Non-melanoma skin cancer: Training of physician support personnel

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BSc
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in partial fulfilment of the requirements for the degree of

Master of Science
in Operations Management and Logistics

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Series Master Theses Operations Management and Logistics

Subject headings: Training, physician support personnel, non-melanoma skin cancer
Executive summary

The number of patients with skin cancer has been growing tremendously in recent years. General practitioners and dermatologists will not have enough capacity to cope with this increasing patient flow in the future. One of Van der Geer-Rutten’s (2012) solutions to cope with this problem was to train physician support personnel so that they are able to carry out tasks for dermatologists and GPs. The project is conducted at MohsA, an independent treatment center for dermatological care located in Venray. The dermatologists of MohsA are driven to improve the dermatological care. Training of physician support personnel about non-melanoma skin cancer is one of these initiatives. The objective of this research was to bring the knowledge of physician support personnel with regard to non-melanoma skin cancer at the right level with the aid of training, so that they will be able to take over tasks from the general practitioners (GPs) and dermatologists. To examine the effectiveness of a training program for physician support personnel with regard to non-melanoma skin cancer the following research question was drawn:

**To what extent can the knowledge and skills regarding non-melanoma skin cancer of physician support personnel be improved so that they are able to make accurate preliminary diagnoses?**

To answer the research question, three supporting and two core questions were drawn:

1A. **What tasks and Knowledge, Skills, Abilities and Other characteristics (KSAOs) are necessary to make correct diagnoses and referrals with regard to non-melanoma skin cancer?**

1B. **What individual characteristics and external factors need to be taken into account that can influence the effectiveness of training?**

1C. **Which combination of training delivery methods is likely to result in the strongest improvement in knowledge and skills of physician support personnel regarding non-melanoma skin cancer?**

2A. **What is the training performance / learning effect of physician support personnel with regard to non-melanoma skin cancer?**

2B. **What is the job performance / transfer effect of physician support personnel with regard to non-melanoma skin cancer?**

Training program

Based on requirements identified in literature, a training program was designed to maximize the learning and transfer effect. The training program included a lecture, case studies and reference material. This combination of training delivery methods ensures that all the knowledge and skills are provided in a way that appears to be most effective and meets all the requirements. The contents of the training consisted of characteristics, risk factors and treatments for the different types of non-melanoma skin cancer. Also the prevention of non-melanoma skin cancer was included. The target group of the training was physician support personnel. Ridderikhoff (1993) showed that physicians use an inductive strategy to make diagnoses. This process is difficult to reproduce. The process of making a diagnosis is not standardized, which exacerbated the determination of required KSAOs. The development of the training program by following the regulative cycle of Van Strien (1986) and using scientific literature it was aimed to provide all the required knowledge and skills for making accurate diagnoses. In the design of the training program it was attempted to maximize the effect of the learning and transfer outcomes.
Method

The learning effect of the training program and also the transfer effect to the job were evaluated in this study. The learning performance of nineteen participants was evaluated with a non-equivalent pretest – posttest design. The job performance was evaluated with a posttest only control group design. Research has shown that individual and environmental characteristics can influence the learning and transfer effect. Therefore, some of these variables were also included. Figure 1 shows the measured variables this research. The nineteen participants were from different healthcare institutions, namely: MohsA, dermatological department of a hospital, two GP practices, and two skin clinics. The learning effect was measured with a pre- and a posttest to assess the knowledge about non-melanoma skin cancer. The transfer effect was measured with the percentage of correct diagnoses made by the participants.

Results

Results showed that the individual characteristics of the participants did not influence the learning effect. So, the differences in learning effect between the two conditions could be assigned to whether the participant received training or not. The effect of training on learning performance was significant, after controlling for the effect of the pre-training performance, \( F(1,16) = 11.97, p < .05, r = .64 \). This is equal to an effect size of \( d = 1.68 \), which is a large effect size.

The pre- and posttest included both cases, measuring the diagnostic skills with regard to non-melanoma skin cancer, and multiple choice questions, measuring knowledge of non-melanoma skin cancer. The differences in scores between the experimental and control condition were caused by an increase in the number of correct multiple choice questions, \( F(1,16) = 6.465, p < .05, r = .52 \). There was no significant difference between the two groups with regard to the number of correct cases (\( p > .05 \)). The multiple choice questions consisted of five knowledge dimensions: epidemiology, pathophysiology, clinical presentation, treatments, and prevention. The pathophysiology and clinical presentation dimensions that were treated most during the training session were also the dimensions where the training participants obtained significantly higher performance (\( p < .05 \)).
To measure the transfer effect, 97 suspicious lesions were diagnosed by the participants. Results showed no significant difference between the experimental and the control condition, but all the participants were capable of making proper diagnoses (75% correct diagnoses). The sensitivity i.e. participants detecting non-melanoma skin cancer (TP), the of all the participant’s diagnoses was 87.5%, the specificity, i.e. participants correctly concluded that lesion is not non-melanoma skin cancer (TN), was 62.2%. A dermatologist also reviewed the diagnoses of the participants because, although the diagnosis and/or follow-up step is wrong, the diagnosis is not harmful for the patient and can therefore be considered as correct. After the review of the dermatologists, only 6 out of the 93 diagnoses were completely wrong, which suggests that participants are already quite capable in making accurate diagnoses.

Although, no significant effect was found that could be ascribed to training, it appeared that the participant’s characteristics ‘job experience’ and ‘anxiety’ had an influence on the correctness of the diagnosis of the participant. This implies that skills for making accurate diagnoses are obtained via experience and that anxious people are less capable in making proper diagnoses than persons who are less anxious.

Discussion
In this study it was examined to what extent the knowledge and skills regarding non-melanoma skin cancer of physician support personnel can be improved so that they are able to make accurate preliminary diagnoses. The results are discussed in this section, also limitations, strengths, suggestions for further research, and practical implications are given.

Design of a training program
In the design of the training program it was aimed to provide all the required knowledge and skills for physician support personnel to make accurate diagnoses with regard to non-melanoma skin cancer. The group that received training rated the training program high on the amount of feedback, perceived utility, and transfer design. Some of the participants indicated that they used the reference material intensively.

Learning effect
The learning effect of the designed training program was high and significant. This was mainly caused by the scores for the multiple choice questions, where the largest improvements were on the pathophysiology and clinical presentation dimensions. These were treated most extensively during the training session. Individual characteristics did not have a significant influence on the learning outcomes.

Transfer effect
The lack of evidence for improved job performance could have been caused by the small sample size. Although no significant learning effect was found, job experience and anxiety had a significant influence on the correctness of the diagnosis. The participants indicated that there was low opportunity to perform on the job, especially in GP practices. This suggests that, currently, the knowledge and skills required from the training program are less applicable in GP practices.
Limitations

Despite the conclusions that could be drawn from this research, it has some limitations in the research design, the participants, the measurements of the learning effect, and the measurements of the transfer effect. First, the limitations in the research design were that the sample size was small and not entirely representative, which also leads to lower statistical power. Also, due to the difficulties of acquiring participants, it was allowed that participants were employed by the same healthcare institution. Second, there were differences in the experience of the participants because non-melanoma skin cancer is treated more often in some of the participating healthcare institutions. Also, participation in this study was voluntary, which could influence the results. Third, a limitation in measuring the learning effect was that the used pre- and posttest had initially been developed to assess the knowledge of GPs. Also, it is possible that the measurement method of the cases in the pre- and posttest was unreliable and did not represent reality. Finally, the limitations in measuring the transfer effect were: the number of diagnoses made by participants was low and differed among the participants; irrelevant patients were included in a few cases; the patients with suspicious lesions were not selected randomly, due to busy schedules of the participants; and, results showed a high correlation between posttest and number of diagnoses in the control group which could have been an explanation for the absence of the transfer effect.

Strengths

First, the research design of this study is powerful because it includes both a science-based design and design science research. Second, in this study, the correctness of the diagnosis was analyzed with measurable data. Third, the 19 participants were from a target group that is hard to reach.

Suggestions for further research

The previous section described limitations which can be an initiator to suggestions for further research. One suggestion is to conduct this study with a larger, more representative sample size to be able to generalize the results to the entire population and also the sample size of diagnoses. Also random assignment of participants will improve the internal validity. Besides extensions in the research design, a suggestion is to include on-the-job training in the training program when a dermatologist is present, because it allows for feedback about the thinking process of the dermatologist and his or her justification for the choices made with regard to diagnosis and treatment. Also, a different measurement method to determine the transfer effect is a suggestion for further research. A final suggestion is redesigning the task allocation between physicians and physician support personnel to improve the opportunity to perform.

Practical implications

In this study, it was shown that physician support personnel already is quite capable in making accurate diagnoses. Currently, it is not possible for doctor’s assistants from GP practices to expand their job activities and thus diagnose patients with suspicious lesions. To reduce the flow of patients referred to the hospital, the aim is to treat the patients in the GP practices as long as possible. A solution is half line care, where a specialized nurse treats patients with non-melanoma skin cancer at the GP practice for a fixed number of hours per week.
Preface

During this study, the healthcare of (non-melanoma) skin cancer has been in the news a few times. I was happy to see that the problems in the skin cancer care are recognized. This made me feel that doing research about this subject was very useful particularly at this moment in time.

I would like to thank my first TU/e supervisor Ad Kleingeld for his extraordinary support and the many hours he has spent on giving me advice about my project. Secondly, I would like to thank Chris Snijders for his objective view at the project and his support in the data analysis, which led to new insights and an improvement of the report.

Great thanks goes to my two supervisors from MohsA, Gertruud Krekels and Simone van der Geer-Rutten for all their support during the entire project; their active role in finding participants, advice about the contents of the training and gathering data. Last but not least I would like to thank all the participants for their contribution to this project.

Nori Magnus,

Eindhoven, March 2014
# Table of Contents

1. Problem statement ............................................................................................................................. 1  
   1.1 Non-melanoma skin cancer (care) ................................................................................................ 1  
   1.2 Research objective ....................................................................................................................... 4  
   1.3 Research questions ....................................................................................................................... 6  
   1.4 Description of the organization .................................................................................................... 7  
   1.5 Outline of this report .................................................................................................................... 8  

2. Literature review ................................................................................................................................. 9  
   2.1 Training ......................................................................................................................................... 9  
   2.2 Factors influencing the effectiveness of training ....................................................................... 11  
   2.3 Evaluation of training ................................................................................................................. 14  
   2.4 Skin cancer training programs for nurse practitioners and GPs ................................................. 17  

3. Design of a training program ............................................................................................................ 20  
   3.1 Required KSAO's physician support personnel .......................................................................... 20  
   3.2 Training program ........................................................................................................................ 21  
   3.3 Conclusion .................................................................................................................................. 24  

4. Method ............................................................................................................................................. 26  
   4.1 Research design .......................................................................................................................... 26  
   4.2 Participants ................................................................................................................................... 27  
   4.3 Procedure ................................................................................................................................... 27  
   4.4 Measures .................................................................................................................................... 30  

5. Results ............................................................................................................................................... 35  
   5.1 Learning effect ............................................................................................................................ 35  
   5.2 Transfer effect ............................................................................................................................ 41  

6. Discussion .......................................................................................................................................... 50  
   6.1 Design of a training program ...................................................................................................... 50  
   6.2 Learning effect ............................................................................................................................ 51  
   6.3 Transfer effect ............................................................................................................................ 51  
   6.4 Limitations .................................................................................................................................. 53  
   6.5 Suggestions for further research ................................................................................................ 54  
   6.6 Practical implications .................................................................................................................. 55  

References ............................................................................................................................................ 57  

Appendix A: Slides from training program ............................................................................................ 61  
Appendix B: Examples of questions from pre- and posttest ................................................................ 78  
Appendix C: Correlation matrix measured variables ............................................................................ 80
1. Problem statement

This section describes the problem statement, the objective of this study, the research questions that will be answered, and the organization where the study was executed.

1.1 Non-melanoma skin cancer (care)

The number of patients with (non-melanoma) skin cancer increases rapidly. In the last decade the number of patients with skin cancer has increased with 5 to 9 percent per year. In the year 2000, 21,500 patients were diagnosed with skin cancer in the Netherlands. In 2010 this number increased to 35,000 new patients (Nijsten, 2012). Skin cancer can be divided in two types: melanoma and non-melanoma skin cancer. The melanoma type is the most well-known type, but non-melanoma skin cancer is the most common type (Hendi & Martinez, 2011; Nijsten, 2012). One of the main causes of non-melanoma skin cancer is sun exposure. Non-melanoma skin cancer is divided into Basal Cell Carcinoma (BCC) and Squamous Cell Carcinoma (SCC). BCC is the most common skin cancer. In the Netherlands one out of six people are diagnosed with BCC in their lives. BCC can be treated well and rarely leads to death (Nijsten, 2012). SCC is the final of three stages. SCC rarely metastasizes but when it does it is difficult to treat. Therefore it is almost immediately treated (Jansen, 2010; Nijsten, 2012). The first stage of SCC is actinic keratosis (AK), which is the most common premalignant skin cancer. The second stage is Morbus Bowen or Bowen’s disease, which is already more malignant than AK (Jansen, 2010). Figure 2 shows the different types of skin cancer.

Melanoma skin cancer is the major cause of death from skin cancer (Nijsten, 2012). The non-melanoma type is far more prevalent and treatment at an early stage ensures a good chance of recovery (Jansen, 2010). Van der Geer-Rutten (2012) stated that especially non-melanoma skin cancer has risen dramatically over the last decades.

Causes

There are several causes for the increase in the number of patients with (non-melanoma) skin cancer (Nijsten, 2012; Van der Geer-Rutten, 2012):

- The average age of the population is increasing, which leads to more sun exposure and therefore more skin cancer lesions.
A new group at risk for developing skin cancer has been identified. Due to the increasing popularity of the solarium younger adults develop more skin cancer lesions.

A tanned skin has become a fashion trend. This leads to increase in use of the solarium (as described above) and unprotected sunbathing.

Besides the increasing number of patients, also the number of visits per patient is increasing. Nijsten (2012) and Van der Geer-Rutten (2012) give two causes, namely:

- Patients develop multiple suspicious skin lesions during their lifetime.
- The monitoring period per patient is longer due to increased life expectancy.

As described above, not only the number of patients, but also the development of multiple skin tumors during a lifetime is increasing. Therefore, skin cancer can be regarded as a chronic disease (Nijsten, 2012; Van der Geer-Rutten, 2012). Little attention has been paid to non-melanoma skin cancer for a long time because of the low mortality rate. However, the morbidity i.e. the state of being diseased or unhealthy within a population, the burden to the health care system, and the related costs are high (Van der Geer-Rutten, 2012).

Effects

The increase in the number of patients and number of lesions per patient causes a larger flow of patients to general practitioners (GP) and to dermatology departments at hospitals. Because the number of GPs and dermatologists is not necessarily increasing, the increase in patients will lead to a shortage of capacity at dermatology departments and possibly also at the GPs. Currently, there are 450 dermatologists in the Netherlands who represent 375 fte. In 2010 there were about 2 million consults at dermatology departments with one-third for skin cancer lesions (Nijsten, 2012). Although, the number of training places was expanded by 20% a few years ago, Nijsten (2012) states that it is unlikely this expansion is sufficient to cope with the increase in the number of patients.

Previous research has shown that GPs often make wrong referrals to the hospital with regard to non-melanoma skin cancer. This leads to an even greater shortage of capacity at the dermatology department since these wrong referrals could possibly have been treated by the GP themselves. For example, Goedhart et al. (2009) studied the prevalence and incidence with regard to AK at the dermatology department of the Catharina Hospital Eindhoven (Dutch: Catharina ziekenhuis Eindhoven) (CzE), the geographic origin of the patients diagnosed with AK, and the diagnosis of the GP who referred the patient. Data were gathered through databases of the dermatology department of the CzE. The files of the patients diagnosed with AK were included. The diagnosis, with which the GP had referred the patient, was reviewed. It appeared that only 15% of the GPs had referred the patient with the diagnosis AK or only mentioned it. So, currently GPs are not entirely capable in recognizing AK which leads to more referrals to the hospital. A large part of the treatments of AK can be executed in GP practices. If GPs recognize and treat patients with AK themselves, the flow of patients to the hospital can be decreased.

Solutions

Because the number of new patients diagnosed with skin cancer is increasing rapidly and also the development of multiple tumors during a lifetime of a patient, solutions have to be found to cope
with these increases. In the future, the capacity of the dermatology departments in hospitals will not be sufficient to treat all the patients. Nijsten (2012) and Van der Geer-Rutten (2012) both propose to redesign the skin cancer care. Van der Geer-Rutten (2012) has developed a disease management model which includes several solutions for the redevelopment of the skin cancer care. A disease management system is defined as: “a system that organizes healthcare for one well documented healthcare problem with a systematic approach” (Van der Geer-Rutten, 2012, p. 64). This model is shown in Figure 3. Some of these solutions are also mentioned by Nijsten (2012).

![Figure 3: Healthcare system for chronic skin cancer (Van der Geer-Rutten, 2012)](image)

The solutions are as follows:

- **Prevention**: With the aid of online information, questionnaires and checklists, and photographs of skin cancer, awareness of the risk factors and characteristics of skin cancer can be created for people. Research is needed to decide how to approach the population. Previous campaigns appeared to be ineffective (Nijsten, 2012).

- **Collaboration**: An inclusion of GPs as full members of the multidisciplinary team will reduce the workload of the dermatologists. GPs can treat certain non-melanoma types themselves and refer the suspicious lesions to the dermatologists (Van der Geer-Rutten, 2012). As became clear from the research of Goedhart et al. (2009) currently not all GPs have the proper knowledge and skills to make correct diagnoses with respect to skin cancer and execute the corresponding treatments.

- **Guidelines**: Clear guidelines, that are up-to-date, have to be established in order to provide standardized evidence-based treatments.

- **Trained nurses**: Trained nurses can take over tasks from dermatologists, which results in a reduction of the workload of the dermatologists.

- **Information technology**: Information technology can be used to consult and retrieve patient-related data, allows for diagnostic and treatment advice, and can be used to communicate amongst healthcare teams.

- **Monitoring and evaluation**: Monitoring and evaluation of gathered data about patients, treatments, and guidelines has to be developed to ensure up-to-date guidelines and adjustment to treatments if necessary.
• **Financial support:** To be able to implement the solutions described above, financial resources are necessary, e.g. from the government and insurance companies.

• **Organization structure:** To manage the healthcare model, given in Figure 3, central coordination is required. Here, dermatologists would be logical central coordinators.

• **Standardized treatment:** By up-to-date guidelines that everyone is obliged to follow standardized treatments are created. Data retrieved after a standardized treatment can be evaluated to verify whether these treatments have the same results and where the differences are.

### 1.2 Research objective

The disease management model of Van der Geer-Rutten (2012) indicates that dermatologists and GPs need to collaborate to cope with the increasing number of patients with non-melanoma skin cancer. In the previous section it was stated that there will be a shortage in capacity at the dermatology department, but possibly also at GP practices. Because Van der Geer-Rutten (2012) suggests to involve GPs more in the care of non-melanoma skin cancer, the shortage in capacity at GP practices will be even more likely.

Previous research has provided solutions to reduce the time the patient spends with the dermatologist by designing a tool specialized nurses can use to diagnose the patient before they see the dermatologist (Jansen, 2010). The tool provides an estimate of the probability that non-melanoma skin cancer is present for two forms of skin cancer (actinic keratosis and basal cell carcinoma), on the basis of a statistical prediction model which includes characteristics about the anamnesis of the patient and clinical characteristics of the lesion. The model estimated AK and BCC correctly in 84.7% and 94.4% respectively (Rinkens, 2011). Timmermans (2012) used the model to examine the accuracy of nurses’ diagnoses.

One of the solutions in Van der Geer-Rutten’s disease management model (2012) was to train nurses to reduce the time the patient spends at the dermatologist. This solution can also be extended to the GPs, because their workload will also increase after participating more in the care of non-melanoma skin cancer. Dermatologists and GPs have various supportive personnel, such as nurses, doctors’ assistants, specialized nurses, and skin therapists. This entire group of physician support personnel could be suitable to carry out tasks delegated by their superiors.

The estimation tool (Jansen, 2010; Rinkens, 2011; Timmermans, 2012) can be used by physician support personnel to diagnose patients, but it is not likely that it improves their knowledge and skills about non-melanoma skin cancer. It is possible that they indirectly gain some knowledge about characteristics of non-melanoma skin cancer with the aid of the tool, but complete understanding will be lacking.

As was mentioned before, non-melanoma skin cancer can be seen as a chronic disease (Nijsten, 2012; Van der Geer-Rutten, 2012). When a patient is then diagnosed with non-melanoma skin cancer, the next time he or she visits the GP or dermatologist, physician support personnel may be allowed to diagnose and treat the patient in routine cases. For this future objective, it is essential that physician support personnel possesses the knowledge and skills about non-melanoma skin cancer.
cancer to be able to diagnose and treat the patient. The estimation tool will not suffice to reach this objective.

In this study the solution of trained physician support personnel is further elaborated on. Currently, it is assumed that physician support personnel does not possess or has only little knowledge and skills to make correct diagnoses with respect to skin cancer and pre-malignancies and recommend the corresponding treatments. The goal of this study was to measure the effectiveness of training about non-melanoma skin cancer for physician support personnel on learning and transfer outcomes. A training program with a combination of delivery methods based on scientific literature was designed to maximize its effectiveness.

In this study the regulative cycle of Van Strien (1986) was used for the design of the training program (Figure 4). First, the problem of untrained physician support personnel was defined (problem definition). Second, no sufficient training program was found to train physician support personnel on non-melanoma skin cancer (diagnosis). Third, a training program was developed for this study, based on scientific literature (plan). Finally, the training was given (intervention) and evaluated (evaluation).

The training was evaluated according the empirical cycle of De Groot (1961) (Figure 4). This cycle represents the hypothetical-deductive research approach. In this cycle hypotheses are specified and defined in measurable variables (induction and deduction) and then checked by collecting new empirical data (testing) and evaluated (evaluation). Evaluation of the training program following the

![Regulative cycle](image)
empirical cycle ensures that the results of this study are based on data that were gathered in a structured way and that all aspects are taken into account. The hypotheses for this study are explained in detail in the next paragraph.

In this study, a training program for physician support personnel was evaluated. Physician support personnel is allowed to do the anamnesis of the patient and to do a total body check. He or she can alert the GP or dermatologist to suspicious lesions and suggest a possible diagnosis. After a final diagnosis of the GP or dermatologist, physician support personnel can carry out simple treatments. It is also possible that the number of correct diagnoses and referrals to dermatologists at hospitals (true positives) by GPs increases because they take the diagnosis of their personnel into account. In the previous section, it was mentioned that GPs are not able to make proper diagnoses with regard to non-melanoma skin cancer at all times. In this study, the diagnoses of the GPs are taken into account to examine whether this is improved.

1.3 Research questions

To achieve the goal described above the following research question has to be answered. The main research question of this study is:

**To what extent can the knowledge and skills regarding non-melanoma skin cancer of physician support personnel be improved via training so that they are able to make accurate preliminary diagnoses?**

To answer the research question two kinds of sub questions are drawn. Question 1A through 1C are related to the design of the training program and question 2A and 2B to the evaluation of the training program, following the empirical cycle of (De Groot, 1961).

To develop a training about non-melanoma skin cancer, it has to be known what knowledge and skills about non-melanoma skin cancer the physician support personnel has to possess. Therefore, the following sub-question is drawn:

1A. What tasks and Knowledge, Skills, Abilities and Other characteristics (KSAOs) are necessary to make correct diagnoses and referrals with regard to non-melanoma skin cancer?

Every trainee has individual characteristics which can influence the effectiveness of the training program. Also, external factors can affect the outcomes of training. The following sub-question is drawn:

1B. What individual characteristics and external factors need to be taken into account that can influence the effectiveness of training?

There are different methods to train persons to improve their knowledge, skills and abilities. To maximize the effect of the training program developed in this study, literature will be reviewed to choose the combination of delivery methods. The sub-question below will be answered:
1C. Which combination of training delivery methods is likely to result in the strongest improvement in knowledge and skills of physician support personnel regarding non-melanoma skin cancer?

After a training program about non-melanoma skin cancer for physician support personnel is developed, it will be evaluated. The learning effect of a training program is measured to examine if the knowledge and skills of the trainee about non-melanoma skin cancer are improved. Eventually, the objective is that the physician support personnel is able to carry out tasks delegated by the dermatologist or GP. Therefore, not only the learning effect, but also the transfer effect, i.e. job performance of the physician support personnel will be measured. Therefore, the following sub-question will be answered:

2A. What is the training performance / learning effect of physician support personnel with regard to non-melanoma skin cancer?
2B. What is the job performance / transfer effect of physician support personnel with regard to non-melanoma skin cancer?

To answer these questions, the following hypotheses are defined:

H1.0: The learning effect of the participants who received training was equal to learning effect of the participants in the control condition.
H1.1: The learning effect of the participants who received training was significantly higher than the learning effect of the participants in the control condition.

H2.0: The transfer effect of the participants who received training was equal to learning effect of the participants in the control condition.
H2.1: The transfer effect of the participants who received training was significantly higher than the learning effect of the participants in the control condition.

1.4 Description of the organization

This section will describe the organization for which the study has been conducted, the organizational goals and the relevant actors that participated in this research.

MohsA

This study was conducted on behalf of MohsA. It is an independent treatment center for dermatological care located in Venray. Its expertise lies in the treatment of skin cancer and Mohs surgery. Mohs surgery is a treatment where the skin cancer is completely removed while as much skin as possible (often in the face) is spared. With this method 100% of the cutting edges is examined for tumor tissue in contrast to the 0.1% with a standard excision. The treatment takes place in one day, which is also an advantage (http://www.mohsa.nl).

MohsA was founded in April 2012. The dermatological care was focused on the treatment of skin cancer. Since July 2013 MohsA is headed by two dermatologists and complete dermatological care is provided (Krekels & Van der Geer-Rutten, 2013). The two dermatologists both obtained their PhD in subjects related to skin cancer. The name ‘MohsA’ is originated from Mohs surgery and the A stands
for Academy: the two dermatologists are involved in scientific research, education in dermat-oncology, and the development of national guidelines with regard to skin cancer (http://www.mohsa.nl).

The focal points are a patient-centered approach, diagnosis and treatment in one day ('one-stop shop'), short access times, attention to pain and scar treatment, prevention of skin cancer, and innovation in cancer care. One of the dermatologists developed a disease management model for skin cancer which can reduce the pressure on the regular dermatology polyclinic and will lead to cost savings for patients and insurance companies (http://www.mohsa.nl). This disease management model was described in the previous section (Van der Geer-Rutten, 2012).

Some aspects that are important for MohsA are (Krekels & Van der Geer-Rutten, 2013):
High patient satisfaction: In 2012 MohsA scored 9,3 on patient satisfaction. The goal is to retain the patient satisfaction above 9 in 2013-2014.
- An informal company culture: The communication between the personnel is informal and there is no hierarchy. New initiatives from employees are taken seriously.
- Monitor and improve expertise: MohsA monitors and improves its expertise by continuously training its own personnel and searching for improvements in dermatological care. To improve the flow of patients and the quality of dermatological care, MohsA enters in a collaboration with different parties, such as skin therapists and GP practices.

**Motivation for research**

As the last aspect in the previous paragraph indicates, the dermatologists of MohsA are driven to improve the dermatological care. These are all based on the disease management model of Van der Geer-Rutten (2012). MohsA not only searches for improvements in the dermatological care for its own organization, but also for the dermatological care in general. Training of physician support personnel about non-melanoma skin cancer is one of these initiatives.

**1.5 Outline of this report**

Figure 5 shows the outline of this report. As can be seen after the problem is stated in this section, Chapter 2 continues with literature to support the research questions drawn in this section. In Chapter 3 the design of the training program will be described. Chapter 4 provides the research design of this study. In chapter 5 the results of the research will be explained. In the final chapter the research questions are answered and limitations and suggestions for further research are described.
2. Literature review

This chapter describes the previous research with regard to training, factors influencing the effectiveness of training, the evaluation of training, and existing training programs about skin cancer for nurse practitioners and GPs.

2.1 Training

According to Goldstein and Ford (2002, p. 1) training is defined as: “the systematic acquisition of skills, concept, or attitudes that results in improved performance in another environment”. Goldstein and Ford (2002) developed a model to develop, execute, and evaluate training in a structured way. This model is given in Figure 6.

For the determination of the individuals who need to receive training a needs assessment has to be done. As can be seen in Figure 6, a needs assessment consists of an organization analysis, a task and KSAO analysis, and a person analysis (Brown, 2002; Landy & Conte, 2009). Goldstein and Ford (2002) add two more steps, getting organizational support and a requirement analysis. After executing the needs assessment it is clear what the objectives of the training program are and a training design can be developed.

Several different training designs are found in literature. These can vary from traditional methods to methods in which a lot of technology is used. Also, several methods are combined to train knowledge and skills to exploit the advantages of the different training delivery methods. The choice of method depends on what has to be learned. According to Arthur, Bennett, Edens, and Bell (2003) skills and tasks that can be trained are divided in three categories: cognitive, interpersonal, and psychomotor. Cognitive skills and tasks are related to knowledge, understanding, and problem

![Training Model](image-url)
solving required for the job. Interpersonal is about the interaction with others. Psychomotor skills
and tasks are physical or manual. Often trainees need to learn several skills and abilities. Table 1
contains the training methods found in the literature. Every method is used to teach a particular skill
or task category. Alvarez, Salas, and Garofano (2004) found that the effectiveness of a certain
training method depends on the degree to which the training method is consistent with the skill
category (cognitive, interpersonal or psychomotor) being trained.

Table 1: Training delivery methods

<table>
<thead>
<tr>
<th>Training method</th>
<th>Pros</th>
<th>Cons</th>
<th>KSAOs</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture and discussion</td>
<td>Low cost</td>
<td>Passive learners, insensitive to individual differences, limited in providing immediate feedback</td>
<td>Knowledge, (attitude)</td>
<td>Goldstein &amp; Ford (2002)</td>
</tr>
<tr>
<td>Case study</td>
<td>Feedback, allows individual to learn by observing others, learners are more willing to attend, useful for single-loop learning</td>
<td>Not useful for learning general principles, lack of guided instruction can be detrimental, not for double-loop learning</td>
<td>Skills in analysis and problem solving</td>
<td>Argyris (1999); Goldstein &amp; Ford (2002)</td>
</tr>
<tr>
<td>Role playing</td>
<td>Experience on-the-job problems</td>
<td>Success depends on willingness of trainee</td>
<td>Attitude, human relation skills</td>
<td>Goldstein &amp; Ford (2002)</td>
</tr>
<tr>
<td>Readings, workbooks</td>
<td>Preparatory: every trainee on same knowledge level, time for complex knowledge in lectures; Post-training: reinforce training material, facilitate transfer to the job</td>
<td>Long feedback lag times, low learning motivation, little or no opportunities for interaction, limited subject matter, high rates of incompleteness of course material</td>
<td>Knowledge, skills</td>
<td>Goldstein &amp; Ford (2002)</td>
</tr>
<tr>
<td>Programmed instruction (involves taking a systematic approach to presenting information to the learner using principles of reinforcement)</td>
<td>Individualized instruction, immediate feedback</td>
<td>Limited flexibility</td>
<td>Knowledge, skills</td>
<td>Goldstein &amp; Ford (2002); Landy &amp; Conte (2009)</td>
</tr>
<tr>
<td>Simulated work settings</td>
<td>Controlled reproducibility, safety considerations, learning consideration, cost effectiveness</td>
<td>High cost</td>
<td>Skills, decision making, problem solving</td>
<td>Goldstein &amp; Ford (2002)</td>
</tr>
<tr>
<td>On-the-job training</td>
<td>Low cost</td>
<td>Use of job aids serving as reminders in recalling training information</td>
<td>Knowledge, skills</td>
<td>Goldstein &amp; Ford (2002); Landy &amp; Conte (2009)</td>
</tr>
<tr>
<td>Job rotation</td>
<td>Trainees develop important network of contacts</td>
<td>Most successful if job rotation is part of an overall career development system</td>
<td>Decision making &amp; problem solving skills</td>
<td>Landy &amp; Conte (2009)</td>
</tr>
<tr>
<td>Distance learning</td>
<td>Different locations at same time, high level of interaction between trainer and trainees</td>
<td>Dependent of communication technology</td>
<td>Knowledge</td>
<td>Goldstein &amp; Ford (2002); Landy &amp; Conte (2009)</td>
</tr>
<tr>
<td>CD-ROM and interactive multimedia</td>
<td>Permits diverse content easily accessed by trainees</td>
<td>Expensive to develop, only suitable for situation where the necessity for updating content is infrequent</td>
<td>Declarative and procedural knowledge, skills</td>
<td>Goldstein &amp; Ford (2002); Landy &amp; Conte (2009)</td>
</tr>
</tbody>
</table>
Table 1 (continued): Training delivery methods

<table>
<thead>
<tr>
<th>Training method</th>
<th>Pros</th>
<th>Cons</th>
<th>KSAOs</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Web-based instruction</td>
<td>Individualized, accessible at any time and location, easy to update, allows for just-in-time training</td>
<td>Low possibility for outside assistance</td>
<td>Knowledge, skills</td>
<td>Goldstein &amp; Ford (2002); Landy &amp; Conte (2009)</td>
</tr>
<tr>
<td>Intelligent tutoring systems</td>
<td>Individualized, immediate feedback, interaction with virtual tutor</td>
<td>Expensive to develop</td>
<td>Knowledge, problem solving</td>
<td>Goldstein &amp; Ford (2002); Salas &amp; Cannon-Bowers (2001)</td>
</tr>
<tr>
<td>Virtual reality training</td>
<td>Highly motivating and interesting, easy to update, integrate and reuse</td>
<td>Expensive to develop</td>
<td>Technical and interpersonal skills</td>
<td>Goldstein &amp; Ford (2002)</td>
</tr>
</tbody>
</table>

The upper part of Table 1 (lecture and discussions to job rotation) shows traditional training methods, the lower part (from distance learning to virtual reality training) contains newer training technologies. Goldstein and Ford (2002) found four limitations of the traditional training methods. First, there are a lot of multinational companies for which classroom and traditional simulation instructions are relatively expensive, because trainees need to travel to a centralized location or there have to be a number of trainers who need to be trained. Second, it is hard to individualize the traditional training methods. Third, the trainer and trainees usually need to be together at fixed times. Therefore, flexibility in receiving training is low. Finally, there is relatively little time to practice skills, because instructions are given in groups and the practice time must be shared across a number of trainees. The training methods in the lower part of Table 1 try to solve some of these limitations.

Although a lot of different training methods are found in literature, there is minimal empirical evidence found about the effectiveness of these methods. Argyris (1999) studied the case study method. He found that case studies are useful for single loop learning which involves the detection and correction of error. However, this method is not useful for double loop learning which involves changes and corrections in underlying policies, assumptions, and goals.

A training design often consists of several training methods as not every method is appropriate for each KSAO. The combination of different methods therefore depends on what has to be learned. Training designs are created around four principles: relevant information or concepts that have to be learned are presented, the missing KSAOs are included, opportunities for trainees to practice the skills are created, and feedback is provided during and after practice (Salas & Cannon-Bowers, 2001).

2.2 Factors influencing the effectiveness of training

Next to the fit of the various training designs to KSAOs to be acquired, described in the previous section, there are other external factors which affect the effectiveness of the training. Several studies exist about external factors that affect learning outcomes and transfer to practice. These factors are divided into three broad categories: individual, training, and organizational characteristics (Alvarez, Salas, & Garofano, 2004). Figure 7 is a visualization of the individual, training, and organizational characteristics that influence the training outcomes and the transfer to
the job. For the corresponding sources of the characteristics, the reader is referred to Mangnus (2013).

Figure 7: Factors influencing training outcomes and transfer of training

Individual or trainee factors refer to the characteristics of the participants that may affect the learning process. An important factor is the motivation of the trainee, defined as: “the direction, intensity, and persistence of learning-directed behavior in training contexts” (p. 678, Kanfer, as cited
Training motivation is positively related to the outcome of training (Mathieu, Tannenbaum, & Salas, 1992). According to Mathieu and Martineau (1997) there are three types of (pre)training motivation: motivation to learn, valance-instrumentality-expectancy (VIE) beliefs, and self-efficacy. Motivation to learn is predicted by several factors. Self-efficacy, internal locus of control, and organizational commitment have a strong, positive relationship with motivation to learn. Achievement motivation, conscientiousness, jobs involvement, organizational commitment, career planning, and career exploration have a significant, moderate, positive relationship with motivation to learn. Anxiety has a negative impact on motivation to learn. Situational characteristics, supervisor support, peer support, and climate were found to have a positive relationship with motivation to learn (Colquitt, LePine, & Noe, 2000). Mathieu, Tannenbaum, and Salas (1992) used some of these variables to predict the learning of the participants. In contrast to the results of Colquitt et al. (2000), they found that career planning and job involvement do not have an influence on the training motivation. Also, the situational characteristics had a moderate, negative influence instead of a moderate, positive influence on the training motivation.

Training design characteristics refer to the different training delivery methods, each having different influences on learning outcomes and transfer of training. Burke and Hutchins (2007) reviewed literature about instructional strategies and methods and their effect on transfer to practice. They studied several factors such as practice and feedback, over-learning, cognitive overload, active learning, behavioral modeling, and error-based examples where practice and feedback, behavioral modeling and error-based examples had a strong or moderate relationship with transfer. Burke and Hutchins (2007) found several studies that conclude that active learning i.e., practice during training has a positive relationship with transfer. Behavioral modeling is defined as: “a logical, transfer-strategy-based research regarding self-efficacy” (Bandura, 1997) and has a moderate to strong relationship with transfer outcomes (Burke & Hutchins, 2007). Finally, giving error-based examples means that the trainees get examples of situations in which is acted incorrectly. Burke and Hutchins (2007) reviewed two studies about error-based examples. One of them concluded that detailed case studies were preferred above error-based examples (Ivancic & Hesketh, 2000), but both studies showed a positive effect on transfer.

The influence of the work environment has been studied less extensively than individual and training design characteristics. Three factors have a significant relationship with training outcomes and transfer, which are climate, support, and opportunity to perform. A positive transfer climate is present when employees are encouraged to use new skills and are supported by supervisors and peers, and the necessary resources are provided (Colquitt, LePine, & Noe, 2000). Although support and opportunity to perform are part of the transfer climate, they are discussed separately because they have been found to have a unique influence on transfer (Burke & Hutchins, 2007). Burke and Hutchins (2007) found mixed support for a positive influence of supervisor support. Peer support, however, was found to have a consistent positive influence on the transfer to practice. To use the learned skills and knowledge employees should get the opportunity during executing their job. To realize this managers should consider modifying the workload of their employees (Burke & Hutchins, 2007).

Mathieu et al. (1992) examined two additional characteristics that could have an influence on learning and transfer outcomes: assignment and situational constraints. They found that participants
who volunteered for training had more positive reactions about the training than participants who were assigned to training. Situational constraints showed a negative relationship with training motivation. Thus, when participants are not informed properly or the facilities are not arranged well, they are less motivated to follow a training program (Mathieu, Tannenbaum, & Salas, 1992).

Clarke (2005) studied the relationship between the workplace learning environment and its relationship with learning outcomes in healthcare organizations. He distinguishes two learning outcomes: training outcomes and workplace learning outcomes. It appeared that a training and development infrastructure had a significant positive effect on training outcomes. The factors that affect workplace learning outcomes were opportunities for independent informal learning, empowerment and communication, and support for reflection and job challenge. Surprisingly no significant effect was found for support for learning transfer. Also opportunities for group informal learning did not have a relationship with learning outcomes. Typical for employees in healthcare organizations is that they have to deal with high work pressure and little time. It can be imagined that individual on-the-job learning has a positive effect when this includes trial and error, observation, reading and self-study, special projects/challenging assignments, job rotation and secondment. These are easily combined when there is little time available.

As can be seen from Figure 7 there are many factors that can affect the learning and transfer outcomes. These should not only be considered in the design of a training program but also be taken into account in the evaluation of the training.

2.3 Evaluation of training

During the needs assessment KSAOs that need to be trained are determined. To examine whether these KSAOs are on a sufficient level after giving training, they should be measured. On this basis, the training criteria are determined (Goldstein & Ford, 2002).

Training criteria

Kirkpatrick (as cited in Arthur, Bennett, Edens, & Bell, 2003; Goldstein & Ford, 2002; Landy & Conte, 2009) categorized training criteria into four levels:

1. Reaction criteria: measures that assess trainees’ enjoyment of and satisfaction with the training program. These criteria are often measured on the basis of a questionnaire.
2. Learning criteria: measures that assess how much the trainee has learned during the training.
3. Behavioral criteria: measures of the extent to which the learning is transferred to the job.
4. Results criteria: measures of the extent to which training can be related to organizational outcomes.

Here the reaction and learning criteria are internal (focus on what occurs within the training program), and the behavioral and results criteria are external (focus on changes that occur back on the job) (Landy & Conte, 2009). Alliger, Tannenbaum, Bennett, Traver, and Shotland (1997) made a few modifications to Kirkpatrick’s criterion levels. These can be seen in Table 2. The reaction criteria are divided into two criteria. Alliger et al. (1997) distinguish the pleasantness of the training and whether the trainees thought the training was useful for their jobs. The learning criteria are divided
into three sub-categories. Knowledge is measured at two different times (one immediately after training and one later) and also the behavior/skills are assessed after training. Behavior criteria are about the transfer to the job, therefore it is called ‘transfer’ in the augmented framework.

Table 2: Training criteria taxonomies (Alliger, Tannenbaum, Bennett, Traver, & Shotland, 1997)

<table>
<thead>
<tr>
<th>Kirkpatrick’s Taxonomy</th>
<th>Augmented Framework</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reactions</td>
<td>Reactions</td>
</tr>
<tr>
<td></td>
<td>Affective reactions</td>
</tr>
<tr>
<td>Learning</td>
<td>Learning</td>
</tr>
<tr>
<td></td>
<td>Immediate knowledge</td>
</tr>
<tr>
<td></td>
<td>Knowledge retention</td>
</tr>
<tr>
<td>Behavior</td>
<td>Transfer</td>
</tr>
<tr>
<td>Results</td>
<td>Results</td>
</tr>
</tbody>
</table>

Arthur et al. (2003) examined the relationship between the training evaluation criteria of Kirkpatrick and the effectiveness of a training program. Medium to large effect sizes were found ($d = 0.60 - 0.63$). The training criteria were measured at different times. It appeared that time intervals were not related to the observed effect sizes. Results from Alliger et al. (1997) showed that immediate knowledge and knowledge retention moderately correlated (.35). So, time has an influence on the learning effect. It should be noted that these results were based on minimal empirical evidence (two studies). The learning effect was moderately correlated to the transfer effect (Alliger, Tannenbaum, Bennett, Traver, & Shotland, 1997). Colquitt et al. (2000) found an even stronger relationship.

As Arthur et al. (2003), Alvarez et al. (2004) examined the relationship between training evaluation and effectiveness. Based on five evaluation models, Alvarez et al. (2004) developed a new integrated model (see Figure 8). The needs analysis (top level) results in three goals, training content and design, changes in learners, and organizational payoffs. The evaluation of these goals can be determined by the variables of the third and fourth level. The relationships of these measurements with effectiveness are supported by the five evaluation models and recent research and theory. In Kirkpatrick’s model positive reactions are related to learning. In Figure 8 can be seen that there is no relation between these elements. Contrary to Kirkpatrick’s model, Alliger et al. (1997) and also Colquitt et al. (2000) did not found a relation between reaction and learning in their meta-analysis. However, when only taking the utility reactions into account, Alliger et al. (1997) did found a moderate effect to immediate learning (.26). Thus, when trainees think the training program was useful it is plausible that their KSAOs are sufficient after training.

![Figure 8: Integrated Model of Training Evaluation and Effectiveness (Alvarez, Salas, & Garofano, 2004)]
Level 1 and 2 of Kirkpatrick’s taxonomy are often measured by the organization. Behavioral and results criteria, on the other hand, are not often measured. This is unfortunate, as it is crucial to know what the costs and benefits are of the training program. This can be measured by doing an utility analysis. Landy & Conte (2009, p. 291) define an utility analysis as: “a technique that assesses the economic return on investment of human resource interventions such as staffing and training.”

**Interpretation**

In the previous section the different levels of evaluation were described. This section describes how the results from the evaluation can be interpreted, i.e. the reliability and validity of the evaluation.

Reliability refers to the stability or consistency of a measure (Trochim, 2000). Reliability is important because it shows that a study would have given the same results when, for example, executed by someone else or at another time. Trochim (2000) distinguishes four types of reliability: test-retest reliability, parallel-forms reliability, internal consistency, and inter-rater reliability. Test-retest reliability refers to the extent to which a test taken at time one correlates with a test taken at time two. When a group of individuals complete two different forms of the same test and obtain the same score, it is known as parallel-forms reliability. The internal consistency reliability measures how well items that reflect the same construct yield similar results. This can be done with the average item-total correlation and the split-half reliability. The Cronbach’s Alpha, $\alpha$, is often used and is equivalent to the average of all possible split-half estimates (Trochim, 2000). Finally, inter-related reliability refers to the level of agreement among raters. Whether results are reliable or not is determined by the correlation between the tests. Results are reliable when there is a correlation of .70 or higher (Trochim, 2000).

Validity is about whether a claims is supported by its measures (Blumberg, Cooper, & Schindler, 2008). There are different types of validity and each have their own threats. These varieties are: internal validity, external validity, and construct validity.

Internal validity is defined as: “a variable of interest (i.e., independent variable) is manipulated to determine its effect on something being measured (i.e., dependent variable)” (Still, 2011, p. 66). Confounding variables are factors, other than the predictor variable, that influence the outcome variable (Field, 2005). In an experimental design with high internal validity these confounding variables are controlled well (Still, 2011). There are several threats found in literature on the internal validity (Blumberg, Cooper, & Schindler, 2008; Goldstein & Ford, 2002; Trochim, 2000): history, maturation, testing, instrumentation, regression, selection, mortality, selection-history, and social threats.

External validity refers to the generalizability, i.e. of results (Goldstein & Ford, 2002; Trochim, 2000). External validity can only be controlled when there is high internal validity in case of training programs, because the training must have been judged effective before it can be expanded to other groups (Goldstein & Ford, 2002). The following threats to external validity are found in literature (Blumberg, Cooper, & Schindler, 2008; Goldstein & Ford, 2002; Trochim, 2000): threats of wrong generalizations and reactive effects.
Trochim (2000, p. 98) defines construct validity as follows: “Construct validity refers to the degree to which inferences can legitimately be made from the operationalizations in your study to the theoretical constructs on which those operationalizations were based”. Landy & Conte (2009) give some examples of constructs, such as intelligence, personality, and leadership. Trochim (2000) describes the following threats:

- Inadequate preoperational explication of constructs, mono-operation bias, mono-method bias, interaction of different treatments, interaction of testing and treatment, restricted generalizability across constructs, and confounding constructs and levels of constructs.
- Social threats: hypothesis guessing, evaluation apprehension, and experimenter expectancies.

The evaluation method has an influence on the internal and external validity of an experiment.

Evaluation methods

There are several experimental designs to measure the different evaluation criteria. Four kinds of experimental designs can be distinguished: pre-experimental design, randomized or true experiment, quasi-experiment, and non-experiment. An experiment is randomized or true if the participants in the groups are assigned randomly. A quasi-experiment is when there is no random assignment, but there is a control group. Otherwise it is a non-experiment (Blumberg, Cooper, & Schindler, 2008; Trochim, 2000).

The designs with strong internal validity are randomized or true experimental designs (Trochim, 2000). Landy & Conte (2009) state that the pretest – posttest control group design is most preferred. Threats on internal validity are controlled quite well in this design (Campbell & Stanley, 1971). However, for a high external validity replication of the experiment with other groups is necessary (Blumberg, Cooper, & Schindler, 2008).

The non-equivalent control group design is a quasi-experimental design and equal to the pre-test – post-test control group design, only the participants in the groups are not assigned randomly. To verify if the test and control group are similar the pre-test results can be compared. When these are similar there is a good internal validity, as it is likely that possible effects from the intervention would have appeared in both groups.

2.4 Skin cancer training programs for nurse practitioners and GPs

In the past, training programs for nurse practitioners and GPs were designed and evaluated. Oliveria et al. (2001) evaluated the ability of trained nurse practitioners to accurately identify (non-melanoma) skin cancer in a clinical setting. A training program about skin cancer was developed. The contents of the training were:

- Workshop: to teach skin assessment and recognition of suspicious lesions.
- Clinical apprenticeship: participation in approximately 100 patient screening examinations with the dermatologist. During each consult the dermatologist discussed with the nurse practitioners the risk of the lesion the skin examination technique, criteria for referral, and patient education about prevention and self-examination.
- Didactic lectures: 5 – 6 hours
Five nurse practitioners participated in the study. All had no experience in evaluation skin lesions. The nurses were assessed on three aspects: the ability to distinguish benign and malignant lesions, the ability to correctly refer patients with suspicious lesions to the dermatologist, and the ability to detect significant skin cancer lesions. The sensitivity and specificity of the nurse practitioners’ diagnoses was measured for these three aspects. Sensitivity is the proportion of true positives (TP) which are correctly identified as such. Specificity is the proportion of true negatives (TN) which are correctly identified. The nurse practitioner’s sensitivity to distinguish benign and malignant lesions was 100%, whereas the specificity ranged from 53% to 100%. The correct referral rate of the nurse practitioners was a sensitivity ranging from 67% to 100% and a specificity ranging from 62% to 100%. Finally, the sensitivity of nurse practitioners to detect significant skin cancer ranged from 50% to 100% and the specificity was 99% to 100%.

The research of Oliveria et al. (2001) differs from the current study in the contents of the training, the evaluation and the participants. However, as can be seen from above results the scores of the nurse practitioners who received training are promising. Limitations of this study were the small sample size (N = 5) and the lack of a pretest measuring the knowledge and skills of the nurse practitioners before training.

More research has been conducted on training GPs in diagnosing (non-melanoma) skin cancer. Bedlow et al. (2000) trained 23 GPs on (non-melanoma) skin cancer. The training consisted of a didactic style of lecture on the clinical features of benign, borderline and malignant lesions, based on an illustrated booklet. This booklet was also distributed among the GPs for use as reference material. During the lecture active involvement by the GPs was included. The effectiveness of the training was measured by a pre- and a post-test which consisted of 30 clinical slides of malignant, benign, and borderline lesions. Each slide was preceded by a short history and was projected for 20 seconds. The percentage of correctly identified lesions showed a significant overall improvement in the GPs’ diagnostic skills ($P < .001$) (Bedlow, et al., 2000). The sensitivity and the specificity of the borderline or malignant lesion diagnoses improved from 63% to 76% and from 55% to 62% respectively (Bedlow, et al., 2000).

Westerhoff, McCarthy, and Menzies (2000) examined the increase in correct diagnoses for melanoma skin cancer by GPs after giving training about using skin surface microscopy. Skin surface microscopy is the examination of skin lesions by the use of an incident light magnification system (Westerhoff, McCarthy, & Menzies, 2000). The training program included a one-hour presentation, a pictorial atlas and a quiz, which gave the participants the opportunity to use the learned method under guidance. Thus, the training was a combination of lecture and discussion, case studies, and readings. The results showed a significant improvement in the percentage of correctly identified lesions in the treatment group (62.7% vs. 54.6%; $P = .007$) and no difference in the control group.

In a second study GPs were trained to make better diagnoses with regard to suspicious pigmented lesions (SPLs) (Burton, et al., 1998). The training program consisted of three elements: a three-hour lecture, an individual attendance at a three to four hour specialist clinic to see how diagnoses are made, and training of taking excisions in a private surgical outpatient clinic. Trained GPs appeared to be significantly better at diagnosing suspicious pigmented lesions than untrained GPs ($P = .04$).
These studies showed that a training program about (non-melanoma) skin cancer can be effective, but if the trainee does not want to use this new knowledge in practice, the training is useless. Mikkilineni et al. (2001) examined the impact of training about basic skin cancer triage on providers’ skin cancer control practices. They evaluated a two-hour, multicomponent training (lecture, instruction, and role play) about basic skin cancer triage. Results showed that primary care providers increased the practice of skin cancer control measures. The providers’ self-reported skin cancer control practices during an initial visit with a new patient increased significantly (2.17 to 3.21, P < .0001) and also a routine consult with a patient with high risk for melanoma (2.15 to 3.00, P < .0001). Also their attitudes towards skin examination and skin cancer counseling were improved significantly (4.20 to 4.60, P < .0001). Earlier negative opinions about early skin cancer detection decreased (2.38 to 1.79, P < .0001). Thus, not only the care providers improved their skills, but with the positive attitudes towards skin examination it is likely they will do it more often in the future.

In this chapter, literature was reviewed with regard to the development and evaluation of a training program. In the next chapter, the design of a training program about non-melanoma skin cancer for physician support personnel is described based on the literature from this chapter.
3. Design of a training program

This chapter describes the design of the training program used in this study. The regulative cycle of Van Strien (1986) is used for the designing process. The training program includes the characteristics, risk factors and treatments for non-melanoma skin cancer. The target group is physician support personnel. The training model of Goldstein and Ford (2002) was used to develop, execute and evaluate the training program. This training model was given in Figure 6 in Chapter 2.

3.1 Required KSAO’s physician support personnel

The goal of the training program is to improve the knowledge and skills of physician support personnel regarding non-melanoma skin cancer, so that they are able to make accurate preliminary diagnoses. Making a diagnosis is difficult because the person who makes the diagnosis has to gather relevant information from the patient, but does not know what is relevant in advance. Relevant information can be: symptoms of the disease, history and life circumstances of the patient, laboratory research, and a patient’s response to a treatment. To gather this information, the person who makes the diagnosis has to have knowledge of the symptoms of the disease and the personal characteristics associated with disease to be able to ask the right questions.

The difficulty of making a proper diagnosis was shown by Ridderikhoff (1993). He found that, physicians start making their diagnosis from the first words from the patient or the feeling they get by the patient instead of gathering information open-minded and making a diagnosis afterwards. This inductive strategy allows for quick response to the patient’s needs but makes it impossible to reproduce the diagnosis process.

The absence of a structured diagnosis process causes the need for a structured method for the development of this training program because the most relevant knowledge and skills regarding non-melanoma skin cancer have yet to be determined. With a needs assessment the relevant tasks and KSAO are determined and which persons have to be trained. The needs assessment consists of an organization analysis, a task and KSAO analysis, and a person analysis (Brown, 2002; Landy & Conte, 2009). In the organizational analysis goals are specified to get a clear view about what the organization wants to achieve, where in the organization these goals are already met and where training is needed (Brown, 2002; Landy & Conte, 2009). MohsA aims to improve the quality of dermatological care. Not only for its own organization, but for the dermatological care in general. The organizational goals are derived from the disease management model of Van der Geer-Rutten (2012).

In the task and KSAO analysis is determined which activities are performed in the diagnosis process and which knowledge, skills, abilities and other characteristics a person needs to perform these activities. After executing the task and KSAO analyses, the KSAOs are linked to the different tasks (Brown, 2002; Goldstein & Ford, 2002; Salas & Cannon-Bowers, 2001). This analysis ensures that only the knowledge and skills necessary for diagnosing non-melanoma skin cancer are included in the training program. The task and KSAO analysis was executed with the aid of a book about non-melanoma skin cancer, written by dermatologists (Krekels & Van der Geer-Rutten, 2010), a partial task and KSAO analysis from previous research about this topic (Rompen, 2013), and interviews with dermatologists.
Table 3 includes the relevant tasks and KSAOs that were determined in the task and KSAO analysis. Tasks that were determined, but not included were: providing care to patients with skin lesions and prescribing treatments, medications and other measures for the purpose of recovery, and tracking and recording patient medical data with respect to non-melanoma skin cancer. These were excluded because the focus of the training was on the recognition of non-melanoma skin cancer. The excluded KSAOs were: skill in treating with nitrogen, and skill in treating with ointment.

<table>
<thead>
<tr>
<th>Task</th>
<th>KSAO</th>
</tr>
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</table>
| Examine patients for suspicious skin lesions to establish the cause of the abnormality and submit the findings in a medical record. | - Knowledge about the clinical factors of AK/BCC/SCC/Morbus Bowen.  
- Knowledge about the anamnesis factors of AK/BCC/SCC/Morbus Bowen.  
- Ability to recognize the symptoms of AK/BCC/SCC/Morbus Bowen.  
- Ability to recognize the differences between AK/BCC/SCC/Morbus Bowen.  
- Ability to recognize the differences between non-melanoma skin cancer and other skin diseases. |
| Make suggestions for the GP to refer patients to a dermatologist.    | - Knowledge about the effects of AK/BCC/SCC/Morbus Bowen.  
- Ability to decide between referring to the dermatologist or self-treatment by nurse or GP.  
- Ability to trust in own competence regarding self-treatment. |
| Actively contributes to the prevention of non-melanoma skin cancer by advising on safe tanning, and examination of the skin for suspicious skin lesions by the patient. | - Knowledge about prevention for AK/BCC/SCC/Morbus Bowen. |

The last phase of the needs assessment is the person analysis. Here it is determined which individuals need training. It was assumed that all participants needed training because they had not received training about non-melanoma skin cancer yet. It was also assumed that the skills and knowledge the participants had obtained during their education was limited. Therefore, the contents of the training was determined by two dermatologists, based on the training objectives obtained from the needs assessment.

3.2 Training program

Figure 7, given in Chapter 2, has shown that instruction style, i.e. the (combination of) training delivery method(s), affects the learning outcomes. Other factors such as practice and feedback, content relevance, and learning goals are related with the learning outcomes. Therefore, these factors were taken into account in the design of the training program.

The effectiveness of training nurse practitioners or GPs in diagnosing skin lesions has been studied earlier (Bedlow, et al., 2000; Burton, et al., 1998; Westerhoff, McCarthy, & Menzies, 2000; Oliveria, et al., 2001). These studies all showed a positive effect of the evaluated training program. However,
there was no evidence that this improvement was the maximum improvement possible. From the studies it also did not become clear which KSAOs for non-melanoma skin cancer had been included and therefore it was not possible to determine whether the appropriate training delivery methods were used. In this study, the contents and training delivery methods were taken into account to ensure that the maximum improvement in learning and transfer effect is obtained with the developed training program. In the development of the training program, three aspects were taken into account: the training objectives, constraints, and the (combination of) training delivery method(s).

**Training objectives**

The training objectives were determined in the needs assessment in the previous section. These objectives consists of the required KSAOs to be able to execute the tasks with regard to diagnose non-melanoma skin cancer (Table 3). With the training objectives, the contents of the training is determined. The contents consisted of characteristics, risk factors and treatments for the different types of non-melanoma skin cancer. Also, the prevention of non-melanoma skin cancer was included and guidelines to make a proper diagnosis.

**Constraints**

Besides the training objectives and the other factors that influence the effectiveness of training, some practical requirements were taken into account. First, the costs of the training had to be relatively low because the participating group consisted only of ten participants and later a second group of nine participants. Because it was also unclear whether the training would be used again in the future, low cost was required.

Second, participation in the training program was voluntary. Therefore it was preferred to keep the duration of the training as short as possible to ensure the minimum number of participants. Also, a relatively short training session was required because the participants were from different healthcare institutions and it was difficult to take into account everyone’s schedule.

Finally, the location of the training was already determined, namely the training facilities at MohsA clinic.

**The (combination of) training delivery method(s)**

Table 1 in Chapter 2 showed the training delivery methods found in the literature. Taking the training objectives of the needs assessment and the constraints into account a combination of the following training delivery methods was chosen: lecture and discussion, case study, and readings.

This combination of training delivery methods was chosen because the cons from one delivery method were compensated for by another training delivery method. For example, a con of lecture is that learners remain passive. However, with case studies there is room for practice and feedback, in which every trainee has to participate actively. Also, giving a lecture is a low cost training delivery method, which was one of the requirements of the training program. Readings used as reference material facilitate transfer to the job (Goldstein & Ford, 2002), which would have a positive effect on the transfer outcomes measured in this study.
One other potential training delivery method was on-the-job training. On-the-job training is low in cost and is useful when knowledge and skills need to be trained (Goldstein & Ford, 2002; Landy & Conte, 2009). However, the physician supportive personnel participated in the study were located at different healthcare institutions and on-the-job training was not possible on every location. Therefore, on-the-job training was excluded as a training delivery method. The contents of the training program was provided by two dermatologists, taking the KSAOs from Table 3 and the preferred training delivery methods into account. Table 4 shows the contents of the training program.

<table>
<thead>
<tr>
<th>Training method</th>
<th>KSAO</th>
<th>Contents</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture and discussion</td>
<td>• Knowledge about the clinical factors of AK/ BCC/ SCC/ Morbus Bowen.</td>
<td>A lecture about the clinical and anamnesis factors of AK/ BCC/ SCC/ Morbus Bowen.</td>
<td>90 minutes</td>
</tr>
<tr>
<td></td>
<td>• Knowledge about the anamnesis factors of AK/ BCC/ SCC/ Morbus Bowen.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Knowledge about the effects of AK/ BCC/ SCC/ Morbus Bowen.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Knowledge about prevention for AK/ BCC/ SCC/ Morbus Bowen.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>During the lecture, trainees can ask questions immediately.</td>
<td></td>
</tr>
<tr>
<td>Case study</td>
<td>• Ability to recognize the symptoms of AK/ BCC/ SCC/ Morbus Bowen.</td>
<td>After the lecture, four case studies are presented. These consist of a picture and description about the anamnesis of the patient and characteristics of the lesion. After showing the case, the trainees get a few minutes to make a diagnosis and treatment/referral suggestion. Hereafter one of the trainees is asked to give her diagnosis and referral decision. The dermatologist gives detailed feedback about the diagnosis and referral decision.</td>
<td>30 minutes</td>
</tr>
<tr>
<td></td>
<td>• Ability to recognize the differences between AK/ BCC/ SCC/ Morbus Bowen.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Ability to recognize the differences between non-melanoma skin cancer and other skin diseases.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Ability to decide between referring to the dermatologist or self-treatment by nurse or GP.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Ability to trust in own competence regarding self-treatment.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reference material</td>
<td></td>
<td>After the lecture, the trainees receive printouts of the lecture slides which they can use as reference material when they examine patients back on the job.</td>
<td>Own time</td>
</tr>
</tbody>
</table>

Burke & Hutchins (2007) found that practice and feedback is strongly related to learning outcomes, Therefore it was included in the training program. During the case studies each participant had the opportunity to practice and feedback was given afterwards. The basic knowledge that could not be obtained during case studies was captured in the lecture part of the training. In this study, also the effectiveness of transfer of training to the job is included as a relevant outcome. It appears that reference material reinforces the training material and facilitates the transfer to the job (Goldstein & Ford, 2002). Therefore, reference material was included to contribute to this effect. Table 5 shows
the outline of the training session. The training session was observed with the aid of a checklist to verify if all the required training methods were indeed used. The slides from the training program are given in Appendix A.

<table>
<thead>
<tr>
<th>Training contents</th>
<th>Details</th>
<th>Number of slides</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>Introduction about the utility of the training program. This section also includes the learning goals.</td>
<td>13</td>
</tr>
<tr>
<td>Melanoma skin cancer</td>
<td>A brief explanation of the characteristics, risk factors and treatments for melanoma skin cancer.</td>
<td>4</td>
</tr>
<tr>
<td>Non-melanoma skin cancer</td>
<td>The characteristics and risk factors of non-melanoma skin cancer in general.</td>
<td>4</td>
</tr>
<tr>
<td>BCC</td>
<td>Characteristics, risk factors, treatment methods, and example images of BCC.</td>
<td>12</td>
</tr>
<tr>
<td>AK</td>
<td>Characteristics, risk factors, treatment methods, and example images of AK.</td>
<td>9</td>
</tr>
<tr>
<td>Morbus Bowen</td>
<td>Characteristics, risk factors, treatment methods, and example images of Morbus Bowen.</td>
<td>3</td>
</tr>
<tr>
<td>SCC</td>
<td>Characteristics, risk factors, treatment methods, and example images of SCC.</td>
<td>11</td>
</tr>
<tr>
<td>Treatment methods</td>
<td>Further explanation of the treatment methods for non-melanoma skin cancer.</td>
<td>9</td>
</tr>
<tr>
<td>Differential diagnosis</td>
<td>Other diseases that can be confused with non-melanoma skin cancer and how they can be recognized.</td>
<td>1</td>
</tr>
<tr>
<td>Prevention</td>
<td>Methods to prevent non-melanoma skin cancer.</td>
<td>13</td>
</tr>
<tr>
<td>Diagnosis</td>
<td>Guidelines to make a proper diagnoses and decide what to advice the GP or dermatologist.</td>
<td>8</td>
</tr>
<tr>
<td>Practice cases</td>
<td>Four case studies consisting of a description about the anamnesis of the patient and characteristics of the lesion, and a picture of the lesion.</td>
<td>10</td>
</tr>
<tr>
<td>Summary</td>
<td>Overview of the characteristics and risk factors of the different types of non-melanoma skin cancer.</td>
<td>5</td>
</tr>
</tbody>
</table>

### 3.3 Conclusion

In this chapter a training program was designed. The training program consisted of a lecture, case studies and reference material. This combination of training methods ensures that all the knowledge and skills are provided in a way that appears to be most effective and meets all the requirements. There were two constraints in the design of the training program: low cost and a relatively short training session.

The contents of the training consisted of characteristics, risk factors and treatments for the different types of non-melanoma skin cancer. Also the prevention of non-melanoma skin cancer is included. The target group of the training is physician support personnel. It was assumed that they had no experience with diagnosing patients. Therefore, guidelines to make a proper diagnoses are also included in the training program. The slides of the training program are given in Appendix A.
In the design of the training program it was attempt to maximize the effect of the learning and transfer outcomes by taking the factors that influence these outcomes into account. These factors were: instructional style, practice and feedback, content relevance, and learning goals (Figure 7). The extensive use of literature and the design of the training according to the regulative cycle was done to ensure that any disappointing results in the evaluation could not be ascribed to the design of the training program. The next chapter includes the research design of how this training program is evaluated.
4. Method

This section describes how the study was conducted. The research design, the participants, the procedure, and the measures are included. In previous research the effectiveness of training programs about (non-melanoma) skin cancer for nurses and GPs has been evaluated (Bedlow, et al., 2000; Burton, et al., 1998; Oliveria, et al., 2001; Westerhoff, McCarthy, & Menzies, 2000). In addition to the learning effect evaluated in those studies, this study also takes the transfer effect to the job into account. The regulative cycle of Van Strien (1986) was used for the designing process.

4.1 Research design

In Chapter 2 different research designs were reviewed. It appeared that the pretest – posttest control group design is most preferred because it controls for all kinds of internal validity threats (Campbell & Stanley, 1971). In this study, random assignment was not possible because participants from the same healthcare institution had to be assigned to either the treatment group or the control group because otherwise, participants from the treatment group could inform participants from the control group what they had learned from training. Therefore, a quasi-experimental design was chosen. To measure the learning effect, the best applicable design for this study was a nonequivalent control group design.

To measure transfer of training effect the participants would have to diagnose patients. However, they did not diagnose patients with suspicious skin lesions yet. Therefore, it was not possible to measure the number of correct diagnoses before training. Because a pretest is not possible in measuring the transfer of training effect the design represents a nonequivalent post-test only control group design. Because a pretest was missing, the difference in scores between the experimental and the control group cannot with complete certainty be assigned to the training the experimental group received.

In Chapter 2, it was mentioned that the taxonomy of Kirkpatrick is often used to evaluate the effectiveness of training (Alliger, Tannenbaum, Bennett, Traver, & Shotland, 1997). Four criteria levels were distinguished, namely: reactions, learning, behavior, and results. In this study the first three levels were examined. The reactions criteria evaluate the usefulness and the design of the training program. The learning effect measures the knowledge and skills of the participants immediately after training. Finally, the transfer effect measures the job performance of the participants after receiving training. Table 6 shows the research design for this study. In this research design the three criteria levels are included.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Person and healthcare institution characteristics</th>
<th>Transfer of training effect</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Learning effect</td>
<td>Reactions + person characteristics</td>
</tr>
<tr>
<td></td>
<td>Pretest training</td>
<td>Training</td>
</tr>
<tr>
<td>1 (E)</td>
<td>O</td>
<td>X</td>
</tr>
<tr>
<td>2 (C)</td>
<td>O</td>
<td>-</td>
</tr>
<tr>
<td>Time</td>
<td>T1</td>
<td>T2</td>
</tr>
</tbody>
</table>

Note: O = observation (measurement), X = intervention, E = experimental, C = control
4.2 Participants

The participants in this study were recruited via two dermatologists and the author’s personal network. Participation in this study was voluntary. Nineteen physician support personnel with different backgrounds participated. These differences can influence the learning outcome. In Figure 9 through Figure 12 general information is depicted about the participants. All the participants were female.

As can be seen in Figure 9, the participants are employed in four different healthcare institutions. Three of these institutions are focused on dermatological care. At the hospital and MohsA, mainly medical dermatological care is provided. The skin clinics are run by skin therapists and provide, for instance, scar and cosmetic skin treatment. At the GP practice dermatological care is provided among several other medical conditions.

4.3 Procedure

After the participants were known, they filled in a survey about their background and other personal characteristics and completed the pretest (see T1, Table 6). After determining the scores for the pretest of the participants, they were allocated to either the experimental or the control group. To minimize the threats to internal validity due to the non-random assignment of participants, matching was used. Participants were allocated to either the treatment or the control group based on their scores for the pretest. The contents of the pretest will be discussed in the next section. The results of the allocation to the two groups is given in Table 7. As can be seen, the average pretest score of the groups is fairly equal, 50% vs. 53%. Except the age and job experience of the participants, the personal characteristics were also fairly similar in both groups. A restriction was
that participants from the same healthcare institution had to be assigned to either the treatment group or the control group. Otherwise participants from the treatment group could have informed participants from the control group what they had learned from training. So, when a participant from MohsA was allocated to the treatment group, all the participants from MohsA were placed in the treatment group. Subsequently, a participant with an equal pretest score was allocated to the control group. If, for example, this participant was from the hospital, all the participants from the hospital were allocated to the control group. Finally, the remaining participants were matched with each other based on their pretest scores as good as possible. Eventually, there were ten participants in the experimental group and nine in the control condition.

<table>
<thead>
<tr>
<th>ID</th>
<th>Healthcare institution</th>
<th>Profession</th>
<th>Age</th>
<th>Pretest score</th>
<th>Job experience (months)</th>
<th>Hrs/week</th>
<th>Self-efficacy</th>
<th>Goal orientation</th>
<th>Anxiety</th>
<th>Career planning</th>
<th>Training motivation</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>MohsA</td>
<td>Doctor assistant</td>
<td>23</td>
<td>23%</td>
<td>1</td>
<td>16</td>
<td>3.4</td>
<td>5.3</td>
<td>2.8</td>
<td>4.3</td>
<td>4.6</td>
</tr>
<tr>
<td>1</td>
<td>MohsA</td>
<td>Doctor assistant</td>
<td>25</td>
<td>46%</td>
<td>24</td>
<td>29</td>
<td>3.6</td>
<td>5.4</td>
<td>3.2</td>
<td>3.8</td>
<td>4.6</td>
</tr>
<tr>
<td>3</td>
<td>MohsA</td>
<td>Nurse</td>
<td>23</td>
<td>65%</td>
<td>12</td>
<td>29</td>
<td>2.9</td>
<td>5.2</td>
<td>3.5</td>
<td>2.8</td>
<td>4.6</td>
</tr>
<tr>
<td>10</td>
<td>MohsA</td>
<td>Nurse</td>
<td>40</td>
<td>65%</td>
<td>120</td>
<td>24</td>
<td>3.2</td>
<td>4.6</td>
<td>2.2</td>
<td>2.2</td>
<td>4.8</td>
</tr>
<tr>
<td>2</td>
<td>MohsA</td>
<td>Skin therapist</td>
<td>23</td>
<td>62%</td>
<td>12</td>
<td>22</td>
<td>2.2</td>
<td>5.0</td>
<td>3.7</td>
<td>2.7</td>
<td>3.9</td>
</tr>
<tr>
<td>4</td>
<td>Skin clinic 1</td>
<td>Skin therapist</td>
<td>32</td>
<td>50%</td>
<td>96</td>
<td>40</td>
<td>3.2</td>
<td>2.5</td>
<td>4.0</td>
<td>3.9</td>
<td>3.9</td>
</tr>
<tr>
<td>9</td>
<td>Skin clinic 1</td>
<td>Skin therapist</td>
<td>28</td>
<td>54%</td>
<td>52</td>
<td>35</td>
<td>2.8</td>
<td>4.0</td>
<td>3.7</td>
<td>2.7</td>
<td>4.7</td>
</tr>
<tr>
<td>6</td>
<td>GP practice 1</td>
<td>Doctor assistant</td>
<td>51</td>
<td>58%</td>
<td>360</td>
<td>28</td>
<td>3.2</td>
<td>5.0</td>
<td>2.0</td>
<td>4.8</td>
<td>5.0</td>
</tr>
<tr>
<td>5</td>
<td>Skin clinic 1</td>
<td>Skin therapist</td>
<td>31</td>
<td>50%</td>
<td>84</td>
<td>40</td>
<td>3.0</td>
<td>4.8</td>
<td>2.8</td>
<td>3.8</td>
<td>4.4</td>
</tr>
<tr>
<td>7</td>
<td>GP practice 1</td>
<td>Doctor assistant</td>
<td>45</td>
<td>27%</td>
<td>300</td>
<td>22</td>
<td>3.4</td>
<td>5.2</td>
<td>1.7</td>
<td>3.5</td>
<td>4.7</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td></td>
<td>32</td>
<td>50%</td>
<td>105</td>
<td>29</td>
<td>3.1</td>
<td>4.9</td>
<td>2.8</td>
<td>3.5</td>
<td>4.5</td>
</tr>
<tr>
<td></td>
<td>Stdev.</td>
<td></td>
<td>10</td>
<td>15%</td>
<td>126</td>
<td>8</td>
<td>0.4</td>
<td>0.4</td>
<td>0.7</td>
<td>0.9</td>
<td>0.4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ID</th>
<th>Healthcare institution</th>
<th>Profession</th>
<th>Age</th>
<th>Pretest score</th>
<th>Job experience (months)</th>
<th>Hrs/week</th>
<th>Self-efficacy</th>
<th>Goal orientation</th>
<th>Anxiety</th>
<th>Career planning</th>
<th>Training motivation</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>Skin clinic 2</td>
<td>Skin therapist</td>
<td>24</td>
<td>27%</td>
<td>60</td>
<td>40</td>
<td>3.4</td>
<td>5.4</td>
<td>3.0</td>
<td>2.8</td>
<td>4.1</td>
</tr>
<tr>
<td>19</td>
<td>Hospital</td>
<td>Doctor assistant</td>
<td>56</td>
<td>42%</td>
<td>276</td>
<td>24</td>
<td>3.8</td>
<td>5.0</td>
<td>2.8</td>
<td>4.2</td>
<td>4.7</td>
</tr>
<tr>
<td>18</td>
<td>Hospital</td>
<td>Nurse</td>
<td>48</td>
<td>73%</td>
<td>276</td>
<td>24</td>
<td>2.9</td>
<td>5.0</td>
<td>2.3</td>
<td>3.2</td>
<td>4.6</td>
</tr>
<tr>
<td>17</td>
<td>Hospital</td>
<td>Nurse</td>
<td>50</td>
<td>69%</td>
<td>336</td>
<td>24</td>
<td>3.1</td>
<td>3.2</td>
<td>4.3</td>
<td>2.7</td>
<td>4.1</td>
</tr>
<tr>
<td>16</td>
<td>Hospital</td>
<td>Doctor assistant</td>
<td>39</td>
<td>65%</td>
<td>204</td>
<td>16</td>
<td>2.9</td>
<td>3.8</td>
<td>3.2</td>
<td>3.2</td>
<td>3.7</td>
</tr>
<tr>
<td>14</td>
<td>Hospital</td>
<td>Doctor assistant</td>
<td>41</td>
<td>50%</td>
<td>240</td>
<td>20</td>
<td>2.8</td>
<td>3.8</td>
<td>2.0</td>
<td>5.0</td>
<td>4.1</td>
</tr>
<tr>
<td>15</td>
<td>Hospital</td>
<td>Doctor assistant</td>
<td>47</td>
<td>54%</td>
<td>192</td>
<td>12</td>
<td>2.7</td>
<td>3.6</td>
<td>2.8</td>
<td>3.0</td>
<td>3.0</td>
</tr>
<tr>
<td>13</td>
<td>GP practice 2</td>
<td>Doctor assistant</td>
<td>45</td>
<td>50%</td>
<td>252</td>
<td>31</td>
<td>3.0</td>
<td>4.6</td>
<td>2.3</td>
<td>3.0</td>
<td>3.6</td>
</tr>
<tr>
<td>11</td>
<td>GP practice 2</td>
<td>Doctor assistant</td>
<td>53</td>
<td>46%</td>
<td>36</td>
<td>25</td>
<td>3.1</td>
<td>5.6</td>
<td>2.7</td>
<td>4.8</td>
<td>4.6</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td></td>
<td>45</td>
<td>53%</td>
<td>208</td>
<td>24</td>
<td>3.1</td>
<td>4.4</td>
<td>2.8</td>
<td>3.5</td>
<td>4.1</td>
</tr>
<tr>
<td></td>
<td>Stdev.</td>
<td></td>
<td>10</td>
<td>14%</td>
<td>100</td>
<td>8</td>
<td>0.3</td>
<td>0.9</td>
<td>0.7</td>
<td>0.9</td>
<td>0.6</td>
</tr>
</tbody>
</table>

At time T2 (see Table 6) the experimental group received training from a dermatologist at the MohsA clinic. The experimental group consisted of participants from three different healthcare institutions. Great effort was made in planning the training session, so that all the participants received training at the same time and from one dermatologists. Unfortunately, it was not possible to get all the participants available at the same time. Three participants received training at another
moment in time and from a different dermatologist. The researcher was present to ensure that both training sessions were equal and that the same subjects were covered.

After training was given (T3), both the experimental and control group completed the posttest. The participants who received training also filled in a survey in which they expressed their opinions on the training and the perceived utility.

After the posttest was completed, the participants had to diagnose patients with suspicious skin lesions and decide whether to treat, take a biopsy, or refer after diagnosis (see T4, Table 6). There were three different procedures for gathering data for the transfer effect (Table 8). The procedure differed when there was a dermatologist or GP present, or no physician.

<table>
<thead>
<tr>
<th>Situation</th>
<th>Questionnaire</th>
<th>Picture</th>
<th>Diagnosis participant</th>
<th>Diagnosis GP</th>
<th>Diagnosis dermatologist</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dermatologist present</td>
<td>0</td>
<td>→</td>
<td>0</td>
<td>→</td>
<td>0</td>
</tr>
<tr>
<td>(hospital / MohsA)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GP present (GP practice)</td>
<td>0</td>
<td>→</td>
<td>0</td>
<td>→</td>
<td>0</td>
</tr>
<tr>
<td>Participant only (skin clinic)</td>
<td>0</td>
<td>→</td>
<td>0</td>
<td>→</td>
<td>0</td>
</tr>
</tbody>
</table>

The patients who arrived at the center or practice were questioned with a previously developed questionnaire (Jansen, 2010) to gather information about the skin lesion. This questionnaire included questions about the anamnestic characteristics of the patient (19 questions) and the clinical factors of the lesion (19 questions). This questionnaire was filled in by the participant. Also, if no dermatologist was present, a picture was taken of the suspicious lesion. After the participant had given her presumed diagnosis, the dermatologist and/or GP made a diagnosis. These diagnoses were listed on a form. The patients signed an information and consent form to authorize use of the gathered data. Final diagnoses were made by a dermatologist using the picture and the questionnaire about the patient’s skin lesion or results of biopsy.

At time T5 (see Table 6), the experimental group filled in a questionnaire about the opportunity to perform the obtained knowledge and skills in practice and the amount of feedback and consultation with superiors and colleagues.
4.4 Measures

In this study three aspects were measured: the learning effect, the transfer effect, individual and work environment characteristics (control variables), and training design characteristics. The measured variables are given in Figure 13. Table 9 shows when the variables were collected.

![Figure 13: Visualization measured variables](image)

<table>
<thead>
<tr>
<th>Table 9: Data collection overview</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Who</strong></td>
</tr>
<tr>
<td><strong>When</strong></td>
</tr>
<tr>
<td><strong>Which variables</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
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<td></td>
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<td></td>
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<td></td>
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<tr>
<td></td>
</tr>
</tbody>
</table>
Learning effect

The learning effect of the training was measured by a pre- and a posttest. These tests were developed by Rompen (2013) to assess the knowledge and skills of GPs about non-melanoma skin cancer. Although the tests were developed to assess the knowledge of GPs, they were used for physician support personnel in this study. The tests both included four cases and 18 multiple choice questions. The cases were pictures of suspicious lesions, similar to those used during the case study part of the training session. Each participant was allowed to ask two questions about the lesion. After receiving answers on their questions, the participants had to make a presumed diagnosis, choosing among four options (AK, BCC, SCC, differential diagnosis). The differential diagnosis varied per case. The limitation of two questions was set to minimize the time to take the tests (Rompen, 2013). Also, they had to indicate their confidence in the diagnosis on a scale of 1 through 5, from completely sure to a complete guess. The multiple choice questions were based on a book about non-melanoma skin cancer, written by dermatologists (Krekels & Van der Geer-Rutten, 2010). The subjects included were epidemiology (i.e., the occurrence and spread of non-melanoma skin cancer among the population), pathophysiology (i.e., knowledge and the study of diseased skin), clinical presentation, treatments, and prevention. Appendix B includes examples of questions from the pre- and posttest.

In the development of the pre- and posttest, firstly one test was developed with 8 cases and 38 multiple choice questions (Rompen, 2013). A pilot test among ten participants revealed that dermatologists, GPs, nurses, and laymen answered respectively 81%, 57%, 65% and 29% of the questions correctly (Rompen, 2013). After the pilot, the questions were divided into two tests, the pre- and the posttest. Two questions appeared to be unreliable and were removed. The correlations between the pre- and posttest for the cases and the multiple choice questions were .61 and .79, respectively. So, the split-half reliability was high.

Each participant took the test individually in the presence of the researcher. This was also necessary for the cases in the test, because these were interactive with the researcher providing answers to the two questions the participants were allowed to ask. After the tests, the participants did not receive feedback about their scores and the answers of the tests, because feedback appeared to have a positive relationship with learning outcomes (Burke & Hutchins, 2007).

Transfer effect

The transfer effect was measured with diagnoses and treatment/referral decisions of the participants. This effect was only measured after training. Since none of the participants had experience with diagnosing non-melanoma skin cancer it was assumed that their scores were similar at the start of the study. Also, the experimental and control group were equivalent. They were matched based on their scores for the pretest.

The sensitivity and specificity of the participant’s diagnoses was measured. It was assumed that the diagnoses of the dermatologist or results from biopsy were the gold standard. As can be concluded from Table 10, the false positives cause in part the increase in the number of patients at the dermatology department. These are the patients who are diagnosed positive for non-melanoma skin cancer by the participant and therefore treated or referred to the hospital, while in reality the
disease is absent. Another reason why a correct diagnosis and referral is important is the health of the patient. When the participant makes a negative diagnosis, so there is no non-melanoma skin cancer present, the patient is not treated or referred to the hospital, although it was necessary.

**Table 10: Overview measurement transfer of training effect**

<table>
<thead>
<tr>
<th>Diagnoses dermatologist</th>
<th>Present</th>
<th>Absent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Present</td>
<td>% true positives</td>
<td>% false positives</td>
</tr>
<tr>
<td>Negative</td>
<td>% false negatives</td>
<td>% true negatives</td>
</tr>
</tbody>
</table>

Sensitivity = 

\[
\frac{\text{true positives}}{\text{condition positive}}
\]

Specificity = 

\[
\frac{\text{true negatives}}{\text{condition negative}}
\]

Previous research has shown that GPs not always make correct diagnosis and referral decisions (Goedhart, Pilon, & Tubergen, 2009). Therefore, after the diagnosis of the participant (if from GP practice), the diagnosis and referral decisions of the GPs were also analyzed.

**Influencing characteristics**

Figure 7 in Chapter 2 showed that individual characteristics, the design of the training, and the work environment can influence the learning and transfer outcomes. The variables, which appeared to have a strong relationship with the outcome or are interesting for this study, are included (see Figure 13). These variables can be seen as control variables. The following individual characteristics were included: self-efficacy, goal orientation, performance self-efficacy, anxiety/negative affectivity, job experience, career planning, perceived utility, age, healthcare institution, training motivation, and motivation to transfer.

The healthcare institutions, where the participants are employed are more or less familiar with skin diseases and non-melanoma skin cancer. The knowledge participants could have absorbed in the past by seeing a patients with skin diseases could also influence the results of the pre- and posttest scores. It is more likely that the participants from MohsA and the dermatology department of the hospital have seen more patients with non-melanoma skin cancer than the participants of the skin clinics and GP practices. This distinction was included as a control variable. The following work environment variables were measured: peer support, opportunity to perform, and personal capacity for transfer.

The design of the training program was a considerable part of this study. Therefore, the opinion of the trainees about training is important because it can be taken into account in possible training programs in the future. The variables included were: transfer design, and training feedback.

Table 11 shows the control variables included in this study, with the source, an example item, and the reliability of the scale.

---

1 Following an interview with a dermatologist it is possible that the participant made the wrong diagnosis, but the right follow-up step. Also, there are more correct treatment and referral steps possible. This could influence the results of the transfer effect,
<table>
<thead>
<tr>
<th>Variable</th>
<th>Scale</th>
<th>Source</th>
<th>Number of items</th>
<th>Example</th>
<th>Reliability (α)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Individual characteristics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-efficacy</td>
<td>1 – 4</td>
<td>Teeuw, Schwarzer, &amp; Jerusalem (1994)</td>
<td>10</td>
<td>I can manage to solve difficult problems if I try hard enough.</td>
<td>.738</td>
</tr>
<tr>
<td>Learning goal orientation</td>
<td>1 – 6</td>
<td>VandeWalle, (1997)</td>
<td>5</td>
<td>I am prepared to choose an challenging work assignment from which I can learn a lot.</td>
<td>.682</td>
</tr>
<tr>
<td>Performance self-efficacy</td>
<td>1 – 5</td>
<td>Gist (1987)</td>
<td>4</td>
<td>I am confident in my competence to use new knowledge and skills in my work.</td>
<td>.479</td>
</tr>
<tr>
<td>Anxiety/negative affectivity</td>
<td>1 – 5</td>
<td>Nijman (2004)</td>
<td>6</td>
<td>I am afraid I do the wrong thing at my job.</td>
<td>.546</td>
</tr>
<tr>
<td>Job experience</td>
<td>In months</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Career planning</td>
<td>1 – 5</td>
<td>Gould (1979)</td>
<td>6</td>
<td>I have a plan for my career.</td>
<td>.847</td>
</tr>
<tr>
<td>Perceived utility</td>
<td>1 – 5</td>
<td>Eerde, Tang, &amp; Talbot (2008)</td>
<td>6</td>
<td>I am capable to apply the learned knowledge and skill during the training, in practice.</td>
<td>.852</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Healthcare institution</td>
<td>Categorical</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Training motivation</td>
<td>1 – 5</td>
<td>Weinstein et al. (1994)</td>
<td>14</td>
<td>I enjoy training programs that help me to develop knowledge and skills that will be useful to me in my work.</td>
<td>.796</td>
</tr>
<tr>
<td>Motivation to transfer</td>
<td>1 – 5</td>
<td>Huczynski &amp; Lewis (1980)</td>
<td>4</td>
<td>This training program will lead to higher personal productivity.</td>
<td>.823</td>
</tr>
<tr>
<td><strong>Work environment characteristics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peer support</td>
<td>1 – 5</td>
<td>Holton III, Bates, &amp; Ruona (2000)</td>
<td>4</td>
<td>My colleagues appreciate my using new skills I have learning in training.</td>
<td>.882</td>
</tr>
<tr>
<td>Opportunity to perform</td>
<td>1 – 5</td>
<td>Holton III, Bates, &amp; Ruona (2000)</td>
<td>4</td>
<td>The resources I need to use the learned knowledge and skills will be available after training.</td>
<td>.896</td>
</tr>
<tr>
<td>Personal capacity for transfer</td>
<td>1 – 5</td>
<td>Ford, Quinones, Sego, &amp; Sorra (1992)</td>
<td>4</td>
<td>I have time in my schedule to change the way I do things to fit my learning.</td>
<td>.873</td>
</tr>
<tr>
<td><strong>Training design characteristics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transfer design</td>
<td>1 – 5</td>
<td>Holton III, Bates, &amp; Ruona (2000)</td>
<td>4</td>
<td>It is clear that those who provide the training, understand how I’m going to use the learned knowledge and skills.</td>
<td>.727</td>
</tr>
<tr>
<td>Training feedback</td>
<td>1 – 5</td>
<td>Holton III, Bates, &amp; Ruona (2000)</td>
<td>4</td>
<td>During the training session, I regularly had conversations with people about how to improve my knowledge and skills.</td>
<td>.896</td>
</tr>
</tbody>
</table>
Burke and Hutchins (2007) showed that feedback has a positive influence on learning and transfer outcomes. To control for this influence, dermatologists and GPs were told not to give feedback to their physician support personnel. As can be seen from Table 12, hardly any feedback was given by the physicians (average score of 1.60). The feedback from colleagues was higher, average score of 2.60, which implies that the participants sometimes consulted each other. However, the score is still relatively low and influence on the learning and transfer effect is not expected.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Scale</th>
<th>Mean</th>
<th>Std. dev.</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feedback from colleagues</td>
<td>1–5</td>
<td>2.60</td>
<td>1.27</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Feedback diagnosis from physician</td>
<td>1–5</td>
<td>1.60</td>
<td>.97</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Feedback details from physician</td>
<td>1–5</td>
<td>1.60</td>
<td>.97</td>
<td>1</td>
<td>4</td>
</tr>
</tbody>
</table>

The data for the measures, described in this chapter, were gathered. The results will be explained in the next chapter.
5. Results

This chapter includes the results of the evaluation of the training program. The learning effect, transfer effect and external influences are described. Appendix C shows the correlations between the variables included in this study. The learning performance of the participants who received training improved significantly, but there was lack of evidence for a significant transfer effect.

5.1 Learning effect

One of the objectives of this study was to examine whether the knowledge about clinical characteristics, risk factors, treatments, and prevention of non-melanoma skin cancer of physician support personnel improved after receiving training about these subjects. Therefore, both the experimental and the control group completed a pre- and posttest developed by Rompen (2013). Both tests included four cases with pictures and 18 multiple choice questions. The score of the cases carried double weight in the total score because the provision of a correct diagnosis has a higher value (Rompen, 2013). In this section the learning effect of the training about non-melanoma skin cancer among the participants is measured. Also, the reliability of the pre- and posttest is examined because if it turns out to be unreliable, conclusions about the learning effect are also less reliable. To be able to attribute the learning effect completely to training, also the effects of participant characteristics are taken into account.

Reliability of pre- and posttest

The pre- and posttest are reliable when they are equally difficult and measure the same knowledge and skills. The reliability of a test means that a person should get the same score on a test if they complete it at two different points in time (Field, 2005). The level of reliability is measured with Cronbach’s alpha, \( \alpha \). This is the average of correlation coefficients of splitting data in every possible way (Field, 2005). An \( \alpha \) above 0.7 represents reliable measurements. Based on a pilot test that Rompen (2013) executed, the split-half reliability of the test was 0.610 for the cases and 0.788 for the multiple choice questions. In this study the overall \( \alpha \) was 0.752. So, the overall test was reliable. The split-half reliability was 0.771, which indicates that both tests are equal.

The pre- and posttest consisted of two parts: cases and MC questions. The reliability of both parts was analyzed. The \( \alpha \) for the cases and the MC questions were 0.156 and 0.741, respectively. The cases are unreliable, because the \( \alpha \) is below the cut-off value of 0.7. This implies that a participant who scored high at the pre-test not necessarily had a high score for the posttest and is therefore not a reliable measure for the learning effect. The MC questions, on the other hand, were reliable.

Besides the overall reliability of the test, it was checked whether the scores for the individual questions correlated with the overall score of the participant for the pre- and posttest. The reliability of individual questions was measured with the item total correlation. The test is reliable when all items correlate with the total (Field, 2005). The usual cut-off value is 0.3. However, for small sample sizes a smaller correlation is allowed (Field, 2005). The item-total correlations were calculated for both tests. The \( \alpha \) for the pretest was 0.614 and for the posttest 0.577. Several questions were below the cut-off value of 0.3. However, the sample was relatively small (N = 19), so the value can be lower. The following questions were nominated to be deleted for the pre- and posttest respectively:

35
C3, C4, M3, M8, M10, M12 for the pretest, and C1, C4, M1, M2, M7, M10 for the posttest because they had a negative correlation with the total score of the participants. In the following section is determined whether deleting these questions influences the learning effect.

To summarize, the pre- and posttest in general are reliable. This this is mainly caused by the MC questions because the cases appeared to be unreliable. Also, some of the questions may need to be removed to increase the reliability of the pre- and posttest. Overall, the pre- and posttest are reliable to measure the learning effect.

Participant characteristics no influence on learning effect

Figure 7 in Chapter 2 showed that personal characteristics could have an influence characteristics on learning outcomes. Some of these characteristics were taken into account to examine if they influenced the learning performance of the participants.

Table 13 shows the measured characteristics of the 19 participants. In addition, the time between the pre- and posttest was included as a control variable.

The age and job experience of the participants varied strongly among the participants. As was shown in Chapter 4, the participants in the control group were older and had much more experience than the participants who received training.

The scores of the participants are above average on all scale variables. High scores on self-efficacy, goal orientation, career planning, and training motivation a larger learning effect is expected. If participants scored high on anxiety, the learning effect is expected to be lower. Especially the training motivation of the participants was high, mean = 4.24. This can be explained by the fact that participants took part voluntarily.

<table>
<thead>
<tr>
<th>Scale</th>
<th>Mean</th>
<th>Std. dev.</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>-</td>
<td>38.05</td>
<td>11.47</td>
<td>23</td>
</tr>
<tr>
<td>Job experience (months)</td>
<td>-</td>
<td>124.36</td>
<td>123.67</td>
<td>1</td>
</tr>
<tr>
<td>Time between pre – post (days)</td>
<td>-</td>
<td>55.63</td>
<td>31.81</td>
<td>21</td>
</tr>
<tr>
<td>Self-efficacy</td>
<td>1–4</td>
<td>3.06</td>
<td>.35</td>
<td>2.22</td>
</tr>
<tr>
<td>Goal orientation</td>
<td>1–6</td>
<td>4.68</td>
<td>.68</td>
<td>3.20</td>
</tr>
<tr>
<td>Anxiety</td>
<td>1–5</td>
<td>3.14</td>
<td>.62</td>
<td>2.00</td>
</tr>
<tr>
<td>Career planning</td>
<td>1–5</td>
<td>2.99</td>
<td>.22</td>
<td>2.67</td>
</tr>
<tr>
<td>Training motivation</td>
<td>1–5</td>
<td>4.24</td>
<td>.55</td>
<td>3.00</td>
</tr>
</tbody>
</table>

The influence of the personal characteristics on the learning outcomes was analyzed with the aid of a multiple regression with the posttest score as dependent variable and the pretest score included as an independent variable. Table 14 reveals that the included personal characteristics did have not a significant effect on the learning effect ($p = .36$). The number of participants is low, $N = 19$. This is

2 The multiple regression was conducted for the pre- and posttest scores where no questions were deleted. The personal characteristics showed no effect on the learning outcomes when the unreliable questions were deleted ($R^2 = .69$, Adjusted $R^2 = .19$, $p = .34$).
only a small, homogenous sample (low standard deviation on most characteristics), what could be the reason for the characteristics being not significant.

Table 14: Coefficients and standard errors of multiple regression on the posttest score.

<table>
<thead>
<tr>
<th>Model</th>
<th>Unstandardized Coefficients</th>
<th>Standardized coefficients</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>Std. Error</td>
</tr>
<tr>
<td>(Constant)</td>
<td>.431</td>
<td>.680</td>
</tr>
<tr>
<td>Score pretest</td>
<td>.543</td>
<td>.461</td>
</tr>
<tr>
<td>Time between pre – post</td>
<td>.002</td>
<td>.001</td>
</tr>
<tr>
<td>Age</td>
<td>-.002</td>
<td>.006</td>
</tr>
<tr>
<td>Job experience</td>
<td>.000</td>
<td>.001</td>
</tr>
<tr>
<td>Healthcare institution</td>
<td>.039</td>
<td>.116</td>
</tr>
<tr>
<td>Profession</td>
<td>-.019</td>
<td>.088</td>
</tr>
<tr>
<td>Level of self-efficacy</td>
<td>.066</td>
<td>.177</td>
</tr>
<tr>
<td>Level of goal orientation</td>
<td>-.100</td>
<td>.096</td>
</tr>
<tr>
<td>Level of anxiety</td>
<td>.018</td>
<td>.072</td>
</tr>
<tr>
<td>Level of career planning</td>
<td>-.013</td>
<td>.217</td>
</tr>
<tr>
<td>Level of motivation for training</td>
<td>-.002</td>
<td>.096</td>
</tr>
</tbody>
</table>

Note R² = .68; Adjusted R² = .17 No significant coefficients. Reference categories are: 'MohsA' for Healthcare institution, and 'physician assistant' for Profession.

Significant learning effect with large effect size

The previous section has shown that the pre- and posttest were reliable and that individual characteristics did not have a significant effect on the learning outcomes. So, the learning effect can be ascribed to the training program. In this section the effects of the training and the scores on the pre- and posttest are included. The learning outcomes were measured with the differences between the scores on the pre- and posttest.

To examine whether there is a significant difference in scores between the experimental group and control group, an Analysis of Covariance (ANCOVA) was conducted. According to Wexley and Latham (1991) ANCOVA has more power than an factorial Analysis of Variance (ANOVA) or a Paired Sample t-test.

First, the relationship between a participants’ score for the pretest and the score for the posttest was examined. It is likely that a participant who scores high on the pretest also has a high score for the posttest. To determine the effect size for an ANCOVA usually the eta squared is used. However, this measure of effect size is slightly biased. Another measure to use is omega squared (Field, 2005). A requirement for the use of this measure is an equal number of participants in each group, which is not the case. Therefore, the effect sizes were calculated with the following formula:

\[ r_{\text{Covariate}} = \frac{t^2}{t^2 + df} = \sqrt{\frac{4.334^2}{4.334^2 + 17}} = .72 \]

The test revealed that the score of the pretest was significantly related to the score of the posttest, \( F(1,16) = 18.78, p < .05, r = .72 \). Thus, the scores on the pre- and posttest are correlated.

---

3 Effect scores pretest on scores posttest when questions deleted: \( F(1,16) = 23.54, p < .05, r = .76 \).
To measure the learning effect, the relationship between whether the participant received or did not receive training and their scores on the posttest was examined. Because there was a significant relationship between the pretest score and the posttest score, this effect had to be controlled for. The learning effect was calculated with the following formula:

\[ r_{\text{Experimental vs. Control}} = \sqrt{\frac{3.460^2}{3.460^2 + 17}} = .64 \]

The effect of whether the participants received training or not was significant, after controlling for the effect of the pretest score, \( F(1,16) = 11.97, p < .05, r = .64 \). This is equal to an effect size of \( d = 1.68 \), which is a large effect size (Cohen, 1988). These results are only reliable when the assumptions for ANCOVA are met. These assumptions are: normally distributed data, homogeneity of variance, independent observations, dependent variable measured on at least an interval scale, and homogeneity of regression slopes. All these assumptions for ANCOVA were checked and met.

The difference between the pre- and posttest scores was significantly larger with the participants who received training than in the control group. Table 15 includes the total pre- and posttest scores from both the experimental and control group and also the scores for the different parts of the test. On average, the participants scored fairly well at the pretest with an average of 51% correct answers; 50% in the experimental condition, and 53% in the control condition. This confirms that the experimental and control group were equivalent. After the experimental group received training, both groups completed the posttest. The total score from both groups together remained equal, namely 51%. However, the experimental group improved its score with 7% to 57% and the scores of the control group deteriorated with 9% to 44%. These results suggest that, although the split-half reliability of the pre- and posttest was reliable, the posttest was more difficult than the pretest.

Table 15: Pre- and posttest scores of the experimental and control group.

<table>
<thead>
<tr>
<th>Group</th>
<th>% Correct cases</th>
<th>Confidence cases</th>
<th>% Correct MC</th>
<th>Total score (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre</td>
<td>Post</td>
<td>Pre</td>
<td>Post</td>
</tr>
<tr>
<td>Experimental (N =10)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>48%</td>
<td>33%</td>
<td>2.95</td>
<td>3.33</td>
</tr>
<tr>
<td>Std. dev.</td>
<td>22%</td>
<td>26%</td>
<td>1.07</td>
<td>1.11</td>
</tr>
<tr>
<td>Min</td>
<td>0%</td>
<td>0%</td>
<td>1.25</td>
<td>1.50</td>
</tr>
<tr>
<td>Max</td>
<td>75%</td>
<td>75%</td>
<td>4.50</td>
<td>4.75</td>
</tr>
<tr>
<td>Control (N = 9)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>44%</td>
<td>25%</td>
<td>3.61</td>
<td>3.56</td>
</tr>
<tr>
<td>Std. dev.</td>
<td>17%</td>
<td>25%</td>
<td>.50</td>
<td>.50</td>
</tr>
<tr>
<td>Min</td>
<td>25%</td>
<td>0%</td>
<td>2.50</td>
<td>2.50</td>
</tr>
<tr>
<td>Max</td>
<td>75%</td>
<td>75%</td>
<td>4.25</td>
<td>4.25</td>
</tr>
<tr>
<td>Total (N = 19)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>46%</td>
<td>29%</td>
<td>3.26</td>
<td>3.43</td>
</tr>
<tr>
<td>Std. dev.</td>
<td>19%</td>
<td>25%</td>
<td>.90</td>
<td>.86</td>
</tr>
<tr>
<td>Min</td>
<td>0%</td>
<td>0%</td>
<td>1.25</td>
<td>1.50</td>
</tr>
<tr>
<td>Max</td>
<td>75%</td>
<td>75%</td>
<td>4.50</td>
<td>4.75</td>
</tr>
</tbody>
</table>

Note: Confidence cases: 1 = complete guess, ..., 5 = completely sure.

\footnote{Effect training on learning outcomes when questions deleted: \( F(1,16) = 11.91, p < .05, r = .64 \).}
The scores of both groups for the pre- and posttest are given in Figure 14. The difference between the experimental condition and the control condition is 16%. Rompen (2013) found that the scores for the pre- and posttest from laymen, GPs, and dermatologists were between 20-30%, 50-60%, and 80-90%, respectively. So, the level of knowledge and skills of the participants from both groups was between the laymen and the GPs before the training. After the experimental group received training, their scores improved to the level of the GPs. As was already mentioned earlier, this difference was significant and shows that the training program was effective with respect to learning outcomes. Figure 15 shows the differences in scores on the post- and pretest per participant. In the control group only one participant had a higher score for the posttest.

The pre- and posttest included both cases and multiple choice questions. To test whether this effect was caused by the specific type of questions, two ANCOVAs were conducted for these parts. Results showed that the differences in scores between the experimental group and control group were caused by an increase in the number of correct multiple choice questions, $F(1,16) = 6.465, p < .05, r = .525$. There was no significant difference between the two groups with regard to the number of correct cases ($p > .05$). These results are in line with the reliability of the tests, because the cases appeared to be not reliable. Table 15 also showed that both groups had fewer cases correct in the posttest than in pretest.

For the cases, the participants had to fill in how confident they were about their diagnosis. This was asked because it is possible that the correct answer was chosen by coincidence. Also, the self-confidence of the participant is of interest. Making a diagnosis comes with responsibility. After receiving training, the participant needs to be self-confident enough to have the courage to actually make the diagnosis with its associated consequences. Before training, the participants from the control condition were more confident about making diagnoses than the participants of the experimental group (Table 15). After receiving training, the confidence level of the experimental group improved (mean = 3.33 – 2.95 = .38) and of the control group slightly decreased (mean = 3.56 – 3.61 = .05). However, an ANCOVA test revealed that these effects were not significant ($p > .05$).

---

5 Results when questions deleted: $F(1,16) = 12.14, p < .05, r = .65$.
6 Results when questions deleted: $p > .05$. 

---
Although the ANCOVA results showed a significant difference in scores between the group that received training and the group that did not, this was only based on a small sample size. To be entirely sure about the difference, a non-parametric test was conducted (Wilcoxon Signed Ranks Test). Non-parametric tests rank the data and are based on fewer assumptions than other statistical tests, e.g. normal distribution of data (Field, 2005). The results of the Wilcoxon Signed Ranks Test showed that, for the experimental group, test scores were significantly higher on the posttest than on the pretest, $T = 3.33$, $p < .05$, $r = -.42^7$. For the control group the opposite was true: test scores were significantly lower on the posttest than on the pretest, $T = 5$, $p < .05$, $r = -.49^8$. So, these results are in line with the results of the ANCOVA tests.

**Significant improvements in Pathophysiology and Clinical presentation**

Results showed that the significant difference in learning effect between experimental and control group was caused by the multiple choice questions from the pre- and posttest. These questions tested participant’s knowledge on the epidemiology, pathophysiology, clinical presentation, treatments, and prevention of non-melanoma skin cancer.

ANCOVAs were conducted to determine the significant differences in scores between the group that received training and the control group per knowledge dimension. The unreliable questions were deleted for these tests. As can be seen from Table 16, the knowledge dimension ‘pathophysiology’ and ‘clinical presentation’ caused the differences in scores between the participants who received training and the control group, $p = .013$ and $p = .001$, respectively. During the training session a lot of attention was paid to the characteristics and there were a lot of visual examples. This could explain the large effect.

<table>
<thead>
<tr>
<th>Knowledge dimension</th>
<th>F</th>
<th>t</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Epidemiology</td>
<td>2.687</td>
<td>1.639</td>
<td>.121</td>
</tr>
<tr>
<td>Pathophysiology</td>
<td>7.902</td>
<td>2.811</td>
<td>.013</td>
</tr>
<tr>
<td>Clinical presentation</td>
<td>17.640</td>
<td>4.200</td>
<td>.001</td>
</tr>
<tr>
<td>Treatments</td>
<td>.927</td>
<td>.963</td>
<td>.350</td>
</tr>
<tr>
<td>Prevention</td>
<td>1.318</td>
<td>1.148</td>
<td>.268</td>
</tr>
</tbody>
</table>

The experimental group did not score significantly better than the control group for the epidemiology, treatments and prevention dimension, $p = .121$, .350, and .268 respectively. In this analysis for physician support personnel the recognition of the different types of non-melanoma skin cancer is the most important. They are not allowed to make diagnoses, so a possible treatment is determined by the GP or the dermatologist. For this reason, the training program focused on the recognition of the characteristics and risk factors. The percentage of time spent on the different knowledge dimensions in the training session as follows: epidemiology (15%), pathophysiology (30%), clinical presentation (30%), treatments (10%), prevention (15%). The contents of the training was described in more detail in Chapter 4. As can be seen 60 percent of the time was spent on the

---

7 Results when questions deleted: $T = 4.00$, $p > .05$, $r = -.28$.
8 Results when questions deleted: $T = 2.00$, $p < .05$, $r = -.48$. 

40
pathophysiology and clinical presentation of non-melanoma skin cancer which is consistent with the results of the learning effect per knowledge dimension.

Table 17 shows the average pre- and posttest scores per knowledge dimension for both groups. The knowledge of the participants who received training with regard to pathophysiology and clinical presentation was improved from 40-50% correct to 70-80% correct, which is a higher score than the GPs in the pilot test of Rompen (2013). The scores from the control group for these significant knowledge dimensions remained 50-60% and 30-40% for pathophysiology and clinical presentation respectively.

<table>
<thead>
<tr>
<th>Knowledge dimension</th>
<th># MCs</th>
<th>Experimental (N = 10)</th>
<th>Control (N = 9)</th>
<th>Total (N = 19)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Std. dev.</td>
<td>Mean</td>
<td>Std. dev.</td>
</tr>
<tr>
<td>Pretest</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Epidemiology</td>
<td>4</td>
<td>.30</td>
<td>.26</td>
<td>.42</td>
</tr>
<tr>
<td>Pathophysiology</td>
<td>4</td>
<td>.47</td>
<td>.23</td>
<td>.59</td>
</tr>
<tr>
<td>Clinical presentation</td>
<td>3</td>
<td>.40</td>
<td>.26</td>
<td>.41</td>
</tr>
<tr>
<td>Treatments</td>
<td>5</td>
<td>.64</td>
<td>.30</td>
<td>.69</td>
</tr>
<tr>
<td>Prevention</td>
<td>2</td>
<td>.95</td>
<td>.16</td>
<td>.94</td>
</tr>
<tr>
<td>Posttest</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Epidemiology</td>
<td>3</td>
<td>.95</td>
<td>.16</td>
<td>.78</td>
</tr>
<tr>
<td>Pathophysiology</td>
<td>5</td>
<td>.78</td>
<td>.14</td>
<td>.58</td>
</tr>
<tr>
<td>Clinical presentation</td>
<td>4</td>
<td>.70</td>
<td>.16</td>
<td>.36</td>
</tr>
<tr>
<td>Treatments</td>
<td>5</td>
<td>.60</td>
<td>.30</td>
<td>.51</td>
</tr>
<tr>
<td>Prevention</td>
<td>1</td>
<td>.60</td>
<td>.52</td>
<td>.33</td>
</tr>
</tbody>
</table>

**Conclusion learning effect**

The learning effect was measured with a reliable pre- and posttest of which only the multiple choice questions were reliable. There were no significant influences from participant characteristics, which indicates that the learning effect can be ascribed to whether the participants received training or not.

The learning effect of the participants was significantly higher than the participants in the control group. Also the effect size was large, $d = 1.68$. The scores from the participants who received training improved from about 50% to 60%, where 60% correct is equal to the scores of GPs according to Rompen (2013). The average scores of the control group were 6% lower in the posttest, which could indicate that the posttest was more difficult than the pretest.

The multiple choice questions consisted of five knowledge dimensions: epidemiology, pathophysiology, clinical presentation, treatments, and prevention. The pathophysiology and clinical presentation dimensions were treated most during the training session and were also the dimensions where the participants showed the significant improvements.

**5.2 Transfer effect**

In the previous section the learning effect of a training about non-melanoma skin cancer was measured. The purpose of a training is to improve the knowledge and skills about a certain subject so that a person can execute his or her tasks better. In this study the transfer effect was measured
by letting the participants diagnose patients with suspicious lesions. The participants filled in a questionnaire about the patient's suspicious lesion and thereafter gave their presumed diagnosis and follow-up step. The diagnosis included two parts: whether the lesion was non-melanoma skin cancer or something else; if it was non-melanoma skin cancer, which type it was. The follow-up step consisted of an advice of the participant to treat the patients or to refer him/her to a dermatologist. After the presumed diagnoses of the participants, a final diagnosis and treatment advice was given by a dermatologist. These diagnoses were used to verify whether the participant was correct.

A sample size of 400 diagnoses, 20 diagnoses per participant, was determined upfront as an appropriate number to generate significant results. In total 97 patients were diagnosed. Four cases had to be deleted because of missing data. The participants who received training made 66 diagnoses and the control group diagnosed 27 patients. Figure 16 shows the number of diagnoses per participant for the experimental and the control group. It can be noticed that there were four participants who did not diagnose any patients. In Figure 17 the number of diagnoses per healthcare institution is given. Overall, 53 of the 93 diagnoses were made by participants employed by MohsA (participant id: 1, 2, 3, 8, and 10).

![Figure 16: Number of diagnoses per participant](image1)
![Figure 17: Number of diagnoses per healthcare institution](image2)

**Experimental vs. control group**

A transfer effect caused by the training program is present when the experimental group diagnosed significantly more patients correctly than the control group. As can be seen from Table 18, the percentage of correct diagnoses in the control group was higher than in the experimental group, 74% vs. 59%. This difference however, was non-significant, $p > .05$.

<table>
<thead>
<tr>
<th>Participant's correct diagnosis</th>
<th>Experimental</th>
<th>Control</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incorrect diagnosis</td>
<td>41% (27)</td>
<td>26% (7)</td>
<td>37% (34)</td>
</tr>
<tr>
<td>Correct diagnosis</td>
<td>59% (39)</td>
<td>74% (20)</td>
<td>63% (59)</td>
</tr>
<tr>
<td>Total</td>
<td>100% (66)</td>
<td>100% (27)</td>
<td>100% (93)</td>
</tr>
</tbody>
</table>

Note: Pearson $\chi^2 = 1.855$, $p = .173$

Overall, the participants diagnosed the presence of non-melanoma skin cancer quite well, sensitivity = 87.5% (Table 19). The sensitivity of the experimental group was slightly higher, 89.5%, where the control group had a sensitivity of 80%. Thus, the participants who received training were more competent in diagnosing the presence of non-melanoma skin cancer. The specificity of the diagnoses...
was higher for the control condition than for the experimental group, 70.6% vs. 57.1%. So, the experimental group was more competent in recognizing non-melanoma skin cancer, but diagnosed for it too often. This could indicate that, after training, their focus was on recognizing non-melanoma skin cancer and thought it was present too often. The control group diagnosed more often for other diseases than non-melanoma skin cancer.

Table 19: Sensitivity and specificity diagnoses per condition

<table>
<thead>
<tr>
<th>Group</th>
<th>Sensitivity</th>
<th>Specificity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>89.5%</td>
<td>57.1%</td>
</tr>
<tr>
<td>Control</td>
<td>80.0%</td>
<td>70.6%</td>
</tr>
<tr>
<td>Total</td>
<td>87.5%</td>
<td>62.2%</td>
</tr>
</tbody>
</table>

As was mentioned in Chapter 4, the participating healthcare institutions provide different kinds of (skin) care. Therefore, the sensitivity and specificity of the diagnoses per healthcare institution were also analyzed. The participants from the GP practices were least capable in recognizing non-melanoma skin cancer (sensitivity = 50%) in comparison to participants from other healthcare institutions (Table 20), but were most capable in recognizing skin lesions that were not non-melanoma skin cancer (specificity = 86%). Despite of the fact that the participants from MohsA received training, they had a lower sensitivity and specificity than the comparable participants (hospital) in the control group. It has to be noticed that there were large differences in the number of diagnoses.

Table 20: Sensitivity and specificity diagnoses per healthcare institution

<table>
<thead>
<tr>
<th>Healthcare institution</th>
<th>NMSC (#)</th>
<th>Sensitivity</th>
<th>No NMSC (#)</th>
<th>Specificity</th>
</tr>
</thead>
<tbody>
<tr>
<td>MohsA</td>
<td>29</td>
<td>83%</td>
<td>20</td>
<td>55%</td>
</tr>
<tr>
<td>Hospital</td>
<td>8</td>
<td>100%</td>
<td>13</td>
<td>69%</td>
</tr>
<tr>
<td>2 GP practices</td>
<td>4</td>
<td>50%</td>
<td>7</td>
<td>86%</td>
</tr>
<tr>
<td>2 skin clinics</td>
<td>4</td>
<td>100%</td>
<td>4</td>
<td>50%</td>
</tr>
</tbody>
</table>

After the participant made a presumed diagnosis, she had to make suggestions to either treat the patient or refer him or her to a dermatologist. The participants who received training made correct treatment / referral choices in 48% of the diagnoses. For the control group, this percentage was 67%. This difference, however was non-significant.

The data were analyzed as if there was only one good diagnosis and treatment per case. However, there are more ways to come to the same conclusion. Therefore, a dermatologist reviewed the presumed diagnoses from the participants, focusing on the question whether the diagnosis would harm the patient or not, e.g. an assistant diagnosed AK and suggested coagulation, however it was not non-melanoma skin cancer and coagulation would have made unnecessary scars. She rated the diagnoses as either correct, incorrect, or overtreatment. There were 13 diagnoses that were not incorrect but constituted an overtreatment e.g. the participant suggested a biopsy and subsequently treatment, when no biopsy was needed because the type of non-melanoma skin cancer could be determined without biopsy. This is not harmful for the patient, but increases the costs of care. She rated six diagnoses as incorrect. So, instead of 75.3% (70) correct diagnoses, 93.5% (87) diagnoses were correct. Table 23 shows the percentages of correct diagnoses and overtreatment based on the results reviewed by the dermatologist. As can be seen, the control group scored even better than
the experimental group in this scenario, 85% vs. 77%, but these difference remained non-significant. Both groups had the same low percentage of incorrect diagnoses, but more diagnoses leading to overtreatment in the experimental condition. This could indicate that the participants in the experimental group are more cautious in making a diagnosis immediately and choose to do a biopsy first to confirm their thoughts.

Table 21: Percentage of correct diagnoses per group (reviewed by dermatologist)

<table>
<thead>
<tr>
<th>Group</th>
<th>% correct diagnoses/ referrals</th>
<th>% incorrect diagnoses/ referrals</th>
<th>% overtreatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>77%</td>
<td>6%</td>
<td>17%</td>
</tr>
<tr>
<td>Control</td>
<td>85%</td>
<td>7%</td>
<td>7%</td>
</tr>
</tbody>
</table>

In a previous study nurses also diagnosed patients with suspicious lesions on the different types of non-melanoma or something else (Rinkens, 2011). The distribution of the number of diagnoses per type of non-melanoma skin cancer is given in Table 24. The percentage of correct diagnoses was 81.7% (165 out of 206 correct diagnoses) (Rinkens, 2011). In the current study physician support personnel from the experimental and control group together made 75.3% (70) correct diagnoses. In 35.5% (33 diagnoses) of all correct diagnoses, also the correct type of non-melanoma skin cancer was diagnosed. Table 25 shows the diagnoses of the physician support personnel compared to the actual diagnoses. In the current study, physician support personnel was more capable in diagnosing AK and SCC, but these results were based on fewer cases. In this study, more AKs were present (38% vs. 29%) and less BCC (8% vs. 17%).

Table 22: Correct diagnoses nurses (Rinkens, 2011)

<table>
<thead>
<tr>
<th>Type</th>
<th>Nurses</th>
<th>Actual</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>AK</td>
<td>66</td>
<td>58</td>
<td>29</td>
</tr>
<tr>
<td>Morbus Bowen</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>SCC</td>
<td>4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>BCC</td>
<td>39</td>
<td>34</td>
<td>17</td>
</tr>
<tr>
<td>Something else</td>
<td>92</td>
<td>108</td>
<td>53</td>
</tr>
<tr>
<td>Total</td>
<td>202</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

Table 23: Correct diagnoses physician support personnel

<table>
<thead>
<tr>
<th>Type</th>
<th>Physician support personnel</th>
<th>Actual</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>AK</td>
<td>32</td>
<td>35</td>
<td>38</td>
</tr>
<tr>
<td>Morbus Bowen</td>
<td>4</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>SCC</td>
<td>4</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>BCC</td>
<td>14</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>Something else</td>
<td>36</td>
<td>45</td>
<td>49</td>
</tr>
<tr>
<td>Total</td>
<td>93</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

Table 24 shows the learning performance per participant and in addition whether they diagnosed the correct type of non-melanoma skin cancer when the disease was present. It was also measured whether the correct decision was made after diagnoses i.e., take a biopsy, refer to dermatologist, or treatment. As was mentioned before the specificity of the diagnoses of the participants from the GP practices was only 50%. These participants were represented by participant 6, 7, 11, and 13. In Table 22 can be seen that the experimental condition was only represented by one participant (6), who made 100% correct diagnoses. The percentage of correct diagnoses in the control condition was 50%, which is the average of participants 11 and 13. These results suggest, although based on limited data, that training is effective for doctor assistants in GP practices.

The correlation between the participant’s score for the posttest and the number of diagnoses was measured to determine whether the diagnoses in the experimental and control group were made by participants who scored high or low on the posttest. A high correlation indicates that the main part of the diagnoses were made by the more capable participants (high posttest scores). The correlation in the control group was moderately high (.62) and almost significant ($p = .08$) which
indicates that the diagnoses made by the control group were mainly from the more excelling participants.

Diagnoses per participant

The gathered data for the transfer effect have a hierarchical structure (Figure 18): diagnoses are nested within persons (and persons within units). A multi-level logistic regression, the so-called “variance component model”, was used to examine whether the characteristics of the participants and/or the characteristics of the lesion had an influence on the correctness of the diagnosis of the participant, while controlling for the fact that participants delivered more than just a single diagnosis. A multi-level logistics regression controls for the correlation of the variance of the residual errors between individual observations (Khan & Shaw, 2011).
The dependent variable used for the analysis was the correctness of the diagnosis. For the diagnosis, the participant had to indicate whether the lesion was non-melanoma skin cancer or something else; if it was non-melanoma skin cancer, which type of non-melanoma skin cancer. After the presumed diagnosis of the participant, a final diagnosis was made by a dermatologist. These diagnoses were used to verify whether the participant was correct. A diagnosis was correct when the participant had both parts correctly answered (non-melanoma skin cancer: yes/no, if yes: type).

Table 25 shows the results of a series of analyses. First, a model without predictors was estimated. The estimate of the variance at the participant level was 19%. This implies that the other 81% of the variance resides at the level of the lesion. Second, the predictors were included in six steps.

Table 25: Parameters and standard errors of multi-level logistic regression of the correctness of the diagnosis (S.E.s are placed in parentheses)

<table>
<thead>
<tr>
<th></th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
<th>Model 4</th>
<th>Model 5</th>
<th>Model 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y = correct diagnosis</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Job experience</td>
<td>.373* (.161)</td>
<td>.198 (.212)</td>
<td>.369 (.246)</td>
<td>.472 (.287)</td>
<td>.457 (.285)</td>
<td>.859 (.886)</td>
</tr>
<tr>
<td>Anxiety</td>
<td>-1.039* (.502)</td>
<td>-1.153* (.583)</td>
<td>-.399 (.709)</td>
<td>.516 (.929)</td>
<td>.457 (.937)</td>
<td>.439 (1.514)</td>
</tr>
<tr>
<td>Mean confidence across</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>diagnoses</td>
<td>2.191* (1.092)</td>
<td>3.036* (1.249)</td>
<td>5.578** (2.081)</td>
<td>5.944** (2.237)</td>
<td>5.494* (2.282)</td>
<td></td>
</tr>
<tr>
<td>Confidence per diagnosis</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>within one participant</td>
<td>1.466** (.409)</td>
<td>1.565** (.437)</td>
<td>1.553** (.446)</td>
<td>1.661** (.500)</td>
<td>1.636** (.504)</td>
<td></td>
</tr>
<tr>
<td>Order of diagnoses within</td>
<td>-.041 (.087)</td>
<td>-.036 (.086)</td>
<td>-.046 (.089)</td>
<td>-.043 (.089)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>one participant</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of diagnoses per</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>participant</td>
<td>.142 (.087)</td>
<td>.270* (.116)</td>
<td>.278* (.118)</td>
<td>.275 (.121)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Posttest score</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>-7.842 (4.164)</td>
<td>-8.640 (4.470)</td>
<td>-8.976 (4.843)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Presumed diagnosis</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>-.449 (.855)</td>
<td>-.354 (.917)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Partwork¹</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mohsa</td>
<td>1.594 (2.943)</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Gp practice</td>
<td>1.367 (3.544)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skin clinic</td>
<td>1.991 (3.638)</td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Note: The symbol ** and * indicate that the estimate is significant at .01 and .05 respectively.

¹Reference category Partwork = hospital.

From the participant characteristics, job experience and anxiety had a significant effect on the correctness of the diagnosis, \( p = .02 \) and \( p = .04 \) respectively. The 19% of variance at the participant level was completely covered after controlling for these two variables. When a participant had more experience, it was more likely that she diagnosed correctly. However, when a participant scored high on anxiety, i.e. she is afraid to do something wrong in her job, it was more likely that she diagnosed incorrectly. As was mentioned before, no significant difference was found between the experimental and control group with regard to correct diagnoses, but the percentage of correct diagnoses was
higher for the control group than for the experimental condition (74% vs. 59%). Due to practical constraints, the participants in the control group were more experienced than the participants who received training. Because job experience has a significant influence on the diagnosis, this could explain the high score of the control group. In fact, when the variable “control group” is added to the analyses it can be seen that the differences between the two groups are non-significant, but this might partly be because the number of cases is too low. Nevertheless, the positive coefficient of the control group completely vanished after controlling for job experience and anxiety.

Both the general confidence of the participant (‘mean confidence across diagnoses’) about her diagnoses and the confidence per diagnosis (‘confidence per diagnosis within one participant’) had a positive influence on the diagnosis of the participant \( p < .05 \) and \( p < .01 \), respectively. That is: participants with higher average confidence levels diagnose better (the effect of the variable ‘mean confidence across diagnoses’). In addition, within participants the diagnoses of cases about which participants were more confident, were also more likely to be correct. Note that although this might sound intuitively obvious, it is typically not a standard finding. Often, certainty does not correlate much with accuracy (cf. (Tazelaar & Snijders, 2013). After adding these variables, the influence of job experience disappeared.

The number of diagnoses varied among the participants. The more diagnoses a participant made, the more likely it was that the diagnosis was correct (‘number of diagnoses per participant’), which indicates that the ‘good’ participants were able to make more diagnoses. The variable “order of diagnoses within one participant” has a negative coefficient, which indicates that as the participant makes more diagnoses, she gets worse. However, this variable was not significant.

The posttest score was nearly significant, but surprisingly it has a strong negative coefficient. This indicates that the higher the participant scored on the posttest the worse she was in diagnosing lesions. A possible explanation is that the control group had on average more experienced persons. This could indicate that job experience is more important than whether a person received training or not. However, the posttest consisted of both cases and multiple choice questions. 70% of the score was determined by the multiple choice questions. Apparently, the knowledge and skills measured with these questions is different from the required knowledge and skills for making proper diagnoses. Thus, the knowledge and skills retrieved from training do not necessarily lead to more correct diagnoses.

Although eighty percent of the variance of the correctness of the diagnoses resides at the lesion level, none of the lesion characteristics had a significant influence on the correctness of the diagnosis of the participant. In other words, no systematic biases are seen in the sense that, for instance, lesions that itch are diagnosed incorrectly more often.

**Low opportunity to perform**

Research has shown that external factors can have an influence on the transfer effect (see Chapter 2). The following external factors were measured in this study: capacity to transfer, peer support, and opportunity to perform. The results are given in Table 27.
The doctor assistants from the GP practices indicated that there was no opportunity to make diagnoses in their busy work schedules. This also became clear from the measured variable ‘opportunity to perform’. This variable was slightly below the average (2.95). The lowest score on this variable was from a participant from a GP practice (2.50). The statistics of the external factors per healthcare institution are given in Table 28 shows that the participants from the GP practice had the least opportunity to perform. Also, the capacity to transfer i.e. the workload of the participant is sufficient to apply the learned material in practice, was lowest for the participants in the GP practice.

Training design

The participants who received training filled in an additional questionnaire about the training and their motivation to use the learned knowledge and skills in practice. The variables measured in this questionnaire were: perceived utility, motivation to transfer, performance self-efficacy, transfer design, and training feedback. The trainees received printouts of the presentation slides that could be used as reference material. After the period of diagnosing patients, the trainees were asked to what extend they the reference material. The statistics of these variables are in Table 29.

As can be seen the scores on all the variables are high, which indicates that the designed training program is a good preparation for transfer to the job. It also showed that the participants used the slides of the training in the period when they had to diagnose patients (mean = 3.10). These results suggest that the absence of a significant transfer effect in this study cannot be attributed to the training program.
Conclusion transfer effect

Results showed no significant transfer effect. The experimental group did not score significantly better on the diagnoses than the control group. However, in general all the participants were capable of making proper diagnoses. After the dermatologist reviewed the data, only 6 of the 93 diagnoses were determined as completely incorrect. This means that if physician support personnel is allowed to make diagnoses themselves in 6 cases it would have harmed the patient. The sensitivity of all the participant’s diagnoses was 87.5%, the specificity was 62.2%. The participants from the GP practices were least capable in recognizing non-melanoma skin cancer (sensitivity = 50%), but they also indicated that there was low opportunity to perform. The significant influence of job experience and anxiety on the correctness of the diagnosis indicates that experience is necessary to make proper diagnoses and that persons who are afraid to do wrong in the job are less capable in making correct diagnoses.
6. Discussion

The number of patients with (non-melanoma) skin cancer increases rapidly. This increase causes a capacity shortage at GP practices and dermatology departments at hospitals. One of Van der Geer-Rutten’s (2012) solutions to cope with this problem was to train physician support personnel so that they are able to carry out tasks for dermatologists and GPs. In this study it was examined to what extent the knowledge and skills regarding non-melanoma skin cancer of physician support personnel can be improved so that they are able to make accurate preliminary diagnoses. To provide an answer to this question, five research questions were drawn. Answers to these questions are provided in the following sections.

6.1 Design of a training program

Currently, physician support personnel does not possess the required knowledge and skills to diagnose non-melanoma skin cancer and is, therefore, not able to carry out these tasks from dermatologists and GPs. Physicians use an inductive process to make a diagnosis, which makes it impossible to develop a standardized process for making diagnoses (Ridderikhoff, 1993). Since the diagnosis process seems very difficult, the aim was to include all the necessary KSAOs in the training program that are required for making a diagnosis with regard to non-melanoma skin cancer. To ensure that all relevant KSAOs were included, a needs assessment was executed.

After the objectives of the training program were determined in the needs assessment, the format of the training needed to be determined. As was shown in Chapter 2, research has shown that the combination of delivery methods influences the effectiveness of a training program. These findings were taken into account to ensure that the required KSAOs actually were absorbed by the participants. A constraint for the training program was that the costs had to be low because the number of participants was only 19 and further use of the training program in the future is uncertain. Also, the duration of the training session had to be relatively short because the participants were from different healthcare institutions and it was difficult to take into account everyone’s schedule.

The required KSAOs, suitable training delivery methods, and the constraints led to a training program that consisted of characteristics, risk factors and treatments for the different types of non-melanoma skin cancer. Also, the prevention of non-melanoma skin cancer and guidelines to make a proper diagnoses were included. These KSAOs were included in a two-hour lecture, including case studies and reference material. Herewith, research questions 1A: ‘What tasks and Knowledge, Skills, Abilities and Other characteristics (KSAOs) are necessary to make correct diagnoses and referrals with regard to non-melanoma skin cancer?’, and 1B: ‘Which combination of training delivery methods is likely to result in the strongest improvement in knowledge and skills of physician support personnel regarding non-melanoma skin cancer?’, were answered.

The group that received training evaluated the training program on the amount of feedback, utility, transfer design and their motivation and self-efficacy to transfer the learning to practice. All the scores were high, which indicates that the designed training program is a good preparation for transfer to the job. Results showed that some of the participants used the reference material extensively, but some of them did not refer to it.
6.2 Learning effect

The objectives of this study were to improve the knowledge and skills of physician support personnel via training so that they are able to make accurate preliminary diagnoses. The learning effect of the participants was measured. It appeared that the knowledge of the participants with regard to non-melanoma skin cancer was improved after training. The obtained level of knowledge can be compared to GPs, based on a pilot test from Rompen (2013).

The learning effect was measured with a pre- and posttest, consisting of four cases and eighteen multiple choice questions. The cases were intended to imitate the reality of making a diagnosis. The knowledge about the characteristics, risk factors, treatment, and prevention of non-melanoma skin cancer was measured in the multiple choice questions. It appeared that the reliability of the cases part in the pre- and posttest was insufficient. The learning effect was therefore primarily based on the scores for the multiple choice questions. This indicates that the knowledge with regard to non-melanoma skin cancer of the participants who received training was improved significantly, but improvement in making accurate diagnoses remains inconclusive. A participant can possess all the knowledge she needs to make a diagnosis, but lack of skills in ‘connecting the dots’ in this knowledge makes it impossible to make an accurate diagnosis.

Individual characteristics of the participant were measured to control for possible influences on the learning effect. None of the measured characteristics had a significant effect on the learning performance of the participants. So, the learning effect can be entirely ascribed to the training program. It has to be noticed that the sample size in the current study was rather small and homogeneous, which could be an explanation for the non-significant results.

Herewith, research question 1C: ‘What individual characteristics and external factors need to be taken into account which can influence the effectiveness of training?’ and 2A: ‘What is the training performance / learning effect of physician support personnel with regard to non-melanoma skin cancer?’ were answered.

6.3 Transfer effect

The improved learning performance does not necessarily lead to improved job performance. The purpose of training is that the knowledge and skills learning in training are eventually applied to the job. The transfer effect of the developed training program was measured in this study, but did not have significant effects. The job performance was measured with participants diagnosing patients on suspicious lesions. The number of diagnoses was relatively small, which could be the cause for the non-significant results.

In general both conditions, whether the participants received training or not, performed well on the job. So, the knowledge and skills with regard to non-melanoma skin cancer of physician support personnel appeared to be already sufficient without receiving training. After the dermatologist reviewed the data, only 6 of the 93 diagnoses were classified as completely incorrect. This means that if physician support personnel was allowed to make diagnoses themselves, it would have harmed the patient in only 6 cases. It has to be noticed that the correlation between the posttest score and the number of diagnoses was high and significant in the control group, unlike the
experimental condition where it was low. This suggests that the diagnoses that represent the control condition were mainly made by participants who scored high on the posttest and thus were considered to have more knowledge with regard to non-melanoma skin cancer. This could be an explanation for the high percentage of correct diagnoses by the control group.

Evidence for improved job performance that could have been ascribed to the training program was lacking in this study, but the job experience and level of anxiety of participants seemed to have a significant effect on the correctness of their diagnoses. Thus, apparently, a person obtains knowledge and skills, required to make an accurate diagnosis, by seeing patients with suspicious lesions. Also, when a person is anxious, i.e. afraid to do something wrong in her work, she is less capable in making accurate diagnoses. So, it is important to reassure the physician support personnel when they have to diagnose patients.

The external factors: opportunity to perform, peer support, and capacity to transfer were measured. Participants from MoshA scored the highest on all three factors. The doctor assistants from the GP practices scored the lowest. An explanation for this result can be that a GP practice provides care to patients with numerous kinds of diseases. The percentage of patients with suspicious skin lesions is therefore lower than at a dermatological department at the hospital or MohsA which only provide skin care. The skin clinics scored slightly above average on all three factors. As MohsA, they provide solely skin care, however, a large part is cosmetic skin care and therefore less suspicious lesions with regard to non-melanoma skin cancer. Apparently, the knowledge and skills with regard to non-melanoma skin cancer are currently less applicable in GP practices and skin clinics than in hospitals and healthcare centers such as MoshA.

The differences in opportunity to perform became also apparent from the number of diagnoses participants made. The skin clinics and GP practices made only a few diagnoses. So, some caution has to be exercised for the conclusion about the transfer effect that are based on these diagnoses.

Herewith, research question 1C: ‘What individual characteristics and external factors need to be taken into account which can influence the effectiveness of training?’ and 2B: ‘What is the job performance / transfer effect of physician support personnel with regard to non-melanoma skin cancer?’ were answered.

At the beginning of this study, it was assumed that the participants were inexperienced in diagnosing non-melanoma skin cancer. Due to difficulties finding participants, a large group of the participants had some experience. Important participants were the doctor assistants from the GP practices, because they can ensure that patients are treated in the GP practice instead of referred to the dermatologist. Although results showed no differences between the experimental and control condition in total, the percentage of correct diagnoses from the GP practice in the experimental group was much higher than in the control group. This could have been caused by the training or it is possible that the doctor assistants from the GP practice in the experimental condition were more skilled in diagnosing patients with regard to non-melanoma skin cancer than the doctor assistants from the GP practice in the control group. The pretest scores show that the assistant in the experimental group scored slightly better than the assistants in the control group (58% vs. 46% and 50%), which could have caused the difference in transfer effect.
6.4 Limitations

Despite the conclusions that could be drawn from this research, it has some limitations in the research design, the participants, the measurements of the learning effect, and the measurements of the transfer effect.

First, there were some limitations in the research design. The sample size in this research was small because acquisition of participants was difficult. A small sample size can invalidate the representativeness for the entire population to whom results will be generalized or transferred. It is possible, that learning and transfer effects will be different when training another group of physician support personnel. Also, it was allowed that participants were employed by the same healthcare institution due to the difficulties of acquiring participants. To prevent that participants from the experimental group communicated with the participants from the control condition, participants from the same healthcare institution had to be in either the experimental or the control condition.

Second, the statistical power of the measurement of the learning and transfer effect was low. This was caused by the small sample size, whereby only large effects can be found. Despite the small sample size, a significant learning effect was found, but there was no evidence for improved job performance.

Third, the participating healthcare institutions were: MohsA, a dermatological department from a hospital, two GP practices, and two skin clinics. MohsA and the hospital only treat patients with suspicious skin lesions, GP practices provide care for all kind of diseases, and skin clinics provide mainly cosmetic care. It is likely that the participants from MohsA and the hospital have seen patients with non-melanoma skin cancer more often than the participants from the GP practices and the skin clinics. This differences in experience could have influenced the results. Also, participation in the training program was voluntary. All the participants were motivated to receive training about non-melanoma skin cancer. The learning effect could decrease when less motivated nurses and assistants are trained.

Fourth, there was a limitation in the measurement of the learning effect. Initially, the pre- and posttest were developed to assess the knowledge and skills about non-melanoma skin cancer of GPs (Rompen, 2013). In the current study the group of participants was physician support personnel. The required knowledge and skills for physician support personnel differ from the GPs. Some of the questions were therefore irrelevant for testing physician support personnel.

Fifth, the cases were added in the pre- and posttest to assess the skills of the participants with regard to diagnose non-melanoma skin cancer. The analysis of the reliability of the pre- and posttest showed that the cases were unreliable. Therefore, the skills for making proper diagnoses were not examined properly in the pre- and posttest.

Sixth, it is possible that the measurement method of the cases was not representative of reality. Results from the pre- and posttest showed that there was no significant difference in the percentage of correctly diagnosed cases between the experimental and control group. During the project, the participants gave feedback about the tests. The cases were considered very difficult because it was...
not possible to feel the skin of the patient and look at the patient comprehensively. Also, it was only allowed to ask two questions. Sometimes, the participant did know which questions to ask, but was not allowed to ask questions anymore. This led to more guessing and it is possible that this caused the non-significant differences in scores between the experimental and control group. In reality, it is allowed to ask as many questions as necessary. Thus, the cases were not representative to reality.

Finally, there were limitations in the measurement of the transfer effect. First, the participants from both conditions were asked to diagnose 20 suspicious lesions after the posttest was completed. There was a restricted time to make these diagnoses. Only one participant managed to diagnose 20 lesions. It appeared that the participants often did not have time to diagnose patients with suspicious lesions. The low number of diagnoses could have been a cause for the lack of transfer effect. Second, even though all participants received a protocol about how to gather the data, irrelevant patients were included (children) in a few cases. Third, the patients with suspicious lesions were not selected randomly, due to busy schedules of the participants. Fourth, the number of diagnoses per participant differed significantly. As mentioned before the opportunity to perform was judged as relatively low. This was mainly due to the doctor assistants from the GP practices having less access to potential patients. At a GP practice patients arrive with several diseases, of which only a small percentage represents suspicious skin lesions. The combination of low availability and busy schedules of the assistants were the cause of the low number of diagnoses made by this group at the GP practices. This caused the diagnoses from MohsA and the hospital to have more weight in the results. Finally, results showed a high correlation between posttest and number of diagnoses in the control group which could have been an explanation for the absence of the transfer effect.

Strengths

Although there were some implications, this research had certainly strengths. First, the research design of this study is powerful because it includes both a science-based design and design science research. The regulative cycle of Van Strien (1986) was used to develop a training program in a structured way and the empirical cycle of De Groot (1961) was used to evaluate the training program. This ensured for an objective evaluation with measurable data.

Making a diagnosis is an intuitive process. In this study, the correctness of the diagnosis was analyzed with measurable data. Hereby, the results were objective instead of subjective when they would have been analyzed by, for instance, a dermatologist.

The target group of the study was physician support personnel. People employed in the healthcare sector are hard to reach. In this study we managed to collect 19 participants who were willing to contribute to this study.

6.5 Suggestions for further research

The previous section described limitations which can be an initiator to suggestions for further research. One suggestion is to conduct this study with a larger, more representative sample to be able to generalize the results to the entire population. Also random assignment of participants will improve the internal validity. Not only the sample size of participants should be extended, but also the number of suspicious lesions the participants diagnose. In this study no transfer effect was
found, and one of the causes could have been the low number of diagnoses. It appeared that there were differences in results between the four healthcare institutions. A suggestion for further research would be to employ not only a larger sample, but also one from only one type of healthcare institution, for example GP practices.

The training program in this study was focused on the characteristics, risk factors and treatment methods of non-melanoma skin cancer. The used training delivery methods were lecture, case studies, and reference material. It appeared that job experience had an influence on the correctness of the diagnoses of the participants. In Chapter 2 it was shown that on-the-job learning is also an appropriate delivery method for the relevant KSAOs that need to be trained. This training delivery method provides the opportunity to become experienced in diagnosing suspicious lesions. In this study, it was not possible to do on-the-job learning because the participants were at different locations. Therefore, a trainer (dermatologist) was not available at all times. On-the-job learning could be an appropriate training delivery method within one organization, when a dermatologist is present. Therefore, a suggestion for further research is to examine the effectiveness of a training program where on-the-job learning is included. As was shown in Chapter 5, a dermatologist reviewed the diagnoses of the participants. It appeared that there are more ways to come to the correct diagnosis. In on-the-job learning the trainee gets feedback about the thinking process of the dermatologist and his or her justification for the choices made with regard to diagnosis and treatment. The review in results from the dermatologist in this study also suggest to search for other measurement methods to determine the transfer effect.

The level of anxiety of the participant also had an effect on the correctness of the diagnoses of the participants. Therefore, a suggestion is to take this into account in the training program. A possible way to include this is letting the participant diagnose patients when a dermatologist or GP is present.

A final suggestion for further research is redesigning the task allocation within a practice. As appeared in this study, the assistants from the GP practices did not have time in their schedules to diagnose suspicious lesions. The participants from the hospital also mentioned this problem. In the current situation, it is not possible for doctor’s assistants to take over tasks from the GP because their current job responsibilities require all their working hours. Research has to be done to determine how the skincare can be transferred from the physician to the physician support personnel. It is likely that more physician support personnel is then needed to cope with the increase in job responsibilities.

6.6 Practical implications

The developed training program can be used to improve the knowledge of physician support personnel with regard to non-melanoma skin cancer. However, there was lack of evidence for the transfer effect of the training. However, the participants diagnosed for non-melanoma skin cancer already quite well. Currently, it is not possible for doctor’s assistants from GP practices to expand their job activities and thus diagnose patients with suspicious lesions. To reduce the flow of patients referred to the hospital, the aim is to treat the patients in the GP practices as long as possible. A solution is half line care, where a specialized nurse treats patients with non-melanoma skin cancer at the GP practice for a fixed number of hours per week. There are already healthcare networks who
have implemented this half line care, such as the Academic Hospital of Maastricht, which has done pilots with half line care for several specialisms (Kroon & Meerlo, 2013).

This training program is useful for training physician support personnel with little experience in diagnosing non-melanoma skin cancer. Participants indicated that they used the slides of the training as reference material. So it is also helpful as only reference material for physician support personnel with experience in diagnosing patients. It could also be used by GPs. This training program was a first step in training physician support personnel and can be used as a first design for a training program which is tested through a more diverse, or more specific, target group.

Conclusion

In the previous sections of this chapter, the sub-questions were answered and limitations were discussed. So, here the main research question: ‘To what extent can the knowledge and skills regarding non-melanoma skin cancer of physician support personnel be improved so that they are able to make accurate preliminary diagnoses?’ can be answered. To summarize the above, the designed training program is effective in improving the learning performance of physician support personnel with regard to non-melanoma skin cancer, but evidence for improved job performance is lacking in this study. However, more insight is created in the current level of the diagnosing skills from physician support personnel, which is already quite well and also the fact that, next to definable knowledge and skills, also necessary knowledge and skills are obtained via job experience.


Appendix A: Slides from training program

Non-melanoma huidkanker

- Gertrud Kreiels, dermatoloog
- Simone van der Geer-Rutten dermatoloog

Leerdoelen

- Het kunnen herkennen van de symptomen van non-melanoma huidkanker.
- Het kunnen herkennen van de verschillen tussen de verschillende vormen van non-melanoma huidkanker en andere huidafwijkingen.
- Het kunnen beslissen over de vervolgstap na het stellen van een diagnose.
- Kennis over de anamnese, klinische factoren en gevolgen van non-melanoma huidkanker.
- Kennis over het voorkomen van non-melanoma huidkanker.

Inhoud

- Inleiding
- Melanoom
- Non-melanoma huidkanker
  - Basaalcellcarcinoom
  - Actinische keratose
  - Morbus Bowen
  - Flaveolocarcinoom
- Preventie
- Diagnostiek
- Oefencassussen

Huidkanker: nieuwe chronische ziekte

- 1 op de 4
- Groei 5-10% per jaar
- 1 op de 2 65-plussers in VS
- Multipale huidtumoren
- Premaligne huidafwijkingen
- Kosten: art. 1 in VS
Huidkankerepidemie

- Veranderd zongedrag
- Brain is gesond
- Economische welvaart
- Vorgening
- Succesvolle orgaantransplantaties

Huidkanker

- Melanoom
- Non-melanoom

Antoniës kernoproloew
- Melanoom
- Non-melanoom

Chronisch Huidkanker

- Afbeeldingen van huidafwijkingen
Tussentijdse stelling 1
Huidkankerbehandeling in de huisartsenpraktijk is onwenselijk
A. Juist
B. Onjuist

Inhoud
- Inleiding
- Melanoom
  - Non-melanoma huidkanker
    - Basaalcellcarcinoom
    - Actincarcinoom
    - Morbus Bowen
    - Plavesielcellcarcinoom
  - Preventie
  - Diagnostiek
  - Oefencasussen

Melanoom: Kenmerken
- Asymmetrie
- Begrenzing: onechter
- Grootte: diameter > 5 mm, groter → hoger risico
- Kleur: meerdere kleuren, grijs/zwart/blauw/rood

Melanoom: Risicofactoren
- Melanoom komt voor in 1° graad: familie
- Patiënt heeft meerdere moedervlekken (> 100)
- Al eerder huidkanker gehad (ook non-melanoma)

Melanoom: Diagnose en behandeling
- Diagnose:
  - Dermatoscopie
  - Diagnostische excisie
- Behandeling:
  - Excisie

Inhoud
- Inleiding
- Melanoom
  - Non-melanoma huidkanker
    - Basaalcellcarcinoom
    - Actincarcinoom
    - Morbus Bowen
    - Plavesielcellcarcinoom
  - Preventie
  - Diagnostiek
  - Oefencasussen
Non-melanoma huidkanker

Non-melanoma huidkanker komt voornamelijk voor bij mensen met huidtype 1 of 2.

<table>
<thead>
<tr>
<th>Huidtype 1</th>
<th>Huidtype 2</th>
<th>Huidtype 3</th>
<th>Huidtype 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verbrand snel, vooral met zon</td>
<td>Verbrand snel, vooral langzaam</td>
<td>Verbrand zelden, bruin gemarkeerd</td>
<td>Verbrand vaak, bruin zeldzaam</td>
</tr>
<tr>
<td>Donkere huid</td>
<td>Lichtere huid</td>
<td>Lichtere huid</td>
<td>Lichtere huid</td>
</tr>
<tr>
<td>Donker haar</td>
<td>Blond haar</td>
<td>Blond haar</td>
<td>Blond haar</td>
</tr>
<tr>
<td>Licht ogen</td>
<td>Donker ogen</td>
<td>Donker ogen</td>
<td>Donker ogen</td>
</tr>
</tbody>
</table>

Non-melanoma huidkanker is afkomstig van de keratocyten.

Inhoud

- Inleiding
- Melanoon
- Non-melanoma huidkanker
  - Basaalcellcarcinoom
  - Actinische keratose
  - Morbus Bowen
  - Plaveiselcellcarcinoom
  - Preventie
  - Diagnostiek
  - Oetencasussen

Tussentijdse stelling 2

Non-melanoma huidkanker is een ouderdomsziekte

- A. juist
- B. onjuist

Basaalcellcarcinoom (BCC): Kenmerken

- Locatie: Op zon blootgesteide deel van de huid 75-80% in het gelaat
- Kleur: Rood en glanzend
- Vorm: Zware of eczemaachtige plek met verhoogd rand
- Begrenzing: Onscherp
- Ververvijl bloedvatenjes om plekje: ja
- Pijnlijk: Nee
- Blasties/Vlek (bij aanraken): Nee
- Grosiek: Groei langzaam

Oppervlakkige/superficiële BCC
BCC: Risicofactoren

- Genetisch:
  - Huidtype 1 of 2
  - Leeftijd > 50
  - Eerdere huidkanker gehad

- Andere factoren:
  - Vaak verbrand als kind of op latere leeftijd
  - Vaak blootgesteld aan de zon
  - Immuno-suppressiva

BCC: Diagnose en behandeling

- Diagnose: Huidkloot
- Behandeling: soort behandeling wordt bepaald door de volgende factoren:
  - Grootte
  - Locatie
  - Histopathologisch subtype:
    - Aggresief (nodulaire / marmeren / tumorachtig)
    -总理 aggressief (nodulaire / tumorachtig)
    - Primair/Recidief
    - Patiënt
    - (Aanwezigheid van een techniek)

BCC: Behandeling

- Fotodynamische therapie (PDT)
- Excisie
- Mohs micrographische chirurgie:
  - lokale lokaal op gewassing (Lancet Oncology 2008)
  - wondbehandeling
  - epitelbehandeling
- Imiquimod creme → alleen als superficiële BCC

Fotodynamische therapie (PDT) (1)

Excisie & Mohs chirurgie

- Restitutie primaire BCC 10%
- Restitutie primair BCC 5%
- Restitutie secundair BCC 10%
- Restitutie secundair BCC 5%
Actinische keratose

Actinische keratose

Actinische keratose

Actinische keratose

AK. Risicofactoren

- Genetisch.
  - Nadat type 1 en 2
  - Leeftijd > 50 jaar
  - Al eerder huidkanker gehad

- Andere factoren:
  - Vaak blootgesteld aan de zon
  - Roken in de zon
  - Organeneczema

Tussentijdse stelling 3

- Actinische keratose hoort niet altijd te worden behandeld
  - A: juist
  - B: onjuist
AK: Diagnose en behandeling

- Diagnose: Hudboor
- Behandeling:
  - Cryotherapie
  - Imiquimod crème
  - 5-fluorouracil crème
  - Curare en coagulatie eerst wordt weefsel weggehaald (curare en) en vervolgens weggewassen (coagulatie)
  - Fotodynamische therapie (PDT)

Cryotherapie

- Behandeling d.m.v. bevrizing van weefsels of huidaandoeningen te behandeien.

Imiquimod & 5-fluorouracil

- Imiquimod crème
  - Superficiële BCC en AK
  - 3-5 dagen per week, gedurende 4-6 weken
- 5-fluorouracil crème
  - AK
  - 2 maal daags, gedurende 4 weken

Inhoud

- Inleiding
- Melanoom
- Non-melanoma huidcanker
  - Basaalcarcinoom
  - Actinische keratose
  - Morbus Bowen
  - Parakeratosecarcinoom
  - Preventie
  - Diagnostiek
  - Oefencassussen

Morbus Dowen: Kenmerken

- Zeldzame vorm
- Verder gevoerde stadium van AK
- Grootte: Vaak > 1 cm
- Vaak
- Kleur: Rood
- Bepaling: scherp beperkt
- Vaak verward met eczeem of psoriasis
- Locatie: Vaak aan handen en onderbenen

Morbus Dowen

- "Huidkanjer in wording" (carcina in situ)
Inhoud

- Inleiding
- Melanoom
- Non-melanoma huidkanker
  - Basalcellcarcinoom
  - Actinische keratose
  - Merkel cellen
  - Plaveiselcelcarcinoom
- Preventie
- Diagnostiek
- Oefencaseetten

Plaveiselcelcarcinoom (PCC): Kenmerken

- Locatie: Op aan zon blootgestelde delen, hoofd-halsgebied (lip en oor)
- Grootte: > 1 cm
- Kleur: Rood
- Pijnlijk ja, vaak
- Groeit snel ja (in weken tot maanden)
- Zuuroud ja, vaak of een harde dikke korst
- Bloedend ja, vaak
Plaveiselcelcarcinoom

PCC: Risicofactoren
- Genetisch
  - Hauttype 1 en 2
  - Leeftijd > 50 jaar
  - In verleden al eens huidkanker gehad

- Andere factoren
  - Regelmatig blootgesteld aan de zon
  - Immunsuppressiva
  - Organtransplantatie
  - Ruken

PCC: Diagnose en behandeling
- Diagnose: Huidbipt
- Behandeling: hangt af van de fase waarin de PCC zich bevindt:
  - Excisie
  - Mohs chirurgie
  - (radiotherapie)

Actinische keratose of PCC

Actinische keratose of PCC

Differentiële diagnose
- Eczem
- Psoriasis
- Mycose
- Huidtype
- Afwijkingen jaak
- Groei
- Boeden
Inhoud
- Inleiding
- Melanoom
- Non-melanoma huidkanker
  - Basalioma
  - Acneïsche keratose
  - Marbas Bowen
  - Plaessielcarcinoom
- Preventie
- Diagnostiek
- Osflocadose

Tussentijdse stelling 4
- Zonprotectie is nodig voor alle Nederlandsers
  - A. Juist
  - B. Onjuist

Huidkanker & UV
- Vooral aan zonlicht blootgestelde huid
- Vooral bij mensen met buitenberoep
- Toename nabij evenaar
- Dierenexperimenten
- ± bij genetische afwijking in UV-repair
- Specifieke UV-mutaties (p p33)
- 80-90% van melanomen/NMSC


Wat kan je eigen huid?
- Verdikking epidermis (opperhuid)
- Pigmentstoring
- Afhankelijk van huidtype
- Beperkt! (factor 4 voor gemiddelde Nederlander)

En baby / kind?
- Huid is dun
- Pas na maanden pigmentvermenging
- Minder verdikking
- Relatief groot oppervlak
- Mutaties worden niet gerepareerd

Preventie
- Op tijd uit de zon
- UV-beschermende kleding
- Beschermende creme
Op tijd uit de zon

UV-beschermende kleding
- Lange mouwen/broek
- PETJE
- Let op: UV-bescherming door wateren

Beschermende crème!
- Zonnebrandcrème
- Licht factor 30 (zeker voor kinderen)
- Niet verbranden
- Niet bruin willen worden
- Niet om langer in de zon te bakken!

UVB & UVA

<table>
<thead>
<tr>
<th>UVB</th>
<th>UVA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pigmentatie</td>
<td>+</td>
</tr>
<tr>
<td>Sunburn</td>
<td>----</td>
</tr>
<tr>
<td>1975 'gevaarlijk'</td>
<td>'veilig' zonnebank</td>
</tr>
<tr>
<td>Huidverdikking</td>
<td>----</td>
</tr>
<tr>
<td>Vitamine D synthese</td>
<td>----</td>
</tr>
<tr>
<td>Mutaties</td>
<td>+</td>
</tr>
<tr>
<td>Immunosupressie</td>
<td>+</td>
</tr>
<tr>
<td>Huidkanker</td>
<td>Huidkanker</td>
</tr>
</tbody>
</table>

Jaren ‘80: Zonnebank BCC 14x8 cm
- Meer melanomen
- Meer paveseseecarcinomen
- Meer basaalseecarcinomen
- Vooral bij gebruik < 35 jaar
- 2001 WHO: CARCINOGEN

Vitamine D
- Wat heb je nodig: UVB
- Aanmaak binnen 5 min.
- Maximaal na 20 min.
- Na 1950: 30x vakansieduur!
- Zonnebrandcrème leidt niet tot tekort
- Advies internationale dermatologen: neem extra vitamin D tabletp. maar ga niet langer in de ZON
- In Nederland: 15 minuten iedere dag!
Tussentijdse stelling 5

- Case finding van acineke keratose is gewenst in de huisartsenpraktijk
  - A. juist
  - B. Onjuist

Inhoud
- Inleiding
- Melanoom
- Non-melanoma huidkanker
  - Basiacellcarcinoom
  - Acineke keratose
  - Morbus Bowen
  - Plevoacellcarcinoom
- Preventie
- Diagnostiek
- Oefencasussen

Diagnostiek: Hoe ga je te werk?

- Stap 1: Verwelkom patiënt
- Stap 2: Anamnese
- Stap 3: Onderzoek huid patiënt
- Stap 4: Stel diagnose en adviseren arts
- Stap 5: Vervolg stap na diagnose

Stap 1: Verwelkom patiënt

- Is de patiënt ouder dan 50?
- Is er op het eerste oog al huidschade te zien? Is de persoon heel erg gebruikt door de zon?
- Wat is het huidtype van de patiënt? Huidtype 1 & 2 hebben een verhoogd risico op huidkanker.

Stap 2: Anamnese

- Hoe lang zit het plekje er al? Als het weken is, denk aan PCC.
- Groeit het plekje? Zo ja, denk aan huidkanker. als het soms weggaat of kleiner wordt, meestal geen huidkanker.
- Boeit het?
- Is het pijnlijk?
- Heeft u ook huidkanker gehad?
- Heeft u een organtransplantatie ondergaan of slik u immunosuppressiva? Zo ja, grote kans op huidkanker.
- Kookt er? Zo ja, verhoogde kans op PCC.

Stap 3: Onderzoek huid patiënt

- Ruw aanvoelen! Denk aan AK
- Glanzend! Denk aan BCC
- Verheven rand! Denk aan BCC
- Bloedend of korst! Denk aan BCC
- Verwijde bloedraadjes om het plekje! Denk aan BCC
- Een bij aanraking! Denk aan PCC
Stap 4: Stel diagnose en adviseer arts

- De diagnose wordt gesteld aan de hand van de antwoorden op de vragen die u heeft gesteld en de kenmerken van het plekje.

- Vervolgstep na diagnose: de vervolgstep hangt af van de vorm van non-melanoma huidkanker, de locatie, de grootte van het plekje en de aantal plekjes op het lichaam.

Stap 5: Vervolgstep na diagnose (doktersassistent huisartsenpraktijk)

- Verdenking AK: behandelen cryo/efudix of verwijzen voor PDT
- Verdenking BCC:
  - Geen excisie biopsie en verwijzen naar dermatoloog
  - Lichaam: biopsie nemen en evt behandelen / verwijzen naar dermatoloog
- Verdenking PCC:
  - Geen verwijzing naar dermatoloog
  - Lichaam: excisie or verwijzen naar dermatoloog
- Twijfel tussen AK en PCC: afhankelijk van de localisatie, direct excisie / verwijzen. Bij grote afwijking: biopsie
- Twijfel tussen BCC en niet-huidkanker: biopsie nemen.

Inhoud

- Inleiding
- Meelmoen
- Non-melanoma huidkanker
  - Basaalcellcarcinoom
  - Actinische keratose
  - Morbus Bowen
  - Plaveiselcellcarcinoom
- Preventie
- Diagnostiek
- Oefencasussen

Case 1: Vraag

- Een man van 67 jaar. Hij is havenwerker geweest als kranenschipper en heeft al jaren last van huidafwijkingen op handen en onderarmen. De plekjes jeukten en bloeden niet.
- Aan welke ziekte lijdt deze man? En hoe zou u deze man behandelen?
Case 1: Antwoord

» AK
De huidswijkingen zijn oppervlakkig, roeien ruw aan, de keratose (abnormale verdikking van de huid) zit vast aan de huid. Er is geen onderhuidse verharding.

» Geen eczeem: eczeem jeukt bijna altijd. Er is schilfering, geen keratose (op deze lokalisatie). Het zijn vrij scherp begrenzde plekjes; eczeem is meestal meer onscherp.

» Geen psoriasis: Psoriasis heeft scherp begrenzde rode schilferende plakken. Het kaarsvetfenomeen (schrapen over de huid geeft een witte laag) is bij psoriasis positief.

Case 2: Vraag


Case 2: Antwoord

» PCC
Een zwelling van 2 cm, verhard, pijnlijk, centraal keratose, bij patiënt met immunosuppressiva en in het verleden AK en Morbus Bowen.

» Voor AK is de laesie te groot, te onderhuids verhard. AK is meestal niet pijnlijk.

» Voor Morbus Bowen is de laesie te onderhuids verhard. Morbus Bowen meestal niet pijnlijk.

Case 3: Vraag

» Vrouw van 71 jaar. Heeft in het verleden last van AK en eczeem gehad. Sinds 2 maanden heeft ze een huidswijking op de handrug die groter en roder wordt. Het jeuk niet, doet geen pijn en bloedt niet.

Case 3: Antwoord

» AK
Het is een oppervlakkig, rood plekje met keratose (abnormale verdikking). Niet pijnlijk, bloedt niet. Er is geen onderhuidse verharding. Dus past bij AK.

» PCC: vaak > 1 cm, onderhuidse verharding, kan bloeden, pijnlijk (bij aanraking)

» BCC: glanzend, zichtbare verwijde bloedvaatjes om het plekje, is zeldzaam op handen en voeten.

» Indien het klinisch twijfelachtig is of er toch een PCC ontwikkelt, dan is een biopsi nodig.

Case 4: Vraag

» Man van 47 jaar. Er komt ustma en eczeem in 1e graad familie voor. Heeft sinds enkele weken jeukende huidswijkingen in het gezicht. Ook enkele afwijkingen aan de handen.
Case 4: Antwoord

- Eczema
  - Vrij snel ontstaat, rode, schilferende plekken verspreid in het gezicht, nek en romp. Temporair is verdunning van de huid en schilfering ten gevolge van het krassen. Familie anamnese is positief voor eczema. Ook andere delen lichaam zouden ontstaan.
  - Geen AA; bij AK: keratose, vaak grote gebieden aangedaan met grote gebieden met AK, vaak bij oudere personen, vaak voorhoofd, scalp.
  - Geen lupus eritematosus: LE schepen beginnend bij LE zonlichtfactor.
  - Geen mycosis (schimmel); hier geen randazciet, er is een vrij groot gebied aangedaan met diverse plekjes, geen contact met dieren etc. Dus onbevreesd.

Samenvatting (I)

- Tabel: verschilende zieken

Samenvatting (II)

- Tabel: verschilende zieken

Toekomst Huidkanker epidemie

- 1 op 4 Nederlanders
- 1 op 2 (65-plussers)
- Chronische ziekte
  - Morbiditeit
  - Mortaliteit
  - Hoge kosten
- Disass Management
  - Grote rol voor huisartsen en arts ondersteunend personeel

Take home

- Denk aan (superficiële) BCC's bij naast eczema
- Denk bij een niet-genezen ulcus (zweer) aan huidkanker
- Denk bij kale hoofdhuid & huidtype 1 aan AK
- Er zijn een aantal vragen die een bepaald type huidkanker doen vermoeden, maar deze gelden niet altijd. Dit blijft de combinatie van kenmerken en risicofactoren van de verschillende soorten huidkanker in gedachten houden!

Huidkanker: voorkomen, ketter dan genezen!!!

...En tot die tijd: wees alert!
Appendix B: Examples of questions from pre- and posttest

**Onderdeel 1: praktijkcases**

Wat zou u van de volgende patiënten willen weten om erachter te komen welke huidaandoening ze hebben? U mag 2 vragen stellen waarop de testafnemer antwoord zal geven. Verder mag u op het einde een diagnose geven en aangeven met welke zekerheid u dit doet.

**Case 1**
Man van 79 jaar.
Bekijk het rood omcirkelde plekje.

Vraag1:
Antwoord1:
Vraag2:
Antwoord2:

Diagnose (omcirkel één antwoord):
- [ ] a. AK
- [ ] b. BCC
- [ ] c. PCC
- [ ] d. Eczeem
- [ ] e. Anders/geen huidkanker

Hoe zeker bent u van deze diagnose (omcirkel één antwoord):
Zeker / tamelijk zeker / tamelijk onzeker / onzeker / een complete gok

**Onderdeel 2: Kennistest**

Beantwoord de volgende meerkeuze vragen. Er is telkens één antwoord juist. Omcirkel telkens het juiste antwoord.

**Voorbeeld:**

Vraag X
- [A] Juiste antwoord
- [B] Foute antwoord
De afkortingen **AK** (actinische keratose), **BCC** (basaalcelcarcinoom) en **PCC** (plaveiselcelcarcinoom) komen veelvuldig voor in de vragenlijst.

**Vraag 2**
Linda wordt langzaam bruin en heeft blond haar en blauwe ogen. Dit zijn eigenschappen van:
- A. huidtype 1
- B. huidtype 2
- C. huidtype 3
- D. huidtype 4

**Vraag 4**
Een blanke patiënt van 56 jaar oud heeft een rood schilferend en ruw plekje in het gelaat. Welke aandoening is het meest waarschijnlijk?
- A. AK
- B. BCC
- C. Eczeem
- D. PCC

**Vraag 11**
Wat zijn kenmerken van BCC? Geef het best passende antwoord.
- A. Centrale ulceratie, glanzend huidkleurig papel, teleangiëctasieën in de rand
- B. Schilferig roze nodulus met een opgeworpen rand en decentrale ulceratie
- C. Schilferig donker papel met een centrale ulceratie
- D. Ruw aanvoelend, teleangiëctasieën in de rand en een opgeworpen rand

**Vraag 16**
Welke bewering over Efudix crème is juist? Efudix crème..
- A. geeft nauwelijks bijwerkingen.
- B. is een behandeling voor Actinische keratosen.
- C. mag alleen door een dermatoloog worden voorgeschreven.
- D. hoeft slechts 5 dagen gesmeerd te worden.

**Vraag 18**
Welke uitspraak over preventiemaatregelen tegen huidkanker is NIET waar?
- A. Vooral jonge kinderen moeten goed beschermd worden tegen teveel zonlichtblootstelling
- B. Zonnebrandcrème met SPF 15 is al voldoende om huidkanker te voorkomen voor mensen met een blanke huid
- C. Primaire preventie dient plaats te vinden door minder expositie aan zonlicht, vermijden van zonnebanken, dragen van beschermende kleding en gebruik van zonnebrandcrèmes met voldoende hoge beschermingsfactoren tegen UVA en UVB
- D. Adequate UV-protectie helpt als secundaire preventie om de ontwikkeling van nieuwe AK te remmen.
## Appendix C: Correlation matrix measured variables

|  | Mean | Std. | N  | 1   | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9   | 10  | 11  | 12  | 13  | 14  | 15  | 16  | 17  | 18  | 19  | 20  | 21  | 22  | 23  | 24  | 25  | 26  | 27  |
|---|------|------|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 1 | group (E, C) | .53 | .51 | 19 |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 2 | pretest score | .51 | .14 | 19 |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 3 | posttest score | .51 | .15 | 19 |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 4 | time between pre- and posttest (in days) | 50.63 | 31.81 | 19 | .53** |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 5 | % correct NMSC or other | .75 | .21 | 15 |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 6 | % correct type NMSC | .64 | .28 | 13 | .59** | .59 |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 7 | % correct diagnoses | .62 | .28 | 15 | .59** | .60** |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 8 | % correct referrals | .56 | .23 | 14 | .57** | .53 | .56** | .53** |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 9 | age (in years) | 38 | 11.47 | 19 | .58** | .58** |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 10 | job experience (in months) | 124 | 123.67 | 19 | .66* |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 11 | Mohs/hospital vs. GP practice/skin clinic | .58 | .51 | 19 |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 12 | physician assistant | .53 | .51 | 19 |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 13 | skin therapist | .26 | .45 | 19 | .63** | .59** |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 14 | nurse | .21 | .42 | 19 | .57** | .54** |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 15 | self-efficacy | 3.06 | .35 | 19 | .47** |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 16 | goal orientation | 4.68 | .68 | 19 | .52** |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 17 | anxiety/negative affectivity | 3.14 | .62 | 19 | .60** |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 18 | career planning | 2.99 | .22 | 19 | .55** |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 19 | training motivation | 4.24 | .55 | 19 | .65** |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 20 | perceived utility | 4.35 | .59 | 10 | .54** | .54** | .65** |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 21 | motivation to transfer | 4.28 | .59 | 10 | .57** | .53** | .63** | .63** | .63** | .63** |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 22 | transfer design | 4.25 | .51 | 10 | .64** |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 23 | training feedback | 3.82 | 1.06 | 9 | .64** | .74** | .65** | .74** |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 24 | performance self-efficacy | 4.03 | .48 | 9 | .74** | .76** | .79** | .76** | .79** | .79** |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 25 | personal capacity for transfer | 3.36 | .49 | 10 | .73** | .70** | .70** | .70** | .70** | .70** | .70** |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 26 | peer support | 4.30 | .52 | 10 | .70** | .66** | .66** | .66** | .66** | .66** | .66** |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 27 | opportunity to perform | 2.95 | .28 | 10 |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |

**Note:** **. Correlation is significant at the .001 level (2-tailed); *. Correlation is significant at the .05 level (2-tailed)