THE FEASIBILITY OF USING A THEORY-BASED, ONLINE DELIVERY MICROLEARNING SYSTEM TO EDUCATE NURSE PRACTITIONERS ABOUT CLINICAL SKIN EXAMINATION FOR MELANOMA

by

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As members of the Dissertation Committee, we certify that we have read the dissertation prepared by *Delaney Baker Stratton*, titled *The Feasibility of Using a Theory-Based, Online Delivery Microlearning System to Educate Nurse Practitioners About Clinical Skin Examination for Melanoma* and recommend that it be accepted as fulfilling the dissertation requirement for the Degree of Doctor of Philosophy.

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DEDICATION

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ABSTRACT

Background: The incidence of malignant melanoma (MM) has doubled in the United States over the past 20 years. Early diagnosis and favorable prognosis rely on patients' accessibility to healthcare providers for clinical skin examination (CSE). Primary care nurse practitioners (PCNPs) can play a vital role in skin cancer early detection but are underprepared with the knowledge and skills to perform this function.

Conceptual Framework: This study is guided by the information, motivation and behavior skills (IMB) model, which highlights the concepts of *information, motivation,* and *behavioral skills* that promote behavior change. The study also uses microlearning as a framework to deliver CSE education. Microlearning is the use of short-term, informal learning activities using small, but self-explanatory learning resources.

Purpose: The purpose was to explore the feasibility of delivering and developing an evidence-based intervention to educate PCNPs about comprehensive CSE for MM**.** Aim 1 was to develop three evidence-based, brief skin cancer videos with content on comprehensive CSE skills (risk assessment, head-to-toe skin examination, skin lesion assessment) that are suitable for online, theory-based delivery to PNCPs in various formats. Aim 2 was to determine enrollment and retention rates, intervention adherence, and acceptability and usability of the intervention following completion of the one-week intervention. The exploratory aim was to explore preliminary associations among *information, motivation* and *behavior skills* for CSE behavior (practice).

Methods: An expert panel of three dermatologists assessed content validity for the videos and the microlearning approach. For Aim 2, 10 PCNPs were recruited from a state NP conference.

Feasibility measures included: enrollment and retention rates, and intervention adherence, usability (Brooke's System Usability Scale) and acceptability (Attitudes Towards Web-based Continuing Learning Survey). For the exploratory aim, the associations among the IMB constructs were assessed using an adapted survey.

Findings: Three short videos with content on comprehensive CSE for MM were developed. The enrollment rate was 35%, the retention rate was 83% and the intervention adherence was at least 50%. The mean average for usability was better (M = 85.8, SD = 10.6) with a range of scores from 72.5 (better) and 100 (superior). The mean for each of the acceptability constructs all ranged between "somewhat agree" and "mostly agree." The mean score for the IMB constructs included: information (M = 91%, SD = 14%), behavior skills (ranking) (M = 60%, SD = 49%), behavior skills (survey) (M = 4.27, SD = .27, α = .72), and motivation (M = 3.18, SD = .62, α = .60). The average number of CSEs performed the week after the intervention was 11 (SD = 9) with a range of 1 to 26. Actual CSE practice had the strongest association with behavior skills (survey) (r = -.33); actual CSE practice shared 11% of the variation in exam scores (R^2 = .11).

Conclusion: Findings from this feasibility study provide a foundation for the use of the microlearning as a method for delivering brief CSE training to PCNPs. The findings also provide support for using the intervention in a future pilot randomized trial.

CHAPTER 1: INTRODUCTION

This research focused on building the science in an understudied area: interventions for primary care nurse practitioners (PCNPs) to improve their clinical skin examination (CSE) skills for the most serious skin cancer, melanoma (MM). CSE is comprised of MM risk assessment, head-to-toe skin examination, and pigmented lesion assessment. The objective of Chapter One is to provide general insight on skin cancer and MM, the state of the science on the training of nurse practitioners (NPs), and the status of NP skin cancer training. Described in this chapter is a summary of the study background, as well as the significance of the study, the study purpose and the conceptual frameworks that guide the research.

Background

In 2014, the Surgeon General's Call to Action identified skin cancer as a major public health problem (U.S. Department of Health Services, 2014). The incidence of malignant melanoma (MM), the deadliest skin cancer, has doubled in the United States over the past 20 years (Guy et al., 2015). Approximately 96,480 new cases of MM will be diagnosed in 2019 and MM will cause 7,320 deaths (Siegel, Miller, & Jemal, 2019). Since 1992, the MM incidence rate in the U.S. has increased by 1.8% to 4.6% every year (Lazovich, Choi, & Vogel, 2012). In some states, MM also may be underreported (Harris et al., 2015).

MM risk is dependent on both genetic (endogenous) and environmental (exogenous) factors. Endogenous risk factors include phenotype (skin color, eye color and propensity for skin to sunburn), personal and family history of MM and number of common and atypical nevi (Fagundo et al., 2011; Gandini, Sera, Cattaruzza, Pasquini, Abeni, et al., 2005; Gandini, Sera, Cattaruzza, Pasquini, Zanetti, et al., 2005). MM often (but not always) arises from a pigmented

lesion (Cabrera & Recule, 2018). Approximately 10% of cutaneous MM occur in the familial setting when two or more close relatives are diagnosed (Gandini, Sera, Cattaruzza, Pasquini, Zanetti, et al., 2005). Phenotypes that are susceptible to UVR include fair skin, freckles, light colored eyes and hair, and inability to tan (Gordon, 2013). Exogenous risk factors include history of sunburn and inadequate sun protection behaviors, both of which are related to ultraviolet radiation (UVR) exposure (Fagundo et al., 2011; Gandini, Sera, Cattaruzza, Pasquini, Picconi, et al., 2005). UVR produces DNA damage, gene mutations, oxidative stress, immunosuppression and inflammatory responses—all of which contribute to skin cancer etiology. Approximately 40% of individuals in the U.S. report a sunburn each year, indicating that most are not adequately protecting their skin from UVR (Holman, Berkowitz, Guy, Hartman, & Perna, 2014).

Both primary and secondary prevention are highly cost-effective and cost-saving (Gordon & Rowell, 2015). Secondary prevention, such as early skin cancer screening and detection, improves MM prognoses because it leads to a greater proportion of removal of thin MM (Bartlett & Karakousis, 2015; Glazer, Rigel, Winkelmann, & Farberg, 2017). Thin MMs are less 2 mm in thickness and are associated with better prognoses (Gershenwald et al., 2017). CSE is the only screening test for MM and only 24% of high risk MM patients have had one CSE in their lifetime (Harris, Salasche, & Harris, 2001; Lakhani, Saraiya, Thompson, King, & Guy Jr, 2014). For patients diagnosed with MM, recurrences often occur during the first five years of diagnosis; and guidelines recommend follow-up intervals ranging from 3 to 12 months (Trotter, Sroa, Winkelmann, Olencki, & Bechtel, 2013).

CSE reduces the incidence of thick MM and repeat skin examinations are associated with increased diagnostic effectiveness and better prognosis (Aitken, Elwood, Baade, Youl, &

English, 2010; Berndt et al., 2012; DiFronzo, Wanek, & Morton, 2001). CSE requires training, and dermatologists conduct the most CSEs. However, the U.S. has an average of just 3.6 dermatologists per 100,000 people (Slade, Lazenby, & Grant-Kels, 2012; Uhlenhake, Brodell, & Mostow, 2009). This ongoing shortage has not changed in the last 30 years, regardless of the increasing incidence of skin cancer (Aquino, Wen, & Wu, 2015; Kimball & Resneck, 2008; Resneck & Kimball, 2004). Compounding the dearth of dermatologists, the approximate wait time for a dermatology appointment is 36 days. Many skin cancers evolve from changing pigmented lesions; patients who report these changes wait for approximately 38.9 days for a dermatology appointment (Slade et al., 2012). On the other hand, practices who employ NPs or physician assistants, have an average wait time of 33.9 days to be seen (Slade et al., 2012).

Problem

The overarching problem addressed in this dissertation is the under-preparation of NPs to conduct CSE. NPs are advanced practice registered nurses (APRNs). APRNs are a subset of nurses prepared with advanced, graduate-level nursing knowledge who provide direct patient care in one of the following roles: certified nurse-midwife, certified registered nurse anesthetist, clinical nurse specialist, and NPs. The NP role was created in the 1960s, in response to the increased demand for primary care (particularly in rural and inner-city settings); NP employment is expected to increase 35.5% over the next decade (Kurtzman & Barnow, 2017). NPs practice autonomously across areas such as family practice, pediatrics, internal medicine, women's health care, and geriatrics. They provide care across the wellness-illness continuum and provide initial, ongoing and comprehensive care. NPs also promote disease prevention, health promotion, health education and counseling along with the diagnosis and management of acute and chronic illness.

NPs are prepared to practice as PCNPs and acute care NPs, which both have separate national consensus-based competencies and separate certification processes (National Council of State Boards of Nursing, 2008). Thus, the NP role encompasses CSE, but CSE training for NPs is limited.

NPs play a vital part in skin cancer early detection, but they are neither confident nor adequately prepared to perform CSE or lesion identification (Loescher, Harris, & Curiel-Lewandrowski, 2011; Loescher, Stratton, Slebodnik, & Goodman, 2018). Limited NPs (20% to 30%) reported completing CSE during annual visits (Blake & Malone, 2014). Only 16% of NPs believe they are prepared for dermatology practice following graduation from their NP program (Shelby, 2014). In a cross-sectional study of 91 NPs, 1% considered their knowledge as "expert," and 43% believed that their knowledge was "basic" or "minimal" (Blake & Malone, 2014). Eighty-one percent of participants had no skin cancer training within the past year, and 41% of participants had only "mild" to "no" confidence in their ability to conduct skin assessments (Blake & Malone, 2014). According to Roebuck and colleagues, 24.6% of NPs cited "inadequate skills" as a barrier to implementing a skin assessment (2015). PCNPs have demonstrated low ability to determine benign from malignant lesions (Loescher et al., 2011; Loescher et al., 2018); regardless of the diagnoses, a majority of PCNPs would refer to a specialist (Shelby, 2014). However, NPs believe that primary care providers (PCPs) play a role in the early detection of skin cancer (Blake & Malone, 2014).

According to a recent systematic review of APRNs' skin cancer knowledge and attitudes, skin examination and skin cancer detection and prevention education and training, Loescher and colleagues (2018) concluded that NP skin cancer knowledge varies, but is less than optimal (<

80% correct knowledge scores) even after an educational intervention. They also concluded that evidence for skin cancer detection and prevention activities remains low. The majority of recent NP educational interventions have small sample sizes (e.g., ranging from 1 to 30) (Ali, Samarasinghe, Russell, & Lear, 2014; Armstrong, 2011; DeKoninck & Christenbery, 2015; Wray, Brant, Hussain, & Muller, 2013), are lengthy (e.g., 14 weeks to 6 months) (Ali et al., 2014), or do not describe the NP's dermatological training (Ali et al., 2014; Armstrong, 2011; DeKoninck & Christenbery, 2015; Wray et al., 2013). Fewer interventions had modules lasting under an hour (15-45 minutes) or were self-directed (reviewing pamphlets, posters, and two presentations) (Bradley, 2012; Chen, Woyansky, & Zundell, 2015a; Hartnett & O'Keefe, 2016).

NPs desire more training and resources; however, there are few established skin cancer training opportunities available for NPs. According to Blake and Malone (2014), 81% of their participants had no training for client-focused skin cancer prevention or early detection within the past year. Dermatology training in academic NP programs only offers three to eight hours of didactic units that relate to dermatology (Shelby, 2014). There is only one recognized NP skin cancer program in the U.S: a post-masters, non-degree fellowship at the Lahey Clinic in Burlington, Massachusetts. Certificates offered by professional organizations such as the Dermatology Nurses Association's Dermatology Certified Nurse Practitioner program and the National Academy of Dermatology Nurse Practitioner's postgraduate certification program.

NPs find skin cancer training to be relevant and are likely to refer peers to a skin cancer educational intervention (Bradley, 2012; Hartnett & O'Keefe, 2016). According to Roebuck et al. (2015), NPs want additional learning activities related to MM. The content of importance to NPs includes the ABCDE rule for pigmented skin lesion assessment (**A**symmetry, **B**order, **C**olor,

Diameter, **E**volution) and AWARE (**A**void, **W**ear sun protective clothing, **A**pply sunscreen, **R**outinely check for skin cancers, **E**ducate others), resources to find free community skin cancer screenings, and the Food and Drug Administration (FDA) sunscreen recommendations (Roebuck et al., 2015; U.S. Food and Drug Administration, 2017). Another important method to assess pigmented skin lesions is the "ugly duckling" sign. The "ugly duckling" sign is when the appearance of a pigmented lesion is vastly different from other moles (Scope et al., 2008).

The format for learning is also important to NPs. NPs stated that continuing education credits are important when deciding to participate in training (Roebuck et al., 2015). NPs prefer to learn via pocket reference guides (52.2%), online learning activities (46.3%) and chapter meeting presentations (44.5%), as compared to poster presentations (4.8%), self-study cases (18%) and brochures (20.2%) (Roebuck et al., 2015). Health education materials are often traditional teaching resources, such as PDF documents and slides, that are reorganized to be easily accessible on the internet (Bricon-Souf, Leroy, & Renard, 2010). However, the disadvantage of this approach is that learners prefer to have access to multiple sources of information (such as video), rather than just PDFs or slides (McVeigh, 2009). Compared to standard online curricula, microlearning videos only require a few minutes, which is valuable in a healthcare provider's hectic schedule. Therefore, the delivery of the intervention for this dissertation study was guided by microlearning: an innovative learning strategy to deliver information quickly to participants over short periods.

In summary, CSE training is appropriate for the NP role, and NPs are amenable to improving their CSE knowledge and skills. However, CSE training available to NPs is limited,

inconsistently described, and is often in a format that is not conducive to busy practitioners. This dissertation study sought to fill these gaps to promote CSE by NPs.

Purpose Statement

The purpose of this dissertation study was to explore the feasibility of developing an evidence-based intervention to educate PCNPs about CSE for MM and delivering it using a theory-based, microlearning system**.** CSE was defined as a MM risk assessment, systematic head-to-toe skin examination, and pigmented lesion assessment. The specific aims of the study were to:

Aim 1

Develop, over three months, three theory-based, brief skin cancer videos with content on CSE for MM that were suitable for electronic delivery to PNCPs in various formats (e.g., mobile phone, tablet, and computer).

Aim 1a. Assess the content validity of the intervention content using an established method and expert panel of three dermatologists.

Aim 1b. Assess the integration of the videos and surveys into Research Electronic Data Capture (REDCap) by conducting an evaluation with the expert panel using Brooke's System Usability Scale (SUS).

Aim 1c. Assess the digital delivery of the videos using Beaudin's Quality Evaluation of Video (QEV).

Aim 2

Determine enrollment and retention rates, intervention adherence, and acceptability and usability of the intervention following completion of the one-week intervention delivered to PCNPs.

Hypothesis 2.1. Enrollment rates will be equal to or better than 60%. Enrollment rates for Internet-based interventions vary between 0.03% and 15% (Horvath et al., 2011; Micheel et al., 2017; Stopponi et al., 2009); however, in-person recruitment yields higher recruitment. For example, an eight-week feasibility study using in-person enrollment, 23 women were screened, and 14 were enrolled (60%) (Cohen et al., 2007).

Hypothesis 2.2. Retention rates will be greater than 50%, based on retention rates reported in a literature review that averaged a retention rate of 53% (with the length of interventions ranging from 2 weeks to 12 months) (Kelders, Kok, Ossebaard, & Van Gemert-Pijnen, 2012).

Hypothesis 2.3. Intervention adherence will be greater than or equal to 50%, based on intervention adherence rates reported in a literature review that that averaged a range of 50% adherence (Kelders et al., 2012).

Hypothesis 2.4. Usability scores will be equal to or higher than 70, based on an empirical evaluation of ten years of SUS data (Bangor, Kortum, & Miller, 2008).

Hypothesis 2.5. Acceptability scores will be equal to or higher than 5, based on Liang et al.'s study on nurse's internet self-efficacy and attitudes toward web-based, continuing learning (2011).

Exploratory Aim

To explore preliminary associations among information, motivation, behavioral skills, and CSE behavior (practice).

Significance to Nursing and Health Care

Skin cancer educational interventions that have been delivered to nurses or NPs were conducted primarily as in-person modules that had either small sample sizes (n=1) and were lengthy (14 weeks – 6 months) (Ali et al., 2014; Armstrong, 2011) or had varying sample sizes (n=6-34) with training modules lasting under an hour or completed at the participant's own pace (Bradley, 2012; Chen, Woyansky, & Zundell, 2015b; Hartnett & O'Keefe, 2016). Some educational interventions were not described (Bradley, 2012; DeKoninck & Christenbery, 2015; Wray et al., 2013). Of particular concern, NPs who participated in these interventions had variable, sub-optimal skin cancer knowledge, even after an intervention (Loescher et al., 2018). There is also a dearth of research on NPs and motivation to conduct CSE. The intervention developed for this dissertation study addressed these gaps by creating a rigorously developed yet brief intervention to teach PCNPs about CSE.

This dissertation study addressed the feasibility of using a microlearning framework, a brief learning approach, to teach PCNPs about CSE. There is very little research on microlearning and no research on microlearning and NPs. Microlearning, otherwise known as "bite-size" learning, is a new teaching and learning perspective that emphasizes the "minute" (Hug & Friesen, 2007). It is defined as "special moments or episodes of learning while dealing with specific tasks or content and engaging in small but conscious steps" (Hug & Friesen, 2007, p. 18). Research findings document that the use of short content may increase information

retention by 20% (Giurgiu, 2017). Microlearning may prove to be another beneficial educational framework for NPs that allows for the dissemination of short, meaningful knowledge. The manuscript entitled, “Microlearning: a framework for skills training in the technology era” in Appendix A, contains more information on microlearning. In this manuscript, the dissertation author synthesized the current literature on microlearning and discussed its significance to Nursing.

This dissertation study also integrated REDCap and Vimeo video as a unique method of digital delivery. REDCap engages potential respondents using a variety of notification methods through both an internet and mobile platform while maintaining HIPAA-compliant data security (Harris et al., 2009). REDCap continues to be a widely used data collection service; however, it has grown in functionality and can deliver digital, mobile interventions. Vimeo is another software program that is under-described in published research. Vimeo is a platform used to develop and disseminate videos to users. Vimeo provides video storage and management, post-production and collaboration features, and high-quality streaming ("Vimeo," 2018). REDCap provides seamless integration of Vimeo videos as an external link, providing sound rationale for intervention delivery to PCNPs.

This dissertation study will add to the current state of the science of CSE. The U.S. Preventative Services Task Force (USPSTF) indicated that there was limited evidence on the ability of PCPs to screen for skin cancer (Wolff, Tai, & Miller, 2009). The USPSTF also found that no professional organizations provide specific recommendations on a clinical, visual skin examination (Bibbins-Domingo et al., 2016). There is no guidance on CSE from the American College of Physicians or the American College of Preventative Medicine. The American

Academy of Family Physicians deems that evidence for CSE is insufficient. The American Academy of Dermatology (AAD) only offers education and resources on CSE, rather than formal guidelines for implementation. The American Cancer Society recommends skin examination during a general cancer-related checkup but offers no formal guidelines. Thus, this dissertation study addressed this gap by offering a framework to guide CSE for skin cancer.

Definitions of Key Terms

Definitions for key terms in this study are based on synthesis from the literature.

CSE

CSE is comprised of MM risk assessment, a systematic, head-to-toe whole body skin examination, and pigmented lesion assessment:

a. MM risk assessment: evaluation of a patient's past medical history, family history, phenotype and UVR exposure to determine susceptibility to skin cancer (American Academy of Dermatology [AAD], 2018)
b. Head-to-toe skin examination: a systematic approach to the skin examination that begins with the head and neck and moves to the arms, chest, abdomen, back, legs, buttocks, and feet. This includes harder to see areas, such as the scalp, ears, postauricular folds, back of neck, fingernails, palms, underarms, groin, in between toes and toenails and heels (AAD, 2018)
c. Pigmented lesion assessment: ability to find and differentiate between a pigmented non-suspicious skin lesion and a pigmented suspicious lesion. This differs from lesion diagnosis, which is the distinct pathological characterization of a lesion in a precise term (e.g. MM, atypical nevi, seborrheic keratoses etc.)

Acceptability

Acceptability is the willingness to use the technology. Determinants of acceptance include the following:

a. Perceived usefulness: user's subjective probability that using the technology will increase his/her job performance within an organizational context (Davis, Bagozzi, & Warshaw, 1989)
b. Perceived ease of use: degree to which the user expects the system to be free of effort (Davis et al., 1989)
c. Behavior: degree to which the users perceive actual practice and willingness to use the technology (Liang, Wu, & Tsai, 2011)
d. Affection: the degree to which users state how they feel and their positive feelings about the technology (Liang et al., 2011)

Usability

Usability is the appropriateness to a purpose of any particular artifact, defined within the context in which it is used (Brook, 1996). It has the following determinants:

a. Effectiveness: user ability to complete tasks using the technology and the quality of task output (Brooke, 1996)
b. Efficiency: amount of resources used when performing tasks (Brooke, 1996)
c. Satisfaction: user's subjective reactions to using the system (Brooke, 1996)

Microlearning

Microlearning is short-term, informal learning activities using small, but self-explanatory learning resources (Göschlberger, 2017)

REDCap (Research Electronic Data Capture)

REDCap is a secure workflow methodology and software application designed for the development and deployment of electronic data capture tools to assist with clinical and translational research (Harris et al., 2009).

Vimeo

Vimeo is an online platform and community developed to create and share videos ("Vimeo," 2018).

Theory-Based, Online Delivery of Microlearning System

An interconnected network of REDCap and Vimeo as the platform to deliver microlearning.

Conceptual Framework

This section addresses the conceptual framework of the study, including the background, constructs, relationships, and operational definitions.

Behavior-change models, such as the information-motivational-behavioral skills (IMB) model, define determinants of behavior that are amendable to change and lead to behavioral intervention and actual behavior (Chang, Choi, Kim, & Song, 2014). In 1992, Fisher and Fisher created the IMB model to explain HIV-related behaviors. In subsequent research, the IMB model has demonstrated applicability and effectiveness for using and testing interventions to promote behavioral changes that emphasize risk prevention and self-care behaviors (Chang et al., 2014). The IMB model is effective for guiding changes in HIV-related preventive behavior (Fisher, Fisher, Williams, & Malloy, 1994; Fisher, Fisher, & Harman, 2003), breast self-examination behavior (Champion, 1990; Misovich, Martinez, Fisher, Bryan, & Catapano, 2003), smoking

cessation (Shell, Newman, Perry, & Folsom, 2011) and motorcycle safety (Murray, 2000). The IMB model has been used to predict healthcare provider behaviors, such as nurses' support of breast feeding mothers (Bernaix, 2000), nurses' accuracy taking blood pressure (Nelson, Cook, & Ingram, 2014), pharmacists' adjustment of medications (Amin & Chewning, 2015) and primary care providers' (PCPs) prescription of pre-exposure prophylaxis (Walsh & Petroll, 2017).

Fisher et al. (2003) reviewed experimental, health promotion intervention research across several health behavior domains; they determined that when all three IMB constructs (*information, motivation* and *behavioral skills*) were present in an intervention, the average intensity of its effect on behavior change was significantly greater (1.80) than when all three were not present (1.13; $t = -2.39$, $df = 27.50$, $p = 0.027$).

The constructs of the IMB model are illustrated in Figure 1. *Information* is an initial prerequisite for engaging in a behavior (Misovich et al., 2003). It is the basic knowledge concerning the targeted health behavior (Fisher & Fisher, 1992) and includes myths or heuristics that permit cognitively effortless—but often incorrect—decisions on whether to engage in behavior (Fisher et al., 2003). *Motivation* refers to the personal attitudes towards the targeted health behavior (personal motivation) and perceived normative support for this behavior (social motivation) (Fisher & Fisher, 1992; Fisher et al., 2003). Motivation determines whether even well-informed individuals will be inclined to undergo behavior change (Fisher et al., 2003). The construct of *behavioral skills* focuses on individuals' objective abilities along with their sense of self-efficacy with the performance of the health behavior (Fisher et al., 2003; Rye, 1998).

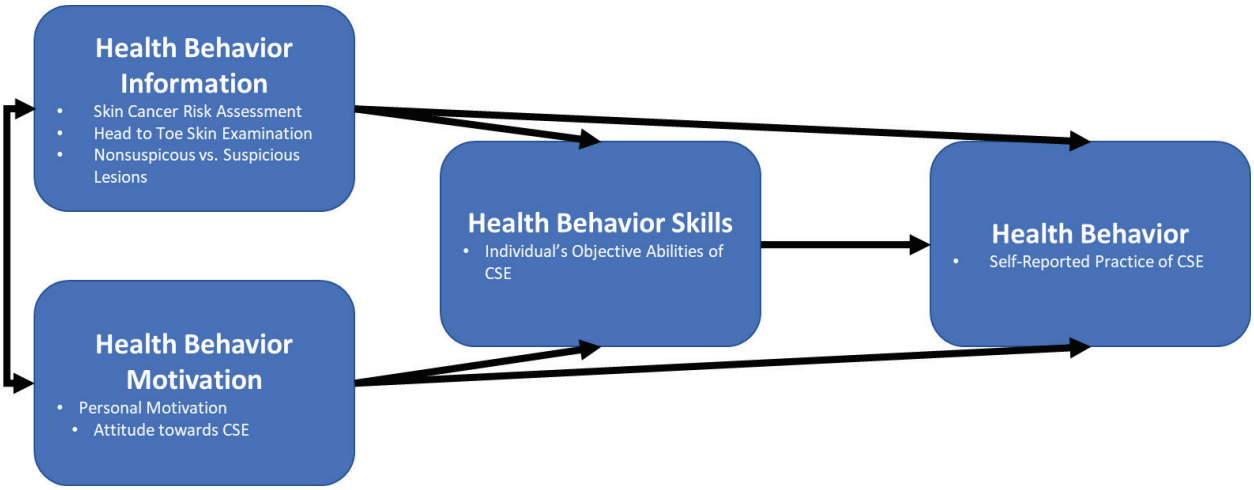

FIGURE 1. Information motivation behavior model.

The presence of both *information* and *motivation* increase the likelihood that a person will use *behavioral skills*, which will lead to desired health behavior (Fisher & Fisher, 1992; Fisher et al., 2003). Therefore, *information* and *motivation* have a direct, unidirectional relationship with *health behavior skills* and *health behavior*. There is a bidirectional relationship between *information* and *motivation* (Fisher & Fisher, 1992). *Information* and *motivation* only have a direct relationship with *health behavior* when complicated or novel *health behaviors skills* are not required to enact the *health behavior* in question (Fisher & Fisher, 1992; Fisher et al., 2003). This relationship explains instances where high levels of *motivation* or acquiring *information* positively impact *health behavior*.

For the purpose of this research, the principal investigator (PI) addressed the association among the constructs to further assess feasibility of using the IMB model in future, larger studies.

The constructs defined above were operationalized in this dissertation study. *Information* consisted of instruction for CSE: MM risk assessment, head-to-toe whole-body skin examination

and pigmented lesion assessment (Chang et al., 2014); PCNPs' knowledge of these components was measured. *Motivation* was PCNPs' personal attitudes towards the CSE (Chang et al., 2014). *Behavioral skills* were the PCNPs' ability to implement CSE. *Health behavior* was self-reported practice of CSE (Chang et al., 2014).

Background on CSE Interventions

Prior to developing the intervention for this dissertation study, it was necessary to determine whether there were previous CSE interventions that could be used or adapted. The PI conducted a systematic review to evaluate current interventions targeting CSE education for PCPs, including NPs. The manuscript, entitled, "Educational interventions for primary care providers to improve clinical skin examination for skin cancer" is in Appendix B. This manuscript contains the full details of the systematic review, including search strategy, data extraction methods, data synthesis, results, discussion of findings, conclusions, and recommendations for future research. For this systematic review, the PI completed the review of literature and outlined the systematic review protocol. She worked with one dissertation committee member to achieve consensus for the articles included in the systematic review. The PI wrote the manuscript, which has been accepted by the Journal of the American Association of Nurse Practitioners and is in press.

The systematic review uncovered a variety of deficiencies in the reported CSE education interventions. There is a dearth of literature on CSE and PCPs and sample demographics were missing for most of the studies. The PI evaluated the interventions using Sidani and Braden's clarifying elements (Sidani & Braden, 2011a). Most of the articles did not clarify the intervention elements of active ingredients, frequency and duration, and the specific objectives of the didactic

portions of the interventions. None of the articles discussed how PCPs should conduct CSE or how they should be taught about CSE. However, the overall outcomes for each study were positive in that they taught NPs about CSE. This systematic review built a foundation for developing the intervention for this dissertation study. The PI used Sidani and Braden's clarifying elements to guide the development of the intervention.

CHAPTER 2: PRESENT STUDY

The purpose of this dissertation study was to explore the feasibility of developing and delivering a theory-based intervention to educate PCNPs about CSE for MM within the context of a microlearning system**.** The full methods, results, and conclusions of this study are presented in a manuscript entitled, "The feasibility of using a theory-based, online delivery microlearning system to educate nurse practitioners about clinical skin examination for melanoma " found in Appendix C of this dissertation. This chapter is a summary of the methods, results, and discussion.

Methods

The PI obtained approval from the Institutional Review Board (IRB) of the University of Arizona (Appendix D). The consent form was a disclosure that preceded the baseline survey. The disclosure stated that participation is voluntary and any participant who declined to complete the survey would not receive any penalty or loss of benefits from the sponsoring organization. The disclosure also stated that if the participant felt uncomfortable at any time, then he or she could discontinue the study at any time. Any PCNP that read the disclosure and proceeded to complete the survey was considered a study participant.

The study design was a one group posttest, cross-sectional design. A purposive sample of a minimum of 10 PCNPs was recruited from NP meetings by the PI. The three intervention videos were delivered individually on a different day and completed within one week. Each participant viewed the videos only once. After the final video, PCNPs received the posttest, along with the usability and acceptability scales (Aim 2 & exploratory aim). One week after the last video, the PCNPs were asked to self-report their use of CSE in their practice.

Feasibility and pilot studies are terms that are often used interchangeably; past literature reviews show that there is a lack of distinction between them (Arain, Campbell, Cooper, & Lancaster, 2010). While some of their objectives overlap, there are key differences between both types of studies (Arain et al., 2010; Cope, 2015). Thabane et al. (2010) outlined the four primary purposes for pilot and feasibility studies, which include testing the process, resources, management and scientific basis of the planned study. A pilot study is a trial run of a full scale study (and includes all of the study components), whereas the intent of a feasibility study is to evaluate interventions (or components of the study) (Tickle-Degnen, 2013). Feasibility studies help build the foundation for subsequent studies by ensuring that implementation is practical and to reduces threats to internal validity (Tickle-Degnen, 2013). Feasibility studies reduce threats to internal and external validity by evaluating participant recruitment, identifying possible retention issues, ability to execute the intervention and extent to which intervention fidelity is maintained (Polit & Beck, 2010; Tickle-Degnen, 2013).

Aim 1

The purpose of Aim 1 was to develop the theory-based, short skin cancer videos on CSE for MM. The development of the intervention was guided using two conceptual frameworks, and operational transparency. The conceptual framework for the intervention was the IMB model, as discussed under the *Conceptual Framework* section in Chapter 1. The conceptual framework for the intervention delivery was microlearning (Appendix A) whereas operational transparency for the intervention was provided by Sidani and Braden's clarifying elements (Sidani & Braden, 2011a; Appendix B). To address Aim 1, an expert panel of three dermatologists assessed content validity (Aim 1a), integration of the videos and surveys (Aim 1b) and digital delivery (Aim 1c)

for usability and quality. For Aim 1a, the CVI was determined by dividing the number of experts giving the fact (or item) a score of three or four and dividing them by the total number of experts (three) (Polit, Beck, & Owen, 2007). For Aim 1b, scores for Brooke's SUS and Beaudin's QEV were analyzed using descriptive statistics. Results are discussed further in Appendix C. Table 1 provides an overview of the aims, hypotheses and measures. The study measures are in Appendix E.

Aim 2

Aim 2 evaluated enrollment and retention rates, intervention adherence, usability and acceptability. Enrollment rate was the percentage of participants who were recruited and consented to the intervention whereas retention whereas retention was the percentage of participants who completed the intervention and survey. Intervention adherence was the extent to which participants experienced the content of the intervention. Usability was evaluated using Brooke's SUS while acceptability was evaluated with Attitudes toward Web-based Continuing Learning Survey (AWCL) (Brooke, 1996; Liang et al., 2011). Data for Brooke's SUS and Beaudin's QEV were analyzed using descriptive statistics. For the AWCL, data analysis consisted of item mean scores, mean construct scores and correlation between each construct. Results are discussed further in Appendix C.

TABLE 1. *Aims, measures and tools.*

Aim	Sub-Aim / Hypothesis	Measure(s) / Tool(s)	Outcome(s)
Aim 1: To develop, over a three-month period, three theory-based, short skin cancer videos with content on comprehensive CSE skills that are suitable for digital delivery to PNCPs in various formats (e.g. mobile phone, tablet and computer).	**Aim 1a:** To assess content validity of the intervention content using an established method and expert panel of three dermatologists.	Content Validity Index (CVI)	Content relevance by experts Clarity by experts
	Aim 1b: To assess the integration of the videos and surveys into Research Electronic Data Capture (REDCap) by conducting an evaluation with three dermatologists and PCNPs using Brooke's System Usability Scale (SUS) to evaluate the use of REDCap.	Brook's System Usability Scale (SUS)	Usability determined by experts
	Aim 1c: To assess the digital delivery of the videos using Beaudin's Quality Evaluation of Video (QEV).	Beaudin's Quality Evaluation of Video (QEV)	Technical production
Aim 2: To determine enrollment and retention rates, intervention adherence, and acceptability and usability of the intervention following completion of the one-week intervention.	Hypothesis 2.1: Enrollment rates will be equal to or better than 60%.	Recruited and consented to the intervention / recruited and chose not to consent or enroll	Enrollment rates
	Hypothesis 2.2: Retention rates will be greater than to 50%.	Completed the intervention and survey / enrolled	Retention rates
	Hypothesis 2.3: Intervention adherence will be greater than or equal to 50%.	Watched all of the videos / total number of participants	Intervention adherence
	Hypothesis 2.4: Usability scores will be equal to or higher than 70.	Brooke's System Usability Scale (SUS)	Usability determined by participants
	Hypothesis 2.5: Acceptability scores will be equal to or higher than 5.	Attitudes towards Web-based Continuing Learning Survey (AWCL)	Acceptability Perceived usefulness Perceived ease of use Behavior Affection Information Motivation Behavior skills CSE health behavior
Exploratory Aim: To explore the association among information, motivation and behavioral skills for CSE practice.	Hypothesis: To explore preliminary associations among information, motivation and behavioral skills for CSE practice.	Adapted Walsh & Petroll's IMB model survey	

Exploratory Aim

To assess the IMB model constructs, a 19-item survey was adapted from a study that evaluated PCPs and HIV pre-exposure prophylaxis prescribing (Walsh & Petroll, 2017). *Information* was assessed through the use of multiple choice questions that focus on factual information (seven items) (Walsh & Petroll, 2017). The answers were scored as correct (1) or incorrect (0) (Walsh & Petroll, 2017). *Motivation* was measured by having participants rate their level of agreement with six items assessing attitudes towards CSE on a five-point Likert scale (1= completely disagree, 5= completely agree). The item scores for *motivation* (Motive2 – Motive6) were reverse coded to be comparable to Walsh and Petroll's score. *Behavior skills* were assessed by asking the participants their comfort conducting CSE (six items), scored on a five-point Likert scale and range from '1' (completely uncomfortable) to '5' (completely comfortable) (Walsh & Petroll, 2017). Behavioral skills also was measured as correctly ranking the order for the steps of a head-to-toe skin examination. CSE behavior skills were analyzed for each area of the body, along with the average score (Table 3). Mean scores were considered correct or incorrect. "Body areas" and "hard to see" areas were considered correct if they were interchanged with one another (e.g., 1st "head and neck," 2nd "scalp, ears, postauricular folds, back of neck" vs. 1st "scalp, ears, postauricular folds, back of neck," 2nd "head and neck"). CSE *health behavior* was assessed by asking participants to self-report the number of times they conducted CSE one week after the intervention. Each of the IMB model constructs' total mean scores was calculated and point-biserial correlation coefficients were determined between the constructs. The point-biserial correlation coefficient is used when one variable is a discrete dichotomy, such as passing or failing a test. Each participants' information scores were recoded

as a discrete dichotomous variable, where 1 = correct and 2 = incorrect. This was also done with the CSE behavior ranking scores, where the scores were recoded as 1 = passed and 0 = failed. Analysis of sample characteristics consisted of descriptive statistics, such as frequencies, measures of central tendency and standard deviation. The exploratory results are discussed further under the *Supplemental Results*.

Supplemental Results

Results for the exploratory aim (explore preliminary associations among information, motivation and behavior skills for CSE behavior [practice]) are discussed in this section. Table 2. lists the mean proportions of items scored correctly for knowledge (a measure for the IMB construct of information). The items with the lowest scores included: "Which of the following are melanoma risk factors" (Info3) (M = 70%, SD = 48%) and "Women are more likely to get melanoma on which body site?" (Info6) (M = 70%, SD = 48%). Info3 was a "check all that apply" item; all three participants responding with the wrong answer and responded with the reverse answer. When Info3 was removed, mean test scores increased slightly from 89% (SD = 16%) to 91% (SD = 14%). All participants correctly answered the items with the images of the suspicious lesions (Info4, Info8), along with the item on the ABCDEs (Info2) and the item about the right arm nevi count (Info5).

TABLE 2. *Information item scores.*

	Item	Mean Score	Standard Deviation
Info2	Which of the following is NOT TRUE about the ABCDEs	100%	0
Info3	Which of the following are melanoma risk factors?	70%	48%
Info4	Is the lesion above suspicious or nonsuspicious? (Suspicious)	100%	0
Info5	Patients with more than 11 nevi on their arm should have a head to toe skin examination.	100%	0
Info6	Women are more likely to get melanoma on which body site?	70%	48%
Info7	Men are more likely to get melanoma on which body site?	80%	42%
Info8	Is the lesion above suspicious or nonsuspicious? (Suspicious)	100%	0
	Grand Mean	91%	14%

[a]The items are based on a scale from 1 (correct) to 0 (incorrect)

For behavior skills (ranking), the average number of participants who answered correctly was collected (Table 3.). All participants correctly ranked "head and neck" (Rank2) and "groin, heels, between toes, and toenails" (Rank6). The participants had the most difficulty ranking "legs and feet," with only six participants correctly ranking it (*SD* = 52%).

TABLE 3. *Behaviors skills (ranking) item scores.*

	Item	Average Score	Standard Deviation
Rank2	Head and neck	100%	0
Rank4	Scalp, ears, postauricular folds, back of neck	80%	42%
Rank7	Arms, hands, chest, abdomen	80%	42%
Rank1	Underarms, palms, fingernails	80%	42%
Rank5	Back, buttocks	70%	48%
Rank3	Legs and feet	60%	52%
Rank6	Groin, heels, between toes, toenails	100%	0
	Grand Mean	60%	49%

[a]The items are based on a scale from '1' (correct) to '0' (incorrect)

For the behavior skills (survey) items, the lowest mean score was "Conducting a systematic CSE" ($M = 4$, $SD = .82$) whereas the highest mean score was "Discussing whether CSE is a good option for a patient" ($M = 4.7$, $SD = .48$) (Table 4).

TABLE 4. *Behavior skills (survey) item scores.* (Cronbach alpha = 0.72)

	Item	Mean Score	Standard Deviation
Skills1	Determining whether a patient's number of nevi impacts their risk for skin cancer.	4.50	0.53
Skills2	Determining whether a patient's risk factors warrant a CSE.	4.10	0.88
Skills3	Discussing the efficacy of CSE with a patient.	4.20	0.92
Skills4	Discussing whether CSE is a good option for a patient.	4.70	0.48
Skills5	Conducting a systematic CSE.	4.00	0.82
Skills6	Following high-risk patients who need CSE and monitor their lesions.	4.10	0.57
	Grand Mean	4.27	0.27

[a]The mean scale scores are based on a scale from '1' (completely uncomfortable) to '5' (completely comfortable)

The findings for the motivation items are found in Table 5. Motiv1, "CSE can be a cost-effective skin cancer prevention intervention if used with an appropriate population of patients," had the highest mean score ($M = 4.9$, $SD = 1.16$). whereas the item "Individuals who are at risk for skin cancer should be encouraged to see a dermatology rather than have a CSE with me" (Motiv4) had the lowest score ($M = 3.3$, $SD = 1.42$).

TABLE 5. *Motivation item scores*. (Cronbach alpha = 0.60)

	Item	Mean Score	Standard Deviation
Motiv1	CSE can be a cost-effective skin cancer prevention intervention if used with an appropriate population of patients	4.90	0.32
Motiv2	CSE is too time intensive to warrant its use (R)	4.30	1.16
Motiv3	Individuals who are at risk for skin cancer should be referred to a dermatologist rather than have a CSE with me (R)	3.60	1.08
Motiv4	Individuals who are at risk for skin cancer should be encouraged to see a dermatologist rather than have a CSE with me (R)	3.30	1.42
Motiv5	There is insufficient evidence at this time for me to consider CSE as an appropriate screening option (R)	4.70	0.48
Motiv6	Primary care providers using CSE for high risk patients will not have a significant impact on diagnosing skin cancer early (R)	4.30	1.25
	Grand Mean	4.18	0.62

[a]The mean scale scores are based on a scale from 1 (completely disagree) to 5 (completely agree)
[b](R) = reverse code

Self-reported CSE was collected from all ten participants. The mean number of reported CSEs within one week was 20 (*SD* = 29.16). However, the range of reported CSEs was 1 to 99. After excluding the outlier (99), the average number of CSEs performed the week after the intervention was 11 (*SD* = 9) with a range of 1 to 26 (Field, 2013).

To explore preliminary associations among information, motivation, behavioral skills for CSE practice, and actual practice a point-biserial correlation matrix was conducted (Table 9). There were no statistically significant associations among the IMB model constructs. Information had a weak to moderate association with behavioral skills (rank) (*r* = .41), followed closely by the weak to moderate association with motivation and behavior skills (survey) (*r* = .39). The weakest association was between motivation and behavior skills (rank) (*r* = .02). Actual CSE practice had the strongest association with behavior skills (survey) (*r* = -.33). The coefficient of determination (R^2) was 0.11.

TABLE 6. *Point-biserial correlation matrix.*

IMB Model Constructs	Information	Behavioral Skills (Rank)	Behavior Skills (Survey)	Motivation
Information	1.00	-.41	-.36	-.21
Behavior Skills (Rank)	-.41	1.00	.26	.02
Behavior Skills (Survey)	-.36	.26	1.00	.39
Motivation	-.21	.02	-.39	1.00
Actual CSE practice	-.13	-.11	-.33	.29

Supplemental Discussion

According to Walsh and Petroll's original testing of the IMB model with PCPs and HIV pre-exposure prophylaxis, an acceptable passing score for *information* is 4 out of 7 items, or a 57% average score (2017). For this study acceptable knowledge was considered greater than or equal to 80% because CSE should be as clinically accurate as possible (Loescher et al., 2018). The average score for the information item scores was above 80% before and after the removal of "Which of the following are melanoma risk factors?" (Info3). Info3 was removed from the mean information item score because it was not reflective of the participants' knowledge. Info3 was a "check all that apply" item; all three participants responding with the wrong answer most likely because they misread the question. Instead of checking all the MM risk factors (skin type 1, family history of MM, history of sunburns) they selected the answer that was NOT a risk factor (HPV exposure). Therefore, this question might not accurately measure knowledge because it may be a poorly worded question. Overall, three participants scored less than 80% on the information items. An image of a benign lesion should be included in the information items, because suspicious lesions are easier to assess. For example, it takes trained dermatologist 215 biopsies before they diagnose one MM (Matsumoto et al., 2018). Overall, the average score for

the information items was acceptable, however some adjustments should be made to strengthen the test.

Only 60% of the participants were able to systematically rank the steps to a head-to-toe skin examination (*SD* = 49%). Participants had the most difficulty ranking "legs and feet." This was most likely caused due to a transcribing error on the survey. For the ranking item, "groin" was supposed to be a separate ranking item from "heels, between toes and toenails." This may have caused confusion when the participants were asked to rank-order the steps. There was also discrepancy with the wording of the question. CSE refers to the use of a MM risk assessment, head-to-toe skin examination and pigmented lesion assessment. The goal of the question was to have the participants correctly rank-ordered the steps to a head-to-toe skin examination. Notably, no professional organizations offer clinical recommendations on how to do a head-to-toe skin examination (Bibbins-Domingo et al., 2016). This may also be a contributing factor as to why the participants had difficulty rank-ordering the steps.

An acceptable score for *motivation* is greater than or equal to 3.5 (Walsh & Petroll, 2017). The total mean score was 4.18, which is more than the desired score. The only item that did not meet the minimum score was "Individuals who are at risk for skin cancer should be encouraged to see a dermatologist rather than have a CSE with me" (Motive4). Walsh and Petroll's lowest scored motivation item was also: "Individuals who are at risk for HIV should be encouraged to use condoms rather than take PrEP." One potential explanation for this lower score that the participants do not feel comfortable comparing their skills to a dermatologist (or comparing PrEP to condoms). Notably, Walsh and Petroll use both positive (one item) and negative items (7 items). Using both positive and negative items helps obtain an accurate

estimate of a construct's reliability (Field, 2013). After the adaption, the PI had one positive item (Motive1) and five negative items. The Cronbach alpha for this scale was .60. Cronbach alpha scores as low as .50 are acceptable in early research (Ponterotto & Ruckdeschel, 2007). An acceptable score for *behavior skills* is greater than or equal to 3.5 (Walsh & Petroll, 2017). The average score for *behavior skills* (survey) was 4.27 (*SD* = .27) and this scale had acceptable internal consistency reliability (α = .72) (Ponterotto & Ruckdeschel, 2007).

For the correlation matrix, while there were no statistically significant associations, some weak to moderate associations were present. Most notably, information had the strongest associations within the group. The weakest association was motivation and behavioral skills (rank). For a point-biserial correlation, we disregard the direction of the relationship for the dichotomic variables because the sign of the coefficient is dependent on which category is recoded (Field, 2013). Notably, actual CSE practice had the strongest association with behavior skills (survey) (*r* = -.33). However, there was a negative association between the two constructs. One explanation for this is confusion of the definition of a CSE. Skills2 ("Determining whether a patient's risk factors warrant a CSE") and Skills5 ("Conducting a systematic CSE") lead the participant to believe that a CSE is a head-to-toe skin examination rather than a combination of a risk assessment, skin examination and pigmented lesion detection. This calls into question what the participants count as a CSE when they self-report the number of CSEs they conducted during the week. The coefficient of determination (R^2) was 0.11. Therefore, 11% of the variability was shared between behavior skills (survey) and actual CSE practice. In summary, more research is needed to improve the measurement of information, motivation, behavioral skills, and behavior in the context of CSE.

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APPENDIX A:

MANUSCRIPT #1:

MICROLEARNING: A FRAMEWORK FOR SKILLS TRAINING IN THE TECHNOLOGY ERA

(For submission to *Nurse Education Today*)

https://www.elsevier.com/journals/nurse-education-today/0260-6917/guide-for-authors

Introduction

Society currently is experiencing the full impact of the digital revolution. Learning is becoming a habitual, highly important task in individuals' lives. Digital media infiltrates the working and personal lives of everyone. The increasing speed, fragmentation, and mobility of information generation and consumption open the door to a new society—the information society (Eibl, 2007; Hug & Friesen, 2007). Theory and research struggle to catch up to developments in technology. In education research, a proliferation of new practices and applications (such as educational games, bulletin boards, blogging or videos) are addressed under terms such as "e-learning," "networked learning" or "distributed education" (Hug, 2007). This phenomenon also has generated more specific terms for labeling and categorizing a particular form and ideas, such as: game-based learning, personal learning environments and microlearning (Hug, 2007).

These practices and terms illustrate an emerging sociotechnical landscape that is constantly shifting and changing. Change creates the need for a new strategy to support life-long learning. One common facet of life-long learning is skills training. Skills training needs to evolve to account for busy work schedules and life, in general. Digital, web-based skills training is an example of a technological change to learning; it is viewed positively by nursing students because of its flexibility, pace of learning, self-direction and widening access to multiple sources of information (Liang et al., 2011). Health education materials in web-based skills training are often traditional teaching resources, such as PDF documents and slides, that are reorganized to be easily accessible on the internet (Bricon-Souf et al., 2010).

Recycling tradition educational materials has some disadvantages. Students prefer to have access to multiple sources of information (such as video or podcasts), rather than just PDFs or slides (McVeigh, 2009). Recycling materials for web-based skills training is not always successful. For example, the Basic Skin Cancer Triage (BSCT) is a two-hour, in-person educational intervention, which had received favorable evaluations. The objective of the BSCT is to increase the ability of primary care providers to triage skin lesions and counsel patients on skin cancer (Mikkilineni, Weinstock, Goldstein, Dube, & Rossi, 2001). To capitalize on the advantages of web-based skills training, such as cost-effectiveness, mass outreach and consistent content delivery, the authors created a two-hour web-based program (Markova et al., 2013). This

program was not as successful as the in-person course, potentially owing to web-based program's instructional design, which lacked high levels of interaction, practice exercises, repetition, feedback and other elements associated with positive learning outcomes. The authors concluded that further tests of the Web-based program are needed (Markova et al., 2013).

Planning for web-based skills training should be intentional and guided by a framework. Intentionality is demonstrated by Harris et al. (2001), who created a web-based continuing medical education (CME) curriculum that used an interactive, problem-based teaching approach, rather than adapting a previous in-person class. The curriculum was developed in two stages: the first stage focused on development of content and technology; the second stage focused on testing the curriculum, incorporating additional educational and technical recommendations from physician users (Harris et al., 2001). This example highlights the importance of intentional planning for web-based learning. However, owing to the rapidly changing technosocial landscape, educators are challenged with keeping up with the fast pace of media production and technology. One framework that keeps pace with the ever-evolving pace of technology is microlearning. The objective of this Contemporary Issue article is to provide an overview of the use of microlearning and its role as a framework for learning. Specifically, this article will highlight the background of microlearning, microlearning as a conceptual framework, how microlearning pertains to nursing, and future research.

Microlearning

Microlearning, otherwise known as "bite-size" learning, is a new teaching and learning perspective, dating back to 2003 (Hug & Friesen, 2007). Microlearning emphasizes the "minute." This particularly important in skill training delivered by nursing schools because much information becomes outdated at a faster pace than ever before (Eibl, 2007). Thus, it is important for nurses to have efficient access to training because of the fast, evolving pace of evidence-based practice and healthcare knowledge. The completion of a nursing degree releases the nurse into the world of life-long learning—which may include skills training. Digital media is blurring the lines between working time and private life; the learner is able to complete training wherever and whenever desired. Microlearning is related to implicit, informal, social and incidental forms of learning because it makes use of everyday information and communication technology for teaching purposes (Buchem & Hamelmann, 2010). Microlearning can have a continuous or

specific focus. Therefore, microlearning is defined as "special moments or episodes of learning while dealing with specific tasks or content and engaging in small but conscious steps" (Hug & Friesen, 2007, p. 18). This general description of microlearning is discrete, but also general enough to adapt with the fast pace of media production and technology. Research findings document that the use of short content may increase information retention by 20% (Giurgiu, 2017).

The focus of this manuscript is on microlearning and how it can be used as a framework for web-based skill training. When microlearning is delivered by platforms such as mobile devices and computers, it is considered web-based learning (Bruck, Motiwalla, & Foerster, 2012) and these platforms boost economic utility (Hug & Friesen, 2007). However, some critics state that microlearning already is an implicit part of microteaching (Hug & Friesen, 2007). Microteaching is the delivery of a small lesson to a target audience; it includes the elements of implementing theory into practice through a lesson, giving and receiving feedback, and engaging in self-reflection (Dwight & Ryan, 1969; Mergler & Tangen, 2010). However, microlearning distinguishes itself from microteaching through its improvisatory forms of learning and participatory culture along with its ability to harness recent digital media development. Microlearners are driven by a particular knowledge gap that they want to close immediately, and focus on obtaining information on a factual level (Kovachev, Cao, Klamma, & Jarke, 2011). Some researchers contend that microlearning has the potential for teaching advanced skills as well. For example, Skalka and Drlik (2017) are pilot testing a microlearning conceptual framework to teach computer programming skills. Additionally, Bogun et al. (2018) created a microlearning program for patients that increases type 2 diabetes knowledge, skills and motivation.

According to Hug (2007), there are seven concepts of microlearning: pedagogy, media, curriculum, process, form, time and content (or, microcontent). The adaptability and flexibility of microlearning is clearly outlined within its concepts; of the seven, five (pedagogy, media, curriculum, processes and form) are variable or do not have a fixed requirement. Pedagogy is the method and practice of teaching; microlearning is compatible with a variety of pedagogies including: reflective, constructivist, conceptualist, behavioralist-learning; or action-, task-, goal-, exercise-oriented learning. Media is the use of books, radio, film, television, Internet, mobile

phones or computers to engage learners and promote learning. Microlearning can be designed for a variety of different curricula, such as those for classroom learning, corporate learning or continuing education. Processes include facets, episodes, fragments, skill elements or discrete tasks. Form describes form of the final microlearning product, which can have the characteristics of a facet, episode, fragment, skill element, etc. The remaining two concepts, content and time, are constant (fixed) and therefore the most defining concepts. Time is defined as short efforts with low degrees of time consumption (Hug, 2007). Microlearning content combines small amounts of content (or units) with a sequence of microinteractions to avoid user information overload (Bruck et al., 2012). A microlearning unit lasts from a few seconds to 15 minutes (Buchem & Hamelmann, 2010; Hug, 2007). Microlearning units are stand-alone bits of information in a permanent state of flux and circulation (Job & Ogalo, 2012). This information is short, reusable, remixable and focuses on a single topic (Job & Ogalo, 2012). Microlearning content is shared through human-to-human interaction and interaction with media (Job & Ogalo, 2012). Microlearning concepts are linked to comprehensive models that take context into consideration and promote translation of microlearning into the real-world setting. For example, a multicomponent model combines microlearning units systematically in linear or branching methods (Swertz, 2006), such as Web-Didactics (see below). Conversely, an aggregation model extracts microlearning units that are fundamentally similar and bundles them as an unstructured mass (Hug & Friesen, 2007), such as a learning portal that allows a learner to pull similar content from the Internet.

Microlearning Frameworks

Microlearning can act as a training framework that offers a variety of different approaches—with varying degrees of emphasis on different microlearning concepts (Hug & Friesen, 2007). Figure 1 highlights different microlearning frameworks used to guide training development.

Microlearning is divided into two different approaches, unstructured or partial structure. The unstructured approach abandons regulation, structure and curriculum to promote autonomous learning, otherwise known as a learner-centered approach (Hug & Friesen, 2007). For example, game-based learning allows the control of learning to be placed in the hands of the learner (Kiili, 2005; Papert, 1993). The partial structure approach specifies activities and actions

from moment to moment (Hug & Friesen, 2007). Within this approach, partial structure can have varying degrees of emphasis on adaptability and structure. Therefore, examined below are three sub-approaches of partial structure: Web-Didactics (Swertz, 2006), integrated microlearning (Gassler, Hug, & Glahn, 2004) and "The *Dr. Who* Principle" (Newman & Grigg, 2007).

Web-Didactics provides a choice of different didactical models, microlearning units, and sequencing models to organize the different knowledge types (sequencing) (Swertz, 2006). In Web-Didactics, each of the microlearning units are decontextualized into specific knowledge types, such as "receptive," "interactive," and "cooperative knowledge" (Swertz, 2006). Essentially, learners collect and sequence knowledge using their preferred navigation method within Web-Didactics. Integrated microlearning is the integration of microlearning activities into everyday life or workflows. Using media, time slots are created for microlearning units based on an individual's use of technology and learning needs (Hug & Friesen, 2007). Integrated microlearning strives to be open, modular and flexible while using management functions (Hug & Friesen, 2007). An example of this approach is a mobile phone application that teaches a skill, such as EKG interpretation; the application prompts the learner to answer questions on different wavelengths, symptoms and heart pathophysiology at customizable, predetermined intervals. "The *Dr. Who* Principle" is based on the assumption that learning is inherently episodic (Newman & Grigg, 2007). Content is structured to fit the episode and the delivery of the episodes in appropriate time slots (Newman & Grigg, 2007). An example is an episodic, story-telling video documentary called "Albert in the Land of the Vikings". The project consists of five-minute videos full of learning content that follow a teddy bear named Albert in search of Viking stories (Newman & Grigg, 2007).

Each of the different sub-approaches emphasizes a different level of structure. Web-Didactics uses sequencing for structure, integration of microlearning uses time slots, and "The *Dr. Who* Principle" uses both short sequences and time slots.

Microlearning in Nursing

Microlearning's full potential shines for users who have difficulty making time for long stretches of learning (Bruck et al., 2012). On average, nurses complete 72.3 tasks per hour, with a mean task length of 55 seconds (Westbrook, Duffield, Li, & Creswick, 2011). Due to the overwhelming amount of tasks completed in a day, nurses are expected to be experts in time management and have little time to set aside for training. The American Association of Nurse Practitioners found that 70% of NPs see at least three patients an hour (American Association of Nurse Practitioners, 2015). Approximately 74% of NPs work full time and 54% work overtime (American Association of Nurse Practitioners, 2018). A British randomized controlled trial found that NPs spent a mean time of 11.57 minutes face to face with patient (SD, 5.79) and 1.33 minutes getting prescriptions signed during a 15 minute appointment (Venning, Durie, Roland, Roberts, & Leese, 2000). Training activities are regarded as breaks in the everyday work process and nurses have minimal time to give to training. Compared to standard online curricula, microlearning videos only require a few minutes of time, which is valuable for skill training for busy practicing nurses.

While microlearning has not been studied extensively in nurses, there is some literature that focuses on healthcare providers and similar learning activities. Bricon-Souf et al. (2010) evaluated medical residents' use of handwritten notebooks and found that they contained small pieces of learning information that is highly contextualized, annotated and partially indexed. The notebooks were often used during an activity and were briefly consulted (Bricon-Souf et al., 2010). The small, highly contextualized units of learning, the accessibility of the notebooks during an activity and the students' brief consultation of their notebooks are reminiscent of microlearning. Microlearning has been tested with nurses learning central line-associated bloodstream infection (CLABSI) prevention (Orwoll et al., 2017) and with a work place health support intervention (Simons, Foerster, Bruck, Motiwalla, & Jonker, 2015). Orwoll et al. (2017) used microlearning by using a CLABSI mobile application that showed in-line explanations of CLABSI prevention bundles and video demonstration that were stored on a cloud platform. Nurses viewed their own self-reported compliance and skill performance. The nurses were also able to compare their compliance to other units (gamification). Gamification is the application of game mechanics in a nongame context to increase performance and engagement (Deterding,

Dixon, Khaled, & Nacke, 2011). Simons et al. (2015) used a mobile application with microlearning cards (microcontent) that contained a question and multiple-choice answers. Their course content had seven modules with 20 questions per module; They documented a high utilization rate of the health quiz, with 66% completing all seven modules (n = 86) (Simons et al., 2015). Other microlearning components included short digital health behavior surveys with personal feedback and a weekly health tip email.

Conclusion

Microlearning positively transforms knowledge; it promotes the facilitation of knowledge and skill growth in healthcare (Job & Ogalo, 2012). However, there is very little research on microlearning in healthcare and particularly little research on microlearning to inform and educate nurses. This manuscript helps build the foundation for using microlearning to frame a feasibility study; the goal of the study is to assess the viability of an online microlearning system to educate NPs about clinical skin examination for melanoma. Microlearning could benefit nurses in that allows for the dissemination of short, meaningful knowledge in a hectic workplace environment. While further research and development is needed, microlearning offers a novel, flexible approach to impacting nurses as life-long learners.

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APPENDIX B:

MANUSCRIPT #2:

EDUCATIONAL INTERVENTIONS FOR PRIMARY CARE PROVIDERS TO IMPROVE CLINICAL SKIN EXAMINATION FOR SKIN CANCER

(In press at *The Journal of the American Association of Nurse Practitioners*)

JAANP Decision

em.jaanp.0.622cae.714e6c6c@editorialmanager.com
on behalf of
JAANP <em@editorialmanager.com>
Wed 3/27/2019 7:15 AM
To: Stratton, Delaney Baker - (dstratton) <dstratton@email.arizona.edu>
Mar 27 2019 10:15AM

RE: JAANP-D-19-00025R1, entitled "Educational interventions for primary care providers to improve clinical skin examination for skin cancer"

Dear Ms. Delaney Baker Stratton,

I am pleased to inform you that your manuscript has now been accepted for publication in Journal of the American Association of Nurse Practitioners. All manuscript materials will be forwarded immediately to the production staff for placement in an upcoming issue.

Thank you for submitting your interesting and important work to the journal.

Sincerely,

Dr. Kim Curry
Editor in Chief
Journal of the American Association of Nurse Practitioners
https://www.editorialmanager.com/jaanp/

Your username is: dstratton
https://www.editorialmanager.com/jaanp/l.asp?i=52105&l=6TU4HXHQ

In compliance with data protection regulations, you may request that we remove your personal registration details at any time. (Use the following URL: https://www.editorialmanager.com/jaanp/login.asp?a=r) Please contact the publication office if you have any questions.

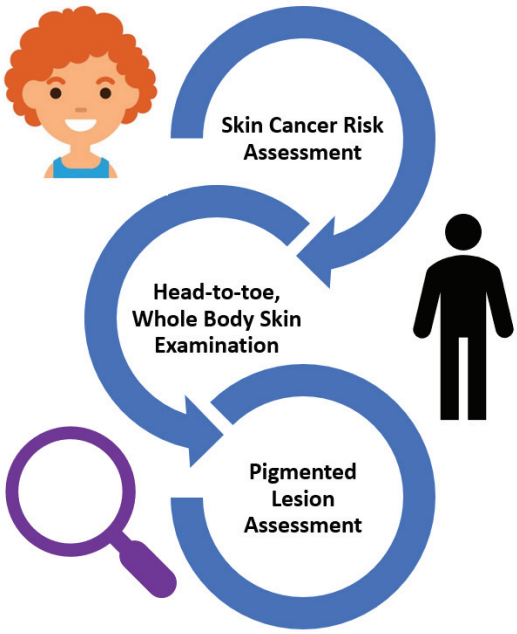
Background

Skin cancer, the most commonly diagnosed cancer in the U.S., is a serious healthcare concern. Since 1992, the incidence of the most serious skin cancer, malignant melanoma (MM), has increased by 1.8% to 4.6% annually (Lazovich et al., 2012). In 2018, there were approximately 91,270 new cases of MM and 9,320 deaths from MM (Siegel, Miller, & Jemal, 2017). In some states, MM also may be underreported—meaning that the actual incidence and overall burden may be higher (Harris et al., 2015). Primary and secondary prevention are invaluable methods of decreasing the burden of skin cancer in the U.S. and are highly cost-effective and cost-saving (Gordon & Rowell, 2015). Secondary prevention, such as early skin cancer detection, improves MM prognoses. Early detection leads to a greater proportion of removal of thin MM (< 2 mm in thickness) (Bartlett & Karakousis, 2015; Glazer et al., 2017). Lesion thickness is important because thinner lesions are associated with better outcomes (Gershenwald et al., 2017). There is no screening test for MM other than the direct skin examination by a healthcare provider (Harris et al., 2001).

Comprehensive clinical skin examination (CSE) consists of a MM risk assessment, head-to-toe whole-body skin examination, and pigmented lesion assessment (See Figure 1). An initial skin cancer risk assessment helps determine if the patient requires a head-to-toe skin examination. Risk assessment is an evaluation of a patient's past medical history, family and personal history of skin cancer, phenotype (e.g., skin susceptibility to burning, numerous moles) and exposure to ultraviolet radiation (UVR) to determine susceptibility to skin cancer (American Academy of Dermatology [AAD], 2018). If the patient has strong risk factors, then the clinician performs a systematic head-to-toe skin examination. The examination begins with the head and

neck, and moves downward to the arms, chest, abdomen, back, legs, buttocks, and feet. The clinician pays close attention to hard-to-see areas such as the scalp, ears, postauricular folds, back of neck, fingernails, palms, underarms, groin, in between toes and toenails, and heels (AAD, 2018). Many MM are a type of pigmented skin lesion; MMs that are not pigmented include desmoplastic (less than 4% of all MMs) and amelanotic (less than 2% of all MMs) (Cabrera & Recule, 2018). Approximately 29.1% of MMs arise from a preexisting nevus, whereas 70.9% are de novo or a new lesion (Pampena et al., 2017). Skin lesion assessment is the ability to find and differentiate between a pigmented non-suspicious or suspicious skin lesion. This assessment differs from lesion diagnosis, which is the distinct pathological characterization of a lesion in a precise term (e.g., MM, atypical nevi, seborrheic keratoses, etc.). Two methods commonly used for skin lesion assessment include: the ABCDE (**A**symmetry, **B**order, **C**olor, **D**iameter, **E**volution) rule and the "ugly duckling" sign (Roebuck, 2015). The "ugly duckling" sign is the appearance of a pigmented lesion that is vastly different from other moles (Scope et al., 2008).

FIGURE 1. Comprehensive clinical skin examination (CSE).



All three components of the CSE are important because the clinician has to identify patients who would benefit most from a skin assessment, be able to conduct a systematic skin examination to ascertain any suspicious lesions and be able to understand which pigmented lesions might be suspicious. The Surgeon General's Call to Action to Prevent Skin Cancer in 2014 identified skin cancer as a major public health problem and encouraged healthcare providers to look for suspicious lesions to improve patients' prognoses (2014). Only 24% of patients who are considered at high risk for melanoma have had one whole body CSE in their lifetime Nurse practitioners (NPs) provide a full spectrum of health care services, including health promotion, disease prevention, health protection, anticipatory guidance, counseling, and disease management (Thomas et al., 2011). These services align with the Surgeon General's Call to Action (2014).

NPs play a vital role in skin cancer early detection, but previous systematic reviews have concluded that NPs are neither confident nor adequately prepared to perform a CSE (Loescher et al., 2011; Loescher et al., 2018). Only 20% to 30% of NPs reported completing CSE on patients during annual visits, along with skin cancer prevention counseling and referrals to dermatologists (Blake & Malone, 2014). Most NPs are not confident with basic dermatology exams following their basic NP education; only 16% of NPs believed they are prepared for dermatology practice (Shelby, 2014). In a study of 91 participants, 81% had no skin cancer education within the past year, and 41% had only "mild" to "no" confidence in their ability to conduct skin assessments (Blake & Malone, 2014). Although NPs' confidence in CSE is lacking, they believe that primary care providers help detect skin cancer early (Blake & Malone, 2014). NPs find skin cancer education to be relevant and are likely to refer peers to a skin cancer educational intervention (Bradley, 2012; Hartnett & O'Keefe, 2016). Additionally, NPs want additional learning activities related to MM (Roebuck et al., 2015). Interventions to train NPs in CSE could be tailored to NPs, and specifically focus on skin cancer risk assessment, head-to-toe skin examination, and skin lesion assessment. Interventions that have been tested in other primary care providers, such as physicians or physician assistants (PAs), either in practice or in education, also may be considered for primary care NPs.

Objectives

The objective of this systematic review was to evaluate current interventions targeting CSE education for primary care NPs and/or other primary care providers that are published in peer-reviewed journals. The questions guiding the review were:

- What are the characteristics of the sample?

- What are the types and numbers of CSE interventions tested in primary care providers?
- What are the clarifying elements (goals, target audience, components, dose and mode of delivery), efficacy, effectiveness, and dissemination of CSE interventions tested in primary care providers?

Methods

Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) is a framework that promotes transparency and complete reporting of systematic reviews and meta-analyses (Liberati et al., 2009). The PRISMA Checklist consists of 27 criteria for the systematic review (i.e., title, abstract, introduction, methods, results, discussion, and funding). PRISMA recommends using a flow diagram to demonstrate the article selection process. The PRISMA checklist requires noting of any biases within and between the studies, a synthesis of the results, a description of the strength of evidence, and the limitations of the research.

The authors searched the PubMed, Google Scholar, CINAHL, and Web of Science databases. The search limitations were English language and human subjects, with no limitation on publication date. Inclusion criteria were the following: 1) intervention studies (consisting of RCTs, quasi-experimental, implementation studies, case studies), and 2) primary care providers (including NPs, physicians, and physician assistants). Excluded were articles that focused on skin cancer but did not include information on head-to-toe skin examination, lesion assessment, risk assessment or did not include an intervention. The key terms used in each database search are in Table 1.

TABLE 1. *Intervention Studies for CSE Database Search and Key Terms.*

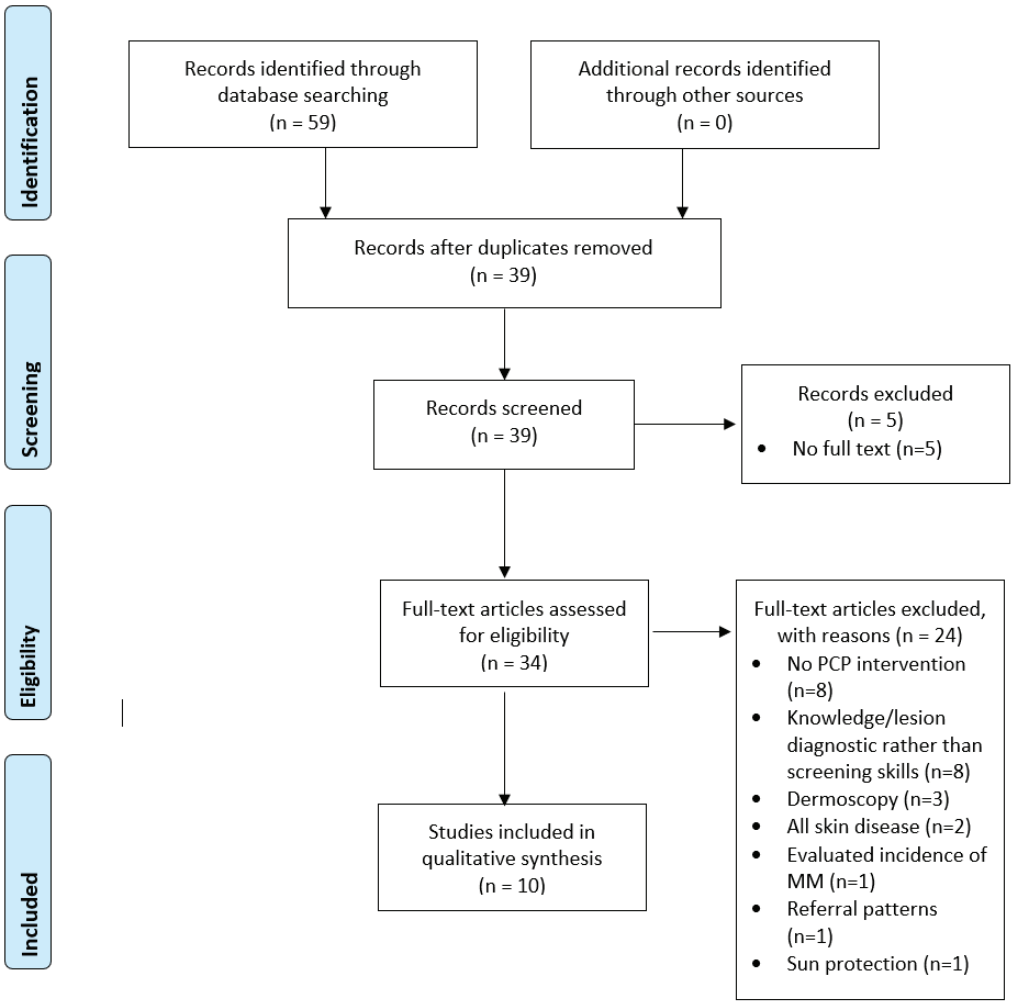
Database	Search Criteria	Results

PubMed	((“primary care nurse practitioners” OR “primary care physicians” OR “primary care physician’s assistants” OR “primary care providers” OR “primary care nurse” OR “general practitioners”) AND (“skin examination” OR “head-to-toe skin examination” OR “full body skin examination” OR “total body skin examination” OR “skin cancer risk assessment” OR “lesion detection” OR “lesion identification”))	Search Results: 57 Abstracts Relevant: 6
Google Scholar	(“nurse practitioners” OR “nurse”) AND (“skin cancer” OR “basal cell carcinoma” OR “squamous cell carcinoma” OR melanoma) AND (“skin examination” OR “skin cancer risk assessment” OR “lesion detection” OR “lesion identification)	Search Results: 428 Duplicates: 0 Abstracts Relevant: 9
Google Scholar	(“primary care physicians” OR “primary care providers”) AND (“skin cancer” OR “basal cell” OR “squamous cell” OR melanoma) AND (“skin examination” OR "risk assessment” OR “lesion detection” OR "lesion identification")	Search Results: 2530 Duplicates: 7 Abstracts Relevant: 22
Google Scholar	(“primary care physician’s assistants” OR “general practitioners”) AND (“skin cancer” OR “basal cell” OR “squamous cell” OR melanoma) AND (“skin examination” OR “skin cancer risk assessment” OR “lesion detection” OR “lesion identification)	Search Results: 642 Duplicates: 7 Abstracts Relevant: 2
CINAHL	((“primary care nurse practitioners” OR “primary care physicians” OR “primary care physician’s assistants” OR “primary care providers” OR “primary care nurse” OR “general practitioners”) AND (“skin cancer” OR “basal cell” OR “squamous cell” OR melanoma) AND (“skin examination” OR “skin cancer risk assessment” OR “lesion detection” OR “lesion identification”))	Search Results: 5 Duplicates: 1 Abstracts Relevant: 0 Full-Text Eligible: 0

Web of Science	((“primary care nurse practitioners” OR “primary care physicians” OR “primary care physician’s assistants” OR “primary care providers” OR “primary care nurse” OR “general practitioners”) AND (“skin cancer” OR “basal cell” OR “squamous cell” OR melanoma) AND (“skin examination” OR “skin cancer risk assessment” OR “lesion detection” OR “lesion identification”))	Search Results: 45 Duplicates: 5 Abstracts Relevant: 0 Full-Text Eligible: 0
Total		Full-Text Eligible for PRISMA: 59 Duplicates: 20

The literature search yielded 3,702 articles. The primary author used Google Scholar search terms to scan the titles and the abstract under the title. If these appeared to meet the inclusion criteria potentially, then the primary author retained these articles for further review. The title/description scan yielded a total of 59 articles. Duplicate articles were removed (n=20), yielding 39 articles. Then, the primary author read the full text of the articles to determine eligibility further. Articles that were not available in full text were not included due to concerns of accuracy, as the author would be unable to review the study in its entirety. Figure 2 shows the flow and articles yielded from this process. A total of ten articles were selected for data extraction. Data extraction was accomplished by both authors using the following categories: sample and setting, goals, components or activities, dose, and mode of delivery, and results. Data were extracted by the primary author and entered in the data table; the second author independently reviewed the articles and compiled the data table. These two authors reached consensus regarding the extracted data and categorization by comparing the data tables and making a decision regarding discrepancies.

FIGURE 2. Flow of literature review for CSE intervention studies.



Guiding Framework for Evaluating Interventions

Intervention clarifying elements, described by Sidani and Braden, as well as the concepts of efficacy, effectiveness, and dissemination of interventions, provided a framework for evaluating the interventions in articles selected for this review (Sidani & Braden, 2011a). The clarifying elements of an intervention are goals, components, dose, and mode of delivery (See Table 2).

TABLE 2. *Sidani & Braden's Clarifying Elements of the Intervention.*

Goal: focuses on what the intervention wants to achieve	Ultimate goal: reflects the problem's resolution or the prevention of the problem's consequences	Example: To promote the early detection and positive prognosis of MM
	Immediate goal: focuses on the problem's specific aspects (determinants that need to be changed to manage the problem)	Example: To educate NPs on how to identify melanoma risk factors
Component: a set of interrelated, specific and nonspecific strategies (or activities) that focus on a common goal	Specific strategies: the active ingredients that comprise the intervention or the elements that are estimated to bring about the intended change	Example: Provide information on melanoma risk assessment, clinical skin examination and skin lesion assessment
	Nonspecific strategies: facilitate the delivery of the active ingredients or are not estimated to produce the intended change	Example: Ability to open and view the educational intervention
Dose refers to the level of intervention delivered to create the intended changes in the targeted aspect of the problem. It is subdivided into amount, frequency and duration.	Amount: is the quantity of the intervention, often operationalized as the number and the length of the sessions or how long it takes a participant to read or view the material	Example: A two-minute video
	Frequency: the number of times the intervention is given over a specific time.	Example: Once over a two-week period
	Duration: total length of required for implementation of an intervention	Example: A two-week period
Mode of delivery is the medium, format and approach.	Medium: the means through which intervention strategies are implemented, for example, face-to-face or virtually.	Example: A virtual medium
	Format: the specific technique used within the selected medium to offer the intervention, such as print or video.	Example: Video

Approach: the manner an intervention is given: either tailored or standardized.	Standardized: giving the same components and activities at the same dose to all the participants Tailored: customizing the intervention to the participants' needs and characteristics.

Efficacy and effectiveness both determine the extent to which an intervention produces outcomes; however, they differ in emphasis and context. Efficacy focuses on internal validity (the validity of the inference based on whether the relationship between two variables is causal), whereas effectiveness focuses on external validity (the inference based on whether the relationship holds across different people, places, treatments, and measures) (Sidani & Braden, 2011b). Effectiveness focuses on a broad representative sample, different settings, and the assessment of relevant health outcomes (including social wellbeing and financial outcomes) (Sidani & Braden, 2011b).

Results

Presented in this section are the results of the systematic review as they pertain to the objectives and framework for evaluating interventions (see Table, Supplemental Digital Content, which outlines all reviewed articles). The ten selected articles from the search had the following designs and foci:

- two case studies of newly-developed nurse-led skin cancer surveillance clinics, NP and registered nurse respectively (Ali et al., 2014; Reece, Harden, Smith, & Ramsay, 2002),
- one pilot study assessing the feasibility of teaching NPs skin assessments and lesion recognition (Oliveria et al., 2001),
- one quasi-experimental (QE) study that focuses on teaching general practitioners (GPs) how to conduct a clinical skin examination to screen for MM (Burton et al., 1998),

- one QE study and one randomized controlled trial (RCT) evaluating an integrated skin examination video for medical students (Garg et al., 2014; Lofgreen, Lehrer, Bennett, Garg, & Dunnick, 2016),
- two QE studies and one RCT evaluating physicians' ability to detect skin cancer early and triage skin lesions (Harris et al., 2001; Markova et al., 2013; Mikkilineni et al., 2001),
- one QE study of clinical simulation for MM screening instruction (Haley et al., 2012).

Of the ten articles reviewed, eight focused on head-to-toe skin examination (Ali et al., 2014; Burton et al., 1998; Garg et al., 2014; Lofgreen et al., 2016; Markova et al., 2013; Mikkilineni et al., 2001; Oliveria et al., 2001; Reece et al., 2002), four focused on risk assessment (Garg et al., 2014; Harris et al., 2001; Lofgreen et al., 2016; Oliveria et al., 2001) and all ten included an activity for skin lesion assessment (suspicious vs nonsuspicious) (See Table, Supplemental Digital Content). Samples included NPs (Ali et al., 2014; Oliveria et al., 2001), GPs (Burton et al., 1998), medical students (Garg et al., 2014; Haley et al., 2012; Lofgreen et al., 2016), physicians (Harris et al., 2001), PCPs (Markova et al., 2013; Mikkilineni et al., 2001), a nurse (Reece et al., 2002) and PA students (Haley et al., 2012). Two articles provided detailed sample demographics of the samples. Only Haley et al. (2012) and Markova et al. (2013) provided the sample gender and age range. Seven articles disclosed their physical settings as clinical practices (Ali et al., 2014; Burton et al., 1998; Reece et al., 2002) or academic settings (Garg et al., 2014; Haley et al., 2012; Lofgreen et al., 2016; Oliveria et al., 2001). Three articles

had virtual settings (Harris et al., 2001; Markova et al., 2013; Mikkilineni et al., 2001). Two articles provided no demographic information (Ali et al., 2014; Reece et al., 2002).

Intervention Goals

Among the articles, the intervention goals varied from general goals, such as preparing a NP to run a weekly one-stop transplant-dermatology surveillance clinic (Ali et al., 2014), to more specific goals, such as to improve the skills, confidence, attitude and knowledge of PCPs regarding skin cancer control with a focus on early detection of MM (Markova et al., 2013). Only one article specified the intervention's objectives, or immediate goals, separately from the purpose of the study (Reece et al., 2002).

Intervention Components and Activities

No articles had definitions of the intervention components; instead, the authors mentioned individual specific activities or strategies performed. All ten interventions had a didactic portion (e.g., review of epidemiology or skin lesion management). Four articles reported an intervention with a clinical portion (Ali et al., 2014; Reece et al., 2002), such as shadowing clinicians in a melanoma clinic (Burton et al., 1998) or a clinical apprenticeship with a dermatologist (Oliveria et al., 2001). One article reported using feedback from the NP's prior dermatology referrals to guide her education (Ali et al., 2014) and one article reported group discussion to score each presented lesion on a patient mannequin (Haley et al., 2012). Two articles did not specify the specific strategies of the didactic portion of their intervention (Ali et al., 2014; Haley et al., 2012). No articles specified how they taught or recommended conducting head-to-toe skin examination or risk assessment. For skin lesion assessment, the procedures taught were the ABCDE rule (Garg et al., 2014; Haley et al., 2012; Harris et al., 2001; Lofgreen

et al., 2016) and the ugly duckling sign (Garg et al., 2014; Lofgreen et al., 2016). Six articles did not specify the strategy for conducting skin lesion assessment (Ali et al., 2014; Burton et al., 1998; Markova et al., 2013; Mikkilineni et al., 2001; Oliveria et al., 2001; Reece et al., 2002).

Intervention Dosing

The dosing amount varied for each intervention, with the number of overall education sessions ranging between one to three and the length of one session ranging from 14 minutes (Garg et al., 2014; Lofgreen et al., 2016) to six months (Ali et al., 2014; Reece et al., 2002). Some authors did not disclose the length of their didactic sessions (Haley et al., 2012; Oliveria et al., 2001; Reece et al., 2002). While the articles did not specify timing and frequency, most sessions occurred one time. The only article where the frequency was ambiguous was a study of competency-based objectives in which the authors did not specify frequency, but rather focused on meeting a predetermined set of standards (Reece et al., 2002). For the studies that included more than one session or also included a clinical, feedback, or group portion, the duration of the intervention was not clear because the authors did not specify the length of these sessions (Ali et al., 2014; Burton et al., 1998; Haley et al., 2012; Oliveria et al., 2001). The intervention conducted by Reece et al. (2002) is an exception: their intervention ended when participants achieved competency in full skin examination, identification of lesions requiring further dermatologic follow-up, and the documentation and referral process at six months.

Intervention Mode of Delivery

To deliver the intervention, seven articles reported using a face-to-face medium (Ali et al., 2014; Burton et al., 1998; Garg et al., 2014; Haley et al., 2012; Mikkilineni et al., 2001; Oliveria et al., 2001; Reece et al., 2002). Of the three articles that used a virtual medium, all

three studies used internet websites (Harris et al., 2001; Lofgreen et al., 2016; Markova et al., 2013); Harris et al. also used an internet portal and email (2001). The most common formats used in the interventions were observation by experts (Ali et al., 2014; Burton et al., 1998; Oliveria et al., 2001), and face-to-face lectures (Burton et al., 1998; Mikkilineni et al., 2001; Oliveria et al., 2001). Videos were the second most common format (Garg et al., 2014; Lofgreen et al., 2016). Regarding approach, one intervention was individually tailored (Reece et al., 2002) and six were standardized (Garg et al., 2014; Harris et al., 2001; Lofgreen et al., 2016; Markova et al., 2013; Mikkilineni et al., 2001; Oliveria et al., 2001), with each participant receiving the same intervention. One intervention approach was mixed, with a standardized intervention and tailored group discussion (Haley et al., 2012) and two intervention approaches were not specified (Ali et al., 2014; Burton et al., 1998).

Efficacy and Effectiveness

No authors evaluated the effectiveness or demonstrated reproducibility of results under less controlled settings of the natural setting. Rather, the authors focused primarily on efficacy—demonstrating a causal relationship between the chosen outcomes and the intervention (Sidani & Braden, 2011b).

CSE Outcomes. During the first two years of implementing the nurse-led surveillance clinic, Ali et al. (2014) found that 18.3% of the participating NP's patients (n = 828) had treatment for precancerous lesions while 6.2% were treated for nonmelanoma skin cancer (NMSC). Before the clinic, these patients would not have received skin surveillance and would not have been efficiently diagnosed and treated within this timeline (Ali et al., 2014). Two studies tested outcomes of the Integrated Skin Examination (ISE) Video, which is an educational

film created by the Integrated Skin Exam Consortium (Garg et al., 2014). The goal of the ISE is to increase awareness of persons at risk for MM and most common anatomical sites of MM. It also looks to promote routine integration of the skin exam and the identification of suspicious pigmented lesions (Garg et al., 2014). The ISE is integrated around the physical exam during a primary care visit. For example, the skin of the back is inspected while auscultating lung sounds. After viewing the video, medical student participants agreed/strongly agreed that they felt confident when conducting an ISE; with the percentage of students reporting confidence significantly increasing from pre- to post-intervention (16.40% to 66.93% ($p < 0.001$) (Garg et al., 2014) and 6.9% to 52.2% ($p < 0.001$) (Lofgreen et al., 2016). The medical students also demonstrated an increased percentage of correct answers related to the ABCDE rule (91.2% to 98.4%, $p < .001$) (Garg et al., 2014). Approximately 97% of the medical students also reported being somewhat/very likely to integrate ISE into routine physical exams ($p < 0.001$) (Lofgreen et al., 2016).

The Basic Skin Cancer Triage curriculum (BSCT) was developed to increase the ability of PCPs to confidently and accurately triage skin lesions and counsel patients on their skin cancer concerns (Mikkilineni et al., 2001). In the original study of the BSCT by Mikkilineni et al. (2001), attitudes about head-to-toe skin examination significantly improved (4.2 to 4.6, $p < 0.0001$) (on a scale of 1 – 5, 5 = strongly agree) and self-reported screening practice increased (2.10 to 3.22, $p < 0.0001$) (on a scale of 1 – 5, 5 = almost always"). Markova et al. (2013) later created a web-based learning version of the BSCT. Physicians were more likely to perform a head-to-toe skin examination, with their scores increasing from 3.2 to 4.0 (on a scale of 1 – 4, 4 = performed) ($p = .04$) and reported increased confidence in performing head-to-toe skin

examination, with scores increasing from 3.0 to 3.6 (on a scale of 1 – 5, 5 = strongly agree) (p = .03) (Markova et al., 2013).

Risk assessment. Garg et al. (2014) found that medical students were more likely to identify demographic groups at high risk for MM post-intervention after viewing the ISE video (42.9% vs. 61%, $p < 0.001$). Using the same video, Lofgreen et al. (2016) also showed improvement in identifying high-risk demographic groups (58.9% vs. 79.3%, $p < 0.001$). Harris et al. (2001) evaluated risk assessment through self-reported confidence and knowledge about risk assessment. The knowledge items were not specified, and the authors indirectly measured risk assessment confidence. For example, the participants rated the item "I believe that many of my patients are at risk of developing skin cancer" (Harris et al., 2001). Oliveria et al. (2001) alluded to a prior written knowledge test conducted in 1999 with the participants; however, they did not mention the evaluation of these items, and we could not find the article. Mikkilineni et al. (2001) indirectly assessed risk factor assessment through participant confidence.

Skin lesion assessment. The assessment of sensitivity for correctly identifying a MM was significantly different between trained (0.50, 95% CI 0.37 to 0.63, p=.04) and untrained GPs (0.34, 95% CI 0.22 to 0.46, p=0.04) (Burton et al., 1998). However, the mean sensitivity for correctly identifying suspicious pigmented lesions was the same for the trained GPs (0.73; 95% CI 0.69 to 0.77) and untrained GPs (0.71; 95% CI 0.64 to 0.78) (Burton et al., 1998). Student PAs' identification of MM using the ABCDE rule significantly increased following the intervention (p = .035) while 67% of PA students (n = 30) and 10% of medical students (n = 29) identified all MMs (Haley et al., 2012). After the ISE video, medical students' knowledge of the ABCDE rule did not significantly improve from pretest to posttest (95.2% vs. 97.8%, p = 0.24)

(Lofgreen et al., 2016). Garg et al. (2014) showed similar scores (91.2% vs., 98.4%); however, they did not report statistical significance. Harris et al. (2001) found that physicians felt "considerably" more confident in evaluating pigmented lesions, including MM, after completing the intervention.

Dissemination

None of the articles addressed the dissemination of the intervention.

Discussion

This systematic review uncovered a variety of deficits in CSE education interventions reported in the literature. The review yielded only ten articles that focused on CSE (skin cancer risk assessment, head-to-toe skin examination, and skin lesion assessment), with no limitation on publication date. Three of the ten articles were published within the past five years; this paucity highlights the insufficient education CSE opportunities available—particularly for NPs. Other systematic reviews focusing on skin cancer and NPs drew similar conclusions (Loescher et al., 2011; Loescher et al., 2018). Sample demographics were also missing for most of the articles. Only Markova et al. (2013) and Haley et al. (2012) documented the gender and age of their participants. Most of the studies were conducted in urban settings, making them less accessible to rural practitioners. The lack of sample demographics is a concern because the reader is unable to confidently interpret external validity—whether the interventions are generalizable to other NPs with certain demographic or practice characteristics.

Along with the lack of studies focusing on CSE education, the authors did not clearly outline or discuss educational interventions. Specification of an intervention, regarding its goals, components, activities, and modes of delivery and doses, serves a variety of important purposes.

Specification clarifies the active ingredients of the intervention, which helps form the basis for developing or selecting instruments and monitoring the fidelity of intervention implementation in specific groups and settings (Sidani & Braden, 2011a). While many of the articles provided the length of the intervention sessions, there was a lack of clarity on the frequency and duration of the interventions. Most interventions also did not incorporate specific goals or objectives in their didactic sessions; instead, they addressed the general goals of the study. Specific, measurable goals provide more clarity for researchers to determine whether they met the objective and if the intervention fulfilled its intended purpose (Farrugia, Petrisor, Farrokhyar, & Bhandari, 2010). Clear goals also guide intervention design and its components and activities; otherwise, an intervention may incorporate activities that negatively impact or distract from the objective (Sidani & Braden, 2011a). Nine studies used a verbal medium to deliver their intervention. Within a verbal medium, healthcare providers facilitating the intervention become the medium, and their characteristics and behaviors influence the implementation of the intervention (Sidani & Braden, 2011a). To avoid this potential bias, treatment manuals or standardized protocols are created to regulate the information that the participants are receiving (Ibrahim, 2016); however, none of the articles discussed either of these procedures. For example, Oliveria et al. (2001) included five to six hours of supplemental lectures that were created by each participant's dermatology clinical preceptor. These supplemental lectures potentially skewed the causal relationship between the intervention and the measured outcomes (Oliveria et al., 2001). Consequently, the reader is unsure if the positive results are because of the intervention, or the ability of the clinical preceptor. Another potential bias in the articles was past skin cancer knowledge. Two articles discussed prior dermatology experience but did not specify the amount

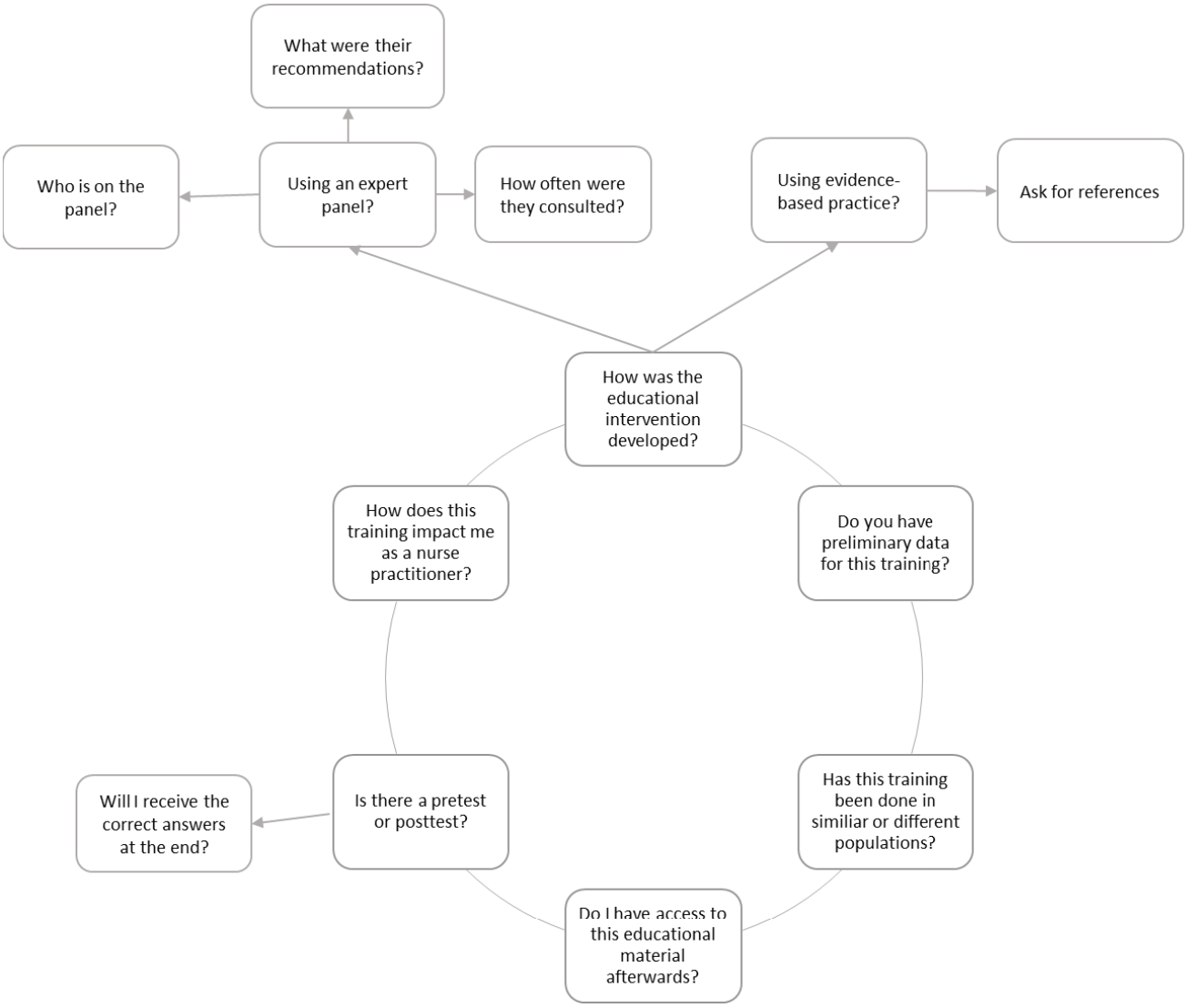
of knowledge or past dermatological experience and had no pretest (Ali et al., 2014; Reece et al., 2002). Only Oliveria et al. (2001) stated that their participants had no prior knowledge of identifying suspicious lesions and Markova et al. (2013) collected participant's self-reported dermatology education.

The findings from some of these studies require further scrutiny as well. For example, the clinical significance of findings from the BSCT interventions is questionable. While the results may be statistically significant, self-reported screening practice increased from "sometimes" (score=2.04) to "about half" (score=2.96) (Mikkilineni et al., 2001). Therefore, participants reported that they would only perform a CSE on a high-risk patient less than half of the time. The results of the web-based learning version of BSCT are less promising. Markova et al. reported their confidence scale as a Likert scale from 1-5, with 1=not confident and 5=extremely confident (2013). The authors reported increasing confidence; however, their participants fall between scores of 3 and 4, which depict "every once in a while" and "sometimes." The authors also stated that the web-based learning version of the BSCT was ineffective (Markova et al., 2013). When testing for medical students' knowledge of the ABCDE rule, both Lofgreen et al. (2016) and Garg et al. (2014) had similar, high scores before and after the intervention. This phenomenon is an example of the ceiling effect, indicating that they had high levels of knowledge at pretest (Powers, Knapp, & Knapp, 2010).

All ten reviewed articles focused on efficacy, or the demonstration of a causal relationship between the intervention and the outcome (Sidani & Braden, 2011b). The objective of efficacy studies is to isolate the casual intervention from other, confounding factors to prove that the intervention works under ideal circumstances. This is understandable, as authors have to

demonstrate that their chosen intervention is responsible for an intended outcome before implementing the intervention in different settings or populations (otherwise known as effectiveness studies). Confounding variables inhibit the accurate efficacy assessment of the different CSE interventions. None of the articles assessed the usability or the feasibility of their interventions. It behooves NPs to choose their educational interventions wisely before participating, by asking questions about the interventions' efficacy and effectiveness. Figure 3 provides examples of questions that NPs can ask to assess an educational intervention and to receive the most benefit out of an intervention. Dissemination was also not discussed in any of the ten reviewed articles. Dissemination differs from the mode of delivery in that it focuses on spreading knowledge and the associated interventions via determined channels using planned strategies (Rabin, Brownson, Haire-Joshu, Kreuter, & Weaver, 2008).

FIGURE 3. NP's Guide to Informed Decision Making—Choosing an Educational Intervention



Potential biases of our systematic review process are incomplete retrieval of identified research and reporting bias. Google Scholar searches yielded over 3,000 articles. While the searches included a variety of different studies (thereby reducing publication bias), there is the potential for the incomplete retrieval of identified research due to the high volume of articles and inability to find the full text of five articles. These five articles were excluded because the author was unable to accurately assess the studies' methods, results and whether the studies met the inclusion/exclusion criteria. Reading-induced visual fatigue can contribute to the incomplete

retrieval of research; therefore, the primary author planned breaks between searches. One way to counteract this bias is to include a librarian on the search review team to help retrieve full-text articles and reduce visual fatigue. Strengths included the use of PRISMA criteria and both authors' expertise in skin cancer prevention and education.

Conclusion

In conclusion, there remains a substantial gap in the literature about educational interventions for CSE education (head-to-toe skin examination, skin cancer risk assessment, and skin lesion assessment), particularly targeting NPs. None of the articles described how investigators taught or recommended conducting CSE; in fact, the articles provided very little content about the procedures. Some articles provided the general topics outlined in their interventions while just two provided the link to the interventional video used. Not only is the literature lacking in quantity, but the current research falls short on the strong implementation of interventions with internal and external validity. The interventions yielded in this search have vague goals, do not outline the frequency or duration of their interventional strategies, and do not implement any treatment manual or standardized intervention protocols. However, while the intervention efficacy is questionable, the overall outcomes of each study were positive.

Implications for Practice

To meet the Surgeon General's goal of addressing the alarming rate of skin cancer, performing CSE is well within the scope of NP practice. This systematic review provides valuable information about existing CSE interventions that the NPs can use to determine what education may be available and which education may provide the best CSE learning opportunities. However, the lack of dissemination of these educational interventions likely renders them inaccessible to NPs. The systematic review also builds a foundation for more rigorously developed interventions that could improve MM evaluation and detection, and ultimately the prognoses of patients with MM. For example, based on the findings of this systematic review, the primary author used Sidani, and Braden's clarifying elements to guide the development of a brief, virtual CSE education for NPs and will explore whether the intervention improves their CSE skills and motivates the use of these skills in clinical practice.

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SUPPLEMENTAL DIGITAL CONTENT TABLE *Educational intervention studies for CSEs*.

Author(s)	Sample / Setting	Goals	Components / Activities	Dose / Mode of Delivery	Results
Ali, Samarasighe, Russell & Lear (2014)	• Transplant advanced NP (n=1) Demographics not specified • Manchester Regional renal and pancreas transplant unit	Train a NP to run a weekly one-stop transplant-dermatology nurse-led surveillance clinic that provided skin surveillance and regular education on photo protection	• Feedback from dermatology referrals from the preceding years • Masters-level module, content not specified • Period of observation of general dermatology clinics	**Dose:** • Amount: six months for the module, not specified for feedback and observation • Frequency: not specified • Duration: not specified **Mode of Delivery:** • Medium: face-to-face for dermatology clinic, unknown for module and feedback • Format: observation • Approach: not specified **Dissemination:** not specified	During the first 2 years, of 828 patients seen, 18.8% had treatment for precancerous lesions; 6.2% had a NMSC
Burton et al. (1998)	• GPs (n=69) • General practice at the University of Newcastle • Reside within one hour's drive of the	To increase GPs' accuracy of diagnosis of MM in people presenting with suspicious	• Lecture on the epidemiology, diagnosis, management of MM with projected color slides of lesions and case studies • Individual attendance at a three to four-hour	**Dose:** • Amount: three hours for lecture, three to four hours at specialist clinic, not specified for surgical clinic • Frequency: one time • Duration: not specified **Mode of Delivery:** • Medium: face-to-face	• Trained GPs had a sensitivity of 0.98 to detect suspicious lesions and untrained GPs had a sensitivity of 0.95

	John Hunter Hospital	pigmented lesions	specialist clinic involving examination of newly referred patients and follow up of patients with treated MM • Session in a private surgical outpatient clinic where GP skills in the diagnosis of all types of skin cancers and their surgical excision are reviewed	• Format: lecture, observation for specialist/surgery clinic • Approach: not specified **Dissemination:** not specified	• Little difference between trained and untrained GPs in detection of suspicious pigmented lesions • Detection of MM was significantly different between trained and untrained respectively (0.50, 95% CI 0.37 to 0.63; and 0.34, 95% CI 0.22 to 0.46, p = 0.04)
Haley et al. (2012)	• First year PA students (n=30) and third year medical students (n=29) • First year PA students Mean age 28 years (range 23-34)	To make students comfortable assessing benign and clinically suspicious pigmented lesions	• Taught ABCDE algorithm/score for visual lesion assessment and management • In groups of three–four, students evaluated 25 lesions on the melanoma trainer module (12) benign nevi [moles], two melanomas, one	**Dose:** • Amount: not specified for the module, unknown for group discussion • Frequency: once for each session • Duration: not specified **Mode of Delivery:** • Medium: face-to-face • Format: group discussion • Approach: not specified **Dissemination:** not specified	• 20 PA students (67%) and three medical students (10%) identified all melanomas • PA student identification of MM for biopsy significantly increased (p = .035)

	Female (77%) • Third year medical students Mean of 24 years of age (range 23-31) Male (73%) • Northwestern University Feinberg School of Medicine		melanoma in situ, 10 lentigos [freckles]) and assigned a score to each feature to determine whether to biopsy		• Medical students: increase in identifying all MM for biopsy was not significant (p = .063)
Garg et al. (2014)	• Second year medical students (n=1138) • 32% from University of Texas Southwestern Medical School, 25.8% from Boston University School of Medicine and 15.9% from Stony Brook University,	Increase MM knowledge and confidence conducting CSE	• Instructional film that focused on: identifying at-risk demographic groups, most anatomical sites for MM, "ugly duckling" sign, ABCDE, integrated skin exam, and testimonial of patients with MM	**Dose:** • Amount: 14 minutes • Frequency: one time • Duration: not specified **Mode of Delivery:** • Medium: face-to-face, virtual • Format: video • Approach: standardized **Dissemination:** not specified	• Increased correct answers of knowledge questions related to identification of high-risk demographic groups (61% vs 42.9%, $p <$ 0.001) and to the ABCDEs (98.4% vs 91.2%, $p <$ 0.001) • Increased confidence when examining the skin for skin

	6.3% from University of Connecticut School of Medicine, 4.1% from University of Utah				cancer (66.93% vs 16.40%, $p < 0.001$)
Harris, Salasche & Harris (2001)	• Physicians (n=354) • 65% active primary care, 22% nondermatology referral specialties, 10% not in active practice and 2% in active dermatology • Online setting	Increase physicians' confidence in managing pigmented skin lesions, increase skin cancer knowledge and improve physicians' decision-making skills	• Four online modules on early recognition of MM, management of skin cancer risk factors, skin cancer prevention strategies and recognition of benign pigmented lesions	**Dose:** • Amount: six hours of AMA CME credit • Frequency: not specified • Duration: six weeks **Mode of Delivery:** • Medium: virtual • Format: online lecture with case studies • Approach: standardized **Dissemination:** not specified	• Physicians felt "considerably" more confident in evaluating pigmented lesions, including MM • 9% improvement on the vignettes answered correctly ($p < 0.001$)
Lofgreen, Lehrer, Bennett, Garg & Dunnick (2016)	• First year medical students (n=142) • University of Colorado School of Medicine	To teach an integrated skin exam. Purpose is to identify high-risk patients &	• Video teaches the integrated skin examination and includes how to identify high-risk patients, and document anatomical areas where a skin exam can	**Dose** • Amount: 14 minutes • Frequency: once • Duration: 14 minutes **Mode of Delivery** • Medium: virtual • Format: video	• 52.2% agreed or strongly agreed that they felt confident examining the skin for skin cancer ($p < 0.001$)

		perform skin examination in conjunction with a routine physical exam	be performed during a routine physical exam	• Approach: standardized **Dissemination:** not specified	• 97.8% were somewhat or very likely to integrate CSE into routine physical exams ($p < 0.001$)
Markova et al. (2013)	• Physicians (n=57) Male (73%) > 46 years of age (41%) • White (82%) At least 75% of time in primary care Practice for at least 1 year MD (86%) Family medicine (91%) 6-15 years in practice (45%) No previous dermatology	To improve the skills, confidence, attitude and knowledge of PCPs regarding skin cancer control with a focus on early detection of MM	• General skin introduction and epidemiology, clinical characteristics of skin lesions and the BSCT algorithm (pattern recognition, differentiation between benign/malignant), TBSE performance, clinical counseling on skin cancer, teaching the thorough skin self-examination to patients, development of office systems to facilitate skin examinations	**Dose:** • Amount: two hours • Frequency: once • Duration: two hours **Mode of Delivery:** • Medium: virtual • Format: lecture, otherwise not specified • Approach: standardized **Dissemination:** not specified	• More likely to perform a CSE at an annual exam (4.0 vs 3.2, $p = .04$) • Less likely to refer patients to a dermatologist for issues relating to skin cancer (2.1 vs 2.7, $p = .02$) • Greater confidence in performing a CSE for skin cancer prevention (3.6 vs. 3.0, $p = .03$)

	training (68%) • From Mid-Atlantic, Ohio, Kansas and Southern California				
Mikkilineni, Weinstock, Goldstein, Dube & Rossi (2001)	• Primary care physicians (n=22) Demographics • Southeastern New England	To increase PCPs' ability to accurately and confidently triage skin lesions and to counsel patients on skin cancer issues	• Packet containing the lecture outline, the BSCT algorithm, skin cancer information pamphlets, review articles • BSCT lecture on skin cancer epidemiology, clinical characteristics and diagnosis, prevention and counseling approaches along with instruction and role play for counseling	**Dose:** • Amount: two hours • Frequency: once • Duration: not specified **Mode of Delivery:** • Medium: written, verbal • Format: pamphlet, face-to-face lecture • Approach: not specified **Dissemination:** not specified	• Attitudes about CSE improved significantly (4.2 to 4.6, $p <$ 0.0001) • Self-reported screening practice increased from 2.10 to 3.22 ($p <$ 0.0001) [2 = sometimes, 3 = about half] • Increased skin exams to the back (OR 1.6: 95% CI, 1.1 to 2.4, $p = .003$), belly (OR 1.8: 95% CI, 1.2 to 2.6, $p < .0001$), and legs (OR 2.4: 95% CI 1.5 to 4.0, $p < .001$)

Oliveria et al. (2001)	• NPs (n=4) • Guttman Diagnostic and Wellness Centers at Memorial Sloan Kettering Cancer Center • No past experience in evaluating skin lesions • No other demographics reported	To teach skin assessment and recognition of suspicious lesions	• Workshop on risk assessment, skin examination technique, identification of suspicious lesions, criteria for referral, patient education about sun protection and skin self-examination • Clinical apprenticeship on patient screening examinations • Supplemental lectures during clinical training	**Dose:** • Amount: not specified for workshop, five to six hours of supplemental lecture, four months for apprenticeship • Frequency: not specified • Duration: not specified **Mode of Delivery** • Medium: verbal • Format: face-to-face lectures, observation • Approach: standardized, tailored **Dissemination:** not specified	• High sensitivity/specificity for lesions that look like MM (100.0, 99.95) respectively • High sensitivity/specificity for lesions concerning for MM or NMSC but with low potential for morbidity (100.0, 99.73) respectively
Reece, Harden, Smith & Ramsay (2002)	• Registered nurse (n=1) • 12 years of experience in hospital-based general dermatology	To teach the following objectives: full skin examination, identification of lesions requiring dermatologic assessment, documentation and	• Worked with a dermatologist for a six-month period • Supplemental background reading and discussion • Tested throughout until competency was reached according to the Post Registration Education Program Requirements	**Dose** • Amount: not specified • Frequency: not specified • Duration: until competency was met (occurred after six months) **Mode of Delivery:** • Medium: verbal, written • Format: face-to-face lectures, observation, reading • Approach: standardized, tailored **Dissemination**: not specified	• "Remains to be shown whether, with adequate training, nurses from other disciplines can meet the criteria for the role" • No results collected

		referral process			

APPENDIX C:

MANUSCRIPT #3:

THE FEASIBILITY OF A THEORY-BASED ONLINE MICROLEARNING SYSTEM TO EDUCATE NURSE PRACTITIONERS ABOUT CLINICAL SKIN EXAMINATION FOR MELANOMA

(For submission to *The Journal of Medical Internet Research*)

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The Feasibility of a Theory-based Online Microlearning System to Educate Nurse Practitioners About Clinical Skin Examination for Melanoma

An Original Paper Submission

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Abstract

Background: Skin cancer is the most common cancer, and survival of the most serious skin cancer, malignant melanoma (MM) depends on early detection. Early detection relies on accessibility to clinical skin examination (CSE). Primary care nurse practitioners (PCNPs) are well-positioned to engage in early detection; however, they may lack the skills, time and motivation to conduct CSE.

Objective: The purpose was to explore the feasibility of implementing and developing a newly developed online microlearning system for PCNPs to improve their CSE skills and motivate the use of these skills in clinical practice. Microlearning is the use of short-term, informal learning activities using small, but self-explanatory learning resources. Specific aims were 1) to develop three theory-based, brief skin cancer videos with content on comprehensive CSE skills that are suitable for online delivery to PNCPs in various formats (e.g., mobile phone, tablet, and computer) and 2) to determine enrollment and retention rates, intervention adherence, and acceptability and usability of the intervention following completion of the one-week intervention. Aim 1 focus on a) content validity, b) the integration of the Vimeo videos and surveys into Research Electronic Data Capture (REDCap) and c) digital delivery.

Methods: For Aim 1, the primary investigator (PI) created storyboards for three videos that address each skill involved in a CSE. Each video contained recordings of the PI demonstrating and describing different skills. Videos were delivered via REDCap and Vimeo. A dermatology expert panel reviewed the videos based on relevance, comprehension, and clarity (Content Validity Index), and evaluated the usability of the

microlearning approach (Brooke's System Usability Scale [SUS]) and technical video production (Beaudin's Quality Evaluation of Video). For Aim 2, the videos were delivered to a sample of 10 PCNPs recruited from a state NP conference and meeting. Enrollment and retention rates were assessed based on metrics from previous studies of CSE in the literature, and intervention adherence. Usability and acceptability were assessed using SUS and the Attitudes toward Web-based Continuing Learning Survey respectively.

Results: Three theory-based, short skin cancer videos on comprehensive CSE were developed and content validity was assessed. Second round CVI scores include: Video 1 (relevance, $M = 3.84$; Clarity, $M = 3.83$), Video 2 (relevance, $M = 3.78$; clarity, $M = 4$) and Video 3 (relevance, $M = 3.89$; clarity, $M = 4$). The integration of REDCap and Vimeo was exceptional (SUS = 95) and the digital delivery of the videos was exceptional on all five technical items ($M = 5$). Ten PCNPs were recruited and enrolled. Enrollment rate was low (35%), whereas retention rate (83%) and intervention adherence (≥ 50%) were high. Participants rated the usability as "better" ($M = 85.8$, $SD = 10.6$) and also favorably ranked acceptability constructs *perceived usefulness* ($M = 5.26$ $SD = 0.08$, $\alpha = .88$), *perceived ease of use* ($M = 5.40$ $SD = 0.41$, $\alpha = .46$), *behavior* ($M = 5.53$ $SD = 0.12$, $\alpha = .85$) and *affection* ($M = 5.77$ $SD = 0.04$, $\alpha = .99$).

Conclusions: Findings indicate that the use of the videos is feasible as a microlearning approach for delivering brief CSE training to PCNPs. The findings also provide support for using the videos for an intervention in a future pilot randomized trial.

Keywords: "Microlearning," "Clinical Skin Examination," "Primary Care," "Nurse Practitioners," "Melanoma," "Skin Cancer," "Information, Motivation, Behavioral Model"

Introduction

The incidence of the deadliest skin cancer, malignant melanoma (MM), has doubled in the United States over the past 20 years.[1] An estimated 96,480 new cases of MM will be diagnosed in 2019 and 7,320 deaths will be caused by MM.[2] Secondary prevention, such as early skin cancer screening and detection, improves MM prognoses. Early detection leads to a greater proportion of removal of thin MM (< 2 mm in thickness), which is associated with better outcomes.[3-5] CSE requires training, however there is currently a shortage of dermatologists. The U.S. has an average of just 3.6 dermatologists per 100,000 people.[6,7] This ongoing shortage has not changed in the last 30 years, regardless of the increasing incidence of skin cancer.[8-10] Thus patients could benefit from availability of more practitioners to conduct CSE. This manuscript describes feasibility testing of a brief CSE training intervention for nurse practitioners (NPs).

Problem

The NP role was created in the 1960s, in response to the increased demand for primary care (particularly in rural and inner-city settings); NP employment is expected to increase 35.5% over the next decade.[11] NPs are prepared to practice as primary care NPs (PCNPs) and acute care NPs.[12] Thus, NPs have the opportunity to play a vital role in skin cancer early detection, but they lack confidence and skills to perform CSE or lesion identification.[13,14] In one study, only 20% to 30% of NPs reported completing CSE on patients during annual visits, along with skin cancer prevention counseling and referrals to dermatologists.[15] Most NPs are not confident with basic dermatology exams following their education from their NP program; only 16% believe they are prepared to conduct a

dermatology assessment.[16] NPs have demonstrated low ability to distinguish lesions that are suspicious for MM from nonsuspicious lesions; [13,14] a majority of NPs would rather refer any skin lesion to a specialist.[16] Although NPs' confidence in CSE is lacking, they believe that primary care providers, in general, help to detect skin cancer early.[15]

NPs desire more training and resources about skin cancer training. NPs find skin cancer training to be relevant and are likely to refer peers to a skin cancer educational intervention.[17,18] Findings from a descriptive study[19] indicated that NPs want additional learning activities related to MM. However, a conclusion from a systematic review [14] was that there are minimal CSE activities for NPs and the activities that exist were poorly reported.. The majority of recent NP CSE-focused interventions have small sample sizes (e.g., ranging from 1 to 30),[20-23] are lengthy (e.g., 14 weeks to 6 months),[20] or do not describe the NP's dermatological training.[20-23] Fewer interventions had modules lasting under an hour (15-45 minutes) or were self-directed (reviewing pamphlets, posters, and two presentations).[17,18,24] Dermatology training in academic NP programs only offers three to eight hours of didactic units that relate to dermatology.[16] There is only one recognized NP skin cancer program in the U.S: a post-masters, non-degree fellowship.[25] Certificates are offered by professional organizations such as the Dermatology Nurses Association's Dermatology Certified Nurse Practitioner program and the National Academy of Dermatology Nurse Practitioner's postgraduate certification program. [26,27]

The format for learning is also important to NPs. These practitioners prefer to learn via pocket reference guides (52.2%), online learning activities (46.3%) and chapter meeting presentations (44.5%), as compared to poster presentations (4.8%), self-study

cases (18%) and brochures (20.2%).[19] Health education materials are often traditional teaching resources, such as PDF documents and slides, that are reorganized to be easily accessible on the Internet.[28] However, the disadvantage of this approach is that learners prefer to have access to multiple sources of information (such as video), rather than just PDFs or slides.[29] Compared to standard online curricula, microlearning videos only require a few minutes—an appealing consideration for a healthcare provider's hectic schedule. Therefore, the intervention for this study was guided by microlearning: an innovative strategy to deliver information quickly to participants over short periods.

Purpose Statement

The purpose of this study was to explore the feasibility of delivering and developing a microlearning intervention to educate PCNPs about comprehensive CSE for MM**.** The intervention videos cover comprehensive CSE skills, defined as MM risk assessment, head-to-toe skin examination, and pigmented lesion assessment. The specific aims of the study were:

Aim 1: To develop three theory-based, short skin cancer videos with content on comprehensive CSE for MM that are suitable for digital delivery to PNCPs in various formats (e.g., mobile phone, tablet, and computer).

Aim 1a: To assess the content validity of the intervention content using an established method and expert panel of three dermatologists.

Aim 1b: To assess the integration of the videos and surveys into Research Electronic Data Capture (REDCap) by evaluating with three dermatologists using Brooke's System Usability Scale (SUS).

Aim 1c: To assess the digital delivery of the videos using Beaudin's Quality Evaluation of Video (QEV).

Aim 2: To determine enrollment and retention rates, intervention adherence, and acceptability and usability of the intervention following completion of the one-week intervention.

Hypothesis 2.1: The enrollment rate will be equal to or better than 60%. Enrollment rates for Internet-based interventions vary between 0.03% and 15%.[30-32] However, in-person enrollment rates are higher than on the Internet. For example, in an eight-week feasibility study using in-person enrollment, 23 women were screened, and 14 were enrolled (60%).[33]

Hypothesis 2.2: Retention rates will be equal to or greater than 50%. This rate was based on retention rates reported in a literature review that averaged a retention rate of 53% (with the length of interventions ranging from 2 weeks to 12 months).[34]

Hypothesis 2.3: Intervention adherence will be equal to or greater than 50%. This rate was based on intervention adherence rates reported in a literature review that that averaged a range of 50% adherence.[34]

Hypothesis 2.4: Usability scores will be equal to or higher than 70, based on an empirical evaluation of ten years of SUS data.[35]

Hypothesis 2.5: Acceptability scores will be equal to or higher than 5, based on Attitudes towards Web-based Continuing Learning Survey (AWCL).[36]

Conceptual Framework

The conceptual framework for this study was microlearning. Microlearning, otherwise known as "bite-size" learning, is a new teaching and learning perspective, that emphasizes the "minute."[37] It is defined as "special moments or episodes of learning while dealing with specific tasks or content and engaging in small but conscious steps."[37] Research findings document that the use of short content may increase information retention by 20%.[38] Microlearning utilizes platforms such as mobiles and computers and falls under online-based learning.[39] Microlearning is for users who have difficulty creating the time to engage in long stretches of learning activities outside of dedicated study times and institutional programs.[39] Microlearning may be another educational framework for NPs that allows for the dissemination of short, meaningful knowledge.

Operational Transparency

The principal investigator (PI) conducted a systematic review that included rigor of previous CSE interventions[40] using Sidani and Braden's clarifying elements (goals, components, activities, dose, and mode of delivery)[41] to provide transparency to the operational aspect of the video intervention. The goal of the video intervention was to inform the participants about CSE, enhance their CSE skills, and motivate them to perform CSE. Each of the three videos had a specific learning objective (or immediate goal): 1) identify MM risk factors, 2) list the steps of a head-to-toe skin examination, and 3) differentiate between nonsuspicious and suspicious pigmented skin lesions. The specific strategies and their respective components and immediate goals are outlined in Table 1. The media for intervention delivery was written (reading) and verbal (audio). The format consisted of a video of skills instruction along with a voiceover PowerPoint

by the PI. The videos each were 5 – 10 minutes in length (amount). Participants viewed each video one time. The PI instructed participants to then space the other two for viewing within a one-week period (frequency); therefore, the duration of the intervention was one week.

Methods

The purpose of a feasibility study is to help build the foundation for subsequent, larger studies.[42] Feasibility studies do this by evaluating the different components of a study in a smaller, cost-effective scale and by ensuring that implementation is practical.[42] Feasibility studies reduce threats to internal and external validity by evaluating participant recruitment, identifying possible retention issues, and determining the extent to which intervention fidelity is maintained.[42,43]

Aim 1

The PI developed three short videos with content on comprehensive CSE for MM. The videos covered comprehensive CSE skills, defined as MM risk assessment, head-to-toe skin examination, and pigmented lesion assessment. The informational content of the videos was adapted from previous studies,[44-46] with adaptation focusing on key concepts that could be addressed in a short amount of time.[39] The risk assessment video described the main risk factors for MM and demonstrated a helpful indicator to guide MM risk assessment.[47] The head-to-toe skin examination video demonstrated the appropriate steps to examining the whole body. The PI systematically walked through the head-to-toe skin examination while emphasizing easily forgotten areas (e.g., behind the ears). The pigmented lesion detection video discussed the ABCDE rule (Asymmetry, Border, Color,

Diameter, Evolving) for pigmented lesion assessment, the ugly duckling sign, and provided images depicting suspicious vs. nonsuspicious pigmented lesions. The PI created storyboards for each video reviewed by a co-author. Storyboards include flowcharting all of the links and elements that will be included in each of the videos to increase coherence and reduce cognitive load.[48]

Following revisions to the storyboards based on the content validity assessment, the PI produced the videos in collaboration with the College of Nursing's Office of Learning and Healthcare Innovation Technology Innovations (LHTI). Both the PI and LHTI worked together to translate the storyboards into the video productions. The videos were uploaded to Vimeo, which is an online platform and community developed to create, upload and share videos.[49] In Vimeo, a link is generated for each video. The PI built the REDCap project and created separate fields for each video. REDCap is a secure workflow methodology and software application designed for the development and deployment of digital data capture tools to assist with clinical and translational research.[50] REDCap provides the option to place the Vimeo video link into the survey, which allows participants to view the video within the survey, without having to open a new browser window. To assess the use of REDCap to integrate the videos, the PI asked the expert panel, which consisted of three dermatology reviewers, to access the videos in REDCap.

Aim 1a assessed the content validity of the intervention by using a modified version of Sidani and Braden's content validity assessment.[51] The components of each module were outlined (See Table 1) and assessed using the content validity index (CVI).The strengths of the CVI include its ease of understandability, computation, and its

focus on relevance and consensus. An expert panel of three dermatologists reviewed the video storyboards.[43] The first content validity survey asked the experts to evaluate the relevance (the degree to which the content has an appropriate sample of activities for the component being measured) and clarity (the extent to which the storyboard is concise, accurate and direct) of the storyboard content,[52] using the scale, 1 = not relevant/clear, 2 = somewhat relevant/clear, 3 = quite relevant/clear, 4 = highly relevant/very clear.[43,53,54] The experts had the opportunity to leave comments with each item to provide further clarification. Based on the CVI scores and recommendations, the PI refined the video content and activities. The expert panel reviewed the content validity for a second time while viewing the actual videos.

Table 1. Component and activities of clinical skin examination (CSE) intervention

Individual Learning Goals	Component	Delivery	Strategies	Measurement
List at least three MM risk factors Use the right arm nevi count to determine potential percentage of body area with nevi	MM risk assessment video	Deliver after baseline survey is completed	Specific strategies: Provide information on: What is skin cancer? MM prevalence MM risk factors Right arm nevus count	Multiple choice questions True/false question
List the steps of a head- to-toe skin examination State the most common area of the body that MM occurs for men State the most common area of the body that MM occurs for women	Head-to-toe skin examination video	One day after MM risk factors video	Specific strategies: Discuss systematic approach (*information*): Head and neck Arms, hands, chest, abdomen Back, buttocks Legs and feet Discuss hard-to-see areas Scalp, ears, postauricular folds, back of neck Underarms, palms, fingernails Groin, heels, between toes, toenails Demonstrate CSE Provide strategies for incorporating CSE while reviewing other systems	Rank the steps of the systematic approach Self-reported completion of CSE Self-reported Likert scale

Differentiate between nonsuspicious-looking and suspicious-looking pigmented skin lesions using the ugly duckling sing and the ABCDEs	Pigmented lesion assessment video	One day after head-to-toe skin examination	Specific strategies: Provide information on: ABCDEs Ugly duckling sign Show images of nonsuspicious and suspicious pigmented lesions	Multiple choice questions

Aim 1b assessed the integration of the videos (Vimeo) and the surveys into REDCap. To accomplish this aim, the PI asked the same three dermatology reviewers to access the videos in REDCap, view the videos and complete Brooke's SUS. The SUS is a simple, 10-item scale that provides a global view on the subjective assessments of usability.[55] This scale proves itself as a highly robust and versatile tool for usability researchers, with over 19 years of use.[35] The scale is 5-point Likert-type with response options ranging from strongly agree (5) to strongly disagree (1).[55] The SUS score is calculated by adding the sum of the scores from each item and multiplying the sum by 2.5.[55] For the odd-numbered items, the item score is the scale's position minus one; for even numbered items, the item score is five minus the scale position.[55] For example, if an even number item were marked strongly disagree (1), then the score would be zero. If an odd number item were marked strongly agree (5), then the score would be zero. The SUS scores range from 0 (worst) to 100 (best).[35] SUS scores are considered passable at 70, better between 70 and 90 and truly superior above 90; an intervention with a score of less than 50 would be concerning.[35]

Aim 1c assessed the digital delivery of the videos. The five technical production items from QEV were used to evaluate the integration of the videos. These items address general video design characteristics, focus on video design, intended content, visual quality, audio quality, and audio-visual relationship.[56] Responses are scored on a 5-point Likert scale that ranges from poor (1) to exceptional (5); respondents have the opportunity to complete open-ended comments after each item.[56] Once the video was finalized, the PI used the following steps to confirm that the REDCap/Vimeo platform was functioning appropriately for the delivery of the surveys and videos:

1. Assembled all questionnaires and the videos into REDCap
2. Set up the timeline for the delivery of each intervention within REDCap.
3. Conducted an initial test of REDCap to ensure that questionnaires and videos displayed appropriately and when prompted by the scheduled timeline on both the mobile and computer platform
4. Finalized survey and video delivery schedule.

Aim 2

Aim 2 determined enrollment and retention rates, intervention adherence, and usability and acceptability of the intervention following completion of the one-week intervention. Enrollment was defined as the percentage of participants who were recruited and consented to the intervention whereas retention was defined as the percentage of participants who completed the intervention and survey. For retention rate, the numerator is the number who completed the intervention and survey, and the denominator is the number of participants who enrolled. Intervention adherence was the extent to which participants experienced the content of the intervention.[34] This included completing all questionnaires and viewing the videos. Video adherence was monitored by Vimeo, which totaled the number of plays, finishes and average percentage of the video watched per module. According to Vimeo, plays are counted when an individual starts to play the video whereas a finish is when the individual views 99% of the video.[57]

Usability was evaluated using the SUS.[55] Acceptability was evaluated with AWCL;[36] the AWCL is based on the technology acceptance model[58] along with other relevant online-based learning studies.[59-61] The questionnaire includes subscales for the constructs of *perceived*

usefulness (five items), *perceived ease of use* (four items), *behavior* (three items) and *affection* (three items).[36] The AWCL is scored with a 7-point Likert-type scale with response options of strongly agree (7) to strongly disagree (1).[36] Liang et al. used an exploratory factor analysis to estimate construct validity of the AWCL questionnaire; the factors accounted for 87.42% of the variance.[36] Reliability (alpha) coefficients for the subscales were 0.96, 0.95, 0.85 and 0.95 respectively.[36] A short survey on participant satisfaction was collected at the end of the study as well and consisted of a combination of free text and scaled items.

The University of Arizona Institutional Review Board approved the study. The design was a one group posttest, cross-sectional design. The three videos were delivered via REDCap/Vimeo. Participants were asked to view each video one time, at least one day apart, and to view all videos within one week. After the third video, participants completed the posttest (usability and acceptability scales) One week after the last video, the PCNPs were asked to self-report their use of CSE in their practice.

Sample

A purposive sample of a minimum of ten PCNPs was recruited by the PI. A sample size of ten is sufficient for a feasibility study because even a few cases are likely to be very informative with respect to the difficulty of recruitment, the acceptability of the intervention, costs, and logistics.[62,63] Eligibility criteria were:

1) Masters NP degree or Doctorate of Nursing Practice degree
2) Family, Adult, or Geriatric NP board certification from either the American Nurses Credentialing Center (ANCC) or the American Association of Nurse Practitioners (AANP)

3) Work in an outpatient setting at least 16 hours/month or 192 hours/year
4) A minimum of one year of experience
5) Access to the internet through a computer or a mobile phone, and
6) English-language proficiency.

Participants were not excluded from the study based on gender, age, race or years in practice. Exclusion criteria were any previous skin cancer continuing education (CE) on CSE or training on CSE. The PI recruited participants at a statewide NP meeting (30th Annual South West Regional Nurse Practitioner Symposium) and a Southern Arizona NP meeting. The PI sent an email to interested NPs that summarized the feasibility study along with a link to the consent, surveys, and first video.

Data Collection

All surveys were managed using REDCap, in which the PI maintained all data instruments, videos and contact information for each participant. The algorithms for delivering each intervention component were automated with REDCap. The videos were incorporated into the questionnaire. Participants who failed to submit the questionnaire were not compensated, and the questionnaires were ineligible for analysis. An incentive for each participant who completed the intervention was a $50 Amazon gift card.

Statistical Analysis

Data from REDCap were exported into SPSS for data analysis. Data analysis of the sample demographics consisted of descriptive statistics (frequencies, measures of central tendency and standard deviation). For Aim 1a, CVI was determined by dividing the number of experts giving the fact (or item) a score of three or four and dividing them by the total number of

experts (three).[53] Scores for SUS were calculated according to Brooke's scoring system and QEV was analyzed using descriptive statistics (Aims 1b and 2). For Aim 2, the AWCL, data analysis consisted of item mean scores, mean construct scores, and correlation between each construct.

Results

Ten PCNPs were recruited, reaching the enrollment target for this feasibility study. Table 2. describes the sample characteristics. Ages primarily ranged from 30 to 59 years and more women (n = 9) than men (n = 1) completed the intervention. Each participant was a family nurse practitioner (FNP) with two having dual certifications in adult nurse practitioner (ANP) and geriatric nurse practitioner (GNP) as well. Most participants worked in a group setting and most had 1 to 10 years of experience (n = 8). Eight participants had their Masters NP degree whereas two had their Doctorate of Nursing Practice. The participants were split between using computers (n = 6) and mobile phones (n = 4) to access the intervention.

Table 2. Demographic and practice characteristics of the sample (n=10)

Characteristics		Frequency	Percentage
Gender			
	Women	9	90
	Men	1	10
Age			
	<30 y	0	0
	30-39 y	3	30
	40-49 y	2	20
	50-59 y	4	40
	>60 y	1	10
NP Certification			
	FNP	8	80
	ANP	0	0
	GNP	0	0
	PNP	0	0
	FNP + ANP	1	10

	FNP + GNP	1	10
Type of NP Practice			
	Group	9	90
	Individual	1	10
Highest Degree Obtained			
	Masters NP	8	80
	DNP	2	20
Years in Clinical Practice			
	1-5	4	40
	6-10	4	40
	11-20	0	0
	21-30	1	10
	31-40	1	10
Which electronic device are you using for this intervention?			
	Computer	6	60
	Mobile	4	40

[a]FNP = family nurse practitioner, ANP = adult nurse practitioner, GNP = geriatric nurse practitioner, PNP = pediatric nurse practitioner

Aim 1: Content Validity

The expert panel conducted two reviews to assess the content validity of the intervention. CVI scores primarily increased or were consistent during the second round of reviews after the PI adjusted the storyboards to address the reviewers' recommendations from the first reviews. The scores of the following components decreased during the second round: right arm nevus count (relevance) and discuss systematic approach (relevance). See Table 3. below.

Table 3. Content validity index

Video 1	1st Review		2nd Review	
	Relevance	Clarity	Relevance	Clarity
What is skin cancer	3.33	2.33	4	3.67
MM prevalence	3.67	3.67	3.67	4
MM risk factors	3.67	3	4	4

Right arm nevus count	4	3	3.67	3.67
Grand mean	3.67	3	3.84	3.83
Video 2	1st Review		2nd Review	
	Relevance	Clarity	Relevance	Clarity
Discuss systematic approach	4.00	3.67	3.67	4
Discuss hard-to-see areas	3.33	3.00	3.67	4
Strategies for incorporating skin examination	3.00	2.67	4	4
Grand mean	3.44	3.11	3.78	4
Video 3	1st Review		2nd Review	
	Relevance	Clarity	Relevance	Clarity
ABCDEs	4	4	4	4
Ugly Duckling	4	4	4	4
Images of nonsuspicious vs suspicious pigmented lesions	3.67	4	3.67	4
Grand mean	3.89	4	3.89	4

[a]Relevance scale (1 = not relevant, 4 = highly relevant)
[b]Clarity scale (1 = not clear, 4 = very clear)
[c]MM = malignant melanoma, ABCDEs = Asymmetry, Border, Color, Diameter, Evolution

Aim 1: Integration of Vimeo & REDCap, Digital Delivery

The integration of Vimeo and REDCap was assessed using Brooke's SUS. The expert panel reviewed the integration of REDCap and Vimeo and the system's usability as superior. The mean average of usability was superior ($M = 95.8$, $SD = 7.2$) with a range of scores from 87.5 (better) and 100 (superior). The digital delivery of the videos was positive. All five technical concepts: video design, intended content, visual quality, audio quality, and audio-visual

relationship, were ranked as exceptional. One expert provided brief positive comments (e.g. [camera] angles used were appropriate").

Table 4. Beaudin's Quality Evaluation of Video

Concept	Items	Mean	Standard Deviation
Video Design	Were the videos well planned, organized, and structured? Was the technology transparent and non-threatening to the viewer? Did the videos demonstrate their ability to transcend space and time? The camera can go where the viewer cannot and the video is an excellent media for presenting information or demonstrations that are timely, however, care must be taken to prevent giving a false idea of reality.	5	0
Intended Content	Do the videos avoid content not related to the subject matter stated in the introduction? Digressions could lead to confusion and may be a waste of video time.	5	0
Visual Quality	Is the camera looking at the scene from the viewers' point of view? This is especially important when psychomotor skills are being taught. Did the scene changes appear to be appropriate? Were special effects used to enhance learning by drawing attention to specific attributes of what is being seen? Were varying types of camera shots, close-ups to long shots, used to provide variety in the video?	5	0
Audio Quality	Was the vocabulary of the narration appropriate for the intended audience? Was the speed of the narration slow enough to be understood? Was the music fitting for the visual effects or audio narration? Were background noises used that were conducive to learning? Were sound effects used to add emphasis to the visual track of a video to enhance learning?	5	0
Audio-Visual Relationship	Was the audio-visual combined well? The audio and visual components should not contradict one another but complement each other. Were there a variety of different types of sounds and visuals to attract and hold attention?	5	0

[a]Likert 5-point scale, 1 = poor and 5 = exceptional

Aim 2: Enrollment and Retention Rate, and Intervention Adherence

For the enrollment rate, twelve NPs consented from a collection of 32 emails (35%) from both a NP conference and a NP meeting. The retention rate was 83%, as ten out of twelve participants completed the intervention and the questionnaires. The intervention adherence was at least 50%. Completion of the questionnaires was 100%, aided by forced choice responses for each item. Video adherence was monitored by Vimeo, which totaled the number of plays, finishes and average percentage of the video watched per module. Only one participant failed to completely watch the first video, ending the video 30 seconds before content was complete. According to Vimeo, plays are counted when an individual starts to play the video whereas a finish is when the individual views 99% of the video.[57] Vimeo recorded six plays for video 1. Of the participants who played video 1, only one failed finish the video. Therefore, the least number of possible participants who completed all of the videos is 50%. See Table 5. for the video adherence for each module.

Table 5. Vimeo Report: Video Adherence

Video	Plays (n = 10)	Finishes (n = 10)	Average percentage of the video watched
Video 1	6	4	92%
Video 2	7	4	97%
Video 3	8	2	98%

Aim 2: Usability, Acceptability and Satisfaction

The mean average of usability was superior ($M = 85.8$, $SD = 10.6$) with a range of scores from 72.5 (better) and 100 (superior). Acceptability of the intervention was assessed using the AWCL. The mean for each of the constructs—perceived use (PU), perceived ease of use (PEOU), behavior and affection—all ranged between "somewhat agree" and "mostly agree" (See Tables 6. And 7.). The Cronbach alpha from PEOU was low (.46) whereas the Cronbach's alpha for Affection was high (.99).

Table 6. Attitudes towards Web-based Continuing Learning Survey Item Scale Scores

Item		Mean Scores	Standard Deviation
PU1	Web-based continuing learning helps my work become more interesting	5.2	1.40
PU2	Web-based continuing learning helps to increase my creativity for work	5.3	1.25
PU3	Web-based continuing learning facilitates the development of my work	5.4	1.17
PU4	Web-based continuing learning effectively enhances my learning	5.2	1.03
PU5	Web-based continuing learning helps me attain better learning outcomes	5.2	1.40
PEOU1	It is convenient to receive training on the job using web-based continuing learning	5.7	1.16
PEOU2	It is easy to get web-based continuing learning to do what I want it to	5.1	1.52
PEOU3	It is easy for me to solve problems at work when I participate in web-based continuing learning	4.9	1.60
PEOU4	The flexibility of web-based continuing learning makes me learn in an easier way	5.9	1.12
Behavior 1	I hope to spend more time using web-based continuing learning	5.7	1.49
Behavior 2	I hope to use web-based continuing learning more often	5.5	1.35
Behavior 3	I want to increase my use of web-based continuing learning in the future	5.4	1.43
Affection 1	I think it is interesting to use web-based continuing learning	5.8	1.31
Affection 2	Web-based continuing learning provides an interesting and attractive environment	5.7	1.49
Affection 3	Using web-based continuing learning can improve my working ability	5.8	1.32

[a]The mean scale scores are based on a scale from 1 (Strongly disagree) to 7 (Strongly agree)
[b] Perceived use = PU, Perceived ease of use = PEOU

TABLE 7. Attitudes towards Web-based Continuing Learning Survey Mean Scale Scores

Constructs	Mean	Standard Deviation	Cronbach's Alpha
PU	5.26	1.03	.88
PEOU	5.40	0.85	.46
Behavior	5.53	1.25	.85
Affection	5.77	1.37	.99

[a]The mean scale scores are based on a scale from 1 (Strongly disagree) to 7 (Strongly agree)
[b] Perceived use = PU, Perceived ease of use = PEOU

The overall satisfaction with the study and the intervention was ranked positively at 98.9% (*SD* = 1.87; 100% = Best). All participants (n = 10) would watch the videos even if they did not receive compensation, believed that the length of the video was "just right", and believed that the content was "just right". Eight participants would prefer to have the videos accessible for one month (80%). When participants were asked what they learned, they cited specific videos (e.g. "scaling suspicious vs. nonsuspicious lesions") (n = 5), increased motivation (e.g. "11 plus nevus right arm increased likelihood to have 100 plus. So quick and easy to check!") (n = 1) and some identified already completing skin assessments (e.g. "was a great refresher") (n = 2).

Discussion

The only CVI scores that decreased were under the relevance category. Both "Right arm nevus count" and "Discuss systemic approach" decreased from 4 (highly relevant) to 3.67 (between highly relevant and quite relevant). According to the scale, both components were ranked at least "quite relevant" on the scale and were kept in the videos. One explanation for this difference is that there was a different, third reviewer during the second round. Otherwise, clarity increased as a whole during the second round of reviews. The expert panel's comments primarily focused on promoting clarity, such as adding the definition of skin cancer to the first video and the definition of a pigmented lesion to the third video. Wording was also adjusted as well (e.g. "get melanoma" to "develop melanoma" and "11 nevi tool" to "right arm nevus count"). The expert panel also offered relevant CSE tips, such as ensuring that the patient removes glasses or hearing aids during the head-to-toe skin examination to better visualize the conchal bowl.

The hypothesis that the enrollment rate will be equal to or better than 60% was not supported. During the study, the PI recruited 22 NPs at a conference in November 2018.

However, enrollment did not start until February 2019, and just five NPs consented during the two-week period after the initial study invitations were sent (enrollment rate = 22%). The PI recruited 10 more participants at a NP meeting and enrolled eight more participants (enrollment rate = 80%). Not only is this a testament to how difficult NPs can be to recruit, [64] but it also emphasizes the importance of a timely follow up after recruitment.

The hypothesis that the retention rate will be greater than or equal to 50% was supported. Ten out of twelve enrolled participants completed the intervention and surveys. The two participants who failed to complete the intervention were followed up via email by the PI. Both participants did not progress past the first video. One participant stated that she was unable to complete the other videos because she was busy with work requirements. She did rate the first video favorably, stating that it was very educational. The second participant accessed the first video on her mobile phone and had no issues. However, she had issues accessing the second video. She was unable to load it on her phone and attempted to copy and paste the address to the URL. When she copied the URL, it stated that she had already reviewed the video. When she contacted the PI, she was outside the one-week time limit. The participant's issues with loading may have been due to her Wi-Fi connection.

The hypothesis that intervention adherence will be greater than or equal to 50% was supported. However, the PI was unable to retrospectively connect the times the videos were played according to the Vimeo report with the time the participant finished the REDCap module. In the future, the PI will need to actively monitor the reports to be able to connect the participants' REDCap and Vimeo reports, or find a way to obtain a timestamp on REDCap. To increase the number of finishes in the Vimeo report, the PI plans move the references and the

acknowledgements from the end of the slide, because participants were more likely to drop off after the content was complete. For example, the references can be sent with the email invitation and the acknowledgements can occur during the beginning of the video.

The hypothesis that usability scores will be equal to or higher than 70 was supported. The participants' mean SUS scores were 85, or "better." Therefore, the participants positively viewed the usability of REDCap and Vimeo. Individual SUS items were not evaluated, as they were not designed to be meaningful apart from the scale.[55] The hypothesis that acceptability scores will be equal to or higher than 5 was also supported.

During Liang et al.'s study, reliability (alpha) coefficients for the subscales were .96 (PU), .95 (PEOU), .85 (behavior) and .95 (affection) respectively.[36] Alpha coefficients that are greater to or equal to .95 are more likely to be redundant.[65] In contrast, the PEOU subscale had a low reliability coefficient, which calls into question whether the PEOU item scan consistently measured *perceived ease of use* (α = .46). A different model may be considered in place of AWCL. Another limitation of this study was selection bias. Only the participants who completed the intervention were able to fill out the usability, acceptability and satisfaction questionnaires. Therefore, the PI reached out to the two participants who were unable to complete the intervention to determine the cause.

Conclusions

In conclusion, three theory-based, short skin cancer videos with content on comprehensive CSE for MM were developed that are suitable for digital delivery to PNCPs in various formats. Findings from this feasibility study provide a foundation for the use of the microlearning as a method for delivering brief CSE training to PCNPs. The findings also provide

support for using the videos as part of an intervention in a future pilot randomized trial. This feasibility study provided valuable lessons to inform next research phase, such as the timeliness of enrollment. The long-term goal is to promote the early detection of skin cancer by providing CSE education to PCNPs and ultimately improving skin cancer prognoses.

Acknowledgements

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Conflicts of Interest

None declared

Abbreviations

JMIR: Journal of Medical Internet Research

MM: malignant melanoma

PI: Principal investigator

CSE: Clinical skin examination

PCNPs: Primary care nurse practitioners

SUS: System Usability Scale

AWCL: Attitudes toward Web-based Continuing Learning Survey

PU: perceived use

PEOU: perceived ease of use

IMB model: information-motivation-behavior model

QEV: Quality Evaluation of Video

REDCap: Research Electronic Data Capture

NP: nurse practitioner

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APPENDIX D:

THE UNIVERSITY OF ARIZONA INSTITUTIONAL REVIEW BOARD APPROVAL LETTER

THE UNIVERSITY OF ARIZONA
Research, Discovery & Innovation

Human Subjects Protection Program

1618 E. Helen St.
P.O.Box 245137
Tucson, AZ 85724-5137
Tel: (520) 626-6721
http://rgw.arizona.edu/compliance/home

Date:	November 02, 2018
Principal Investigator:	Delaney B Stratton
Protocol Number:	1810024767
Protocol Title:	The feasibility of utilizing a theory-based, online delivery of microlearning system (TOMS) to teach nurse practitioners about clinical skin examination.
Determination:	Approved
Expiration Date:	October 30, 2023

Documents Reviewed Concurrently:

Data Collection Tools: *ContentValidityByExperts.pdf*
Data Collection Tools: *Demographics.pdf*
Data Collection Tools: *IMBModelSurvey.pdf*
Data Collection Tools: *IMBModelSurveySelfReportedBeha.pdf*
Data Collection Tools: *SUS&AWCLBYNPS.PDF*
Data Collection Tools: *SUS&QEVByExperts.pdf*
HSPP Forms/Correspondence: *Advisor Confirmation Email.pdf*
HSPP Forms/Correspondence: *Confirmation for Scientific Review and Department Review.pdf*
HSPP Forms/Correspondence: *Stratton Appendix_Waiver_8.16.2018.pdf*
HSPP Forms/Correspondence: *Stratton Application for Human Research_10.30.18.pdf*
HSPP Forms/Correspondence: *Stratton List of Research Personnel_08.15.2018.pdf*
Informed Consent/PHI Forms: *Disclosure Form_10.23.18.doc*
Informed Consent/PHI Forms: *Disclosure Form_10.23.18.pdf*
Informed Consent/PHI Forms: *Expert Disclosure Form_10.23.18.doc*
Informed Consent/PHI Forms: *Expert Disclosure Form_10.23.18.pdf*
Other: *IRB Response.docx*
Other Approvals and Authorizations: *30667_Stratton_Exempt SRC Outcome Report 9.26.2018.pdf*
Other Approvals and Authorizations: *COI Certification Complete for 1810024767.msg*
Participant Material: *Module 1 - Melanoma Risk Assessment.pptx*
Participant Material: *Module 2 - Head to Toe Skin Examination.pptx*
Participant Material: *Module 3 - Pigmented Lesion Detection.pptx*
Recruitment Material: *Recruitment Email_10.21.2018.docx*
Recruitment Material: *Recruitment Flyer_08.15.2018.pub*

Regulatory Determinations/Comments:

- The project is not federally funded or supported and has been deemed to be no more than minimal risk.

- The project listed is required to update the HSPP on the status of the research in 5 years. A reminder notice will be sent 60 days prior to the expiration noted to submit a 'Project Update' form.

This project has been reviewed and approved by an IRB Chair or designee.

- The University of Arizona maintains a Federalwide Assurance with the Office for Human Research Protections (FWA #00004218).
- All research procedures should be conducted according to the approved protocol and the policies and guidance of the IRB.
- Amendments to exempt projects are required. See the Guidance on Minimal Risk or Exempt Research for a list of changes that would require an amendment be submitted to the office.
- The Principal Investigator should notify the IRB immediately of any proposed changes that affect the protocol and report any unanticipated problems involving risks to participants or others. Please refer to Guidance Investigators Responsibility after IRB Approval and Minimal Risk or Exempt Research.