

MASTER

Nurses' accuracy in diagnosing non melanoma skin cancer

Rinkens, F.J.C.H.

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Nurses' accuracy in diagnosing non melanoma skin cancer

by
Frank Rinkens

Student identity number 0567654

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Supervisors:

Dr. ir. P.A.M. Kleingeld, TU/e, Human Performance Management

Prof. Dr. C.C.P. Snijders, TU/e, Human Technology Interaction

Dr. G.A.M. Krekels, CzE, Department of Dermatology

Drs. S. van der Geer Rutten, CzE, Department of Dermatology

TUE. School of Industrial Engineering.
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Preface

I feel very lucky that I had the opportunity to study a subject of great social importance, namely the accurate diagnosis of non melanoma skin cancer. In this preface I therefore want to thank the persons who helped me with this study and the realization of this report. First of all, I would like to thank my first TU/e supervisor Ad Kleingeld for his useful advice and confidence. During our discussions about the report, his enthusiasm really inspired me. I also would like to thank Chris Snijders for his support of the project. His professional advice and suggestions to previous versions of my report improved the quality of this report.

Within the Catharina Hospital Eindhoven I owe thanks to my two supervisors, Gertruud Krekels en Simone van der Geer-Rutten. They provided me with the necessary information through which I have been able to achieve optimal results. I owe special thanks to Anja van de Wetering-van de Elzen, Elisabeth van Hoof, and Helma Breviers-Sengers for their contributions and enthusiasm during this study.

For all the people I may have forgotten, SORRY, please fill in your name here.....

Executive summary

Introduction

Skin cancer is the most frequent form of cancer and its incidence has increased over the past 40 years. In the Netherlands, between 1989 and 2009, the incidence of types of skin cancer, like non melanoma skin cancer, increased with an average of 3% per year between 1989 and 2009 [1]. Most skin cancers are classified of the type non melanoma. This type can be divided in two categories. These are basal cell carcinoma (BCC) and squamous cell carcinoma (SCC). BCC is the most common kind of skin cancer but fortunately also the least serious kind because it grows slowly and hardly ever spreads. SCC is more serious because it spreads to vital organs. However, spread only occurs in a few cases in every 100 and it does so slowly. Furthermore, SCC is the final state of three states. The first state is Actinic Keratosis (AK), a skin condition that is not cancer, but sometimes changes into SCC. The state of the lesion between AK and SCC is called Morbus Bowen [3; 4].

An innovative diagnosing process is needed to properly handle the increase of skin cancer patients. One possibility is to use non physicians, such as nurses for the detection of suspicious lesions that can lead to skin cancer (Oliveria, Nehal, Christos, Sharma, Tromberg, and Halpern, 2001; Oliveria, Altman, Christos, and Halpern, 2002). Because of the increase of patients with skin cancer, dermatologists will not be able to handle all these patients in the future. The dermatology department of Catharina hospital Eindhoven (CzE) is also confronted with the increase of skin cancer patients. Therefore, it is interesting to assess if nurses at the dermatology department can be used for non melanoma skin cancer detection.

This study will focus on nurses and their role in skin cancer detection since this is the main question from CzE. The main question of this study was:

Can the nurses at the dermatologist department be used in diagnosing non melanoma skin cancer?

To provide an answer to this question several sub questions were generated that have been dealt with in this study:

1a: What is the accuracy of nurses detecting non melanoma skin cancer?

1b: Are there differences in accuracy among nurses with different backgrounds?

1c: Can statistics be used to improve the accuracy of nurses detecting non melanoma skin cancer?

2: How do patients perceive nurses diagnosing non melanoma skin cancer?

3: How do nurses perceive the work experience after adding the new diagnosing task?

4: Does the use of nurses in non melanoma skin cancer detection lead to cost reductions?

Method

To determine if nurses could be used for skin cancer detection, three nurses from the dermatology department were selected to participate in this study. These three nurses were: a regular nurse, an oncology nurse and a manager/oncology nurse. They diagnosed patients using the skin cancer questionnaire developed by Jansen (2010), see Appendix A. Their diagnoses were compared with that of the dermatologists/biopsies and this provided the information necessary to answer questions 1a en 1b. The skin cancer questionnaire was also used to compute a statistical model using logistic regression to answer question 1c. During this study, new patients and chronic patients, who arrived at the department during the oncology consultation hours, were asked to participate in the study. These patients filled in a patient perception questionnaire about their perceptions of the

nurse, see Appendix B. This questionnaire provided the information to answer question 2. At the end of the study, interviews were held to assess how the nurses perceived the diagnosing task, see Appendix C. These interviews were used to answer question 3. Finally some information about costs was gathered to answer question 4.

Results

The results of the comparison between the diagnoses of the nurses and dermatologists/biopsies showed that the percentage correct diagnoses of the nurses was 81.7% with a 95% confidence interval of (76.1, 87.3). To further assess the accuracy of the diagnoses, the study focused on AK and BCC, because these two types occur most often. For AK the results showed that the nurses made relatively few false positives, namely 11.1% (a lesion was classified as AK by the nurse when in fact it was not) and false negatives, namely 13.8% (a lesion classified as not AK by the nurse when in fact AK was present). The overall percentage correct AK diagnoses was 88.1%. For BCC similar results were found. The nurses made relatively few false positives, namely 7.1% and made 20.6% false negatives. The overall percentage correct BCC diagnoses was 90.6%. These results showed that nurses are indeed able to accurately detect non melanoma skin cancer (question 1a).

The results also showed that there were small but statistically non significant differences between the nurses (question 1b). The manager/oncology nurse, oncology nurse, and the regular nurse had respectively 78.3%, 81.4%, and 85.7% correct diagnoses. For AK the overall percentage correct diagnoses were 91.3%, 84.3%, 88.9% respectively and for BCC 85.5%, 92.9%, and 93.7% respectively.

A model with the characteristics of the skin cancer questionnaire was computed and showed that for AK this model had an overall correct percentage of 84.7% and for BCC 91.4% (see table AK and table BCC). These models compared to the nurses scored lower on the amount of true positives. For AK this percentage predicted by the model was 70.2% and for BCC 60.6%. Furthermore, the results showed that the use of a statistical model predicting the diagnoses of the dermatologists/biopsies could further improve the accuracy of the nurses, see table AK and table BCC (question 1c). The models improved the number of true negatives of the nurses. For AK the percentage true negatives increased from 88.5% to 92.8% and for BCC from 92.7% to 97.6%. These results could be achieved if nurses put more weight or less weight on certain characteristics. For AK, the nurses should put less weight on shininess, and more weight on widened blood vessels and frequent sun exposure before 65 years old. For BCC the nurses should put less weight on induration and keratosis, and more weight on dark red color, light red color, wound, does the lesion bleed when drying, and shape. The amount of true positives predicted by the model was the same as predicted by the nurses. For AK this was 87.7% and for BCC 78.8%. This model was computed with the characteristics of the skin cancer questionnaire and the diagnoses of the nurses as predictors.

Table AK

Prediction model without nurse diagnoses	Sig.	Percentage correct model without nurse diagnoses	Prediction model with nurse diagnoses	Sig.	Percentage correct model with nurses diagnoses
Shape	+++	Overall 84.7%	Shape	+	Overall 91.3%
Sun exposure before 65 years old	++	True positives 70.2%	Sun exposure before 65 years old	++	True positives 87.7%
Wound	++	True negatives 90.6%	Shininess	+	True negatives 92.8%
Shininess	++		Often been on summer holiday	++	
Keratosis	+++		Widened blood vessels	++	
Often been on summer holiday	++		AK diagnoses nurses	+++	
Light red	++		Constant	++	
Localization	++				
Widened blood vessels	(+)				
Itchiness	(+)				
Keratosis X Light red	++				
Constant	++				

Note. (+) p>.10, + p<.10, ++ p<.05, +++ p<.01

Table BCC

Prediction model without nurse diagnoses	Sig.	Percentage correct model without nurse diagnoses	Prediction model with nurse diagnoses	Sig.	Percentage correct model with nurses diagnoses
Dark red	++	Overall 91.4%	Dark red	+	Overall 94.4%
Light red	++	True positives 60.6%	Light red	++	True positives 78.8%
Shininess	+	True negatives 97.6%	Age	++	True negatives 97.6%
Age	++		Induration	++	
Induration	+		Often been on summer holiday	++	
Often been on summer holiday	++		Wound	++	
Wound	++		Keratosis	++	
Keratosis	+++		Lesion bleed when drying	+	
Lesion bleed when drying	(+)		Shape	++	
Shape	++		BCC diagnoses nurses	+++	
Constant	+++		Constant	+++	

Note. (+) p>.10, + p<.10, ++ p<.05, +++ p<.01

The results of the patient perception questionnaire showed that the patients in general were satisfied with the nurses diagnosing them, see table patient perception (question 2). Scores of 3 or higher indicate that patients were satisfied with the item measuring patient perception. An important issue is the nurses who told the diagnoses to the patients obtained a higher score on patient perception. Furthermore, the patient perception analyses showed that patients who visited before, did prefer the dermatologist doing the examination instead of the nurse. However, these type of patients and new patients were willing to be examined again by a nurse in the future.

Table patient perception

Condition	All
Response	N=194
Service	4.36 (.51)
Skilled healthcare provider	4.22 (.65)
Knowledgeable about skin condition	3.82 (.82)
Completeness and thoroughness of examination	3.98 (.76)

Results of the interviews with the nurses provided no signs that nurses felt uncomfortable or even stressed during the diagnosing task (question 3). On the contrary, they enjoyed performing the task and saw it as an opportunity to learn from it. The nurses were also willing to perform this task in the future under certain conditions, such as having an appropriate room available and transferring some tasks to other nurses. Furthermore, it seems that some cost benefits of around 25 Euros per patient can be expected if nurses diagnose patients (question 4).

Conclusions and recommendations

Based on these findings the main question *“can the nurses at the dermatologist department be used in diagnosing non melanoma skin cancer?”* can be positively answered. Nurses are able to accurately detect non melanoma skin cancer without experiencing pressure or stress and patients have a positive perception of the nurses. Based on the conclusions, some recommendation can be made. Nurses at the dermatology department should first make their own diagnoses based on the lesion and the questions they ask to the patient. Then, the nurses can verify their diagnoses using the model with the diagnoses of the nurses as predictor. In this model they put their own diagnosis as a predictor and fill in the additional characteristics that were still significant predictors. If the prediction of this model is the same as the diagnosis of the nurse, then the nurse should use it as the final diagnosis. However, if the prediction of the model is different from the diagnosis of the nurse, then the nurse should consider the prediction of the model as the final diagnosis because it predicts true negatives better than the nurse. After they have verified their diagnosis, it is important to tell and explain the diagnosis to the patient and explain what kind of treatments there are. If the nurse is still unsure about the diagnosis, it is still important to tell this to the patient. The nurse should explain to the patient that there is still some doubt about the diagnosis and that the dermatologists will make the final decision.

Limitations and future research

This research is not without limitations. The first limitation of this research is that the results that nurses can accurately predict skin cancer, are difficult to generalize among the nurses at the dermatology department at the CzE. Only one nurse of each type of nurse at the dermatology department (regular nurse and oncology nurse) has participated in this research. Therefore, the results of these two nurses can also be due to the experience of these nurses. Nurses with less experience might not have the accuracy in diagnosing non melanoma skin cancer. Furthermore, the manager/oncology nurse worked as oncology nurse for year and half, but was manager during this study for about two and a half years. Therefore, it is difficult to say whether or not this nurse had the same knowledge and skills as the oncology nurse during this research. The following limitation of this research is that the nurses did not always completely fill in the skin cancer questionnaire. During the logistic regression analyses this became problematic with some of the characteristics which are potential interesting for predicting non melanoma skin cancer. Another issue is that some of the characteristics, for example usage of immunosuppressant, did occur only occasionally, which made it difficult to assess their effect on predicting non melanoma skin cancer. Another limitation of this research is the costs analysis. Although a cost reduction was found it is not sure whether or not an actual cost reduction will happen. A dermatologist receives a honorarium for patients that have non melanoma skin cancer. Perhaps nurses would also receive a honorarium when they diagnose patients or they receive an increase in salary because of this new task. Also it is possible that a new nurse has to be hired to carry out tasks that need to be transferred, as indicated by the nurses. However, to

determine the fee, salary increase, or hiring a new nurse went beyond the scope of this study and therefore it is difficult to say if an actual cost reduction will happen.

Future research should extend this type of research with more nurses of each type of nurse, regular and oncology. With the results of studies with more nurses, it is possible to generalize the results of this study among the nurses at the dermatology department of the CzE. Furthermore, future research should also focus on using the statistical models for AK and BCC computed in this research. It is interesting to investigate how accurately these models perform in reality. Also, using a sample size where characteristics such as usage of immunosuppressant is more present than in this study could also provide additional significant predictors for these models. This could possibly increase the accuracy of the models. Future research should also pay more attention to cost reductions. This research found a cost reduction based on the salary that a nurse and a dermatologist earn per hour. However tasks could be transferred when the diagnosing task is added to the responsibilities of a nurse. Perhaps this leads to hiring a new nurse which can undo the cost reductions. Finally, an important aspect is that this research found that the patients had confidence in the abilities of the nurses to diagnose skin cancer whereas other research reported opposite results. Future research could use interviews with patients to further investigate why or why not patients have this confidence in abilities of the nurses.

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1. Introduction

Skin cancer is the most frequent form of cancer and its incidence has increased over the past 40 years. In the Netherlands, between 1989 and 2009, the incidence of melanoma of the skin increased with an average of 4% per year (men 4.5% and women 3.5%). Up until now, there are no signs that this growth will decline and therefore the incidence of melanoma will probably increase further in the coming years. The incidence of other types of skin cancer, like non melanoma skin cancer, increased with an average of 3% per year between 1989 and 2009 [1]. Most skin cancers are classified of the type non melanoma. This type of skin cancer starts in basal cells or in squamous cells which are located at the base of the outer layer of the skin. Most non melanoma skin cancer develops on sun exposed parts of the body and depending on the type, this type of skin cancer is either fast or slow growing but it rarely spreads to other parts of the body [2]

This increase has led to efforts in the primary and secondary prevention of skin cancer. The primary interventions have focused on minimizing sun exposure and on sun protection. The secondary interventions have focused on the detection and excision of suspicious lesions that can lead to skin cancer (Oliveria, Nehal, Christos, Sharma, Tromberg, and Halpern, 2001; Oliveria, Altman, Christos, and Halpern, 2002). Because of the location on the surface of the skin, skin cancer can be detected early on by total body skin exams. Currently, this is done by dermatologists and other practicing physicians and they provide the appropriate treatment (Oliveria et al, 2002). However, because of the increase of patients with skin cancer, dermatologists will not be able to handle all these patients in the future. Therefore, new interventions are needed to diagnose these patients. One of these interventions is that nonphysician healthcare providers, such as nurses, provide patients with prevention, detection, and screening services (Oliveria et al 2001).

The dermatology department of Catharina hospital Eindhoven (CzE) is also confronted with the increase of skin cancer patients. Because of these findings in the literature, the CzE would like to know if nurses at the dermatology department are able to accurately detect non melanoma skin cancer.

1.1 Non melanoma skin cancer

Skin cancer can be put in two broad categories. These are malignant melanoma and non melanoma. Malignant melanoma skin cancer is the most severe type of skin cancer because it can spread rapidly from the skin into internal organs through the lymph nodes or blood. Although non melanoma has a lower mortality rate than melanoma, non melanoma skin cancer occurs more frequently and imposes a vast burden on the health care system. The non melanoma skin cancer type can also be divided in two categories. These are basal cell carcinoma (BCC) and squamous cell carcinoma (SCC). BCC is the most common kind of skin cancer but fortunately also the least serious kind because it grows slowly and hardly ever spreads. SCC is more serious because it spreads to vital organs. However, spread only occurs in a few cases in every 100 and it does so slowly. Furthermore, SCC is the final state of three states. The first state is Actinic Keratosis (AK), a skin condition that is not cancer, but sometimes changes into SCC. The state of the lesion between AK and SCC is called Morbus Bowen [3; 4].

1.2 Research questions

In this part of the thesis the research questions are developed. As was pointed out by the research of Oliveria et al (2001), non physicians are in an optimal position to provide cancer prevention,

detection, and screening. The reason for this is that they have experience with skin cancer lesions because of performing biopsies or treating these lesions. This study will focus on nurses and their role in skin cancer detection since this is the main question from CzE. The main question of this study is:

Can the nurses at the dermatologist department be used in diagnosing non melanoma skin cancer?

This question is not only about the degree to which nurses provide correct diagnoses. Patient perception of the nurses is also an important issue as is the perception of the nurse about diagnosing patients. Four sub questions are defined and explained.

A study by Zagula-Mally, Rosenberg, and Kashgarian (1974), showed that nurses, who were trained to recognize typical basal and squamous cell cancers and solar keratoses by the authors of the paper, were able to accurately diagnose non melanoma skin cancer. Therefore, this study explores if nurses at the dermatology department are able to accurately detect non melanoma skin cancer. Maquire and Frost (1994) also showed that dermatology nurses scored significantly higher in recognizing lesions than oncology nurses and nurse practitioners. Furthermore, it is interesting to look if statistical models can improve the accuracy of the diagnoses. The thesis by Jansen (2010) concluded that there is a huge potential for statistical models to predict and rule out non melanoma skin cancer. This results in the following three research questions.

Question 1a: What is the accuracy of nurses detecting non melanoma skin cancer?

Question 1b: Are there differences in accuracy among nurses with different backgrounds?

Question 1c: Can model based predictions be used to improve the accuracy of nurses detecting non melanoma skin cancer?

Another important aspect of this study is the perceptions of the patients. If the current research were to show that nurses are able to perform tasks of a dermatologist, but patients do not feel safe or do not trust the diagnosis of a nurse, then the intervention at CzE may not be successful. Previous studies found contradicting results. A study by Federman, Reid, Feldman, Greenhoe, and Kirsner (2001) reported that patients have confidence in the ability of nurse practitioners to correctly diagnose skin cancer whereas a study by Owen, Maeyens, and Weary (1997) suggested that patients do not have confidence in the abilities of a nurse practitioner. This leads to the following research question.

Question 2: How do patients perceive nurses diagnosing non melanoma skin cancer?

Adding a new task to the existing work responsibilities can lead to an increase in the stress levels of nurses. Corner (2003) has reported that when nurses take on a new task, this can lead to a nurse experiencing burnout. If the participants in this study feel increased stress or experience burnout, it can result in a decrease in performance. This leads to the third research question.

Question 3: How do nurses perceive the work experience after adding the new diagnosing task?

It is interesting for CzE to look if there are any cost benefits to achieve with nurses. In these times of budget cuts in healthcare, it is important that new interventions not only lead to high-quality care, but also to cost reductions. Therefore, the implementation of nurses diagnosing non melanoma skin cancer should also lead to cost advantages. This leads to the final research question.

Question 4: Does the use of nurses in non melanoma skin cancer detection lead to cost reductions?

1.3 Outline of this thesis

This section provides the outline of this thesis. Chapter 2 will provide information on the CzE where this research was carried out. Chapter 3 provides additional literature to support the research questions defined in chapter 1. In chapter 4, the study design will be explained. Chapter 5, 6, and 7 provides the results of the analyses that are needed to answers the research questions. Chapter 8, provides the conclusions of this thesis and recommendations are made about the results. The final chapter provides the limitations of this thesis and future research directions.

2. Description of the organization

This section will describe the organization in which the research has been conducted.

2.1 Catharina hospital Eindhoven

The Catharina hospital Eindhoven (CzE) was founded in the 19th century and has been at its current location since 1973. Currently, the CzE has approximately 3000 employees. Besides the basic functions of the hospital, it also offers top clinical care in a couple of areas such as cardiac rhythm diagnosis and treatment, interventional cardiology, hemodialysis, in vitro fertilization, and radiotherapy. Moreover, the hospital plays a referral function in areas such as vascular surgery, gynaecological and urological oncology, and oncological surgery [5].

At the CzE innovation is highly valued. This is evident from the advanced technology and equipment that are used in many areas of diagnostics and therapy. One example is the aforementioned interventional cardiology. Other examples are the robot-assisted surgical technique of orthopedics, the highly advanced imaging techniques (among MRI) of the diagnostic radiology, and specialized skin cancer surgery (Mohs surgery) [4].

CzE is a training hospital. In thirteen medical fields residents are trained to become medical specialists. In the coming years that number will be further increased. In addition, the hospital works together with various educational institutions. The hospital has a partnership with the University of Maastricht for the training of interns and a partnership with Fontys Hogeschool Eindhoven for the training of nurses [4].

2.2 Skin cancer at the dermatology department

The dermatology department at CzE is run by a partnership of five dermatologists. The patients that visit the dermatology department are either referred by a general practitioner in the area of Eindhoven, or they visit the department on their own initiative. When a patient visits the department, a resident has a consult with the patient. The resident is supervised by a dermatologist. This means that the dermatologist also sees the patient after which a definite diagnosis is made. After establishing the diagnosis, the patient is scheduled for treatment if necessary. On date of the appointment, the patient receives the treatment and a checkup appointment is scheduled if necessary. Furthermore, if patients have a checkup appointment, he/she does not need to get a consultation and can be treated immediately. Examples of treatments a patient can receive are photodynamic therapy, excision, mohs surgery, and cryotherapy. It can also happen that the dermatologist is not sure of the diagnosis. To get a definite diagnosis, a biopsy will then be taken and is send to the pathological anatomy laboratory (PA-lab). A patient has to wait approximately two weeks for the result of the biopsy. When the result is available, the patient receives a call with the result and a appointment for treatment is scheduled. Figure 1 shows this process.

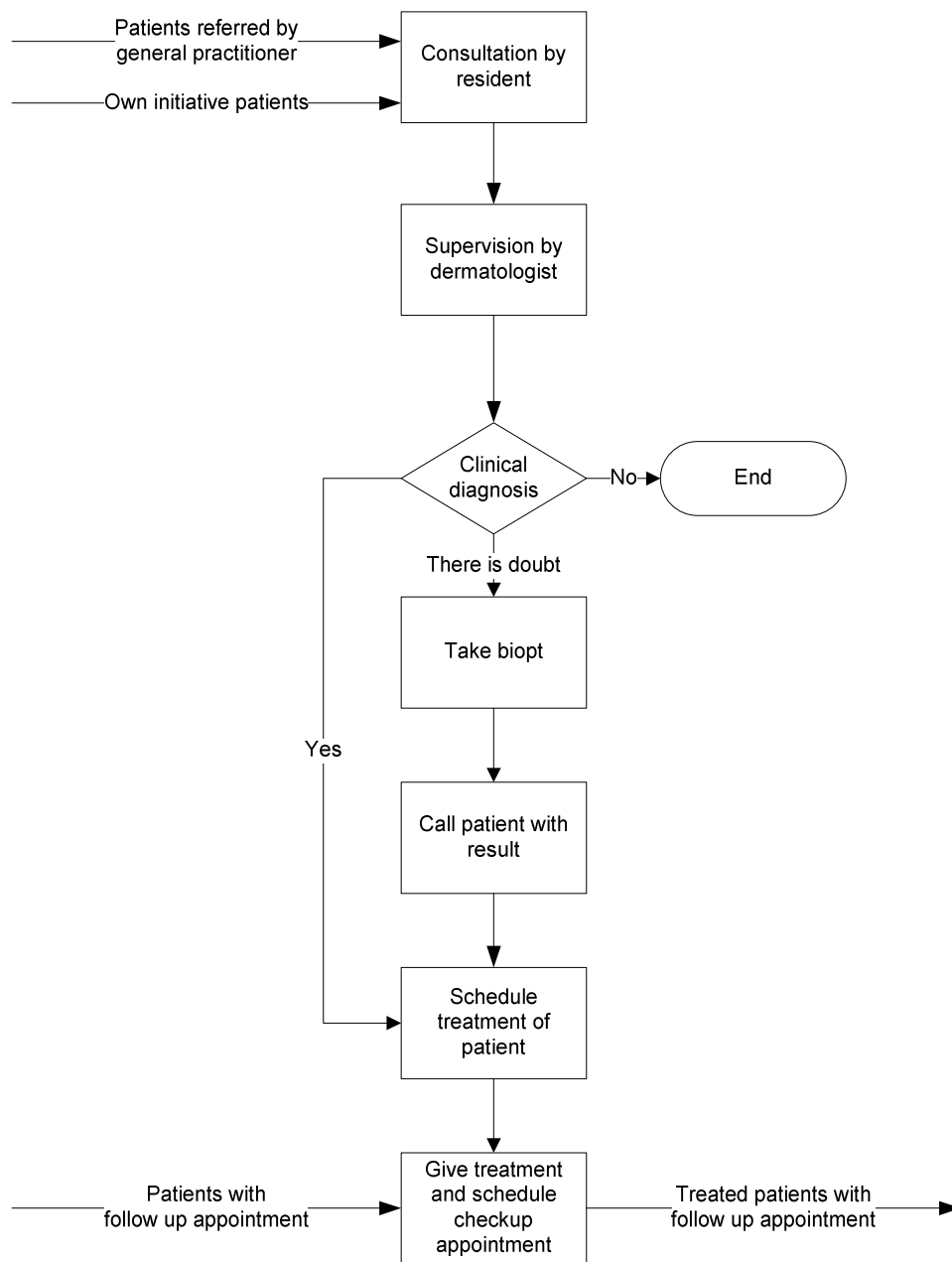


Figure 1: Process of providing care for patients with non melanoma skin cancer (based on Goedhart, Pilon, and van Tubergen, 2009)

As of 2004, the CzE has its own skin cancer centre and is one of the few hospitals in the Netherlands that possesses a skin cancer centre. The skin cancer centre is a part of the dermatology department but it also cooperates with other specialties in the hospital such as plastic surgery and ophthalmology. The skin cancer centre focuses on, the identification, treating and preventing skin cancer its precursors. The treatments carried out in the skin cancer centre are mohs surgery and photodynamic therapy. At the CzE, mohs' surgery is the most common method to remove suspicious spots. In this surgery skin cancer is surgically removed, while saving as much skin as possible. Photodynamic therapy is a treatment with a cream. This cream becomes active when it is exposed to light of a certain wavelength. It is a day treatment consisting of two steps and is performed by a nurse [4].

3. Literature

This section of the thesis looks at the literature to describe what is already known about nurses detecting suspicious lesions. Furthermore, this section will look at patients' perception when nurses diagnose them, if cost benefits can be achieved with nurses diagnosing patients, and at possible negative effects that new responsibilities can have on nurses.

3.1 Skin cancer assessment by nurses

A study conducted by Maguire and Frost (1994) evaluated nurses' frequency of skin cancer assessment, ability to recognize cutaneous malignant melanoma which is a type of malignant melanoma skin cancer that may occur on the nail bed or foot pad, knowledge of risk factors and preventive measures, teaching practices, and barriers to skin cancer assessment. The sample consisted of 178 nurses. The type of nurses used were nurse practitioners, dermatology nurses, and oncology nurses. Experts in the field of dermatology, oncology, biostatistics, and public health provided the content validity. The most interesting finding of the study for this thesis was that dermatology nurses scored significantly higher in recognizing lesions (64% correct) than oncology nurses (46% correct) and nurse practitioners (48% correct).

A study conducted by Zagula-Mally, Rosenberg, and Kashgarian (1974) investigated the frequency of skin cancer in a rural Tennessee county. In contrast to the study conducted by Maguire et al (1994) Zagula-Mally et al (1974) used trained nurses to detect skin cancer. The trained nurses and dermatologists interviewed and examined 978 Caucasian adults. The nurses had previously been trained at the West Tennessee Cancer Clinic and other university-associated dermatology clinics to recognize typical basal and squamous cell cancers and solar keratoses (non melanoma skin cancer), and to distinguish these from verrucae, seborrheic keratoses, senile sebaceous gland hyperplasia, and nevi. Selected cases from the sample, all those with suspected skin cancer, were later revisited by a dermatologist to verify the nurses' impressions. Results of the study showed that the nurses detected skin cancers in 48 people. Forty-three of these were clinically verified by the dermatologist. The study did not report false negatives, i.e. nurses predicting that the patient did not have skin cancer when in fact skin cancer was present, according to the dermatologist.

Another study showing similar results as the study of Zagula-Mally et al (1974) was conducted by Katris, Donovan, and Gray (1998). They compared the performance of trained registered nurses to plastic surgeons participating in a skin cancer screening program. The role of the nurse was not to diagnose skin cancer, but to not miss any lesions that required further specialist examination. Each patient in the study underwent two total body skin exams, one by a nurse and one by a plastic surgeon. The diagnosis of the specialist plastic surgeon and histology were held as the gold standard. Results of the study showed that plastic surgeons issued 77 individual referrals for suspicious lesions of being skin cancer. Nurses issued 73 of these 77 cases. Furthermore, in 33 cases there was not total agreement between the nurse and the plastic surgeon. These included the four cases missed by the nurses and 29 other lesions that the nurses identified as suspicious but that did not result in a referral from the plastic surgeon. Assuming the plastic surgeons were accurate, the authors analyzed a) how accurate the diagnosis was when a suspicious lesion was present and b) how accurate the diagnosis was when a suspicious lesion was not present, see Table 1. Analyses revealed that nurses were very accurate in identifying a suspicious lesion when it was actually present: 95% hits and 5% false negatives. There were relatively few false positives (16%) when a lesion was identified as suspicious when in fact it was not suspicious.

Table 1: Nurses' classification (Based on Katris et al, 1998)

Surgeon classification suspicious lesions	Nurses' classification suspicious lesions		
		Yes	No
Present	77	73 hits (95%)	4 false negatives (5%)
Absent	179	29 false positives (16%)	150 correct rejected (84%)
Total	256	102	154

Oliveria et al (2001) conducted a study to investigate if trained nurse practitioners can identify skin cancer. The difference between the nurses at the dermatology department who participated in this thesis and a nurse practitioner is that a nurse practitioner may diagnose and treat patients in an independent location, without the continuous observation of a physician, whereas a nurse at the dermatology department is not allowed to diagnose patients. During the research of Oliveria et al (2001), nurses were evaluated on competency to detect suspicious lesions. Three competencies were evaluated: 1) the nurse practitioner's ability to distinguish between benign and malignant lesions, 2) the nurse practitioner's ability to refer patients with a suspicious lesion for a dermatologic follow up, and 3) the nurse practitioner's sensitivity to detect significant skin cancer lesions. For all these competencies, the sensitivity and specificity of the nurse practitioners were calculated. Sensitivity measures the proportion of actual positives which are correctly identified as such (e.g. the percentage of patients having a benign or malignant lesion which need to be referred by the nurse practitioner). Specificity measures the proportion of negatives which are correctly identified (e.g. the percentage of patients who are correctly identified as not having a benign or malignant lesion by the nurse practitioner). The evaluation of the first competency (table 2) showed that the sensitivity of the five nurse practitioners to refer benign and malignant lesions for dermatologic follow up was 100%. The specificity of this competency ranged between 53% and 100%, with an average of 73.6%. The evaluation of the second competency (table 3) showed that the sensitivity ranged from 67% to 100%, with an average of 78.25%, and the specificity ranged between 62% and 100%, with an average of 77.5%. The evaluation of this last competency (table 4) showed that the sensitivity ranged from 50% to 100%, with an average of 83.33%, and the specificity from 99% to 100%, with an average of 99.8%.

Table 2: Classification table first competency

Observed	Predicted by nurse practitioner		
	Benign or malignant		
		Negative(%)	Positive(%)
Benign or malignant	Negative (%)	73.6	26.4
	Positive (%)	0.0	100.0

Table 3: Classification table second competency

Observed	Predicted by nurse practitioner		
	Suspicious lesion for follow up		
		Negative(%)	Positive(%)
Suspicious lesion for follow up	Negative (%)	77.5	22.5
	Positive (%)	21.75	78.25

Table 4: Classification table third competency

Observed	Predicted by nurse practitioner		
	Skin cancer lesions		
		Negative(%)	Positive(%)
Skin cancer lesions	Negative (%)	99.8	0.2
	Positive (%)	16.67	83.33

These studies suggests that nurses are able to detect skin cancer or at least can identify suspicious lesions that require further specialist examination. However, only one of these studies, Zagula-Mally et al (1974), conducted research on nurses diagnosing non melanoma skin cancer which is the type of skin cancer diagnosed in this thesis. Therefore, the result of this study seems to indicate that nurses at the dermatology department should be able to accurately detect non melanoma skin cancer. The other studies looked at malignant melanoma skin cancer, which occur far less than non melanoma skin cancer. However, the results of these studies showed that nurse were able to accurately detect these kind of skin cancers as well. Therefore, it can be expected that nurses at the dermatology department should be able to accurately detect non melanoma skin cancer because they have seen this more often during biopsies or treatments.

3.2 Patients' perceptions of nurses

A study conducted by Wiles, Postle, Steiner, and Walsh (2003) investigated patients' perceptions of nurse led intermediate care. Results of this study show that, in general, patients expressed very few concerns about the nurse led care. Patients felt at ease because they knew that a doctor would be called if needed. However, a few people did not perceive the nursing care as adequate. They reported a lack of confidence in the nurses' abilities or were concerned about whether a doctor could be contacted. Regardless of these negative aspects, most patients felt that nurses were more understanding and caring than doctors and were less likely to use medical jargon.

Federman, Reid, Feldman, Greenhoe, and Kirsner (2001) studied the differences between patients' perspective on dermatologic care provided by primary care providers (PCPs), including nurse practitioners and by dermatologists. Participants were put into two groups. Patients in group 1 were treated by a PCP and patients in group 2 were treated by a dermatologist. Results of the study showed that patients in group 1 were confident in the abilities of PCPs to diagnose skin cancer (73%). A comparison between group 1 and 2 showed that patients in group 2 were less likely than group 1 to be confident in the abilities of PCPs to diagnose skin cancer ($p=.002$). The study also showed that among those who had been treated previously for a skin disorder by their PCP, there was a high satisfaction rate (78% reported a high satisfaction rate), although this was significantly less than the satisfaction rate of subjects treated by dermatologists. Seventy-seven of all the patients in the study reported to have a preference for the dermatologist.

A study conducted by Owen et al (1997) contradicts the result found by Federman et al (2001) that patients have confidence in the abilities of nurse practitioners to treat their skin conditions. In their study they found that patients did not believe that a nurse practitioner was able to treat their skin condition adequately. Fewer than 1% of the patients who participated (1 of 115) believed that a nurse practitioner was able to treat their skin condition adequately. Ninety-one percent of the patients (105 of 115) reported that their condition could be best treated by a dermatologist.

3.3 Drawbacks in terms of stress or burnout

Giving nurses more responsibilities, such as identifying suspicious lesions, can also have drawbacks. Corner (2003) reported that when nurses take on substantial responsibility and aspects of delegated medical practices, training and supervision of these nurses need close attention. This is because when nurses take on extra responsibilities, it does not mean that they receive a larger amount of supervision. Questions such as which aspects of nurses' practice should be supervised, and how this can be done while maintaining supervision and management by senior nurses, need to be resolved as new models of care are developed. Furthermore, Corner (2003) reported that these extra responsibilities can result into nurses experiencing burnout because the nursing training has not prepared them for it. So this raises the question: How do the new responsibilities affect nurses? Therefore this thesis will not only look at the perceptions of the patients but also at the perception of the nurses themselves. Do they perceive more stress or show they certain burnout symptoms?

3.4 Benefits of nurses in terms of costs

Studies have shown that hospitals with a high proportion of registered nurses provide better care, as reflected in lower mortality rates (Fagin, 1990). A registered nurse is a healthcare professional that is usually equipped with a four year degree and has the most responsibility in providing direct patient care [5]. Other publications also showed that cost savings can result from registered nurses' high productivity. In one hospital, researchers compared the changes in patients' needs in 1969 with those in 1985 and correlated them with the percentage of registered nurses during this time period. The results showed that, by 1972, the hospital's nursing salary budget supported 1,169 FTEs. Of those 1,169 FTEs, 36% were registered nurses, which accounted for 17.8% of the corporate budget. By 1985, the hospital's nursing salary budget supported 1,618 FTEs, of which 94% were registered nurses. But, this percentage only accounted for 14.7% of the corporate budget (Fagin, 1990).

4. Method

This section of the thesis explains how the research was conducted. A description will be given about the nurses and patients who participated in this study. Furthermore, the design and procedure of the research are explained.

4.1 Nurses

Interviews with nurses at the dermatology department indicated that there were two wards in the dermatology department, the oncology ward and the regular ward. Regarding skin cancer, the differences between nurses working on the oncology ward and the regular ward was that nurses on the regular ward only saw skin cancer patients when they had to perform a biopsy or remove stitches. Nurses on the oncology ward not only performed biopsies and removed stitches, but they also provided treatments, such as photodynamic therapy. Furthermore, they also worked as an assistant during Mohs surgery. This means that nurses handled skin cancer patients after these patients had a consult with the dermatologist. From the interviews, it also became clear that these nurses did not receive a special training regarding skin cancer treatment although nurses working oncology ward did get a training regarding oncology but not specifically on skin cancer. The nurses gained most of their knowledge through on the job learning. This means that nurses examined suspicious lesions together with dermatologists.

During this research, a nurse from both wards participated. Furthermore, a third nurse participated who had worked at the oncology ward for a about a year and a half but had also been manager of the dermatology department for about two and a half year during this research. To summarize, an overview is presented in Table 5 to show the different potential participants and their characteristics.

Table 5: Overview of characteristics of participants

	Oncology	Regular	Oncology/management
Experience /Tasks	- Perform biopsy; - Remove stitches; - Give treatment, (photodynamic therapy) - Assistant during Mohs surgery	- Perform biopsy; - Remove stitches;	- Perform biopsy; - Remove stitches; - Give treatment, (photodynamic therapy) - Assistant during Mohs surgery
Training	- No training - On the job learning	- No training - On the job learning	- No training - On the job learning

4.2 Patients

At the CzE, two types of potential skin cancer patients arrived at the department during the oncology consultation hours. The first type were the so called chronic patients. These patients came back to check up their previously treated lesions. Some of these patients also had new suspicious lesions that needed to be checked. The second type were the new patients, patients who had their first suspicious lesion. Furthermore, patients could be referred by a general practitioner or came to the hospital on their own initiative. Both new patients and chronic patients with suspicious lesions participated in the study.

The goal was that each nurse diagnosed 70 patients. This number of patients was a compromise between desired statistical power (likelihood of detecting actual differences among nurses) of the research and practical limitations. To get a power of .80, each nurse would have to see about 300 patients during this research. On the other hand, the data collection period for this research was about 10 weeks. During these 10 weeks, each nurse had one whole day to see patients. On a single day a nurse could see about 10 patients. This means that each nurse could see 100 patients. However, due to the summer holiday, a nurse did not have the full 10 weeks available due to summer holidays. Therefore, the compromise was that each nurse should see 70 patients. This has consequences for the study. With this number of patients, significant differences could be found when the differences between the nurses was at least 25%.

4.3 Questionnaires

The nurses in this research diagnosed patients with the help of the questionnaire developed by Jansen (2010). The questionnaire consisted of 44 questions used to determine whether a patient has non melanoma skin cancer or not. The questions were related to two different categories namely clinical characteristics and anamnesial characteristics. Clinical characteristics were directly observable and related to the lesion, such as shininess of the lesion and color of the lesion. Anamnesial characteristics referred to the (medical) history of the patient. These questions were related to sun exposure but also to whether the patient had a organ transplantation and used immune suppressing drugs. For this study, some questions were removed from this questionnaire, such as questions related to the general practitioner, and other questions were added, such as how confident the nurse was about the diagnosis. These decisions were made with the help of a dermatologist at the dermatology department. The complete questionnaire contained 49 questions and can be found in Appendix A (in Dutch). Nurses could use this questionnaire as a tool to help them to establish a diagnosis, although they were not aware of the main predictors established by Jansen (2010).

This questionnaire was used to answer research question 1a: What is the accuracy of nurses detecting non melanoma skin cancer and 1b: Are there differences in accuracy among nurses with different backgrounds? To be more specifically, two questions were used to answer research question 1a and 1b. The first question was what is the diagnosis? The nurse could give two answers. The first answer was non melanoma skin cancer and the second was something else which were all other skin conditions that were not non melanoma skin cancer, such as different types of nevi (sharply-circumscribed and chronic lesions of the skin), different types of warts, lentigines (a small pigmented spot on the skin with a clearly-defined edge, surrounded by normal-appearing skin) and other skin defects. The second question was, if it is non melanoma skin cancer which type is it? Furthermore, the accuracy of the diagnoses made by the nurses was also compared with a statistical prediction model computed from the characteristics from the questionnaire in Appendix A.

To compute the statistical model, logistic regression analyses was used. As explained above, logistic regression is characterized by an outcome variable that is dichotomous and predictor variables that are continuous or categorical. This means that the outcome variable (Y) has two categories, 1 or 0. In a multiple regression analysis, the outcome variable is predicted from a combination of each predictor variable X_i multiplied by its respective regression coefficient (b_i):

$$Y = b_0 + b_1X_1 + b_2X_2 + \dots + b_nX_n + \varepsilon_i$$

The probability of Y occurring is predicted given known values of X_i . The equation becomes:

$$P(Y) = 1 / (1 + e^{-(b_0 + b_1X_1 + b_2X_2 + \dots + b_nX_n + \epsilon_i)})$$

Where $P(Y)$ is the probability of Y occurring (between 0 and 1), and e is the base of the natural logarithms. For this study the so called cut off value is 0.5. This means when $P(Y)$ is smaller than 0.5, than it is predicted that Y does not occur. If $P(Y)$ is greater than 0.5, that it is predicted that Y does occur.

Data about patients' perceptions were gathered using a questionnaire which can be found in Appendix B. The questionnaire was based on the studies of Agosta (2005) and Alongi, Geolot, Richter, Mapstone, Edgerton, and Edlich (1979). Both studies were related to care provided by nurse practitioners, a nurse with a master's degree and training in the diagnosis and management of general medical conditions, and not specifically on nurses performing skin cancer assessment. Therefore, some the questions were changed in such a way that they were appropriate for this research. The questions were related to following topics: 1) time/hastiness, 2) the diagnosis of the nurse, 3) expertise/knowledge of the nurse, 4) completeness and thoroughness of the examination, 5) preference of the patient for dermatologist or nurse, and 6) overall satisfaction. The first five topics are related to the nurse and the consult, whereas the sixth subject is related to a patient's preference. This questionnaire was used to answer the second research question: How do patients perceive nurses diagnosing non melanoma skin cancer?

Data about nurses' perception about the diagnosing task were gathered using a questionnaire and an interview. Both can be found in Appendix C. The questionnaire used was the "Utrechtse Burnout Scale (UBOS)" and measured whether nurses experienced burn out symptoms. The interview consisted of questions related to the diagnosing task in terms of stress, but also examined how a nurse came to a certain diagnosis, and if they wanted to perform task in the future and under which conditions. The UBOS and the interview were used to answer research question 3: How do nurses perceive the work experience after adding the new diagnosing task?

4.4 Validity

Several threats on the internal validity of this research could be identified (Judd, Smith, and Kidder, 1991). The first one is diffusion. The participants during the research could talk to each other and change ideas about how to diagnose a patient. This could lead to a situation in which each participant worked the same and had the same performance, but in reality one of the participants was just helping the other. To reduce this threat, the researcher explained to the nurses the importance of not talking to each other about diagnosing patients and the considerations they made to reach a diagnosis. Another factor was confounding. This means that the performance increased but not because of the questionnaire but because of another variable. An example could have been that nurses studied during their free time to increase their performance. If participants did this, this should be reported to the researcher so that during interpreting the results of the analyses it could be taken into account. However, during this research none of the nurses studied skin cancer lesions or other related subjects.

4.5 Procedure

Figure 2 shows the procedure of the study. At the beginning of the study, the three nurses completed the UBOS questionnaire to get a baseline measurement about the degree to which they experienced burnout. During this study, new patients and chronic patients, who arrived at the department during the oncology consultation hours, were asked to participate in the study. This was either done by the nurse herself, or the nurse instructed the front desk to ask patients if they were willing to participate in this study. Patients were seen before they had their appointment with the dermatologist. When a patient was willing to participate, the nurses called the patient in the waiting room and entered one of the examination rooms of the dermatology department. The nurse explained to the participant what the goal of the study was.

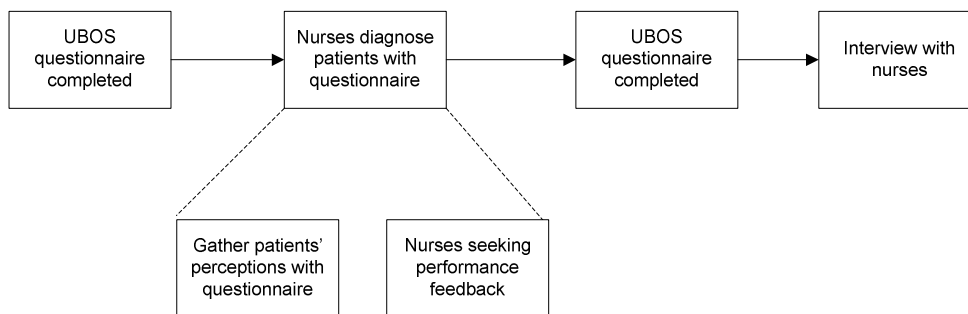


Figure 2: Procedure of the research

Of every patient, one suspicious lesion was examined by the nurses. If a patient had several lesions the nurse asked if the patient had a specific lesion the dermatologist had to look at. If this was not the case, the nurse had to make a decision which lesion to examine. The nurse made this decision based on which lesion seemed suspicious of skin cancer. During the examination of the lesion, the researcher kept track of the time the nurse needed to do the examination. After the nurse had completed the skin cancer questionnaire regarding the sun behavior and the lesion, patients were asked to fill in the questionnaire regarding patients' perceptions. The researcher helped the patients with answering the questionnaire if patients had problems with answering it. After the questionnaire was completed, patients were guided back to the waiting room before they had their appointment with a dermatologist. While the patient completed the patients' perception questionnaire, the nurse left the room and gave the completed questionnaire to the dermatologist who would fill in the actual diagnosis or indicate that a biopsy had to be done. If a biopsy had been taken, the researcher could find its result in the information system of the hospital after one to two weeks.

During the diagnosis task, nurses also searched performance feedback. The diagnosis outcomes were not kept hidden from the nurses during the data gathering period. The nurse could seek feedback by looking at the dermatologists' answers on the questionnaire. At the end of the study, when all the patient information was gathered, the nurses completed the UBOS questionnaire again and the researcher held the interviews with the nurses. Furthermore, information was gathered to get an overview of the costs made by dermatologists and nurses for examining possible skin cancer patients.

5. Diagnoses

This chapter looks at how accurately the nurses diagnosed non melanoma skin cancer. First the percentage correct diagnoses are determined for all the nurses together and for each of the three nurses separately. Also the number of false positives and negatives are discussed. The next step is to compare the diagnoses of the nurses with a statistical model that predicts the diagnoses of the dermatologists/biopsies. This gives an insight whether or not the nurses perform better than the model. Finally the diagnoses of the nurses are used as a predictor variable to assess if the statistical model has an added value on the diagnoses of the nurses. Based on this model, some conclusions about training of the nurses can be drawn.

5.1 High percentage correct diagnoses of the nurses

In total, the three nurses had diagnosed 206 patients, however 4 patients were deleted because of missing data. Table 5 provides an overview of the diagnoses made by the nurses and the actual diagnoses made by the dermatologists/biopsies. The percentage correct diagnoses was 81.7% (165 correct diagnoses) with a 95% confidence interval [6] of (76.1, 87.3). Table 6 shows how many of the actual diagnoses the nurses had correct and where differences were between the actual diagnoses and the diagnoses of the nurses.

Table 5: Overview of the diagnoses (All nurses)

	Nurses	Actual
AK	66	58 (51, 7)*
Morbus Bowen	1	2 (0, 2)
SCC	4	0 (0, 0)
BCC	39	34 (16, 18)
Something else	92	108 (95, 13)

* Numbers in parentheses are diagnoses by the dermatologist and biopsy results, respectively

Table 6: Crosstabs of the diagnoses made by the nurses

Dermatologists/biopsy	Nurses					Total
	AK	Morbus Bowen	SCC	BCC	Something else	
AK	50	1	1	4	2	58
Morbus Bowen	1	0	1	0	0	2
SCC	0	0	0	0	0	0
BCC	4	0	1	27	2	34
Something else	11	0	1	8	88	108
Total	66	1	4	39	92	202

5.1.1 High percentage correct diagnoses manager/oncology nurse

The manager/oncology nurse diagnosed 69 patients during this study. Table 7 shows an overview of the diagnoses this nurse made. Also, the actual diagnoses of the lesions are reported. The actual diagnoses contain diagnoses made by a dermatologist and diagnoses from a biopsy when a dermatologist was not sure of the diagnosis he or she made (55 diagnoses made by a dermatologist and 14 biopsy findings). The percentage correct diagnoses was 78.3% (54 correct diagnoses) with a 95% confidence interval [6] of (67.8, 88.7). Table 8 shows how many of the actual diagnoses the

manager/oncology nurse had correct and where differences were between the actual diagnoses and the diagnoses of this nurse.

Table 7: Overview of the diagnoses made by the manager/oncology nurse

	Manager/oncology nurse	Actual
AK	31	29 (27, 2)*
Morbus Bowen	0	1 (0, 1)
SCC	3	0 (0, 0)
BCC	16	12 (4, 8)
Something else	19	27 (24, 3)

* Numbers in parentheses are diagnoses by the dermatologist and biopsy results, respectively

Table 8: Crosstabs of the diagnoses made by the manager/oncology nurse

Dermatologists/biopsy	Manager/oncology nurse					Total
	AK	Morbus Bowen	SCC	BCC	Something else	
AK	27	0	0	1	1	29
Morbus Bowen	0	0	1	0	0	1
SCC	0	0	0	0	0	0
BCC	2	0	1	9	0	12
Something else	2	0	1	6	18	27
Total	31	0	3	16	19	69

5.1.2 High percentage correct diagnoses oncology nurse

The oncology nurse diagnosed 70 patients during this study. Table 9 shows the overview of the diagnoses this nurse made. The actual diagnoses are 51 made by a dermatologist and 19 biopsy findings. The percentage correct diagnoses was 81.4% (57 correct diagnoses) with a 95% confidence interval [6] of (70.8, 90.4). Table 10 shows how many of the actual diagnoses the oncology nurse had correct and where differences were between the actual diagnoses and the diagnoses of this nurse.

Table 9: Overview of the diagnoses made by the oncology nurse

	Oncology nurse	Actual
AK	18	17 (13, 4)*
Morbus Bowen	0	0 (0, 0)
SCC	1	0 (0, 0)
BCC	16	13 (5, 8)
Something else	35	40 (33, 7)

* Numbers in parentheses are diagnoses by the dermatologist and biopsy results, respectively

Table 10: Crosstabs of the diagnoses made by the oncology nurse

Dermatologists/biopsy	Oncology nurse					Total
	AK	Morbus Bowen	SCC	BCC	Something else	
AK	12	0	1	3	1	17
Morbus Bowen	0	0	0	0	0	0
SCC	0	0	0	0	0	0
BCC	0	0	0	12	1	13
Something else	6	0	0	1	33	40
Total	18	0	1	16	35	70

5.1.3 High percentage correct diagnoses regular nurse

The oncology nurse diagnosed 63 patients during this study. Table 11 shows the overview of the diagnoses this nurse made. The actual diagnoses are 56 made by a dermatologist and 7 biopsy findings. The percentage correct diagnoses was 85.7% (54 correct diagnoses) with a 95% confidence interval [6] of (75.1, 96.3). Table 12 shows how many of the actual diagnoses the regular nurse had correct and where differences were between the actual diagnoses and the diagnoses of this nurse.

Table 11: Overview of the diagnoses made by the regular nurse

	Regular nurse	Actual
AK	17	12 (11, 1)*
Morbus Bowen	1	1 (0, 1)
SCC	0	0 (0, 0)
BCC	6	9 (7, 2)
Something else	39	41 (38, 3)

* Numbers in parentheses are diagnoses by the dermatologist and biopsy results, respectively

Table 12: Crosstabs of the diagnoses made by the regular nurse

Dermatologists/biopsy	Regular nurse					Total
	AK	Morbus Bowen	SCC	BCC	Something else	
AK	11	1	0	0	0	12
Morbus Bowen	1	0	0	0	0	1
SCC	0	0	0	0	0	0
BCC	2	0	0	6	1	9
Something else	3	0	0	0	38	41
Total	17	1	0	6	39	63

Figure 3 summarizes the above percentages and the confidence intervals. Another interesting finding is that the manager/oncology nurse had seen a lot more patients with AK (42%) than the other two nurses (oncology: 24%; regular: 19%). A possible explanation for this finding is that the manager/oncology nurse had seen more control patients (42%) than the other two nurses (oncology: 0%; regular: 5%). With control patients, the chance is higher that they have a certain type of skin cancer than new patients. If a patient gets for example AK during his/her lifetime, then the skin is damaged. If these patients do not cover themselves when going into the sun or use sun protection, they are very likely to get AK again. This also raises another important question. If the manager/oncology nurse saw more control patients, this nurse could also see the patient history (what kind of diagnoses are made in the past). This would mean that it was easier for the manager/oncology nurse to make the correct diagnosis. However, during this study the nurse did not seek any information about the previous diagnoses of the patient. The researcher of this study was present during the examinations and explained to the nurse that it was important that she should diagnose the patients without any knowledge of the previous conditions the patient was treated for at the dermatology department.

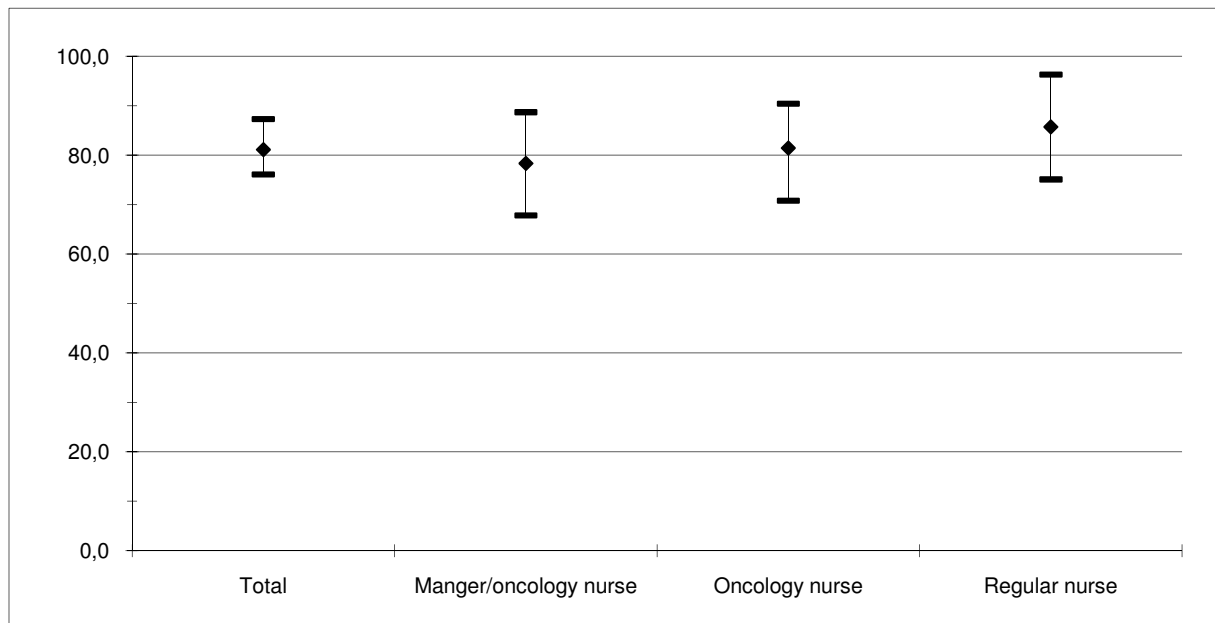


Figure 3: 95% Confidence intervals for the diagnoses of the nurses

From the above results a first preliminary conclusion can be drawn. The percentages of the correct diagnoses made by the nurses indicate that they are able to accurately predict non melanoma skin cancer. To get a better insight in the accuracy, the next section shows classification tables that report the amount of false positives and negatives the nurses had.

5.2 False positives and negatives in diagnoses of the nurses

This section provides the classification tables to further asses the accuracy of the diagnoses made by the nurses. Furthermore, this section will focus only on AK and BCC. This focus was chosen because these two types of non melanoma skin cancer occur most often.

5.2.1 False positive and negative AK and BCC diagnoses

All three nurses together had 178 correct AK diagnoses (88.1%), see Table 13. Furthermore, Table 13 also shows that the nurses were accurate in identifying an AK lesions when present: 86.2% correct AK diagnoses and 13.8% false negatives (lesion classified as not AK when in fact AK was present). There were also relatively few false positives (11.1%) when a lesion was classified as AK when in fact it was not. Table 14 shows that the three nurses had 183 correct BCC diagnoses (90.6%). Table 14 also shows that the nurses were reasonable accurate in identifying a BCC lesions when present: 79.4% correct BCC diagnoses and 20.6% false negatives (lesion classified as not BCC when in fact BCC was present). There were also relatively few false positives (7.1%) when a lesion was classified as BCC when in fact it was not.

Table 13: Classification table AK all nurses

Observed by dermatologist/biopsy	Predicted by nurses			Percentage correct
	AK			
	Negative AK	Positive AK		
AK	Negative AK	128	16	88.9
	Positive AK	8	50	86.2
Overall percentage				88.1

Table 14: Classification table BCC all nurses

Observed by dermatologist/biopsy		Predicted by nurses		
		BCC		
		Negative BCC	Positive BCC	Percentage correct
BCC	Negative BCC	156	12	92.9
	Positive BCC	7	27	79.4
Overall percentage				90.6

5.2.2 False positive and negative AK and BCC diagnoses for each type of nurse

Tables 15, 16, and 17 show that the manager/oncology, oncology nurse, and the regular nurse had 63, 59, and 56 respectively correct AK diagnoses (91.3%, 84.3%, and 88.9% respectively). Tables 15, 16, and 17 also show that the manager/oncology and regular nurse were accurate in identifying an AK lesions when present: 93.1% and 91.7% correct AK diagnoses and the oncology nurse was reasonably accurate, 70.6%. The nurses had 6.9%, 29.4%, and 8.3% (manager/oncology nurse, oncology nurse, and regular nurse respectively) false negatives. The manager/oncology nurse, oncology nurse, and the regular nurse had also relatively few false positives (10.0%, 11.3%, and 11.8% respectively) when a lesion was classified as AK when in fact it was not.

Table 15: Classification table manager/oncology nurse AK

Observed by dermatologist/biopsy		Predicted by manager/oncology nurse		
		AK		
		Negative AK	Positive AK	Percentage correct
AK	Negative AK	36	4	90.0
	Positive AK	2	27	93.1
Overall percentage				91.3

Table 16: Classification table oncology nurse AK

Observed by dermatologist/biopsy		Predicted by oncology nurse		
		AK		
		Negative AK	Positive AK	Percentage correct
AK	Negative AK	47	6	88.7
	Positive AK	5	12	70.6
Overall percentage				84.3

Table 17: Classification table regular nurse AK

Observed by dermatologist/biopsy		Predicted by regular nurse		
		AK		
		Negative AK	Positive AK	Percentage correct
AK	Negative AK	45	6	88.2
	Positive AK	1	11	91.7
Overall percentage				88.9

Tables 18, 19, and 20 show that the manager/oncology, oncology nurse, and the regular nurse had 59, 65, and 59 respectively correct BCC diagnoses (85.5%, 92.9%, and 93.7% respectively). Tables 18, 19, and 20 also show that the oncology nurse was accurate in identifying a BCC lesions when present: 92.3% BCC diagnoses and the manager/oncology and regular nurse were reasonably accurate, 75.0% and 66.7 respectively. The nurses had 25.0%, 7.7%, and 33.3% (manager/oncology nurse, oncology nurse, and regular nurse respectively) false negatives. The manager/oncology nurse, oncology nurse, and the regular nurse had also relatively few false positives (12.3%, 7.0%, and 1.9% respectively) when a lesion was classified as BCC when in fact it was not.

Table 18: Classification table manager/oncology nurse BCC

Observed by dermatologist/biopsy		Predicted by manager/oncology nurse		
		BCC		
		Negative BCC	Positive BCC	Percentage correct
BCC	Negative BCC	50	7	87.7
	Positive BCC	3	9	75.0
Overall percentage				85.5

Table 19: Classification table oncology nurse BCC

Observed by dermatologist/biopsy		Predicted by oncology nurse		
		BCC		
		Negative BCC	Positive BCC	Percentage correct
BCC	Negative BCC	53	4	93.0
	Positive BCC	1	12	92.3
Overall percentage				92.9

Table 20 Classification table regular nurse BCC

Observed by dermatologist/biopsy		Predicted by regular nurse		
		BCC		
		Negative BCC	Positive BCC	Percentage correct
BCC	Negative BCC	53	1	98.1
	Positive BCC	3	6	66.7
Overall percentage				93.7

For AK and BCC, the percentages correct diagnoses are higher than 81.7% found in Section 5.1. The reason for this is that the nurses made more incorrect diagnoses for Morbus Bowen and SCC. However, the mistakes made for Morbus Bowen are not as serious as other mistakes, such as diagnosing a patient with BCC when in reality the patient had something else or a different type of non melanoma skin cancer. The 2 actual Morbus Bowen diagnoses were identified by the nurses as AK and SCC (table 6). Because Morbus Bowen is the state of the lesion between AK and SCC, the AK diagnosis was assessed less severe by the nurses and the SCC diagnosis was assessed too severe. SCC was not diagnosed by the dermatologists/biopsies. However the nurses diagnosed 4 patients incorrectly with SCC (table 6).

Finally, it is interesting to look at the influence of the feedback the nurses sought. As explained in the method chapter, the diagnoses of the dermatologists were not kept hidden from the nurses and

therefore they could see how often they made the right or wrong diagnosis. To assess if this had an effect on the percentage correct diagnoses, the data was split in half and the percentage correct diagnoses was calculated. Table 21 shows the results and it can be concluded that the feedback did not improve the percentage correct diagnoses.

Table 21: Influence of feedback on percentage correct diagnoses

	Overall correct percentage AK diagnoses		Overall correct percentage BCC diagnoses	
	<i>First</i>	<i>Last</i>	<i>First</i>	<i>Last</i>
Manager/oncology nurse	90.0	92.3	90.0	82.1
Oncology nurse	85.3	83.3	94.1	91.7
Regular nurse	87.1	90.6	93.5	93.8
Overall	87.4	88.8	92.3	88.8

From the above analyses it can be concluded that the nurses predicted non melanoma skin accurately. The overall percentage correct diagnoses are high for AK and BCC, and the number of false negatives and false positives is also relatively small. The next step is to assess if statistical models can further improve the accuracy of the diagnoses. First the diagnoses of the nurses are compared with a model predicting the diagnoses of the dermatologists/biopsies. Later on, analyses are used to determine if a statistical model has an added value on the diagnoses of the nurses. Finally, a model is computed to predict the diagnoses of the nurses.

5.3 Comparing the diagnoses of the nurses with a model predicting the diagnoses of the dermatologists/biopsies

This section compares the diagnoses of the nurses with a statistical model derived from the logistic regression analysis which predicts the diagnoses of the dermatologists/biopsies in order to determine whether the statistical model is more accurate in diagnosing non melanoma skin cancer than the nurses. This was done using the logistic regression syntax provided by Kleingeld and Snijders. Eleven characteristics were used in the AK analysis and can be divided into clinical characteristics and anamnesial characteristics. The clinical characteristics were: shape, wound, shininess, keratosis, light red, localization, widened blood vessels, itchiness and an interaction effect of keratosis and light red. The anamnesial characteristics were frequent sun exposure before 65 years old and often been on summer holiday. For the BCC analysis, ten characteristics were used. The clinical characteristics were: dark red, light red, shininess, induration, wound, keratosis, shape, and does the lesion bleed when drying. The anamnesial characteristics were: age and often been on summer holiday. Due to missing data, because of not completed diagnoses questionnaires, the N for AK analyses are 196 and for BCC 198.

5.3.1 Nurses predict true positive AK better than the statistical model

As explained in the method chapter, logistic regression was used to compute the statistical model. Table 22 shows the characteristics that are significant predictors for the AK diagnoses of the dermatologists/biopsies. Furthermore, table 22 shows the marginal effects of the characteristics (calculated by Snijders). These marginal effects show what the average effect is on the probability of having AK. For example, the average effect of a lesion being light red on the probability of a lesion being AK is .16. This means when the probability of a lesion being AK is .5, this probability increases to .66 if the lesion is light red. Table 23 shows the classification table of the model and table 24

shows the classification table of the diagnoses of the nurses. The model predicting AK has a total percentage correct diagnoses of 84.7%. The nurse has a slightly higher percentage, namely 88.3%. But the most interesting finding is that the nurse is better in predicting true positives, and therefore has fewer false negatives, than the model. The nurse has 87.7% correct true positives whereas the model has only 70.2% correct. Furthermore, the type of nurse did not have a significant prediction value for AK. To analyze this the type of nurses was added as an additional predictor in the logistic regression analysis. Although the manager/oncology nurse was a significant predictor and the total percentage correct diagnoses increased from 84.7% to 86.2%, this was probably due to the fact that the manager/oncology nurse had seen more AK patients than the other 2 nurses instead of the reason that the manager/oncology nurse had more accurate AK prediction skills.

Table 22: Result of Logistic Regression with AK as dependent variable

Predictor	B (SE)	95% CI for exp b			Marginal effect (dy/dx)
		Lower	exp b	Upper	
Shape	-2.64 (.62)***	.02	.07	.24	-.23
Frequent sun exposure before 65 years old	1.46 (.52)**	1.55	4.30	11.92	.13
Wound	-1.30 (.66)**	.08	.27	.99	-.12
Shininess	-1.94 (.89)**	.03	.14	.83	-.17
Keratosis	2.80 (.76)***	3.70	16.47	73.20	0.25
Often been on summer holiday	-.48 (.18)**	.43	.62	.88	-.04
Light red	1.90 (.65)**	1.89	6.70	23.80	.16
Localization	1.83 (.70)**	1.59	6.20	24.20	.16
Widened blood vessels	1.47 (.96) ^a	.67	4.35	28.35	.13
Itchiness	1.40 (.94) ^a	.04	.25	1.55	-.08
Keratosis X Light red	-1.61 (.77)**	.04	.20	.91	-.14
Constant	-6.71 (2.70)**		.00		

Note. $R^2 = .42$ (Cox & Snell), $.59$ (Nagelkerke); Model $\chi^2 = 131.35$; * $p < .1$, ** $p < .05$, *** $p < .001$;

^a $p > .1$ but retained as predictor

Table 23: Classification table model AK

Observed by dermatologist/biopsy		Model		
		AK		Percentage correct
		Negative AK	Positive AK	
AK	Negative AK	126	13	90.6
	Positive AK	17	40	70.2
Overall percentage				84.7

Table 24: Classification table nurses AK

Observed by dermatologist/biopsy		Nurses		
		AK		Percentage correct
		Negative AK	Positive AK	
AK	Negative AK	123	16	88.5
	Positive AK	7	50	87.7
Overall percentage				88.3

Note: 2 cases with no idea classified as incorrect prediction

5.3.2 Nurses predict true positive BCC better than the statistical model

Logistic regression analysis of BCC shows the following results. Table 25 shows the characteristics that are significant predictors for the BCC diagnoses of the dermatologists/biopsies.

Furthermore, table 25 shows the marginal effects of the characteristics (calculated by Snijders). These marginal effects show what the average effect is on the probability of having BCC. For example, the average effect of a lesion being dark red on the probability of a lesion being AK is .62. This means when the probability of a lesion being AK is .2, this probability increases to .82 if the lesion is dark red. Table 26 shows the classification table of the model and table 27 shows the classification table of the diagnoses of the nurses. The model predicting BCC has a total percentage correct diagnoses of 91.4%. The nurse has a slightly lower percentage, namely 90.4%. But the most interesting finding is that the nurse, like AK, is better in predicting true positives than the model. The nurse has 78.8% correct true positives whereas the model has only 60.6% correct. The type of nurse did not have a significant influence on the percentage correct BCC diagnoses.

Table 25: Result of Logistic Regression with BCC as dependent variable

Predictor	B (SE)	95% CI for exp b			Marginal effect (dy/dx)
		Lower	exp b	Upper	
Dark red	4.21 (1.83)**	1.87	67.52	2442.35	.62
Light red	3.60 (1.07)**	4.44	36.64	302.39	.12
Shininess	1.15 (.68)*	.83	3.14	11.85	.03
Age	.10 (.03)**	1.04	1.10	1.17	.00
Induration	-1.44 (.87)*	.04	.24	1.30	-.04
Often been on summer holiday	.52 (.23)**	1.08	1.68	2.60	.01
Wound	2.64 (.86)**	2.61	14.00	75.03	.07
Keratosis	-1.92 (.48)***	.06	.15	.38	-.05
Does the lesion bleed when drying	.88 (.63) ^a	.70	2.42	8.27	.02
Shape	2.12 (.77)**	1.87	8.36	37.50	.06
Constant	-1.61 (.77)***				

Note. $R^2 = .39$ (Cox & Snell), $.66$ (Nagelkerke); Model $\chi^2 = 80.88$; * $p < .1$, ** $p < .05$, *** $p < .001$;
^a $p > .1$ but retained as predictor

Table 26: Classification table model BCC

Observed by dermatologist/biopsy		Model		
		BCC		
		Negative BCC	Positive BCC	Percentage correct
BCC	Negative BCC	161	4	97.6
	Positive BCC	13	20	60.6
Overall percentage				91.4

Table 27: Classification table nurses BCC

Observed by dermatologist/biopsy		Nurses		
		BCC		
		Negative BCC	Positive BCC	Percentage correct
BCC	Negative BCC	153	12	92.7
	Positive BCC	7	26	78.8
Overall percentage				90.4

Note. 2 cases with no idea classified as incorrect prediction

From the above analyses it can be concluded that the diagnoses of the nurse and the prediction of the models of AK and BCC do not differ much in terms of overall percentage correct. However, nurses are better in predicting true positives than the models, whereas the models are slightly better in predicting true negatives. This is an interesting finding because it is perhaps possible to improve the performance of the nurses with the models in terms of true negatives. To investigate this, the next

section shows the results of logistic regression analyses using the diagnoses of the nurse as a predictor. Furthermore, these analyses also indicate which characteristics were given too much or too low weight in the diagnoses of the nurses and therefore can explain how the accuracy of the nurses can be improved.

5.4 The added value of the models on the diagnoses of the nurses

As explained above, the analyses in this section uses the diagnoses of the nurses as a predictor in the logistic regression. The diagnoses was added to the models computed in Section 5.3. Furthermore, the two cases where the nurses did not know which kind of non melanoma skin cancer it was, were classified as an incorrect prediction to keep N=196 for comparison between the new model and the diagnoses of the nurses for AK and N=198 for BCC.

5.4.1 Model AK can improve true negative diagnoses

Logistic regression analyses with the diagnoses of the nurses as additional predictor shows the following results. Table 28 shows which characteristics are significant predictors of AK. The diagnoses of the nurse is the most significant predictor, which is of course not that surprising because of the high percentage correct diagnoses made by the nurses.

Table 29 shows the classification table of the model. This model predicting AK has a total percentage correct diagnoses of 91.3%. The nurses had a slightly lower percentage, namely 88.3%. The percentage of true positives stays the same, namely 87.7%. But the most interesting finding is that the model improves the percentage of true negatives from 88.5% for the nurses to 92.8% correct in the new model as predicted from the model in Section 5.3.1.

Table 28: Result of Logistic Regression with AK as dependent variable and AK diagnoses nurses as additional predictor

Predictor	B (SE)	95% CI for exp b		
		Lower	exp b	Upper
Shape	-.96 (.58)*	.12	.38	1.19
Frequent sun exposure before 65 years old	1.56 (.59)**	1.49	4.78	15.29
Shininess	-1.53 (.89)*	.04	.22	1.24
Often been on summer holiday	-.43 (.21)**	.43	.65	.99
Widened blood vessels	3.33 (.97)**	4.13	27.80	187.26
AK diagnoses nurses	4.80 (.73)***	29.04	121.07	504.77
Constant	-5.48 (.63)**	.12	.00	1.19

Note. $R^2 = .49$ (Cox & Snell), $.70$ (Nagelkerke); Model $\chi^2 = 103.46$; * $p < .1$, ** $p < .05$, *** $p < .001$

Table 29: Classification table model with nurse diagnoses AK

Observed by dermatologist/biopsy	Model with nurse diagnoses		
	AK		
	Negative AK	Positive AK	Percentage correct
AK	Negative AK	129	92.8
	Positive AK	8	87.7
Overall percentage			91.3

The next step is to look on which characteristics the nurses put too much or too little. These characteristics can explain how nurses could improve their accuracy. From table 28 it can be seen that there are still 5 significant characteristics of the 10 characteristics from the model predicting the diagnoses of the dermatologists/biopsies. Of these 5 characteristics 2 are anamnesial (frequent sun exposure before 65 years old and often been on summer holiday) and 3 are clinical (shape, shininess,

and widened blood vessels). These 5 characteristics can improve the accuracy of the nurses as follow. The characteristics shape, shininess, and often been on summer holiday all have a minus sign. This means that the nurses put too much weight on these characteristics. Furthermore, the nurses put too little weight on the characteristics frequent sun exposure before 65 years old and widened blood vessels. Widened blood vessels is the most important predictor besides the prediction of the nurses, whereas shape and often been on summer holiday are less important predictors. Furthermore, shininess and frequent sun exposure before 65 years old are fairly important predictors.

5.4.2 Model BCC can improve true negative diagnoses

As with AK, for BCC the diagnoses of the nurses was used as a additional predictor in the logistic regression analysis. Table 30 shows which characteristics are significant predictors of BCC. The diagnoses of the nurse is a significant predictor, which is of course not that surprising because of the high percentage correct diagnoses made by the nurses.

Table 31 shows the classification table of the model. This model predicting BCC has a total percentage correct diagnoses of 94.4%. The nurses had a slightly lower percentage, namely 90.4%. The percentage of true positives stays the same, namely 78.8%. But the most interesting finding is, as with AK, that the model improves the percentage of true negatives from 92.7% for the nurses to 97.6% correct in the new model as predicted from the model in Section 5.3.2.

Table 30: Result of Logistic Regression with BCC as dependent variable and BCC diagnoses nurses as additional predictor

Predictor	B (SE)	95% CI for exp b		
		Lower	exp b	Upper
Dark red	4.18 (2.81)*	.91	65.57	4707.70
Light red	3.71 (1.33)**	3.04	41.	558.66
Age	.10 (.03)**	1.03	1.10	1.17
Induration	-2.15 (1.06)**	.02	.12	.92
Often been on summer holiday	.64 (.26)**	1.13	1.89	3.17
Wound	2.08(.94)**	1.26	7.97	50.46
Keratosis	-1.39 (.50)**	.10	.25	.66
Does the lesion bleed when drying	1.17(.70)*	.82	3.22	12.71
Shape	2.84 (.92)**	2.81	17.08	103.90
BCC diagnoses nurses	3.08 (.77)***	4.86	21.75	97.35
Constant	-17.28 (4.14)***		.000	

Note. $R^2 = .44$ (Cox & Snell), $.74$ (Nagelkerke); Model $\chi^2 = 62.92$; * $p < .1$, ** $p < .05$, *** $p < .001$

Table 31: Classification table model with nurse diagnoses BCC

Observed by nurses	Model with nurse diagnoses			
	BCC			
	Negative BCC	Positive BCC	Percentage correct	
BCC	Negative BCC	161	4	97.6
	Positive BCC	7	26	78.8
Overall percentage				94.4

The next step is to look on which characteristics the nurses put too much or too little weight. These characteristics can explain how nurses could improve their accuracy for BCC diagnoses. From table 30 it can be seen that there are still 9 significant characteristics of the 10 characteristics from the model predicting the diagnoses of the dermatologists/biopsies. Of these 9 characteristics 2 are anamnesial (age and often been on summer holiday) and 7 are clinical (dark red, light red, induration, wound,

keratosis, does the lesion bleed when drying, and shape). These 9 characteristics can improve the accuracy of the nurses as follow. The characteristics induration and keratosis, both have a minus sign. This means that the nurses put too much weight on these characteristics. Furthermore, the nurses put too little weight on the characteristics dark red, light red, age, often been on summer holiday, wound, does the lesion bleed when drying, and shape. Dark red and light red are the most important predictors besides the prediction of the nurses, whereas age and often been on summer holiday are less important predictors. Furthermore, induration, wound, keratosis, does the lesion bleed when drying, and shape are fairly important predictors.

To conclude, the above analyses show that the accuracy of the diagnoses of the nurses can be improved, both for AK and BCC. To be more specific, if nurses put more weight or less weight on certain characteristics the percentage of true negatives will improve. For AK these characteristics are widened blood vessels, shininess, and frequent sun exposure before 65 years old. The nurses should put less weight on shininess, and more weight on widened blood vessels and frequent sun exposure before 65 years old. For BCC these characteristics are dark red, light red, induration, wound, keratosis, does the lesion bleed when drying, and shape. The nurses should put less weight on induration and keratosis, and more weight on dark red, light red, wound, does the lesion bleed when drying, and shape.

6 Patient perception

This chapter of the master thesis looks at how patients perceived nurses diagnosing non melanoma skin cancer. This chapter is divided into two parts. The first part analyzes how patients perceived the nurse. The second part focuses on the subgroup of patients who had visited the dermatology department before.

6.1 Patient perception part 1: How patients perceive the nurses

The first step in assessing the patient perception was to prepare the data for the analyses. First the amount of missing data was assessed. In total, 206 patients have participated in the research. Before the analysis start, the variable “the nurse was rushed” was recoded because this was a negative question, whereas the others were positive questions.

The missing data analysis showed that for the variables “I trust the diagnosis of the nurse” and, “I am satisfied how the nurse made the diagnosis” there were 68 patients who did not answer these questions. This can be explained because the regular nurse did not give the patient a diagnosis. Therefore these patients could not answer these two questions. Further analysis showed that there was one case that misses 6 variable of the 9 (.5% of all respondents) and 3 cases that misses all 9 variables. Therefore these cases were removed from the dataset. Also, the analysis showed that only 58.3% of the patients had no missing data.

Furthermore there were 8 cases where patients had a negative answer on the first eight questions but rated the variable “How do you rate the examination you received from the nurse as to completeness and thoroughness” as positive and were willing to be examined by a nurse in the future. It seemed that these patients did not understand how to fill in the questionnaire. Therefore these cases were removed.

When the variables “I trust the diagnosis of the nurse” and “I am satisfied how the nurse made the diagnosis” were not considered the missing data seemed missing at random. Therefore, for the remaining seven variables an imputation method was used, the model based method EM (Hair, Black, Babin, Anderson, and Tatham, 2006).

6.1.1 Data reduction of the questionnaire

Next, an exploratory factor analysis was conducted. The goal of the factor analysis was data reduction. Therefore a component factor analysis with Direct Oblimin as rotation method was used because it was expected that the factors were correlated.

The factor analysis found 2 factors. Factor 1 included the following three variables: 1) “Overall I am satisfied with my visit with the nurse”, 2) “The nurse was caring”, and 3) “I was satisfied with the amount of time the nurse spent with me”. This factor gave a view of the service provided by the nurse as perceived by the patient. The second factor included the following three variables: 1) “The nurse was knowledgeable about my skin condition”, 2) “I trust the diagnosis of the nurse”, and 3) “I am satisfied how the nurse made the diagnosis”. This factor gave view of the knowledge of the nurse perceived by the patients. However, the missing data analysis showed that there was a lot of missing data on the variables “I trust the diagnosis of the nurse” and “I am satisfied how the nurse made the diagnosis” because the regular nurse did not inform the patient about the diagnosis she made. Therefore, factor 2 was not applicable to all three nurses, but just on the oncology nurse and the manager/oncology nurse. Because of this, it was decided to split this factor into a single item, “The

nurse was knowledgeable about my skin condition”, for all three nurses, and a factor with the variables “I trust the diagnosis of the nurse” and “I am satisfied how the nurse made the diagnosis” for the oncology nurse and the manager/oncology nurse.

The variables “The nurse was a skilled healthcare provider” and “How do you rate the examination you received from the nurse as to completeness and thoroughness” had both a crossloading (loading score of .5 or higher on more than one factor) and were therefore removed from the factor analysis. However these variables were used as a single item. Furthermore the variable “the nurse was rushed” had a communality score lower than .5, namely .243, and was therefore removed from the analysis.

The two factors explained 86.68% of the total variance. The Cronbach alpha’s of factor 1 was .905 and for factor 2 .893. A summary of the factor loadings can be found in Table 32 for the Oblimin rotation, Table 33 shows the correlations between the factors and single items.

Table 32: Factor Loadings (n=194)¹

		Factor	
Category label	Item	1	2
Service	Overall I am satisfied with my visit with the nurse	.92	
Service	The nurse was caring	.92	
Service	I was satisfied with the amount of time the nurse spent with me	.91	
Knowledge ^a	I trust the diagnosis of the nurse		.95
Knowledge ^a	I am satisfied how the nurse made the diagnosis		.95
Eigen Value		3.23	1.10
Variance Explained		64.67	22.01
Cumulative variance explained		64.67	86.68

Note. Extraction Method: Principal Component Analysis, Rotation Method: Oblimin with Kaiser Normalization; Factorloadings below .5 not shown in the table.

^a For these variables n=133

Table 33: Correlations between the factors and single items

	N	1	2	3	4	5
1. Service	194	1.00	.58**	.85**	.38**	.41**
2. Knowledge	133		1.00	.58**	.71**	.53**
3. The nurse was a skilled healthcare provider	194			1.00	.40**	.42**
4. The nurse was knowledgeable about my skin condition	194				1.00	.31**
5. How do you rate the examination you received from the nurse as to completeness and thoroughness	194					1.00

**p<.001

After the scores for the factors were calculated it became clear that in general, patients perceived the nurse and the examination as positive, with scores ranging between 3.82 and 4.36, see Table 4.

¹ The factor analysis was also conducted with Varimax as rotation matrix. This produced similar results as the Direct Oblimin rotation, with factor loadings that differed .04 or less from the loadings reported in Table 2.

This can be considered as positive because a mean of 3.00 is a neutral score. Scores above 3.00 are considered as positive and below 3.00 as negative. This positive response was also found for each type of nurse. Further analyses should indicate whether or not significant differences were found among the three nurses. This was done using ANOVA.

6.1.2 Differences among the nurses

An oneway ANOVA was carried out with Scheffe as the post hoc test. The Scheffe post hoc criterion was chosen because it is a conservative procedure and this means that there is control for the Type I error (differences are found between groups, but in reality there are no differences).

The analysis of variance showed that there were significant differences between the nurses for the factor Service, and the three single items “The nurse was a skilled healthcare provider”, “The nurse was knowledgeable about my skin condition”, and “How do you rate the examination you received from the nurse as to completeness and thoroughness”, see Table 34.

Table 34: Results of one-way analysis of variance, comparing the manager/oncology nurse, regular nurse, and oncology nurse

Condition	All	Manager/oncology nurse	Regular nurse	Oncology nurse	ANOVA	Effect size
Response	N=194	N=64	N=61	N=69	F(2, 191)	d
Service	4.36 (.51)	4.53 ^a (.45)	4.10 ^{a, b} (.45)	4.44 ^b (.53)	14.2 ^{**}	.96 ^a , .69 ^b
Skilled healthcare provider	4.22 (.65)	4.36 ^a (.63)	4.02 ^a (.56)	4.62 (.70)	4.8 [*]	.57 ^a
Knowledgeable about skin condition	3.82 (.82)	4.11 ^a (.69)	3.43 ^{a, b} (.82)	3.91 ^b (.80)	12.4 ^{**}	.91 ^a , .60 ^b
Completeness and thoroughness of examination	3.98 (.76)	4.34 ^{a, c} (.51)	3.74 ^a (.73)	3.87 ^c (.86)	12.6 ^{**}	.96 ^a , .66 ^c

Note. For nurses who share a superscript for a variable, multiple comparison (Scheffe) test yielded statistically significant differences ($p < .05$)

* $p < .05$, ** $p < .001$

Post hoc analyses using the Scheffe post hoc criterion for significance indicated that patients had a higher perception of the service provided by the manager/oncology nurse ($M=4.53$, $SD=.45$) compared to the regular nurse ($M=4.10$, $SD=.45$), $F(2,191)=14.2$, $p < .001$. Furthermore the analysis showed that patients had a higher perception of the service provided by the oncology nurse ($M=4.44$, $SD=.53$) compared to the regular nurse ($M=4.10$, $SD=.45$), $F(2,191)=14.2$, $p < .001$.

For the single item “The nurse was a skilled healthcare provider” post hoc analysis indicated that patients had a higher perception of the expertise of the manager/oncology nurse ($M=4.36$, $SD=.63$) compared to the regular nurse ($M=4.02$, $SD=.56$), $F(2,191)=4.8$, $p < .05$.

For the item “The nurse was knowledgeable about my skin condition”, patients rated the manager/oncology nurse as more knowledgeable about their skin condition ($M=4.11$, $SD=.69$) than the regular nurse ($M=3.43$, $SD=.82$), $F(2,191)=12.4$, $p < .001$. Also, the patients rated the oncology nurse as more knowledgeable about their skin condition ($M=3.91$, $SD=.80$) than the regular nurse ($M=3.43$, $SD=.82$), $F(2,191)=12.4$, $p < .001$.

Finally, the post hoc analysis indicated that patients rated the examination on completeness and thoroughness of the manager/oncology nurse ($M=4.34$, $SD=.51$) higher compared to the regular

nurse ($M=3.74$, $SD=.73$), $F(2,191)=12.6$, $p<.001$. Furthermore the analysis indicated that patients rated the examination on completeness and thoroughness of the manager/oncology nurse ($M=4.34$, $SD=.51$) higher compared to the oncology nurse ($M=3.87$, $SD=.86$), $F(2,191)=12.6$, $p<.001$.

Table 46 also shows the effect sizes of the differences between the nurses. The effect size was calculated by the following formula (Morris and DeShon, 2002):

$$d = \frac{M_1 - M_2}{\sqrt{\frac{(n_1 - 1)SD_1^2 + (n_2 - 1)SD_2^2}{n_1 + n_2 - 2}}}$$

The effect size d is considered small when d is around .2, considered medium when d is around .5, and is considered large when d equals or is greater than .8 (Cohen, 1988). From Table 34 it became clear that the effect size for the manager/oncology nurse and regular is large for the variables Service, “The nurse was knowledgeable about my skin condition”, and “How do you rate the examination you received from the nurse as to completeness and thoroughness”. The other effect sizes were medium.

The second factor, Knowledge, could only be compared between the manager/oncology nurse and the oncology nurse. Therefore an independent sample t-test has been conducted. The test showed a significant difference between the manager/oncology nurse and the oncology nurse $t(131)$, $p<.05$. Patients rated the knowledge of the manager/oncology nurse ($M=4.30$, $SD=.53$) higher compared to the oncology nurse ($M=3.99$, $SD=.81$). The effect size $d=.45$ and is therefore a medium effect.

From these analyses it seems that the patients rated the manager/oncology nurse as the most satisfying nurse. A possible explanation for this difference can be found in the amount of time the nurses spent with a patient. An oneway Anova analysis was conducted to find differences among the nurses, Table 35 shows these results. All nurses had significant differences and the effect sizes are large. The manager/oncology nurse spent a significant amount of time more diagnosing the patient ($M=8.77$, $SD=2.66$) than the other two nurses ($M=5.48$, $SD=1.62$ for the regular nurse, $M=7.23$, $SD=1.41$ for the oncology nurse), $F(2,143)=13.1$, $p<.001$.

Table 35: Results of one-way analysis of variance, comparing the manager/oncology nurse, regular nurse, and oncology nurse

Condition	Manager/oncology nurse	Regular nurse	Oncology nurse	ANOVA	Effect size d
Response	N=51	N=56	N=39	F(2, 143)	
Time (in minutes)	8.77 ^{a, b} (2.66)	5.48 ^{a, c} (1.62)	7.23 ^{b, c} (1.41)	13.1 ^{**}	1.51 ^a , .70 ^b , 1.14 ^c

Note. For nurses who share a superscript, multiple comparison (Scheffe) test yielded statistically significant differences. ****p<.001**

6.1.3 Explaining the positive patient perception

Next, a multiple linear regression analysis was conducted to examine whether there were variables that could explain the positive patient perception. The two factors and three single items were used as the dependent variable and the variables type of nurse, time of the consult, visited the dermatology department before, and did the nurse tell the patient the diagnosis were used as the independent variables. The variable type of nurse and diagnosis told to patient had to be recoded

into dummy variables in order to perform a regression analysis. The dummy coding is represented below.

Dummy Coded Variables			
Type of nurse	Diagnosis told	Manager/oncology nurse	Diagnosis
Manager/oncology (1)	Yes (1)	1	1
Regular (2)	No (2)	0	0
Oncology (3)	Yes (1)	0	1

First, the correlations between the independent variables were calculated to determine whether or not there were high correlations (above .8 or .9). High correlations could lead to multicollinearity. From Table 36 it can be concluded that there is no correlation that is above .8 (Field, 2005). Therefore, this is a first sign that there was no problem with multicollinearity.

Table 36: Correlation matrix

	1	2	3	4	5	6	7	8	9
1. Diagnosis	1.00	-.475**	-.523**	-.064	.359**	.221**	.323**	.190**	^a
2. Manager/oncology		1.00	.504**	-.300**	.229**	.334**	.243**	.167*	.230**
3. Time of consult			1.00	-.187*	.293**	.312**	.201*	.127	.121
4. Visited before				1.00	-.086	-.102	-.106	-.016	-.168
5. Service					1.00	.326**	.329**	.677**	.512**
6. Completeness and thoroughness of examination						1.00	.306**	.408**	.528**
7. Knowledgeable about skin condition							1.00	.414**	.718**
8. Skilled healthcare provider								1.00	.600**
9. Knowledge									1.00

^a Cannot be computed because at least one of the variables is constant

** $p < .01$; * $p < .05$

6.1.3.1 Service

The regression analysis using the factor Service as the dependent variable showed that the overall regression result was significant $F(4,140)=6.758$, $p < .01$. However the adjusted R squared was low namely .138 (perhaps due to only 4 independent variables). Table 49 shows the coefficients of each variable. There is just one significant predictor for Service namely Diagnosis and has a coefficient of .311. This means that when a nurse told the patient the diagnosis, the service of the nurse perceived by the patient increases with .311, controlling for the other variables in the model. Furthermore, Table 37 shows that the values for VIF are around 1 and therefore there are no problems with multicollinearity (when these values are above 10 then there is reason for concern).

Table 37: Regression analysis with Service as dependent variable

Service	B (SE)	Beta	VIF	R squared	Adjusted R squared
(Constant)	4.042 (.172)**			.162	.138
Diagnosis	.311 (.098)**	.324	1,728		
Manager/oncology	-.003 (.103)	-.003	1,827		
Time of consult	.000 (.000)	.126	1,514		
Visited before	-.003 (.078)	.004	1,160		

** $p < .01$

6.1.3.2 Rating of the examination in terms of completeness and thoroughness

The regression analysis using the single item Rating of the examination as the dependent variable showed that the overall regression result was significant $F(4,140)=5.916$, $p < .01$. However the adjusted R squared was low namely .120. Table 38 shows the coefficients of each variable. There is just one significant predictor for Rating of the examination namely manager/oncology nurse and has a coefficient of .377. This means that when the manager/oncology nurse diagnosed a patient, the rating of the examination in terms of completeness and thoroughness perceived by the patient increases with .377, controlling for the other variables in the model. Furthermore, because the same independent variables are used as the regression analysis of Service, the VIF scores are not reported because they are the same. This was also done for the other regression analyses described below.

Table 38: Regression analysis with Rating of the examination as dependent variable

Service	B (S.E.)	Beta	R squared	Adjusted R squared
(Constant)	3.438 (.278)**		.162	.138
Diagnosis	.018 (.158)	.012		
Manager/oncology	.384 (.166)*	.245		
Time of consult	.001 (.000)	.182		
Visited before	-.007 (.126)	-.005		

* $p < .05$; ** $p < .01$

6.1.3.3 Knowledgeable about my skin condition

The regression analysis using the single item Knowledgeable about my skin condition as the dependent variable showed that the overall regression result was significant $F(4,140)=4.231$, $p < .01$. However the adjusted R squared was low namely .082. Table 39 shows the coefficients of each variable. There is just one significant predictor for Service namely Diagnosis and has a coefficient of .387. This means that when a nurse told the patient the diagnosis, the nurse's knowledge about the skin condition perceived by the patients increased with .387, controlling for the other variables in the model.

Table 39: Regression analysis with Knowledgeable about my skin condition of the examination as dependent variable

Service	B (S.E.)	Beta	R squared	Adjusted R squared
(Constant)	3.545 (.305)**		.108	.082
Diagnosis	.387 (.173)*	.235		
Manager/oncology	.175 (.182)	.104		
Time of consult	.000 (.001)	.017		
Visited before	-.078 (.138)	-.049		

* $p < .05$; ** $p < .01$

6.1.3.4 The nurse is a skilled healthcare provider(single item)/Knowledge(factor)

The regression analysis using the single item The nurse is a skilled healthcare provider as the dependent variable showed that the overall regression result was not significant $F(4,140)=1.435$, $p=.226$. This means that the independent variables did not predict whether or not the patients perceived the nurse as a skilled healthcare provider. Furthermore, for the factor knowledge the overall regression result was also not significant $F(3,85)=2.598$, $p=.058$.

6.2 Patient perception part 2

The second part of the analysis of the patient perception questionnaire looked at how many patients visited the dermatology department before, which kind of physician had made a diagnosis, and whether they had a preference for the dermatologist or preferences for a combination of a examination by a nurse and diagnosis by a dermatologist. Furthermore, this part looked at how many patients were willing to be examined again by a nurse in the future.

Of the 202 patients who answered the question A "Have you visited the dermatology department before for a skin condition?", 93(46.0%) answered yes and 109 (54.0%) answered no. Table 40 shows which kind of physician the former group saw in the past. Most of the patients saw a dermatologist (50.0%) for the diagnosis. Table 41 shows the preferences of the patients who visited the dermatology department in the past. This table shows that 49.4% of the patients prefer to see the dermatologist for the diagnosis and not a combination of an examination by a nurse and the dermatologist checking the diagnosis of the nurse. Only 10.1% preferred the combination of nurse and dermatologist.

Table 40: Descriptives which kind of physician

Answers	Frequency	Percent
Dermatologist	46	50.0
Resident	13	14.1
Physician assistant	5	5.4
I do not know	2	2.2
Dermatologist and resident	25	27.2
Dermatologist, resident, and physician assistant	1	1.1
Total	92	100,0

Table 41: Descriptives preference

<i>Answers</i>	<i>Frequency</i>	<i>Percent</i>
Strong preference for dermatologist	19	21.3
Slight preference for dermatologist	25	28.1
No preference	36	40.4
Slight preference for pre examination by nurse	7	7.9
Strong preference for pre examination by nurse	2	2.2
Total	93	100.0

A regression analysis was carried out to examine why patients who have been examined before have a preference for the dermatologist instead of the combination nurse and dermatologist. The independent variables used were the first 9 question except the question whether the nurse was hasty, the amount of time the nurse spent diagnosing the patient, and whether or not the nurse told the patient the diagnosis. The overall regression result was not significant $F(9,38)=.857, p=.57$.

Next, both for the new patients and the patients who visited the dermatology department before, descriptive analyses were carried out to find out whether patients were willing to be examined again by a nurse in the future. The results are shown in Table 42. This table shows that most of the patients were willing to be examined again by a nurse: 84.9% of the new patients and 84.8% of the patients who visited the dermatology department before.

Remarkable is that patients who visited the dermatology department before have such a high percentage because they indicated that they prefer the dermatologist over the combination of a nurse and a dermatologist.

Table 42: Descriptives willing to be examined again by a nurse in the future

<i>Answers</i>	<i>New patients</i>		<i>Patients who visited the dermatology department before</i>	
	<i>Frequencies</i>	<i>Percentage</i>	<i>Frequencies</i>	<i>Percentage</i>
Yes	79	84.9	89	84.8
I have doubts	10	10.8	11	10.5
No	4	4.3	5	4.8
Total	93	100.0	105	100.0

7. Work experience and costs

This section answers the third and fourth research questions, how do nurses perceive the work experience after adding the new diagnosing task, and does the use of nurses in non melanoma skin cancer detection lead to cost reductions?

7.1 Work experience

To examine if the diagnosing task influenced the nurses' work experience, interviews were held (see Appendix C). The interview asked question about if the nurses experienced stress during the diagnosis task, if they wanted to perform this task in the future and under which circumstances, and the certainty of the diagnoses they made. Furthermore the nurses filled in the Utrechtse Burnout Scale (UBOS) which consist of This scale uses three subscales (see Appendix C):

1. Exhaustion: feeling tired, empty, overloaded;
2. Detachment: a detached, cynical attitude regarding work;
3. Competence: a feeling that one can handle work, having self-confidence.

The nurses filled in the scale before the start of this study to get a baseline measurement. Afterwards, when all the patients were diagnosed, the nurses filled in the scale again and keeping in mind that the diagnosing task was an actual task in their work responsibilities.

During this study, the manager/oncology nurse did not experience stress and did not think about the diagnoses during her free time. However, this nurse felt some pressure to make correct diagnoses. The reason for this was that the nurses sees herself as a perfectionist and during this study she saw that she did not know as much as she thought she did. This lead to that the nurse, although in general she was sure of her diagnoses, became less confident about the diagnoses she made. The oncology and regular nurse also did experience any stress during this study and did not felt pressured to make the correct diagnoses. The reason for this was that they knew that the patient went to the dermatologist afterwards. If they made an incorrect diagnosis, the dermatologist would correct this. Also, these two nurses became more sure of the diagnoses they made during the study. This has the following reason. During the study, the diagnoses questionnaires were not kept hidden from the nurses. Instead, every nurse had her own map with the questionnaires, this made it easier for the researcher to collect all the necessary data. On these questionnaires, the dermatologist wrote down the actual diagnosis or that a biopsy had been taken. If the dermatologist wrote down the actual diagnosis, the nurses could compare this with their own diagnosis. Because of the high percentage correct diagnoses (chapter 5) the nurses became more confident of the diagnoses.

This is an interesting observation because it would be a problem when nurses were sure of a diagnosis when it was actually incorrect. This could be a problem because this could mean that a nurse thinks she has enough knowledge to diagnose the patient when in reality she has not. Therefore, the dermatologist must correct to many diagnoses of the nurse and the nurse intervention would not be successful. To examine this a bit more in detail, frequency tables were produced for the incorrect diagnoses. The frequency table 43 shows how often the manager/oncology, regular, and oncology nurse were certain or uncertain of the diagnoses they made when it turned out that they made an incorrect diagnosis. The manager/oncology nurse was uncertain or very uncertain in 66.7% of the incorrect diagnoses she made. The regular nurse was uncertain about all the incorrect diagnoses she made and the oncology nurse was only uncertain in

53.8% of the incorrect diagnoses. This means that the oncology nurse is still certain or very certain in 46.2% of the incorrect diagnoses. This could mean that this nurse is too confident in her diagnosing capabilities. However, because this nurse had only 13 of the 70 diagnoses incorrect, this is not as big of a problem as when the nurse had a far more than 13 incorrect diagnoses. On the other hand, the regular nurse was still in 23 cases uncertain in her diagnoses when they were correct, see table 44. This could mean that the nurse felt uncomfortable in the diagnosing task, but from the interview, this did not seem true (did not experience stress or felt pressured to give the correct diagnosis). The manager/oncology nurse was certain or very certain in 71.1% of the diagnoses that turned out to be correct. For the oncology nurse this percentage was 84.3%.

Table 43: Frequency table certainty of diagnosis that turned out to be incorrect

	Frequency (Percentage)		
	Manager/oncology nurse	Regular nurse ^a	Oncology nurse
Very certain	0 (0.0)	0 (0.0)	1 (7.7)
Certain	5 (33.3)	0 (0.0)	5 (38.5)
Uncertain	9 (60.0)	8 (100.0)	7 (53.8)
Very uncertain	1 (6.7)	0 (0.0)	0 (0.0)
Total	15 (100.0)	8 (100.0)	13 (100.0)

^a Regular nurse had 1 missing data

Table 44: Frequency table certainty of diagnosis that turned out to be correct

	Frequency (Percentage)		
	Manager/oncology nurse ^a	Regular nurse ^b	Oncology nurse ^c
Very certain	3 (5.7)	0 (0.0)	4 (7.8)
Certain	35 (66.0)	8 (25.8)	39 (76.5)
Uncertain	15 (28.3)	23 (74.2)	8 (15.7)
Very uncertain	0 (0.0)	0 (0.0)	0 (0.0)
Total	53 (100.0)	31 (100.0)	51 (100.0)

^a 1 missing data, ^b 22 missing data, ^c 7 missing data

The nurses felt that the diagnosing task add extra value to their work. The diagnosing task gave them a feeling that they became more competent and could better help the patients better. All the three nurses enjoyed performing the diagnosing task and would not mind doing this in the future. However, they suggested some conditions. The nurses suggested that a training was needed to accurately diagnose patients. This could be done by diagnosing patients together with a dermatologist. Also using a dermatoscope and getting taught what you actually see would be helpful to accurately diagnose patients. Furthermore, the nurses indicated that having a appropriate room available is also necessary, because patients have to take off their clothes. Finally, the nurses indicated that some of the tasks should be transferred to other nurses if the diagnosing task were to be added to their responsibilities in the future.

The UBOS questionnaire showed that none of the nurses was experiencing a burnout before or during this study (a high degree of exhaustion and detachment and a slight degree of competence are indicative for burnout). The manager/oncology nurse scored low on the exhaustion and detachment scale before and after (.4 on the exhaustion scale and .2 on the detachment scale) diagnosing the patients. The score on the competence scale was very high (5.83 before and 5.67 after the diagnosing task). The oncology nurse had a high score on the exhaustion scale before and after the diagnosing task (2.8 and 3.6 respectively). The detachment score was medium (2.0 before and

1.2 after the diagnosing task). The score on the competence scale was high (5.17 before and 4.83 after the diagnosing task). Finally, The regular nurse had the following scores before the diagnosing task: exhaustion score was very low, detachment score was low, and competence score was medium (.0, .4, and 4.83 respectively). After the diagnosing task the regular nurse had the following scores exhaustion score was low, detachment score was medium, and the competence score was high (.6, 1.0, and 5.5 respectively).

7.2 Costs

This section investigates whether or not the intervention of nurses detecting non melanoma skin cancer can lead to cost reductions. In these times of budget cuts in healthcare, it is important that new interventions not only lead to high-quality care, but also has cost reductions.

A nurse earns between 20 and 25 Euros per hour and a dermatologist 130 Euros per hour. In the current situation, the patients has a consult with the dermatologist that takes between 15 minutes. These 15 minutes consist of diagnosing the patient, explaining the diagnosis and the treatment options, and processing the results of the consult into the computer. This means that the costs made by the dermatologist to see one patient is 32.50 Euros. In the situation where a nurse does a pre examination which includes some explanation of the diagnosis and the possible treatments, a patient spends 8 minutes at the nurse and 2 minutes at the dermatologist to verify the diagnosis made by the nurse and process the results of the consult into the computer. The costs made by the nurse to diagnose a patient becomes between the 2.67 and 3.33 Euros, depending on the salary of the nurse, and the costs made the dermatologist becomes 4.33 Euros. Therefore the total costs made is between the 7.00 and 7.67 Euros. This leads to a cost reduction between 24.83 and 25.50 Euros per patient.

However this is not the complete picture. As explained in Section 2.2, the dermatology department provides several treatments for patient, such as photodynamic therapy, excision, and mohs surgery. For each of these treatments, the costs for a single patient can be found at the website of the CzE [7]. These costs are a combination of costs related to the hospital and a fee for the dermatologist (not the including the costs made by a dermatologist for a consult as calculated above; between 21.67 and 32.50 Euros). It only seems fair that in the new situation, the nurse also receives a fee or receives a increase in salary because of the new task. On the other hand, the nurses in this study made clear that if they had to diagnose patients, some of their tasks should be transferred to other nurses. Perhaps even a new nurse should be hired to take over these tasks. However, to determine the fee, salary increase, or hiring a new nurse goes beyond the scope of this study but should be kept in mind to determine more accurately the costs savings made by the nurse intervention.

8. Conclusions and discussion

As explained in the Introduction of this thesis, non melanoma skin cancer increased with an average of 3% per year between 1989 and 2009 and will continue to grow in the future. Because of this increase of patients, dermatologists will not be able to handle all these patients in the future. The dermatology department of CzE is also confronted with this increase of patients, and would like to know if nurses at the dermatology department are able to accurately detect non melanoma skin cancer. Therefore, this thesis investigated if nurses could be used for diagnosing patients with non melanoma skin cancer. To provide an answer to this question, several research questions were formulated. This chapter provides the answers to these research questions.

8.1 Nurses diagnosing patients with non melanoma skin cancer

The first three research questions of this thesis were related to the accuracy of the diagnoses made by the nurses: Question 1a: "What is the accuracy of the nurses detecting non melanoma skin cancer?"; Question 1b: "Are there difference in accuracy among nurses with different backgrounds?"; Question 1c: "Can statistics be used to improve the accuracy of nurses detecting non melanoma skin cancer?".

8.1.1 Percentage correct diagnoses

To answer question 1a, several analyses were carried out. First the overall accuracy scores of the three nurses together were calculated. The results showed that in 81.7% of the cases the nurses made the correct diagnoses with a 95% confidence interval of (76.1, 87.3). This result provides a first indication that nurses can accurately predict non melanoma skin cancer. To get a better insight in this accuracy, classification tables were drawn to find out how many false positives (nurses diagnosed non melanoma skin cancer when in reality it was not present) and false negatives (in reality patient has non melanoma skin cancer but nurses did not diagnoses this) the nurses had.

8.1.2 Accuracy AK

A correct AK diagnosis is when a patient has AK and is diagnosed by the nurse as AK and when a patient does not have AK and is diagnosed by the nurse as not AK. For AK the three nurses together had 88.1% correct AK diagnoses, 88.9% true negatives (patient does not have AK and nurse diagnosed this) and 86.2% true positives (patient does have AK and nurse diagnosed this). Furthermore, the nurses had relatively few false positives 11.1% and false negatives 13.8%. Therefore, the conclusion is that for AK the nurses were accurate in diagnosing this skin condition.

8.1.3 Accuracy BCC

For BCC the result showed a slightly different picture. A correct BCC diagnosis is when a patient has BCC and is diagnosed by the nurse as BCC and when a patient does not have BCC and is diagnosed by the nurse as not BCC. In total the nurses had 90.6% correct BCC diagnoses. However the nurses were more accurate in diagnosing true negatives (92.9%) than true positives (79.4%). An explanation for this result is that BCC is difficult to detect, even for dermatologists, and a biopsy is often taken to make the correct diagnosis when BCC is suspected. Of the 34 patients who had BCC in this study, 18 were diagnosed by a biopsy. This is a possible explanation for the lower true positives percentage. Because of the lower true positives percentage, the nurses had a relatively high percentage false negatives (20.6%). The nurses made relatively few false positives (7.1%). For BCC, the conclusion is that nurses are able to accurately diagnose BCC. However, nurses are able diagnose patients who do not have BCC more accurately than patients who have BCC. These results provide a second and a

more detailed indication that nurses are able to accurately diagnose non melanoma skin cancer, when it is present and not present.

8.1.4 Using statistics to improve the accuracy of the nurses

Next, models for predicting the diagnoses of the dermatologists/biopsies for non melanoma skin cancer were calculated using logistic regression. The predictions of these models were compared with the diagnoses of the nurses.

8.1.4.1 AK

The N for the AK analyses was 196. The reason for this was because of missing data in the skin cancer questionnaire. Therefore, the percentages of the nurses in this section is slightly different from the percentages of Section 8.1.2. The results showed that for AK, the nurses were more accurate in diagnosing than the model predicting AK diagnoses made by the dermatologists/biopsies. The nurses had 88.3% correct AK diagnoses whereas the model had 84.7% correct diagnoses. The difference was caused by the amount of true positives. The nurses had 87.7% true positives compared with only 70.2% true positives predicted by the model. The percentage correct true negatives was slightly higher for the model predicting the diagnoses of the dermatologists/biopsies, 90.6% for the model and 88.5% for the nurses. Further analyses showed that if the AK diagnoses of the nurses were used as a predictor, the model for predicting the diagnoses of the dermatologists/biopsies became more accurate than the nurses. The percentage of correct AK diagnoses slightly increased to 91.3% (3.0% increase). This slight increase was caused by the increase in true negatives predicted by this model, 92.8% (4.3% increase). Nurses could achieve this increase if they put less weight on shininess, and more weight on widened blood vessels and frequent sun exposure before 65 years old.

8.1.4.2 BCC

The N for the BCC analyses was 198. The reason for this was because of missing data in the skin cancer questionnaire. Therefore, the percentages of the nurses in this section is slightly different from the percentages of Section 8.1.3. For BCC, the results showed that the nurses were slightly less accurate (90.4%) in diagnosing BCC as than model predicting the BCC diagnoses made by the dermatologists/biopsies (91.4%). However, the nurses were more accurate in predicting true positives than the model. The nurses predicted 78.8% true positives whereas the model only predicted 60.6%. Further analyses showed that if the BCC diagnoses of the nurses were used as a predictor, the model for predicting the diagnoses of the dermatologists/biopsies became more accurate than the nurses. The percentage of correct AK diagnoses slightly increased to 94.4% (4.0% increase). This slight increase was caused by the increase in true negatives predicted by this model, 97.6% (4.9% increase). Nurses could achieve this increase if they put less weight on induration and keratosis, and more weight on dark red, light red, wound, does the lesion bleed when drying, and shape.

With these findings, research question 1a can be answered. Nurses are able to accurately detect non melanoma skin cancer. They are able to make an accurate distinction between non melanoma skin cancer's presence and absence. These results are consistent with other studies. For example, a study conducted by Zagula-Mally et al (1974) also showed that nurses were accurate in detecting non melanoma skin cancer. They found that of the 48 patients diagnosed with skin cancer, dermatologists verified 43 of these and the nurses did not diagnose any false negatives. Furthermore, the results of this study are also consistent with the results of the study by Katris et al (1998). They reported that of

the 77 patients that were referred with lesions of being skin cancer, nurses issued 73 of them (95%). The nurses had also relatively few false positives (16%) when a lesion was identified as suspicious when in fact it was not suspicious.

The results to answer research question 1b showed that there were small but statistically non significant differences in accuracy among the three nurses. The manager/oncology nurse had 78.3% correct diagnoses, the oncology nurse had 81.4%, and the regular nurse 85.7%. If looked specifically at AK and BCC lesions some differences were also found. For AK it seemed that the oncology nurse was less accurate in diagnosing AK when present, 70.6% against 93.1% for the manager/oncology nurse and 91.7% for the regular nurse. For BCC it seemed that the oncology nurse was more accurate in diagnosing BCC when present (92.3%) than the manager/oncology nurse (75.0%) and the regular nurse (66.7%). Furthermore, it seemed that the regular nurse had fewer false positives (1.9%) than the other nurses (12.3% for the manager/oncology nurse and 7.7% for the oncology nurse). However, because of the small sample size it was impossible to investigate whether these differences were statistically significant (see limitations).

The results to answer research question 1c showed that nurses could further improve their accuracy by putting more weight or less weight on certain characteristics. The increase in accuracy was caused by a higher percentage of true negatives that could be predicted using these characteristics. The positive answers on research question 1a, 1b, and 1c provides the first evidence that the dermatology department can use nurses for diagnosing skin cancer.

8.2 Patient perceptions of nurses diagnosing non melanoma skin cancer

The result that nurses are able to accurately detect non melanoma skin cancer is not a sufficient justification to use this intervention at the dermatology department of the CzE. If patients do not have enough confidence in the abilities of the nurse, the dermatology department should not use nurses for diagnosing patients. Therefore the second research question was formulated: How do patients perceive nurses diagnosing non melanoma skin cancer? To find an answer to this question a patient satisfaction questionnaire was filled in by the patients and was analyzed.

Results of the analyses showed that the patients were in general satisfied with the nurses. The mean scores on the 2 factors (service and knowledge) and three single item variables (skilled healthcare provider, knowledgeable about skin condition, and completeness and thoroughness of examination) were all higher than 3, indicating that agreed with the statements in the questionnaire and therefore leading to a high satisfaction level. However, the results also showed that the manager/oncology nurse had the highest scores on the factors and single items.

To get a better insight in the positive patient perception, multiple regression analyses were carried out. Results of these analyses showed that the two nurses who told the diagnoses to the patient, obtained higher scores on the factor service and the single item knowledgeable about my skin. When a nurse tells the diagnosis to the patient, patients feel that they received a better service than when the nurse does not tell the diagnosis. Furthermore, telling the diagnosis also leads to that the patient thinks that the nurses has more knowledge about their skin condition than when a nurse does not tell the diagnosis. A possible explanation for these findings is that, when a nurse examines a patient for skin cancer, patients probably expect that the nurse also tells them what the diagnosis is because that is a part of the service. Perhaps, when a nurse does not tell the diagnosis, patients feel that the service is incomplete. Also, telling the diagnosis may give the patient a feeling that the nurse knows

has enough knowledge to do the diagnosing task. The multiple regression analysis also showed that when the examination was carried out by the manager/oncology nurse, the patient rated the examination higher in terms of completeness and thoroughness.

These results also explain that the manager/oncology nurse had the highest patient perception. This nurse told all the patients she saw, what she thought what the diagnosis was. Furthermore, she explained what kind of treatments there were to treat the skin condition. If a patient indicated that he or she did not want a certain treatment, because of a bad experience in the past, the nurse discussed alternative treatments if possible. Therefore, this nurse also had to longest consultation time.

The patient perception analyses also revealed that patients who visited the dermatology department before, did prefer the dermatologist doing the examination instead of a combination of a pre examination of the nurse and the dermatologist verifying the diagnosis made by the nurse. However, these patients, and new patients, were also willing to be examined again by a nurse in the future. A possible explanation for this result is that patients who visited before, probably know what kind of skin condition they have and how serious it is. They do not mind being examined by a nurse but they want to see the dermatologist for the diagnosis.

With these findings, research question 2 can be answered. Patients perceive nurses diagnosing them for non melanoma skin cancer as positive. An important aspect is that nurses should tell the patients what the diagnosis is.

When comparing the results of this study with other studies, some similarities are found. A study conducted by Federman et al (2001) showed that patients were confident in the abilities of primary care providers, including nurse practitioners, to diagnose skin cancer. This was also found in this study with the high scores on knowledgeable about my skin condition and the nurse is a skilled healthcare provider. Also the study by Federman et al (2001) showed that patient who had been treated by the dermatologist, preferred to be examined again by a dermatologist in the future. This result was also found in this study. On the other hand, a study by Owen et al (1997) has contradicting findings. In this study, patients indicated that they did not believe that a nurse practitioner was able to treat their skin condition.

The results of the patient perception provides further evidence that the dermatology department can use nurses for diagnosing skin cancer.

8.3 Work experience and costs

It is also important to know how the nurses perceived the diagnosing task. Not only patients should feel confident in the abilities of the nurse, the nurses should also feel confident to perform the diagnosing task. Therefore, interviews were held to find out if the nurses perceived stress during this study. The interview results showed that this was not the case. Only the manager/oncology nurse perceived some pressure to make the correct diagnosis, because she sees herself as a perfectionist. So it was more a personal item that made her feel pressured instead of the diagnosing task itself. Instead feeling stressed by the task, the nurses enjoyed performing the task and saw it as an opportunity to learn from the it. This is of course a positive result, because the nurses have enough abilities to accurately diagnose patients but they also see it as a challenge to further improve themselves. Furthermore, an indication was found that the nurse intervention can lead to some cost

reductions, between 24.83 and 25.50 Euros. These results and the results of the accuracy and patient perception provide strong evidence that nurses can be used to diagnose patients that are suspected with non melanoma skin cancer. Next, some recommendations will be made for implementing this nurse intervention.

8.4 Recommendations

Now that it is known that nurses can be used for diagnosing patients with skin cancer, some recommendations can be made.

8.4.1 Where in the process

The nurses participated in this research can be used to make a separation between patients who have non melanoma skin cancer and patients who have another skin condition. But the question is, in which step of the process nurses should diagnose patients. If nurses do this at the hospital, then there is the chance that patients feel that it is a duplication of work. First they see the nurse and afterwards they see the dermatologist who may ask similar questions. Furthermore, the nurses indicated that when they diagnose patients at the hospital, they need an appropriate room to do this, which may present a practical limitation.

Perhaps nurses can diagnose patients at the GPs. If nurses would be used to diagnose patients with suspicious lesions at the GPs, they will see a different type of patient. Most of the patients that arrive at the dermatology department have already been screened by a GP. Therefore these patients are already suspected of non melanoma skin cancer or other skin defects. Nurses performing skin cancer screening sessions at the GP level, would also see a lot of patients who do not have non melanoma skin cancer or other skin defects. Therefore, it is difficult to say whether or not the nurses would have the same accuracy scores found in this study. A research done by Goedhart, Pilon, and van Tubergen (2009) showed that the GPs are not able to accurately diagnose suspicious non melanoma skin cancer lesions. Of the 109 patients with AK who visited the dermatology department at the CZE after seeing a GP, the GP only diagnosed 16 of them with AK (14.7% true positives). Comparing this with the nurses in this study, the nurses diagnosed 50 of the 58 patients who had AK as AK (86.2% true positives). This suggests that nurses would be more accurate to diagnose AK than the GP at the GP level. Therefore, it seems a good initiative to let nurses diagnose patients at the GP. When nurses would diagnose patients at the GP, they could make the distinction between non melanoma skin cancer and other skin conditions. Based on this study, this increases the percentage correct diagnoses from 81.7% to 88.1%. The reason for this increase is that the nurses are accurate for diagnosing AK and BCC but for the other 2 types, Morbus Bowen and SCC, the percentage correct diagnosis is very low and even 0% for Morbus Bowen. Another advantage of nurses diagnosing patients at the GP is that perhaps nurses could identify patients who have a type of non melanoma skin cancer, who would otherwise be sent home by the GP because the GP is less accurate in diagnosing non melanoma skin cancer. This could also lead to cost reductions for the CZE. Patients who are sent home by a GP but in reality have a certain type of non melanoma skin cancer, enter the hospital later on. Meanwhile the skin cancer could become worse and more severe and expensive treatments are needed to remove it.

However, this raises another issue. Nurses in the Netherlands are not allowed to make a diagnosis and send the patient homewards. For the patients who have, according to the nurse, non melanoma skin cancer this would not be a big problem because they have to go to the hospital and still see a

dermatologist. But for the people who do not have a serious skin condition, according to the nurse, these are sent home and do not see a dermatologist. However, a simple solution for this problem is that nurses could discuss each diagnosis they made with the GP. The GP has the final decision about the skin condition of the patient and therefore makes the decision about sending patients to the hospital or sending them home.

8.4.2 How to diagnose patients

This study showed that the model with the diagnoses of the nurses as a predictor could further improve their accuracy if they put more weight or less weight on certain characteristics. To be more specific, the percentage true positives increased when this model was used. This could mean that the nurses themselves are a little risk averse. If nurses have doubt they rather predict a type of non melanoma skin cancer to be sure the patient receives the best possible attention. The model could take away this risk averse behavior of the nurses.

The nurses at the dermatology department could use this model as follows. Nurses diagnosing patients should first make their own diagnosis, as was done in this research. Then, to check their diagnoses, they could use the model. In this model they put their own diagnosis as a predictor and fill in the additional characteristics that were still significant predictors. If the prediction of this model is the same as the diagnosis of the nurse, then the nurse should use it as the final diagnosis. However, if the prediction of the model is different from the diagnosis of the nurse, then the nurse should consider the prediction of the model as the final diagnosis because it has a higher percentage correct diagnoses compared to the nurses, especially in predicting true negatives. For example, if the nurse diagnoses a patient with AK but the model predicts something else than AK, then the nurse should consider the diagnosis of the model. The prediction will be made by entering the values of the characteristics in the logistic regression function explained in Section 4.3.

However, some nuance should be placed. As explained in Section 4.3, the logistic regression function calculates the probability of Y, in this study AK or BCC, occurring. In this study, if $P(Y)$ was smaller than 0.5, then it was predicted that Y did not occur. If $P(Y)$ was greater than 0.5, then it was predicted that Y did occur. For example, this means that when the model of AK (Section 5.4.1, table 28) predicts AK with a probability of .53, the model gives the nurse the outcome AK. However, the nurses should take this probability into account when they deviate from their own diagnosis. With a probability of .53 it is still fairly uncertain if the patient actually has AK. Therefore, nurses should only follow the prediction of the model when the probability is either very high (0.9) or very low (0.1).

Another option is to train nurses. An important question is: which type of nurse should receive training? Looking back at the literature of Section 3.1 some clues to answer this question can be found. In the studies of Zagula-Mally et al (1974), Katris et al (1998), and Oliveria et al (2001), used nurses without a dermatology background. These nurses first received a training before they had to identify suspicious skin cancer lesions. For example, the nurses in the study of Katris et al (1998) received training in the form of reading material from dermatology texts, research papers, and on the job training. The nurses in the study of Zagula-Mally et al (1974) received training in recognizing AK, BCC, and SCC and to distinguish this from other skin conditions like verrucae and nevi. However, in the study of Maquire and Frost (1994) nurse practitioners, dermatology nurses, and oncology nurses were used. These nurses had skin cancer assessment as part of their scope of practice but reported frequencies of performance were low. Furthermore, these nurses did not receive any form

of training during the study. Based on these findings it seems that nurses without any experience with skin cancer need a form of training to recognize lesions whereas nurses with experience with skin cancer perhaps do not need training or less training. The models computed in Section 5.3.1 for AK and 5.3.2 for BCC, which predict these types of non melanoma skin cancer accurately (84.7% and 91.4% respectively), could be used as input for training nurses. Nurses could receive training about the significant clinical characteristics and how to interpret them. For example, nurses could get trained in assessing when a lesion can be classified as shiny, or when a lesion has induration. This is, of course, important because it is the input for the models. If nurses would use the model without knowing how to interpret the characteristics, the nurses could still make incorrect diagnoses. Training could be done by diagnosing patients together with a dermatologist. The dermatologist could explain to the nurses how the significant characteristics can be seen in the lesion.

It is also interesting to provide feedback to the nurses about the incorrect diagnoses. During this research, nurses sought feedback by looking if they made the correct diagnosis. This is what DeNisi and Kluger (2000) indicated as feedback on the task level (shrinking the gap between actual performance and performance goals). However, this is not the type of feedback that nurses can use to better interpret the characteristics and improve their diagnosis which was found in this study (Section 5.2.2, table 21). With this kind of feedback, nurses are only told that their diagnosis can be improved without providing information how to do this. Therefore, feedback should focus on what DeNisi and Kluger (2000) indicate as attention on task learning (focus on details of performance). This leads to performance improvements if it provides process information on how nurses could improve their accuracy of the diagnoses. This process information should focus on why the nurses made an incorrect diagnosis. Which characteristics did the nurses miss or did they misinterpreted a certain characteristic leading to an incorrect diagnosis? If not enough process information is given to the nurses, this outcome type of feedback can cause the nurses to focus away from the diagnosing task (e.g. worry about his/her diagnosing skills) at the expense of the actual performance.

8.4.3 What should the nurse tell the patients

It is also important that nurses always tell the patient what they think the diagnosis is. As the results indicated, telling the diagnosis increases the service of the nurse perceived by patients, and patients perceive that the nurse is knowledgeable about their skin condition. This reassures the patient, which increases the satisfaction level of the patient. If nurses are not sure about the diagnosis, they should also tell this to the patient and explain that the patient also sees the dermatologist who makes the definitive diagnosis. Besides telling the diagnosis, nurse should also explain which kind of treatments there are for the skin condition they have. Therefore, the dermatologist only has to verify the diagnosis of the nurse and this could lead to cost reductions.

9. Limitations and future research

This research is not without limitations. These will be discussed in this chapter and future research directions will be discussed.

9.1 Limitations

The first limitation of this research is that the results that nurses can accurately predict skin cancer, are difficult to generalize among the nurses at the dermatology department at the CzE. As explained in the method section there are two types of nurses at the dermatology department, regular nurses and oncology nurses. Only one nurse of each type has participated in this research. Therefore, the results of these two nurses can also be due to the experience of these nurses. Nurses with less experience might not have the accuracy in diagnosing non melanoma skin cancer. Furthermore, the manager/oncology nurse worked as oncology nurse for year and half, but was manager during this study for about two and a half years. Therefore, it is difficult to say whether or not this nurse had the same knowledge and skills as the oncology nurse during this research. This nurse can be best seen as a nurse that did not fit any of the two categories and it is therefore difficult to use to generalize the results among other nurses at the dermatology department.

Another issue involves the patients used in this research. The dataset consisted of patients that visited the dermatology department in the CzE. This means that the results can only be generalized to patients at this dermatology department. If nurses would be used to diagnose patients with suspicious lesions at GPs, for example, they will see a different type of patient, as most of the patients that arrive at the dermatology department are already screened by a GP. Therefore these patients are already suspected of non melanoma skin cancer or other skin conditions. Nurses performing skin cancer screening sessions at the GP level, would also see a lot of patients who do not have non melanoma skin cancer or other skin defects. Therefore, it is difficult to say whether or not the nurses would have the same accuracy scores found in this research.

Another limitations considering the patient sample was that the manager/oncology had seen more patients with AK than the other two nurses. Therefore the nurses did not exactly see the same type of patient. A possible explanation for this is that the manager/oncology nurse saw more patients who visited the dermatology department before. These kind of patients already had non melanoma skin cancer before. When a patient has this, the skin is already damaged and they have a greater chance that the patient gets the condition again.

The following limitation of this research is that the nurses did not always completely fill in the skin cancer questionnaire. During the logistic regression analyses this became problematic with some of the characteristics which are potential interesting for predicting non melanoma skin cancer. Another issue is that some of the characteristics, for example usage of immunosuppressant, did occur only occasionally, which made it difficult to assess their effect on predicting non melanoma skin cancer. Also the patient satisfaction questionnaire had some missing data. The reason for this is that some of the patients did not understand or read the answer possibilities correctly. Some of the patients answered the questions about the nurse negatively, but were willing to be examined again by a nurse in the future and rated the examination as positive. Therefore, it was unclear to the researcher whether or not the patients correctly filled in the questionnaire and were removed from this study.

Another limitation of this research is the costs analysis. Although a cost reduction was found it is not sure whether or not an actual cost reduction will happen. A dermatologist receives a honorarium for patients that have non melanoma skin cancer. Perhaps nurses would also receive a honorarium when they diagnose patients or they receive an increase in salary because of this new task. Also it is possible that a new nurse has to be hired to carry out tasks that need to be transferred, as indicated by the nurses. However, to determine the fee, salary increase, or hiring a new nurse went beyond the scope of this study and therefore it is difficult to say if an actual cost reduction will happen.

The next limitation is the golden standard used in this research. For this research, the diagnoses of the dermatologists or the biopsies when a dermatologist was not sure of the diagnosis were used as golden standard. However, one of the dermatologist at the dermatology department indicated that they diagnosed 90% of the patients correctly. Of the 40 biopsies taken during this research, the dermatologists had 47.5% (19 cases) incorrect diagnoses compared with the biopsies. In 7 of these 19 cases, the dermatologists were doubting between 2 or 3 types of non melanoma skin cancer when the biopsy showed that the correct type was one of them. Of these 7 cases the nurses had 4 cases correct (3 AK and 1 BCC). In 4 of the 19 cases, the dermatologists did not fill in a diagnosis but requested a biopsy without a diagnosis. In 3 of these cases the nurse had the correct diagnosis (all were diagnosed as something else). Therefore in 7 of the 19 case the dermatologists had an incorrect diagnosis but the nurses had a correct one. However, this leads to another limitation of this research. The dermatologists were not instructed to fill in 1 diagnosis on the skin cancer questionnaire. Therefore it is not exactly clear if the 7 incorrect cases of the dermatologists that were correctly diagnosed by the nurses were still incorrect when the dermatologists filled in 1 diagnosis. Furthermore, the dermatologists are far more capable than the nurses to precisely indentify what the something else diagnoses are. If the nurses diagnosed a patient with something else and in reality it was not non melanoma skin cancer, than the nurse made a correct diagnosis whereas the dermatologist could make the wrong something else diagnosis if a biopsy was taken.

Finally, not enough patients were diagnosed to investigate whether or not the differences between the nurses were statistically significant. In this research each nurse diagnoses around the 70 patients. To examine if the differences between the nurses were significant, 2000 patients needed to be diagnosed by each of the three nurses. With this amount of patients the smallest difference between the nurses (78.3% of manager/oncology nurse and 81.4% of oncology nurse) would be significant. Furthermore, the largest difference (78.3% of manager/oncology nurse and 85.7% regular nurse) between the nurses would be significant if 333 patients were diagnosed by each type of nurse.

9.2 Future research

The first advice for future research is to extend this type of research with more nurses of each type of nurse, regular and oncology. With the results of studies with more nurses, it is possible to generalize the results of this study among the nurses at the dermatology department of the CzE. This type of study could also be carried out at other hospitals in the Netherlands to generalize these findings among nurses throughout the Netherlands.

As explained in the limitations, the golden standard used in this study was the diagnoses of the dermatologists supplemented with biopsies when they were unsure of the diagnosis. Future research should use biopsies for all patient as golden standard. Because of the errors that dermatologist make, the percentages found in this research can differ. Furthermore, future research should also

pay more attention to cost reductions. This research found a cost reduction based on the salary that a nurse and a dermatologist earn per hour. However, as indicated in the interviews with the nurses, tasks should be transferred when the diagnosing task is added to their responsibilities. Perhaps this leads to hiring a new nurse which can undo the cost reductions.

Another important aspect is that this research found that the patients had confidence in the abilities of the nurses to diagnose skin cancer whereas other research (Owen et al, 1997) reported the opposite result. Future research could use interviews with patients to further investigate why or why not patients have this confidence in abilities of the nurses, instead of a questionnaire with answers on a likert scale. Using interviews can lead to a more detailed picture of this issue.

Next, it is interesting to look at the possibility that patients fill in the whole or part of the skin cancer questionnaire and take a picture of the lesion. This could be send to the dermatology department where nurses can use this to make a diagnosis. If this kind of research shows similar results as this one in terms of accuracy, perhaps patients have to come to the hospital only when there is a serious skin condition. This could perhaps lead to further cost reduction because the patients with an actual skin condition who enter the hospital could be increased. The obvious true negatives can be filtered out based on the questionnaire and pictures they send to the hospital.

Furthermore, future research should also focus on using the statistical models for AK and BCC computed in this research. It is interesting to investigate how accurately these models perform in reality. As explained in Section 8.4.2 nurses without experience with skin cancer lesion could be trained how to interpret the significant characteristics and fill these in into the model predicting non melanoma skin cancer. Nurses who have experience with non melanoma skin cancer lesions, like the nurses in this study, could use the models which includes their own diagnoses as a predictor. Also, using a sample size where characteristics such as usage of immunosuppressant is more present than in this study could also provide additional significant predictors for these models. This could possibly increase the accuracy of the models.

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Appendix A

Vragenlijst – Huidkanker

1. Wat is de datum?
2. Wat is de naam van de patiënt?
3. Geslacht
 - ◇ Man
 - ◇ Vrouw
4. Wat is het patiëntnummer?
5. Komt u voor het eerst bij de poli?
 - ◇ Eerste keer
 - ◇ Vaker hier geweest
6. Als u al vaker hier bent geweest, was dat voor huidkanker?
 - ◇ Ja
 - ◇ Nee
7. Bent u voor uw beroep regelmatig in de zon geweest (meer dan 5 uur per dag)?
 - ◇ Ja
 - ◇ Nee
 - ◇ Weet niet
8. Bent u, voor uw 65^e, in uw vrije tijd regelmatig in de zon geweest?
 - ◇ Ja
 - ◇ Nee
 - ◇ Weet niet
9. Bent u, na uw 65^e, in uw vrije tijd regelmatig in de zon geweest?
 - ◇ Ja
 - ◇ Nee
 - ◇ Weet niet
 - ◇ Nog geen 65
10. Houdt of hield u van zonnen?
 - ◇ Ja
 - ◇ Nee
 - ◇ Weet niet
11. Bent u wel eens langer dan 3 maanden in de tropen geweest?
 - ◇ Ja
 - ◇ Nee
 - ◇ Weet niet
12. Bent u vaak op zonvakantie geweest (om bruin te worden)?
 - ◇ Vaak
 - ◇ Regelmatig
 - ◇ Soms
 - ◇ Zelden
 - ◇ Nooit
13. Bent u als kind vaak verbrand door de zon?
 - ◇ Vaak
 - ◇ Regelmatig
 - ◇ Soms
 - ◇ Zelden
 - ◇ Nooit
 - ◇ Weet niet
14. Bent u vaak in uw latere leven verbrand door de zon?
 - ◇ Vaak
 - ◇ Regelmatig
 - ◇ Soms
 - ◇ Zelden
 - ◇ Nooit
15. Heeft u in het verleden gebruik gemaakt van een zonnebank?
 - ◇ Ja
 - ◇ Nee
16. Zo ja, hoe vaak?
 - ◇ Dagelijks
 - ◇ Wekelijks
 - ◇ Maandelijks
 - ◇ Jaarlijks
17. Gedurende hoeveel jaar heeft u gebruik gemaakt van een zonnebank?
18. Op welke leeftijd bent u begonnen de zonnebank te gebruiken?
19. Heeft u een orgaan transplantatie ondergaan?
 - ◇ Ja
 - ◇ Nee
20. Zo ja, in welk jaar?

21. Gebruikt u medicijnen die het immuunsysteem onderdrukken?
- ◇ Ja
 - ◇ Nee
 - ◇ Weet niet
22. Zo ja, welke van de volgende middelen?
- ◇ Prednison
 - ◇ Imuran
 - ◇ Prograft
 - ◇ Cellcept
 - ◇ Cyclosporine
 - ◇ Iets anders namelijk:
23. Komt huidkanker in uw 1^e graads familie voor (ouders, eigen kinderen, broers, zussen, grootouders)?
- ◇ Ja
 - ◇ Nee
 - ◇ Weet niet
24. Zo ja, bij hoeveel personen?
25. Hoe lang zit het plekje waar u nu voor komt er al?
- ◇ Dagen
 - ◇ Weken
 - ◇ Maanden
 - ◇ Half jaar
 - ◇ Jaren
 - ◇ Weet niet
26. Bloedt het plekje als u zich afdroogt?
- ◇ Ja
 - ◇ Soms
 - ◇ Nee
 - ◇ Weet niet
27. Jeukt het plekje?
- ◇ Heel erg
 - ◇ Een beetje
 - ◇ Niet meer dan normaal
28. Zit het plekje op de kale schedel, gelaat, oren, onderarmen, of de rug van uw hand?
- ◇ Ja
 - ◇ Nee
29. Waar zit het plekje precies?
30. Bent u doorverwezen door de huisarts, of op eigen initiatief naar de poli gekomen?
- ◇ Doorverwezen door de huisarts
 - ◇ Op eigen initiatief
31. Wat is de huidtype van de patiënt?
- ◇ 1
 - ◇ 2
 - ◇ 3
 - ◇ 4
 - ◇ 5
 - ◇ Weet niet
32. Hoe groot is het plekje op zijn grootst gemeten (maximale diameter in mm)?
33. Hoe rood is het plekje?
- ◇ Huidskleurig
 - ◇ Licht rood
 - ◇ Donker rood
 - ◇ Vuur rood
 - ◇ Bruin
 - ◇ Andere kleur, namelijk:
34. Wat is de vorm van het plekje?
- ◇ Plat/Macula
 - ◇ Verheven/Papel, nodulus
35. Hoe schilferig is het plekje?
- ◇ Niet
 - ◇ Beetje
 - ◇ Veel
36. Groeit het plekje?
- ◇ Ja
 - ◇ Nee
 - ◇ Weet niet
37. Hoe verhard (eelt-achtig) is het oppervlak?
- ◇ Niet
 - ◇ Voelt alleen ruw
 - ◇ Voelt en ziet ook ruw
 - ◇ Dikke gelige plek
38. Is er sprake van onderhuidse verdikking?
- ◇ Ja
 - ◇ Nee
39. Is het plekje scherp begrensd?

- ◇ Ja
 - ◇ Nee
40. Glanst het plekje?
- ◇ Ja
 - ◇ Nee
41. Doet het plekje pijn bij aanraking?
- ◇ Ja
 - ◇ Nee
42. Is er sprake van kleine verwijde bloedvaatjes in of om het plekje?
- ◇ Ja
 - ◇ Nee
43. Is er sprake van een wondje (zweer/ulceratie)?
- ◇ Ja
 - ◇ Nee
44. Zijn er overige tekenen van zonbeschadiging bij de patiënt?
- ◇ Ja
 - ◇ Nee

45. Wat is de diagnose?
- ◇ Nonmelanome huidkanker
 - ◇ Iets anders
46. Welk type nonmelanome huidkanker?
- ◇ Actinische keratose
 - ◇ Basaalcelcarcinoom
 - ◇ Plaveiselcelcarcinoom
 - ◇ Morbus Bowen
47. Hoe zeker bent u van de diagnose?
- ◇ Zeer zeker
 - ◇ Zeker
 - ◇ Onzeker
 - ◇ Zeer onzeker
 - ◇ Ik gok
48. Wat heeft u de patiënt verteld?
49. Wat is het advies?

Dermatoloog

1. Diagnose?
2. Biopt? *Ja/Nee*
3. Behandeling

Appendix B

Tevredenheidsonderzoek

Deze vragenlijst maakt deel uit van een afstudeerproject aan de Technische Universiteit Eindhoven en wordt uitgevoerd in samenwerking met CZE dermatologie. Deze korte vragenlijst vraagt naar uw mening over het consult die u zojuist heeft gekregen van een verpleegkundige.

De antwoorden worden anoniem verwerkt en zijn alleen toegankelijk voor de onderzoeker van de Technische Universiteit Eindhoven. Degene die het consult/onderzoek gedaan heeft en anderen binnen afdeling Dermatologie krijgen de antwoorden niet te zien. Uw antwoorden hebben geen gevolgen voor degene die u behandeld heeft en is alleen bedoeld om inzicht te krijgen in hoe u het consult/onderzoek ervaren heeft.

Hoe moet u deze vragenlijst invullen?

Het is belangrijk dat u de vragen goed doorleest en dat alle vragen worden beantwoord. Er zijn geen goede of foute antwoorden. Geef steeds het antwoord dat het best bij u past door het vakje aan te kruisen. De vragenlijst bevat 16 vragen.

Alvast bedankt voor uw medewerking.

	Volledig mee oneens	Mee oneens	Niet mee eens, niet mee oneens	Mee eens	Volledig mee eens
1. Over het algemeen ben ik tevreden met mijn bezoek aan de verpleegkundige.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. De verpleegkundige is een deskundige zorgverlener.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. De verpleegkundige is zorgzaam.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Ik ben tevreden met de hoeveelheid tijd die de verpleegkundige aan mij heeft besteed.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. De verpleegkundige was gehaast.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. De verpleegkundige heeft verta nd van mijn huidaandoening.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Ik heb vertrouwen in de diagnose van de verpleegkundige.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Ik ben tevreden met de manier waarop de diagnose is gesteld.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. Hoe beoordeelt u het onderzoek dat u hebt gekregen van de verpleegkundige op volledigheid en grondigheid?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Slecht	Matig	Redelijk	Goed	Zeer goed
10. Bent u in het verleden bij CZE Dermatologie onderzocht of behandeld voor een vergelijkbare huidaandoening?	Ja <input type="checkbox"/>		Nee <input type="checkbox"/>		
	Dermatoloog	Arts assistent	Physician assistant	Weet niet	Anders, namelijk
11. Indien u in het verleden bij CZE Dermatologie onderzocht of behandeld bent, bij welk type arts bent u geweest voor een diagnose? Meerdere antwoorden mogelijk.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Stel, in de toekomst wordt een vooronderzoek voor huidaandoeningen gedaan door een verpleegkundige en de diagnose wordt altijd gecontroleerd door een dermatoloog (specialis t). Met deze situatie in gedachten, beantwoordt de vragen 12 en 13.					
	Ja		Ik twijfel hierover		Nee
12. Zou u bereid zijn om in de toekomst opnieuw onderzocht te worden door een verpleegkundige?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Sterke voorkeur voor diagnose door dermatoloog	Lichte voorkeur voor diagnose door dermatoloog	Geen voorkeur voor diagnose door dermatoloog	Lichte voorkeur voor diagnose door verpleegkundige	Sterke voorkeur voor diagnose door verpleegkundige
13. Indien bij u in het verleden door de dermatoloog (specialis t) de diagnose is gesteld en u dit vergelijkt met het consult dat juist is gedaan door de verpleegkundige, wat zou dan uw voorkeur hebben?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

14. Als u wilt, mag u uw naam invullen

15. Wat is uw geboortedatum?

16. Overige opmerkingen

Appendix C

Stress scale

De volgende uitspraken hebben betrekking op hoe u uw werk beleeft en hoe u zich hierbij voelt. Wilt u aangeven hoe vaak iedere uitspraak op u van toepassing is door steeds het best passende cijfer (van 0 to 6) in te vullen.

	0	1	2	3	4	5	6
	Nooit	Een paar keer per jaar	Eens per maand of minder	Een paar keer per maand	Eens per week	Een paar keer per week	Dagelijks
1.		Ik voel me mental uitgeput door mijn werk.					
2.		Ik twijfel aan het nut van mijn werk.					
3.		Een hele dag werken vormt een zware belasting voor mij.					
4.		Ik weet de problemen in mijn werk adequaat op te lossen.					
5.		Ik voel me "opgebrand" door mijn werk.					
6.		Ik heb het gevoel dat ik met mijn werk een positieve bijdrage lever aan het functioneren van de organisatie.					
7.		Ik merk dat ik teveel afstand heb gekregen van mijn werk.					
8.		Ik ben niet meer zo enthousiast als vroeger over mijn werk.					
9.		Ik vind dat ik mijn werk goed doe.					
10.		Als ik op mijn werk wat afrond vrolijk me dat op.					
11.		Aan het einde van een werkdag voel ik me leeg.					
12.		Ik heb in deze baan veel waardevolle dingen bereikt.					
13.		Ik wil gewoon mijn werk doen en verder niet worden lastig gevallen.					
14.		Ik voel me vermoeid als ik 's morgens opsta en weer een werkdag voor me ligt.					
15.		Ik ben cynischer geworden over de effecten van mijn werk.					
16.		Op mijn werk blaak ik van zelfvertrouwen.					

Scoringsinstructie

De U (uitputtings)-schaal bestaat uit de items:

1.	Interpretatie van de scores		
3.			
5.		Zeer laag	Score gelijk aan 0.20
11.		Laag	Score tussen 0.21 en 0.80
14.		Gemiddeld	Score tussen 0.81 en 2.20
Totaal		Hoog	Score tussen 2.21 en 3.60
Delen door 5	U-score:	Zeer hoog	Score hoger dan 3.61

De D (distantie)-schaal bestaat uit de items:

2.	Interpretatie van de scores		
7.			
8.		Zeer laag	Score gelijk aan 0.00
13.		Laag	Score tussen 0.01 en 0.80
15.		Gemiddeld	Score tussen 0.81 en 2.20
Totaal		Hoog	Score tussen 2.21 en 3.40
Delen door 5	D-score:	Zeer hoog	Score hoger dan 3.41

De C (competentie)-schaal bestaat uit de items:

4.	Interpretatie van de scores		
6.			
9.			
10.	Zeer laag	Score gelijk of minder dan 2.50	
12.	Laag	Score tussen 2.51 en 3.50	
16.	Gemiddeld	Score tussen 3.51 en 4.83	
Totaal	Hoog	Score tussen 4.84 en 5.50	
Delen door 6	C-score:	Zeer hoog	Score hoger dan 5.51

Interview verpleegkundige

1. In het algemeen heb ik vertrouwen in de diagnoses die ik heb gesteld.				
1: Volledig mee oneens	2: Mee oneens	3: Niet mee eens, niet mee oneens	4: Mee eens	5: Volledig mee eens
Licht uw antwoord kort toe.				

2. Ik voel druk om de juiste diagnose te stellen.				
1: Volledig mee oneens	2: Mee oneens	3: Niet mee eens, niet mee oneens	4: Mee eens	5: Volledig mee eens
Licht uw antwoord kort toe.				

3. Ik ervaar meer stress dan normaal als ik een diagnose moet stellen.				
1: Volledig mee oneens	2: Mee oneens	3: Niet mee eens, niet mee oneens	4: Mee eens	5: Volledig mee eens
Licht uw antwoord kort toe.				

4. Ik denk aan de diagnoses die ik heb gesteld, zelfs als ik me ontspan.				
1: Volledig mee oneens	2: Mee oneens	3: Niet mee eens, niet mee oneens	4: Mee eens	5: Volledig mee eens
Licht uw antwoord kort toe.				

5. In het algemeen, wat vond je van de taak die je moest uitvoeren?

6a. Wil je dit werk, identificeren van huidkanker, daadwerkelijk gaan doen? Ja / Nee

6.b Zo ja waarom?

6.c En onder welke voorwaarden? Bijvoorbeeld, een training, meelopen met een dermatoloog, overdragen van andere taken die je nu moet doen, geschikte ruimte.

6.b Zo nee, waarom niet?

7. Hoe ervaar je het dat je de patient moet vertellen wat je denkt wat de diagnose is? Heb je daar moeite mee? Of heb je het gevoel dat je er te weinig van weet om de patient goed uit te leggen wat hij/zij heeft?

8. Zijn er bepaalde antwoorden op vragen die je naar de diagnose stuurde?

9. Werd je zekerder over de diagnoses naarmate de tijd vorderde en waarom wel/niet?