goal is to be able to identify melanoma or another malignancy using these methods. Identifying skin lesions can be a challenging goal given many skin conditions have a similar appearance to multiple other skin conditions. Multiple characteristics of melanoma have been identified and if present when using the one of these methods a referral to dermatology for biopsy should be initiated (Geller & Swetter, 2019).

During a physical examination of the skin, providers should use a systematic approach using a standardized order to the exam. Providers should be mindful that melanoma can occur anywhere on the surface of the skin, even areas not routinely exposed to the sun. Using a routine approach decreases the likelihood of skipping areas during the exam. The three main methods commonly used by providers during a naked eye examination are Asymmetry Border Color Diameter Evolving (ABCDE) rule, "Ugly Duckling" sign, and Glasgow seven-point checklist (Geller & Swetter, 2019).

ABCDE Rule

The ABCDE rule was first introduced as the ABCD rule in 1984 and later revised as the ABCDE rule in 2004 (Jensen & Elewski, 2015). The rule was developed to help clinicians diagnose melanoma at an early stage. The acronym stands for asymmetry, border, color, diameter, and evolving. According to the ABCDE rule, lesions are suggestive of melanoma if they are asymmetrical, have uneven or irregular borders, color that varies within the lesion, diameter greater than 6mm, or if the lesion is changing or evolving. Changes in a lesion can include size, shape, color, if the lesion is new, or symptoms such as itching and bleeding. The sensitivity and specificity of the ABCDE method vary depending on the number of criteria included in the evaluation, which can risk under or over referral to dermatology. When using a single criterion, the sensitivity of the rule is 97% at identifying melanoma compared to 43% when all five are utilized. However, the specificity is approximately 36% with one criterion and 100% when all five criteria are used in evaluation. Limitations exist due to the variation in sensitivity and specificity. Due to low specificity and high sensitivity when one criterion is used, the ABDCE rule has a higher risk of unnecessary referral or biopsy. On the other hand, when multiple criteria used, the rule has low sensitivity and high specificity meaning there is a higher chance of missing malignant lesions (Swetter & Geller, 2019).

"Ugly Duckling" Sign

The "ugly duckling" sign was created from the observation that in an individual with multiple nevi the nevi typically have a similar appearance to each other. A pigmented lesion that is noticeably different from the others is cause for concern. The "ugly duckling" sign has been referenced as being the "F" for funny looking when used in combination with the ABCDE rule. Although if a lesion does not meet the ABCDE criteria, the lesion still may fall into the "ugly

duckling" category and the two methods do not need to be used in conjunction. The predictive value of the "ugly duckling" sign has limited research analyzing the statistical improvement in recognition of suspicious lesions. An experimental study by Gaudy-Marqueste et al., specificity for identifying melanomas using the "ugly duckling" method was 96%, which was higher than the 88% specificity of a lesion focused exam (2017). The study also found using "ugly duckling" sign to evaluate lesions decreased the potential for biopsy by a factor of 6.9 (Gaudy-Marqueste et al., 2017). Another limitation for the "ugly duckling" method is potential individual variation between provider and patient for what is considered "ugly" or different from other lesions present (Swetter & Geller, 2019).

Glasgow Seven-Point Checklist

The revised Glasgow seven-point checklist can be utilized by both clinician and patient. The checklist was originally developed in the United Kingdom to help primary care providers navigate the need for referral. The checklist contains a total of seven features which are divided into major and minor features based on their significance. Major features include a newly identified lesion or existing lesion with a change in size, shape, and/or color. Minor features include diameter greater than 7mm, inflammation, crusting or bleeding, and change in sensation (i.e. pain, itching). A referral to dermatology for further evaluation is indicated if one major feature or at least three minor features are present. One study evaluating the sensitivity and specificity of the checklist found a 92% sensitivity and 33% specificity for melanoma with using at least one major and one minor feature to assess a lesion. A limitation for the seven-point checklist is that few studies have been completed to evaluate its reliability (Swetter & Geller, 2019).

Dermoscopy

Dermoscopy is a non-invasive technique used to assess skin lesions to improve the diagnostic accuracy of a healthcare provider. Dermoscopy is performed using a tool called a dermoscope or dermatoscope that provides transillumination and tenfold magnification. Dermoscopy has also been referred to as dermatoscopy, epiluminescence microscopy, incident light microscopy, and skin-surface microscopy. Dermoscopy allows clinicians to visualize colors and structures in the epidermis, dermoepidermal junction, and upper dermis not visible to the naked eye. Analyzing the colors and structures of a lesion can help clinicians in identifying a malignancy (Marghoob et al., 2013).

Background

Dermoscopy was first introduced as surface skin microscopy in 1663 to examine nail capillaries and over 200 years later was used to examine lip capillaries. Fast-forward to the 1920s, German dermatologist Johann Saphier published his work using a binocular microscope with a light source to examine the skin and created the term “dermatoscopy”. His work also included observations of specific structural changes within a skin lesion (Braun, Rabinovitz, Oliviero, Kopf, & Saurat, 2005). Once the concept of dermoscopy reached the United States in the 1950s, Leon Goldman was the first to publish articles on dermoscopy and use of dermoscopy in the evaluation of pigmented skin lesions. Goldman created the first portable dermoscope in 1958 (Compton, 2010). Shortly thereafter in 1971, Rona MacKie had discovered the advantage of using dermoscopy in assessing pigmented skin lesions prior to operative procedures and could aid in forming a differential diagnosis for skin lesions. Dermatoscopy or dermoscopy is now utilized in both primary care and dermatology (Braun et al., 2005).

Since the development of the first model, dermoscopes have become more intricate devices with varying techniques. Currently there are three types of dermoscopes available: nonpolarized contact, polarized noncontact, and polarized contact. Standard or nonpolarized contact dermoscopy requires direct contact with the skin and an immersion fluid between the scope and the skin. Dermoscopy allows for improved visualization of the superficial layers of the skin which is useful for diagnosing benign skin lesions. Polarized dermoscopy is more useful for assessing specific structures within a lesion. Polarized light has a higher sensitivity for distinguishing structures associated with skin cancer and allows visualization of deep layers of the epidermis and papillary dermis. While both have their pros and cons, both provide a complementary approach to assessing skin lesions (Marghoob et al., 2013).

Clinical Role

Dermoscopy has gained popularity in multiple countries around the world including the United States. A survey conducted by the AAD between 2010 and 2014 found an increase in use by dermatologists from 40% to 81%. Similarly, 88% of European and 87% of Canadian dermatologists have reported using dermoscopy in practice (Marghoob & Jaimes, 2017). Along with dermatologists, dermoscopy has also found value in the primary care setting. Because primary care is often the place for an initial encounter to access healthcare, primary care clinicians have a vital part in detecting preventable diseases like skin cancer. Use of dermoscopy in primary care is intended to help providers evaluate both pigmented and nonpigmented skin lesions and use their evaluation to determine whether a lesion should be biopsied or referred. Studies have shown clinicians have increased diagnostic ability and improved the benign to malignant ratio of lesions biopsied with the use of dermoscopy. According to a meta-analysis by Wolner et al. (2017), use of dermoscopy had a sensitivity and specificity of 90%. In comparison,

the NEE was found to have 71% sensitivity and 81% specificity. Improving sensitivity without decreasing specificity equals an increase rate of detecting melanoma without increasing total number of unnecessary biopsies of benign lesions (Marghoob & Jaimes, 2017).

Multiple factors may influence the diagnostic performance of dermoscopy. Examples of these factors include experience level of the provider, diagnostic algorithm used, prevalence of melanoma in the given population, and patient related aspects. Research has also shown education and training influence a provider's diagnostic skill using dermoscopy. According to a review published by Herschborn (2012), a one-day dermoscopy training course with supplemental resources provided improved the diagnostic abilities of the participating physicians. Similarly, a study completed by Secker, Buis, Bergman, and Kukutsch reports improved sensitivity in the diagnosis of various pigmented skin lesions when provided with a short education course on dermoscopy (2017).

Use in Primary Care

With solid evidence supporting the improved diagnostic accuracy of skin lesions, dermoscopy makes a reliable technique for both general and specialized providers to use in practice. Dermoscopy is commonly utilized among dermatologists (Marghoob & Jaimes, 2017). However, its use in primary care remains underutilized. In a review by Fee, McGrady, Rosendahl, and Hart (2017), reported rates of dermoscopy use by primary care providers in the United States ranged between 6-8.3%. Barriers for the underutilization of dermoscopy mentioned include cost, lack of training or experience, and lack of reimbursement (Fee et al., 2017).

Lack of training refers to both NEE and dermoscopy techniques. Training and experience have a substantial role in a clinician's ability to diagnose accurately as there are several colors, structures, and patterns that can be recognized with a skin lesion. Educating providers on

dermoscopy methods enhances provider confidence, diagnostic accuracy, and the frequency of skin cancer screenings in primary care (Liebman et al., 2012).

A lengthy or formal training course is not necessary to make an improvement in clinical practice. A study done with primary care providers has shown as little as a one-day training course in dermoscopy along with consistent use of the technique has been shown to have higher diagnostic accuracy for melanoma when compared with NEE (Marghoob & Jaimes, 2017). Similarly, primary care providers in a different study were given a one-hour prerecorded lecture with materials for self-study. The participating providers had improved sensitivity in identifying melanoma in dermoscopic and clinical images as compared to baseline (Holmes et al., 2018). A previous practice improvement project involving a two-hour education session and educational handout provided to participating primary care providers showed an increase in provider confidence in using dermoscopy to evaluate skin lesions (Hencley, 2017)

Aside from clinical use with diagnosing skin cancer, performing a dermoscopic exam also provides an opportunity to provide patients with education (Liebman et al., 2012). The USPSTF recommends providers educate all fair skinned children, adolescents, and young adults from 10-24 years about minimizing exposure to ultraviolet radiation to reduce their risk for skin cancer (USPSTF, 2016). By adopting dermoscopy to practices that care for adolescents and young adults that provides a moment for screening and education that align with professional recommendations.

Dermoscopic Skin Characteristics

Because there are multiple characteristics to identify within a skin lesion, several multi-step algorithms have been developed to aid providers is recognizing these structures to verify a diagnosis. Colors, general structures, and vascular structures are identified using dermoscopy.

Providers are then able to associate these characteristics to confirm a skin lesion. Colors seen using dermoscopy include yellow, red, brown, blue, gray, black, and white. The variation in color is due to location and differences in concentration of melanin within the skin. Melanin will appear black in the stratum corneum, brown in the epidermis and superficial dermis, and blue and/or gray in the dermis. Red is associated with vascularity and a thrombus will look black. Collagen or scarring within the skin has a white appearance. Keratin or sebum production has a yellow appearance (Marghoob & Jaimes, 2017).

Structures seen with a dermoscope depend on the distribution and concentration of melanin, keratin, collagen, and vascularity. Varying combinations of these structures correlate to certain skin lesions. Homogenous blue pigment, pigment network, negative network, angulated lines, streaks, and a peripheral rim or aggregation of globules are all trademark signs of melanocytic nevi or moles. Angiokeratomas and cherry angiomas have red, blue, purple, or black colored lagoons. Seborrheic Keratoses feature fingerprint-like structures, sharply demarcated borders, milia-like cysts, comedo-like openings, moth-eaten borders, or a brain-like pattern. Basal cell carcinoma features leaf-like structures, spoke-wheel-like and concentric structures, arborizing vessels, large blue/gray ovoid nests, multiple blue gray nonaggregated globules, shiny white blotches and strands, and shallow ulceration. Squamous cell carcinoma has a white/yellow scale or crust, glomerular vessels, white circles, brown circles, rosettes, and brown dots/globules with a radial alignment. Finally, common structures associated with melanoma include an atypical pigment network, atypical vascular pattern, irregular streaks, atypical dots or globules, blue-white veil, angulated lines with a zigzag pattern or polygons, and regression structures (Marghoob & Jaimes, 2017).

For nonpigmented or hypopigmented lesions, vascular structures may be the only characteristic available to help a clinician in identifying the skin lesion. Evaluation of these lesions is suggested using noncontact dermoscopy but if a contact scope is only available ultrasound gel is suggested for the liquid interface because there is a reduction in pressure on vessels to avoid obscurity of vascular patterns. Evaluation of vascular structures involves assessing morphology, distribution, arrangement, and presence of a white or pink halo. However, these characteristics are not exclusive to different skin lesions. For example, dotted vessel morphology is associated with SCC, BCC, melanocytic tumors, porokeratosis, clear cell acanthoma, and psoriasis. Arborizing vessels are seen in BCC, melanoma, and intradermal nevi. Glomerular vessels are associated with SCC, clear cell acanthoma, and Bowen disease. Hairpin vessels are common in seborrheic keratosis but can also be observed in melanoma (Marghoob & Jaimes, 2017). Although these vascular patterns alone cannot be used in diagnosing a skin lesion, they can help in narrowing a differential and can be used in combination with pigmentation and general structures.

Dermoscopy Examination and Algorithms

The goal of evaluating a lesion in primary care is to decide to initiate an intervention such as perform a biopsy, refer to a dermatologist, or monitor the lesion. An algorithm helps to shorten and simplify the evaluation process while maintaining the integrity of diagnostic accuracy. A two-step evaluation method was first introduced in 2003 by a panel for the Consensus Internet Meeting on Dermoscopy (Marghoob & Jaimes, 2018).

The current two step method first involves differentiating pigmented from nonpigmented lesions. Features of melanocytic lesions include pigment network, angulated lines, negative network, aggregated (three or more) or peripheral rim of globules, streaks, homogenous blue

pigmentation, parallel pattern (palm and sole lesions), and pseudonetwork (face). A lesion with at least one of these characteristics is considered melanocytic and the examiner can proceed to the second step of the evaluation process (Marghoob & Jaimes, 2018).

For lesions that do not have any of these characteristics, they should be evaluated for structures consistent with BCC, SCC, seborrheic keratosis, angioma, hemangioma, or angiokeratoma which were discussed in the previous section. The lesion should also be evaluated for dermatofibroma. A dermatofibroma is a melanocytic lesion if a network is present. A nonmelanocytic dermatofibroma under polarized light will have a central scar-like area with shiny white lines often having ring-like globules toward the center. A dermatofibroma will also be firm upon palpation. There is also a small class of featureless lesions that do not fall under the pigmented or nonpigmented classification. These featureless lesions should still be evaluated for melanoma (Marghoob & Jaimes, 2018).

The goal of a melanocytic lesion undergoing evaluation in the second step is to distinguish a nevus or mole from a melanoma or other suspicious lesion. Methods commonly used to evaluate these lesions in primary care settings are described below (Marghoob & Jaimes, 2018).

ABCD Dermoscopy Rule

The ABCD rule was originally created to help primary care providers navigate differentiating a malignant from benign melanocytic lesion (Ahnlide, Bjellerup, Nilsson, & Nielsen, 2016). The method uses a scoring system to analyze four components of a lesion: asymmetry, border sharpness, colors, and dermoscopic structures. Asymmetry assesses the contour and distribution of structures and color along multiple axes. When assessing the border, clinicians should divide the lesion into eight equal pie-like sections noting the presence or lack of

an abrupt border in each section. Coloring is scored based on which color is present: red, white, light brown, dark brown, blue gray, and black. Five dermoscopic structures to note include pigment network, homogenous areas greater than 10% of the lesion, dots, globules, and branched streaks. The scores from the four sections are weighted and totaled to determine the final dermoscopic score (FDS). The score given will help providers determine the possibility of malignancy. The FDS can range from 1-8.9: scores less than 4.75 are considered benign, scores 4.75 to 5.45 are considered suspicious, and scores greater than 5.45 are likely malignant. The ABCD rule has been found to have a sensitivity ranging from 78% to 90% and specificity ranging from 45% to 90% depending on the experience of the clinician (Marghoob & Jaimes, 2017).

Category		**Points**	**Multiply: Points x Factor**
Asymmetry	No asymmetry Asymmetry on 1 axis Asymmetry on 2 axes	0 1 2	x 1.3
Border	No sharp border	0	x 0.1
	1-8 segment(s) with sharp border	1 point for each segment with sharp border (maximum 8)	
Color	White Red Light brown Dark brown Blue gray Black	1 point for each present	x 0.5
Dermoscopic structures	Network Aggregated globules Dots Structureless areas Branched streaks	1 point for each present	x 0.5
			FDS: 1-8.9

Figure 4. ABCD rule of dermoscopy.

Menzies Method

The Menzies method was developed to assist providers in distinguishing melanoma from other pigmented skin lesions. The range of sensitivity is 85% to 92% and specificity is 38% to 78% depending on provider level of experience. Menzies method was created based on the sensitivity of specific features associated with melanoma. Two negative features with a 0% sensitivity for melanoma are symmetry and presence of only one-color. A lesion with both negative features excludes a diagnosis of melanoma. There are also nine positive features having a sensitivity of at least 85%. Such features include blue-white veil, brown dots, pseudopods, radial streaming, scar-like depigmentation, peripheral black dots or globules, broad network, blue gray dots, and five or more colors in a lesion. The presence of any one of the positive features elevates suspicion for a melanoma (Marghoob & Jaimes, 2017).

Seven-Point Checklist

The seven-point checklist is essentially a list of the seven most common dermoscopic features connected to melanoma. The list is comprised of both major and minor criteria. Major criteria are atypical pigment network, blue-whitish veil, and atypical vascular pattern. Two points are added to the score for every major criterion present. Minor criteria are irregular streaking, irregular dots or globules, irregular blotches, and regression structures. One point is given for each minor criterion noted within the lesion. A score of three or more is indicative of melanoma. The presence of any one of the major or minor criterion is adequate for a biopsy. The sensitivity ranges from 62-95% and a specificity of 35-97% in clinicians with varying experience (Marghoob & Jaimes, 2017).

Criteria		Definition
Major criteria (2 points for each)	Atypical pigment network	Irregular hyperpigmented network
	White-blue areas	Structureless white-blue area with a "ground-glass" appearing surface. These areas cannot take up the entire skin lesion
	Atypical vascular pattern	Irregular linear or dotted vessels with irregular distribution
Minor criteria (1 point for each)	Radial streaming (streaks)	Radial, asymmetric linear at the edge of a skin lesion
	Irregular blotches	Structureless areas with black, brown and/or gray pigmentation consisting of irregular shape and/or distribution
	Irregular dots and globules	Irregularly distributed black or brown round structures
	Regression structures	White areas (depigmentation) with irregular shape and/or distribution

Figure 5. The seven-point checklist of dermoscopy.

CASH Algorithm

CASH is an algorithm for color, architectural order verses disorder, symmetry, and homogeneity or heterogeneity of structures (Marghoob & Jaimes, 2017). The CASH algorithm is the only method to include architectural disorder as a means of assessing pigmented skin lesions (Henning et al., 2007). Color refers to having multiple colors within the lesion (Marghoob & Jaimes, 2017).

Architectural order consists of uniform structures and a distribution pattern consistent with benign lesions. Benign lesions typically have a network consisting of brown homogenous pigmented lines and hypopigmented holes. Dots and globules in the lesion have similar color, size, and shape. Dots tend to be located centrally or on pigmented lines. Globules and blotches are either centrally located or are distributed at the periphery. Streaking, radial streaming, and pseudopods typically have symmetrical distribution at the periphery (Henning et al., 2007). Architectural disorder is just the opposite. Disorder refers to inconsistent structures and lack of benign patterns. In disordered or malignant lesions, the network has disorderly lines and an

asymmetric distribution of holes at the periphery. Dots and globules vary in color, size, and shape. Dots have an asymmetric distribution at the periphery. Globules also have an asymmetric distribution but typically have a focal aggregation. Blotches have no pattern and can be scattered throughout the lesion. Streaking, radial streaming, and pseudopods are asymmetrical at the periphery (Henning et al., 2007).

Symmetry is evaluated based on shape and pattern. Homogeneity refers to the uniformity of dermoscopic structures. A scoring system is used to evaluate a lesion using the CASH algorithm. Scores range from 2 to 17. A score over 8 is indicative of melanoma. The CASH algorithm has sensitivity of 87-98% and a specificity of 67-68% (Marghoob & Jaimes, 2017).

Pattern Analysis

Pattern analysis is a method of dermoscopic examination that is more intricate and requires a clinician to have knowledge and experience of dermoscopic features of benign nevi and melanoma. Pattern analysis has a high sensitivity when used by experienced providers, but has been shown to have poorer diagnostic accuracy than naked eye examinations when used in non-expert practitioners. Benign lesions typically have few colors and a more symmetric and have an organized pattern of dermoscopic structures. Melanomas tend to have an asymmetric pattern, disorganized dermoscopic structures, and are multicolored (Marghoob & Jaimes, 2017).

Limitations

In primary care, dermoscopy is used in the examination of skin lesions to determine if a referral or biopsy is warranted. Dermoscopy is meant to be a technique that can aid a provider in narrowing a differential diagnosis, and not to make a diagnosis. There is potential for cancerous lesions to lack certain dermoscopic features. Because some dermoscopic features may not be

present, histologic examination of a lesion remains the gold standard for a diagnosis of skin cancer (Marghoob & Jaimes, 2017).

While dermoscopy can improve a provider's diagnostic accuracy, it is a multifaceted technique that has limitations based on an individual's knowledge and level of experience. A minimal amount of training is needed to provide a benefit over other clinical examination methods. Although one-day training course previously mentioned increased a provider's diagnostic accuracy, several years may be warranted for a provider to feel confident with their dermoscopic skills (Marghoob & Jaimes, 2017).

Theoretical Framework

Utilizing theories and/or models can help develop a practice improvement project and guide implementation into clinical practice. Evidence-based practice (EBP) is the interdisciplinary approach of applying the most current research to improving patient outcomes and clinical practice (Iowa Model Collaborative, 2017). When utilizing the newest research, there can be learning curve to adopting new or updated practices and using the Diffusion of Innovations (DOI) theory was useful in guiding the participants to adopt the use of dermoscopy throughout the project (Kaminski, 2011).

The Iowa Model of Evidence-Based Practice

Since the original development, the Iowa Model of EBP has been updated and validated to improve its ability to influence clinical change. The model uses a multi-phase approach with feedback loops to assess and make changes to the selected topic or problem (Iowa Model Collaborative, 2017). The utilization of the Iowa Model of EBP in reference to the project is discussed throughout the next few paragraphs.

Topic Selection

The topic of choice is typically selected based on an identified trigger issue or a potential opportunity for change based on new research that has not yet been applied to practice. When the topic has been identified, stating the purpose of the change is intended to guide the process of adopting the change. The low incidence of skin exams by primary care providers, lack of training for identifying skin cancers, provider unfamiliarity with dermoscopy, and increased incidence of skin cancers in the United States are examples of triggers identified for co-investigators of the project (Curiel-Lewandrowsi et al., 2012). The purpose of introducing dermoscopy was to increase the frequency and accuracy of skin examinations performed by primary care providers and improve provider confidence in identifying benign and concerning skin lesions through educating providers on the benefit of utilizing dermoscopy in practice.

Team & Evidence

Once the problem has been clearly identified, a team should be assembled to guide the project and gather evidence to support change for the topic of concern. The team can include nurses, advanced practice providers, physicians, interdisciplinary colleagues, and other experts on the topic. Selected committee members for the project include: Dean Gross, PhD, FNP-BC, committee chairperson; Kelly Buettner-Schmidt, PhD, RN; Anna Thomas, DNP-APRN; and Nicole German, PhD. Other team members include primary care providers, nurses, and support staff at a primary care clinic in a community of 120,000 in the upper Midwest.

Collecting evidence starts by identifying potential resources and key terms to use in the search. Databases are used to gather evidence from multiple types of sources (Melnyk et al., 2014). Information collected includes the incidence & prevalence of skin cancer, pathophysiology of common malignant skin lesions, skin cancer screening techniques, and

significance and use of dermoscopy in practice. Information has been acquired through textbooks, electronic databases, and the help of healthcare professionals. The information was graded and contains both quantitative and qualitative characteristics.

Design & Implement

With enough evidence to support the change, a plan was designed to implement the change. Herschborn (2012) described how diagnostic accuracy of primary care providers improved with use of dermoscopy when accompanied by a one-day training session. In order to integrate dermoscopy and promote a sustainable change in primary care practice, a combination of an education session and time for clinical practice using dermoscopy was used in familiarizing dermoscopy with primary care providers. The providers were able to participate in a voluntary educational session that provided them with the basics of skin cancer, specific characteristics of the most common skin cancers seen in practice and learn how to use a dermoscope. The educational session also included time for practice using a dermoscope to identify images of both benign and malignant skin lesions. A total of two sessions were provided to increase access for providers to participate. A three-month period was then given for the providers to implement dermoscopy into practice. During the three-month period, the co-investigator made biweekly visits to the site until the final date of implementation. The project was evaluated using a pre- and post-implementation survey to assess the participating provider's knowledge of skin cancer, familiarity with dermoscopy, views on utilizing dermoscopy in practice, and confidence in using dermoscopy to diagnose skin lesions. The surveys were compared, and the results were disseminated.

Summary

The Iowa model provided a guide for cultivating objectives and implementation of this practice improvement project. Permission for using the Iowa model was given on March 25, 2019 (Appendix A). The evidence supporting dermoscopy gave the project a foundation for implementation along with research for future improvements to skin cancer screening in primary care.

Diffusion of Innovations

Diffusion of Innovations is a theory commonly used in nursing as changes in evidence helps guide changes in clinical practice. The Diffusion of Innovations theory was created by E. M. Rogers in 1962. The theory was developed to explain how a new concept (innovation) is adopted through a population over time. An innovation can be an idea, item, or behavior that is identified as new to the population. The innovation is adopted by a population through a process of five stages. The stages in order include knowledge or awareness, persuasion or interest, decision or evaluation, implementation or trial stage, and confirmation or adoption. In the initial stage of knowledge or awareness the population is exposed to the innovation but may not know everything about the innovation. In the persuasion or interest stage, the population becomes more interested in the innovation and will try to find more information regarding the innovation. Decision or evaluation: individuals in the population test out the innovation and will decide whether or not they will use it in future practice. Implementation or trial: Individuals completely use the innovation. Confirmation or adoption: Individuals decide to continue using the innovation (Kaminski, 2011). The innovation for the project is dermoscopy and the intent is to familiarize primary care providers with the practice of dermoscopy.

Diffusion

Diffusion is the process of adopting a change over time. The four main components in the diffusion process include innovation, communication channels, time, and a social system. Dermoscopy is the innovation utilized in the project. The communication channel will be in the form of face to face education session, site visits with providers, standardized survey questions, and an educational handout for the providers to reference. Following the education session, a three-month period will be given for providers to practice the skills and knowledge provided into their practice. The social system being used is the primary care providers at the clinic (Kaminski, 2011).

Innovation Characteristics

Different innovations have various characteristics, which aid in the success of the innovation. In 2003, Rogers identified five characteristics that can be used to evaluate any innovation. These characteristics include observability, relative advantage, compatibility, trialability, and complexity. Observability describes the extent to which the outcomes of an innovation are noticeable to potential adopters. Relative advantage is the significance in improved diagnosis the innovation appears to be than current practice. Compatibility describes how consistent the innovation appears to be with socio-cultural ideals, prior ideas, and/or anticipated needs. Trialability is the extent to which the innovation can be utilized on a restricted basis. Complexity refers to the degree of simplicity or how easy the innovation is to use or understand (Kaminski, 2011).

Adopter Categories

The rate an innovation is adopted depends on the previously mentioned characteristics and the individuals or adopters that comprise a population. DOI has five categories of adopters

include innovators, early adopters, early majority, late majority, and laggards. The proportions of these categories follow distribution of a normal bell-shaped curve (Kaminski, 2011).

Innovators (2.5%) make up the smallest portion of the population and take the least amount of time to adopt a change. They are often said to be adventurous, risk takers, and have an appreciation for advances in technology. Innovators are motivated by the idea of change and put in the effort toward building the foundation of promoting the innovation. The process of adopting the new change starts with this portion of the population and are the gate keepers for the next group, the early adopters (Kaminski, 2011).

Early adopters (13.5%) who take advantage once the benefits of the innovation have been noted by the innovators. The early adopters can also be known as trend setters and want to be recognized first with the innovation. The early adopters are great test subjects as they are thought of as opinion leaders and role models (Kaminski, 2011).

Early majority (34%) also serve as opinion leaders later in the process of diffusion. They enjoy using transformative changes with practice as a way of increasing productivity. Early majority frequently deliberate and communicate with their peers about innovations, but only take referrals from trusted peers within their industry. They like to have evidence and reliability backing the innovation (Kaminski, 2011).

Moving to the more conservative side, the late majority (34%) are doubtful and cautious but also respond to peer pressure and a necessity for innovation. They are motivated by cost and the need to keep up with competitors but are hesitant with technology. They confide in one single, trusted advisor, instead of may like the early majority. They are also easily swayed by the laggards (Kaminski, 2011).

Laggards (16%) are the biggest skeptics of all five categories and therefore the most difficult to convert toward utilizing the innovation. They are isolated from their peers and view technology as bothersome. Laggards are apprehensive of innovation and tend to be stuck in their ways. The laggards will only invest in technology if all other options have failed or appear worse than other options (Kaminski, 2011).

CHAPTER THREE: METHODS

The design of this project was intended for practice improvement in the primary care setting. The project was designed with the purpose of increasing participating provider's certainty with dermoscopy, expertise in using the dermoscope, and correctly identify both benign and malignant skin lesions.

Implementation Plan

The project was implemented with family medicine providers at a clinic in the upper Midwest. The clinic offers primary care, physical therapy, urgent care, and lab services. The setting was chosen based on interest regarding dermoscopy education from the family medicine providers including Anna Thomas, DNP, APRN, a committee member for the project. One of the participating providers owns a dermoscope but had not been using the dermoscope due to lack of training and the other family medicine providers had been completing skin examinations using the naked eye and light from the otoscope.

The intent of the project was to build and enhance skills associated with utilization of dermoscopy in primary care practice. The participants of the project were chosen as they are all family medicine providers who participate in primary care and had expressed interest in learning about dermoscopy. Interest was determined while the co-investigator completed clinical hours at the facility. All participants were read the consent prior to participating in the educational session and consent was given with completion of the pre-implementation survey. Prior to implementation, approval was given by both North Dakota State University IRB (Appendix E) and Essentia Health (Appendix F).

Following approval, the co-investigator hosted a one-hour long educational session and provided a handout including information on the basics of skin cancer, application of the

dermoscopic algorithms (ABCD rule and seven-point checklist) and demonstration of a dermoscope. The dermoscope used for training and practice was the Welch Allyn 47300 Episcope. The handout was developed using evidence-based resources utilized throughout the project. A one-hour session was chosen based on evidence found from Herschborn (2012). The ABCE rule and seven-point checklist were chosen based on straightforwardness, applicability to skin lesions seen in primary care, and effectiveness based on evidence (Unlu, Akay, & Erdem, 2014).

A three-month period was provided for participating primary care providers to implement dermoscopy and refining their skills with the tool. The providers were encouraged to utilize dermoscopy on any patient but particularly those presenting with a skin complaint or annual physical examinations. During the three-month period, the co-investigator made five site visits on December 4, 2019, December 17, 2019, January 8, 2020, February 4, 2020, February 18, 2020. The co-investigator used the site visits to discuss progress with using dermoscopy and answer provider questions. The objectives involving knowledge, application, and confidence in identifying various skin lesions and using a dermoscope were evaluated with a pre- and post-implementation survey completed by the participating providers. The survey questions were taken from a practice improvement project previously developed by Erin Hencley. Hencley's permission for use and modification of the surveys was obtained prior to project implementation (APPENDIX D) (2017).

Evaluation

Evaluation of this practice improvement project was completed to ensure the objectives of the project had been met. A logic model (Appendix I) was used to showcase the components

of the inputs, outputs, activities, short-term outcomes, and long-term outcomes. Evaluation of each objective is expanded upon in subsequent paragraphs.

Objectives

1. Develop a comprehensive handout on dermatologic lesions for providers in an urban primary care clinic in eastern North Dakota to use in conjunction with dermoscope application by October 2019.

Development of an educational handout was combined with an in-person education session. The education session provided primary care providers with evidence-based techniques for utilizing dermoscopy in practice. Evaluation of the education session and demonstration provided was completed through the analysis of pre- and post-surveys. Questions in both surveys aimed at assessing the quality of the education provided to the primary care providers.

2. Increase knowledge of primary care providers in identifying both benign and malignant skin lesions using dermoscopy during a three-month implementation period.

The handout and education session combined with demonstration provided the participating primary care providers with information in identifying benign and malignant skin lesion. An increase in knowledge was evaluated using a Likert scale addressing the provider's change in knowledge and comfort level in identifying skin lesions throughout the implementation period. Site visits were also utilized to answer questions, track provider progression with utilization of dermoscopy, and address disparities in knowledge. Questions from providers and the amount of dermoscopy use varied with experience levels among the providers. On the pre- and post-implementation survey, statement two, statement three, and question one were intended to evaluate objective two.

3. Increase provider application and confidence using dermoscopy at the conclusion of the three-month implementation period.

Throughout the three-month implementation period, the participating primary care providers were to utilize the educational handout and other materials provided along with the Welch Allyn 47300 EpiScope on patients presenting for both skin concerns and annual exams. The intent of practicing the skill of dermoscopy as frequently as possible was to improve each provider's confidence with the dermoscope and dermoscopy techniques. Evaluation of provider application and confidence was assessed using a Likert scale. On the pre- and post-implementation survey, statement three and question one were intended to evaluate objective three.

CHAPTER FOUR: RESULTS

The project as previously described started on November 18, 2019, concluded on February 18, 2020, and occurred at an urban primary care clinic in eastern North Dakota. The population of the project included primary care providers at the urban primary care clinic in eastern North Dakota. Surveys were administered at the start and conclusion of the implementation period. Seven participants responded to the pre-implementation survey provided and six participants responded to the post-implementation survey. The surveys were only distributed to primary care providers at the urban primary care clinic in eastern North Dakota; no patients or other employees were involved. Participation in the survey was voluntary for the primary care providers.

Sample Demographics

Of the seven participants, six were female and one was male. The type of healthcare provider included two physicians, three nurse practitioners, and two physician assistants. The average amount of primary care experience ranged from less than 1 to 32 years with the average being 7 years.

Data Analysis and Results

The pre- and post-implementation surveys developed by Hencley used in evaluation of the project consisted of a Likert scale with response choices of strongly disagree, disagree, agree, and strongly agree (2017). In addition to the surveys developed by Hencley, two additional questions were included. While the additional questions did not aid in evaluating the objectives, the questions served to assess the participating provider's perceived change in clinical practice and intentions to purchase a dermoscope. The pre-implementation survey included five questions and the post-implementation survey included seven questions. The data collected from both

surveys were quantitative. Data analysis of the pre- and post-implementation surveys were completed using Qualtrics. Bar graphs with the data collected from both surveys are described below.

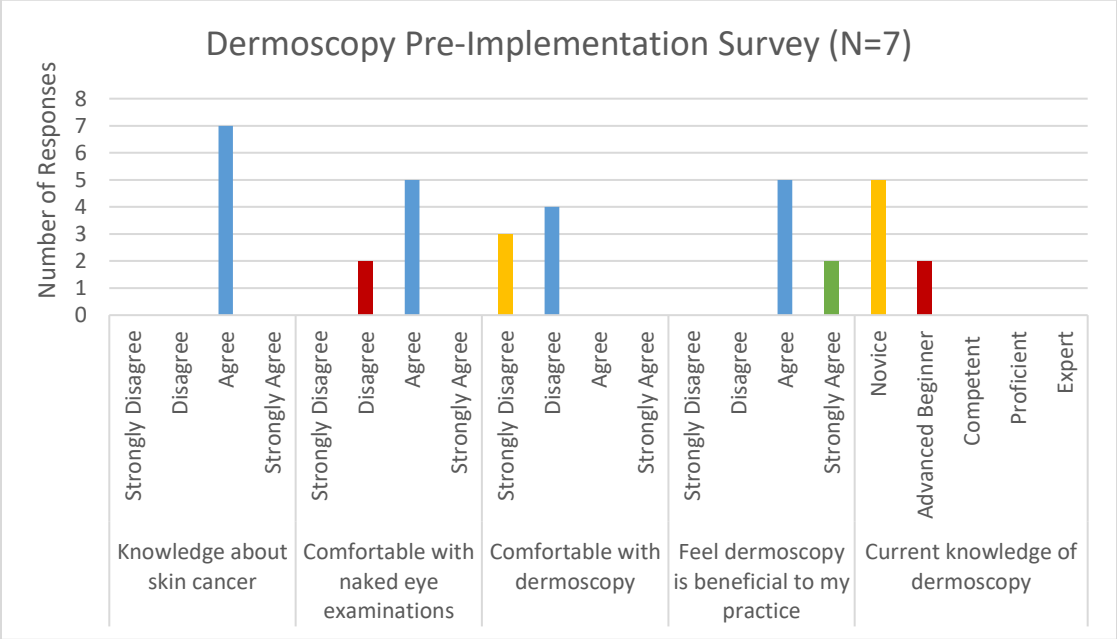

Figure 6. Dermoscopy pre-implementation survey results.

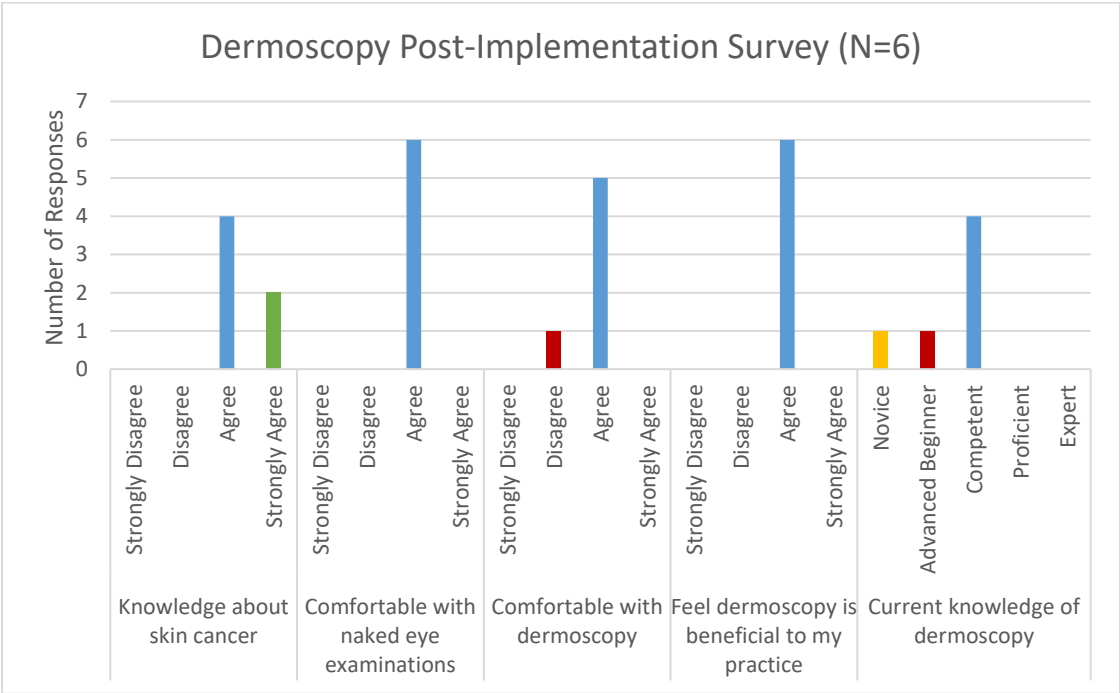

Figure 7. Dermoscopy post-implementation survey results (Part 1).

Statement One

I am knowledgeable about skin cancer prevalence and prevention strategies. The statement was used to determine a starting point of the providers general knowledge of skin cancer and screening guidelines prior to the dermoscopy education session. All seven of the initial participants answered agree. For the post-implementation survey, four participants answered agree and two answered strongly agree.

Statement Two

I feel comfortable performing naked eye skin examinations. Statement two was used to establish a baseline comfortability in performing naked eye examinations among the providers. Comparing the results of the pre- and post-implementation survey was aimed to evaluate objective three. On the pre-implementation survey, two providers answered disagree and five providers answered agree. On the post-implementation survey, all six providers answered agree.

Statement Three

I feel comfortable with the practice of dermoscopy. The aim of statement three was to assess as provider comfortability with dermoscopy before and after the education session and implementation period. On the pre-implementation survey, three providers answered strongly disagree and four providers answered disagree. On the post-implementation survey, one provider answered disagree and five providers answered agree.

Statement Four

I feel that using dermoscopy will benefit my practice and my patients. The statement was used to determine the value of dermoscopy among the participating providers. On the pre-implementation survey, five providers answered agree and two providers answered strongly agree. All six providers answered agree on the post-implementation survey.

Question One

What do you consider your current level of knowledge of dermoscopy? The question was created to establish each provider's perception of their baseline knowledge and skill of dermoscopy. On the pre-implementation survey, five providers answered novice and two providers answered advanced beginner. On the post-implementation survey, one provider answered novice, one provider answered advanced beginner, and four providers answered competent.

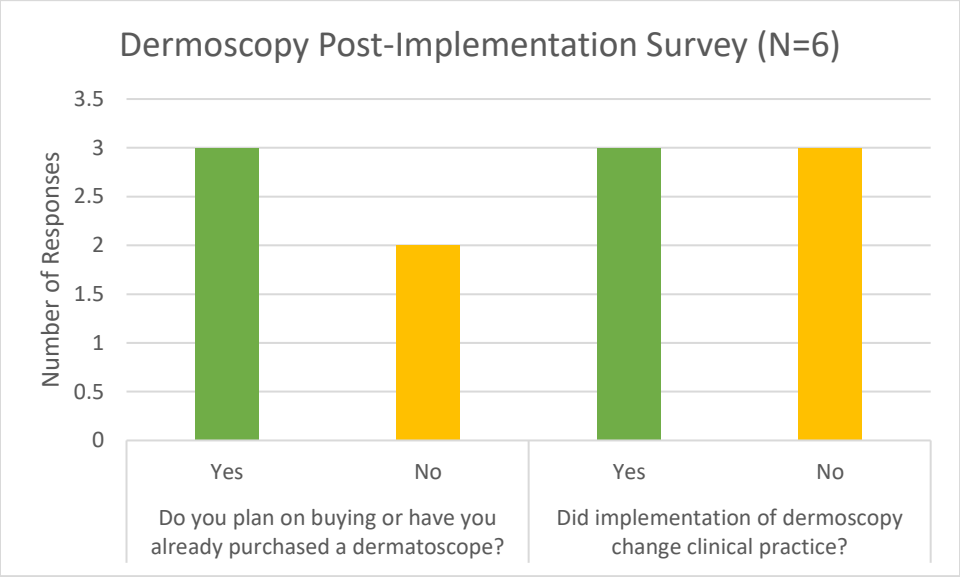

Figure 8. Dermoscopy post-implementation survey results (Part 2).

Question Two

Do you plan on buying or have you already purchased a dermoscope? The question was added to the post-implementation survey to evaluate if any providers had already purchased or intended to purchase a dermoscope. Three providers answered yes and two providers answered no.

Question Three

Did implementation of dermoscopy change clinical practice? The question was added to the post-implementation survey to evaluate whether dermoscopy changed clinical practice among the providers. Three providers answered yes and three providers answered no.

CHAPTER FIVE: DISCUSSION AND RECOMMENDATIONS

Summary and Synthesis

While dermoscopy has been widely used by dermatologists, primary care providers have shown to use dermoscopy in 6.0% to 8.3% of visits. Barriers to utilization in primary care included cost and lack of training or experience in using dermoscopy (Fee et al., 2017). Liebman et al. (2012) found education on dermoscopy can improve provider confidence, diagnostic accuracy, and the occurrence of skin cancer screenings in the primary care setting. However, the education and training does not have to be extensive. A one-day training course on dermoscopy combined with consistent practice using a dermoscope lead to improved diagnostic accuracy for melanoma when compared to using the NEE when evaluating a skin lesion (Marghoob & Jaimes, 2017). A previous practice improvement project using a two-hour education session and educational handout for participating primary care providers showed an increase in provider confidence in using dermoscopy (Hencley, 2017). The findings from Hencley's practice improvement project were similar to those found with this project. The findings from the previously mentioned research support the findings of the project, which are discussed in subsequent paragraphs.

Objective One

The first objective of the project was to develop an educational handout to provide the participating primary care providers during the education session was met. The idea of the educational handout came from findings based on Hencley's project (2017). The co-investigator was responsible for creating the handout using current and evidence-based information regarding dermoscopy prior to project implementation on November 18, 2019. In the original project objectives, a timeline of October 2019 was stated. The date changed due to delay of

implementation site approval and availability of the primary care providers. The original project design offered two education sessions, but only one was needed as timing allowed for all providers in the clinic to participate in a single session. The educational handout included the ABCD rule of dermoscopy, seven-point checklist, and general information on basal cell carcinoma, squamous cell carcinoma, and melanoma. The handout was then utilized during the educational session to help the providers practice identifying specific characteristics in various skin lesions and was a reference for the providers to utilize throughout the implementation period. Although data were not collected in reference to the quality of the handout, qualitative data from site visits suggested the handout was easy to use and provided a strong reference for the providers.

Objective Two

The second objective of the project to increase knowledge of primary care providers in identifying both benign and malignant skin lesions using dermoscopy during a three-month implementation period was met. The results of the project show an increase in knowledge of skin cancer, comfortability with naked eye examinations, comfortability using dermoscopy, and current knowledge of dermoscopy.

Objective Three

The third objective of the project to increase provider application and confidence using dermoscopy at the conclusion of the three-month implementation period was met. Data shows an increase in comfortability using dermoscopy and current knowledge of dermoscopy. Additional questions were added to the post-survey to evaluate application of dermoscopy to clinical practice. The questions assessed perceived benefit, change in clinical practice, and provider intention for buying a dermoscope. Providers remained consistent in feeling dermoscopy is

beneficial for practice. Three of the six providers who participated in the post-implementation survey either have a dermoscope or plan to purchase one. One provider was previously known to have a dermoscope prior to project implementation. Of the providers that answered the post-implementation survey, the results were equally split on whether providers felt dermoscopy changed their clinical practice. Perceived change in clinical practice is a potential area for further research as it would be interesting to assess confounding variables such as amount of provider experience and the extent providers were able to practice dermoscopy.

The Iowa Model of EBP and DOI theory were used to structure the design, implementation, and evaluation of the project. The benefit of using the revised Iowa Model of EBP is the multi-phase approach to assist in the design of the project. In designing the project, the co-investigator could not move forward unless components of each phase were met. If criteria were not met in a particular phase, the co-investigator had to re-evaluate and change the plan to move to the next phase. The model also provided feedback loops that aided in assessing changes that needed to be made in the implementation plan (Iowa Model Collaborative, 2017).

While the DOI theory was overall useful in project implementation, certain components were more helpful than others. Identifying the type of adopter was the most helpful. While completing site visits, the co-investigator was able to identify providers who were more eager and those who were more resistant to practicing dermoscopy throughout the implementation period. By identifying which providers were innovators, early adopters, early majority, late majority, and laggards, the co-investigator could use the time at the site visit to provide more encouragement to practice dermoscopy for the identified late majority and laggards of the group. Identifying the components of diffusion was also helpful especially in designing the implementation plan for the project (Kaminski, 2011)

The stages component of the DOI theory wasn't as useful because several stages including knowledge or awareness, persuasion or interest, and decision or evaluation had already been completed prior to design and implementation of the project. The stages of the DOI include knowledge or awareness, persuasion or interest, decision or evaluation, implementation or trial stage, and confirmation or adoption. At the start of the co-investigator's implementation of the project, provider awareness and interest in dermoscopy had already been established. The entire premise of the project involves the implementation stage where individuals completely use the innovation, which was the dermoscope. At the conclusion of the DOI stages confirmation or adoption is to occur. While the questions added to the post-implementation survey were included with the intent of assessing longevity of dermoscopy use among the providers, the primary care provider's use of dermoscopy long-term was not evaluated and remains an open-ended question for further research (Kaminski, 2011).

Technology continues to become intertwined with healthcare delivery. Smartphone applications have been developed based on algorithms to detect melanoma and other skin cancers. By providing the general population with access to a smartphone application, the number of individuals that can assess a skin lesion expands well beyond the number of individuals that can be seen by a primary care provider or dermatologist for skin cancer screening and evaluation. However, recent research has alluded to these applications being unreliable. A review of nine studies assessing the reliability of six smartphone applications available for anyone to use found inconsistencies in accurate identification of both benign and malignant skin lesions (Freeman et al., 2020).

Recommendations

The goal of skin cancer screening is the ability to identify skin lesions with malignant characteristics. By utilizing dermoscopy, primary care providers can break down practice barriers to skin cancer screening. The results of the project show a general improvement in comfortability and knowledge with dermoscopy among the providers. Based on these findings, the co-investigator recommends consistent use to improve the skill of each provider. While one of the providers had a dermoscope prior to project implementation, purchasing a dermoscope would be recommended for consistent use from the primary care providers. If providers are unable to purchase a dermoscope, purchasing a shared dermoscope could be discussed with the clinic manager. One of the previously identified barriers was lack of reimbursement for dermoscopy. The CPT code 96999 could be used to improve provider reimbursement for using dermoscopy and would be provided to the clinic manager to show how dermoscopy use would benefit the clinic (AAPC Coder, 2020).

The co-investigator would also suggest changes to future projects to improve quality of data. As previously mentioned, the results for whether dermoscopy changed clinical practice were equally split amongst providers. To address the divide, future projects should include qualitative data to investigate why providers felt there was or wasn't change to clinical practice. Another change that could be made is including tracking of providers use of dermoscopy via chart auditing of CPT codes.

Dissemination

Prior to implementation, the project had already been presented to undergraduate nursing students, fellow graduate nursing students, and nurse practitioners. These sites included the North Dakota Nurse Practitioner Association (NDNPA) 2019 Pharmacology Conference. A

poster session for the undergraduate and graduate nursing students at North Dakota State in April 2019 gave the opportunity to educate future healthcare professionals on the evidence and benefit behind dermoscopy in primary care. The NDNPA 2019 Pharmacology Conference provided an opportunity for other nurse practitioners and nurse practitioner students to learn about the project and how dermoscopy could potentially benefit their own practices.

Prior to the education session and implementation period, the participating providers either disagreed or strongly disagreed with the statement regarding comfortability with dermoscopy. The providers also viewed their current knowledge of dermoscopy as either novice or advanced beginner. Through the post-implementation survey and site visits, the co-investigator learned the providers felt dermoscopy could benefit their clinical practice with more time to practice the skill of dermoscopy. The clinic participating in the project is one of several clinics offering primary care in the community where the clinic is located. The clinic is also part of a larger healthcare organization that spans several states in the upper Midwest. Through communication of the findings within the organization, a goal would be to have other primary care providers learn about dermoscopy and apply dermoscopy to their clinical practice. The influence of the project has the potential to extend into other clinics in the local community and beyond. The co-investigator is willing to participate in meetings, educational sessions, or publications that would allow information regarding dermoscopy to be shared with other primary care providers.

Future dissemination also includes a poster session in April 2020 and publication of this practice improvement project. The co-investigator plans to seek out a primary care journal interested in publishing information on the benefit of utilizing dermoscopy in primary care. Publication in journals such as the Journal of Aging and Health or Journal of the American

Academy of Nurse Practitioners would allow the co-investigator to expand the audience of primary care providers who may be interested in learning more about dermoscopy or using dermoscopy in practice.

Strengths and Limitations

Strengths

Seven primary care providers participated in the pre-implementation survey. For the post-implementation survey, 6 of the 7 or 85.7% of the initial group participated in the survey upon completion of the implementation period. Although the sample size for the project is small, data comparison between the pre- and post-implementation survey were consistent with 85.7% of the providers responding to the post-implementation survey. The results of the project were also consistent with previous findings from Hencley. Consistency in the response to the surveys and findings from Hencley's project are considered strengths of the project.

Another strength of the project in educating primary care providers to use a dermoscope is the cost benefit provided to patients. By using a dermoscope to assess a skin lesion at the current appointment, primary care providers can potentially save the patient time by sparing the patient a referral to a dermatologist. Along with the time component is the cost of a dermatology referral, transportation to appointments, and potential procedures that may be unnecessary.

Limitations

One limitation of the project was the amount of time each provider was able to practice using a dermoscope. Through conducting site visits, some providers seemed to utilize dermoscopy more than others. One of the reasons given by the providers who did not practice dermoscopy was lack of applicable patient visits and lack of need for dermoscopy in most patient visits. Along with the extent to which dermoscopy was able to be utilized, provider willingness

to utilize dermoscopy also played a role in extent of dermoscopy use. Despite initial willingness to participate in the project and encouragement given throughout the project implementation period, one provider verbalized they had not utilized dermoscopy during a co-investigator site visit two weeks prior to the conclusion of the implementation period. The provider gave reasons including lack of opportunity in clinic visits, lack of time during a visit, and forgetfulness. Reimbursement and time during visits were factors identified by Fee et al. (2019) as a barrier to dermoscopy use in practice. Using CPT code 96999 would provide reimbursement for using dermoscopy and give providers incentive to use dermoscopy as part of the services offered (AAPC Coder, 2020).

Another limitation was the number of years of experience of the primary care provider. The co-investigator noted three of the participating providers were in their first year of practice. Based on information obtained during site visits, the providers still in the first year of practice weren't as apt to use dermoscopy during clinic visits. Upon inquiring about the reasoning for their lack of dermoscopy use, the main reasons provided by the providers included lack of opportunity in clinic visits, lack of time during a visit, and forgetfulness. The perception of the co-investigator was that adjusting to practice played a role in the decreased dermoscopy use for those with less than one year of experience. The other providers who had a more established practice appeared to be using the dermoscope more frequently. There hasn't been any literature identified to support perception verses accuracy with the amount of experience in relation to dermoscopy use, which would be an area for further research.

Application to the Advanced Practice Nurse Role

The advanced practice nurse provides both a leadership and clinical role in the community serving both individuals and families. Completion of the project has shown how

nurse practitioners utilize both these roles to implement strategies that minimize and manage health concerns. In primary care, nurse practitioners use three levels of prevention to implement said strategies. Levels of prevention include primary, secondary, or tertiary. Secondary prevention encompasses evidence-based screening measures to aid in early detection and slow disease progression (Fletcher & Fletcher, 2020). Skin cancer screen was identified as an area of screening that does not show enough evidence to routinely complete on all patients regardless of risk factors (USPSTF, 2016). While the evidence does not favor routine skin cancer screening, skin concerns are still a common problem seen among primary care providers. A study completed by Sauver et al. (2013) found skin related visits were among the most common seen in primary care. The gap between screening recommendations and frequency of skin related concerns in primary care provides an opportunity for the Doctor of Nursing Practice to combine the leadership and clinician roles to improve the quality of healthcare delivery. Part of the outcomes of Doctor of Nursing Practice program at North Dakota State University aim at utilizing technology and evidence-based prevention and intervention strategies to promote health, improve health disparities, and improve the quality of healthcare delivery (North Dakota State University, 2019). The project embodies these outcomes. Dermoscopy is an evidence-based technology that has been shown to improve the diagnostic accuracy of melanoma in providers with even minimal training (Marghoob & Jaimes, 2017). By disseminating dermoscopy into the primary care setting, providers would have a skill allowing them to confidently assess skin lesions. Dermoscopy can be utilized to promote skin health, improve detection of skin cancer, and reduce the number of referrals or unnecessary procedures for the patient. In the case of a skin cancer diagnosis dermoscopy would facilitate timely intervention. Dermoscopy is just one of many evidence-based tools nurse practitioners can implement into practice.

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APPENDIX A. PERMISSION TO USE AND/OR REPRODUCE THE REVISED IOWA MODEL (2017)

Kimberly Jordan <UIHCNursingResearchandEBP@uiowa.edu>

To: Erin Lubitz

March 25, 2019

You have permission, as requested today, to review and/or reproduce *The Iowa Model Revised: Evidence-Based Practice to Promote Excellence in Health Care.* Click the link below to open.

The Iowa Model Revised: Evidence-Based Practice to Promote Excellence in Health Care

Citation: Iowa Model Collaborative. (2017). Iowa model of evidence-based practice: Revisions and validation. *Worldviews on Evidence-Based Nursing, 14(3), 175-182. doi:10.1111/wvn.12223*

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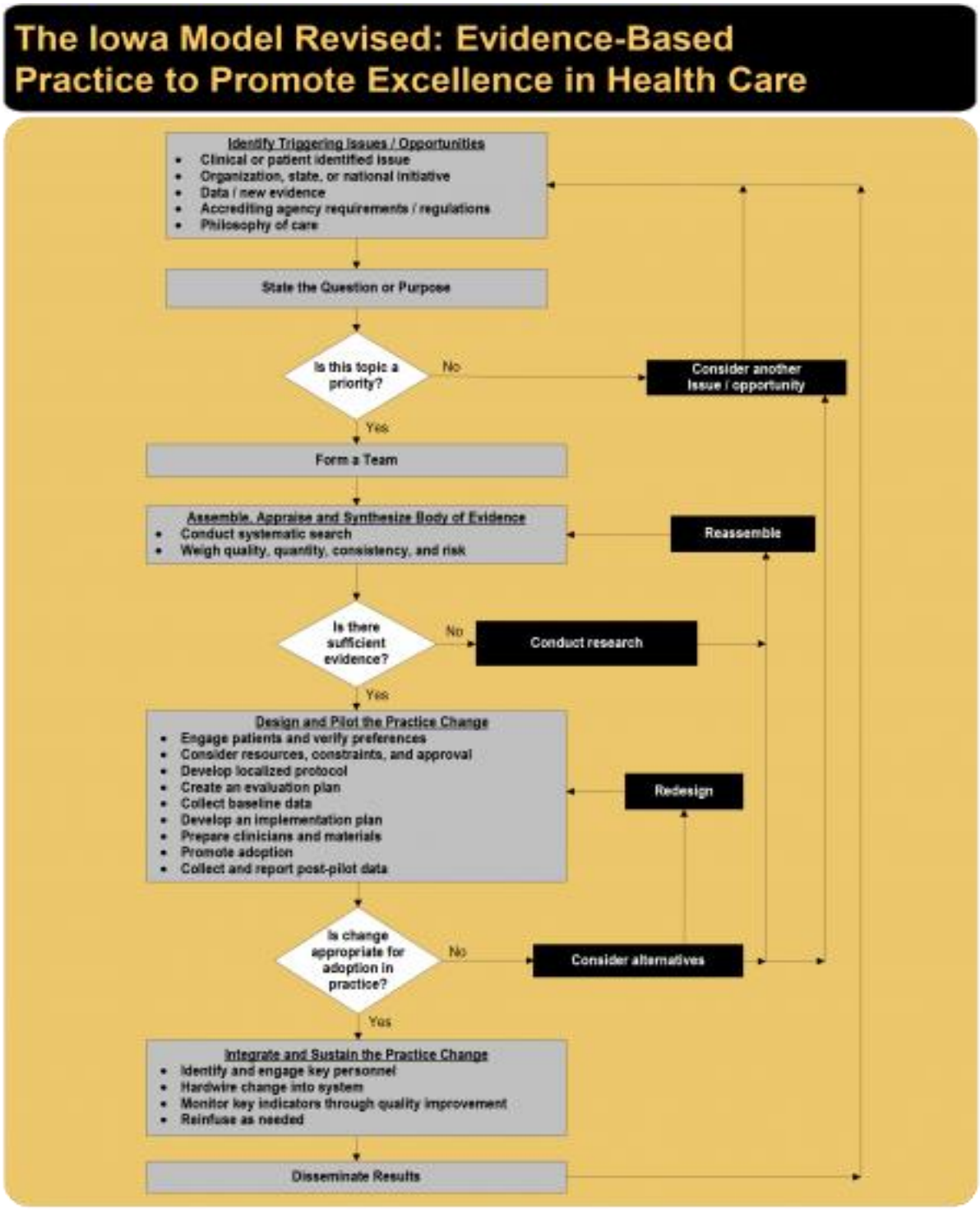
Please contact UIHCNursingResearchandEBP@uiowa.edu or 319-384-9098 with questions

APPENDIX B. THE IOWA MODEL REVISED: EVIDENCE-BASED PRACTICE TO PROMOTE EXCELLENCE IN HEALTHCARE



(Iowa Model Collaborative, 2017)

APPENDIX C. PERMISSION TO USE DERMNET NZ IMAGES

Wed 10/2/2019 1:58 PM

Thank you for your inquiry and interest in DermNet images.

You are very welcome to use DermNet NZ's online watermarked pictures for personal reasons, or for your teaching session or non-commercial project, providing their source is acknowledged (DermNetNZ.org), and that you don't alter or sell them.

We can supply unwatermarked digital images suitable for electronic use or publication in a standard text, journal or brochure for a fee. For details, refer to image use licence at https://www.dermnetnz.org/image-licence/, and download our form at https://www.dermnetnz.org/assets/DermNet-Image-Application-Form.docx.

Dr Amanda Oakley

CNZM MBChB PGDipHealInf FRACP FNZDS
Founder and Editor in Chief of DermNet New Zealand
Dermatologist at Waikato District Health Board and Tristram Clinic
Adjunct Associate Professor, University of Auckland
www.dermnetnz.org

APPENDIX D. PERMISSION TO USE DERMOSCOPY IMPLEMENTATION SURVEY

Mon 9/23/2019 9:34 PM

Hi Erin,

Glad to hear my project is serving others well! You have my permission to use my surveys from my project.

Hope all goes well,

Erin Hencley

Mon 9/30/2019 3:00 PM

Hi Erin,

That’s completely fine to add some questions, thank you for asking.

Erin

APPENDIX E. NORTH DAKOTA STATE UNIVERSITY IRB APPROVAL

NDSU NORTH DAKOTA STATE UNIVERSITY

October 31, 2019

Dr. Dean Gross
Nursing

Re: IRB Determination of Exempt Human Subjects Research:
Protocol #PH20092, "Skin Cancer Screening in Primary Care Using Dermoscopy"

Co-investigator(s) and research team: Erin Lubitz
Date of Exempt Determination: 10/31/2019 Expiration Date: 10/30/2022
Study site(s): Essentia Health Sponsor: n/a

The above referenced human subjects research project has been determined exempt (category #1) in accordance with federal regulations (Code of Federal Regulations, Title 45, Part 46, Protection of Human Subjects). This determination is based on the original protocol submission (received 10/28/2019).

Please also note the following:
• If you wish to continue the research after the expiration, submit a request for recertification several weeks prior to the expiration.
• The study must be conducted as described in the approved protocol. Changes to this protocol must be approved prior to initiating, unless the changes are necessary to eliminate an immediate hazard to subjects.
• Notify the IRB promptly of any adverse events, complaints, or unanticipated problems involving risks to subjects or others related to this project.
• Report any significant new findings that may affect the risks and benefits to the participants and the IRB.

Research records may be subject to a random or directed audit at any time to verify compliance with IRB standard operating procedures.

Thank you for your cooperation with NDSU IRB procedures. Best wishes for a successful study.
Sincerely,

Kristy Shirley

Kristy Shirley, CIP, Research Compliance Administrator

For more information regarding IRB Office submissions and guidelines, please consult https://www.ndsu.edu/research/for_researchers/research_integrity_and_compliance/institutional_review_board_irb/. This Institution has an approved FederalWide Assurance with the Department of Health and Human Services: FWA00002439.

INSTITUTIONAL REVIEW BOARD
NDSU Dept 4000 | PO Box 6050 | Fargo ND 58108-6050 | 701.231.8995 | Fax 701.231.8098 | ndsu.edu/irb

Shipping address: Research 1, 1735 NDSU Research Park Drive, Fargo ND 58102

APPENDIX F. APPROVAL FROM ESSENTIA HEALTH FOR PROJECT IMPLEMENTATION

Essentia Health

October 25, 2019

To whom it may concern,

Re: Skin Cancer Screening in Primary Care using Dermoscopy

Thank you for submitting the Human Subject Research Determination Form and information for the project listed above. Based on a review of the documentation you provided, this project does not meet the definition of research with human subjects, according to the Office of Human Research Protections (OHRP) guidance: "*Research* means a systematic investigation, including research development, testing and evaluation, designed to develop or contribute to generalizable knowledge."

Because the project does not meet the federal definition of human subjects research, it will not require further review by the Essentia Health Institutional Review Board or a scientific review committee. If during the process of data collection or analysis it becomes clear that findings could be generalizable or benefit others, please submit your project for IRB review at that time.

If you have any questions concerning this letter, please contact me at 218-576-0489.

I wish you success with your project.

Sincerely,

Deneice Kramer

Deneice Kramer, MBA, MA, CCRP
Manager, Human Research Protection Program

502 East 2nd Street
Duluth, MN 55805

essentiainstitute.org

APPENDIX G. DERMOSCOPY PRE-IMPLEMENTATION SURVEY

Healthcare providers: Please fill out the following survey to assist the co-investigator in identifying current strengths and needs with your experience with dermoscopy. Participation is completely voluntary, yet greatly appreciated.

1-Strongly Disagree 2-Disagree 3-Agree 4-Strongly Agree

I am knowledgeable about skin cancer prevalence and prevention strategies.	-1- Strongly Disagree	-2- Disagree	-3- Agree	-4- Strongly Agree
I feel comfortable performing naked eye skin examinations.	-1- Strongly Disagree	-2- Disagree	-3- Agree	-4- Strongly Agree
I feel comfortable with the practice of dermoscopy.	-1- Strongly Disagree	-2- Disagree	-3- Agree	-4- Strongly Agree
I feel that using dermoscopy will benefit my practice and my patients.	-1- Strongly Disagree	-2- Disagree	-3- Agree	-4- Strongly Agree

What do you consider your current level of knowledge of dermoscopy?	-1- Novice	-2- Advanced Beginner	-3- Competent	-4- Proficient	-5- Expert

APPENDIX H. DERMOSCOPY POST-IMPLEMENTATION SURVEY

Healthcare providers: Please fill out the following survey to assist the co-investigator in identifying current strengths and needs with your experience with dermoscopy. Participation is completely voluntary, yet greatly appreciated.

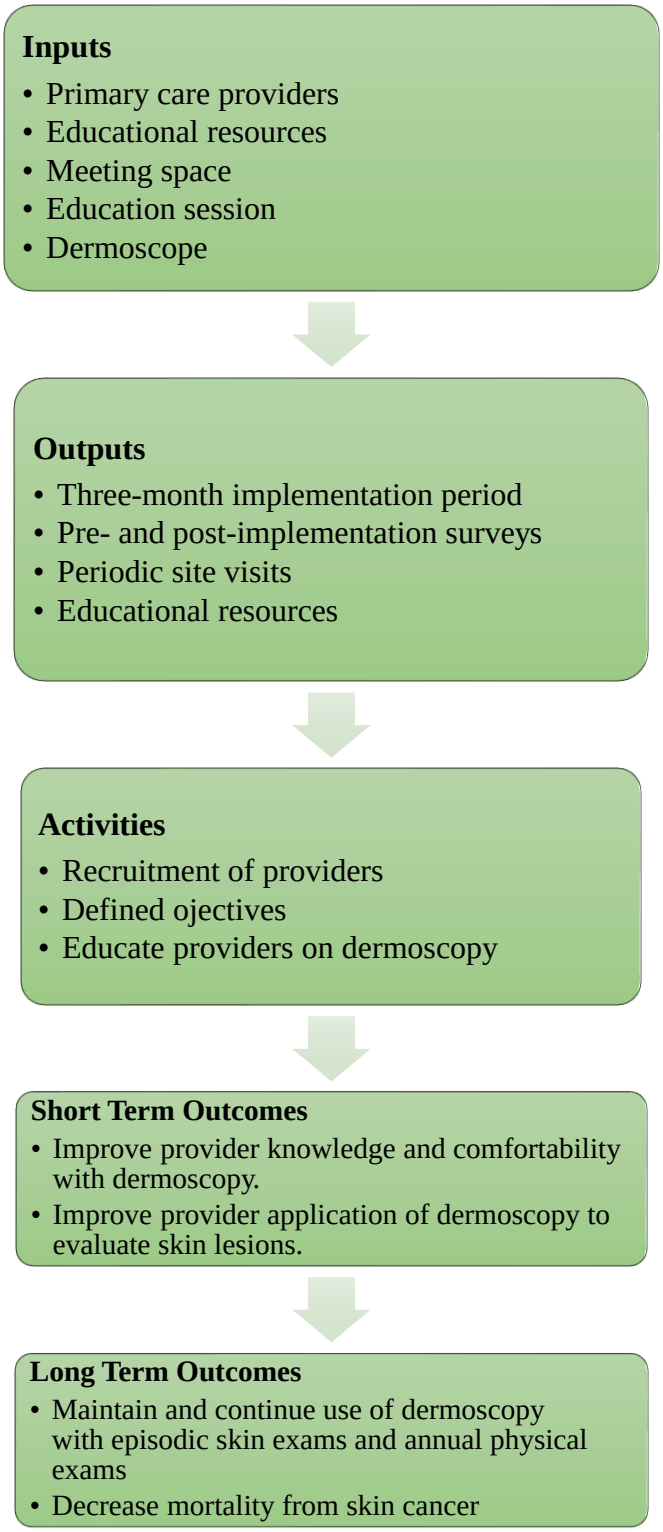
1-Strongly Disagree 2-Disagree 3-Agree 4-Strongly Agree

I am knowledgeable about skin cancer prevalence and prevention strategies.	-1- Strongly Disagree	-2- Disagree	-3- Agree	-4- Strongly Agree
I feel comfortable performing naked eye skin examinations.	-1- Strongly Disagree	-2- Disagree	-3- Agree	-4- Strongly Agree
I feel comfortable with the practice of dermoscopy.	-1- Strongly Disagree	-2- Disagree	-3- Agree	-4- Strongly Agree
I feel that using dermoscopy will benefit my practice and my patients.	-1- Strongly Disagree	-2- Disagree	-3- Agree	-4- Strongly Agree

What do you consider your current level of knowledge of dermoscopy?	-1- Novice	-2- Advanced Beginner	-3- Competent	-4- Proficient	-5- Expert

Do you plan on buying or have you already purchased a dermoscope?	Yes	No
Did implementation of dermoscopy change clinical practice?	Yes	No

APPENDIX I. LOGIC MODEL



APPENDIX J. EXECUTIVE SUMMARY

Background and Significance

Despite advances in modern medicine, skin cancer has become one of the most common forms of cancer in the United States. Both the number of new cases and mortality rate continue to rise annually. The United States Preventative Services Task Force (USPSTF) does not recommend routine whole-body skin examinations on all adults by clinicians as the benefits do not outweigh the risks, particularly for melanoma. The USPSTF recommendation is among many barriers for performing skin examinations including lack of training, poor confidence, and time restraints. Melanomas found by healthcare providers are consistently thinner than those found by the patient. In cancers like melanoma, which have a better prognosis when diagnosed early, breaking down these barriers can be crucial for timely and appropriate intervention. Using dermoscopy to enhance a skin examination has been found to improve provider confidence and accuracy of identifying various skin lesions including melanoma.

Project Design and Results

The purpose of the project was to increase primary care provider confidence in identifying skin lesions and increase application of dermoscopy to skin cancer screenings in primary care by providing practitioners with an education module combined with time for clinical practice using dermoscopy. Upon creation of an educational handout, the co-investigator provided a presentation educating primary care providers on skin cancer basics, dermoscopy, and application of dermoscopy to skin lesions. The participating providers were then given a three-month implementation period to practice dermoscopy. A pre- and post- implementation survey was administered prior to and immediately following completion of the implementation period.

Five in person site visits were made to answer questions and assess progression of implementing dermoscopy among the healthcare providers.

Recommendations

- Findings of the project show a general improvement in comfortability and knowledge with dermoscopy. Based on these findings, the co-investigator recommends consistent use to improve the skill of each provider.
- If providers are unable to purchase a dermoscope, purchasing a shared dermoscope could be discussed with the clinic manager.
- One of the previously identified barriers was lack of reimbursement for dermoscopy. CPT code 96999 could be used to improve provider reimbursement for using dermoscopy providing motivation for continued use from both primary care providers and clinic managers.
- Recommendations for future projects include collecting qualitative data on provider perception of change to clinical practice and assessing application via chart auditing of CPT codes.

Conclusion

Seven participants in the pre-implementation survey and six participants in the post-implementation survey. In comparing data from the surveys, results show an overall increase in skin cancer knowledge, comfort in performing naked eye examinations, comfort level in using dermoscopy, and perceived level of expertise in using dermoscopy. Additional questions were included to evaluate provider application of dermoscopy to practice. Results were equally divided on provider perception of change to clinical practice.