

SKIN CANCER SCREENING WITH THE USE OF DERMOSCOPY IN PRIMARY CARE

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**Title**

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PRIMARY CARE

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**DOCTOR OF NURSING PRACTICE**

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## ABSTRACT

According to the American Cancer Society (ACS) (2018), skin cancer is the most common type of cancer in the United States. Though rare, melanoma is the skin cancer linked with the highest mortality rate (The Skin Cancer Foundation, 2019). However, skin cancer screenings fall well below levels of other routine cancer screenings and over half of patients who were referred to a dermatologist for a suspicious lesion were eventually diagnosed with skin cancer in a location other than the referral site (Bruner & Schaffer, 2012; Kownacki, 2014). Compared to naked eye examinations, dermoscopy has led to earlier detection of melanoma and other cancerous skin lesions like squamous cell carcinoma and basal cell carcinoma (Marghoob & Jaimes, 2019).

Barriers to full body skin examination include lack of time at office visits, preoccupation with competing co-morbidities, and a lack of expertise in lesion identification. Providers feel there is a lack of training and exposure to skin examination, causing a decreased confidence in diagnosing suspicious lesions (Curiel-Lewandrowski, Chen, & Swetter, 2012; Hershcorn, 2012; Shellenberger et al., 2018). Hencley (2017) found that comfortability, knowledge, and usefulness of dermoscopy increased after implementing a two-hour dermoscopy training and practice seminar. In this practice improvement project, an educational seminar and resource surrounding the practice of dermoscopy was created for rural primary care providers (PCPs) in North Dakota and Minnesota.

The purpose of the practice improvement project was to train and educate rural PCPs about the practice of dermoscopy with the aim to improve their knowledge and comfortability with clinical application of dermoscopy. Pre- and post-dermoscopy education surveys compared the PCPs' knowledge level of dermoscopy, general skin cancer topics, their opinions on their

comfortability with the practice of dermoscopy, and the usefulness of dermoscopy. Ultimately, the goal was that rural PCPs will develop dermoscopy skills to increase accuracy in the management of skin lesions prior to patients having to travel to urban dermatology clinics. Overall, the practice improvement project found that dermoscopy knowledge, comfortability, and usefulness increased after the two-hour dermoscopy training course.

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## **DEDICATION**

I dedicate this disquisition to my family for their unwavering support throughout my doctorate education endeavors.

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## CHAPTER ONE. INTRODUCTION

According to the American Cancer Society (ACS), skin cancer is the most common type of cancer in the United States. Every year more skin cancer is diagnosed than all other cancers combined, and by the age of 70, one in five Americans will develop skin cancer. From 1994 to 2014, the treatment and diagnosis of nonmelanoma skin cancers increased by 77% (ACS, 2017).

The three main types of skin cancer are melanoma, basal cell carcinoma (BCC), and squamous cell carcinoma (SCC). BCC is the most common form of skin cancer, with an estimated 4.3 million cases diagnosed in the United States each year. The second most common form of skin cancer is SCC (The Skin Cancer Foundation, 2019). More than one million cases of SCC are diagnosed in the United States each year, resulting in more than 15,000 deaths.

Melanoma accounts for the most skin cancer deaths and an estimated 7,230 people will die from melanoma in 2019. However, the number of deaths related to melanoma is expected to decrease by 22% in 2019. The number of new melanoma cases in 2019 is expected to increase by 7.7% (The Skin Cancer Foundation, 2019). Educating the public about reducing their modifiable risk factors, doing self-skin examinations, and scheduling annual skin-examinations with healthcare providers may help identify melanoma in its early stages.

The three main factors placing individuals at higher risk of skin cancer include: individuals with a strong family history of skin cancer, those with reduced immunity, and people who have previously had skin cancer (ACS, 2017). Other risk factors include: ultraviolet (UV) radiation exposure, fair skin/hair, exposure to certain chemicals, numerous atypical moles, and a history of severe sunburns. UV rays are typically received from the sun; however, sun lamps and indoor tanning beds are man-made and can also lead to skin cancer (ACS, 2017). The main culprit of skin cancer is too much exposure to (UV) rays from the sun. In fact, 90% of

nonmelanoma skin cancers are related to UV exposure from the sun and a clear majority of melanomas are caused by the sun (The Skin Cancer Foundation, 2019).

Primary prevention strategies are key in reducing risk for skin cancer. Encouraging sun protection methods such as seeking shade during the daytime hours, wearing sun protective clothing, applying sunscreen, avoiding intentional tanning or tanning beds, and avoiding midday hours in the sun are the chief recommended strategies (ACS, 2017; The Skin Cancer Foundation, 2019). Sunscreen should be applied before going outside, be broad spectrum, and contain at least 15 sun protection factor (SPF). If outdoors for an extended period, water-resistant and 30 SPF sunscreen should be applied with reapplication every 2 hours (ACS, 2017; The Skin Cancer Foundation, 2019).

Routine skin examinations fall under a secondary prevention strategy. The goal of skin cancer screenings through routine skin examinations is to identify suspicious skin lesions and determine if the lesion is concerning for skin cancer, specifically melanoma. The guidelines for skin examinations vary, but predominant skin cancer organizations recommend monthly self-skin exams as well as annual skin examinations with a healthcare provider (American Academy of Dermatology [AAD], 2018).

## **Background**

In the past decade, the number of new melanoma cases diagnosed annually has increased by 53%, and one person dies of melanoma every hour (Skin Cancer Foundation, 2019). Given the prevalence of skin cancer in the United States and the increasing cases of melanoma, healthcare providers are essential for completing and promoting full body skin examinations. Skin examinations can detect skin cancers such as BCC and SCC with more favorable outcomes than melanoma. Tumor thickness is crucial when determining cancer prognosis. Statistically,

thicker melanoma lesions have less favorable outcomes than thinner tumors. Melanomas detected by clinicians during a skin examination are thinner than those detected by patients (Geller & Swetter, 2019).

Historically, skin examinations completed by primary care providers occur via naked eye examination (NEE), which means that the provider is using their eyes alone to examine skin lesions. Varying comfort level of identifying skin lesions and the different techniques used among primary care providers lead to inconsistent exam results. However, there are algorithms and instruments like the magnifying glass, light, and dermascope available to assist providers with skin examinations. The instrument most recognized and used for completing skin examinations is the dermascope, which is used in the practice of dermoscopy. The evidence shows that use of the dermascope, after an educational seminar, leads to an increase in overall accuracy with the exams as well as provider confidence (Chappuis et al., 2016; Koelink, Kollen, Groenhof, van der Meer, & van der Heide, 2014; Kownacki, 2014).

Dermoscopy is an in vivo, noninvasive method chiefly used for identification of non-pigmented and pigmented skin lesions. Dermoscopy is performed with a handheld instrument called a dermascope. The dermascope is equipped with magnification and light to provide ample visualization of skin lesions to aid in early detection of melanoma. Dermoscopy is routinely used by dermatologists but continues to gain more popularity among primary care clinicians. Compared to the current practices of NEE in primary care, dermoscopy has led to earlier detection of melanoma and other suspicious skin lesions such as SCC and BCC (Marghoob & Jaimes, 2019). By using dermoscopy in primary care locations, providers can achieve increased skin cancer screening rates, offer the patient reassurance, place a referral to a specialist, or perform a biopsy (Marghoob & Jaimes, 2019).

A previous practice improvement project involving dermoscopy use for skin cancer screening was implemented at a student health center in North Dakota. The practice improvement project revealed that provider comfortability increased with dermoscopy as well as NEE after implementing the dermoscopy training and practice. Providers also had increased feelings that dermoscopy would benefit their practice and their patients (Hencley, 2017).

### **Significance of Project**

With the rising number of melanoma occurrence in the United States, routine skin examinations are crucial for early detection of skin cancer. Despite this knowledge, the number of annual skin examinations performed by primary care providers fall short. In fact, skin cancer screenings fall well below levels of other routine cancer screenings and over half of patients who were referred to a dermatologist for a suspicious lesion were eventually diagnosed with skin cancer in a location other than the referral site (Bruner & Schaffer, 2012; Kownacki, 2014). This fact alone emphasizes the importance of full body examinations by primary care providers (PCPs). Barriers to full body skin examination include: lack of time at office visits, preoccupation with competing co- morbidities, and a lack of expertise in lesion identification. Many healthcare providers feel there is a lack of training and exposure to skin examination, causing a decreased confidence in diagnosing suspicious lesions (Curiel-Lewandrowski, Chen, & Swetter, 2012; Hershcorn, 2012; Shellenberger et al., 2018). There are specific checklists/mnemonics used to aid healthcare providers during their skin examinations. One popular mnemonic is the ABCDE (Asymmetry, Border, Color, Diameter, and Evolution) method, but there can be inconsistency in practice, and it may not be applicable to every patient with a skin concern (Ahnlide, Bjellerup, Nilsson, & Nielsen, 2016).



By providing education on dermoscopy to healthcare providers, these barriers can be overcome, and increased skin cancer screenings can be achieved. Providing education about skin examination techniques and the use of dermoscopy to providers in rural health clinics offers an evidence-based method that they can continue to use in their practice.

### **Purpose of the Project**

Skin cancer screenings methods such as the ABCDE mnemonic and NEE have varied sensitivity and specificity. The sensitivity of the ABCDE mnemonic identifying a melanoma lesion is 97% when one criterion is used and 43% when all five criteria are used. In contrast, the specificity of the ABCDE mnemonic is 100% when all five criteria are used and 36% when one criterion is used. However, providers who have been trained in dermoscopy have improved ability to identify skin lesions suspicious of cancer compared to the NEE alone (Hayes, 2017; Herschorn, 2012; Jacobson, 2016). The sensitivity of identifying melanoma with dermoscopy is 76-79% compared to the 56% with the NEE alone. Dermoscopy improves the healthcare provider's ability to recognize suspicious lesions that require biopsy and improves the sensitivity of diagnosing melanoma while preserving the specificity at 71% (Marghoob et al., 2013).

Therefore, using dermoscopy with skin examinations offers primary care providers confidence to identify benign and malignant skin lesions. The purpose of this project is to increase skin cancer screening prevalence in primary care in rural settings by implementing a learning module and clinical practice with dermoscopy. Additionally, the intent is to increase provider comfortability in identifying and monitoring skin lesions with a dermascope within their practice.

## CHAPTER TWO. LITERATURE REVIEW

Skin cancer incidence continues to rise in the United States and is the most common form of cancer. According to current estimates, one in five Americans will develop skin cancer and approximately ninety-five hundred Americans are diagnosed with skin cancer every day. Astonishingly, there are over one million Americans living with melanoma (AAD, 2018).

The most common forms of skin cancer are BCC and SCC. Fortunately, both basal cell and squamous cell carcinoma have a high cure rate when detected early and with appropriate treatment. Regrettably, the third and rarest form of skin cancer, melanoma, is associated with a high mortality rate. There are many risk factors for developing skin cancer, but the largest culprits are UV exposure, skin type, gender, and age.

Prevention and detection are essential in reducing mortality, morbidity, and cost with skin cancer. Prevention is achieved through promoting sun-safe behaviors and discouraging indoor and outdoor tanning (Taber et al., 2018; Watson et al., 2015). Skin cancer screenings are crucial to early detection; however, the evidence behind these screenings is associated with mixed recommendations. The United States Preventative Services Task Force (USPSTF) (2016), recently updated their recommendations and noted that there is insufficient evidence to recommend total body skin examinations (TBSE) for detecting melanoma. The research conducted by the USPSTF (2016), suggested that the current evidence is lacking regarding the harms and benefits of visual examination by a clinician to screen for skin cancer and more research needs to be conducted to determine the benefits and risks of skin cancer screening through routine TBSE. These recommendations do not align with those of various organizations including the American Academy of Dermatology (AAD). The AAD (2018) recommends that

patients complete routine skin self-examinations and see their healthcare provider for an annual TBSE.

A skin screening program study completed in Germany screened adults over the age of twenty for a period of one year. After five years, they found that melanoma mortality had declined by nearly 50% compared with surrounding states (Swetter & Geller, 2014). Moreover, research continues to provide support for skin cancer screenings with the use of a dermascope, particularly in the primary care setting (Buckley & McMonagle, 2014; Jacobson, 2016; Marghoob et al., 2013).

## **Types of Skin Cancer**

### **Precancerous Lesions**

One major risk factor for skin cancer is exposure to ultraviolet (UV) radiation. One of the most common sources of UV radiation is through sun exposure, which causes damage to the DNA of skin cells. Once the damage affects the DNA of the genes that control the skin cell production, skin cancer occurs. Large amounts of sun damage can lead to benign lesions called seborrheic keratoses (SK) and precancerous lesions known as actinic keratoses (AAD, 2018; ACS, 2018).

SK are epidermal tumors that result from benign proliferation of immature keratinocytes. The benign lesions start out as small, rough bumps that slowly thicken and develop into a wart-like, stuck on appearance with well demarcated borders. SK typically appear after the age of fifty but can also develop in young adulthood (Goldstein & Goldstein, 2019). SK are commonly referred to as the barnacles of age. Factors that contribute to SK development include: skin type, family history of SK, and sun exposure. SK are typically located on the head, neck, chest, or

back, but do not affect the palms or soles. The color of the SK ranges from white to black, but most lesions are tan or brown colored (AAD, 2018).

Actinic keratoses (AK) result from proliferation of atypical epidermal keratinocytes. AK usually present as erythematous, scaly or rough patches of skin that vary in color. AK lesions can be white, pink, red, or brown in color. The lesions typically appear on sun-exposed areas such as the dorsal side of the hands, scalp, and face. AK have the potential to develop into squamous cell carcinoma (SCC), however the risk is low. There is much debate among healthcare providers regarding the percentage of AK lesions that develop into SCC. The estimate of annual rates of transformation of AK to SCC, range from 0.03-20% (Jacobson, 2016; Padilla, 2019).

Histological findings and skin cancer screenings are crucial for diagnosis and treatment of precancerous lesions since they can resemble warts, dysplastic nevi, AK, SK, and forms of skin cancer.

### **Basal Cell Carcinoma**

Basal cell carcinoma (BCC) is the most common form of skin cancer. According to the Skin Cancer Foundation (2019), an estimated 4.3 million cases of BCC are diagnosed in the United States each year, resulting in more than 3,000 deaths. BCC is a nonmelanocytic cancer formed from the basal layer of the epidermis. BCC can be aggressive, invasive, and destructive to the surrounding skin and bone. BCC typically appears on sun exposed areas such as the head, neck, or the back of the hands, but it can also develop on the trunk, legs, and arms (AAD, 2018; Wu, 2019).

BCC lesions can appear in a multitude of variations. These lesions can be flat, firm, pale or yellow areas. They may appear like a scar. They can also appear as a raised, red patch that can be pruritic. Other times, the lesions are small, pink or red, translucent, shiny, pearly bumps,

which may have blue, black, or brown areas. BCC can also present as pink growths with raised edges and a lower area in the center. Blood vessels may spread out from these lesions.

Sometimes the lesions appear as open sores with oozing or crusted areas that do not heal or heal and then resurface (ACS, 2018).

### **Squamous Cell Carcinoma**

According to the Skin Cancer Foundation (2019), squamous cell carcinoma (SCC) is the second most common type of skin cancer with more than 1 million cases of SCC diagnosed each year. SCC occurs from uncontrolled, abnormal cell growth from the squamous cells in the epidermis. SCC lesions can appear as open sores, wart-like lesions, raised lesions with central indentation, or red, scaly patches. SCC lesions can also crust and bleed (Lim & Asgari, 2019; The Skin Cancer Foundation, 2019). SCC typically occurs in skin that has been exposed to sun for years, and commonly appears on the head, neck, lower legs, and back of the hand.

Individuals who use tanning beds are at an increased risk of developing SCC, particularly earlier in life (AAD, 2019; The Skin Cancer Foundation, 2019). Other risk factors for developing SCC include chronic inflammation, immunosuppressive therapy, current AK, and genetic factors.

Tobacco smoking, human papillomavirus infection, diet high in meat and fat, certain antifungal medication, and medical conditions such as: xeroderma pigmentosum, epidermodysplasia verruciformis, albinism, epidermolysis bullosa all increase an individual's lifetime risk (Lim & Asgari, 2019). Certain outdoor occupations such as those in agriculture and farming put individuals at increased risk of skin cancer. Smit-Kroner and Brumby (2015), reviewed the literature surrounding estimated UV exposure to farmers. The results varied from suggesting that farmers are exposed to UV three times more than indoor workers to six to eight times more than indoor workers.

Lesion type and location effect the clinical appearance of the SCC. Invasive SCC usually appears as indurated, hyperkeratotic papules, nodules, or plaques, and there may be ulceration (ACS, 2016; Lim & Asgari 2019). They are often asymptomatic but can be pruritic or painful. The lesion is generally 0.5 to 1.5 cm in diameter but can be larger. Invasive SCC involves the full thickness of the epidermis and penetrates the dermis or deeper tissues. SCC in situ, or Bowen's disease, is the earliest form of SCC and occurs when the cells of the cancer invade only the full thickness of the epidermis and do not infiltrate the deeper layers such as the dermis. SCC in situ presents as a well-demarcated, scaly patch or plaque and is often erythematous. SCC in situ can also be pigmented or skin colored, grows slowly, and is typically asymptomatic (ACS, 2016; Lim & Asgari, 2019).

## **Melanoma**

Melanoma is the most fatal form of skin cancer and the fifth most common cancer in American women and men. In the United States, melanoma is rising faster than any other potentially preventable cancer with the incidence increasing more than tenfold in recent decades (Swetter & Geller, 2019). According to the Skin Cancer Foundation (2019), a projected 192,310 cases of melanoma will be diagnosed in the United States in 2019, and roughly 7,230 people will die from melanoma in 2019. Melanoma commonly occurs on sun-exposed areas of the skin, especially skin that has been sunburned in the past. The melanoma develops when unrepaired DNA damage to skin cells, usually caused by UV rays, triggers mutations which leads to rapidly multiplying skin cells which then forms malignant tumors. The tumors originate in the melanocytes in the basal layer of the epidermis. Melanomas often resemble nevi and may even develop from nevi. Most melanomas are brown or black, but they can also be red, purple, blue, white, or skin-colored (The Skin Cancer Foundation, 2019). Those individuals who have a

family or personal history of skin cancer, atypical nevi, high nevus count, red hair phenotype and immunosuppression, are at higher risk for developing melanoma. The overall incidence of melanoma increases with age and the five-year survival rate is dependent on the stage of the skin cancer at the time of diagnosis (Swetter & Geller, 2019).

Melanoma has five stages (Swetter & Geller, 2019; The Skin Cancer Foundation, 2019). Stage 0 is in situ or intraepithelial melanoma. These melanomas are localized and have not penetrated below the epidermis. Stage I and II are invasive cutaneous melanoma, localized, and penetrate the dermis. Stage II tumors are generally 1 mm thick or larger and they may have ulceration or traits that put them at risk of infiltrating nearby lymph nodes. Stage III is regional nodal disease and stage IV is distant metastatic disease. Patients with stage II to IV melanoma are more likely to develop metastases and have a higher chance of mortality. Those patients with stage I melanoma usually have the lesions excised contributing to a long disease-free survival with a cure likely following. The survival rates are most reliant on the tumor thickness at diagnosis with the 10-year survival rate being 92% when the melanoma is less than 1 mm thick and 50% when the tumor is greater than 4 mm thick (Swetter & Geller, 2019; The Skin Cancer Foundation, 2019).

Most melanomas start as a superficial tumor that remains within the epidermis for many years growing horizontally (Swetter & Geller, 2019). When the growth phase infiltrates the dermis, the tumor is considered to have vertical growth and increased metastatic potential. The growth phases of the tumor depend upon the subtype of melanoma. There are four subtypes of melanoma: nodular melanoma, acral lentiginous melanoma, superficial spreading melanoma, and lentigo maligna melanoma. Nodular melanomas account for 15-30% of all melanomas and are more difficult to diagnosis early because they can present as a darkly pigmented papule/nodule

or amelanotic with symmetric borders and a small diameter. Acral lentiginous melanomas usually appear as a dark brown to black irregular macule or patch located on the palms, soles, or beneath the nails. This subtype of melanoma is most common among dark-skinned individuals. Superficial spreading melanoma accounts for around 70% of all melanomas and tend to present with components of the ABCDE warning signs. The tumor may present as a pigmented macule (red, black, blue, gray, white) or thin plaque with irregular border, and a large diameter. Lentigo maligna melanoma also arises with the ABCDE warning signs but grows at a slower rate and begins as a tan or brown macule that may develop darker asymmetric foci (Swetter & Geller, 2019).

Early diagnosis of melanoma improves patient outcomes survival rates (Hayes, 2017). However, early detection can be challenging due to different subtypes of melanoma and the variability in their clinical presentation. With the use of dermoscopy and TBSE, healthcare providers are better equipped to diagnose thinner melanoma tumors and increase the survival rates among these patients (Hayes, 2017).

### **Skin Cancer Screening Recommendations**

Skin cancer screenings are essential to early detection; however, the evidence behind these screenings is associated with mixed recommendations. The United States Preventative Services Task Force (USPSTF) provided an update to their 2009 recommendations on skin cancer screening in July 2016. For asymptomatic adults, the USPSTF suggested that more research needs to be conducted because “the current evidence is insufficient to assess the balance of benefits and harms of visual skin examination by a clinician to screen for skin cancer in adults” (USPSTF, 2016, para. 1). However, the USPSTF does recommend that individuals age 6 months to 24 years with fair skin type be counseled about minimizing their UV radiation



exposure. Additionally, the USPSTF recommends offering this counseling to those age 24 and older depending on their risk factors (Geller & Swetter, 2019). These risk factors include: fair complexion, persons who use indoor tanning beds, history of sunburns or previous skin cancer, a family history of melanoma, history of dysplastic nevus (atypical mole), and persons with multiple ( $\geq 100$ ) nevi (Bibbins-Domingo et al., 2016; Geller & Swetter, 2019).

On the other hand, the ACS (2018) does not have specific skin cancer screening guidelines but recommends that individuals be familiar with their skin and report any unusual freckles, blemishes, or different mole patterns to their primary care provider. The ACS also stresses the importance of provider skin examinations and monthly skin self-examinations for individuals who are at higher risk of skin cancer (American Cancer Society [ACS], 2018).

Additionally, the American Academy of Dermatology (2018), recommends that all individuals perform skin self-examinations and have a skin exam completed by a healthcare provider annually. The AAD's recommendations coincide with The Skin Cancer Foundation (2019) recommendation that everyone complete monthly self-skin examinations to identify any new or changing lesions that might be cancerous or precancerous. The recommendations on how often an individual is to complete these exams depends upon their risk factors (Geller & Swetter, 2019).

Even though more studies are needed to evaluate the benefits and potential harms of routine skin examinations for skin cancer prevention among the adult population, a review of evidence conducted by Shellenberger, Nabhan, and Jonnalagadda (2016), supported the fact that TBSE can lead to the detection of earlier stage melanomas as well as a reduction in disease-specific mortality. If melanoma is suspected upon skin examination, an urgent referral to dermatology for a biopsy is recommended (Bruner & Schaffer, 2012). Skin cancer screenings are

important because when skin cancer is found and removed early, it is almost always curable (The Skin Cancer Foundation, 2019). Swetter and Gellar (2019) reiterate the importance of early detection to aid in identifying thinner melanoma tumors and thus reducing mortality rates. The survival rates are 92% when the melanoma tumor is less than or equal to 1 mm thick. However, the survival rate is reduced to 50% when the tumor is greater than 4 mm thick (Swetter & Gellar, 2019). Evidence shows that melanoma mortality is directly related to the tumor thickness upon diagnosis. Other studies have found thinner melanomas are detected with TBSE completed by healthcare providers. Shellenberger et al. (2018) reviewed the evidence regarding a possible melanoma mortality reduction with TBSE for early detection. The data review supported the evidence that TBSE by healthcare providers can lead to the detection of earlier stage melanomas and reduce disease-specific mortality. Another study suggested that PCPs with extra training could assess suspicious skin lesions with dermoscopy and biopsy the lesion if necessary, leading to a quicker diagnosis and treatment, lower cost, and more convenience to the patient, especially for those living in rural areas (Buckley & McMonagle, 2014).

The total quality of the skin cancer screening can be largely impacted by the type of screening completed by the healthcare provider. There are many different techniques, checklists, and tools used in skin examinations that vary in sensitivity and specificity. The different types of screening techniques used in skin examinations today are discussed in the following paragraphs.

### **Current Skin Cancer Screening Techniques**

Many checklists and tools have been created to identify pigmented and non-pigmented lesions. Largely, the focus is placed on identifying malignant lesions such as melanoma due to its high mortality rate. Because skin lesions have endless variations, identifying melanoma is challenging. Thankfully, many clinical features indicative of melanoma have been identified.

Three main tools exist to assist healthcare providers in identifying suspicious skin lesions with NEE. These include: the “ugly duckling sign,” the ABCDE rule, and the Glasgow seven-point checklist.

### **“Ugly Duckling” Sign**

The “ugly duckling” sign is based on the notion that all nevi tend to look the same as the other nevi on a person’s skin making up a “profile.” Therefore, with the “ugly duckling” sign, the malignant lesions look different from all the other nevi and are easier to identify due to this phenomenon (Swetter & Geller, 2019). Even when this method is used by non-dermatologists, research has found that the “ugly duckling” sign is at least 85% sensitive and 83% specificity (Herschorn, 2012). In another study, Gaudy-Marqueste et al. (2017) compared clinical images to dermoscopic images and found that the “ugly duckling” sign specificity was 96% and 95% respectively.

### **ABCDE Rule**

Currently, the NEE along with the ABCDE rule is most often used among primary care providers during skin examinations. The ABCDE rule was developed in 1985, and assesses for (A) asymmetry, (B) border irregularity, (C) color variation, (D) diameter larger than 6 mm, and (E) evolving in size, shape, or color. The ABCDE rule was established to help differentiate benign pigmented lesions from melanomas (Herschorn, 2012; Swetter & Geller, 2019). Studies have assessed the diagnostic accuracy of the ABCDE rule and suggest that there are limitations. There is variability in the sensitivity and specificity of the ABCDE rule when the criteria are used individually or in combination, and there is risk for over- and under-referral. When one criterion is met during the skin exam, sensitivity is 97.3% and specificity 36%. The sensitivity is 43% and specificity 99.6% when all five criteria are met on the skin exam (Herschorn, 2012;

Swetter & Geller, 2019). Since there is high specificity and low sensitivity with all five criteria, there is a lower incidence of benign lesion biopsies and referrals, but an increased chance that melanoma or a malignant lesion may be missed. This is the opposite when one criterion is used. There is low specificity, but high sensitivity. Therefore, there is a higher chance that many benign lesions would be biopsied and referred. There are limitations with the ABCDE rule in that the criteria are less applicable to the nodular melanoma subtypes and not at all applicable for subungual melanomas, or melanoma of the nail (Swetter & Geller, 2019).

### **Glasgow Seven-Point Checklist**

The Glasgow seven-point checklist was developed in the United Kingdom in 1980, with the goal of assisting primary care providers in identifying skin lesions concerning for melanoma. The checklist contained features that each scored one point and those lesions with scores of three or greater were advised to be referred for specialist opinion (Walter et al., 2013).

The Glasgow checklist was revised in 1989. This revision included three major criteria and four minor criteria for lesion evaluation. The four minor criteria are as follows: diameter greater than or equal to 7 millimeters, inflammation, crusting or bleeding, and sensory change. The three major criteria include: change in size/new lesion, change in shape, and change in color. A referral is indicated if the lesion meets at least three minor features or one major feature (Swetter & Geller, 2019). The scoring was also revised and is now weighted. Each major feature receives a score of two points and each minor feature receives a score of one point. Referral is warranted for any lesion scoring three or more points, just as in the original seven-point checklist. In comparing the original and revised seven-point checklists, both successfully identified melanoma and other significant lesions (Walter et al., 2013).

Under the revised seven-point checklist, the determined sensitivity was 100% and the specificity 37% in diagnosing melanoma (Swetter & Geller, 2019). Adding a diagnostic aid like dermoscopy, can increase the sensitivity for skin cancer detection and decrease the number of specialty referrals and biopsies (Wu, Marchetti, & Marghoob, 2015).

### **Dermoscopy**

Dermoscopy is used to detect melanoma in its early stages and can help the clinicians differentiate pigmented lesions between benign and cancerous growths (Jacobson, 2016).

Dermoscopy practice requires the use of a dermascope which is a noninvasive, hand-held, lighted device with ten-fold magnification (Herschorn, 2012). Dermoscopy provides more details at the microscopic level such as the architecture, vascular structure, and the color distribution across the lesion (Fink & Haenssle, 2017).

### **Background**

Skin surface microscopy, incident light microscopy, epiluminescence microscopy, and dermatoscopy are synonyms for dermoscopy (Marghoob & Jaimes, 2019). The evolution of dermoscopy started back in 1663, but the technique was not used to assess pigmented skin lesions until the 1950s. Skin surface microscopy was first discussed during the first half of the 20<sup>th</sup> century and was based off earlier findings from colposcopy for the cervical region. Approximate two decades later, oil-immersion fluid was utilized to improve skin surface visualization and pigmented lesion diagnosis (Kaliyadan, 2016). In 1971, Dr. Mackie identified the advantages of dermoscopy for differentiating between benign and malignant pigmented lesions (Stephen & Fleming, 2013). Dermascope-like devices were first used in the late 1980s, and in the 1990s, the hand-held dermascopes were developed. Definitive criteria for pigmented lesion diagnosis began around the 1990s as well (Kaliyadan, 2016).

There are three types of dermascopes and the most common use 10-fold magnification. The three types of dermascopes are contact polarized light, contact nonpolarized light, and noncontact polarized light (Marghoob & Jaimes, 2019; Stephen & Fleming, 2013). Nonpolarized requires contact between the dermascope and the skin and requires a liquid interface. The deep layers are not visualized as well as the superficial layers with nonpolarized dermoscopy. Polarized dermoscopy does not require contact and can be used with or without a liquid interface, such as alcohol or ultrasound gel. However, the clinician can achieve a clearer image if they use contact and a liquid interface. Polarized dermoscopy penetrates deep layers of epidermis allowing for improved visualization of structures, vasculature, and colors (Marghoob & Jaimes, 2019; Stephen & Fleming, 2013). Dermascopes have continued to evolve since the first model was released and have become a popular skin examination tool among primary care providers.

Dermascopes can now attach to cellphones to capture a photo and instantly upload the image into the patient's electronic medical record (EMR) (Fink & Haenssle, 2017). These advances led to sequential digital dermoscopy (SDD) devices. The digital overview, dermoscopic images, and close-up images can be stored electronically and offer side-by-side comparison during skin examination. The rationale behind SDD is that nevi remain stable and melanoma tend to change over time. Many studies have shown that SDD is effective in detecting melanoma early, specifically in those patients who are high risk and have multiple atypical nevi (Fink & Haenssle, 2017).

### **Clinical Role of Dermoscopy**

Dermoscopy practice continues to gain popularity among clinicians in the United States. Approximately 40% of dermatologist used dermoscopy in their practice in 2010 compared to 81% since 2014. Increased dermoscopy use among non-dermatologist healthcare providers has

been documented along with increased diagnostic skills with the use of dermoscopy (Marghoob & Jaimes, 2019). In an Italian study, practitioners achieved a reduction in benign referral and improved lesion identification after just one day of dermoscopy education (Kownacki, 2014). Menzies (2003) discusses two different meta-analyses that suggested dermoscopy is significantly better (49% and 56%), at identifying nonmelanoma and melanoma compared to the NEE. Dermoscopy requires training just like other diagnostic techniques, but the primary care providers in one study only received a two-hour education session for distinguishing between malignant and benign lesions with a simple dermoscopic algorithm (Menzies, 2013).

With the practice of dermoscopy, increased sensitivity and specificity for the diagnosis of melanoma has been established when compared to NEE. Comparative studies reveal that when trained healthcare providers use dermoscopy it is superior to the NEE alone. Additionally, when NEE and dermoscopy are used in combination, the sensitivity and specificity for diagnosing melanoma increases further to 90% (Marghoob & Jaimes, 2019; Menzies, 2013). Dermoscopy reduces the number of unnecessary referrals to specialist, benign biopsies, and missed malignant lesions (Chappuis et al., 2016; Marghoob & Jaimes, 2019). Accuracy of lesion identification with dermoscopy is dependent upon the clinician's comfortability with dermoscopy practice.

Diagnostic accuracy of dermoscopy is influenced by several factors such as: the algorithm used to evaluate the lesion, prevalence of melanoma in the patient population, clinical context, patient related circumstances, and provider experience with dermoscopy (Marghoob & Jaimes, 2019). With the use of diagnostic algorithms and short dermoscopy training sessions, non-dermatologists in primary care settings can increase their melanoma identification accuracy. The continued practice of dermoscopy is necessary for skill sustainability and accuracy. One study looked at the primary care providers' accuracy after 16 months and found that they still

successfully demonstrated dermoscopy effectiveness (Herschorn, 2012). Additionally, another study showed dermoscopic diagnostic accuracy of 80% in providers with more than 10 years of dermoscopy experience compared to 56% in those providers with 1-2 years of experience (Gereli et al., 2010). Hencley (2017) found that primary care providers' comfort level with dermoscopy practice and performing NEE increased after the two-hour educational session. The practice improvement project also found that clinicians felt that practice of dermoscopy would be beneficial to them and patient care (Hencley).

### **Use in Primary Care**

Clinicians who specialize in dermatology, or dermatologists, are the main users of dermoscopy in their practice. Lack of training and inexperience are the main culprits behind lower routine use of dermoscopy in primary care settings. Training in dermoscopy is crucial for sustainability of its use in clinical practice due to the multitude of colors, shapes, patterns, and structures of skin lesions. Educational dermoscopy sessions improve provider confidence, increase skin cancer screenings in primary care settings, and aid in accurate diagnosis (Chappuis et al., 2016; Koelink et al., 2014; Kownacki, 2014).

Research shows that even minimal training in dermoscopy can influence outcomes by increasing diagnostic accuracy and reducing unnecessary biopsies (Hayes, 2017; Herschorn, 2012; Kownacki, 2014; Marghoob et al., 2013; Menzies, 2013). In a study cited by Hencley (2017), primary care providers who received one-day training and routinely used dermoscopy were shown to diagnose melanoma more accurately than those who used NEE for the same. In addition, primary care physicians trained in dermoscopy were shown to reduce their benign-to-malignant ratio from 9.5 to 3.5 (Marghoob et al., 2013). Argenziano et al. (2006) found that general practitioners reduced their benign to malignant excision rate from 18:1 to 4:1 (as cited in



Kownacki, 2014). This not only represents a cost savings to the patient but also spares the patient unwanted anxiety. Alongside these benefits, clinicians can provide education and counsel patients on skin cancer prevention during the dermoscopy exam.

### **Dermoscopic Exam**

Several algorithms and scoring systems are available to aid in a systematic approach to teach and practice dermoscopy for benign and malignant lesion identification. There are multistep processes to assist the clinician in identifying structures within the lesion to confirm the diagnosis. The first step involves determining if the lesion is melanocytic or nonmelanocytic. The main components of dermoscopy focus around histologic correlation in combination with the vascular structures, general structures, and colors of the skin lesion. When looking at the lesion through dermoscopy the colors represent the concentration of melanin within the skin lesions. Some of the colors that may be viewed include red, brown, yellow, gray blue, black, and white. In the epidermis and superficial dermis, melanin appears brown and in the stratum corneum, the melanin appears black. Within the dermis, melanin appears gray and blue. White indicated collagen or fibrosis and yellow lesions are associated with sebum or keratin. Vasculature is red in color and thrombus lesions will appear black (Marghoob & Jaimes, 2019).

The structure of the skin lesion is determined by the amount and distribution of collagen, keratin, melanin, and vasculature. Specific diagnoses are determined by the combination of structures viewed under dermoscopy. Hallmark melanocytic lesions include the following structures: pigment network, negative network, peripheral or aggregated rim of globules, homogeneous blue pigmentation, angulated lines, and streaks. Arborizing vessels, large blue/gray ovoid nests, leaf-like structures, concentric and spoke-wheel-like structures, multiple blue/gray nonaggregated globules, shallow ulceration, and shiny white blotches and strands are

structures of BCCs. Features of SCCs include brown dots/globules aligned radially, white/yellow scaly crusts, brown circles, rosettes, glomerular vessels, and white circles. Milia-like cysts, fingerprint-like structures, moth-eaten borders, comedo-like openings, sharp demarcation, and gyri and sulci are distinctive of seborrheic keratoses. Cherry angiomas or angiokeratomas are found in the combination of red, blue, purple, and black. Finally, the associated features of melanoma include an atypical pigment network, vascular pattern, and dots, irregular streaks, angulated lines that appear in the pattern of a zigzag or polygons, regression structures, and a blue-white veil (Marghoob & Jaimes, 2019).

Vascular structures may provide the only clues for diagnosis in lesions that are amelanotic or hypomelanotic. When visualizing blood vessels, the preferred dermascope is the noncontact polarized light. If a contact dermascope is being used, then ultrasound gel must be applied to the lesion to reduce the applied pressure and prevent the vessels from blanching. Vascular structures viewed with dermoscopy include the presence of a white or pink halo, morphology, arrangement, and distribution. The common melanocytic morphology viewed with dermoscopy is serpentine, comma, dotted, and corkscrew. Hairpin, glomerular, or arborizing morphology is more common with nonmelanocytic lesions. The arrangement of the lesion structure can be a crown, string of pearls, clustered, or radial and can be randomly distributed, central, focal, diffuse, or peripheral (Marghoob & Jaimes, 2019). Although certain skin lesions are commonly associated with some vascular morphologies, the presence of a specified morphology is not exclusive to a particular diagnosis. There is overlap among the morphologies and specific diagnoses; however, when the clinical context is carefully considered the positive predictive value can steer the clinician to the correct diagnosis.

## **Dermoscopic Algorithms**

Dermoscopic algorithms and checklists were created to assist providers in identifying malignant and benign lesions with the use of dermoscopy. These algorithms include: the ABCD rule of dermoscopy, pattern analysis, the seven-point checklist, the three-point check list, and Menzies method (Appendix K). Algorithm selection is based on clinician experience and practice. Dermatologists use the algorithms that assist in differentiating between the subtypes of cancerous skin lesions and primary care providers are recommended to use the algorithms that differentiate between pigmented cancers. Algorithms that are short and straightforward in dermoscopic criteria are intended to be used in primary care settings. These algorithms assist the non-dermatologist clinician in the basics of pigmented and non-pigmented lesion assessment (Marghoob & Jaimes, 2018)

Dermoscopy in primary care helps the healthcare provider decide whether to refer to dermatology, perform a biopsy, reassure the patient that the lesion is benign, or continue to monitor the lesion for any change. Forming a diagnosis with dermoscopy requires evaluation of the lesion's features, pattern, symmetry, color, and structure. The usual methods of dermoscopic evaluation used in primary care are discussed in the subsequent paragraphs.

### **ABCD Rule of Dermoscopy**

The ABCD rule of dermoscopy was established to differentiate between malignant and benign melanocytic lesions to determine if excision is necessary. This algorithm, first introduced in 1994, contains a semi-quantitative scoring system revolving around asymmetry, border, color, and different dermoscopic structures. The risk that the lesion is a melanoma is greater when the total dermoscopic score is higher (Ahnlide et al., 2016; Marghoob & Jaimes, 2018).

The ABCD rule of dermoscopy benefits those clinicians who are not familiar with dermoscopy because of its simplicity. Asymmetry focuses on the distribution and contour of the colors and structures within the lesion perpendicular axes. Scoring for asymmetry ranges between zero and two points. The border is assessed for abrupt cutoffs between the lesion and the normal skin. First, the lesion is divided into eight sections like a pie. In each segment that presents with an abrupt cutoff of pigment the score of one is assigned. Therefore, the border score can range from zero-eight points. The color score ranges from one to six and refers to the presence of red, white, black, dark brown, light brown, or blue-grey within the lesion. The dermoscopic structure score ranges from one to five and includes the presence of pigment network, branched streaks, homogenous or structureless areas greater than 10%, dots, or globules within the lesion. The total dermoscopic score is calculated after each assigned score is multiplied by a weighted factor and totaled. The sensitivity of the ABCD rule of dermoscopy ranges from 78-90%, and the specificity ranges from 45-90% among experts and non-experts (Ahnlide et al., 2016; Marghoob & Jaimes, 2018).

### **Pattern Analysis**

With pattern analysis, numerous diagnostic associations are possible depending on the local and global features of the skin lesion. Pattern analysis is considered a more complex method of dermoscopic examination of skin lesions. The reason for this is because the user needs to have previous knowledge of typical dermoscopic patterns of melanoma and nevi. When used by experienced clinicians, this method is highly sensitive and specific, but non-experts may have worse diagnostic accuracy than with the NEE (Gereli, Onsun, Atilganoglu, & Demirkesen, 2010; Marghoob & Jaimes, 2018).

### **Seven-Point Checklist**

The seven-point checklist was developed in the late 1990s and is divided into minor and major criteria. The seven dermoscopic features make up the criteria and are all commonly seen in melanoma. The minor criteria include regression structures, irregular blotches, dots, streaks, or globules. Major criteria include atypical vascular pattern, blue-white veil, or an atypical pigment network. The score is calculated by the sum of two points for each of the major three criteria and one point for each of the four minor criteria. If the final score is three or more, this suggests melanoma. Among experts and non-experts, the sensitivity ranges from 62-95% and specificity from 35-97% (Gereli et al., 2010; Marghoob & Jaimes, 2018).

### **Three-Point Checklist**

Another dermoscopy algorithm is the three-point checklist, which is a condensed version of the seven-point checklist designed for non-expert use. This checklist was initially created to be a skin cancer screening tool for pigmented melanoma and BCC and has a sensitivity of 79-91% and a specificity of 71-72% for these diagnoses. The three criteria evaluated in the checklist include blue-white structures, asymmetry, and atypical pigment network. Each criterion present in the lesion receives one point. A score of two or more warrants a referral to a specialist or a biopsy (Jaimes & Marghoob, 2019).

### **Menzies Method**

Menzies method was first developed to aid in differentiating pigmented skin lesions from invasive melanoma. The method uses nine positive features which have a high specificity for melanoma and two negative features that have a low sensitivity for melanoma. The negative features include the presence of only one color and the symmetry of the pigmented lesion. If the lesion contains both features, then the diagnosis is essentially negative for melanoma because the

sensitivity is 0%. The positive features include five to six colors within the lesion, multiple brown or blue-gray dots, pseudopods, scar-like depigmentation, a blue-white veil, broadened network, peripheral black dots or globules, or radial streaming. If the lesion possesses any of these positive features, there is concern for melanoma (Marghoob & Jaimes, 2018).

### **Limitations**

There are limitations to the complex and sophisticated practice of dermoscopy. The diagnostic accuracy is dependent on the clinician's knowledge and expertise in dermoscopy. Additionally, there is a limited amount of training required for dermoscopy to be more advantageous over clinical examination. Even with experts, dermoscopy can fail to accurately identify melanoma that lack specific dermoscopic criteria. Dermoscopy alone cannot render a malignant diagnosis and histopathologic examination is the gold standard for skin cancer diagnosis (Marghoob & Jaimes, 2019).

The cost of dermoscopy is dependent upon the dermascope purchased and the associated education. Dermascopes can range in price from \$250 to \$3000 (Jacobson, 2016). The cost is dependent on the quality and brand of the dermascope. Rural providers may be deterred from purchasing a dermascope due to the price. Additionally, the dermascope is only useful and effective if the provider has been trained on the practice of dermoscopy. The time and cost associated with educational sessions, conferences, and textbooks to learn the practice of dermoscopy can also be a limitation.

With the advancements in technology such as digital dermoscopic images, long-distance consultations can occur. However, the digital dermoscopic images may not be as accurate as in-vivo dermoscopy. The clinical setting determines the practicality of dermoscopy. In primary care, dermoscopy aides the healthcare provider in assessing pigmented and non-pigmented

lesions to determine if a biopsy is indicated or if a specialist should further evaluate (Marghoob & Jaimes, 2019).

### **Summary**

Dermoscopy use along with clinical judgement, and NEE have proven to be effective in the diagnosis of melanocytic lesions. Multiple simplified, specific, and sensitive algorithms are available and recommended for non-experts such as primary care clinicians to use in dermoscopy practice. Primary care providers can be confident in using dermoscopy to detect melanoma with the use of these algorithms, a small amount of education, and clinical practice.

## **CHAPTER THREE. THEORETICAL FRAMEWORK**

Practice improvement projects are developed through the guidance of theoretical frameworks and models to implement change in clinical practice. Evidence-based practice (EBP) improves patient care by advising clinicians to utilize the most current best practice evidence. EBP is the corner stone in assisting healthcare providers in the highest quality care to patients. The theory and model chosen to guide the project are the Diffusion of Innovation Theory and the Iowa Model of Evidence-Based Practice (Rogers, 2003; Titler et al., 2001).

### **The Iowa Model of Evidence-Based Practice**

Maria G. Titler and her colleagues (2001) developed the Iowa model of EBP. The Iowa model of EBP is a framework used to guide research aimed at initiating change in clinical practice and improvements in patient care. The model acts as a guide to implement the research into clinical practice (Melnyk & Fineout-Overholt, 2015). The model (APPENDIX D) outlines the realistic multiphase process for implementing change with feedback loops to evaluate and reconstruct (Melnyk & Fineout-Overholt, 2015). After the need for change is acknowledged then the literature is reviewed, critiqued, and synthesized to summarize the research-based evidence that supports the proposed change to clinical practice. The implementation can then take place in practice followed by the evaluation and dissemination of the results. The application of the Iowa model of EBP through this practice improvement project is further discussed in the following paragraphs.

### **Selecting a Topic**

A topic for EBP is selected through existing clinical concerns or through new knowledge that is not yet utilized in clinical practice. Topics can be selected through problem-based triggers or knowledge-based triggers. In knowledge-based triggers, new research and guidelines that can



lead to potential changes in current standards are explored. With problem-focused triggers, the existing data presents with areas of potential improvement (Melnik & Fineout-Overholt, 2015). The review of literature shows that PCPs may not have adequate training to identify skin cancers and that the routine skin examinations are not being completed (Curiel-Lewandrowski, Chen, & Swetter, 2012; Hencley, 2017; Hershcorn, 2012; Wu et al., 2015). The aim of dermoscopy is to increase skin examinations performed in primary care settings given the evidence-based research indicating the benefits with the practice of dermoscopy.

### **Forming a Team**

The members of the team may include advanced practice providers, interdisciplinary colleagues, topic experts, and practice stakeholders. Additional team members include the other healthcare professionals such as PCPs, nurses, and support staff at the rural clinic. A team was formed for this practice improvement project, made up of a committee, after the co-investigator identified if the topic is of interest to the organizations involved. Once the topic of interest is identified, then the co-investigator forms the team to assist in development, implementation, and evaluation of the practice change. Based on these criteria the committee members were selected and include: Dean Gross, PhD, FNP-BC, committee chair; Shannon David, PhD, graduate appointee; Kelly Buettner-Schmidt, PhD, RN; and Mandy Rath, MSN, FNP-C.

### **Evidence Retrieval**

Many electronic database searches were utilized to identify the key evidence-based literature to compose the practice improvement project. These databases included CINAHL, EBSCO, PubMed, and Cochrane. To start the evidence retrieval, key terms were used along with identifying appropriate available resources (Roush, 2015). The key terms utilized in the searches included: skin cancer, prevention, primary care, dermoscopy, ABCDE, Menzies method,

screening, melanoma, basal cell carcinoma, squamous cell carcinoma, actinic keratosis, and seborrheic keratosis. The information gathered surrounded the prevalence and pathophysiology of skin lesions and skin cancer, current skin cancer screening techniques, the practice of dermoscopy, and its associated benefits. Electronic databases, healthcare professional websites, and textbooks aided in collecting the evidence-based literature for this practice improvement project.

### **Grading the Evidence**

The evidence was critiqued, graded, and synthesized after the retrieval process to assess the research quality and strength. In the Iowa Model, this stage is where each piece of literature is evaluated on its effectiveness, appropriateness, and feasibility. The evidence gathered must be high quality and show a purpose to invoke an effective EBP change (Roush, 2015). The literature gathered for the project was composed of qualitative and quantitative data on the different types of skin lesions, the practice of dermoscopy, and skin cancer screening in the primary care setting.

### **EBP Standard Development**

Following the critiquing and synthesizing of the literature, practice recommendations can be created. These recommendations revolved around the needs assessment and practice guidelines while considering the usefulness, relevance, and effectiveness to practice (Terry, 2014). The purpose of this project was to increase skin cancer screening prevalence in rural primary care by implementing a learning module and clinical practice with dermoscopy. The intent was to increase provider knowledge and confidence in identifying and monitoring skin lesions with a dermascope. The project objectives focus on promoting dermoscopy sustainability in clinical practice through implementing an educational resource on the use of dermoscopy,

increasing provider knowledge, and comfortability with dermoscopic skin examinations in rural clinics.

### **Implementation of EBP**

EBP implementation occurs over a designated time frame with the PCPs, the rural healthcare facilities, and those in the leadership roles that support the clinical change and practice improvement project. The most crucial components of maintaining the implementation process include providing the necessary resources, follow-up reinforcement of the learning, data collection of outcomes, analysis of data, and interpretation of the results (Terry, 2014). These components also assist in the evaluation of the practice improvement project.

### **Evaluation**

To promote integration of the EBP change within the clinical setting, on-going evaluation is necessary (Terry, 2014). Evaluation methods include feedback loops and assessments to promote sustainability and success of the practice improvement change. For the practice improvement project, statistical analysis through pre- and post-dermoscopy education surveys and personal interviews were collected and analyzed for evaluation support.

### **Summary**

Success and sustainability of this practice improvement project was achieved by using the Iowa model of EBP as a guideline for implementation at rural primary care sites. The EBP behind dermoscopy provides the vital groundwork for successful implementation, future research for skin cancer screening, and continued clinical application in primary care settings.

### **Diffusion of Innovations**

E. M. Rogers developed the Diffusion of Innovation (DOI) theory in 1962 (LaMorte, 2018; Rogers, 2003). The purpose of the DOI theory is to assist in disseminating behavior

changes into clinical practice settings. The framework of the theory explains the process of innovation and the stages associated with adopting the new idea. This leads to narrowing the knowledge gap between what is in use and what is known (LaMorte, 2018). The DOI theory will be used to change the behavior of PCPs in rural primary care by increasing the use of the dermascope for skin cancer screenings.

## **Diffusion**

Diffusion of new ideas and knowledge into clinical practice can occur in a myriad of ways. Diffusion is used to communicate how new innovations gain momentum and spread through certain populations or social systems. There are four main elements in Rogers' DOI theory: innovation, communication channel, time, and social system (Rogers, 2003). Innovation is achieved through the population or individual identifying the idea, product, or behavior as new or ground-breaking. Through diffusion, one can achieve innovation (LaMorte, 2018). The innovation in this practice improvement project is dermoscopy. The communication channel is how individuals convey information pertinent to the innovation amongst one another (Rogers, 2003). Face to face communication, standardized survey questions, and the education resources are the main communication methods for this practice improvement project.

The time component is spread throughout specific points of the practice improvement project. For the individual to accept and adopt the innovation, change cannot occur all at once but rather over a course of time. During this project, there was a three-month period for the individuals involved to recognize that dermoscopy is a valuable and useful innovation. After the three-month time period, a survey was distributed to help measure the degree to which PCPs in the rural healthcare setting adopted dermoscopy in their clinical practice. The social system assists in shaping the diffusion boundaries. The engaged social system for this project includes

primary care providers at Four Seasons Wellness and Essentia Health in rural Minnesota because they expressed interest in enhancing their knowledge and clinical practice of dermoscopy.

### **Qualities of Innovation**

The adoption of innovation is the main goal behind the DOI theory. The attributes that contribute to the adoption of and innovation include relative advantage, compatibility, complexity, trialability, observability, and reinvention (Rogers, 2003). The relative advantage is the degree to which the innovation is perceived as better than the previous idea. The clearer the added value of the innovation is to potential end users, the faster and easier the innovation is adopted. Compatibility is how consistent the innovation matches with the existing values, norms, and needs of the social system. The primary care providers at both rural clinics expressed interest in further exploring the use of dermoscopy in their clinical practice.

Complexity is the perceived difficulty to understand and use the innovation (Rogers, 2003). The innovation is more quickly adopted if it is easier to use and understanding. The practice of dermoscopy is complex in nature and takes time to master due to the extent of variables with each skin lesion. The degree of complexity has already been voiced by a PCP at one of the implementation sites, and so a slow but consistent rate of adoption is projected. The haste of which the innovation is adopted also depends on the trialability. Trialability is the extent to which the innovation can be tested and practiced with before adoption (Rogers, 2003). Learning the practice of dermoscopy and examining lesions with a dermascope should be broken down into a systematic approach because of its complexity. Through the education resources and demonstrating the use of dermoscopy in sections, the attribute of trialability within the DOI theory was met during this project.

Observability looks at the degree to which the perceived outcomes of using the innovation are visible to others. The diffusion process occurs more rapidly if members of the related audiences and the social system can view the results with little difficulty (Rogers, 2003). Direct action such as: biopsy, close monitoring, confirmation of a benign lesion, or a dermatology referral can occur when looking at the skin lesions with dermoscopy. The outcomes and results may be observed by the patients who have the skin exam performed with dermoscopy and the PCPs at each rural health clinic. Finally, reinvention is the degree to which the innovation can be customized and modified by other individuals or social systems. The innovation is diffused more rapidly when it can easily be reinvented (Rogers, 2003).

Dermoscopy has been used by dermatologists for many years, but not routinely used in a primary care setting. Dermoscopy is easily implemented into primary care practice once it is well understood and if a dermascope is available. This project is an example of reinvention itself because a similar project was completed at North Dakota State University Student Health Services (Hencley, 2017).

### **Adopter Categories**

Adoption of innovation does not happen simultaneously in a social system, but rather occurs at the rate of which individuals decide to adopt the change behavior or proposed idea. In the DOI theory, there are five adopter categories; innovators, early adopters, early majority, late majority, and laggards (LaMorte, 2018; Rogers, 2003).

Innovators are those individuals who seek to try the innovation first, are willing to take risks and be the first to adopt a new idea (LaMorte, 2018; Rogers, 2003). Early adopters are those in leadership roles who embrace change opportunities and are comfortable with adopting new ideas. The early majority still adopt new ideas before the average individual, but usually

need to see the evidence that the innovation works before adopting. They comprise about 34% of the population. Another 34% of individuals make up the late majority. These individuals are skeptics and often do not adopt the change or innovation until it has been tried by most others. Laggards are conservative and need confirmed success and peer pressure from the other adopter group before adopting the innovation. When promoting innovation, the key to success is understanding the attributes of the target population as well as those characteristics that will help and hinder the process (LaMorte, 2018; Rogers, 2003).

### **Summary**

The DOI theory emphasizes the importance of targeting adopter categories and appealing to those specific groups to improve and sustain innovation adoption rates. By using the DOI theory for this project, exact adopter categories and the techniques to implement the change behavior of dermoscopy for those groups can be identified to ensure success and sustainability.

## **CHAPTER FOUR. PROJECT DESCRIPTION**

### **Congruence of the Project to the Organization's Strategic Plan**

This practice improvement project was implemented at rural health primary care settings: Four Seasons Wellness and Essentia Health. The project aligns well with each organization's mission to quality and high standard care. Four Seasons Wellness's mission is "Enhancing the quality of life for our community with honesty, compassion and kindness throughout all life stages" (Four Seasons Wellness, 2018). Essentia Health's mission is "We are called to make a healthy difference in people's lives" (Essentia Health, 2019). Interest in the use of dermoscopy for skin examinations and skin cancer screening was voiced by the providers at these organizations. Providers also mentioned interest in gaining exposure and experience with dermoscopy for their clinical practice given the high incidence of patients with UV exposure from farming. The intent of using dermoscopy with NEE is to improve knowledge of dermoscopy and accurate identification of skin lesions, increase provider comfortability, and provide high quality patient care.

### **Project Objectives**

The purpose of this project is to increase skin cancer screening prevalence in primary care in rural settings by implementing a learning module and clinical practice with dermoscopy. Additionally, the intent is to increase provider comfortability in identifying and monitoring skin lesions with a dermascope within their practice.

The project objectives created for effective implementation of this dissertation were focused on implementing, educating, and utilizing the practice of dermoscopy to rural health primary care providers at Four Seasons Wellness and Essentia Health. The objectives included:

- I. Implement an educational resource surrounding the use of dermoscopy for rural PCPs.



- II. Increase knowledge and comfortability on the appearance and identification of malignant and benign skin lesions with dermoscopy among rural PCPs.
- III. Promote sustainability of the clinical use of dermoscopy in the rural primary care setting by December 2019 through providing a copy of the educational resources and supplemental references to the rural PCPs.

### **Project Design**

The design of this practice improvement project was tailored to improving the knowledge and comfortability of dermoscopy among PCPs in rural health clinics: Four Seasons Wellness in Steele, ND and Essentia Health in rural clinics in Minnesota and North Dakota. Four Seasons Wellness did not own a dermascope and used a pen or otoscope light with a magnifying glass or naked eye to perform skin examinations. Interest in dermoscopy and purchasing a dermascope was expressed by the provider, Mandy Rath, FNP-C, to the co-investigator. However, identifying what type of dermascope to purchase was a barrier to her purchasing this tool.

The intent of this project was to advance the development and skills associated with the use of dermoscopy for skin examinations. The purpose of this practice improvement project was to implement education regarding dermoscopy as well as sustain its use in clinical application. The combinations of these elements allowed for the providers to maximize and improve their dermoscopy practice. Multiple studies have shown that a one-day training course with supplemental resources enables clinicians to improve their dermoscopy skills as well as their confidence and diagnosis accuracy (Curiel-Lewandrowski et al, 2012; Hershcorn, 2012; Wu et al., 2015).

Following in the steps of Hencley (2017), the co-investigator conducted one, two-hour session at each implementation site where education was presented along with dermoscopy

techniques. A dermascope, power-point presentation, laminated educational resource, skin cancer handouts, and a dermoscopy textbook was presented during the session. The PCPs had the opportunity to practice with the dermatoscopes using the algorithms discussed during the session. The algorithms presented during the educational session included: the ABCD rule of dermoscopy and the three-point checklist. These algorithms were chosen by Hencley (2017) for their efficacy, simplicity, and ease of use in primary care. With this practice improvement project, there were two dermoscopy education seminars. The following table displays the components of the project design.

Table 1

*Original Project Design*

	Implementation Site #1: Four Seasons Wellness	Implementation Site #2: On site educational session with Essentia Health PCPs
Implementation Date	Fall 2019	Fall 2019
Pre-dermoscopy education Survey	Yes	Yes
2-hour Educational Session with Educational Resources Provided	Yes	Yes
Dermascope lent to clinic for PCP to use over 3 Months	Yes	No, 1-2 dermatoscopes will be available for hands-on practice during the educational session
Monthly Informal Visits	Yes	No
Post- dermoscopy education Survey	Yes – after the 3-month implementation period	Yes, after the educational session

Prior to implementing the project, the providers were asked to complete a pre-dermoscopy education survey via Qualtrics to assess current comfortability and knowledge with dermoscopy. At Four Seasons Wellness, one dermascope was loaned to the clinic for use after the completion of the educational session and pre-dermoscopy education survey. The dermascope was placed in a central location for ease of access over the three-month period.

During that time the co-investigator made monthly informal visits to answer any questions about dermoscopy and discuss the experiences the provider had clinically with dermoscopy. The informal visits from the co-investigator helped encourage the PCP to use dermoscopy for routine and episodic patient skin exams. For the educational session implemented with Essentia Health PCPs, there was a dermascope available for PCPs to use during the educational session. Because the PCPs work at different Essentia Health facilities in rural Minnesota and North Dakota, dermascopes were unable to be loaned out to each provider for the three-month implementation period.

Once the three-month implementation period was completed, a post-dermoscopy education survey assessing the same topics was administered for the providers to complete voluntarily. The pre- and post-dermoscopy education surveys were created and used by Hencley (2017). Permission to reproduce these surveys (APPENDIX G-I) for this practice improvement project was granted.

The pre- and post- dermoscopy education surveys evaluated the provider responses using a Likert scale. The survey questions addressed the providers' thoughts on the practicability of dermoscopy, comfortability with dermoscopy, personal knowledge before and after the implementation of the project, and implications for future use (Hencley, 2017). The surveys were administered electronically using Qualtrics. Using the Qualtrics features to analyze and report on final data points, the data analysis was performed at the end of the project.

### **Timeline of Project Phases**

The project was implemented at one rural health primary care location and at an educational session for rural PCPs in North Dakota and Minnesota. Starting with Four Seasons Wellness, the one-two hour education session took place on October 18, 2019. After completing

the educational session, one dermascope was loaned to the clinic and placed in a central location for the provider to utilize over the course of two months. The co-investigator made informal monthly visits to check in on the progress and answer any questions the provider had. A pre- and post- dermoscopy education survey was completed by the provider. The data was compiled by Qualtrics at the conclusion of the project. The same process was implemented at an educational session for a group of four Essentia Health PCPs in rural Minnesota and North Dakota on November 15, 2019. A dermascope was not loaned to each of these providers for two months, and the post-survey was administered at the conclusion of the educational session. Data was then compiled, and the results of the project were reported.

### **Resources**

The resources utilized to implement this practice improvement project included time, locations, primary care providers, financial means, and technology. Approval from Four Seasons Wellness and Essentia Health was obtained. The key stakeholders for sustainability and success of this project included the primary care providers from both clinics. Other personnel included this practice improvement project's committee members, the co-investigator, other healthcare professionals such as nurses, and those specific patients who will provide their consent for participation of skin examinations by the PCP. One committee member, Mandy Rath, FNP-C, is also the provider at Four Seasons Wellness. This helped ensure that the aims of the project aligned with the needs of the primary care providers at both clinic locations.

The largest resource of this practice improvement project was the educational resources and demonstration with dermoscopy. The resources were created using textbooks, recommendations from the committee members with expertise and experience with dermoscopy, online resources, and electronic applications. Permission was obtained from multiple online

resources to reproduce/use images. The resource included the three-point checklist and the ABCD rule of dermoscopy to assist providers in identifying benign and malignant skin lesions. Photographs were included for the providers to practice using the dermascope. A one-page handout discussing skin cancer prevalence, risks, and prevention was also provided for the PCPs to distribute to their patients.

A personal textbook on dermoscopy was also provided to the PCP at Four Seasons Wellness over the course of the two-month implementation period as an additional source for dermoscopy use. NDSU School of Nursing had one dermascope for the co-investigator and the provider to use throughout the project.

Technology resources for implementing this project included computers, internet access capable of viewing dermoscopy resources, online documents, and electronic mail. The other main resource for the project was the dermascope which was used extensively throughout the project's entirety at Four Seasons Wellness.

The funding for this project included the cost for the textbooks, creation of the educational resources, printing, miscellaneous office supplies, and online applications. The total cost was relatively minor for these materials. Additionally, a dermascope was borrowed from the NDSU School of Nursing for use at Four Seasons Wellness over the two-month period.

### **Evaluation Plan**

Evaluation of the practice improvement project will assess if the below objectives of the project were met. By using a logic model, evaluation of each objective will be discussed. The logic model (APPENDIX E-F) displays the inputs, activities, outputs, short term outcomes, and long-term outcomes to define the specific elements of each objective. The following paragraphs

explain how each objective will be evaluated at the completion of the practice improvement project.

## **Objectives**

- I. Implement an educational resource surrounding the use of dermoscopy for rural PCPs

This objective was evaluated with the pre- and post-dermoscopy education surveys. Specifically, the questions were directed at the practicability and quality of the education provided during the session.

- II. Increase knowledge and comfortability on the appearance and identification of malignant and benign skin lesions with dermoscopy among rural PCPs.

The improvement was assessed based on the provider responses regarding the knowledge and comfortability changes that occurred after the educational seminar for the Essentia Health PCPs and over the course of the two-month implementation period for the Four Seasons Wellness PCP. This was completed on the pre- and post-dermoscopy education survey questions using the Likert scale and during the informal monthly visits with the provider discussing her experiences.

- III. Promote sustainability of the clinical use of dermoscopy in the rural primary care setting by December 2019 through providing a copy of the educational resource and supplemental references to the rural PCPs.

Likert scale survey questions were used to evaluate the practicability and future use of dermoscopy. Continued use and sustainability was met by providing copies of the educational resources along with the dermascope for the provider at Four Seasons Wellness to increase exposure and continued practice with dermoscopy.

## **Protection of Human Subjects**

Like the project completed by Hencley (2017), healthcare providers, nurses, and patients who visited the clinic sites were the human subjects involved in this project. The patients included those who present to the clinic for a routine annual physical or skin lesion concerns. Education about dermoscopy was provided to the patient from the healthcare provider. The patient will then choose if they would like to have a skin exam with dermoscopy performed. For this project, there are no special considerations taken to include or exclude women, children, and minorities.

Comparable to the project implement by Hencley (2017), the design was intended for healthcare providers to increase their comfort and knowledge with dermoscopy. This provided little to no risk for the healthcare providers who participated. A potential risk associated with the practice improvement project was time spent with each patient who consented to receive screening with dermoscopy. Even though dermoscopy is painless, patients may experience some discomfort as minimal clothing is recommended to perform the examination. Additionally, patients may experience psychological distress if a suspicious skin lesion is identified, requiring further work-up with dermatology leading to financial burdens for the patient depending upon the recommendations and interventions.

Participation was completely voluntary from patients, nurses, and providers. Verbal consent, explanation of voluntary involvement, and provider discretion for dermoscopy screening was highlighted throughout the practice improvement project. Pre-and post-dermoscopy education surveys were also voluntary for the healthcare providers to complete.

Potential benefits for this proposed practice improvement project include: an increase in the prevalence of skin cancer screenings completed in rural primary care settings, an increase in

knowledge and comfort with the use of dermoscopy among healthcare providers, and an overall enhancement in the quality of life of patients.



## **CHAPTER FIVE. RESULTS**

### **Adjustments to Project Design**

There were two components with this practice improvement project and adjustments to the original project design occurred due to unforeseen circumstances. In the first component of the project which was implemented at Four Seasons Wellness, the primary care provider had the opportunity to utilize a dermascope after the two-hour educational session on dermoscopy and apply knowledge of dermoscopy to clinical practice over the course of two months. The other component of this practice improvement project was implemented with Essentia Health PCPs and focused on a two-hour educational session but omitted the use of the dermascope for the PCPs over two months due to cost and dermascope availability constraints. Because clinical application with dermoscopy was omitted in the second implementation at Essentia Health, the post-dermoscopy education survey was administered immediately following the two-hour educational session. Another component of the practice improvement project that changed from the original design was that the implementation period at Four Seasons Wellness. The dermascope was loaned to Four Seasons Wellness for two months instead of three months because only one PCP was evaluated in this component of the project. The following table displays the changes to the original project design.

Table 2

*Final Project Design*

	Implementation Site #1: Four Seasons Wellness	Implementation Site #2: Interactive Video Network (IVN) educational session with Essentia Health PCPs
Implementation Date	October 18, 2019	November 15, 2019
Pre- dermoscopy education Survey	Yes	Yes
2-hour Educational Session with Educational Resources Provided	Yes	Yes
Dermascope lent to clinic for PCP to use over 2 Months	Yes	No
Monthly Informal Visits	Yes	No
Post- dermoscopy education Survey	Yes – after the 2-month implementation period	Yes, after the educational session

The project described above was initiated on two separate dates. On October 18, 2019, the project was implemented at Four Seasons Wellness in Steele, ND and concluded on December 18, 2019. On November 15, 2019, the project was implemented via interactive video network (IVN) with Essentia Health PCPs and concluded after the 2-hour education session that same day. Between the two implementation sites, there was a total of five PCP participants. All five participants completed the pre- dermoscopy education and post- dermoscopy education survey. The pre-dermoscopy education survey was administered prior to the implementation at both sites. The post-dermoscopy education survey was administered at the conclusion of the 2-hour educational session for the Essentia Health PCPs and after a 2-month implementation period for the PCP at Four Seasons Wellness. The surveys were only administered to PCPs at both institutions. No nurses, patients, students, or any other individuals were involved. The survey participation was completely voluntary for the PCPs.

## **Sample Demographics and Data Analysis**

The PCPs involved in this practice improvement project were both female and male. There were four female participants and one male participant. One female participant was the owner of her own clinic, Four Seasons Wellness, in rural North Dakota. The remaining participants were PCPs at Essentia Health in rural North Dakota and Minnesota. The PCPs at Essentia Health were all part of a residency program with less than one year of experience. The provider at Four Seasons Wellness has 10 years of experience as nurse practitioner.

The data analysis of the PCPs pre-and post-dermoscopy education surveys were compiled electronically through the Qualtrics program. The pre-and post-dermoscopy education surveys were distributed through email to each of the PCPs and reports were generated within Qualtrics. The Qualtrics reports include percentages of each answer for the pre-and post-dermoscopy education survey questions and bar graphs that are included in the following sections.

### **Data Results**

The project objectives included: 1) implement an educational resource surrounding the use of dermoscopy for rural PCPs; 2) increase knowledge and comfortability on the appearance and identification of malignant and benign skin lesions with dermoscopy among rural PCPs; and 3) promote sustainability of the clinical use of dermoscopy in the rural primary care setting by December 2019 through providing a copy of the educational resource and supplemental references to the rural PCPs.

The survey data was quantitative in nature and included a five-point Likert scale with the response choices of *strongly disagree*, *disagree*, *agree*, *strongly agree*. There was a total of four Likert scale questions asked. All five PCPs completed the pre-and post-dermoscopy education

surveys in their entirety. Bar graphs included within the next pages represent the data from the pre-dermoscopy education survey and post-dermoscopy education survey separately.

### **Statement One**

*I am knowledgeable about skin cancer prevalence and prevention strategies.* The purpose of this statement was to establish a basis of the PCPs' general knowledge on skin cancer prior to providing education on the complex topic of dermoscopy. Four participants responded that they agreed while one participant disagreed on the pre-dermoscopy education survey. On the post-dermoscopy education survey, two participants strongly agreed, two more participants agreed, and one participant disagreed.

### **Statement Two**

*I feel comfortable performing naked eye examinations.* Statement two was intended to assess the baseline comfortability of naked eye skin examinations among the PCPs, as this is necessary component to the dermoscopy examination. The pre-dermoscopy education survey revealed that two PCPs disagreed, while three PCPs agreed. On the post-dermoscopy education survey, two PCPs disagreed, two PCPs agreed, and one PCP strongly agreed.

### **Statement Three**

*I feel comfortable with the practice of dermoscopy.* The purpose of this statement was to identify the PCPs' comfortability with dermoscopy prior to and after the educational session on dermoscopy as well as the implementation period for the provider at Four Seasons Wellness. On the pre-dermoscopy education survey, two providers strongly disagreed, two providers disagreed, and one provider agreed. The post-dermoscopy education survey revealed that one provider still strongly disagreed, three providers agreed, and one provider strongly agreed.

### Statement Four

*I feel that using dermoscopy will benefit my practice and my patients.* Statement four was created to establish the value of the practice improvement project to the PCPs participating. One PCP strongly disagreed, two providers agreed, and two providers strongly agreed on the pre-dermoscopy education survey. Four of the PCPs strongly agreed while one of the providers agreed on the post-dermoscopy education survey.

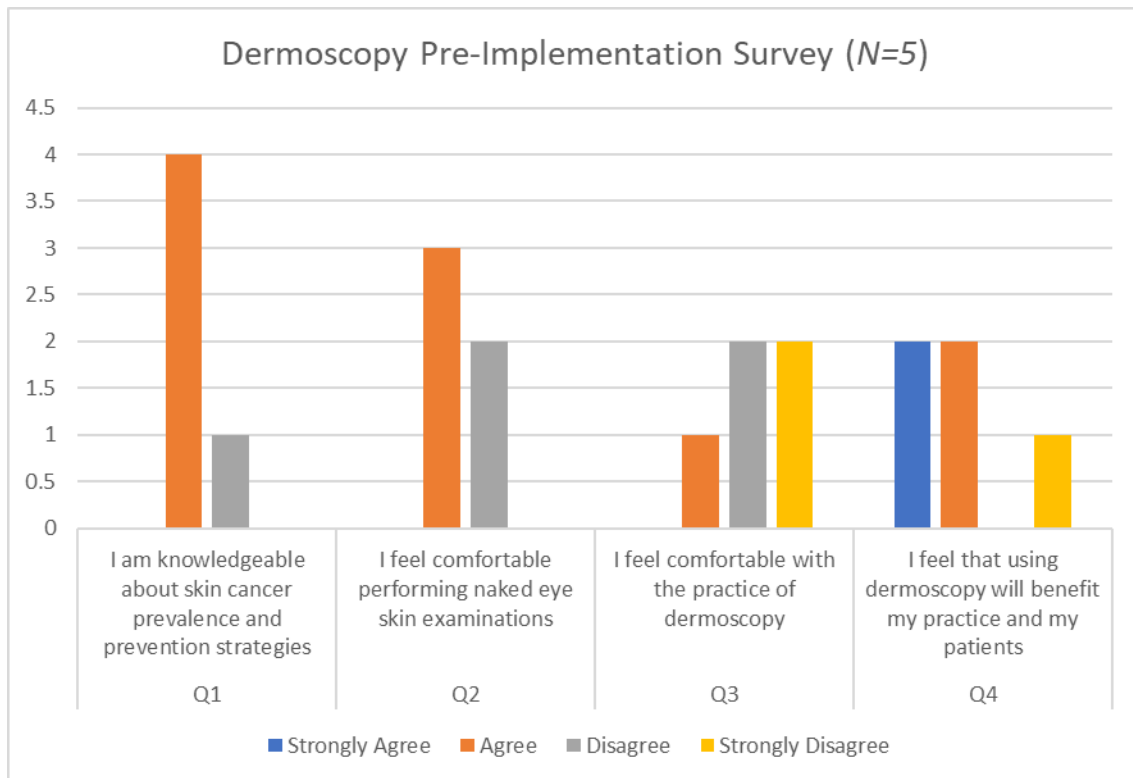


Figure 1. Pre-implementation dermoscopy survey results.

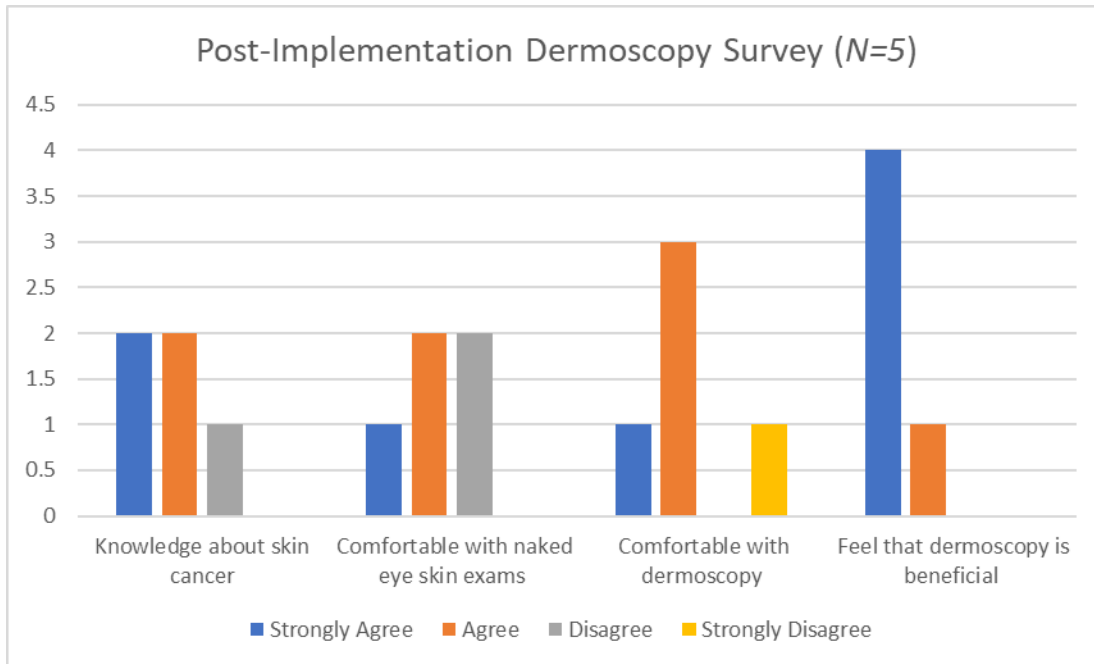


Figure 2. Post-implementation dermoscopy survey results.

One survey question on both the pre-and post-dermoscopy education survey included a scale rating comfort level including: novice, advanced beginner, competent, proficient, and expert. All (five of five) of the PCPs responded to this question on the pre-and post-dermoscopy education survey. The respondents' answers to the question are given below:

### Question One

*What do you consider your current level of knowledge of dermoscopy?* The intent of this question was to discern each provider's knowledge level on dermoscopy prior to and after the dermoscopy educational session and implementation. The purpose of this question was to also establish the benefit of the project. Four of the providers considered themselves as novices while one provider considered themselves competent on the pre-dermoscopy education survey. On the post-dermoscopy education survey, one provider reported novice level, two providers responded advanced beginner level, one provider responded competent, while one provider responded proficient.

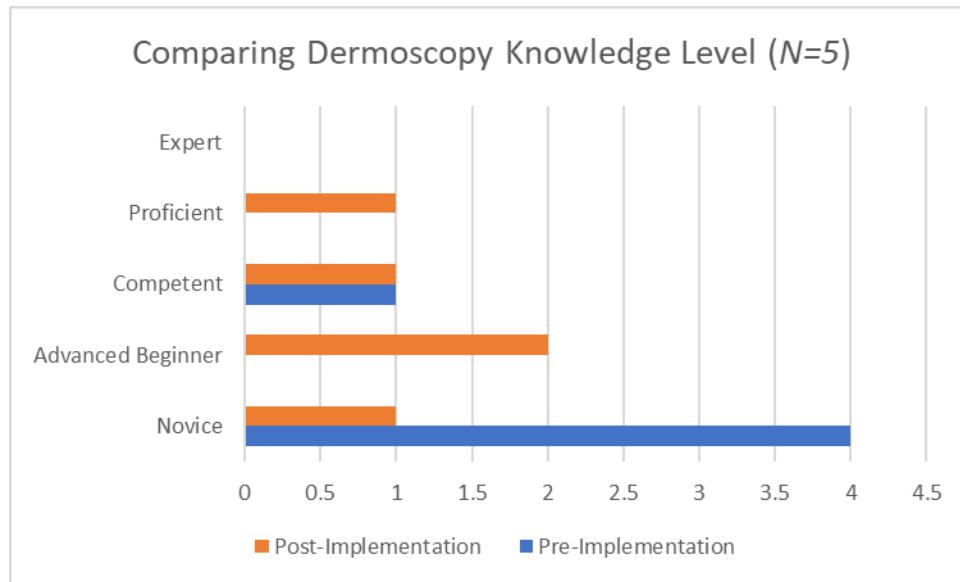


Figure 3. Comparison of dermoscopy knowledge pre-and post-implementation survey results.

## CHAPTER SIX. DISCUSSION AND RECOMMENDATIONS

Skin cancer is the most common type of cancer worldwide and in the United States. While rare, melanoma carries the highest mortality of any type of skin cancer. According to The Skin Cancer Foundation (2019), the number of new melanoma cases diagnosed in 2019 is estimated to increase by 7.7%. With skin cancer plaguing individuals and melanoma cases on the rise, PCPs can catch these diagnoses early during skin examinations. The main goal with a skin examination is to identify skin lesions suspicious for skin cancer, specifically melanoma. Unfortunately, skin cancer screenings are low and are only documented about 8%-21% of the time at annual examinations (Curiel-Lewandrowski et al., 2012).

Research has attributed several reasons to low documented skin examinations and decreased skin cancer screening rates. The main reason behind this dilemma is an inconsistent guideline for skin cancer screening (Herschorn, 2012). Healthcare providers who received training in dermoscopy, even with a one-day educational session reported increased accuracy in identifying melanoma with application of dermoscopic algorithms (Herschorn, 2012). PCPs who received training in dermoscopy with a two-hour educational session reported increased comfortability with naked eye examinations as well as practice with dermoscopy in clinical application (Hencley, 2017). PCPs who completed a one-day training improved their diagnostic accuracy of all pigmented skin lesions after the training program, and diagnostic accuracy increased even further, except for nevi after the dermoscopy training (Secker, Buis, Bergman, & Kukutsch, 2016).

By introducing the practice of dermoscopy and the clinical application algorithms to rural PCPs, skin cancer screening barriers can be eliminated. The aim of this practice improvement project was to provide rural PCPs with up-to-date, evidence-based practice surrounding skin



cancer screening. Additionally, the intent was to provide the PCPs with education for clinical application of dermoscopy for increased comfortability and knowledge in identifying suspicious skin lesions with dermoscopy in their clinical practice.

### **Quantitative Results and Interpretation**

The inferences made from this practice improvement project are discussed with some caution due to the convenience sample and size of the sample for this practice improvement project. However, there was 100% response rate from the five PCPs who participated in the practice improvement project.

There are some common themes found from the five participants between the pre- and post-dermoscopy education surveys. With regards to pre-dermoscopy education survey question, “I feel comfortable with the practice of dermoscopy,” 40% of PCPs strongly disagreed, 40% disagreed, and 20% agreed. After the dermoscopy educational session, the post-dermoscopy education survey revealed that 20% strongly disagreed, 60% of the PCPs now agreed, and 20% strongly agreed. Overall, there was a positive shift in increased comfortability with the practice of dermoscopy among the PCPs after receiving the educational session. These findings correlate with the research conducted by Hencley (2017), suggesting that after a two-hour educational seminar, PCPs felt more comfortable with the practice of dermoscopy. Hencley (2017) found that there were still 33.3% of providers who disagreed with the statement indicating they feel comfortable with the practice of dermoscopy.

PCPs also gained a slight increase in their comfortability with naked eye examinations. The pre-dermoscopy education survey revealed that 40% of PCPs answered “disagree,” and did not feel comfortable with naked eye examinations, while 60% of PCPs answered “agree,” and felt comfortable with naked eye examinations. The post-dermoscopy education survey revealed

that 40% of PCPs continued to feel uncomfortable with naked eye examinations, while 60% of PCPs feel comfortable with naked eye examinations, 20% of which strongly agree. When comparing the results, 100% of providers from Hencley (2017) felt comfortable with the naked eye examinations on the post-dermoscopy education survey. However, it is important to note that only three of the seven providers participated in the post-dermoscopy education survey. Multiple studies have shown that a one-day training course with supplemental resources enables clinicians to improve their dermoscopy skills as well as their confidence and diagnosis accuracy (Curiel-Lewandrowski et al. 2012; Hershcorn, 2012; Wu et al., 2015).

The benefits of dermoscopy were well established after the educational session. The pre-dermoscopy education survey responses showed that PCPs generally agreed that dermoscopy would benefit their practice and their patients, with 80%, 40% of which strongly agreed. Of the PCPs, 20% strongly disagreed, and felt that dermoscopy would not benefit their patients or their practice. Following the educational session, the responses found that PCPs 100% agree that dermoscopy would benefit their practice and their patients, 80% of which strongly agree and 20% agree. These results suggest a subjective usefulness of dermoscopy to patient care and to the providers surveyed. The results from this practice improvement project were consistent with the same survey question Hencley (2017) administered at a student health center in North Dakota.

Finally, the data analysis of the PCPs' comfort level of dermoscopy knowledge improved following the educational session. PCPs improved from an 80% novice level pre-dermoscopy education survey to 20% novice level post-dermoscopy education survey. Pre-dermoscopy education survey, 20% of PCPs felt competent with their dermoscopy knowledge level and this was consistent with the post-dermoscopy education survey responses. There were no advanced beginner or proficient responders from the pre-dermoscopy education survey results. Post-

dermoscopy education survey results revealed that 40% of PCPs rated themselves as advanced beginner and 20% rated themselves as proficient in dermoscopy practice. The results correlate with other research noting an improved knowledge level in dermoscopy after a two-hour educational session. In the project conducted by Hencley (2017), providers increased their knowledge level from novice to advanced beginner from pre-dermoscopy education survey to post-dermoscopy education survey respectively. Overall, educational dermoscopy sessions improve provider confidence, increase skin cancer screenings in primary care settings, and aid in accurate diagnosis (Chappuis et al., 2016; Koelink et al., 2014; Kownacki, 2014).

### **Dissemination**

Dissemination of this practice improvement project occurred in multiple stages. During the pre-implementation stage of this project, the information was disseminated through a poster presentation at North Dakota State University (NDSU) for the School of Nursing (SON) and again during the North Dakota Nurse Practitioners' Association (NDNPA) Annual Pharmacology Conference in Bismarck in September 2019. Both dissemination presentations were prior to the educational sessions. The findings of this practice improvement project will be disseminated in the post-implementation period in April 2020 at NDSU SON's poster presentations. Additionally, there are potential future dissemination plans which include submitting a publication of this practice improvement project to the Journal of Nursing Education and participating in educating nurse practitioner graduate students at NDSU with a dermoscopy seminar.

### **Project Limitations and Future Research Recommendations**

The practice improvement project was implemented in two different locations and the design varied slightly for each of these locations. The dermoscopy education session was

implemented face-to-face with Four Seasons Wellness and a dermascope was loaned to the facility for a two-month period. With Essentia Health PCPs, the dermoscopy educational seminar was completed via an Interactive Video Network (IVN) and no dermascopes were available for the providers to use for two-months following the education session. There was a total of five PCPs who participated in the project. The sample size and facilities were chosen due to rural location, willingness of the rural PCPs to participate, connection with the co-investigator to Four Seasons Wellness through a committee member, and connection with the committee chair to NDSU HRSA nurse residency grant with Essentia health systems. Of the sample size, 100% responded to the pre-and post-dermoscopy education survey.

Another potential limitation to the practice improvement project was the lack of clinical application of dermoscopy each provider received over the implementation period. Of the participating providers, only one PCP had the opportunity to utilize a dermascope for a two-month period. The other four PCPs were exclusively educated on the practice of dermoscopy and how to utilize this instrument in practice. Unfortunately, these providers were unable to have the hands-on experience with the dermascope for a two-month implementation period following the same educational session. Regarding the provider who used the dermascope for two months, dermoscopy examination was offered during annual exams, and during exams with skin concerns or complaints. However, there was not a running total kept of the amount of cases the provider used dermoscopy during the two-month trial.

After reflecting on this practice improvement project, changes to the project can be made to improve future research. Future research in dermoscopy could include a larger sample size of providers and the educational session could include hands-on experience with the dermascope for each provider. Another possibility would be to see if 3-D printed skin models with specific

skin lesions could be obtained for use at the education session for skin examination practice. This would allow for each provider to have hands-on practice with the dermascope and provide a “life-like” experience with different examples of skin lesions in a realistic manner. Another option, but costly, would be to allow each provider access to a dermascope for use in their clinic for two- to three-months following the education session. This exposure may increase use and sustainability as the provider would have the opportunity to continue to practice their dermoscopy skills.

### **Implications for Advanced Practice Nursing**

This practice improvement project revealed that dermoscopy can impact current and future advanced nursing practice. Through this practice improvement project, an educational resource surrounding the use of dermoscopy was developed and implemented for rural PCPs in North Dakota and Minnesota, but in the future could provide benefits to rural settings through the entire country. The educational resource surrounded background information about dermoscopy as well as clinical application. No direct data was collected on this objective alone. However, even without collecting direct data related to the educational resource, qualitative data suggests that the information presented during the educational session served as a strong indicator for increasing knowledge and feelings of benefit towards dermoscopy in clinical practice. In the future, implementing dermoscopy and TBSE education into core curriculum for advanced practice registered nurses could provide an opportunity to increase provider comfortability and confidence in identifying suspicious skin lesions in clinical practice.

Research still suggests that providing a one-day educational session with straight-forward algorithms to PCPs on a complex subject, like dermoscopy, leads to increased lesion identification accuracy, provider knowledge and comfortability on the clinical application of

dermoscopy (Curiel-Lewandrowski et al., 2012; Hershcorn, 2012; Hencley, 2017; Kownacki, 2014; Wu et al., 2015). Dermoscopy has the potential to be an essential component to the rural healthcare setting. PCPs have the unique opportunity to eliminate a healthcare barrier with lack of access to dermatologists. Additionally, PCPs could aide their patients in reducing the healthcare burden of extra incurred costs with travel expenses and additional clinic visits to the specialist.

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## APPENDIX A. IRB APPROVAL



September 12, 2019

Dr. Dean Gross  
Nursing

Re: IRB Determination of Exempt Human Subjects Research:  
Protocol #PH20045, "Skin Cancer Screening with the Use of Dermoscopy in Primary Care"

Co-investigator(s) and research team: Gretchen Peters  
Date of Exempt Determination: 9/12/2019 Expiration Date: 9/11/2022  
Study site(s): Four Seasons Wellness Clinic, Steele, ND and Essentia Clinic, Baxter, MN  
Sponsor: n/a

The above referenced human subjects research project has been determined exempt (category # 2(i)) 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 8/30/2019) with pre- and post-tests (received 9/6/2019).

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,

A handwritten signature in purple ink that reads "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/](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](https://www.ndsu.edu/irb)

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

NDSU is an EO/AA university.

## APPENDIX B. PROJECT CONSENT

NDSU North Dakota State University  
School of Nursing  
PO Box 6050  
Fargo, ND 58108-6050  
701.231.7395

Hello,

My name is Gretchen Peters, I have been a practicing RN for 5 years and I'm currently in a doctoral program at NDSU. As part of my doctoral degree requirements, I need to complete a project that improves healthcare for patients. During my years of practice, I have noted that skin examinations and skin cancer screenings are not routinely performed at annual visits with primary care providers. According to the research, skin cancer screenings fall well below levels of other routine cancer screenings. Fortunately, dermoscopy increases skin cancer screening rates and appropriate intervention for the skin lesion. I would appreciate your assistance with this research project surrounding skin cancer screenings with dermoscopy in primary care. This research will help healthcare providers/systems better understand how dermoscopy can improve healthcare outcomes.

All survey responses will be kept confidential. The questionnaire is anonymous and contains no personal identifying items. The survey should take less than 5 minutes to complete. Completion of the survey will constitute your consent to participate in the survey. Participant information will be used to provide education to healthcare providers. In addition, the survey results may be used in a future publication in a healthcare journal. The research project has been reviewed and was approved by the IRB from North Dakota State University on September 12, 2019.

If you have any questions or comments, please feel free to contact: Dean Gross (dean.gross@ndsu.edu or 701-231-8355). If you have questions about the rights of human participants in research, or to report a problem, contact the North Dakota State University IRB Office by telephone at 701.231.8995 or toll-free at 855.800.6717, by e-mail at NDSU.IRB@ndsu.edu.

Thank you for your assistance.

Gretchen Peters, RN, DNP Graduate Student; North Dakota State University

Dean Gross, Ph.D., FNP-BC; North Dakota State University

## APPENDIX C. PERMISSION TO USE AND/OR REPRODUCE THE IOWA MODEL

(1998)

Permission to Use and/or Reproduce the Iowa Model (1998)

Kimberly Jordan - University of Iowa Hospitals and Clinics <noreply@qualtrics-survey.com>

To: Gretchen Peters

March 15, 2019

You have permission, as requested today, to review and/or reproduce *The Iowa Model of Evidence-Based Practice to Promote Quality Care (Revised 1998)*. Click the link below to open.

[The Iowa Model of Evidence-Based Practice to Promote Quality Care \(Revised 1998\)](#)

Copyright is retained by University of Iowa Hospitals and Clinics. **Permission is not granted for placing on the internet.**

**Citation:** Titler, M. G., Kleiber, C., Steelman, V. J., Rakel, B.A., Budreau, G., Everett, L. Q., ...Goode, C. J. (2001). The Iowa model of evidence-based practice to promote quality care. *Critical Care Nursing Clinics of North America*, 13(4), 497-509.

In written material, please add the following statement:

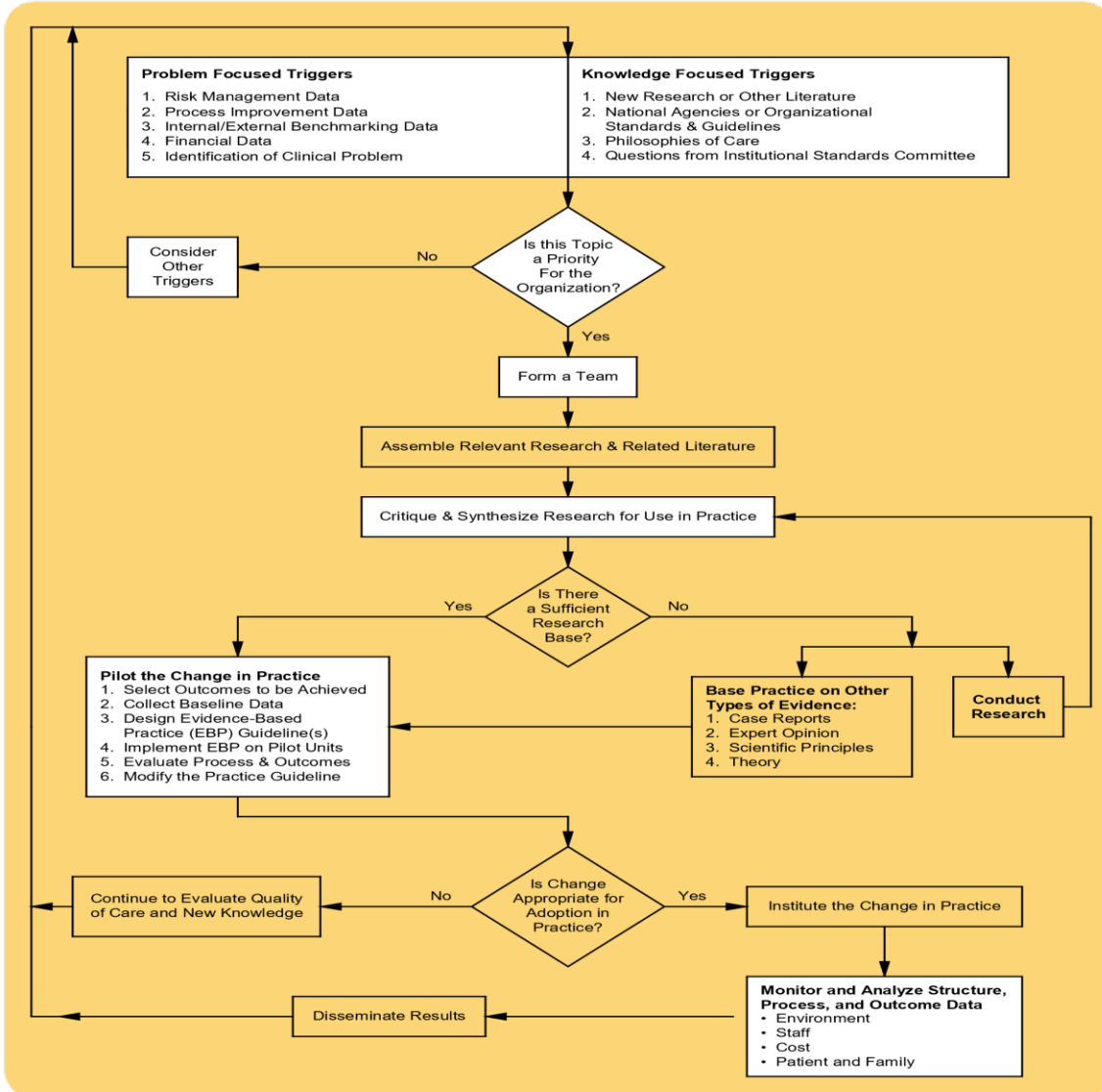
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Please contact UIHCNursingResearchandEBP@uiowa.edu or 319-384-9098 with questions.



## APPENDIX D. THE IOWA MODEL OF EBP

# The Iowa Model of Evidence-Based Practice to Promote Quality Care



◇ = a decision point

Titler, M.G., Kleiber, C., Steelman, V.J., Rakel, B. A., Budreau, G., Everett, L.Q., Buckwalter, K.C., Tripp-Reimer, T., & Goode C. (2001). The Iowa Model Of Evidence-Based Practice to Promote Quality Care. *Critical Care Nursing Clinics of North America*, 13(4), 497-509.

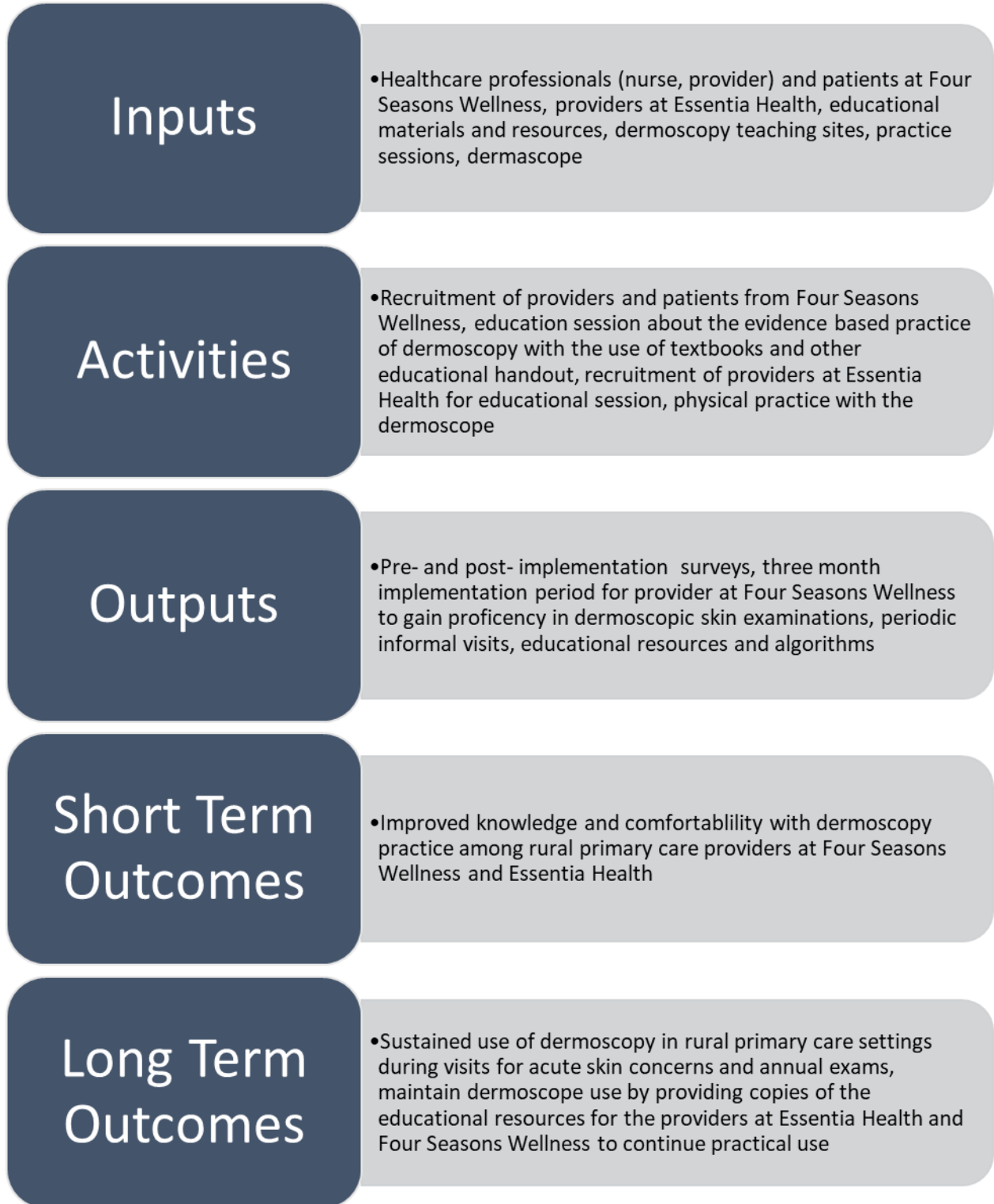
**REQUESTS TO:**  
 Department of Nursing  
 University of Iowa Hospitals and Clinics  
 Iowa City, IA 52242-1009

DO NOT REPRODUCE WITHOUT PERMISSION

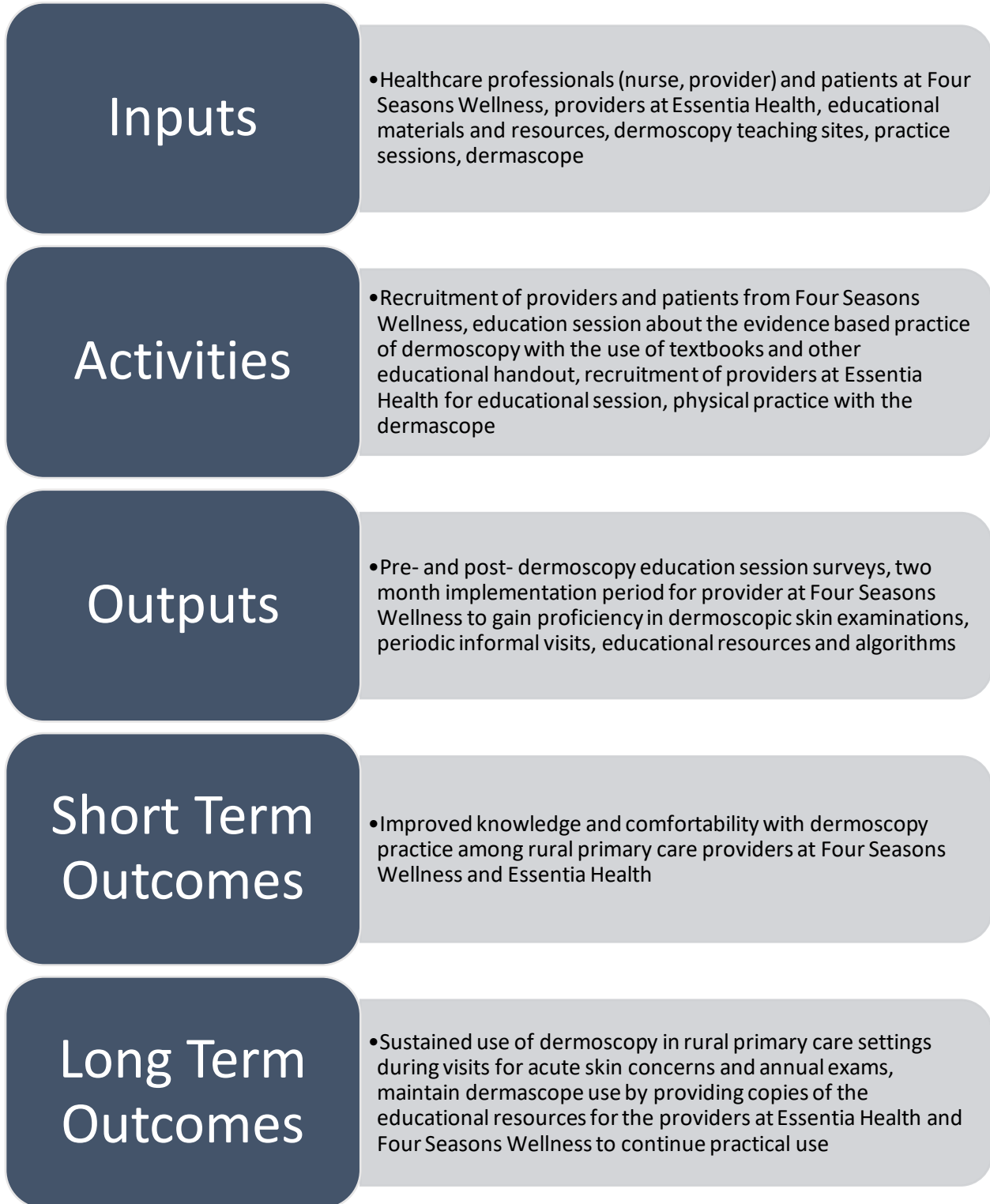
Revised April 1998 © UIHC

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## APPENDIX E. ORIGINAL LOGIC MODEL



## APPENDIX F. REVISED LOGIC MODEL



## **APPENDIX G. PERMISSION TO USE AND/OR REPRODUCE HENCLEY 2017**

### **SURVEYS**

Dissertation

Erin Hencley - <email redacted>

To: Gretchen Peters

March 9, 2019

Hi Gretchen,

My name is Erin Hencley and Dean reached out to me regarding your project - sounds like you're going to do a similar one to mine! He mentioned you'd like to use my survey questions, so I told him I would email you that you have full permission to use those. I'm happy to touch base on any other questions you may have about dermoscopy/my project as well. You can email me back using this address or give me a call and we can chat too! My phone number is <redacted>. I really enjoyed completing this project, so I'm excited someone else is also focusing on the same topic!

Erin Hencley

## APPENDIX H. 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
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*Permission to use/reproduce granted (See APPENDIX G)*

## APPENDIX I. 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
---	---------------	--------------------------	------------------	-------------------	---------------

*Permission to use/reproduce granted (See APPENDIX G)*

**APPENDIX J. APPROVAL FROM FOUR SEASONS WELLNESS FOR PROJECT  
IMPLEMENTATION**



**Four Seasons Wellness**  
**110 W Broadway Ave**  
**PO Box 397**  
**Steele, ND 58482**  
**P: (701) 475-4488 F: (701) 540-6379**

10/16/19

To whom this may concern:

This document is to confirm the willingness of Four Seasons Wellness, and associated staff, to participate in Gretchen Peter's Dissertation: Skin Cancer Screening with the use of Dermoscopy in Primary Care. As a small rural clinic with limited resources, I look forward to the education regarding dermoscopy and incorporating this into my primary care practice.

This document also confirms my willingness to sit on Gretchen Peter's supervisory committee as an outside expert. I am willing to assist with and provide any direction that is needed to help ensure that Gretchen's dissertation is the best possible.

Sincerely,

*Mandy Rath, FNPc*  
Mandy Rath, FNPc

## **APPENDIX K. LIST OF OUTSIDE RESOURCES**

### **ABCD Rule of Dermoscopy**

This item is available at:

Marghoob, A. A. & Jaimes, N. (2018). Dermoscopic evaluation of skin lesions. Retrieved from [https://www.uptodate.com/contents/image?imageKey=DERM%2F57741&topicKey=DERM%2F13522&search=overview%20of%20dermoscopy&rank=2~150&source=see\\_link&sp=0](https://www.uptodate.com/contents/image?imageKey=DERM%2F57741&topicKey=DERM%2F13522&search=overview%20of%20dermoscopy&rank=2~150&source=see_link&sp=0)

### **Pattern Analysis**

This item is available at:

Marghoob, A. A. & Jaimes, N. (2018). Dermoscopic evaluation of skin lesions. Retrieved from [https://www.uptodate.com/contents/image?imageKey=DERM%2F78774&topicKey=DERM%2F13522&source=see\\_link&sp=0&search=pattern%20analysis](https://www.uptodate.com/contents/image?imageKey=DERM%2F78774&topicKey=DERM%2F13522&source=see_link&sp=0&search=pattern%20analysis)

### **Three-point Checklist**

This item available at:

Jaimes, N. & Marghoob, A. A. (2019). Dermoscopic algorithms for skin cancer triage. Retrieved from [https://www.uptodate.com/contents/image?imageKey=DERM%2F68025&topicKey=DERM%2F100084&source=see\\_link&sp=0&search=three%20point%20checklist](https://www.uptodate.com/contents/image?imageKey=DERM%2F68025&topicKey=DERM%2F100084&source=see_link&sp=0&search=three%20point%20checklist)

### **Seven-point Checklist**

This item available at:

Marghoob, A. A. & Jaimes, N. (2018). Dermoscopic evaluation of skin lesions. Retrieved from [https://www.uptodate.com/contents/image?imageKey=DERM%2F60378&source=history\\_widget](https://www.uptodate.com/contents/image?imageKey=DERM%2F60378&source=history_widget)



## **Menzies Method**

This item available at:

Marghoob, A. A. & Jaimes, N. (2018). Dermoscopic evaluation of skin lesions. Retrieved from [https://www.uptodate.com/contents/image?imageKey=DERM%2F66385&source=history\\_widget](https://www.uptodate.com/contents/image?imageKey=DERM%2F66385&source=history_widget)

## **APPENDIX L. EXECUTIVE SUMMARY**

According to the American Cancer Society (ACS) (2018), skin cancer is the most common type of cancer in the United States. Though rare, melanoma is the skin cancer linked with the highest mortality rate (The Skin Cancer Foundation, 2019). However, skin cancer screenings fall well below levels of other routine cancer screenings and over half of patients who were referred to a dermatologist for a suspicious lesion were eventually diagnosed with skin cancer in a location other than the referral site (Bruner & Schaffer, 2012; Kownacki, 2014).

Compared to naked eye examinations, dermoscopy has led to earlier detection of melanoma and other cancerous skin lesions like squamous cell carcinoma and basal cell carcinoma (Marghoob & Jaimes, 2019). Hencley (2017) found that comfortability, knowledge, and usefulness of dermoscopy increased after implementing a two-hour dermoscopy training and practice seminar. A two-hour dermoscopy educational seminar and resource was replicated for rural primary care providers (PCPs) in North Dakota and western Minnesota.

### **Background**

Studies suggest that routine skin cancer screenings are much lower than other routine cancer screenings. In fact, screenings are only documented about 8%-21% of the time at annual examinations (Curiel-Lewandrowski et al., 2012). Research has attributed several reasons to low documented skin examinations and decreased skin cancer screening rates. Barriers to full body skin examination include lack of time at office visits, preoccupation with competing co-morbidities, and a lack of expertise in lesion identification. Providers feel there is a lack of training and exposure to skin examination, causing a decreased confidence in diagnosing suspicious lesions (Curiel-Lewandrowski et al., 2012; Hershcorn, 2012; Shellenberger et al., 2018). Research suggests that providing a one-day educational session with straight-forward

algorithms to PCPs on a complex subject, like dermoscopy, leads to increased lesion identification accuracy, provider knowledge and comfortability on the clinical application of dermoscopy (Curiel-Lewandrowski et al., 2012; Hershcorn, 2012; Hencley, 2017; Kownacki, 2014; Wu et al., 2015).

### **Process**

Data was collected by evaluating the provider responses using Likert scale questions on pre- and post-dermoscopy education surveys. The survey questions addressed the providers' thoughts on the practicability of dermoscopy, comfortability with dermoscopy, personal knowledge before and after the implementation of the project, and implications for future use (Hencley, 2017). The surveys were administered electronically using Qualtrics. Using the Qualtrics features to analyze and report on final data points, the data analysis was performed at the end of the project

### **Findings and Conclusion**

There were common themes found from the five participants between the pre- and post-dermoscopy education seminar surveys. With regards to the pre-dermoscopy education survey question, "I feel comfortable with the practice of dermoscopy," there was an overall positive shift in increased comfortability with the practice of dermoscopy among the PCPs after the educational session.

PCPs also gained an increased comfortability with naked eye examinations. The pre-dermoscopy education survey revealed that 40% of PCPs answered "disagree," and did not feel comfortable with naked eye examinations, while 60% of PCPs answered "agree," and felt comfortable with naked eye examinations. The post-dermoscopy education survey revealed that

40% of PCPs continued to feel uncomfortable with naked eye examinations, while 60% of PCPs feel comfortable with naked eye examinations, 20% of which strongly agree.

Additionally, the benefits of dermoscopy were well established after the educational session. Following the educational session, the survey responses suggested that PCPs 100% agree that dermoscopy would benefit their practice and their patients, 80% of which strongly agree and 20% agree.

Finally, the data analysis of the PCPs' comfort level of dermoscopy knowledge improved following the educational session. PCPs improved from an 80% novice level pre-dermoscopy education survey to 20% novice level post-dermoscopy education survey. Pre-dermoscopy education survey, 20% of PCPs felt competent with their dermoscopy knowledge level and this was consistent with the post-dermoscopy education survey responses. There were no advanced beginner or proficient responders from the pre-dermoscopy education survey results. Post-dermoscopy education survey results revealed that 40% of PCPs rated themselves as advanced beginner and 20% rated themselves as proficient in dermoscopy practice.

### **Recommendations**

Dermoscopy has the potential to be an essential component to the rural healthcare setting. Research continues to suggest that providing a one-day educational session with straight-forward algorithms to PCPs on a complex subject, like dermoscopy, leads to increased lesion identification accuracy, provider knowledge and comfortability on the clinical application of dermoscopy (Curiel-Lewandrowski et al., 2012; Hershcorn, 2012; Hencley, 2017; Kownacki, 2014; Wu et al., 2015). In the future, implementing dermoscopy and TBSE education into core curriculum for advanced practice registered nurses could increase provider comfortability and confidence in identifying suspicious skin lesions in their clinical practice. PCPs have the unique

opportunity to eliminate the access barrier to dermatologists. Additionally, PCPs could reduce healthcare burdens of extra incurred costs with travel expenses and additional clinic visits to the specialist.