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REVIEW

The Past, the Present and the Future of Teledermatology: A Narrative Review

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Abstract: Teledermatology may be defined as the application of telemedicine to dermatology. According to published data, teledermatology is more widespread in Europe and North America, probably where resources for health care are greater than in other areas of the world. Indeed, teledermatology requires advanced technology to be efficient, as high image quality is necessary to allow the dermatologist to make correct diagnoses. Thanks to the recent advances in this field, teledermatology is become routinary in daily clinical practice. However, its use has been improved over time, overcoming several challenges. The aim of this narrative review is to retrace the almost 30-year history of teledermatology, to address the new challenges posed by advancing technologies such as artificial intelligence and the implications it may have on healthcare.

Keywords: teledermatology, artificial intelligence, dermatology

Introduction

Teledermatology may be defined as the application of telemedicine to dermatology.[1] The World Health Organisation (WHO) has described the telemedicine as "delivery of health care services using information and communication technologies for the exchange of valid information for diagnosis, treatment, prevention of disease and teaching, where distance is a critical factor".[1] Of interest, the word "teledermatology" contains the root "tele", which from ancient Greek means "distant",[2] and "dermatology" which is a visual-dependent speciality. On consequence, the use of telemedicine in dermatological practice may be well suited to the needs just described. Globally, teledermatology is classified into two categories: real-time (RT) teledermatology (or synchronous) where the interaction between physician and patient is live with a video-call;[3,4] and store-and-forward (S&F) teledermatology (or asynchronous) where the patient first transmits the images or health-related information to the dermatologist who will then provide the required indications.[3,4]

According to published data, teledermatology is more widespread in Europe and North America, probably where resources for health care are greater than in other areas of the world.[3] Indeed, teledermatology requires advanced technology to be efficient, as high image quality is necessary to allow the dermatologist to make correct diagnoses. In this sense, the spread of smartphones with increasingly high-quality cameras at affordable prices for the population is one of the reasons for the growing use of teledermatology.[2]

Currently, teledermatology is become routinary in daily clinical practice. However, its use has been improved over time, overcoming several challenges. The aim of this narrative review is to retrace the almost 30-year history of teledermatology, to address the new challenges posed by advancing technologies such as Artificial Intelligence (AI) and the implications it may have on healthcare.

Material and Methods

A thorough research of the current literature was carried out by using several databases (PubMed, Google Scholar, Cochrane Skin, Embase, EBSCO and MEDLINE) (until December 31, 2023) through the use of the following keywords:

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"telemedicine", "teledermatology", "artificial intelligence", "dermatology", "ChatGpt". In particular, articles regarding the use of teledermatology were screened. Meta-analyses, reviews, and real-life studies were considered, selecting the most relevant documents. Thus, the research was advanced by reviewing the abstracts and the texts of collected articles, as well as the references were also reviewed to include articles that could have been missed. Only English language manuscripts were considered. This article is based on previously conducted studies and does not contain any studies with human participants or animals performed by any of the authors.

History of Teledermatology

The first teledermatological experience was reported in Norway in 1993, in a manuscript describing the growing use of telemedicine in various specialties in this country.[5] However, the first publication about the use of teledermatology reported on PubMed date back to 1995.

The first paper is from the United States (US), where the demand for dermatologists was particularly high. Indeed, in rural areas the number of specialists was small in the face of the high frequency of skin diseases, which were estimated to account for 2% of public health expenditure.[6] The aim of the authors was to describe Oregon's teledermatology program within the National Library of Medicine's high-performance computing and communications to generate much-needed basic and clinical research information about one specific telemedicine application.[6]

In 1997, the accuracy of teledermatology was studied for the first time by comparing diagnoses in a nursing home in Minnesota with those of teledermatologists who were sent the same images, reporting an agreement of 88%.[7]

Commercial videoconferencing units were firstly used for teledermatology.[8] Moreover, despite the use of S&F teledermatology was firstly predominant, the use of RT teledermatology is increasing, probably due to the increasingly higher quality of the images that the devices used for RT teledermatology have over S&F and to the shorter consultation time.[9]

As regards teledermatological programs, there has been an up and down over time. Indeed, there were 62 teledermatological programs in 2003 in US,[10] and only 38 programmes in 2011.[10] However, reality virtual consultations practically doubled compared to 2003.[10] Subsequently, US teledermatological programs were 102 in 2016, of which 62 were governmental.[11] This is probably due to the advancement of telecommunication technologies, but also to the support of academic institutions, which remain the primary users of teledermatology, both in 2011 and 2016.[11] On the same way, the use of teledermatology in private practice is increased in recent years.[11] By 2022, it is estimated that around 38% of the world's countries have integrated teledermatology programs into the healthcare system.[12]

An important contribution to the development of teledermatology was made by its use for US troops in war zones.[13] A 2014 study took stock of the telemedicine consultation programs used by the US Army Medical Department in the years between 2004 and 2012.[13] Teledermatology, with 4379 consultations, accounted for about 40% of the total, due to its visual nature and the possibility of easily sending images.[13] The average response time was 5 hours and 14 minutes and 98% of consultations were answered within 24 hours.[13] In summary, teledermatology has avoided unnecessary military evacuations and brought specialised care to difficult areas such as war zones, providing important support to military missions.[13]

As already mentioned, the spread of teledermatology is not limited to the US.[9] Indeed, European Countries such as the Netherlands and Switzerland which, like the US, have long waiting lists for dermatological examinations, use teledermatology extensively.[9] In the Netherlands, it has been integrated into the healthcare system since 2006 and is fully reimbursed.[9] In addition, about 50% of general practitioners use secondary teledermatology, which consists on the use of telemedicine programs to have a specialist consultation with a dermatologist.[14] It is also very widespread in Australia, given the presence of rural areas with a lack of dermatologists,[12] so much so that guidelines were drafted in 2020.[15] Other countries such as India, the US and the United Kingdom have drawn up guidelines on teledermatology, and more and more international and national societies (such as the American Association for Teledermatology and the British Association of Dermatology) have published recommendations and guidance on teledermatological practice, particularly on the acquisition and transmission of good-quality images.[16]

Similarly, the scientific interest on teledermatology raised in the last years. At the end of 2023, there were 1397 results by searching for the term "teledermatology". In particular, interest in this discipline increased in 2020 with the onset of the SARS-CoV-2 pandemic, where publications on teledermatology almost tripled compared to the previous year.[17] Certainly, social distancing measures put in place to prevent Covid-19 infection limited access to healthcare facilities. In this context, telemedicine

played a key role to answer to patients' needs.[17,18] The increased interest in this matter is evidenced by the significant increase in papers on teledermatology. Searching for the word "teledermatology" on PubMed, there were 79 publications on the topic in 2019, compared with 205 in 2020 and 246 in 2021.

Finally, the increasing use of teledermatology was also supported by several studies that show that teledermatology can lower healthcare costs when used for triage,[19] while remaining very satisfactory for patients and professionals from the point of view of accuracy.[19]

Teledermatology and COVID-19: Before and After

On March 11, 2020, the WHO declared Coronavirus disease 2019 (COVID 19) as a pandemic.[20] This disease, caused by the coronavirus called Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-CoV-2), was initially diagnosed in Wuhan, China, in late 2019, and then spread rapidly around the world.[20–22] The clinical features of COVID-19 range from being completely asymptomatic to severe pneumonia and death.[20,22] This required the use of restrictive measures by governments to reduce the transmission of the virus, given the absence of effective therapies and vaccines at that stage.[20,22] Access to health care facilities was also limited to severe cases, leading to a complete revolution of the daily dermatological practice.[17,23] On the other hand, the need for dermatologists increased during the pandemic for several reasons such as the frequent association of SARS-CoV-2 infection with skin disorders such as erythematous rash, the increased use of protective devices and hand sanitizers worsening pre-existing skin conditions and increasing dermatitis, dermatological consultations on interactions of immunomodulating therapies for chronic inflammatory diseases.[24] Similarly, the use of dermatology was also required during the COVID-19 vaccination campaign, due to the cutaneous reactions following COVID-19 vaccination.[25–29]

Globally, the implementation of teledermatology was the main strategy to solve these issues, allowing patients continuous care.[30]

Kwatra et al, recalling that most outpatient dermatology visits were non-urgent and highlighting the large volume of dermatological consultations, suggested that they needed to be cancelled to reduce the progression of infection.[31] He also suggested the use of teledermatology to reschedule such visits, while only urgent ones should be conducted by making use of protective equipments.[31] One of the most representative examples of these indications is Italy. Radi et al of the Polytechnic University of the Marche Region immediately realized the 2020 SIDeMAST (Società Italiana di Dermatologia e Malattie Sessualmente Trasmesse) guidelines on the management of dermatological patients.[32] Services in most areas were postponed indefinitely and admissions for surgery were reduced from 15 to 3 per day, selecting patients for whom surgery was unavoidable.[32] The experience in the early 2020s of Marasca et al from the Dermatology Clinic at the University of Naples Federico II was even more pronounced in terms of numbers and, in addition, video consultations via webcam for patients with dermatological problems from chemotherapy were introduced.[33] This tool was also used to lecture medical students, with appreciated results.[33] One of the issues, however, was the comparison with face-to-face visits. Stadler et al used surveys to study the satisfaction of patients who had received dermatological consultations via the media during the pandemic. 92% of the 91 respondents declared themselves to be "very happy" or "good" when asked "How satisfied have you been?" and 82% stated that they would use teledermatology again in the future, although 58% of these only if combined with personal contact.[34] The dermatologists' point of view was instead analyzed by Sharma et al wondering whether teledermatology also played a role at the end of the pandemic.[35] Among the 184 specialists who completed the surveys, 58% believed that teledermatology was convenient for the majority of patients, as there was no need to travel or wait in queues.[35] However, 71% of the dermatologists felt that making diagnoses was more difficult than face-to-face visits.[35] The most frequently used media were WhatsApp messages, calls and video calls, while when asked to rate the overall experience with teledermatology from 1 to 10, the average response was 5.9.[35] Nevertheless, 70% of the dermatologists believed that they would also use teledermatology at the end of the pandemic, in combination with the live visit, and only 15% of them would not use it again.[35] The end of the pandemic has not led to the disappearance of teledermatology, which remains integrated in clinical practice today.[36] Certainly, virtual visits are reduced, but many studies have shown that teledermatology is particularly useful for chronic skin conditions such as psoriasis, atopic dermatitis, acne and hidradenitis,[37–41] especially for patients undergoing biological therapy, as it saves them time and money.[42] In addition, during the pandemic, physicians promoted WhatsApp and Facebook groups that helped limit the spread of fake-news about their medical conditions and are still active today.[43,44] To date, given the favorable attitude of physicians and patients towards teledermatology, several countries have extended the support programs and resources that were made available

for it during the pandemic, such as in the US.[45] However, there is a need for internationally shared laws and guidelines that can regulate the use of teledermatology in order to reduce disparities in the quality of service and to improve medico-legal aspects, such as the use of digitally signed informed consent.[43,44]

The Teledermatology of the Future: The Use of Artificial Intelligence

Artificial Intelligence (AI) is the ability of a machine to exhibit human capabilities such as reasoning, learning, planning and creativity.[46] It is based on "machine learning", namely through the data used to train the AI algorithm (training datasets) to make decisions and predictions, and with experience the algorithm automatically improves.[47] In turn, Machine Learning contains the deep-learning sub-type, based on artificial neural networks (ANNs), a mathematical model inspired by the way neural networks work and whose performance depends on the number of ANNs and the training datasets.[47] The popularity of AI has increased rapidly in recent years and one of the questions raised is how much the physician's practice can gain from it. Several studies have been conducted among the different specialities, but it is those dependent on imaging that have the greatest benefits, such as radiology, ophthalmology and dermatology.[48] Moreover, 86% of them attributed AI to having a greater impact on their work than in other areas.[48] In dermatology, it has been studied for years how technologies can improve the work of the specialist, in particular the performance on the diagnosis of skin tumours such as melanoma, for which early recognition is essential. Suffice it to say that a superficial melanoma has a 5-year survival rate of over 99%, with a reduction of less than 40% for metastatic forms.[46] An early attempt for a fully automatic computer-vision system to aid in early melanoma diagnosis and biopsy decision-making was made with the MelaFind. Its use was approved in 2011 on the basis of data published by Monheit et al that showed more than 98% sensitivity for melanomas and borderline lesions.[49] In 2017, however, the device was discontinued due to lack of benefit in clinical practice.[46] It is precisely the comparison between the decisions made by humans and those of the computer algorithm on images of skin diseases that has been the subject of discussion over the last decade. Although several studies have spoken of equivalence between diagnoses correctly posed by the algorithm and humans, there are significant risks involved in the use of AI in clinical practice.[50] Premature use can lead to misdiagnosis, either in the failure to recognise malignancy or in overtreatment.[50] Despite the advancement of technology, there is a need for increased datasets that only the clinician can contribute.[50] Moreover, it should not be forgotten that not all patients support the use of AI in healthcare. According to the survey by Khullar et al, 71.5% of the respondents would not be comfortable with a diagnosis by a system with 90% accuracy, although they could not explain why.[51] In addition, the formation of image sets requires the patients' consent, an aspect investigated by Ly et al, who observed that most patients were not against this, although for body parts such as the face and genitals they were less predisposed than for areas such as the hands.[52] Recent years have also seen the spread of AI-powered chatbots, of which ChatGPT is the most renowned.[53] It is based on deep-learning technology and one of the major risks being observed is the tendency of users to ask questions of a medical nature, including dermatology. Typing "ChatGPT and dermatology" on the chat, one gets general information that is scientifically superficial and cannot replace a dermatological examination.[53] AI answers are not always reliable as the data available to the system are incomplete and a physical examination of the patient is not possible.[53] ChatGPT nevertheless remains a supportive tool for the physician, especially considering the future improvements it will undergo.[53]

Discussion

To date, we can consider teledermatology cost-effective, particularly for purposes such as diagnosis, triage and monitoring of skin diseases and for prescription renewal visits. More specifically, 4 models of teledermatology use have been described:[5] triage model (identification of care priorities by assessing the clinical condition of patients and their developmental risk), consultative model (a referring doctor provides information to the dermatologist about the patient who remains in the referrer's care. The specialist provides the referrer with specific recommendations on the case), direct-care model (the patient receives the consultation and treatment directly from the specialist), follow-up model (form of direct-care in which chronic skin conditions are monitored over time).[54]

The attraction for teledermatology since its inception stems from the idea of extending dermatological care to patients unable to receive live visits.[55] This problem arises due to the lack of dermatologists, for example in rural areas and for ethnic minorities.[56] Associated with this is the high demand for specialist visits, which prolongs waiting lists.[57] One of the objectives of teledermatology is therefore also to reduce these. Bearing in mind that the quality of this type of

examination can never exceed that of a face-to-face examination, as a complete examination of the body is not possible, over the years there has been an improvement in technology to provide the dermatologist with better and better quality images.[55] The latter is a fundamental factor for a visual-dependent speciality, particularly for the management of skin cancers.[58–60] The COVID-19 pandemic, with the social distancing measures put in place to stem the contagion, has led to an increase in the use of telemedicine to provide patient care.[61–64] In this context, teledermatology was an indicative example, as it made it possible to carry out non-urgent examinations that would have been cancelled with the pandemic, renewals of treatment plans for biological therapies, and check-ups for chronic patients.[65] The end of the pandemic, although naturally associated with a reduction in the use of teledermatology due to a return to face-to-face visits, did not make this tool disappear. In fact, teledermatology has proved to be cost-effective, because it makes it possible to increase visits where there is a problem of waiting lists to select patients for surgical procedures by avoiding a live visit.[66] However, the shortcomings of a remote visit should not be forgotten, including the availability of the internet, the quality of the devices that must transmit sharp images, the ability of users to use them, the risk of misdiagnosis or missing a diagnosis of incidental malignancy.[66] Furthermore, there is a need for internationally shared guidelines to address certain medico-legal shortcomings, such as the absence of informed consent for teledermatology patients and the risk of loss of privacy of patients.[67] To date, the advancement of technologies has led to the development of AI, with devices that can express human capabilities, including reasoning and decision-making. Several studies have shown, however, that at present no programme, despite advanced, can replace a dermatological examination, not least because of the absence of datasets that need to be supplemented by the dermatologists themselves.[67] It also raises ethical and medico-legal issues that need to be addressed at an international level.[68]

Conclusion

Teledermatology is a tool that satisfies patients and physicians for the above-mentioned reasons and is a tool that supports the work of specialists but does not replace them. This also applies to AI, whose decision-making capabilities cannot surpass those of humans because they are still scientifically superficial, and patients do not yet trust them. The hope is that with the inexorable advancement of technology, the real-time visit and the decisions made by the doctor will not be supplanted, but complemented by the available devices, since none of these can ever replace the doctor–patient relationship, the basis of healthcare.[69]

Disclosure

The authors report no conflicts of interest in this work.

References

1. Bashshur R, Shannon G, Krupinski E, Grigsby J. The taxonomy of telemedicine. *Telemed J e-Health off J Am Telemed Assoc*. 2011;17(6):484–494. doi:10.1089/tmj.2011.0103
2. McKoy K, Halpern S, Mutyambizi K. International Teledermatology Review. *Curr Dermatol Rep*. 2021;10(3):55–66. doi:10.1007/s13671-021-00333-6
3. Maddukuri S, Patel J, Lipoff JB. Teledermatology addressing disparities in health care access: a review. *Curr Dermatol Rep*. 2021;10(2):40–47. doi:10.1007/s13671-021-00329-2
4. Villani A, Scalvenzi M, Fabbrocini G. Teledermatology: a useful tool to fight COVID-19. *J DermatolTreat*. 2020;31(4):325. doi:10.1080/09546634.2020.1750557
5. Coates SJ, Kvedar J, Granstein RD. Teledermatology: from historical perspective to emerging techniques of the modern era: part I: history, rationale, and current practice. *J Am Acad Dermatol*. 2015;72(4):563–566. doi:10.1016/j.jaad.2014.07.061
6. Perednia DA, Brown NA. Teledermatology: one application of telemedicine. *Bull Med Libr Assoc*. 1995;83(1):42–47.
7. Wurm EMT, Hofmann-Wellenhof R, Wurm R, Soyer HP. Telemedicine and teledermatology: past, present and future. *J der Dtsch Dermatologischen Gesellschaft*. 2008;6(2):106–112. doi:10.1111/j.1610-0387.2007.06440.x
8. Crichton C, Macdonald S, Potts S, et al. Teledermatology in Scotland. *J Telemed Telecare*. 1995;1(3):185. doi:10.1177/1357633X9500100310
9. Tensen E, van der Heijden JP, Jaspers MWM, Witkamp L. Two decades of teledermatology: current status and integration in National Healthcare Systems. *Curr Dermatol Rep*. 2016;5:96–104. doi:10.1007/s13671-016-0136-7
10. Armstrong AW, Wu J, Kovarik CL, et al. State of teledermatology programs in the United States. *J Am Acad Dermatol*. 2012;67(5):939–944. doi:10.1016/j.jaad.2012.02.019
11. Yim KM, Florek AG, Oh DH, McKoy K, Armstrong AW. Teledermatology in the United States: an update in a dynamic era. *Telemed J e-Health off J Am Telemed Assoc*. 2018;24(9):691–697. doi:10.1089/tmj.2017.0253

12. López-Liria R, Valverde-Martínez MÁ, López-Villegas A, et al. Teledermatology versus face-to-face dermatology: an analysis of cost-effectiveness from eight studies from Europe and the United States. *Int J Environ Res Public Health*. 2022;19(5). doi:10.3390/ijerph19052534
13. Hwang JS, Lappan CM, Sperling LC, Meyerle JH. Utilization of telemedicine in the U.S. military in a deployed setting. *Mil Med*. 2014;179 (11):1347–1353. doi:10.7205/MILMED-D-14-00115
14. van der Heijden JP, Spuls PI, Voorbraak FP, de Keizer NF, Witkamp L, Bos JD. Tertiary teledermatology: a systematic review. *Telemed J e-Health off J Am Telemed Assoc*. 2010;16(1):56–62. doi:10.1089/tmj.2009.0020
15. Abbott LM, Miller R, Janda M, et al. Practice guidelines for teledermatology in Australia. *Australas J Dermatol*. 2020;61(3):e293–e302. doi:10.1111/ajd.13301
16. Tognetti L, Fiorani D, Russo F, et al. Teledermatology in 2020: past, present and future perspectives. *Ital J Dermatol Venereol*. 2021;156 (2):198–212. doi:10.23736/S2784-8671.21.06731-6
17. Marasca C, Annunziata MC, Camela E, et al. Teledermatology and inflammatory skin conditions during COVID-19 era: new perspectives and applications. *J Clin Med*. 2022;11(6). doi:10.3390/jcm11061511
18. De Lucia M, Potestio L, Costanzo L, Fabbrocini G, Gallo L. Scabies outbreak during COVID-19: an Italian experience. *Int J Dermatol*. 2021;60 (10):1307–1308. doi:10.1111/ijd.15809
19. Zakaria A, Miclau TA, Maurer T, Leslie KS, Amerson E. Cost minimization analysis of a teledermatology triage system in a managed care setting. *JAMA dermatol*. 2021;157(1):52–58. doi:10.1001/jamadermatol.2020.4066
20. Mahase E. Covid-19: WHO declares pandemic because of "alarming levels" of spread, severity, and inaction. *BMJ*. 2020;368:m1036. doi:10.1136/bmj.m1036
21. Potestio L, Genco L, Villani A, et al. Reply to "Cutaneous adverse effects of the available COVID-19 vaccines in India: a questionnaire-based study". *J Eur Acad Dermatol Venereol*. 2022. doi:10.1111/jdv.18341
22. Habas K, Nganwuchu C, Shahzad F, et al. Resolution of coronavirus disease 2019 (COVID-19). *Expert Rev Anti Infect Ther*. 2020;18 (12):1201–1211. doi:10.1080/14787210.2020.1797487
23. Ruggiero A, Martora F, Fabbrocini G, et al. The role of teledermatology during the COVID-19 pandemic: a narrative review. *Clin Cosmet Invest Dermatol*. 2022;15:2785–2793. doi:10.2147/CCID.S377029
24. Ibrahim AE, Magdy M, Khalaf EM, Mostafa A, Arafa A. Teledermatology in the time of COVID-19. *Int J Clin Pract*. 2021;75(12):e15000. doi:10.1111/ijcp.15000
25. Potestio L, Napolitano M, Bennardo L, Fabbrocini G, Patruno C. Atopic dermatitis exacerbation after Covid-19 vaccination in Dupilumab-treated patients. *J Eur Acad Dermatol Venereol*. 2022. doi:10.1111/jdv.17964
26. Potestio L, Fabbrocini G, D'Agostino M, Piscitelli I, Martora F. Cutaneous reactions following COVID-19 vaccination: the evidence says "less fear". *J Cosmet Dermatol*. 2023;22(1):28–29. doi:10.1111/jocd.15533
27. Martora F, Villani A, Battista T, Fabbrocini G, Potestio L. COVID-19 vaccination and inflammatory skin diseases. *J Cosmet Dermatol*. 2023;22 (1):32–33. doi:10.1111/jocd.15414
28. Potestio L, Villani A, Fabbrocini G, Martora F. Cutaneous reactions following booster dose of COVID-19 mRNA vaccination: what we should know? *J Cosmet Dermatol*. 2022. doi:10.1111/jocd.15331
29. Martora F, Villani A, Marasca C, Fabbrocini G, Potestio L. Skin reaction after SARS-CoV-2 vaccines Reply to "cutaneous adverse reactions following SARS-CoV-2 vaccine booster dose: a real-life multicentre experience". *J Eur Acad Dermatol Venereol*. 2023;37(1):e43–e44. doi:10.1111/jdv.18531
30. Villani A, Megna M, Scalvenzi M, Fabbrocini G, Ruggiero A. Teledermatology and chronic skin diseases: real life experience in a Southern Italian Dermatologic Centre. *Dermatol Ther*. 2020;33(6):e13839. doi:10.1111/dth.13839
31. Kwatra SG, Sweren RJ, Grossberg AL. Dermatology practices as vectors for COVID-19 transmission: a call for immediate cessation of nonemergent dermatology visits. *J Am Acad Dermatol*. 2020;82(5):e179–e180. doi:10.1016/j.jaad.2020.03.037
32. Radi G, Diotallevi F, Campanati A, Offidani A. Global coronavirus pandemic (2019-nCOV): implication for an Italian medium size dermatological clinic of a II level hospital. *J Eur Acad Dermatol Venereol*. 2020;34(5):e213–e214. doi:10.1111/jdv.16386
33. Marasca C, Ruggiero A, Annunziata MC, Fabbrocini G, Megna M. Face the COVID-19 emergency: measures applied in an Italian Dermatologic Clinic. *J Eur Acad Dermatol Venereol*. 2020;34(6):e249. doi:10.1111/jdv.16476
34. Stadler PC, Senner S, Frey S, et al. Teledermatology in times of COVID-19. *J Dermatol*. 2021;48(5):620–624. doi:10.1111/1346-8138.15812
35. Sharma A, Jindal V, Singla P, Goldust M, Mhatre M. Will teledermatology be the silver lining during and after COVID-19? *Dermatol Ther*. 2020;33 (4):e13643. doi:10.1111/dth.13643
36. Martora F, Fabbrocini G, Megna M, et al. Teledermatology for common inflammatory skin conditions: the medicine of the future? *Life*. 2023;13(4). doi:10.3390/life13041037
37. Patruno C, Potestio L, Scalvenzi M, et al. Dupilumab for the treatment of adult atopic dermatitis in special populations. *J DermatolTreat*. 2022:1–6. doi:10.1080/09546634.2022.2102121
38. Patruno C, Potestio L, Napolitano M. Clinical phenotypes of adult atopic dermatitis and related therapies. *Curr Opin Allergy Clin Immunol*. 2022;22(4):242–249. doi:10.1097/ACI.0000000000000837
39. Napolitano M, Fabbrocini G, Genco L, Martora F, Potestio L, Patruno C. Rapid improvement in pruritus in atopic dermatitis patients treated with upadacitinib: a real-life experience. *J Eur Acad Dermatol Venereol*. 2022;36(9):1497–1498. doi:10.1111/jdv.18137
40. Napolitano M, Maffei M, Patruno C, et al. Dupilumab effectiveness for the treatment of patients with concomitant atopic dermatitis and chronic rhinosinusitis with nasal polyposis. *Dermatol Ther*. 2021:e15120. doi:10.1111/dth.15120
41. Lacarrubba F, Dini V, Napolitano M, et al. Ultrasonography in the pathway to an optimal standard of care of hidradenitis suppurativa: the Italian Ultrasound Working Group experience. *J Eur Acad Dermatol Venereol*. 2019;33(Suppl 6):10–14. doi:10.1111/jdv.15847
42. Megna M, Potestio L, Battista T, et al. Immune response to Covid-19 mRNA vaccination in psoriasis patients undergoing treatment with biologics. *Clin Exp Dermatol*. 2022. doi:10.1111/ced.15395
43. Gisondi P, Bellinato F, Piaserico S, Di Leo S, Cazzaniga S, Naldi L. Preference for telemedicine versus in-person visit among patients with psoriasis receiving biological drugs. *Dermatol Ther*. 2021;11(4):1333–1343. doi:10.1007/s13555-021-00555-3
44. Megna M, Camela E, Villani A, Tajani A, Fabbrocini G, Potestio L. Teledermatology: a useful tool also after COVID-19 era? *J Cosmet Dermatol*. 2022;21(6):2309–2310. doi:10.1111/jocd.14938

45. Cohn E, Han G. Teledermatology: a Postpandemic Update. *Cutis*. 2023;112(5):209–211. doi:10.12788/cutis.0882
46. Liopyris K, Gregoriou S, Dias J, Stratigos AJ. Artificial intelligence in dermatology: challenges and perspectives. *Dermatol Ther*. 2022;12 (12):2637–2651. doi:10.1007/s13555-022-00833-8
47. Li Z, Koban KC, Schenck TL, Giunta RE, Li Q, Sun Y. Artificial intelligence in dermatology image analysis: current developments and future trends. *J Clin Med*. 2022;11(22). doi:10.3390/jcm11226826
48. Scheetz J, Rothschild P, McGuinness M, et al. A survey of clinicians on the use of artificial intelligence in ophthalmology, dermatology, radiology and radiation oncology. *Sci Rep*. 2021;11(1):5193. doi:10.1038/s41598-021-84698-5
49. Monheit G, Cognetta AB, Ferris L, et al. The performance of MelaFind: a prospective multicenter study. *Arch Dermatol*. 2011;147(2):188–194. doi:10.1001/archdermatol.2010.302
50. Navarrete-Dechent C, Dusza SW, Liopyris K, Marghoob AA, Halpern AC, Marchetti MA. Automated dermatological diagnosis: hype or reality? *J Invest Dermatol*. 2018;138(10):2277–2279. doi:10.1016/j.jid.2018.04.040
51. Khullar D, Casalino LP, Qian Y, Lu Y, Krumholz HM, Aneja S. Perspectives of patients about artificial intelligence in health care. *JAMA Network Open*. 2022;5(5):e2210309. doi:10.1001/jamanetworkopen.2022.10309
52. Ly S, Reyes-Hadsall S, Drake L, et al. Public perceptions, factors, and incentives influencing patient willingness to share clinical images for artificial intelligence-based healthcare tools. *Dermatol Ther*. 2023;13(11):2895–2902. doi:10.1007/s13555-023-01031-w
53. Potestio L, Martora F, Villani A, Ruggiero A, Scalvenzi M, Megna M. ChatGPT and Dermatology: friends or foes? *Clin Exp Dermatol*. 2023. doi:10.1093/ced/llad227
54. Pathipati AS, Lee L, Armstrong AW. Health-care delivery methods in teledermatology: consultative, triage and direct-care models. *J Telemed Telecare*. 2011;17(4):214–216. doi:10.1258/jtt.2010.010002
55. Landow SM, Mateus A, Korgavkar K, Nightingale D, Weinstock MA. Teledermatology: key factors associated with reducing face-to-face dermatology visits. *J Am Acad Dermatol*. 2014;71(3):570–576. doi:10.1016/j.jaad.2014.02.021
56. Ahuja S, Briggs SM, Collier SM. Teledermatology in rural, underserved, and isolated environments: a review. *Curr Dermatol Rep*. 2022;11 (4):328–335. doi:10.1007/s13671-022-00377-2
57. Suneja T, Smith ED, Chen GJ, Zipperstein KJ, Fleischer ABJ, Feldman SR. Waiting times to see a dermatologist are perceived as too long by dermatologists: implications for the dermatology workforce. *Arch Dermatol*. 2001;137(10):1303–1307. doi:10.1001/archderm.137.10.1303
58. Villani A, Scalvenzi M, Micali G, et al. Management of advanced invasive melanoma: new strategies. *Adv Ther*. 2023;40(8):3381–3394. doi:10.1007/s12325-023-02555-5
59. Villani A, Potestio L, Fabbrocini G, Scalvenzi M. New emerging treatment options for advanced basal cell carcinoma and squamous cell carcinoma. *Adv Ther*. 2022;39(3):1164–1178. doi:10.1007/s12325-022-02044-1
60. Villani A, Ocampo-Garza SS, Potestio L, et al. Cemiplimab for the treatment of advanced cutaneous squamous cell carcinoma. *Expert Opin Drug Saf*. 2022;21(1):21–29. doi:10.1080/14740338.2022.1993819
61. Picone V, Martora F, Fabbrocini G, Marano L. "Covid arm": abnormal side effect after Moderna COVID-19 vaccine. *Dermatol Ther*. 2022;35(1): e15197. doi:10.1111/dth.15197
62. Martora F, Fabbrocini G, Marasca C. Pityriasis rosea after Moderna mRNA-1273 vaccine: a case series. *Dermatol Ther*. 2022;35(2):e15225. doi:10.1111/dth.15225
63. Martora F, Picone V, Fornaro L, Fabbrocini G, Marasca C. Can COVID-19 cause atypical forms of pityriasis rosea refractory to conventional therapies? *J Med Virol*. 2022;94(4):1292–1293. doi:10.1002/jmv.27535
64. Picone V, Fabbrocini G, Martora L, Martora F. A case of new-onset lichen planus after COVID-19 vaccination. *Dermatol Ther*. 2022;12 (3):801–805. doi:10.1007/s13555-022-00689-y
65. Martora F, Fabbrocini G, Nappa P, Megna M. Impact of the COVID-19 pandemic on hospital admissions of patients with rare diseases: an experience of a Southern Italy referral center. *Int J Dermatol*. 2022;61(7):e237–e238. doi:10.1111/ijd.16236
66. Pasquali P, Sonthalia S, Moreno-Ramirez D, et al. Teledermatology and its current perspective. *Indian Dermatol Online J*. 2020;11(1):12–20. doi:10.4103/idoj.IDOJ_241_19
67. Arimany-Manso J, Pujol RM, García-Patos V, Saigí U, Martin-Fumadó C. Medicolegal aspects of teledermatology. *Actas Dermosifiliogr*. 2020;111 (10):815–821. doi:10.1016/j.ad.2020.08.008
68. Giansanti D. The Artificial Intelligence in Teledermatology: a narrative review on opportunities, perspectives, and bottlenecks. *Int J Environ Res Public Health*. 2023;20(10). doi:10.3390/ijerph20105810
69. Camela E, Potestio L, Fabbrocini G, Pallotta S, Megna M. The holistic approach to psoriasis patients with comorbidities: the role of investigational drugs. *Expert Opin Investig Drugs*. 2023;1–16. doi:10.1080/13543784.2023.2219387