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The use of teledermatology and teledermoscopy for referrals of patients with suspected skin cancer
[Användning av teledermatologi och teledermatoskopi för remittering av patienter med misstänkt hudcancer]

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HTA-centrum, Region Västra Götaland

Abbreviation list

AK	Actinic keratosis
BCC	Basal cell carcinoma
F	Female
FBSE	Full body skin examination
FTF-visit	Face-to-face-visit
GP	General practitioner
M	Male
M/F	Male/female
MM	Malignant melanoma
MM*is*	Malignant melanoma *in situ*
NA	Not applicable
NMSC	Non melanoma skin cancer
PCP	Primary care provider
PHC	Primary health care centre
RCT	Randomized controlled trial
SCC	Squamous cell carcinoma
SCC*is*	Squamous cell carcinoma *in situ*
S&F	Store and forward
SR	Systematic review
TD	Teledermatology
TDS	Teledermoscopy
UV	Ultraviolet
VA	Veterans affairs

Summary of the Health Technology Assessment

Background

Patients with suspected skin cancer are referred from the general practitioner (GP) to the dermatologist, traditionally by text-based referral without photo documentation. Teledermatology (TD) implies electronic referral including a digital image of the skin lesion. The technology is called teledermoscopy (TDS) when dermoscopic images are added**.** The dermatologist prioritizes further management based on the assessment of the referral containing clinical information and the images.

Objective

To evaluate if electronic referrals including macroscopic and/or dermoscopic images compared with standard text referrals lead to more adequate prioritization, reduce the time to correct diagnosis and treatment for adult patients with suspected skin cancer, as well as reduce the number of dermatologist consultations without increasing the amount of incorrect assessments.

Main results

A systematic literature search identified 28 publications including two randomized controlled trials (RCT), five cohort studies and 21 cross-sectional studies which met the inclusion criteria.
Based on two cohort studies, TDS referral resulted more often in correct prioritization of patients with skin cancer lesions than after conventional referral; OR 13.2, 95% CI 3.5 to 50.5. Low quality of evidence (GRADE ⊕⊕◯◯). No malignant melanomas were mismanaged after TDS referral. Less than 1% of skin lesions assessed through TDS as benign and not necessary for a dermatologist consultation were actually precancerous lesions. Patients prioritized not to see a dermatologist may have the disadvantage of not undergoing a full body skin examination (FBSE).
Time to treatment was shorter after TD/TDS compared with standard referral in one RCT and five cohort studies reporting this outcome. Low quality of evidence (GRADE ⊕⊕◯◯).
Preventable visits to a dermatologist were increased after TD/TDS compared with standard referral; OR 2.8 (1.8 to 4.6), based on two RCT's and supported by two additional cohort studies. Low quality of evidence (GRADE ⊕⊕◯◯).
An additional question, how TD/TDS and clinical evaluation (face-to-face, FTF) compared to a reference standard of histopathology was evaluated in five cross-sectional studies. The diagnostic accuracy (in this context, sensitivity) and the accuracy of proposed management plans varied between 81% and 100% for both TD/TDS and FTF. It is difficult to evaluate if there is any significant difference between the methods' sensitivity, due to imprecision and heterogeneity in the studies. The addition of dermoscopic images to macroscopic images was reported to increase sensitivity.
There are different technologies for the available electronic referral systems. Sufficient studies on cost-effectiveness are lacking.
Ethical aspects include the concern about the risk of missing a malignant lesion among those patients that are prioritized not to see a dermatologist. The electronic transfer of individual patient data has to be secured.

Concluding remarks

TD/TDS referrals may improve the prioritization of skin cancer patients and reduce the time to treatment for patients with suspected skin cancer compared with standard referrals. The number of unnecessary visits to a dermatologist may be reduced. The risk of missing a malignancy among those referred by TDS and assessed as not in need to see a dermatologist, is low. The quality of evidence is low for all reported outcomes (GRADE ⊕⊕◯◯).

Svensk sammanfattning

Bakgrund

Patienter med misstänkt hudcancer remitteras från primärvård till hudklinik, vanligen via pappersremiss utan fotodokumentation. Teledermatologi (TD) innefattar elektronisk remiss med kliniska data samt digitala bilder på hudförändringen. Att inkludera bilder tagna med hjälp av ett dermatoskop som ger en förstoring kallas teledermatoskopi (TDS). Dermatologen gör en prioritering av remissen baserad på bedömning av bilder samt klinisk information.

Frågeställning

Kan elektronisk remiss med tillägg av digitala bilder, jämfört med standardremiss, förbättra prioritering och därmed minska tiden till korrekt diagnos och behandling för patienter med misstänkt hudcancer, samt öka andelen remitterade patienter som inte behöver komma för konsultation utan att andelen felaktiga (falskt negativa) bedömningar ökar?

Resultat

Litteratursökningen identifierade 28 publikationer (två randomiserade studier (RCT), fem kohortstudier och 21 tvärsnittsstudier) som uppfyllde uppställda inklusionskriterier.
Två kohortstudier redovisade att remittering via TD/TDS resulterade oftare i en korrekt prioritering av patienter med hudcancer, jämfört med traditionell remittering; OR 13.2, 95% KI 3.5; 50.5. Begränsat vetenskapligt underlag (GRADE ⊕⊕◯◯). Inga maligna melanom missades vid TDS remittering. Falskt negativa svar (förstadier till hudcancer) förekom i mindre än 1% av de hudförändringar som initialt bedömdes som benigna. Patienter som prioriteras till att inte bedömas kliniskt av hudläkare riskerar att inte få den helkroppsundersökning, som rekommenderas av hudläkare, för att utesluta andra hudförändringar på övriga delar av kroppen. Tid till behandling var kortare efter TD/TDS jämfört med traditionell remiss enligt en RCT och fem kohortstudier. Begränsat vetenskapligt underlag (GRADE ⊕⊕◯◯).
Antalet besök hos dermatolog kunde reduceras efter TD/TDS jämfört med traditionell remiss; OR 2.8 (1.8; 4.6), enligt två RCT och stött av ytterligare två kohortstudier. Begränsat vetenskapligt underlag (GRADE ⊕⊕◯◯).
Säkerheten med teledermatologi är även belyst via ytterligare en frågeställning; hur bra är TD/TDS jämfört med klinisk bedömning av patienten, relaterat till en referensstandard, histopatologi, att skilja maligna från benigna lesioner? Av fem tvärsnittstudier visade två samma sensitivitet, medan tre studier visade lägre sensitivitet för TD/TDS jämfört med klinisk bedömning. Sensitiviteten varierade mellan 81% och 100% vid båda metoderna. Tillägg av dermatoskopiska bilder ökade i vissa fall sensitiviteten.

Analyser avseende metodens kostnadseffektivitet är otillräckliga. Kostnader tillkommer för investering i ett elektroniskt system för bild-och dataöverföring samt utbildning. Bedömning av TD/TDS remisser tar längre tid än för standardremisser vilket medför en kostnadsökning. Besparingar kan förväntas pga färre besök på hudklinik och färre onödiga operationer i primärvård. Etiska aspekter inkluderar osäkerheten i att inte bli bedömd av hudläkare samt säkerheten kring elektronisk överföring av patientdata.

Sammanfattande bedömning

Elektronisk bildöverföring vid remittering av patienter med misstänkt hudförändring kan förbättra prioriteringen av patienter med hudcancer, vilket resulterar i kortare handläggningstider och att andelen som inte behöver ses av hudläkare ökar. Det finns en liten risk att bedömning av enbart fotoremiss utan efterföljande klinisk bedömning av patienten kan innebära att premaligna eller maligna lesioner missas. Denna risk finns även vid klinisk bedömning. Begränsat vetenskapligt underlag (GRADE ⊕⊕◯◯).

Summary of the Health Technology Assessment from The Regional Health Technology Assessment Centre (HTA-centrum)

The Regional Health Technology Assessment Centre (HTA-centrum) of Region Västra Götaland, Sweden (VGR) has the task to make statements on HTA reports carried out in VGR. The English summary is a concise summary of similar outline as the summaries in the Cochrane systematic reviews. The Swedish summary summarises the question at issue, results and quality of evidence regarding efficacy and risks, and economical and ethical aspects of the particular health technology that has been assessed in the report, and is ended with a final statement/concluding remark from HTA-centrum.

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Summary of Findings – table

Teledermatology/teledermoscopy referral versus standard referral

Outcomes	Study design Number of studies Total number of patients	Relative effect (95%CI)	Absolute effect TD/TDS vs standard referral	Quality of evidence GRADE
Correct prioritization	2 cohort studies MM MM + SCC	OR 11.4, (1.8; 170.5) OR 13.2, (3.5; 50.5)	100 vs 25% and 93 vs 67%	⊕⊕◯◯ Low[1]
Time to treatment	1 RCT (all skin lesions) 5 cohort studies		Median 41 vs 127 days Difference (range): 3-49 days shorter for TD/TDS	⊕⊕◯◯ Low[2] ⊕⊕◯◯ Low[3]
Preventable visits to a dermatologist	2 RCT (all skin lesions) 2 cohort studies	OR 2.8 (1.8; 4.6)[4]	39 vs 18% and 18 vs 0%. 42 vs 0% and 76 vs 0%	⊕⊕◯◯ Low[5] ⊕⊕◯◯ Low[6]

OR = odds ratio, MM = malignant melanoma, RCT = randomized controlled trial, SCC = squamous cell carcinoma, TD = teledermatology, TDS = teledermoscopy

[1] Study limitations not serious enough to downgrade.
[2] Very serious indirectness, all types of skin lesions included. Skin cancers not separately presented.
[3] Unclear risk of bias. Potential selection bias works in the direction of counteracting an effect. Potential reporting bias due to poor reporting of data. In summary, not reason to downgrade. All studies show result in the same direction, although the size of the estimate of the effect is unclear.
[4] The only study in which patients, also after standard referral, could be prioritized not to see a dermatologist.
[5] Downgraded two steps due to serious indirectness, all types of skin lesions included, and unclear risk of bias (incomplete follow-up).
[6] The effect size is difficult to interpret since the comparison by default is made with zero events. Study limitations not serious enough to downgrade.

Quality of evidence

High quality ⊕⊕⊕⊕	We are very confident that the true effect lies close to that of the estimate of the effect.
Moderate quality ⊕⊕⊕◯	We are moderately confident in the effect estimate: The true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low quality ⊕⊕◯◯	Confidence in the effect estimate is limited: The true effect may be substantially different from the estimate of the effect.
Very low quality ⊕◯◯◯	We have very little confidence in the effect estimate: The true effect is likely to be substantially different from the estimate of effect

Participants in the HTA-project

1a Who posed the question?

Program och prioriteringsrådet, Gothenburg, Region Västra Götaland.

1b Participants from the clinics, in the project

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1d Are there any conflicts of interest for the proposer or any of the participants in the work group?

Markus Danielsson, Karin Terstappen, Anette Aldenbratt, Martin Gillstedt are co-authors in the publication Börve et al., 2014.
Karin Terstappen is also co-author in the publication Börve et al., 2013 and Tidig upptäckt av symtomgivande cancer (translation: Early detection of cancer with symptoms), SBU, 2014.

Skin cancer and present treatment

2a Skin cancer; type and severity

The incidence of skin cancer in Sweden as well as in all western societies is constantly rising among fair-skinned individuals. Skin cancer is the second most common cancer in Sweden (The Swedish Cancer Registry of the National Board of Health and Welfare, 2012).

Malignant tumors are more common in the skin than in any other organ. The three main types of skin cancer are malignant melanoma (MM), squamous cell carcinoma (SCC) and basal cell carcinoma (BCC). SCC and BCC are commonly referred to as non-melanoma skin cancer (NMSC). This report will not cover other, rare types of skin cancer.

The main risk factor for the development of skin cancer is exposure to solar UV radiation. Individuals with light coloured skin and/or light/red hair have an increased risk of developing skin cancer (Kennedy *et al*., 2003; Vahlquist *et al*., 2012).

All types of skin cancer can be cured if detected early, and effective treatment is given. (Vahlquist *et al.*, 2012).

Malignant Melanoma

Malignant melanoma (MM) is a severe, and sometimes fatal type of skin cancer. The precursor lesion of a MM is called MM *in situ* (MM*is*). The risk for hematogenous and lymphatic spreading is high. Accurate management is critical due to the morbidity and mortality associated with MM.

In addition to solar UV radiation, artificial UV radiation from solariums probably has an additive effect. Patients with a large number of common and/or atypical nevi as well as previous MM have an increased risk of developing MM. The genotype may also be involved in among 5-10% of all MMs. The majority of all MM arises from mutated melanocytes in normal skin (*de* novo) but may also appear within a nevus. The prognosis depends on the clinical and histopathological characteristics. The most important prognostic factor is the thickness of the melanoma (according to Breslow thickness). Melanomas with a Breslow thickness of ≤ 1 mm have a much more favorable prognosis compared with a MM with a Breslow thickness of > 4 mm. The five year survival rate of the latter is less than 50%, but individuals with surgically excised MM ≤ 1.0 mm have a survival rate of 95–98% (Bolognia *et al*., 2012; Vahlquist *et al*., 2012).

There are various subtypes of MMs. Depending on the subtype, the Breslow thickness and invasion depth of MMs can increase between 0.05 to 0.5 mm monthly (Liu *et al*., 2006; Tejera-Vaquerizo *et al*., 2010).

Thus, in terms of the prognostic outcome, the time to diagnosis and surgical treatment is crucial. With early detection and effective treatment, MM can be cured (Bologna *et al*., 2013; Vahlquist *et al*., 2012; Nationellt vårdprogram malignt melanom, 2013).

Squamous Cell Carcinoma

Squamous cell carcinoma (SCC) is the second most common type of skin cancer in Sweden. Squamous cell carcinoma *in situ* (SCC*is*) is the precursor to SCC and usually arises from atypical keratinocytes in epidermis, the most superficial layer of the skin. Actinic keratosis (AK) are the earliest precursors to SCC and amongst the most frequently

encountered skin lesions in clinical practice. It is estimated that approximately 0.01%/AK evolves into SCC each year. The main risk factors are UV radiation (both solar and artificial UV radiation) and a light skin type.
However, SCC does not always arise due to UV radiation. Genital SCCs are generally associated with Human papilloma virus (HPV) infection, and sometimes with the skin disease Lichen Sclerosus (LS). Rare genetic syndromes may also play a role in the development of SCC (Bologna et al., 2013). A few SCCs occur due to previous ionizing radiation therapy, chemicals (e.g. arsenic), chronic ulcers, sinus tracts and scars (National Health & Medical Research Council. Non-Melanoma Skin Cancer: Guidelines for treatment and management in Australia. 2002).
The total amount of UV radiation is important for the development of SCC. Consequently, SCC most frequently arises in chronically UV-exposed skin areas. SCC has the potential to spread to regional lymph nodes. The risk of developing metastasis in SCC is estimated to be 2-5% (Czarnecki *et al*., 1994; Joseph *et al*., 1992; Veness *et al*., 2007). The risk for metastasis of SCC depends on the etiology and anatomic site of the tumor, the tumor size, the growth speed, immunosuppression and histopathological degree of anaplasia. With early detection and treatment, SCC can be cured (Bologna *et al*., 2013; Vahlquist *et al*., 2012).

Basal Cell Carcinoma

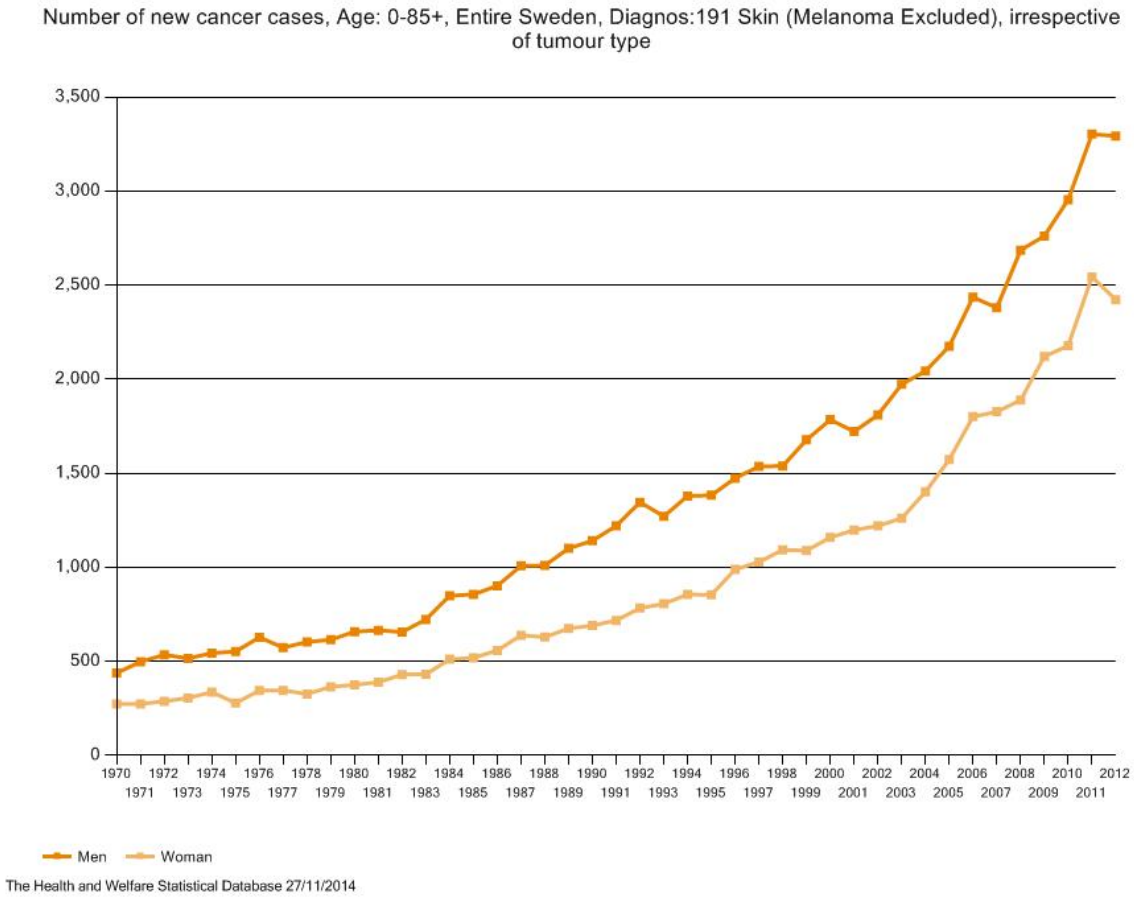
Basal cell carcinoma (BCC), the most common type of skin cancer, grows slowly and rarely metastasizes. However, a BCC can invade surrounding tissue and infiltrate e.g. an eye.
Due to the large number, BCC cause a substantial cost for the health care system as well as suffering for the patients. These tumors arise from immature epithelial cells within sun damaged skin. A few BCCs occur due to previous ionizing radiation therapy, chemicals (e.g. arsenic), chronic ulcers, sinus tracts and scars. Genetic disorders and immunosuppression are other risk factors (Bologna *et al*., 2013; National Health & Medical Research Council. Non-Melanoma Skin Cancer: Guidelines for treatment and management in Australia, 2002).

Degree of severity

- ☑ Risk of premature death
- ☑ Risk of permanent illness or damage, or reduced quality of life
- ☑ Risk of disability and decreased health-related quality of life

2b Prevalence and incidence of skin cancer

Skin cancer is the most rapidly increasing malignancy in Sweden (figure below, Incidence of skin cancer in Sweden). Among all cancer cases in Sweden, MM and SCC represent 15%. The latter is the second most common cancer among Swedish males and females after prostate and breast cancer, respectively (The Swedish Cancer Registry of the National Board of Health and Welfare. Cancer incidence in Sweden 2012, 2014).

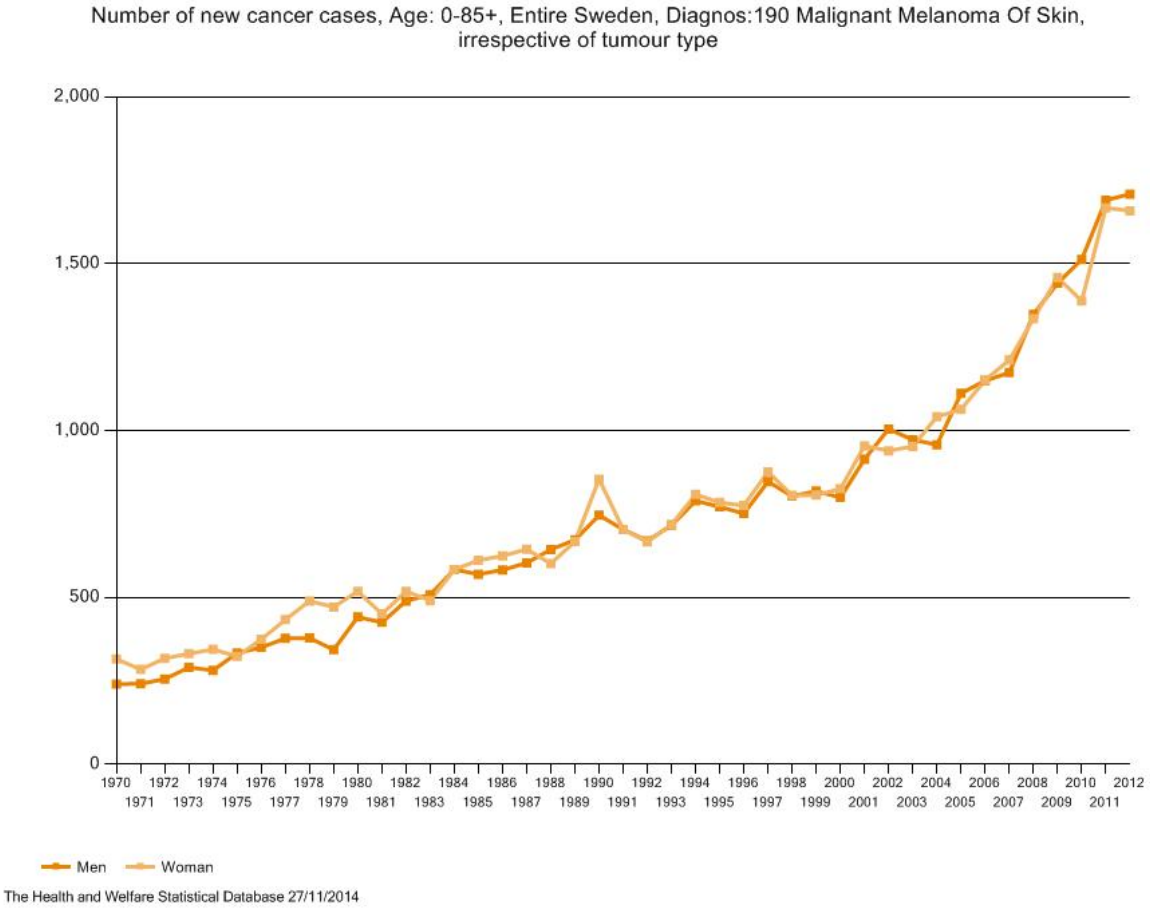


Malignant melanoma

Malignant melanoma (MM) was the sixth and fifth most common cancer in Sweden 2012 among males and females, respectively. The annual incidence of MM has increased more rapidly since 2000 (figure below). A total number of 3368 invasive MM (men: 1709; females: 1659) and 2620 MM*is* lesions (men: 1296; females: 1324) were registered in Sweden 2012. Accordingly, the total amount of MMs registered in 2012 in Sweden were 5988. The age-standardized yearly incidence rates per 100.000 persons for invasive MM were 36.4 in males and 32.1 in females (The Swedish Cancer Registry of the National Board of Health and Welfare. Cancer incidence in Sweden 2012, 2014).

In 2011, there were approximately 30 500 individuals who had or had had MM and 486 individuals died from MM (men 284; females 202). The five year survival rate was 94% among women and 84 % among men. In comparison, the five year survival rate was approximately 50% in the 1960's (Nationellt vårdprogram malignt melanom, 2013; Vahlquist *et al*., 2012).
In parallel to the increased incidence of MM, the number of deaths have increased from the 1970's. In 1999, the mortality was 4 per 100.000 (348 cases) compared to 5.2 per 100.000 (486 cases) in 2011.
There are regional differences in the number of cases with MM. The southern coastal regions of Sweden are more affected than other regions, and the prevalence of MM in Region Västra Götaland (VGR) is above the average of the country. The number of new cases of invasive MMs in VGR was 716 in 2012. The age-standardized incidence rates per

100.000 persons for MM were 47.8 in males and 39.9 in females. Data is not available for MM*is* (The Swedish Cancer Registry of the National Board of Health and Welfare. Cancer incidence in Sweden 2012, 2014).



Squamous cell carcinoma

The annual incidence of skin cancer mainly consisting of SCC has increased over the past decade and is 4.7% for women 6.9% for men. In total 5152 individuals (men 2938; females 2214) were diagnosed with SCC in 2012. In Sweden, the age-standardized incidence rates per 100.000 persons for invasive SCC were 79.2 in males and 41.8 in females.
In 2012, the total number of new invasive SCC in VGR was 1079 and the age-standardized incidence rates per 100.000 persons were 85.8 in males and 51.5 in females. The mortality rates for SCC for men and women are 0.8 and 0.5 cases per 100.000, respectively (The Swedish Cancer Registry of the National Board of Health and Welfare. Cancer incidence in Sweden 2012, 2014).

In 2012, 7865 SCC*is* lesions (men: 3579; females: 4286) were diagnosed. Data is not available for SCC*is* regarding age-standardized incidence rates and annual increases for the last ten years (The Swedish Cancer Registry of the National Board of Health and Welfare. Cancer incidence in Sweden 2012, 2014).

Basal Cell Carcinoma (BCC)

Basal cell carcinoma is the most common type of all cancer. The incidence rate is estimated to be ten times higher today than 30 years ago. In 2004, 31.770 BCC were reported in Sweden. In 2008, 36.560 new cases were reported. The lifetime cumulative rate of developing BCC before the age of 75 is 15% among Swedish men and women (The Swedish Cancer Registry. National Board of Health and Welfare. Basal Cell Carcinoma in Sweden 2004-2008, 2009).

2c Present treatment of skin cancer

Skin cancer can be treated surgically as well as non-surgically. The most frequently used methods in Sweden are surgery, destructive methods, and medical treatments. Surgery, with histopathological verification of the diagnosis and complete removal of the lesion, is the preferred procedure. Other methods that primarily are used for precursors and superficial NMSCs include destructive therapies (cryosurgery, curettage and electrodesiccation, laser ablation), medical treatments (topical creams such as imiquimod, 5-fluorouracil, ingenol mebutate, diclofenak), photodynamic therapy and radiation therapy.

2d Number of patients per year who undergo treatment

Every year approximately 24 000 paper-based referrals of suspected skin cancers are sent to the five Departments of Dermatology and Venereology in VGR (See table below).

Hospital	**Number of referrals**	**Number of surgical procedures of suspected skin cancer**
Sahlgrenska University Hospital	8600	1200
Skaraborg Hospital	3400	1200
Uddevalla Hospital	5400	1300
Southern Älvsborg Hospital	3500	1300
Frölunda Specialist Hospital	2900	800

(Statistics from “Nominering ordnat införande 2013-01-30”)

The annual distribution of different skin malignancies in VGR is presented in the table below.

Number of patients with diagnosed skin cancer in the Region Västra Götaland

Year	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**Total**
MM	478	461	551	569	575	699	718	719	4770
MMis	272	296	319	384	349	634	704	619	3577
SCC	891	826	833	912	846	946	1047	1202	7503
SCCis	1096	1165	1238	1331	1264	1706	1612	1587	10999
Other	40	41	65	53	68	66	77	76	486
Total	**2777**	**2789**	**3006**	**3249**	**3102**	**4051**	**4158**	**4203**	**27335**

(Data is presented by Regionalt cancercentrum Väst.)

2e The normal pathway of a patient through the health care system

A referral to a dermatologist is needed when a general practitioner (GP) cannot exclude skin cancer. In the Swedish National Health Service, the normal clinical pathway for patients with suspected skin cancer is based on traditional paper-based referrals sent from a GP at a primary health care center (PHC) to a Dermatology clinic by mail or fax (including patient self-referrals). These conventional text-based referrals rarely include photo documentation. The referrals also vary greatly in quality, and can lack important descriptive clinical details. This can lead to incorrect prioritization of patients. At the Dermatology department, the referrals are assessed and given a priority regarding when to book the patient for a dermatologist consultation, depending on the suspected severity of the lesion. The patient is thereafter examined at a dermatologist consultation that includes a clinical, as well as a dermoscopic evaluation, of the lesion. At the initial clinical face to face visit (FTF), also a full body skin examination (FBSE) is performed to detect so called "incidental findings".

2f Actual waiting time in days for medical assessment and handling of referrals

A study recently performed at the Department of Dermatology and Venereology, Sahlgrenska University Hospital in Gothenburg and Skaraborg Hospital in Skövde showed that it usually takes approximately four to five days for a paper referral to arrive at the Dermatology clinic. The referral is then assessed and triaged by a dermatologist within 24 hours (Börve et al., 2014). The triage decision by the dermatologist depends on the suspected severity of the lesion. Patients with suspected MM and SCC are called to a FTF visit, within two weeks (high priority), with or without subsequent surgery/biopsy and histopathological analysis and diagnosis. Patients with suspected MM*is* and SCC*is* are prioritized to a FTF visit within two to four weeks (medium priority). Patients with a preliminary diagnosis of BCC, AK, dysplastic nevus (DN) or other benign melanocytic/non-melanocytic lesions are called to a FTF-consultation within 4-12 weeks (low priority).

Patients in need of surgical treatment often visit the hospital twice. The first visit is a FTF with a FBSE with a clinical and dermoscopic evaluation. The second visit is for the surgical treatment. The current clinical pathway usually implies several months before the referring GP receives an answer regarding diagnosis, management and treatment.

Teledermatology and Teledermoscopy

3a Description of the health technology at issue

In teledermatology (TD), digital images of suspected skin lesions are transferred electronically with relevant medical and clinical information to a dermatologist. When dermoscopic images are added, the technology is called teledermoscopy (TDS). The technique can be used for referral of patients instead of traditional text-based referrals. The dermatologist then assesses the referral and prioritizes to whether and how soon the patients should be seen for a consultation. This is the question of issue in the present HTA-report.
The technique can also be used in remote areas for diagnosis and management consultation, without a clinical visit to the dermatologist.

Dermoscopy (epiluminescence microscopy) is a diagnostic tool particularly useful in the early detection of malignant skin lesions. It is the most used non-invasive diagnostic technique to increase the diagnostic accuracy in dermatological practice when assessing suspected skin tumors.

TD/TDS can be used in two ways: store-and-forward (S&F) TD, which is most common, and real time/live interactive TD. The advantage of the S&F TD/TDS method is that the GP and the dermatologist do not have to participate at the same occasion. Until today, TD and TDS have usually required the use of non-transportable digital dermoscopy equipment, a melanographer (specially trained photographer), and a technology to transfer the images from the equipment to a computer and subsequently a transfer of the images and the medical record to a dermatologist (Morton 2011; Tan 2010). New technologies have lately been developed to perform TD/TDS in a more convenient way.

3b The work group's understanding of the potential value of teledermatology and teledermoscopy

Teledermatology and teledermoscopy are proposed to be used when referring patients with suspected skin cancer from GPs at PHCs to dermatologists.
With early detection, diagnosis and effective treatment all types of skin cancer can be cured. In comparison with the present traditional paper referral system, TD and TDS referrals (electronic medical records and macroscopic/dermoscopic images) may provide substantial improvements of the handling of patients who have suspected skin cancer in the general practice setting. It may provide more accurate prioritization, as well as faster diagnosis, and consequently shorter time to treatment.

A better prioritization can result in an improved access to dermatologists for those patients who have severe lesions, and a reduction of visits for those who are not in need for consultation with a dermatologist. However, the sensitivity and specificity of this strategy is not yet fully clarified. It is important that the sensitivity to correctly prioritize patients with malignant lesions is sufficiently high and that these patients are not referred back to the GP or have no follow-up at all.
Other possible benefits of the TD/TDS approach are faster feedback to the GP, easy available 'second opinion'-system, and more information to plan for surgical treatment at the first visit.

A limitation of the technique is that the FBSE to detect incidental findings, cannot be performed when only images of the particular skin lesions are evaluated. Incidental findings are reported in 1%-15%, also including cases with MM (Aldridge *et al*., 2013, Viola *et al*., 2011, Börve *et al*., 2014). Thus, TD and TDS referrals cannot completely substitute for a FBSE by a dermatologist and is not fully comparable to a FTF visit. A FBSE is recommended regardless of the used referral system and can be performed at the PHC.

A technical system that is presently available in Sweden today is to refer the patient by a smartphone application with clinical and dermoscopic images, although only one lesion can be sent at a time. The county of Gävleborg has recently introduced a system with integrated macroscopic and dermoscopic images in the medical record system through an image program Picsara. It allows an unlimited number of lesions to be referred.

3c **The main question for the current HTA project**

Can electronic referrals, with macroscopic and dermoscopic images added, of adult patients with suspected skin cancer, better prioritize to a face-to-face consultation with a dermatologist, and thereby reduce the time to correct diagnosis and treatment without increasing the amount of incorrect assessments compared with traditional text-based referral?

3d **PICO**

P= Patients, I= Intervention, C= Comparison, O=Outcome

P	Adult patients with skin lesions, in whom malignancy cannot be excluded
I	Photo referral (excluding patient self-referrals) with digital technology (macroscopic and/or dermoscopic image) and subsequent clinical pathway with assessment of referral, and if indicated consultation/surgical treatment
C	Traditional paper based or electronic referral without photo documentation (excluding patient self-referrals) and subsequent clinical pathway with assessment of referral, and if indicated consultation/surgical treatment
O	<u>Critical for decision making</u> Correct prioritization of skin cancer Time to treatment <u>Important but not critical for decision making</u> Preventable visits to a dermatologist

An additional question is how the diagnostic accuracy of teledermatology/ teledermoscopy compares to a reference standard (clinical evaluation and histopathology). Thus, this comparison differs from the comparison between TD/TDS and standard referral in the main question (3c). The diagnostic accuracy of TD/TDS is compared with a reference standard, preferably histopathology, but also with the clinical evaluation. This question is accounted for under 5b and in Appendix 5.

Review of the Quality of Evidence

4 Search strategy, study selection and references – Appendix 1

In October 2013, with an update in July 2014, two librarians (TS, UWA) performed systematic searches in PubMed, EMBASE, the Cochrane Library, and a number of HTA-databases. Reference lists of relevant articles were also scrutinised for additional references. Search strategies, eligibility criteria and a graphic presentation of the selection process are accounted for in Appendix 1. The librarians conducted the literature searches, selected studies and independently assessed the obtained abstracts and a first selection of full-text articles for inclusion and exclusion. Any disagreements were resolved in consensus. The remaining articles were sent to the participants, who read the articles independently and then decided in a consensus meeting which articles that should be included.

The literature search identified a total of 865 articles after removal of duplicates. The librarians then excluded 790 after reading the abstracts. Another 12 articles were excluded by the librarians after reading the articles. The remaining 63 articles were sent to the participants, and 28 of them were included in the report. The final report included two randomized controlled trials, five cohort studies and 21 cross-sectional studies. The original articles have been critically appraised using modified checklists from SBU (Swedish Council on Health Technology Assessment), and the QUADAS-2 tool. Excluded articles are presented in Appendix 3.

5a Present knowledge of teledermatology and teledermoscopy as referral method

Seven publications including two randomized controlled trials (RCT) and five cohort studies met the inclusion criteria for the central question (PICO). Twenty-one cross-sectional studies fulfilled the criteria to evaluate sensitivity (5b and Appendix 5).
The included studies are presented in Appendix 2.

Outcomes critical for decision making:

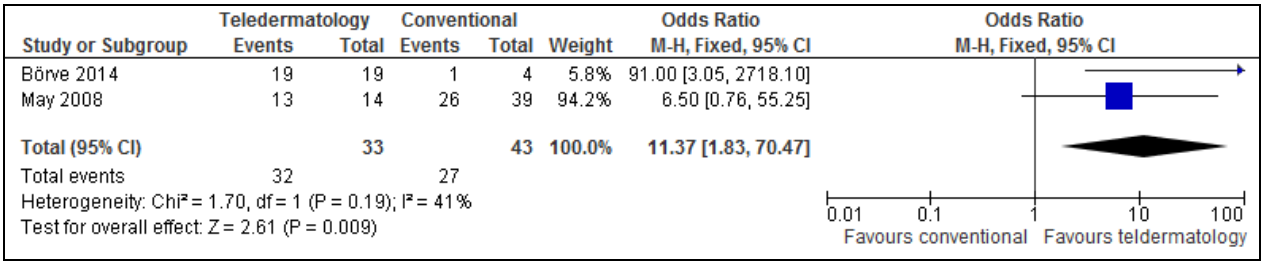
Correct prioritization of skin cancer (Appendix 4.1)
Two cohort studies that used both macroscopic and dermoscopic images of skin lesions have reported correct prioritization as an outcome.

One cohort study (Börve, 2014) reported a higher proportion of correctly prioritized MM and MM*is* in the TDS-group compared with the conventional referral group; 100% vs. 25% and 100% vs. 40%. Thus, no MM's or MM*is*' were missed. Among patients with SCC, 65% (11/17) were correctly prioritized after TDS referral compared with 40% (2/5) after standard referral. Among the 816 lesions referred by TDS, 346 (42%) were assessed as benign without any differential diagnoses. Three (0.9%) of these were diagnosed with actinic keratosis (pre-cancerous lesion), and would have been mismanaged in a real-life situation if they had been referred back without any follow-up. Only 0.4% of TDS referrals had to be excluded due to insufficient image quality.

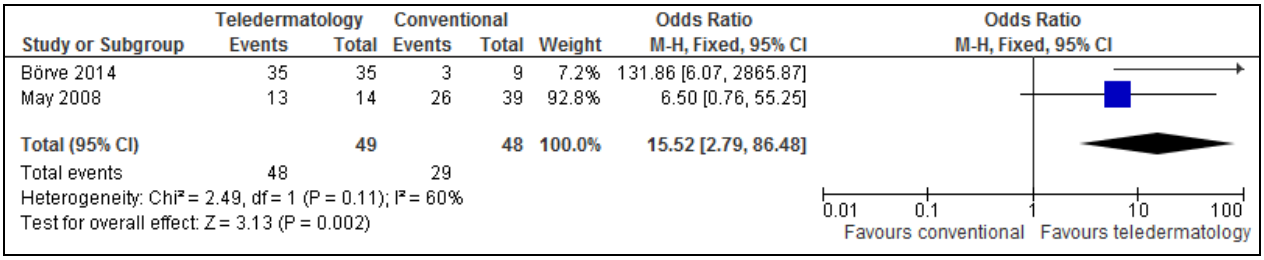
The second cohort study (May, 2008) showed that according to histopathology, prioritization was correct more often in the TDS-group than in the standard referral group. In the TDS group, 1/20 malignant lesions were prioritized as "soon" instead of "urgent", while 34/76 malignant lesions in the standard group were prioritized as "soon" (n=27) or "routine" (n=7).

These two cohort studies have been included in meta-analyses for MM separately, and together with SCC (see below). All comparisons indicate a better prioritization with TD/TDS than by standard referral.

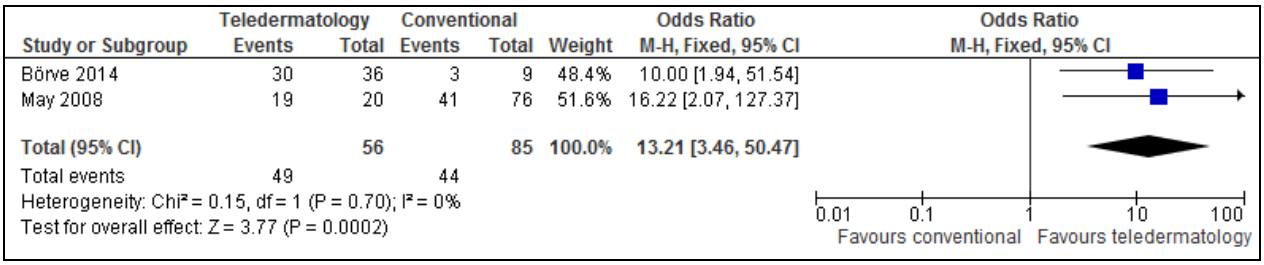
Correct prioritization for MM



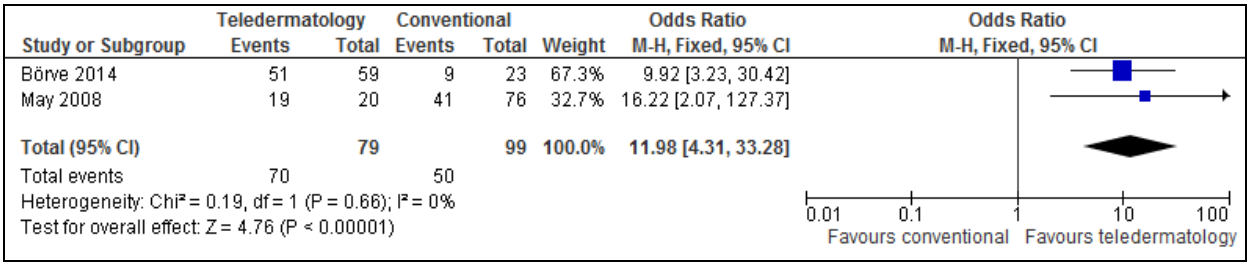
Correct prioritization for MM and MMis



Correct prioritization for skin cancer (MM and SCC)



Correct prioritization for skin cancer (MM, SCC and in situ lesions)



Conclusion
TD/TDS referrals compared with standard referrals may improve the prioritization of patients with malignant skin tumours. Low quality of evidence (GRADE ⊕⊕◯◯). The risk of assessing premalignant or malignant lesions as not in need to see a dermatologist is low.

Time to treatment (Appendix 4.2)
This outcome includes time to treatment or to decision, consultation or biopsy. Standard referrals often include several days for the writing of the referral, the postal delivery, and the assessment, while TD/TDS implies immediate electronic delivery. The reported time in the TD/TDS-group is likely to be biased in several studies, due to awareness of the new technology, compared with standard referral.
One RCT (including all types of skin lesions) and five cohort studies (including suspected skin cancers) reported this outcome. The settings differ between studies, and thus also the baseline time to treatment, reflecting the availability to dermatologists. All studies showed a reduction in time, when TD/TDS referrals were used compared with standard referrals.

One cohort study (Börve, 2014) reported the median waiting time to treatment of MM; 9 days vs. 35 days (p=0.0001), and the median waiting time for diagnosis and treatment of all malignant lesions; 36 vs. 85 days. (p=0.0001). A significantly higher proportion of skin cancer patients received definitive care at first clinical visit if they were referred by TD/TDS versus standard referral (93.4% vs 82.2%). Two prospective cohort studies (May, 2008; Morton, 2010), reported the median time to treatment for MM separately; 56 vs. 73 days and 36 vs. 39 days. Two cohort studies reported the mean time to biopsy for all skin cancers; 9.7 vs. 13.8 days (Kahn, 2013) and 38 vs. 57 days (Hsiao, 2008).
The RCT (Whited 2002) did not report the results for patients with suspected skin cancer separately. For all types of skin lesions, the median time to consultation or decision was 41 vs. 127 days, comparing TD with text-based electronic referral (p=0.0001).

The shortened time to treatment after TD/TDS referral is partly explained by the use of e-referral and often immediate assessment compared with standard referral. To evaluate the effect of attaching images, both referral methods should have used e-referral and applied the same routines for assessment. Thus in the present report, the vast majority of studies compare the entire concept of a TD/TDS program with the presently used standard referral system, when evaluating time as an outcome. In three studies, electronic referral was applied also for controls. The comparison was thus between whether digital images were included in the referral or not. In two cohort studies comprising patients with suspected skin cancer, the reported difference in mean waiting for MM was 3 days, for SCC the range was 4 to 22 days, and for BCC 3.5 to 23 days. In the RCT, comprising patients with general skin lesions, the difference in mean time to consultation was 50 days. All comparisons were in favor of TD/TDS and of statistical significance.

Conclusion
TD/TDS referrals of patients with suspected skin cancer may reduce the time to treatment compared with standard referrals. Low quality of evidence (GRADE ⊕⊕◯◯).

Outcomes important for decision making:

Preventable visits to a dermatologist (Appendix 4.3)
Two RCT's and three cohort studies reported data related to this outcome.
Both RCT's included all types of skin lesions (Eminovic, 2009; Whited 2002). They reported that

TD referrals increased the number of preventable visits compared with standard referral (39% vs 18% and 18% vs 0%).
One cohort study (Börve, 2014) showed that scheduled visits to the dermatologist could be prevented in 42% after TDS referral as compared with 0% after standard referral. This finding was supported by Morton (2010), who reported that prioritization to lower level of care was increased with teledermatology as compared with standard referral (72% vs 0%). The comparison is problematic since the standard referrals usually imply that all patients are scheduled for a consultation with the dermatologist.
A third cohort study demonstrated a reduced mean number of clinical visits after TD referral.

The benefit of preventing unnecessary visits to the dermatologist would be counteracted if patients with malignant lesions are assessed as benign (false negative assessment of TD/TDS) without any follow-up at the PHC. This risk is low. Within the group of patients assessed as not in need of a dermatologist consultation, the dermatologist still recommends a FBSE to be performed.

Conclusion
TD/TDS may reduce the need for face-to-face dermatologist consultation compared with standard referrals in patients with general skin lesions including cancer.
Low quality of evidence (GRADE ⊕⊕◯◯).

5b Diagnostic accuracy of teledermatology/teledermoscopy

An additional question of the assessment of TD/TDS was to evaluate the accuracy of TD/TDS to differentiate between malignant and benign lesions, compared with a reference standard. Histopathology and clinical evaluation were used as reference standards. The comparison of TD/TDS with a reference standard may add additional information on the safety of TD/TDS.

Population: Adult patients with suspected skin cancer
Index test: Teledermatology/teledermoscopy (TD/TDS), evaluation of digital images
Reference test: Histopathology or clinical evaluation “face-to-face” (FTF)
Accuracy outcome measures: Sensitivity (differentiate between malignant and benign lesions, group into diagnostic groups, and correctly prioritize to adequate management)
Specificity

The literature search identified 21 cross-sectional studies fulfilling the criteria for evaluating diagnostic accuracy. The most important aspect of diagnostic accuracy in this context is sensitivity, i.e. not to misdiagnose a malignancy as a benign condition. Studies were included if reported data allowed calculation of sensitivity.

The preferred reference standard is histopathology. Only five studies compared both TD/TDS and FTF with histopathology (Appendix 5.1). The sensitivity to differentiate between malignant and benign, or to propose an accurate management plan, ranged between 81%-100% for both teledermatology and clinical dermatology. Three studies reported similar sensitivity, while two reported lower sensitivity in absolute numbers for TD/TDS compared with FTF, using histopathology as reference standard. These two studies did not report any hypothesis testing.

16 studies used clinical evaluation (FTF) as reference standard and histopathology was applied only in some of the cases. Given that FTF has a sensitivity of itself compared with histopathology of 80-100%, to differentiate between malignant and benign lesions (Appendix. 5.1), these studies are much less valuable to examine the diagnostic accuracy of TD/TDS. The sensitivity in these studies was highly variable and ranged between 70% and 100% (Appendix 5.2). The reasons for the large variability are probably different competence among individual dermatologists, but also different settings and study populations of both high- and low-risk populations. There is thus a problem with applicability of some study results to Swedish settings.

The additional value of TDS compared with only TD, was reported in four cross-sectional studies. One study, using clinical evaluation as reference standard and histopathology in selected cases, demonstrated that 82.5% - 90% of TD-referrals prioritized malignant lesions correctly (Senel, 2013). TDS increased the correct prioritization to 93-98%. Another study reported that the sensitivity to manage MM correctly increased from 84% to 88% when TDS was added to TD in assessment of pigmented lesions (Warshaw 2009b), while the assessment of non-pigmented lesions was not affected at a sensitivity of 96% (Warshaw 2009a). The sensitivity to correctly decide on referral or not, was not affected by TDS (98%) in the fourth study (Bowns, 2006).

Conclusion

The sensitivity of TD/TDS to differentiate between malignant and benign lesions or to correctly prioritize to adequate management compared with FTF, using histopathology as reference standard, is difficult to evaluate due to imprecision and heterogeneity in the studies. The sensitivity varied between 80%-100% for both methods. The addition of dermoscopic images to macroscopic images may increase the sensitivity. Low quality of evidence (GRADE ⊕⊕◯◯).

5c Ongoing research

A search in www.clinicaltrials.gov (2014-03-18) with the keywords:
(teledermatology OR teledermatoscopy OR teledermoscopy OR telemedicine OR store-and-forward OR phone* OR smartphone* OR iphone* OR android*) AND (melanocytic OR melanoma* OR non-melanoma* OR "squamous cell" OR "basal cell" OR skin cancer OR skin tumor OR skin tumour OR skin tumors OR skin tumors OR skin neoplasms OR skin lesions) identified 166 trials.
One of the trials is relevant for the question at issue. It is an interventional study from the USA, comparing store-and-forward (S&F) teledermatology with FTF-visits in patients with premalignant or malignant lesions.
The primary outcome measure is:

- Aggregated diagnostic concordance which is defined as the agreement of the in-person dermatologist's principle diagnosis with the teledermatologist's primary diagnosis or any of the differential diagnoses.

The secondary outcome measures are:

- Diagnostic concordance between the in-person dermatologist and the teledermatologist for their primary diagnosis.
- Diagnostic concordance between the in-person dermatologist and teledermatologist based on standard clinical diagnostic categories for each lesion.
- The concordance between the in-person dermatologist and teledermatologist for the chosen management plan for each lesion.
- The sensitivity of S&F evaluation to detecting lesions that are either premalignant or malignant.
- The specificity of S&F evaluation to detecting lesions that are either premalignant or malignant.

6 Which medical societies or health authorities recommend the new health technology?

- ☐ The National Board of Health and Welfare
- ☐ Medical societies
- ☐ Other health authority

Ethical aspects

7 Ethical analysis – Appendix 6

Although the TD/TDS technology may improve prioritization of patients with suspected skin cancer, reduce the time to treatment, and prevent unnecessary visits to the dermatologist, important outcomes like prognosis and survival have not been studied.

There are two major concerns about the technology, affecting the patients in whom the referral was assessed as not in need to see a dermatologist. The first concern is the potential risk of misdiagnosing a malignancy for a benign lesion. It is important that the new technology does not imply impaired diagnostic accuracy. The second concern is the importance of a FBSE. Is the FBSE the responsibility of the GP, if the patient is not seen by a dermatologist? The dermatologists will most likely recommend the GP to perform a FBSE, which will put additional strain on the GP's workload.

Patients, who have been referred to but not seen by a dermatologist, may experience unease and uncertainty. It is important that the different possible scenarios are explained to the patient at the time of referral.

Safe transmission of patient data is mandatory. If a common patient record system was at hand, available both for the dermatologists at the hospitals and the GP's, transmission of patient data would not be an issue.

Organisation

8a **When can this new health technology be put into practice?**
It depends on which referral system will be used.

8b **Is this technology used in other hospitals in Western Region of Sweden or in other hospitals in Sweden?**
A TD/TDS referral system is since the year 2014 already in use in the County of Gävleborg.

8c **According to the work group, will there be any consequences of the new health technology for personnel?**
Dermatologists assessing TD/TDS referrals must undergo continuous medical education within the field of dermoscopy. It may take longer time for the dermatologist to assess the TD/TDS referral than a paper referral. Referral assessment time is reported on in some of the studies, but was not a prespecified outcome in this report. See also 9d.
GPs must be educated in the use of the new health technology.
No other consequences are expected.

8d **Consequences for other clinics or supporting functions at the hospital or in the whole Western Region of Sweden?**
There are five Departments of Dermatology and Venereology (Sahlgrenska University Hospital, Skaraborg Hospital, Uddevalla Hospital, Southern Älvsborg Hospital, Frölunda Specialist Hospital) and 200 PHCs in VGR, all of which can be included in the use of the new technology.

Economy aspects

9a Present costs of currently used technologies

At present, patients with suspected skin cancer in VGR are not referred via a TD/TDS referral system. The TD/TDS technology is in use in the county of Gävleborg but the total costs are not available. The cost for an introduction of the technology in VGR is therefore not fully known.

The average cost per patient with skin cancer in 2013 at the Department of Dermatology and Venereology, Sahlgrenska University Hospital in Gothenburg is presented in the table below (Source: Cognos).

ICD0-code	Diagnosis	Average cost/patient in SEK
C43	MM	2076
D03	MM*is*	1919
C44	SCC, BCC	3185
D04.9	SCC*is*	2420
D48.5	Tumour of uncertain nature of the skin	1883

9b Expected costs of the new health technology?

The costs depend on which technology will be used. This HTA report does not cover economical analyses of TD/TDS. It is neither a complete review over appropriate technologies used within the field of TD/TDS. It should be taken into consideration that the following calculations are only examples.

Estimated costs for equipment used in the mobile TD and TDS referral system as described in the study by Börve, 2014:

Startup costs:
Mobile phone + dermoscope = approximately 10 000 SEK/PHC
Wireless internet connection or 3G: 300 SEK/PHC
Salary costs for employees conducting the education for GP's: 200 000 SEK
Travelling costs for car rental and fuel associated with education: 50 000 SEK.
Total costs: 2 850 000 SEK (based on 200 PHS's in Västa Götaland).

Continuous costs for equipment and technology support:
Additional costs for IT-solutions comprising the mobile application and secure web platforms are also added if the technology is introduced. Approximate cost per year to use the service must furthermore be negotiated with companies offering the technology. There will probably also be an additional yearly license fee (per PHC or for the region) and an annual fee for technical support.

<u>Estimated costs for the TDS/TD referral system used in Gävleborg</u>

One-time startup cost:
All the necessary equipment for the TD/TDS referral system (official website for the county of Gävleborg): 12 752 SEK/PHC.

Regardless of TD/TDS technology used, there is a one-time cost for medical education in dermoscopy for each dermatologist. The recommended education is a web based dermoscopy course and given by the University of Medicine of Graz, Austria. It is estimated that at least 12 dermatologist in VGR (four dermatologists at Sahlgrenska University Hospital, two at Skaraborg Hospital, two at Southern Älvsborg Hospital, two at Uddevalla Hospital and two at Frölunda Specialist Hospital) have to undergo the recommended education.

Cost per physician: 54 000 SEK.
In total for 12 dermatologist: 648 000 SEK.

9c **Total change of cost**

The total change of cost depends on which technology will be used. The following calculation is according to statistics from "Nominering ordnat införande 2013-01-30". The amount of potentially preventable visits for patients with benign skin lesions is estimated to be reduced with approximately 10% or 2 380 visits (per year) at a dermatologist. This implies savings of approximately 2.9 million SEK if the average visit at a dermatologist costs 1200 SEK. In addition, 3480 visits before surgery can be preventable on a yearly basis which may translate to savings of approximately 4.2 million SEK.
If a reduction of the surgical procedures within the primary health care are estimated to 20-40%, this would imply approximately 4500 - 9000 fewer surgical procedures per year within VGR. GPs excise three to seven times as many melanocytic lesions in comparison to dermatologists to find a MM. Hence, several surgical procedures are likely performed unnecessarily since the lesion is not assessed by or in cooperation with a dermatologist (Lindelof *et al*., 2008). Each surgical procedure including histopathological analysis at the department of Pathology costs approximately 3900 SEK. This is equivalent to savings of 17.5 – 35.1 million SEK.
If a better prioritization of skin cancer patients would result in improved prognosis, additional cost savings may be considered. New drugs for treatment of metastatic melanoma cost approximately 800 000 SEK per patient and year. Additional costs are those for visits at physicians or nurses, X-ray treatments (including PET-scans), taking of specimens, patient transports, sick-leaves, hospice, palliative treatment etc.

9d **Can the new technology be adopted and used within the present budget (clinic budget/hospital budget)?**

The time for assessing TD/TDS referrals must be increased at the Departments of Dermatology and Venereology. Each TD/TDS referral assessment takes approximately six to eight minutes in comparison with approximately two minutes for the conventional paper based referrals. These numbers translate into at least a 40 weeks working load for a dermatologist in the whole of VGR. Thus, more time has to be devoted to assessment of referrals every day at every Department of Dermatology. Every preventable visit also reduces the clinic's budget. There must be a discussion about how to handle this within the Departments of Dermatology and Venereology.

9e Are there any available analyses of health economy?

An economic analysis of S&F TD referral system for patients with suspected skin cancer reported that TD was a cost-effective method of managing referrals (Moreno-Ramirez, 2009). The cost per patient was 79.78 EUR in the TD group compared to 129.37 EUR in the conventional group ($p < 0.005$). Another cost minimization analysis of S&F TD compared to conventional referrals concluded that patients within the TD group incurred on average 340 USD in costs compared to on average 372 USD in the conventional group (Pak, 2009).
Societal savings due to the use of TD applied to all dermatology referrals can be accomplished in countries with larger distances to dermatologist or when unnecessary visits can be avoided and patients can be treated by the GP at the PHC. To achieve cost effectiveness, TD should be applied only in those cases with a reasonable probability that an unnecessary visit can be avoided (Eminovic, 2010).

A systematic review showed that referrals with photo included led to faster management of patients with suspected skin cancer. The dermatologist may also improve the management plans and save resources (SBU, Swedish Council on Health Technology Assessment, 2014).

Unanswered Questions

10a **Important gaps in scientific knowledge?**

Studies on patient-important outcomes like survival and prognostic factors are lacking.

Additional studies comparing TD/TDS with standard referral would give better estimates of the effect sizes and strengthen the quality of evidence.

The effect of relying on GPs to perform a FBSE on patients not being evaluated by a dermatologist is not studied.

Further studies are needed regarding which TD/TDS referral system should be used and which one is the most cost-effective. However, a system with medical records of patients common to all participating units (hospitals, PHCs) may also be a solution with images integrated in the same patient record system. A system with medical records accessible and available within VGR would eliminate the demands on secure internet solutions and maintain the confidentiality and privacy of patient records. A TD/TDS solution like this is already in use in the county of Gävleborg.

10b **Is there any interest in your own clinic/research group/organisation to start studies/trials within the research field at issue?**

An ongoing research project at Sahlgrenska University Hospital is now evaluating the use of mobile teledermatology in all kinds of dermatology conditions exclusive of malignant tumors (Danielsson M, Borve A, Dahlén Gyllencreutz J, Terstappen K, Johansson Backman E, Aldenbratt A, Gillstedt M, Sandberg C, Paoli J).

The TD/TDS technology is primarily meant to be used at PHCs for managing patients with suspected skin cancer. If the technology is implemented, physicians at other departments in hospitals or in a non-hospital area *i.e.* in remote areas (such as the northern parts of Sweden) can benefit from this new development within TD/TDS.

The TD technique can perhaps also be useful as follow-up of individuals with chronic skin conditions. Studies regarding more detailed description of the image quality might also be interesting. Another interesting topic of future studies might be the possibility of improving MM prognosis with TD/TDS.

Appendix 1, Search strategy, study selection and references

Question(s) at issue:

Can electronic referrals, with macroscopic and dermoscopic images added, of adult patients with suspected skin cancer, better prioritize to a face-to-face consultation with a dermatologist, and thereby reduce the time to correct diagnosis and treatment without increasing the amount of incorrect assessments compared with traditional text-based referral?

P	Adult patients with skin lesions, in whom malignancy cannot be excluded
I	Photo referral (excluding patient self-referrals) with digital technology (macroscopic and/or dermoscopic image) and subsequent clinical pathway with assessment of referral, and if indicated consultation/surgical treatment
C	Traditional paper based or electronic referral without photo documentation (excluding patient self-referrals) and subsequent clinical pathway with assessment of referral, and if indicated consultation/surgical treatment
O	<u>Critical for decision making</u> Correct prioritization of skin cancer Time to treatment <u>Important but not critical for decision making</u> Preventable visits to a dermatologist

An additional question is how the diagnostic accuracy of teledermatology/teledermoscopy compares to a reference standard (clinical evaluation and histopathology). Thus, this comparison differs from the comparison between TD/TDS and standard referral in the main question (3c). The diagnostic accuracy of TD/TDS is compared with a reference standard, preferably histopathology, but also with the clinical evaluation. This question is accounted for under 5b and in Appendix 5.

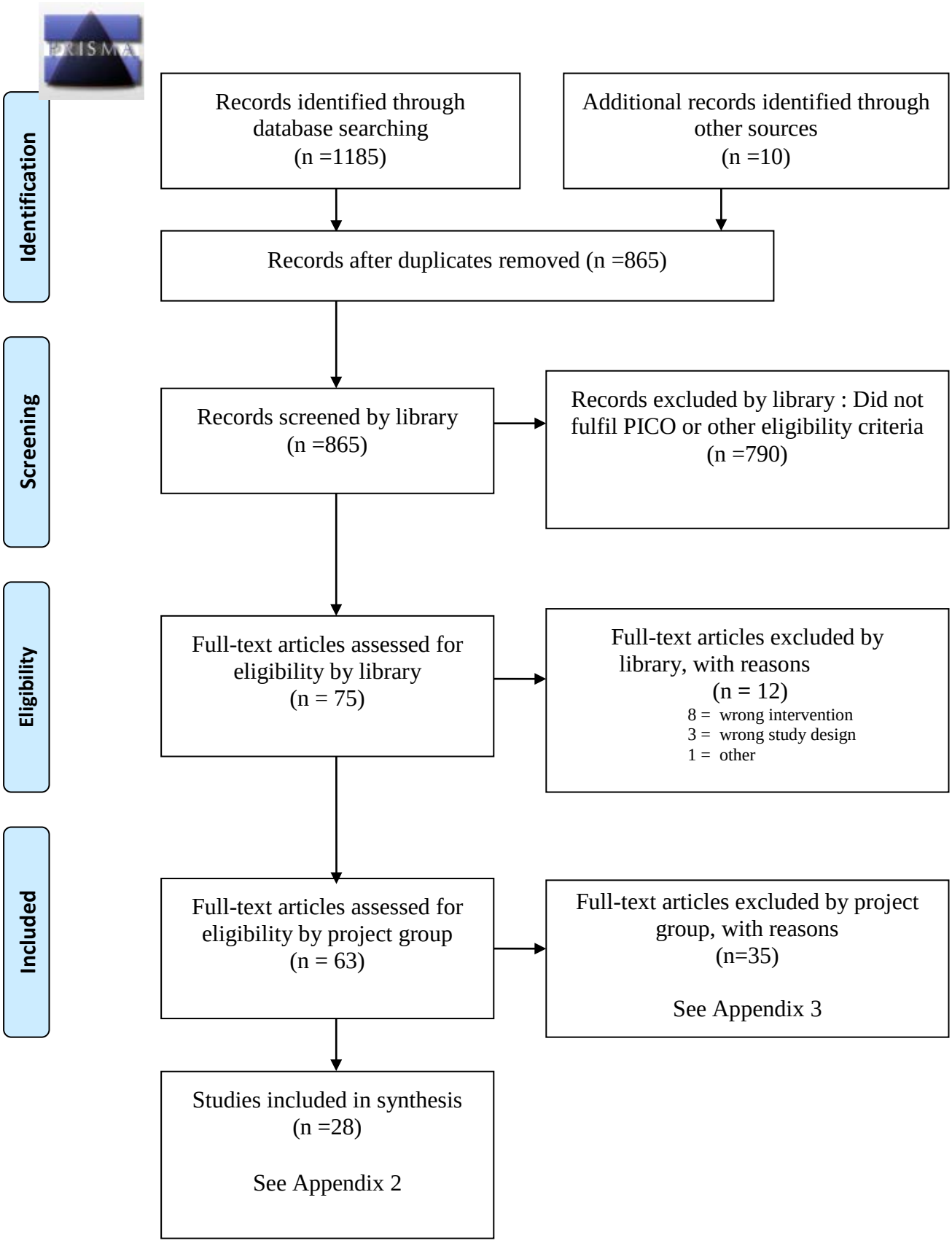
<u>Eligibility criteria</u>

Study design:
Randomized controlled trials
Cohort studies
Cross-sectional studies for diagnostic accuracy

Limits:
Publication date: 1995-

Language:
English, Swedish, Norwegian, Danish

Selection process – flow diagram



Search strategies

Database: PubMed
Date: 2013-10-25
No of results: 496 results
Search updated: 2014-07-16, 53 results

Search	Most Recent Queries	Result
#76	**Search #70 NOT #69 Filters: Publication date from 1995/01/01; Danish; Norwegian; Swedish; English**	**496**
#71	Search #70 NOT #69	563
#69	Search ((animals[mh]) NOT (animals[mh] AND humans[mh]))	3827274
#70	Search #67 NOT #68	564
#68	Search Editorial[ptyp] OR Letter[ptyp] OR Comment[ptyp]	1271752
#67	Search #66 OR #65	593
#66	Search #61 AND #58	278
#65	Search #64 AND #59 AND #58	432
#58	Search #53 OR #54 OR #57	683688
#59	Search mobile[tiab] OR smartphone*[tiab] OR cellular phone[tiab] OR cell phone[tiab] OR iphone*[tiab] OR android*[tiab] OR "Cellular Phone"[Mesh] OR digital[tiab] OR photography[mesh]	523131
#64	Search #63 OR #61	41492
#63	Search "Dermatology"[Mesh] OR dermatology[tiab] OR dermatoscopy[tiab] OR dermoscopy[tiab] Sort by: Author	2620
#61	Search "Telemedicine"[Mesh] OR teledermatology[tiab] OR tele-dermatology[tiab] OR teledermatoscopy[tiab] OR tele-dermatoscopy[tiab] OR teledermoscopy[tiab] OR tele-dermoscopy[tiab] OR telemedicine[tiab] OR tele-medicine[tiab] OR store-and-forward[tiab]	15788
#53	Search ((("Nevi and Melanomas"[Mesh]) OR "Neoplasms, Squamous Cell"[Mesh]) OR "Neoplasms, Basal Cell"[Mesh]) OR "Skin Neoplasms"[Mesh]	252116
#54	Search melanocytic[tiab] OR melanoma*[tiab] OR non-melanoma*[tiab] OR nonmelanoma*[tiab] OR malignan*[tiab] OR squamous cell[tiab] OR basal cell[tiab]	506858
#57	Search "Telemedicine"[Mesh] OR teledermatology[tiab] OR tele-dermatology[tiab] OR teledermatoscopy[tiab] OR tele-dermatoscopy[tiab] OR teledermoscopy[tiab] OR tele-dermoscopy[tiab] OR telemedicine[tiab] OR tele-medicine[tiab] OR store-and-forward[tiab]	95540

Database: EMBASE (OVID SP)
Date: 2013-10-25
No of results: **513 results**
Search updated: 2014-07-16, 82 results

#	Searches	Results
1	exp melanocytic nevus/	3120
2	exp melanoma/	106138
3	exp skin carcinoma/ or exp non melanoma skin cancer/	156560
4	exp skin cancer/ or exp skin tumor/	263309
5	(melanocytic or melanoma* or non-melanoma* or nonmelanoma* or malignan* or "squamous cell" or "basal cell").ti,ab.	627131

6	(skin and (cancer or cancers or tumor or tumors or tumour or tumours or neoplasm or neoplasms or lesion or lesions)).ti,ab.	125978
7	1 or 2 or 3 or 4 or 5 or 6	867649
8	exp mobile phone/	6865
9	exp digital imaging/	3912
10	exp photography/	58407
11	(mobile or smartphone* or "cellular phone" or "cell phone" or iphone* or andriod* or digital).ti,ab.	156551
12	8 or 9 or 10 or 11	213054
13	exp dermatology/	29122
14	(dermatology or dermatoscopy or dermoscopy).ti,ab.	37659
15	13 or 14	57677
16	exp telemedicine/	18317
17	exp teledermatology/	256
18	(teledermatology or tele-dermatology or teledermatoscopy or tele-dermatoscopy or teledermoscopy or tele-dermoscopy or telemedicine or tele-medicine or store-and-forward).ti,ab.	7393
19	16 or 17 or 18	20437
20	15 or 19	77532
21	7 and 12 and 20	765
22	7 and 19	456
23	21 or 22	1089
24	**limit 23 to (embase and (danish or english or norwegian or swedish) and yr="1995 -Current" and (article or conference paper or note or "review"))**	**513**

Database: The Cochrane Library (Wiley)
Date: 2013-10-25
No of results:18 ref.
Other Reviews 1
Trials 15
Technology Assessments 2
Search updated: 2014-07-16, 2 results
Trials 2

ID	Search	Hits
#1	teledermatology or tele-dermatology or teledermatoscopy or tele-dermatoscopy or teledermoscopy or tele-dermoscopy or telemedicine or tele-medicine or store-and-forward:ti,ab,kw (Word variations have been searched)	999
#2	dermatology or dermatoscopy or dermoscopy:ti,ab,kw (Word variations have been searched)	1973
#3	#1 or #2	2928
#4	mobile or smartphone* or "cellular phone" or "cell phone" or iphone* or andriod* or digital:ti,ab,kw (Word variations have been searched)	3870
#5	melanocytic or melanoma* or non-melanoma* or nonmelanoma* or malignan* or "squamous cell" or "basal cell":ti,ab,kw (Word variations have been searched)	10974
#6	(skin and (cancer or cancers or tumor or tumors or tumour or tumours or neoplasm or	3852

	neoplasms or lesion or lesions)):ti,ab,kw (Word variations have been searched)	
#7	#5 or #6	13625
#8	#3 and #4 and #7	15
#9	#1 and #7	7
#10	**#8 or #9**	**18**

Database: CRD
Date: 2013-10-25
No of results: 21 ref.

ID	Search	Hits
#1	(teledermatology or tele-dermatology or teledermatoscopy or tele-dermatoscopy or teledermoscopy or tele-dermoscopy or telemedicine or tele-medicine or store-and-forward)	16
#2	(dermatology or dermatoscopy or dermoscopy) AND (mobile or smartphone* or "cellular phone" or "cell phone" or iphone* or andriod* or digital)	9
#3	**#1 OR #2**	**21**

The web-sites of **SBU, Kunnskapssenteret, Sundhedsstyrelsen** and **NHS Evidence** were visited in October, 2013.
One reference of relevance to the question at issue was found; SBU, “Tidig upptäckt av symtomgivande cancer”

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Author, Year, Country	Study Design	Study Duration (years)	Study Groups; Intervention vs control	Patients (n)	Mean age (years)	Men (%)	Included Disorders	Type of photo	Photo-grapher	Telederm-atologists	Outcome variables
Eminovic, 2009 Netherlands	RCT two sites Cluster randomiza tion	2004-2005 15 and 12 months	Teledermatology vs. paper referral	631 enrolled 605 analyzed 236 for main outcome	42 (23) vs. 44 (20)	44%	Skin lesions	Digital camera (2 close-ups and 2 overviews)	85 GP's at 34 practices	5 at 2 hospitals	Preventable visits
Whited, 2002 N Carolina USA	RCT single site	Not reported	Teledermatology vs. text-based e-referral	275	60.9 (13.8) vs. 61.6 (12.9)	95%	Skin lesions	Digital camera Macroscopic image	Not reported 3 PHC Veterans Affairs	Not reported	Time to treatment Preventable visits

Abbreviations: MM= malignant melanoma, SCC= squamous cell carcinoma, RCT = randomized controlled trial, GP = general practitioner, PHC = primary healthcare center, M/F= male/female

Author, Year, Country	Study Design	Study Duration (years)	Study Groups; Intervention vs control	Patients (n)	Mean age (years)	Men (%)	Included Disorders	Type of photo	Photo-grapher	Telederm-atologists	Outcome variables
Börve 2014 Sweden	Cohort pro-spective	Jan-Dec 2012 1 year	Teledermoscopy vs. paper referral	772 vs 746	54 range (18-93)	39 %	Skin lesions of concern requiring referral	Smartphone 1 clinical and 1 dermoscopic image	122 GP's at 20 PHC	4 (1 registrar) at 2 hospitals	Correct prioritization of malignancies Time to treatment Preventable visits
Hsiao 2008 California USA	Cohort retro-spective	2003–2007 4.5 years	Teledermatology vs. conventional referrals	92 vs 77	68.1 (SD11.2) vs. 66.9 (SD10.5)	100 %	Surgically excised suspected skin cancer	Digital image	Not reported 3 PHC Veterans Affairs	Not reported 1 dermatology surgery dep. Veterans Affairs	Time to treatment (biopsy/surgery) Preventable visits
Kahn 2013 California USA	Cohort retro-spective	7 months	Teledermatology vs. text-based e-referral	123 vs 170	65.4 vs. 64.7	55 vs. 52 %	Biopsy-proven skin cancer	Macroscopic image	Not reported 4 PHC	Not reported remote telederm atologists 1 dermatology surgery dep. Kaiser Permanente	Time to biopsy
May 2008 UK	Cohort pro-spective	1 year 2005	Teledermoscopy vs. paper referral	20 vs. 76	Not presented	Not presented	Suspected skin cancer (MM, SCC)	Digital camera 3 images; macroscopic, close-up and dermoscopic	Not reported GP's in the community	Not reported Several hospitals in the region	Correct prioritization Time to treatment
Morton 2011 UK	Cohort	6 months 2008	Teledermoscopy vs. text based e-referral	289 vs 188	51 range (4-91) vs. 52 range (10-95)	41 vs. 49%	Suspected skin cancer	4 images; macroscopic, close-up and dermoscopic	Referred to medical photograph er in 2 PHC	Not reported (a dermatologist)	Time to treatment Preventable visits

Abbreviations: MM= malignant melanoma, SCC= squamous cell carcinoma, RCT = randomized controlled trial, GP = general practitioner, PHC = primary healthcare center, M/F= male/female

Author, Year, Country	Study Design	Study Duration (years)	Study Groups; Intervention vs control	Patients (n)	Mean age (years)	Men (%)	Included Disorders	Type of photo	Photo-grapher	Telederm-atologists	Outcome variables
Bowns 2006 UK	Cross sectional study within a RCT	1997-	Teledermoscopy vs. face-to-face or histopathology	256 (target 446 in RCT)	Median age band 55-64	47%	Skin lesions including suspected skin cancer	Macroscopic and dermoscopic	Medical Photograp hy department	3 consultants	Sensitivity for diagnosing malignancy Specificity
Börve 2012 Sweden	Cross-sectional	Not reported	Teledermoscopy vs. face to face	40	49 (18-95)	77%	Benign, malignant tumors, dermatitis	Digital camera in mobile phone Single macroscopic image	3 GP's at 1 PHC	2 derma-tologists	Sensitivity for correct prioritization and diagnosis Specficity
Börve 2013 Sweden	Cross-sectional	16 weeks	Teledermoscopy vs. face to face Ref: histopathology	69 lesions 62 patients	64 (25-94)	63%	Suspicious lesions in need of biopsy	Iphone app + dermoscopy Macroscopic and dermoscopic images	1 derma-tologist	2 telederm-atologists	Sensitivity for correct prioritization
Coras 2003 Germany Switzerland	Cross-sectional	16 months	Teledermoscopy vs. face to face and histopathology in selected cases	45 skin lesions	Not presented	Not presented	Pigmented skin lesions	Digital camera Dermoscopic images	3 derma-tologists	1 telederma-tologist	Sensitivity for identifying malignancy Specificity
Ishioka 2009 Brazil	Cross-sectional	24 months	Teledermoscopy vs. face to face Ref: histopathology	64	(5-86)	39%	Pigmented lesions selected from histo-pathology	Digital camera Clinical and dermoscopic images	2 derma-tologists	2 derma-tologists	Sensitivity for correct diagnosis Specificity
Joliffe 2001 UK	Cross-sectional	Not reported	Teledermatology vs. face to face	819 lesions in 611 patients	8-94	24%	Pigmented lesions	Digital camera Clinical images	2 consultants 1 registrar in derm-atology	Same doctors several months later	Sensitivity for referral "not to be missed" Specificity

Abbreviations: MM= malignant melanoma, SCC= squamous cell carcinoma, RCT = randomized controlled trial, GP = general practitioner, PHC = primary healthcare center, M/F= male/female

Author, Year, Country	Study Design	Study Duration (years)	Study Groups; Intervention vs control	Patients (n)	Mean age (years)	Men (%)	Included Disorders	Type of photo	Photo-grapher	Telederm-atologists	Outcome variables
Kroemer 2011 Austria	Cross-sectional	3 months	Teledermoscopy vs. face to face Ref: histopathology	113 lesions 88 patients	Median 69 (3-93)	87%	Skin tumors	Mobile phone camera 3 clinical and dermoscopic images	Derma-tologists at 1 center	1 dermatologist	Sensitivity for correct diagnostic group Specificity
Lewis 1999 UK	Cross-sectional	7 months 1998	vs. face to face and histopathology when indicated	141 patients 56 analyzed	Not presented	Not presented	Skin lesions referred for consultation	Digital camera	GP or professional photo-grapher	Different dermatologists at 2 hospitals	Sensitivity for classification malignant/benign Specificity
Massone 2014 Austria	Cross-sectional	2 years 2008-2010	Teledermoscopy vs. face to face or histopathology	690 patients 962 lesions 170 lesions included	47 (18-84)	93%	Suspicious skin lesions	Digital camera Dermoscopic and if needed, clinical image (no patient data, except age, sex , location)	2 GP's	1 /2 tele-consultants	Sensitivity for diagnostic group Specificity
Nami 2014 Austria and Italy	Cross-sectional	1 year 2011-2012	Teledermatology vs. face to face	391	Not presented	Not presented	Non-pigmented lesions 59 premalignant /malignant	Smartphone 1-6 macroscopic images	1 Final-year-resident to become a GP	1 telederm-atologist	Sensitivity for diagnostic group Specificity
Oliveira 2002 Brazil	Cross-sectional	2 months	vs. face to face or histopathology	103 photographed, 90 in analysis	Not presented	Not presented	Skin lesions, 8 malignant	Digital camera,	1 nurse at PHC	1 Telederm atologist	Sensitivity for identifying malignancy Specificity

Abbreviations: MM= malignant melanoma, SCC= squamous cell carcinoma, RCT = randomized controlled trial, GP = general practitioner, PHC = primary healthcare center, M/F= male/female

Author, Year, Country	Study Design	Study Duration (years)	Study Groups; Intervention vs control	Patients (n)	Mean age (years)	Men (%)	Included Disorders	Type of photo	Photo-grapher	Telederm-atologists	Outcome variables
Piccolo 2004 Austria, Italy, Slovenia, Japan	Cross-sectional	Not reported	Teledermoscopy vs. histopathology by 2 dermopathologists	73 patients, 77 lesions	28 (4-77)	87%	Akral melanocytic lesions	Dermoscopic images	Dermosco pists at 2 department s	11 telederm-atologists	Sensitivity for diagnosing melanoma Specificity
Romero Aguilera 2014 Spain	Cross sectional study within a RCT	18 months 2004-2005	Teledermoscopy vs. face to face (1/3 dermatologists)	457	36 (2 months-86 years)	44%	General skin conditions	Digital camera Clinical image	12 GP's and 6 pediatricia ns at	3 telederm-atologists	Sensitivity for correct malignant diagnosis
Senel 2013 Turkey	Cross-sectional	6 months 2009	Teledermoscopy vs. face to face Histopathology in selected cases	150	55	51%	Non-melanocytic lesions	Digital camera Clinical and dermoscopic images	Technician	2 telederm-atologists	Sensitivity for correct prioritization
Shapiro 2004 USA	Cross-sectional	25 months	Teledermatology vs. face to face (1 dermatologist)	61 enrolled 49 analyzed	Not reported	54%	Skin growths	Digital camera Clinical images	1 GP	1 telederm-atologist	Sensitivity correct prioritization (perform biopsy) Specificity
Tadros 2009 UK	Cross-sectional	Not reported	Teledermoscopy vs. face to face Ref: histopathology or follow-up	300	Not reported	Not reported	Suspect skin cancer and mom-malignant lesions	Digital camera 2 clinical images: wide and close-up	GP's	Not reported	Sensitivity for overall correct diagnosis and malignancy Specificity
Tan 2010 New Zeeland	Cross-sectional	7 months 2008	Teledermoscopy vs. face to face (2/3 dermatologists) and histopatholo	200	11-94	59%	Skin lesions	Panoramic, macroscopic and dermoscopic images	Melanogra pher	2 derma-tologists	Sensitivity for diagnosing malignancies Specificity

Abbreviations: MM= malignant melanoma, SCC= squamous cell carcinoma, RCT = randomized controlled trial, GP = general practitioner, PHC = primary healthcare center, M/F= male/female

Author, Year, Country	Study Design	Study Duration (years)	Study Groups; Intervention vs control	Patients (n)	Mean age (years)	Men (%)	Included Disorders	Type of photo	Photo-grapher	Telederm-atologists	Outcome variables
Van der Heijden 2013 Netherlands	Cross-sectional	16 months 2010-2011	Teledermoscopy vs. face to face	105 7 skin cancers (2MM)	median 47 (6-84)	45%	Pigmented skin lesions (urgent excluded)	Digital camera Clinical and dermoscopic images	13 GP's	4 derma-tologists	Sensitivity
Warshaw 2009 a USA	Cross-sectional	Nov 2002-Aug 2005	Teledermatology and clinical dermatology vs. histopathology	728 patients Veterans Affairs	71 (21-94)	98%	Non-pigmented skin neoplasms, 389 malignant lesions	Macroscopic and dermoscopic	Not reported Probably dermatol ogists	1 of 3 derma-tologists	Sensitivity for diagnostic groups and accurate management
Warshaw 2009 b USA	Cross-sectional	Nov 2002-Aug 2005	Teledermatology and clinical dermatology vs. histopathology	542 patients Veterans Affairs	66 (23-94)	96%	Pigmented skin neoplasms, 124 malignant lesions	Macroscopic and dermoscopic	Not reported Probably dermatol ogists	1 of 3 derma-tologists	Sensitivity for accurate management
Whited 1998 USA	Cross-sectional	Not reported	Teledermatology vs. face to face Ref: histopathology	13 lesions in 12 patients	Not reported	Not reported	Suspected skin cancer	Digital camera Clinical images	Not reported Probably dermatol ogists	2 derma-tologists	Sensitivity for correct diagnosis Specificity

Abbreviations: MM= malignant melanoma, SCC= squamous cell carcinoma, RCT = randomized controlled trial, GP = general practitioner, PHC = primary healthcare center, M/F= male/female

Project: The use of Teledermatology and Teledermoscopy for referrals of patients with suspected skin cancer
Appendix 3. Excluded studies

Study (author, publication year)	Reason for exclusion
Drugge, 2009	Intervention not concurrent with PICO
Di Stefani, 2007	No sensitivity presented, only concordance
Edison, 2008	Wrong outcome
Emery, 2010	Intervention not concurrent with PICO
Eminovic, 2010	Economic analysis
Ferrandiz, 2007	Population and intervention not concurrent with PICO. Cohort. Comparison between two cohort studies. Multi-center.
Ferrandiz, 2012	Population and outcome not concurrent with PICO. Case-control design. Teledermatology-group prospective.
Heffner, 2009	Population not concurrent with PICO (pediatric population)
Kaliyadan, 2013	Population not concurrent with PICO (non cancer diagnosis)
Kanthraj, 2013	No separate presentation of sensitivity or specificity
Karavan, 2014	No outcomes concurrent with PICO presented
Knol, 2006	Population not concurrent with PICO
Krupinski, 2002	Outcome not concurrent with PICO. No control group.
Lamel, 2012	No separate presentation of sensitivity or specificity
Lester, 2014	Not a diagnostic study. No control group regarding preventable visits.
Lim, 2012	Population and comparison not concurrent with PICO
Lyon, 1997	Sensitivity not presented
Mahendran, 2005	Sensitivity not presented

Project: The use of Teledermatology and Teledermoscopy for referrals of patients with suspected skin cancer
Appendix 3. Excluded studies

Study (author, publication year)	Reason for exclusion
Moloney, 2014	Population not concurrent with PICO
Moreno-Ramirez, 2006	Sensitivity not presented
Moreno-Ramirez, 2007	Sensitivity not presented
Moreno-Ramirez, 2009	Economic analysis
Ndegwa, 2010	Canadian HTA-report published before the SR Warshaw et al 2011.
Oakley, 2006	Sensitivity not presented
Pak, 2003	Data regarding malignant lesions not possible to extract
Pak, 2009	Economic analysis
Rubegni, 2011	No separate presentation of sensitivity or specificity
Senel, 2014	No separate presentation of sensitivity
Shin, 2014	Population not concurrent with PICO
Tan, 2010 (b)	No separate presentation of sensitivity or specificity
Tromme, 2012	Not suitable design
Viola, 2011	Teledermatology not examined
Warshaw, 2011	Systematic review, only used for checking references to original articles.
Whited, 1999	Only agreement, no sensitivity
Zelickson, 1997	Mixed diagnoses, sensitivity not presented separately

Project: The use of teledermatology and teledermoscopy for referrals of patients with suspected skin cancer
Appendix 4.1
Outcome variable: Correct prioritization of skin cancer

* + No problem
? Some problems
- Major problems

Author, year	Country	Study design	Number of patients n=	Result		Comments	Directness*	Study limitations *	Precision *
				Intervention Teledermatology referrals	Control Standard referrals				
Börve 2014	Sweden	Cohort	816 referrals in 772 patients vs 746 referrals	<u>Correct prioritization:</u> <u>MM</u>: 100% (19/19) <u>MM*is*:</u> 100% (16/16) SCC: 65% (11/17) SCC*is*: 71% (5/7) 3 AK/ 229 malignant lesions would have been missed	<u>Correct prioritization:</u> <u>MM</u>: 25% (1/4) p = 0.002 <u>MM*is*:</u> 40% (2/5) p = 0.008 SCC: 40% (2/5) p = 0.61 SCC*is*: 44% (4/9) p = 0.36	<u>Mobile phone system TD/TDS</u> Conventional referrals only include cases from one of two hospitals due to different priority rules.	+	?	?
May 2008	UK	Cohort Prospectively collected cases of verified skin cancer (MM, SCC) Retrospective controls (histology proven)	96	<u>Correct priority was given to</u>: MM: 93% (13/14) SCC: 100% (6/6) <u>Median waiting times from referral to clinic:</u> Urgent priority cases with MM (n=13/14): 14 days (range 1-34) Urgent priority cases with SCC (n=6/6): 13.5 days (range 11-19) "Soon" priority cases with MM (n=1/14): 68 days* "Soon" priority cases with SCC (n=0/6): - "Routine" priority cases with MM (n=0/14): - "Routine" priority cases with SCC (n=0/6): -	<u>Correct priority was given to</u>: MM: 67% (26/39) p= 0.08 SCC: 41% (15/37) p= 0.009 <u>Median waiting times from referral to clinic:</u> Urgent priority cases with MM (n=26/39): 24 days (range 6-59) Urgent priority cases with SCC (n=15/37): 24 days (range 1-42) "Soon" priority cases with MM (n=9/39): 44 days (range 8-129) "Soon" priority cases with SCC (n=18/37): 34 days (range 19-110) "Routine" priority cases with MM (n=3/39): 130 days (range 77-177) "Routine" priority cases with SCC (n=4/37): 125.5 (28-179)	All patients with malignant lesions in the teledermatology group, except one, were prioritized as urgent. The patient not given the priority urgent was upgraded from" routine" by the GP to "soon" by the teledermatologist. 7 patients managed conventionally with malignant lesions were not upgraded. For patients managed conventionally 12 patients with MM and 22 patients with SCC waited for "soon" or "routine appointments. *One patient with MM was prioritized as soon but failed to attend first appointment.	?	-	-

Project: The use of teledermatology and teledermoscopy for referrals of patients with suspected skin cancer
Appendix 4.2
Outcome variable: Time to treatment

* + No problem
? Some problems
- Major problems

Author year	Country	Study design	Number of patients n=	Result		Comments	Directness *	Study limitations *	Precision *
				Intervention Teledermatology referrals	Control Standard referrals				
Whited 2002	USA	RCT Emergent cases not eligible	275 (135 vs 140)	<u>Median time to consultation or decision:</u> 41 days (range 0-251) Mean time 73.8 (SD 71.6)	<u>Median time to consultation or decision:</u> 127 days (range 2-251) Mean time 114.3 (SD 72.3)	p = 0.0001, log-rank test Suspected skin cancer not presented separately E-referral also among controls	?	+	+
Börve 2014	Sweden	Cohort	816 referrals in 772 patients vs 746 referrals	<u>Median waiting time for diagnosis and treatment for malignant lesions:</u> 36 days (229/816) <u>Median waiting time for a first visit with a dermatologist:</u> MM: 9 days MM*is*: 10 days SCC: 13 days SCC*is:*13 days BCC: 28 days <u>Median waiting time for surgery:</u> MM: 9 days MM*is*: 12 days SCC: 15 days SCC*is:*13 days BCC: 34 days <u>Primary management on a first FTF-visit:</u> 93.4% (95% CI, 91.5-95.0%) <u>Severity of MM:</u> 16 MMis of a total of 35 MM (46%) <u>Median Breslow thickness of the invasive MMs:</u> 1.0 mm	<u>Median waiting time for diagnosis and treatment for malignant lesions:</u> 85 days (323/746), p < 0.0001 <u>Median waiting time for a first visit with a dermatologist:</u> MM: 14 days MM*is*: 17 days SCC: 21 days SCC*is:* 96 days BCC: 34 days <u>Median waiting time for surgery:</u> MM: 35 days, p < 0.0001 MM*is*: 62 days, p = 0.028 SCC: 48 days, p = 0.046 SCC*is:* 118 days, p = 0.022 BCC: 89 days, p < 0.0001 <u>Primary management on a first FTF-visit:</u> 82.2% (95% CI, 79.2-84.9%) <u>Severity of MM:</u> 7 MMis of a total of 20 MM (35%) <u>Median Breslow thickness of the invasive MMs:</u> 2.2 mm	Significantly shorter waiting time for patients with malignant lesions in the TDS group (p = 0.0001) From date of referral. Patients with MM, SCC, BCC and dysplastic naevi required significantly fewer visits in the TDS group to receive their diagnosis and primary management. TD-referrals were assessed within 48 hours after sent from GP. Conventional referrals were assessed within 5-6 days (including post delivery time of 4-5 days)	+	?	?

Project: The use of teledermatology and teledermoscopy for referrals of patients with suspected skin cancer
Appendix 4.2
Outcome variable: Time to treatment

* + No problem
? Some problems
- Major problems

Author year	Country	Study design	Number of patients n=	Result		Comments	Directness *	Study limitations *	Precision *
				Intervention Teledermatology referrals	Control Standard referrals				
Hsiao 2008	USA	Retrospective cohort Population defined by surgically excised suspected skin cancer (all types)	169	<u>Mean time interval for surgery:</u> 104 days (SD=67) <u>Mean time interval for an initial teledermatology evaluation:</u> 4 days (SD=5) <u>Mean time interval for biopsy:</u> 38 days (SD=41)	<u>Mean time interval for surgery:</u> 125 days (SD=63) p < 0.006 <u>Mean time interval for a FTF-visit:</u> 48 days (SD=38) <u>Mean time interval for biopsy:</u> 57 days (SD=52)	<u>Patients with MM in TD-group vs. conventional group</u>: 4.35 % vs 3.9% (Remaining diagnoses: NMSC) Remaining diagnoses explains the long waiting times for surgery. Limitations: a retrospective study conducted on a Veterans Affairs healthcare system and a specific skin cancer population which may not be directly comparable to other organizations.	+	?	+
Kahn 2013	USA	Retrospective cohort Population defined by biopsy proven skin cancer (SCC, BCC)	293	<u>Mean time to biopsy of skin cancer:</u> 9.7 days <u>Mean time to biopsy of SCC:</u> (n=93) 8.9 days (0.95CI: 5.6 – 12.2) <u>Mean time to biopsy of BCC:</u> (n=218) 10.0 days (0.95CI: 8.1 – 11.9)	<u>Mean time to biopsy of skin cancer:</u> 13.8 days p < 0.0001 <u>Mean time to biopsy of SCC:</u> (n=93) 14.1 days (0.95CI: 11.3 – 16.9) p < 0.001 <u>Mean time to biopsy of BCC:</u> (n=218) 13.5 days (0.95CI: 12.0 – 15.0) p < 0.001	E-referral also among controls	+	+	+
May 2008	UK	Cohort Prospectively collected cases of verified skin cancer (MM, SCC) Retrospective controls (histology proven)	96	<u>Median time to treatment:</u> Urgent priority cases with MM (n=12/13) 21.5 days (range 7-47) Urgent priority cases with SCC (n=5/5) 56 days (range 37-167) “Soon” priority cases with MM (n=1/13) - (failed to attend first appointment) “Soon” priority cases with SCC (n=0/5) “Routine”priority cases with MM (n=0/13) - “Routine” priority cases with SCC (n=0/5) -	<u>Median time to treatment:</u> Urgent priority cases with MM (n=26/39) 41 days (range 14-119) Urgent priority cases with SCC (n=15/37) 73 days (range 1-248) “Soon” priority cases with MM (n=9/37) 51 days (range 18-130) “Soon” priority cases with SCC (n=18/37) 82.5 days (range 19-268) “Routine”priority cases with MM (n=3/39) 136 days (range 98-178) “Routine” priority cases with SCC (n=4/37) 125.5 (46-343)		?	-	-

Project: The use of teledermatology and teledermoscopy for referrals of patients with suspected skin cancer
Appendix 4.2
Outcome variable: Time to treatment

* + No problem
? Some problems
- Major problems

Author year	Country	Study design	Number of patients n=	Result		Comments	Directness *	Study limitations *	Precision *
				Intervention Teledermatology referrals	Control Standard referrals				
Morton 2011	UK	Prospective cohort Referral type by GP's choice Population defined by urgent suspected skin cancer	Interven-tion group: 321/411 attended for photo-graphy. 289/321 has comp-lete data. Control group: 188/231 has complete data.	<u>Mean waiting time for MM:</u> 36 days <u>Mean waiting time for SCC:</u> 28 days <u>Mean waiting time for BCC:</u> 35 days	<u>Mean waiting time for MM:</u> 39 days <u>Mean waiting time for SCC:</u> 50 days <u>Mean waiting time for BCC:</u> 58 days	<u>Definitive care* received at initial visit to the specialist team:</u> TD-group: 263/289 (91%) Conventional group: 117/186 (63%) $p < 0.00001$ * Consequence of correct prioritization SD not reported. Number of malignancies not reported. E-referral also among controls	?	-	?

Abbreviations:
BCC = Basal cell carcinoma
FTF-visit = Face-to-face visit
GP = General practitioner
MM = Malignant melanoma, MM*is* = Melanoma *in situ*
NMSC = Non melanoma skin cancer
SSC = Squamous cell carcinoma, SCC*is* = Squamous cell carcinoma *in situ*,
TD = Teledermatology, TDS = Teledermoscopy

Project: The use of teledermatology and teledermoscopy for referrals of patients with suspected skin cancer
Appendix 4.3
Outcome variable: Preventable visits to a dermatologist

* + No problem
? Some problems
- Major problems

Author, year	Country	Study design	Number of patients n=	Result		Comments	Directness*	Study limitations *	Precision *
				Intervention Teledermatology referrals	Control Standard referrals				
Eminovic 2009	Nether-lands	Cluster RCT	110 GP's randomized, 84 included in the analysis. 631 patients included in study. 605 included in the analysis. 369 patients had complete data.	Consultation preventable for: 39% (78/200) No. of preventable office consultations/No. of patients: Benign skin tumor: 6/27 Malignant skin tumour: 0/11 Pigmented lesion: 3/7 Premalignant tumor: 1/4	Consultation preventable for: 18.3% (31/169), difference 20.7%, 95% CI (8.5%; 32.9%) No. of preventable office consultations/No. of patients: Benign skin tumor: 4/34 Malignant skin tumour: 0/6 Pigmented lesion: 3/10 Premalignant tumor: 3/12	Patients with skin lesions. "Preventable" = evaluated as not necessary for a dermatologist consultation	+	?	+
Whited 2002	USA	RCT Emergent cases not eligible	275	18.5% (25/135)	0% (0/140), p=0.001	Patients with skin lesions.	+	+	+
Börve 2014	Sweden	Cohort	816 TD-referrals in 772 patients vs 746 conventional referrals	42% (346/816 skin tumour referrals)	0% (0/746)	3 (0.4%) cases in the TD group, assessed as benign, were AK	+	?	+
Hsiao 2008	USA	Retrospective cohort Study population defined by surgically excised suspected skin cancer (all types)	169	Number of clinical visits per referral: Mean (SD) 0.98 ± 0.52	Number of clinical visits per referral: Mean (SD) 1.13 ± 0.38, p = 0.02		+	?	+
Morton 2011	UK	Prospective cohort Referral type by GP's choice Population defined by urgent, suspected skin cancer	Intervention group: 321 of 411 attended for photography. 289/321 has complete data. Control group: 188/231 has complete data.	Number of patients triaged to lower level of care: 71.6% (207/289)	Number of patients triaged to lower level of care: 0% (0/188)		?	-	?

Abbreviations:
AK = actinic keratosis
RCT = randomized controlled trial
TDS = Teledermoscopy
TD = Teledermatology

* + No problem
? Some problems
- Major problems

Project: The use of teledermatology and teledermoscopy for referrals of patients with suspected skin cancer.
Appendix 5.1
Outcome variable: Diagnostic accuracy or accuracy of management plan for teledermatology/teledermoscopy and clinical dermatology in reference to histopathology

Author year	Country	Study design	Number of patients n=	Result		Comments	Directness*	Study limitations *	Precision *
				Teledermatology/teledermoscopy vs. histopathology	Clinical dermatology Face-to-face (FTF) vs. histopathology				
Coras 2003	Germany Switzer-land	Cross-sectional	45 skin lesions	Sensitivity: 81% (13/16) Specificity: 93% (27/29)	Sensitivity: 81% Specificity: 97% (28/29)	Diagnosis grouped as malign or benign. TDS only Reference standard is histopathology.	?	?	?
Ishioka 2009	Brazil	Cross-sectional	64 Pigmented skin lesions	Sensitivity for correct diagnosis of skin cancer : 86.7% (26/30) 4 malignancies were classified as benign (false negative) Specificity: 72.7% (24/33) 9 benign lesions were classified as malignant (false positive)	Sensitivity for correct diagnosis of skin cancer : 96.7% (29/30) 1 malignancy was classified as benign (false negative) Specificity: 66.7% (22/33) 11 benign lesions were classified as malignant (false positive)	Diagnosis grouped as malign or benign. TD and TDS Reference standard is histopathology.	?	?	?
Warshaw 2009 a	USA	Cross-sectional	728 Non-pigmented lesions	Sensitivity for malignant lesions: TD only: Aggregated diagnostic: 73% (284/389) Management plan: 96% (373/389) TD and TDS: Aggregated diagnostic: 82% (314/383) Management plan: 96% (368/383) Specificity for benign lesions: TD only: Aggregated diagnostic: 44% (149/339) Management plan: 59% (199/337) TD and TDS: Aggregated diagnostic: 44% (147/333) Management plan: 61% (202/331)	Sensitivity for malignant lesions: Aggregated diagnostic: 86% (335/389) Management plan: 99% (385/389) Aggregated diagnostic: 86% (329/383) Management plan: 99% (379/383) Specificity for benign lesions: Aggregated diagnostic: 65% (220/339) Management plan: 65% (219/337) Aggregated diagnostic: 44% (147/333) Management plan: 61% (202/331)	TD and TDS Equivalence considered within +/- 10% Difference: -13.1 95% CI (-17.7 to -8.5) -3.6 (-5.7 to -1.5) -3.7 (-7.9 to 0.6) -2.9 (-4.9 to -0.8) -20.6 (-26.2 to -15.1) -5.9 (-10.6 to -1.2) -20.1 (-25.6 to -14.7) -4.8 (-9.3 to -0.3)	?	+?	+

* + No problem
? Some problems
- Major problems

Project: The use of teledermatology and teledermoscopy for referrals of patients with suspected skin cancer.
Appendix 5.1
Outcome variable: Diagnostic accuracy or accuracy of management plan for teledermatology/teledermoscopy and clinical dermatology in reference to histopathology

Author year	Country	Study design	Number of patients n=	Result		Comments	Directness*	Study limitations *	Precision *
				Teledermatology/teledermoscopy vs. histopathology	Clinical dermatology Face-to-face (FTF) vs. histopathology				
Warshaw 2009 b	USA	Cross-sectional	542 Pigmented lesions	Sensitivity for MM: 81% (29/36) 7 MM would have been mismanaged Sensitivity for all 124 malignant lesions: Management plan: 84%(TD) -88% (TDS) Specificity for all 418 benign lesions: Management plan: 66%(TD) -70% (TDS)	Sensitivity for MM: 97% (35/36) 1 MM would have been mismanaged Sensitivity for all 124 malignant lesions: 97% (TD)-98% (TDS) Specificity for all 418 benign lesions: Management plan: 57% (TD/TDS)	TD and TDS Reference standard is histopathology. Same study as Warshaw 2009 a, but only pigmented lesions reported.	?	+?	+?
Whited 1998	USA	Cross-sectional	13 lesions in 12 patients	Sensitivity for correct diagnosis of skin cancer : Dermatologist 1: 100% (8/8) Dermatologist 2: 100% (8/8)	Sensitivity for correct diagnosis of skin cancer : Dermatologist 1: 100% (6/6)* Dermatologist 2: 100% (8/8)	TD only Data calculated from Table 1 *2 patients were seen only by 1 dermatologist	-	?	-

Abbreviations:
FTF-visit = Face-to-face visit
MM = Malignant melanoma
NMSC = Non melanoma skin cancer
SCC =
TD = Teledermatology
TDS = Teledermoscopy

* + No problem
? Some problems
- Major problems

Project: The use of teledermatology and teledermoscopy for referrals of patients with suspected skin cancer
Appendix 5.2
Outcome variable: Diagnostic accuracy or accuracy of management plan or prioritization for teledermatology/teledermoscopy in reference to clinical dermatology

Author year	Country	Study design	Number of patients n=	Result		Comments	Directness*	Study limitations *	Precision *
				Sensitivity	Specificity				
Bowns 2006	UK	Cross-sectional	256	Sensitivity (to refer or not): 98% (83/85) TD: 98% (95% CI 92-99%) TDS: 98% (95% CI 92-99%)	Specificity (to refer or not): 43% (74/171) TD: 39% (95%, CI 32-47%) TDS: 43% (95%, CI 36-51%)	Reference standard histopathology or clinical evaluation Histology in 64%	+	+?	+
Börve 2012	Sweden	Cross-sectional	40	Correctly diagnosed malignant lesions: Dermatologist 1: 83% (5/6), (0.95 CI: 44% - 99%) Dermatologist 2: 67% (4/6), (0.95 CI: 22% - 96%)	Correctly diagnosed benign lesions: Dermatologist 1: 76% (26/34) Dermatologist 2: 79% (27/34)	Only TD Among the 3 misdiagnosed tumours (2 SCC*is*, 1 BCC) malignancy had been suggested in all 3 cases as a differential diagnosis.	+	?	-
Börve 2013	Sweden	Cross-sectional	62 patients 69 lesions	Correct management of malignancies: Dermatologist 1: 100% (40/40) Dermatologist 2: 98% (39/40)		Reference standard is histopathology.	+	?	?
Jolliffe 2001	UK	Cross-sectional	819 lesions in 611 patients	Sensitivity for referral "not to be missed": 69% (99/143) among consultants 92% (131/143) among registrars Mean sensitivity 81%	Refer or not refer: Specificity: 82% (553/676) among consultants 64% among registrars		?	?	+
Kroemer 2011	Austria	Cross-sectional	88	Sensitivity for correct diagnosis of skin cancer: NMSC: 97% MM: 100% Benign non-melanocytic: 76% Benign melanocytic: 87%	Specificity: Benign non-melanocytic: 97% Benign melanocytic: 99% Specificity for TD: NMSC: 92% MM: 98% Specificity for TDS: NMSC: 94% MM: 97%	TD and TDS Reference standard is histopathology. Both macroscopic images and dermoscopic images resulted in the same sensitivities for all four diagnostic groups.	+?	+?	?
Lewis 1999	UK	Cross-sectional	56	Sensitivity: 88%	Specificity: 80%	Diagnosis grouped as malign or benign, Reference standard is FTF diagnosis	-	-	?
Massone 2014	Austria	Cross-sectional	690	Sensitivity for appropriate management plan: 100 % (26/26)	Specificity for diagnostic group: 95.8%		?	-	-

* + No problem
? Some problems
- Major problems

Project: The use of teledermatology and teledermoscopy for referrals of patients with suspected skin cancer
Appendix 5.2
Outcome variable: Diagnostic accuracy or accuracy of management plan or prioritization for teledermatology/teledermoscopy in reference to clinical dermatology

Author year	Country	Study design	Number of patients n=	Result		Comments	Directness*	Study limitations *	Precision *
				Sensitivity	Specificity				
Nami 2014	Italy Austria	Cross-sectional	391	Sensitivity for diagnostic group: 96.6% (57/59)	Specificity: 93.3% (104/108)	Pigmented skin lesions were excluded from the study. 17% were self-referrals	?	+?	+?
Oliveira 2002	Brazil	Cross-sectional	92	Sensitivity: 100%	Specificity: 98%	Diagnosis grouped as malign or benign, Reference standard is face-to-face diagnosis	-	-	-
Piccolo 2004	Austria Italy Slovenia Japan	Cross-sectional	73	Mean sensitivity for 11 TDs: 91% (SD 9%) range 83%-100%	Mean specificity for 11 TDs: 95% (SD 4%) range 92%-100%	Reference standard is histopathology.	?	?	-
Romero Aguilera 2014	Spain	cross-sectional within a RCT	457	Sensitivity for correct diagnosis: NMSC: 100% (9/9) BCC: 100% (6/6) SCC: 100% (3/3)			?	?	?
Senel 2013	Turkey	Cross-sectional	150	Sensitivity for accurate management of malignant lesions: Teledermatology with only clinical information and images: Teledermatologist A: 82.5% (33/40) correct Teledermatologist B: 90% (36/40) correct Teledermatology with the addition of dermoscopic images: Teledermatologist A: 92.5% (37/40) correct Teledermatologist B: 97.5% (39/40) correct		Reference standard is face-to-face diagnosis and histopathology in selected cases.	+?	?	?
Shapiro 2004	USA	Cross-sectional	61	Sensitivity (for biopsy or no biopsy): 100% (n=49) (95% CI: 87% - 100%)	Specificity: 100% (n = 49) (0.95 CI: 85% - 100%)	Reference standard is histopathology	?	?	-

* + No problem
? Some problems
- Major problems

Project: The use of teledermatology and teledermoscopy for referrals of patients with suspected skin cancer
Appendix 5.2
Outcome variable: Diagnostic accuracy or accuracy of management plan or prioritization for teledermatology/teledermoscopy in reference to clinical dermatology

Author year	Country	Study design	Number of patients n=	Result		Comments	Directness*	Study limitations *	Precision *
				Sensitivity	Specificity				
Tadros 2009	United Kingdom	Cross-sectional	300	<u>Sensitivity for correct diagnosis of skin cancer :</u> Among 4 clinicians, sensitivity rates ranged from: 80.4% - 84.2%. 90.2% of malignant lesions (true positive) were correctly identified.	Among 4 clinician, specificity rates ranged from: 68%-84%. 76.6% of benign lesions were correctly identified.	Reference standard is histopathology. The mean overall diagnostic accuracy between the 4 teledermatologists was 83.2% (range 78.9-87.3) Diagnostic accuracy in a random sample of 30 patients in the teledermatology group was comparable to that reported for patients in FTF-group.	?	-	-
Tan 2010	New Zealand	Cross-sectional	200 patients 491 lesions	Among malignant lesions 1 BCC was misdiagnosed <u>Sensitivity for 2 dermatologist (A+B) compared with FTF/histopathology</u> MM: A: (n=18) 100% / 100% B: (n=11) 93% / 100% SCC invasive: A: (n=14) 100% / 100% B: (n=18) 100% / 100% BCC: A: (n=70) 94% / - B: (n=61) 90% / -	Teledermoscopy approximated 90% specificity for MM and NMSC <u>Specificity for 2 dermatologist (A+B) compared with FTF/histopathology</u> MM: A: (n=18) 99% / 98% B: (n=11) 100% / 99% SCC invasive: A: (n=14) 98% / 96% B: (n=18) 98% / 97% BCC: A: (n=70) 100% / - B: (n=61) 100% / -	TD and TDS Limitation: the same dermatologists were used for both the teledermoscopic and FTF diagnosis.	+	+?	+
Van der Heijden 2013	The Nether-lands	Cross-sectional	105	<u>Sensitivity for correct prioritization:</u> 100 % (7/7 malignant lesions)			?	-	-

Abbreviations:
BCC = Basal cell carcinoma
FTF-visit = Face-to-face visit
GP = General practitioner
MM = Malignant melanoma

Appendix 6

ETHICAL ANALYSIS OF TELEDERMATOLOGY AND TELEDERMOSCOPY

Question	Answer/ comment
1. From the patient's perspective, how does teledermatology (TD) and teldermoscopy (TDS) affect the patient's quality of life and life expectancy?	In the absence of false negative malignant diagnoses, the patient's life expectancy is affected in a positive manner, since TD/TDS referrals lead to earlier diagnosis and treatment of malignant melanoma. Also, early diagnosis and treatment of other skin cancers can improve the patient's quality of life. For example basal cell carcinomas in the face can have a cosmetic importance if left untreated for a long time. The low risk of a skin cancer being mismanaged, may result in a worsened prognosis, although this outcome has not been studied. There is a risk that teledermatology can have the tendency of giving false positive malignant diagnoses and that the patient is shown the diagnosis given by the dermatologist. This can result in unnecessary anxiety and influence quality of life negatively. The patient who is prioritized not to see a dermatologist, might feel disappointed and uncertain whether the decision was correct. Information at the time of referral is important. Others may feel relieved, not to have to see a dermatologist, but instead get a quick reply.
2. How severe is the patient's need that teledermatology must meet?	Incidence of malignant melanoma is increasing in Sweden. Early detection, diagnosis and effective treatment for patients with suspected MM is crucial. If TD/TDS can reduce the time to treatment, this effect may imply improved outcomes.
3. Does teledermatology have any influence on how others view the patient (concerning humanity and human dignity), or on how the patient views himself or herself (concerning humanity and human dignity)?	No, it does not seem applicable to teledermatology.
4. Can teledermatology affect the patient's ability and possibility to be independent?	Yes, unnecessary visits to a dermatologist can be avoided. Particularly old people can have a hard time to travel long distances for a face-to-face visit.
5. If implemented, does teledermatology require any special steps to not compromise the patient's autonomy?	Yes. TD/TDS referrals must strictly maintain the confidentiality and privacy of patient records while transferred. Also, the pictures should be stored within the patient journal system securely.

6. How does teledermatology affect the patient's physical, moral and personal integrity?	Patients can misinterpret the diagnosis given by the dermatologist to the GP. Some patients may feel uneasy having their pictures taken and sent over the internet without understanding all the technical details of how the information is secured when transferred.
7. Is teledermatology cost-effective?	Cost-effectiveness is insufficiently examined, but unnecessary visits can be avoided, and skin excisions at primary health care centres can be prevented also leading to less histopathological examinations However, in the long run, a teledermatological referral system that is easy to use can also lead to more referrals being sent compared to the traditional paper based system.
8. How does teledermatology affect resources?	New routines will be necessary at the Dermatology department to prioritize teledermatology referrals. Education for GPs on how to get high quality teledermoscopy images and manage the tele-referral system will be needed. Also, education on interpreting teledermoscopy images and using the tele-referral system will be needed for dermatologists.
9. Is teledermatology in conflict with professional values?	One might miss incidental findings in those patients not visiting a dermatologist for a face-to-face examination. Since only the lesion under suspicion in sent in the tele-referral system, other lesions on the body might be missed that would have been discovered in a full body skin examination. Often a full body skin examination is not performed at the primary health care center.
10. Does teledermatology change the role of the professional in relation to the patient?	Yes, TD/TDS referrals may result in less face-to-face visits and more consultations over distance. However, this might influence the personal relationship with the dermatologist which might feel less secure and more anonymous. The patient might think: "What if my images have been mixed up with someone elses?" The doctor might see his/her occupation as less inspiring due to the lack of personal interaction with patients.

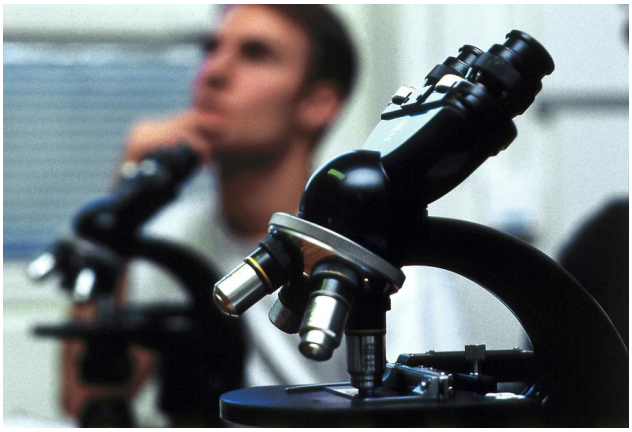
11. Does teledermatology affect, or does it put any new demands on, a third party?	Yes. Administration for the TD/TDS system.
12. Is there any legislation of relevance with regard to teledermatology?	Teledermatology must maintain the confidentiality and privacy of patient records.
13. Is there any risk of conflict between the procedure of teledermatology and values of the society, or values of different groups?	There might be a wish for some individuals to avoid having pictures taken and stored, and instead have a face to face visit with a dermatologist.
14. Is there a risk that an introduction of teledermatology will cause a conflict with particular interests?	Yes. Who shall administer and manage the TD/TDS referral service?
15. Can an introduction of teledermatology influence the trust of the health care system?	Teledermoscopy and teledermatology cannot substitute for a FBSE by a dermatologist.
CONCLUSIONS	Teledermatology/teledermoscopy implies positive effects for patients with suspected skin cancer. Ethical concerns mainly affect the group that is prioritized not to see a dermatologist. The follow-up, also including a FBSE by the GP, and how it will be resolved, is unclear. The low risk of being mismanaged (false negative results from the teledermatology assessment) needs further attention.

Abbreviations:

FBSE = Full body skin examination
MM = Malignant melanoma
PHC = Primary healthcare center
TD = Teledermatology
TDS = Teledermoscopy

Region Västra Götaland, HTA-centrum

Health Technology Assessment
Regional activity-based HTA



HTA

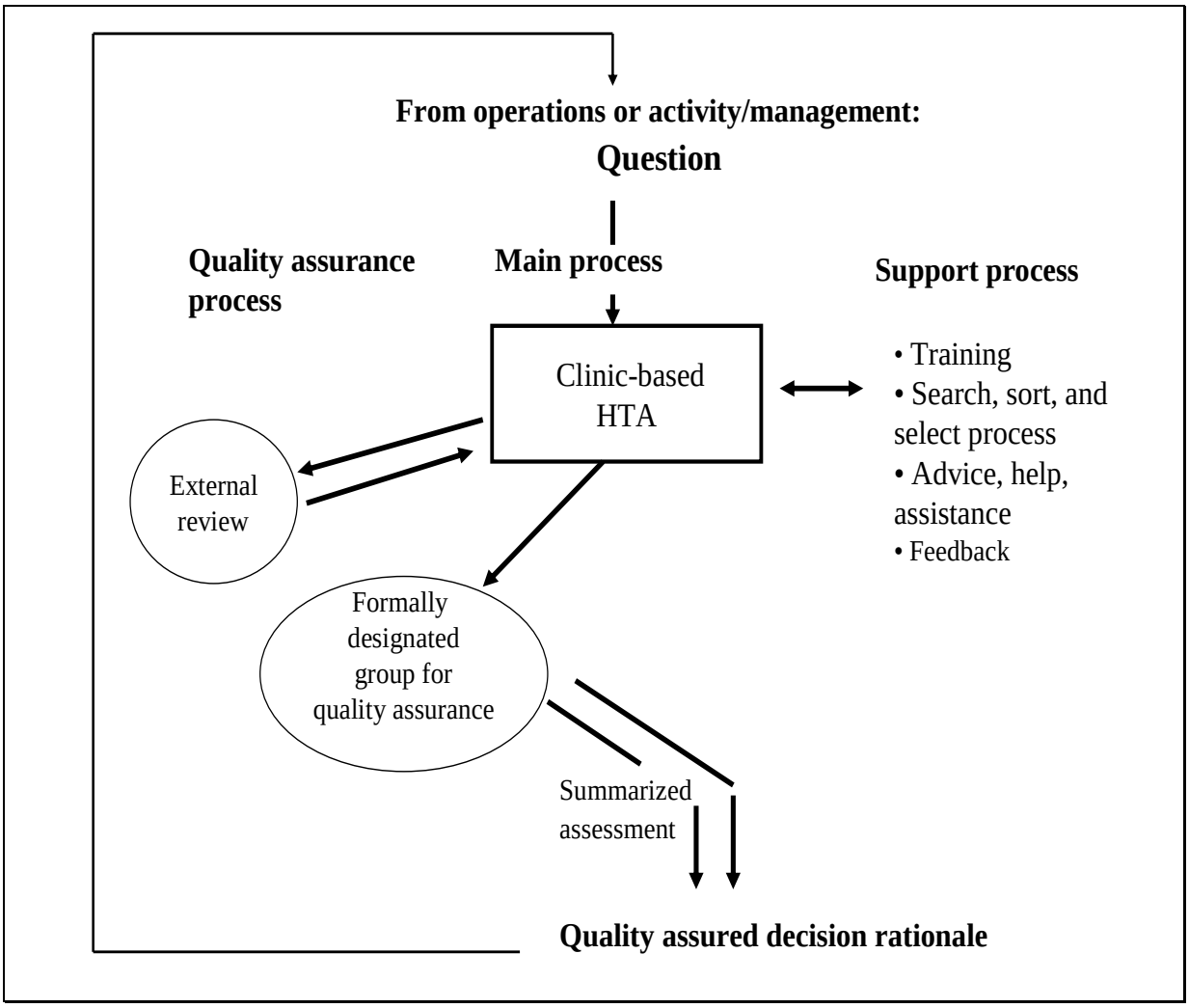
Health technology assessment (HTA) is the systematic evaluation of properties, effects, and/or impacts of health care technologies, i.e. interventions that may be used to promote health, to prevent, diagnose or treat disease or for rehabilitation or long-term care. It may address the direct, intended consequences of technologies as well as their indirect, unintended consequences. Its main purpose is to inform technology-related policymaking in health care.

To evaluate the quality of evidence the Centre of Health Technology Assessment in Region Västra Götaland is currently using the GRADE system, which has been developed by a widely representative group of international guideline developers. According to GRADE the level of evidence is graded in four categories:

High quality of evidence	= (GRADE⊕⊕⊕⊕)
Moderate quality of evidence	= (GRADE ⊕⊕⊕O)
Low quality of evidence	= (GRADE ⊕⊕OO)
Very low quality of evidence	= (GRADE ⊕OOO)

In GRADE there is also a system to rate the strength of recommendation of a technology as either “strong” or “weak”. This is presently not used by the Centre of Health Technology Assessment in Region Västra Götaland. However, the assessments still offer some guidance to decision makers in the health care system. If the level of evidence of a positive effect of a technology is of high or moderate quality it most probably qualifies to be used in routine medical care. If the level of evidence is of low quality the use of the technology may be motivated provided there is an acceptable balance between benefits and risks, cost-effectiveness and ethical considerations. Promising technologies, but a very low quality of evidence, motivate further research but should not be used in everyday routine clinical work.

Christina Bergh, Professor, MD.
Head of HTA-centrum


From operations or activity/management:
Question
Quality assurance process
Main process
Support process
Clinic-based HTA
• Training
• Search, sort, and select process
• Advice, help, assistance
• Feedback
External review
Formally designated group for quality assurance
Summarized assessment
Quality assured decision rationale

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