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REVIEW ARTICLE

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Telemedicine and psoriasis: A review based on statements of the telemedicine working group of the International Psoriasis Council

Mohamed H. M. El Komy[1] | **Andrea Chiricozzi**[2,3] | **Peter van de Kerkhof**[4] | **April Armstrong**[5] | **Vahid Diamei**[6] | **Christophe Hsu**[8] | **Joel Gelfand**[7] | **Alexander A. Navarini**[8]

[1]Department of Dermatology, Kasr Alainy Hospital, Faculty of Medicine, Cairo University, Egypt

[2]UOC di Dermatologia, Dipartimento di Scienze Mediche e Chirurgiche, Fondazione Policlinico Universitario A. Gemelli-IRCCS, Rome, Italy

[3]UOC di Dermatologia, Dipartimento di Medicina e Chirurgia Traslazionale, Università Cattolica del Sacro Cuore, Rome, Italy

[4]Department of Dermatology, Radboud University Nijmegen Medical Centre, Nijmegen, The Netherlands

[5]Department of Dermatology, Keck School of Medicine, University of Southern California, Los Angeles, California, USA

[6]Department of Dermatology, University Hospital Zürich, Zürich, Switzerland

[7]Perelman School of Medicine, Psoriasis and Phototherapy Treatment Center, University of Pennsylvania, Philadelphia, Pennsylvania, USA

[8]Department of Dermatology, University Hospital Basel, Basel, Switzerland

Correspondence
Peter van de Kerkhof, Department of Dermatology, Radboud University Nijmegen Medical Centre, Nijmegen, The Netherlands.
Email: Peter.vandekerkhof@radboudumc.nl

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Abstract

During the past few decades, classical in-person communication has been enriched by opportunities for telemedicine. We are in a learning healthcare environment that takes advantage of the opportunities of telemedicine and in-person consultations, reconciling the individuality of the patient and his/her psoriasis. A working group of experts in telemedicine was installed by the International Psoriasis Council (IPC) to formulate the opportunities and limitations of telemedicine in the diagnosis and treatment of psoriasis. The working group formulated statements on various aspects of telemedicine according to the nominal group technique to reach a consensus on these statements and explore the variation of opinions. Thirty-six statements regarding teledermatology and psoriasis were agreed upon by the IPC working group. The value and necessity for the implementation of teledermatology in dermatologic healthcare practices for psoriasis are essential. Management of psoriasis through teledermatology is feasible with a few exceptions. In this communication, the statements are presented and discussed in the context of the available literature, and finally, a call to action by IPC is formulated related to these statements.

KEYWORDS
access to care, artificial intelligence, psoriasis, teledermatology, telemedicine

INTRODUCTION

Technology has provided numerous opportunities for communication. This has profoundly changed the ways in which people communicate. In-person communication has been enriched by the opportunities that the Internet provides in dermatology as well. In this sense, telemedicine (TM) comprises communication through pictures and video, text messages via mobile phones, questionnaires and Q&A via the Internet. Access to care is enhanced not only by TM in a busy and hectic world but also in the offerings of care in remote areas. However, the human touch of the in-person doctor–patient relationship is where we come from and has been regarded as the most optimal context for the care of patients with psoriasis. Different views on the TM's value in the treatment of psoriasis have been reported by dermatologists and patients. As every patient's psoriasis is unique, opportunities and limitations need to be considered in a personalized manner.

In healthcare systems, TM has not yet been established, and reimbursement is seldom established. Guidelines and regulatory platforms for TM are available in some countries. With respect to TM, we are in a learning healthcare environment.

The coronavirus disease 2019 (COVID-19) pandemic has resulted in limited access to in-person care, and TM has been practiced by colleagues who show reluctance towards TM. COVID-19 has also intensified the implementation of TM in the management of psoriasis not only limited to the context of the pandemic but also as an enrichment of offerings of care to our patients.

The International Psoriasis Council (IPC) has decided to install an international TM working group of experts on psoriasis and experience in TM. The task of the working group was to develop a roadmap based on the formulation of statements regarding TM and psoriasis. This roadmap will serve as a call to action for TM development as an integrated part of innovative care for psoriasis. To make this 'call to action' applicable for the reorganization of psoriasis care, the statements will focus on but not be exclusively restricted to psoriasis.

METHODS

A working group of experts in TM was installed by the IPC to formulate an orientation on TM and psoriasis. The expertise of members of the working group comprised: clinical expertise in treating psoriasis; experience in treating patients with psoriasis with TM; expertise in research on teledermatology (TD) related to psoriasis; expertise in techniques relevant to psoriasis; and expertise in epidemiology and psoriasis.

This orientation of the working group may serve as a discussion of how IPC can stimulate the development and implementation of TM focused on psoriasis diagnosis and management.

The group had discussions on how TM is defined and positioned, the value of *store and forward* (SAF), live video conferencing (LVC) and hybrid TM in the management of psoriasis. The group discussed the legal aspects, cost-effectiveness and reimbursement of this approach. The value of TM during the COVID-19 pandemic was discussed, and the group envisaged the development of TM beyond the COVID-19 era by learning from the current intensified use of TM-mediated consultation. The group discussed what could be transported to a virtual work and what could not. Furthermore, the opportunities of TM as an unprecedented innovation for psoriasis care were explored, such as in early diagnosis and follow-up of psoriasis patients, including as a tool in triaging for referral to a board-certified dermatologist for further management. Discussions included the opportunities and restrictions of pictures, artificial intelligence (AI) and automated Psoriasis Area and Severity Index (PASI) measurements. The group expressed different views on which treatments could be initiated and which treatment was maintained by TM. The working group is aware of the limitations in access to care and discusses the potential value of TM in improving access to care in underserved areas. The working group formulated statements according to the principles of the nominal group technique (NGT).[1] As the consensus process took place during the COVID-19 pandemic, face-to-face meetings were not possible. Two plenary internet meetings were organized of 2 h each. In addition, the consensus process consisted of three rounds of e-mail exchange, and after each round, a consolidation voting was done using Survey Monkey. The process had four stages: (1) Identification of essential issues related to psoriasis and TM in an inaugural meeting of all members of the working group. (2) Subsequently by e-mail exchange the statements were refined. (3) Voting, using an online survey conducted by Survey Monkey, followed in three rounds until the formulation of the statements reached 100% consensus on clarity of formulation. (4) Final voting on 36 statements followed (Table 1). In 33 statements, 100% consensus was reached, and in

TABLE 1 Statements formulated by the telemedicine working group of IPC

Teledermatology definitions and general positioning

Q1) Telemedicine in dermatology is called teledermatology and is a subset of telehealth in skin disease.

Q2) Teledermatology replacing 'in-person' visits is now often feasible because of better internet connectivity and better data handling technologies, as well as the availability of cameras in every smartphone.

Q3) Teledermatology requires staffing and resources to implement.

Q4) Teledermatology is defined as the remote interaction of a dermatologist or other clinician qualified to practice dermatology with a patient or a referring health professional.

Q5) Teledermatology can use skin imaging (including pictures taken with a smartphone camera or classical photographic equipment) and other medical data as the basis for making medical decisions.

Q6) Teledermatology image data can be created and submitted by laypersons or health professionals.

Q7) Teledermatology can be used as an add-on to healthcare provider in-person consultations.

Q8) Teledermatology can, in some cases, replace in-person consultations, including but not limited to follow-up visits when in-person visits are not possible.

Value of TM, including SAF, LVC and hybrid in the management of psoriasis

Q9) The in-person consultation is the gold standard for diagnosis of psoriasis and empathic doctor–patient relationships, permitting a holistic approach to psoriasis patients.

Q10) LVC has the advantage of being a remote live consultation and allows an empathetic relationship with the patient to build over time.

Q11) SAF with adequate guidance for patients when taking photographs can be accurate for the diagnosis of psoriasis.

Q12) SAF and LVC permit accurate disease assessment and facilitate a doctor–patient relationship sufficient for managing the treatment if the technology is available and depending on the patient and provider preference.

Q13) Combining 'store and forward' of pictures and 'live video conferencing' in a hybrid mode enables a structured collection of pictures, as well as live and empathic discussions.

Legal aspects, cost-effectiveness and reimbursement

Q14) Every national healthcare system should legalize and establish the preferred teledermatology systems, such as LVC and SAF

Q15) Security, safety and privacy protocols for data communicated through teledermatology must be established.

Q16) SAF and LVC have to be reimbursed based on par with in-person visits, according to the national systems of reimbursements.

COVID-19 and teledermatology

Q17) During the COVID-19 pandemic, TD replaced many in-person visits, resulting in continued care of many psoriasis patients.

Q18) It is an opportunity to investigate how patients and their doctors experienced telemedicine consultations during the COVID-19 pandemic.

What can be transported to virtual work and what cannot?

Q19) Teledermatology can approach the quality of in-person evaluations in certain circumstances.

Q20) Specific body regions frequently affected with psoriasis are difficult to evaluate with the current photography technology or due to patient privacy concerns, including the genitals and areas covered by hair and skin folds, while larger areas are easier to evaluate.

Q21) Symptoms can be collected by questionnaire, namely itching pain and production of scales.

Q22) PROs that may be collected via questionnaire include psychological features, quality of life impairment and benefit of treatment.

Q23) Disease-modifying factors may be collected by questionnaire, namely extrinsic risk factors, including mechanical stress, air pollution, drugs, vaccinations, infections, smoking and alcohol.

Q24) Some comorbidities can be screened for with questionnaires.

Q25) Physical surrogate markers other than the skin frequently require an in-person visit, such as screening for comorbidities.

Q26) Special situations where in-person visits are preferred (Table 2)

Does telemedicine provide unprecedented opportunities for innovation in psoriasis care

Q27) Teledermatology consultations for early diagnosis of psoriasis should be available where culturally acceptable.

Q28) Teledermatology consultations have been shown to be suitable for follow-up of psoriasis patients.

Q29) Telehealth advice is increasingly used and can be a nondiagnostic tool also triaging to refer to a board-certified dermatologist for further management.

Pictures, AI and automated Psoriasis Area and Severity Index measurements

Q30) In teledermatology, photographs of patients with psoriasis are essential for diagnosis and concomitant skin diseases.

Q31) The quality of photographs should be optimized by providing patients with instructions consistent with the American Teledermatology Association guidelines

(Continues)

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Q32) Further research on AI-assisted diagnosis of psoriasis should be a priority.

Q33) All automated methods to grade clinical severity, such as a 'PASI app', must have been validated for accuracy before they are marketed.

Which treatments can be initiated and continued by teledermatology

Q34) Which therapies can be initiated by teledermatology (Table 3)

Q35) Which therapies can be continued by teledermatology (Table 4)

Access to care in underserved areas

Q36) Access to care in underserved areas can be improved by providing a framework for the optimal use of teledermatology.

Abbreviations: AI, artificial intelligence; COVID-19, coronavirus disease 2019; IPC, International Psoriasis Council; LVC, live video conferencing; PASI, Psoriasis Area and Severity Index; PRO, patient-reported outcomes; SAF, store and forward.

three statements, the individual working group members had different views. Crucial in the process was that all working group members participated in the generation of statements, clarification, reaching a consensus on the formulations and voting.

In this consensus article, the statements are organized under the overarching headings introduced above and discussed in the context of the available literature. These sections are summarized in terms of the call to action.

RESULTS

The working group statements regarding definition, positioning, value, utilization and innovations, as well as cost-effectiveness and reimbursement in the field of TD for psoriasis are shown in Table 1.

TD: Definitions and general positioning (Q1–Q8)

Medicine at a distance or TM can be defined as the use of electronic information and communication technologies to deliver medical care services, including prevention, diagnosis, treatment, follow-up and rehabilitation, without physical encounters between the participants.[2,3]

TD is a subset of TM that has been gaining popularity in recent years and even more during the late COVID-19 era.[4] As dermatology relies on visual signs, skin images captured with smartphones, video feeds and digital or classic photography incorporated in a TD model can be an alternative to in-person consultations in certain situations, such as in geographically or economically disadvantaged populations, during lockdowns and in cases of military deployments.[5] Moreover, TD may deliver professional dermatological medical care remotely to patients and/or their healthcare providers, reducing the long wait time for specialist consultation. With the excessive use of mobile phones in our daily lives, its use as a platform for TD may render mobile TD more accessible even to individuals who are technology novices.[6]

A systematic review by Trettel et al.[7] shows that most articles report that TM was feasible, reliable or effective in the management of skin diseases, including psoriasis. Nami et al.[8] show that the concordance between SAF TD and in-person consultation was 94% for contact dermatitis and 100% for seborrhoeic dermatitis; however, the concordance was only 71% for psoriasis. The authors emphasized that, in certain cases, such as palmoplantar and inverse forms, psoriasis is complex to diagnose.

Nonetheless, TD requires resources for system organization, staffing, education (patients and healthcare providers) and telehealth technology, which, in turn, includes issues of software platforms, devices, privacy and connectivity.[9,10]

Call to action

The IPC provides a major contribution to teaching dermatologists about innovations in psoriasis management. The IPC considers TD a priority in teaching programmes.

Value of TM: SAF, LVC and hybrid in the management of psoriasis (Q9–Q13)

The value of touch as one of the five senses classified by Aristotle has been discussed in light of the patient–doctor relationship. In the classical view, touch is understood in the context of empathy and solidarity; it has the potential to communicate and soothe. Medicine is inferior if it avoids the power of touch.[11] TM is interpreted upfront as medicine without touch and the question arises to what extent the virtual world provides the essential elements that would permit an empathic doctor–patient relationship and permit the technical aspects of dermatological care.[12]

An impressive increase in TM has been reported in most regions of the world, with up to a 154% increase in telehealth visits in 2020 in the United States.[13–16] This trend for increased use of telehealth systems will help assign psoriasis patients to a specialized dermatologic TD service when appropriate. This triaging with improved access to a dermatologist through TD may provide the patient with the initial diagnosis of psoriasis and an early management of the disease and its comorbidities that may even occur in the paediatric age group.[17] However, patients in developing countries and those within certain cultures or backgrounds may find consultation without meeting the doctor in person a challenging concept, especially with regard to patients' privacy and confidentiality.[18] In the Kingdom of Saudi Arabia, patients' acceptance is one of the barriers that challenge the application of TM in this region.[19] Similarly, in Jordan, many patients do not accept TM for fear of being treated by a doctor with a different cultural or religious background from their own; this is especially the case for female patients who prefer a culturally sensitive examination.[20]

While TM is an effective means of improving the healthcare systems' efficiency, what is the status of psoriasis and TD? In a systematic review, it was shown that TD is efficient for the diagnosis, decision-making and follow-up of patients with psoriasis.[21–23]

TD can be carried out through (a) an *asynchronous mode* or SAF digital photos for a dermatologist to review at different dates and locations, (b) a *synchronous mode* through LVC or telephone calls between participants, and (c) a *hybrid mode* combining both the aforementioned methods.[9,24] Both SAF and LVC have advantages and limitations that can be technical, financial and/or emotional. Although SAF seems to be the standard of care for TD,[25] several factors may influence the choice of the TD mode used with the hybrid mode, holding the potential to combine the advantages of both SAF and LVC.

The practice of dermatology essentially depends on visual clarity for proper recognition of the forms and patterns of lesions that determine the cutaneous disease.[26] In particular for the diagnosis of seldom variants of psoriasis such as pustular psoriasis with its various presentations,[27] optimal photographs are important. Thus, for psoriasis management through TD, visual clarity of all cutaneous lesions is essential for the appreciation of the psoriatic lesions and also for the detection of associated and/or concomitant cutaneous diseases, including those with a higher incidence of occurrence among psoriasis patients, such as nonmelanoma skin cancers and infectious events.[28] Moreover, the early diagnosis of concomitant skin diseases among psoriasis patients is crucial for those receiving immunosuppressive medications and phototherapy. For all forms of TD, the quality of photographs is crucial.

Call to action

The IPC will provide a professional forum to share best practices on personalized care using TD and in-person consultations.

The IPC will work with other worldwide professionals and patients' organizations to improve access to care using TD as part of treatment offerings. Such collaborations may also help explore acceptable methods for the application of TD among different ethnic/cultural backgrounds.

Legal aspects, cost-effectiveness and reimbursement (Q14–Q16)

The first conceptual framework for TD implementation was published in 2015 based on a literature review.[29] Most countries, however, lack a regulatory framework to authorize, integrate and reimburse TM services, which also limits its use in emergency and outbreak situations. For countries without integrated TM into their national healthcare system, the COVID-19 pandemic is a call to adopt the necessary regulatory frameworks for supporting the wide adoption of TM.[30]

Based on a guideline built on the best evidence, a quality TD system was developed. The German guideline provides an example of the best practice-relevant standards.[31] It describes technical aspects, legislation, evidence for the validity of TD, indications and contraindications, patient information, quality assurance, patient perspective, the perspective of the healthcare professional, implementation and application in various fields of interest. The American Telemedicine Association also provides useful TD guidelines that apply to individual providers, group and specialty practices, hospitals and healthcare systems.[32]

The Australasian College of Dermatologists guideline on TD, last updated March 2020, includes modalities of TD, patient selection and consent, imaging, quality and safety, privacy and security, communication and documentation and retention of clinical images.[33] Safeguarding patient privacy and mitigating medicolegal risk is of major importance as well, together with adequate training to prevent circumstances involving what might be termed 'telemalpractice'.[34,35]

Based on national guidelines and cost-effectiveness studies on psoriasis, a reimbursement system for TD can

be installed. Cost-effectiveness of TD has been reviewed by Wang et al.[36] TD studies in Spain and Philadelphia has demonstrated cost-effectiveness of TD in different scenarios.[37,38] Indirect costs have also been shown to be considerably lower for TD, when one factor is associated with loss of productivity,[39] costs to companions who accompany the patient and costs of lost leisure time.[36,38] Furthermore, TD could enable earlier initiation of appropriate therapy, resulting in increased cost-effectiveness of psoriasis management.

Reimbursement policies for TD services are not yet well established, and this is a serious barrier to care.[40] The Netherlands offers full reimbursement for services.[41] Dermatologists in the United States, indicate that reimbursement issues regarding TD are a major challenge.[9]

Call to action

The IPC will raise awareness of the following positions:

A. IT security and prevention against unauthorized disclosure.

B. Data protection in particular regarding images by encryption of data.

C. Traceability of electronic clinical records.

D. To protect the data subject's privacy, explicit consent of the data subject is required for data sharing.

E. The installation of a reimbursement system is needed urgently.

COVID-19 and TD (Q17–Q18)

In Egypt, during the COVID-19 pandemic, 71.6% of surveyed dermatologists reported that the interval between face-to-face follow-up visits was prolonged for psoriasis patients. This delay affected patients psychologically (34.4%), interfered with drug compliance (40.4%) and worsened psoriasis manifestations (23.8%).[42] During the COVID-19 pandemic, dermatologists had to use TM application to continue care for patients with psoriasis.

The question arises as to how patients experience visits via TM. Patients surveyed at the George Washington Medical Faculty Associates Dermatology Department, who attended telehealth appointments during the COVID-19 pandemic, indicated that the most common reasons why respondents liked telehealth were because of time efficiency (81.1%), not requiring transportation (74.2%) and maintaining social distancing (73.6%). The most common reasons why respondents did not like TD were: a lack of physical touch (26.8%) and a feeling that they received an inadequate assessment (15.7%). Few patients reported that they were unlikely to undertake another telehealth visit (9.94%) or recommended a telehealth visit to others (6.92%).[43]

In Italy, among 246 participants, almost half (48%) of patients with psoriasis on maintenance treatment with biologics preferred TM over an in-person visit. Elderly patients (older than 60 years) had a preference for in-person visits. Furthermore, 56% of the patients with a preference for in-person visits indicated that they were unable to use video communication tools.[44]

However, do healthcare systems have a regulatory framework to authorize, integrate and reimburse TM services in emergencies and outbreak situations? An updated framework for TM during the COVID-19 pandemic could be applied to improve the national public health response.

Call to action

The IPC provides a resource centre on COVID-19 on the IPC web page to communicate innovations, have statements related to COVID-19, report new findings from the Psoprotect registry and share best practices related to TM in times of lockdown.

What can be transported to virtual work and what cannot? (Q19–Q26)

Armstrong et al.[22] show that SAF TD between primary care physician and a dermatologist providing assessments, recommendations, education and prescriptions is as effective as in-person management in improving clinical outcomes among patients with psoriasis. Of the 296 randomized participants, the adjusted difference between the online and in-person groups with respect to PASI score and body surface area (BSA) were within prespecified equivalence margins, which demonstrated equivalence between the two interventions. Additionally, this online model results in a reduction of Skindex and Dermatology Life Quality Index (DLQI), similar to in-person treatment.[45]

Chambers et al.[46] reported that psoriatic patients who were treated with SAF TD or in person for 24 weeks experienced a clinically equivalent reduction in psoriasis disease severity, with no significant differences in mean changes in their quality of life. The latter authors indicate that a thoughtfully developed telehealth programme has the potential to improve access, clinical outcomes and quality of life for patients with psoriasis.

In paediatric psoriasis, the effectiveness and safety of short-contact dithranol therapy were studied in two

settings of patient care: regular daycare and daycare with TM home treatment with care instruction via LVC. A mean percentage reduction in PASI score of −69.3% was found, with no significant differences between classical in-person day-care settings and home treatment with care instruction via video conferencing. This prospective observational study is a showcase of the value of TM to assist parents at home in the complex topical treatment of children with psoriasis.[47]

Educational motivation is another important aspect of consultation for patients with psoriasis. Balato et al.[48] compared TM and in-person treatment of psoriasis in a randomized controlled trial over 12 weeks. Daily TM, providing reminders and educational tools via mobile phones resulted in better improvements in terms of PASI, Self-Assessed PASI, BSA, Physician Global Assessment and DLQI ($p < 0.05$).

The question arises as to the extent to which the empathic and communication aspects of internet offerings are inferior to in-person consultations. In contrast to the classical belief, evidence is accumulating for comparable effectiveness of psychological Internet and face-to-face treatments.[49,50] Psychotherapy via the Internet is an evidence-based offering of psychotherapy.

In a 12-month randomized controlled equivalency trial, 296 psoriasis patients were randomized to online or in-person care for psoriasis.[22] The between-group difference in the overall improvement in EuroQol and Patient Health Questionnaire-9 fell within the equivalence margin. The online health model is equivalent to in-person care for reducing functional impairment and depressive symptoms in patients with psoriasis. This implies that, in the overall emotional experience, the patient is not in an inferior condition following an Internet-based treatment for psoriasis compared with traditional in-person offerings.

Internet-based mental health interventions may provide unique aspects that in-person treatments do not have.[51] Further studies are needed to determine which patient pretreatment characteristics are predictive for optimal therapeutic relationships during internet interventions.[52,53]

Moreover, in the treatment of psoriasis, cognitive behavioural therapy via the Internet (ICBT) proved to be a valuable transition from in-person to virtual treatment. The addition of ICBT had a significant effect on daily activities but not on psychological functioning.[54] Although, ICBT plus 'care as usual for psoriasis' may not be cost-effective compared with 'care as usual for psoriasis', for a subset of patients who experience high self-assessed disease severity and impact, the ICBT proved to be a cost-effective addition.[55]

Call to action

TD can approach the quality of in-person evaluations in certain circumstances. The development of treatment algorithms may comprise in-person and TD approaches. The IPC provides a platform for professionals to exchange best practices and develop insights on which aspects of the disease in a patient require what kind of treatment approach and the opportunities and limitations of the healthcare system to accommodate treatments algorithms with in-person and TD offerings, including dermatological and psychological aspects and comorbidities.

It is reasonable to assume that some visual limitations may be encountered during TD consultations for psoriasis. The points to be considered include the following:

- At the first consultation and at regular intervals, patients with severe psoriasis who have received photo(chemo) therapy and immunosuppressive medications should undergo a whole-body skin examination for skin cancers. At present, whole-body skin examination using TM is difficult to achieve.
- Online inspection of genital skin and mucosa can be both embarrassing and difficult or even impossible for many patients. Indeed, technical difficulties exist for all patients concerning the inspection of the scalp, gluteal cleft, external ear meatus, perianal area and back in TD.

For these reasons, in-person consultation is still required once in a while.

Call to action

Sharing experiences on the use of TD in a discussion forum may help explore opportunities and limitations and help to develop a protocol for TD use in certain settings.

In the literature, apart from the quality of life and physical disability index, information on the use of questionnaires is limited. The structured interviews of patients have yielded an important improvement in the quality of care. A drawback is that the number of questionnaires that we can ask the patient to fill out is limited. Moreover, investigation of the joints, tendinitis and dactylitis may be difficult via the Internet as these are functional investigations.

Situations where in-person consultation is mandatory have been suggested. Table 2 summarizes the percentage

TABLE 2 Special situations where in-person visits are preferred

Answer choices	Responses	
When a biopsy is required	100.00%	8
Difficult areas such as genitalia, flexures and scalp	87.50%	7
Patients with severe psoriasis (IPC definition)	75.00%	6
Patients who refused the prescribed medication	75.00%	6
Children with psoriasis (diagnostic difficulties)	75.00%	6
Cancer checkup	75.00%	6
Arthritis, enthesitis and dactylitis	62.50%	5
Metabolic syndrome	50.00%	4
Nail disease	37.50%	3
None of the above	0.00%	0
Total respondents: 8		

Abbreviation: IPC, International Psoriasis Council.

and number of working group members who agreed with the statements.

Call to action

The opportunities and limitations of TD versus in-person consultations in certain settings and the need for detailed data collection through questionnaires must be explored. The IPC calls for collaboration with other international organizations investigating TM to improve psoriasis care beyond the skin.

Does TM provide unprecedented opportunities for innovation of psoriasis care (Q27–Q29)

Early diagnosis of psoriasis with active intervention aimed at clear or virtually clear skin is the ambitious aim of dermatological care for patients with psoriasis. Although evidence for true disease modification by early active intervention is solid in other immune-mediated diseases, such as rheumatoid arthritis and Crohn's disease, evidence is accumulating that early active intervention is important in psoriasis.

Therefore, easy access to dermatological care is crucial. TM opens the possibility of a low-threshold dermatological consultation with experts in the field of psoriasis for early active treatment.

Call to action

The opportunities and limitations of TD with respect to early diagnosis and treatment of psoriasis are being defined, whereas TD used for follow-up of psoriatic patients and triaging for referral needs to be continually optimized.

Pictures, AI and automated PASI measurements (Q30–Q33)

Photography in dermatology is commonly used in clinical settings for educational purposes and to track disease progression in patients. Dermatology has played an important role in the introduction of AI into the medical field because of its morphological characteristics, and most diagnoses are based on visual patterns.

With the development of deep learning in medical imaging, convolutional neural networks (CNNs) used to determine whether a skin is 'abnormal' or 'normal' has made remarkable achievements. In addition to CNNs, other techniques are used for diagnosis and decision tree support vector machines.

Experience with the success of machine learning and lesion segmentation in recent years has shown that the quality of photographs affects the results of machine learning. The quality of the photographs used for TD and machine learning was determined by two types of features. The first type is related to the most common technical features such as illumination, contrast and sharpness. The second type relates to the semantics of photographs, such as the region of interest and the texture of the lesion. Machine learning combines both types of information to create diagnostic interpretations.

The quality of the photos depended on the type of device used to capture the images. For example, the use of smartphone cameras has improved over the years. However, many of their camera features are computer-simulated, and in many areas, they simply cannot match the capabilities of compact cameras. Although a cell phone camera is an easy-to-use tool for taking good-quality photos quickly, its colour cannot be used as a reliable reference for colour selection.

Ideally, to improve the quality of photographs taken by patients, AI should be used to guide patients in taking photos. However, because TD is relatively new, there has been little work addressing the issue of automatically assessing the quality of patient images. Nevertheless, there are some proven basic recommendations for image acquisition:

- If the patient cannot see a skin lesion or take a photo of a lesion, ask a family member or friend to assist, or use the auto-timing feature to capture the image.
- Use soft, indirect light to avoid the shadow.
- Take at least one overview and twoto three close-up photographs.
- Make sure that the photos are not blurred and can be evaluated by experts.
- Photographs were taken in front of the bright background. Do not take photos in front of a window or other brightly lit background.
- In low-light conditions, the flash is turned on to avoid grainy or blurry images. For brighter light, a flash is not required. Flash can help eliminate shadows; however, it can also cause excessive white.
- Do not use software to edit your photos.

In recent years, AI has demonstrated its potential in the diagnosis and treatment of psoriasis.[56–58] To realize this potential, further research is needed on the appropriate implementation of applications supported by AI in the diagnosis and treatment of psoriasis, regardless of skin type, ethnicity or geographic location.

Assessment tools such as PASI and BSA are essential for the evaluation of psoriasis and are increasingly supported by AI. However, it takes time to obtain a PASI score in a busy practice. An automated tool for PASI measurement would facilitate clinical practice. Therefore, intensive research to evaluate AI-assisted tools is desirable.

Smartphones are particularly effective for reaching many people around the globe and have great potential to enable compact, easy-to-use biomedical imaging for AI-assisted diagnostics.

Call to action

A holistic assessment of smartphone applications that leverage AI techniques for skin disease diagnosis are needed to enable better reproducibility and demonstrate value in intended clinical settings.

Resources at the IPC website are needed for instructions to make optimal pictures. Furthermore, research and implementation of AI-assisted diagnosis of psoriasis have to be prioritized.

Which treatments can be initiated and continued by TD (Q34–Q35)

The working group queried the scenario where the patient received care by TD and did not have ready access to blood and radiologic tests (Tables 3 and 4). One expert who was not seeing patients regularly anymore was withheld from voting. The expert panel demonstrated full confidence in initiating topical therapies (100% consensus), whereas the group was reluctant in starting both systemic conventional and biological agents (Q34). A partial consensus was reached regarding apremilast. A completely different approach was stated by the expert panel concerning treatment continuation in TD (Q35). Full or almost full consensus was detected for the continuation of topical therapies, apremilast and biological agents (100% agreement for both interleukin-23 [IL-23] and IL-17 antagonists, and 85.71% [6/7 voters] agreement for anti-tumor necrosis factor-α). Conventional systemic therapies did not obtain strong agreement to be continued by TD, particularly cyclosporine having the lowest rate (42.86%).

TABLE 3 Which therapies can be initiated by teledermatology?

Answer choices	Responses	
Topical	100.00%	7
Methotrexate	14.29%	1
Cyclosporin	14.29%	1
Acitretin	0.00%	0
Apremilast	57.14%	4
IL-23 antagonists	14.29%	1
IL-17 antagonists	14.29%	1
TNF-α antagonists	0.00%	0
Total respondents: 7		

Abbreviations: IL, interleukin; TNF, tumor necrosis factor.

TABLE 4 Which therapies can be continued by teledermatology?

Answer choices	Responses	
Topical	100.00%	7
Methotrexate	57.14%	4
Cyclosporin	42.86%	3
Acitretin	57.14%	4
Apremilast	100.00%	7
IL-23 antagonists	100.00%	7
IL-17 antagonists	100.00%	7
TNF-α antagonists	85.71%	6
Total respondents: 7		

Abbreviations: IL, interleukin; TNF, tumor necrosis factor.

Call to action

TD is an adequate tool for the initiation and continuation of topical therapies and continuation of treatment with biologics.

Access to care in underserved areas

Years of life lost to a disease and years lived with disability ranked dermatological diseases as the fourth leading cause of global nonfatal disease burden.[59] Improving access to dermatologic care is essential, especially in underserved areas and populations. Several factors may shape the underservice, including a shortage of dermatologists, rural communities, geographical difficult-to-access locations, military deployments, refugee sites, curfews, natural disasters and the financial status of patients. The late pandemic era has also rendered several previously privileged populations to be underserved and has demonstrated the value of employing telecommunications as an alternative to in-person consultations.

TD may help increase access to professional dermatological care for medically disadvantaged populations.[59] In Connecticut, USA, implementation of a SAF TD system between community primary and tertiary care centre resulted in an increase in dermatological consultations from 11% to 44% and a decrease in waiting time from 77 to 28 days.[60] Even in resource-poor situations, TD may still be an impactful modality[61] for cutaneous health. The context and structure of TD practices may need to be adjusted according to each healthcare system's capabilities and cultural views.

Call to action

In teaching programmes globally, TD programmes should aim to improve access to care in line with the needs and opportunities in the region.

DISCUSSION

TD is a vital part of dermatological practice according to the working group of the IPC. We are still in a learning healthcare environment, taking advantage of the opportunities of TD and in-person consultations while reconciling the individuality of the patient and his/her psoriasis.

Continuing medical education programs need to comprise principles and opportunities of TM; in particular, instructions to make optimal pictures and opportunities of TD in the diagnosis and treatment of psoriasis. Sharing best practices on personalized care using TD and in-person consultations is important in a changing landscape of care and the rapid development of therapeutic possibilities. The opportunities and limitations of TD should be developed to incorporate an integrated vision of TD and in-person consultations, in a concept of personalized medicine, including dermatological and psychological aspects and comorbidities.

Opportunities and limitations of TD regarding triaging for referral should be explored for early diagnosis and active treatment of psoriasis and opportunities of TM as a follow-up of the psoriatic patient. The group agreed upon the initiation and continuation of topical treatments as well as the continuation of most biologic therapies and apremilast for psoriasis through TD.

On the other hand, the group acknowledges that special sites and situations may require in-person visits at some time during the course of the disease. In a learning healthcare environment, we must discover which treatments can be initiated and maintained by TD. It is important that differences in ethnic/cultural backgrounds are reconciled as well as other socioeconomic factors. To improve access to care, remote areas with limited access to care models for TD must be developed.

Frameworks for regulations on TD have to be developed regarding IT security and prevention against unauthorized disclosure, particularly through data protection of images by encryption of data and of traceability of electronic clinical records. The privacy should be guaranteed by explicit consent of the data subject. Furthermore, the installation of reimbursement systems is needed urgently. Additionally, research and implementation of AI-assisted diagnosis of psoriasis and the opportunities of computational medicine have to be prioritized.

The IPC will provide a forum to share best practices on personalized care using TD and in-person consultations. The IPC will work with other worldwide organizations to improve access to care using TD as part of patient care offerings.

AUTHOR CONTRIBUTIONS

All authors have made a substantial contribution to the concept and design of the article, the analysis or interpretation of data for the article, drafted the article or revised it critically for important intellectual content and approved the version to be published.

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CONFLICTS OF INTEREST

Mohamed EL-Komy received fees for advisory boards and/or speaker honoraria from Janseen, AbbVie, UCB and Amgen. *Andrea Chiricozzi* served as an advisory board member and consultant and has received fees and speaker's honoraria or has participated in clinical trials for AbbVie, Almirall, Leo Pharma, Lilly, Janssen, Novartis and Sanofi Genzyme. *Peter van de Kerkhof* received fees for consultancy service or lecturership from Almirall, Abbvie, Eli Lilly, Novartis, Janssen Pharmaceutica, Leo Pharma, Bristol Myers Squibb, UCB, Boehringer Ingelheim and Dermavant. *April Armstrong* has served as a research investigator and/or scientific advisor to AbbVie, Almirall, Arcutis, ASLAN, Beiersdorf, BI, BMS, EPI, Incyte, Leo, UCB, Janssen, Lilly, Nimbus, Novartis, Ortho Dermatologics, Sun, Dermavant, Dermira, Sanofi, Regeneron, Pfizer and Modmed. *Vahid Diamei* declares being a consultant and/or advisor and receiving grants from AbbVie, Almirall, Amgen, BMS, Boehringer Ingelheim, Celgene, Eli Lilly, LEO Pharma, Janssen-Cilag, Novartis, Pfizer, Sandoz, Sanofi and UCB. *Joel Gelfand* declares being a consultant for Abbvie, BMS, Boehringer Ingelheim, Janssen Biologics, Novartis Corp and UCB (DSMB). The author has received grants (to the Trustees of the University of Pennsylvania) from Amgen and Pfizer Inc. He is the Deputy Editor of the *Journal of Investigative Dermatology*. He is receiving honoraria from the Society for Investigative Dermatology as a Chief Medical Editor, Healio Psoriatic Disease. *Alexander A. Navarini* declares being a consultant and advisor and/or receiving speaking fees and/or grants and/or served as an investigator in clinical trials for AbbVie, Almirall, Amgen, Biomed, BMS, Boehringer Ingelheim, Celgene, Eli Lilly, Galderma, GSK, LEO Pharma, Janssen-Cilag, MSD, Novartis, Pfizer, Pierre Fabre Pharma, Regeneron, Sandoz, Sanofi and UCB. The remaining author declares no conflict of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

ETHICS STATEMENT

Not applicable.

ORCID

Mohamed H. M. El Komy http://orcid.org/0000-0002-9653-2938
Andrea Chiricozzi https://orcid.org/0000-0002-6739-0387
Peter van de Kerkhof http://orcid.org/0000-0003-0084-3131
Alexander A. Navarini http://orcid.org/0000-0001-7059-632X

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