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Position paper: Telemedicine in occupational dermatology – current status and perspectives

Peter Elsner¹, Andrea Bauer², Thomas Ludwig Diepgen³, Hans Drexler⁴, Manigé Fartasch⁵, Swen Malte John⁶, Sibylle Schliemann¹, Wolfgang Wehrmann⁷, Jörg Tittelbach¹

(1) Department of Dermatology, University Hospital Jena, Jena, Germany

(2) Department of Dermatology, University Allergy Center, University Hospital Dresden, Dresden, Germany

(3) Institute of Clinical Social Medicine, University Hospital Heidelberg, Heidelberg, Germany

(4) Department of Occupational, Social and Environmental Medicine, University of Erlangen-Nuremberg, Germany

(5) Division of Clinical and Experimental Occupational Dermatology, Institute of Preventive and Occupational Medicine (IPA), Ruhr University, Bochum, Germany

(6) Division of Dermatology, Environmental Medicine, Health Theory, Institute of Interdisciplinary Dermatological Prevention and Rehabilitation (iDerm) at Osnabrück University, Lower Saxony Institute of Occupational Dermatology (NIB), Osnabrück University, Osnabrück, Germany

(7) Joint Dermatology Practice, Münster, and Osnabrück University

Summary

Teledermatology is the use of telecommunication technologies to exchange medical information for diagnosis, consultation, treatment and teaching in dermatology. While its use has been evaluated in a wide range of dermatological diagnoses, only few studies exist on its validity, diagnostic precision, feasibility, and cost-effectiveness in occupational dermatology. However, these studies show a considerable potential for diagnosis, prevention, treatment support and follow-up of patients with occupational skin diseases. Asynchronous (store and forward; SAF) or synchronous dermatology teleconsults could assist occupational medicine specialists not only in occupational preventive care, but also in the context of skin cancer screening in outdoor workers. Thus, teledermatology might contribute to earlier prevention and notification of occupational skin diseases. Modern smartphone apps with artificial intelligence technologies may also facilitate self-monitoring in employees working in high-risk jobs.

Current status of teledermatology

Telemedicine (e-health) involves the use of telecommunication technologies to exchange medical information for diagnosis, consultation, treatment and teaching [1]. The omnipresence of personal computers, digital photography and the internet that has evolved since the last decades of the past century and of smartphones after the turn of the millennium has brought about a revolution in telemedicine. While this was initially limited to research questions, it has found its way into routine clinical practice in recent years [2]. Given that dermatology is a uniquely visual medical specialty, it is particularly suited for telemedical diagnosis and consultation [3].

Two forms of technology are primarily deployed in teledermatology [3]: i) store-and-forward (SAF) technology where clinical images and additional information are assessed at a different time and location (asynchronous communication method), and ii) video conferencing which is characterized by simultaneous image-based diagnosis and consultation. Teledermatology consultations can take place between physicians from different specialties (teleconsult) or directly with patients (teleconsultation).

A recent systematic review showed that teledermatology has been used in a wide variety of dermatological diagnoses, with a particular focus on the diagnosis of skin cancer [4]. The majority of studies originate from countries with an unequally distributed density of dermatologists and large geographical distances, such as the USA, or countries with a low density of specialists, such as the United Kingdom. This explains the original use of teledermatology predominantly as a method of overcoming large spatial distances, especially in connection with the provision of care to dermatological patients at research stations, during military operations or during space missions, as well as to assist general practitioners if there are no dermatologists available. The primary focus of numerous studies on teledermatology was placed on diagnostic precision as compared to face-to-face consultations, with the majority of studies showing equal or even superior reliability and effectiveness of teledermatology [4].

Both with regard to teledermatology research and in terms of providing teledermatology services, Germany is clearly lagging behind other countries, a circumstance that will have to change in the future. On the one hand, even today office-based dermatologists frequently find no successor for their practice when they retire, especially in rural areas; on the other hand, it is likely that many patients who become increasingly immobile (due to aging and need for home care) will be more and more dependent on telemedicine for specialist care. In addition, the possibilities opened up by artificial intelligence (AI) and machine learning with respect to image-based diagnostic support are expected to provide

added diagnostic value with the use of teledermatology methods [5].

To date, the use of teledermatology in Germany has been hampered not only by a lack of telematic infrastructure but also by the insufficient remuneration of telemedical services by statutory health insurance funds. Other factors include legal uncertainties and a lack of training and experience on the part of physicians and nursing staff with regard to modern information and communications technology [6]. The German federal government has recognized this fact and the Act on Secure Digital Communication and Applications in Health Care ("E-Health Act") passed by the German federal parliament on December 3, 2015, and having come into effect on January 1, 2016, was intended to promote telemedical services [7]. An amendment to the E-Health Act is planned for the current legislative period, with the goal of establishing electronic patient records and improve interconnectedness [8].

In a position paper published in 2015, the German Society of Dermatology and the Professional Association of German Dermatologists actively promoted teledermatology, especially in the form of video consultations. Establishing a primary diagnosis via telemedicine was, however, considered problematic unless this took place in the context of a consult between physicians [9]. In Germany, the latter is limited by legal aspects concerning professional conduct (ban on remote treatment pursuant to Sec. 7 (4) of the Professional Code of Conduct for physicians practicing in Germany [MBO-Ä]).

Telemedicine in occupational dermatology: current status

Occupational dermatology refers to applied dermatology in the field of occupational and environmental dermatoses, with a particular focus on exogenous skin disorders predominantly caused by a patient's occupational activity [10]. This relates both to dermatitis triggered by exposure at the workplace and, increasingly, also to skin cancer induced by occupational carcinogens or natural UV radiation [11]. Since the introduction of the dermatologist's procedure in the 1970s, expert medical assessment and care of patients with recognized occupational skin diseases, which initially dominated the field of occupational dermatology, have increasingly been supplemented by prevention [12, 13].

To date, teledermatology methods have only rarely been employed in occupational dermatology. One typical example of its use involves the medical support for workers affected by skin disorders who are deployed to locations where dermatological expertise is not available. Coastal states are required to provide telemedical assistance services (TMASs) for ship crews. Given that skin disorders are a frequent reason for

consulting the TMAss, telemedical assistance services co-operate with dermatologists in order to enable medical care on board and thus avoid costly evacuations [14]. Similarly, the German armed forces have for some time now relied on telemedicine [15] and teledermatology support based in Germany during foreign missions.

The benefit of SAF teledermatology in occupational health care was demonstrated in a case series of railroad workers [16]. By bringing in dermatological expertise, it was possible to identify skin lesions occurring at the workplace as phototoxic reactions and to eliminate the hazard by reducing the exposure and implementing protective measures. A prospective comparative study on SAF teledermatology at the workplace among workers in “wet” occupations revealed that cases of incipient hand dermatitis could be identified by teledermatology with a high degree of accuracy; there was, however, a tendency to overestimate the severity of hand dermatitis [17]. Teledermatology assessment of the “Osnabrück Hand Eczema Severity Index” (OHSI) and the “Hand Eczema Severity Index” (HECSI), which are validated scoring systems for hand dermatitis, revealed that a specific score was useful when assessing incipient hand dermatitis using teledermatology [18].

Since 1973, the Occupational Safety Act (ASiG) has formed the mandatory legal basis for occupational health care of employees in the Federal Republic of Germany [19]. Pursuant to Sec. 11 of the Workers’ Protection Act (ArbSchG 1996), every employer “is required to provide employees at their request (...) with the opportunity to undergo a regular occupational health check-up, depending on the hazards to their safety and health at the workplace”; this is specified in the Regulation on Occupational Preventive Care (ArbMedVV 2013) which states possible reasons for mandatory check-ups as well as instances where such exams may be offered to or requested by the employee [19]. Pursuant to the ArbMedVV, in order to provide occupational preventive care services, the physician is required to be a board-certified specialist in occupational medicine or to be otherwise qualified in the field of occupational medicine. If physicians do not have the required specialist expertise or equipment, the ArbMedVV requires them to consult physicians who meet these requirements. Thus, teleconsults between occupational health physicians and dermatologists play a useful role in optimizing occupational preventive care [20]. On the one hand, this may contribute to increasing and ensuring the quality of occupational health care; on the other hand, it may help save employers and employees time and money as it allows employees to directly present to an off-site specialist [20]. Given the lesser amount of time and other resources required, the store-and-forward method is likely to be superior to a video consultation. Especially with respect to the management of chronic wounds, it has been shown that SAF methods are

diagnostically reliable and that the treatment plans resulting from SAF methods match those resulting from face-to-face consultations [21]. The time and travel required for skin patch testing, which is usually part of the guideline-based diagnostic workup during the dermatologist’s procedure, could be reduced by utilizing telemedical methods [22].

With regard to the diagnosis of UV-induced skin cancer by means of teledermatology, especially nonmelanoma skin cancer, it is not yet possible to come to a conclusive assessment. While teledermatology was associated with a high degree of diagnostic accuracy in a Brazilian study [23], a US study found teledermatology to be only moderately reliable [24]. In this context, however, it is important to bear in mind that non-dermatologists commonly select lesions that are not suitable for teledermatology, which may suggest a false degree of diagnostic accuracy [25].

Potential of teledermatology in the prevention of occupational skin diseases

Although the aforementioned studies were able to demonstrate the potential benefits of teledermatology in occupational health care, a comprehensive assessment and its use in routine clinical practice are still lacking.

The need for occupational dermatology care in Germany is to a large extent based on occupational disease (OD) no. 5101 of the Occupational Disease Regulation (“severe or recurrent skin disease that has required the abandonment of all activities that caused or may have caused the disease, its deterioration or recurrence”); with more than 24,000 reported cases each year, OD 5101 is responsible for the vast majority of OD notifications (primarily in the form of dermatologist’s reports) [26]. Thanks to comprehensive preventive measures on the part of the statutory accident insurance, only a small percentage of insured individuals are forced to abandon their job; thus, only a small percentage of notified cases lead to recognition as OD 5101 [26].

A teledermatology consult to support occupational medicine specialists and company physicians, whose job it is to assist the employer in providing primary preventive measures at the workplace, could lead to earlier notification of an imminent case of OD 5101 and thus to earlier deployment of preventive measures as part of the dermatologist’s procedure. While the “Skin Hazards Report” for company physicians is supposed to serve this purpose, it is only rarely used, one of the reasons being that it is frequently not possible to bring in an occupational dermatologist – as is usually required – in a timely and uncomplicated manner [27].

In the dermatologist’s procedure, teledermatology consultations using video conferencing have considerable potential not only to reduce the amount of face-to-face

consultations as part of monitoring preventive measures but also to increase adherence to therapeutic and preventive measures [28]. Thus, it would also be possible to document the disease course over time. Smartphone-based self-monitoring by patients with occupational skin diseases in conjunction with teledermatology interventions could additionally improve the success rate of preventive measures, as has been shown for other chronic conditions [29]. Experience made in the dermatologist's procedure over the past decades has shown that providing patient information and education plays a significant role in bringing dermatitis under control and ultimately in the patient's ability to remain in the job [30, 31]. However, it is not uncommon for patients to fail to participate in prevention programs due to long distances to training centers or personal or familial obligations that prevent them from attending such programs [32]. Teledermatology services aimed at patient education might help reduce the impact of such deficits [33].

Potential of teledermatology for the diagnosis and follow-up of recognized occupational skin diseases

Effective January 1, 2015, occupational disease no. 5103 was incorporated into the Occupational Disease Regulation; it is defined as "squamous cell carcinoma or multiple actinic keratoses of the skin caused by natural UV radiation" [11]. For this occupational disease, there is no preliminary procedure similar to the dermatologist's procedure [11, 34]. Hence, the recognition procedure is only initiated once the accident insurer has been notified of the suspicion of an occupational disease. To date, the Regulation on Occupational Preventive

Care only names exposure to artificial optical radiation as a reason for providing mandatory and voluntary preventive care services. Given the high risk of developing a medical condition caused by natural UV radiation, it can be expected that Annex 3 of the Regulation on Occupational Preventive Care will be expanded to include natural UV radiation. In this regard, teledermatology could assist occupational physicians in providing preventive care, especially in those cases where employees decide to use these services and evaluation of skin lesions is required. Experience has shown that outdoor workers too rarely make use of the skin cancer screening covered by statutory health insurance funds. Quality-assured dermatological follow-up is required following recognition of OD 5103. New-onset precancerous lesions and skin tumors must be documented and treated "with all suitable means" [35, 36]. Regular dermatological follow-up exams are time-consuming, both for the often-elderly patients and dermatologists alike; here, teledermatology methods might reduce the amount of time and money invested and also help create more flexibility in terms of the frequency of exams. In this context, it has been shown that automated detection of actinic keratoses in clinical photographs is, in principle, feasible [37]. A corresponding smartphone follow-up app used by patients themselves could – in the event of a suspicious lesion – prompt a teledermatology consultation and, if necessary, subsequent treatment.

Outlook and need for research

The present analysis shows that teledermatology has considerable potential for improving the care of patients with (imminent) occupational skin diseases in terms of prevention, diagnosis, adherence to treatment and follow-up (Table 1). This could make up for existing and still increasing gaps in

Table 1 Potential of telemedicine in occupational dermatology.

	OD 5101: severe and/or recurrent skin disease	OD 5102/5103: occupational skin cancer
Prevention	<ul style="list-style-type: none"> ▶ Self-monitoring in patients exposed to skin hazards at the workplace ▶ Video consultation as part of the dermatologist's procedure ▶ Online training as part of the dermatologist's procedure 	<ul style="list-style-type: none"> ▶ Online training with respect to sun protection
Diagnosis	<ul style="list-style-type: none"> ▶ Teleconsult (SAF, video consult) to assist occupational/company physicians in occupational preventive care ▶ Teleconsult as regards the diagnostic workup and reading of patch test reactions 	<ul style="list-style-type: none"> ▶ Teleconsult (SAF, video consult) to assist occupational/company physicians in skin examinations (preventive care)
Treatment	<ul style="list-style-type: none"> ▶ Video consultation as part of treatment support and to improve adherence in the dermatologist's procedure 	<ul style="list-style-type: none"> ▶ Video consultation as part of treatment support
Follow-up	Not applicable	<ul style="list-style-type: none"> ▶ Self-monitoring, video consultation during follow-up

Abbr.: OD, occupational disease; SAF, store and forward.

nationwide patient care caused by the decrease in dermatological services available. Teledermatology consults could be used to better assist occupational and company physicians in the future and to help include those patients with occupational skin diseases in the dermatologist's procedure who have previously not been reached, or to notify the accident insurer to initiate a recognition procedure (if the criteria for OD 5102/5103 are met). As regards dermatitis and patch testing, there are to date only few publications on teledermatology. Such studies may have certain imitations as the severity of hand dermatitis tends to be overestimated. There is also the issue of assessing alterations that cannot be identified visually but only by means of palpation such as the inflammatory infiltrate in the case of contact allergic reactions. These limitations should be further investigated in clinical studies. With regard to UV-induced skin cancer, there is more data available, showing the usefulness of teledermatology. There is, however, a lack of systematic studies on the telemedical cooperation between dermatologists and occupational/company physicians.

Patients could use AI-supported applications for self-monitoring of their skin disease and obtain telemedical assistance on an as-needed basis. Although feasible in principle, smartphone-based, AI-supported image analysis for self-monitoring of the skin has not been employed in individuals exposed to skin hazards at the workplace. Such analysis methods could, on the one hand, inform the company physician at the first sign of skin lesions, thus allowing for very early prevention; in patients with recognized occupational skin diseases, on the other hand, such apps could be coupled with teledermatology interventions without having to actually visit a dermatologist. It has been demonstrated that automated detection of actinic keratoses in clinical photographs is feasible in principle [37]. A corresponding smartphone follow-up app used by patients themselves could, in the case of patients with recognized OD 5103, prompt a teledermatology consultation and, if necessary, subsequent treatment. This would make it possible to individually adjust follow-up intervals for (the often elderly) patients with OD 5103.

Optimized reporting through teledermatology would also simplify and expedite the administrative procedures for the statutory accident insurance.

Factors that limit the use of teledermatology methods include technological considerations such as the availability of broadband, cost aspects, the requirements of data protection and the ban on remote treatment applicable in Germany pursuant to the Professional Code of Conduct for physicians. Another important aspect is the lack of competent experts, given that even the use of teledermatology methods is unlikely to be able to compensate for the decrease in dermatological services available [38].

Tapping the potential of teledermatology in occupational dermatology, as defined in the German government's E-Health

Strategy [39], also requires that occupational dermatologists closely cooperate with the statutory accident insurance in cases of imminent or existing occupational diseases. Before teledermatology methods can be used on a nationwide level, it is imperative that their effectiveness and safety as well as related economic aspects be evaluated in prospective studies. This will then also require that the fee schedule used by the statutory accident insurance be modified to include such services and pay physicians appropriately. In the future, continued medical education programs for occupational dermatologists [40] should place special focus on teledermatology methods.

Correspondence to

Prof. Dr. med. Peter Elsner
Department of Dermatology
University Hospital Jena

Erfurter Strasse 35
07743 Jena, Germany

E-mail: elsner@derma-jena.de

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