

An Exploration of Dutch Dermatologists' Experience and Satisfaction with Teledermatology: A Sociotechnical and Complex Adaptive System Perspective

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Submitted to: JMIR Dermatology on: February 23, 2024

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An Exploration of Dutch Dermatologists' Experience and Satisfaction with Teledermatology: A Sociotechnical and Complex Adaptive System Perspective

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Abstract

Background: Despite the global upscale of teledermatology during the COVID-19 pandemic, persistent barriers, such as the quality of the anamnesis and photos, continue to hinder the effective use of teledermatology in practice. A better understanding of the dermatologists' experiences and satisfaction with using the teledermatology system necessitates surveying. A holistic evaluation may provide valuable insight to understand how barriers interrelate which is deemed necessary for the innovation of teledermatology in practice.

Objective: We aim to understand dermatologists' experience and satisfaction with their training, support communication, interaction and usage of a teledermatology platform of a Dutch digital hospital during the COVID-19 pandemic.

Methods: An online questionnaire was sent in December 2021 to Dutch dermatologists who 1) had an active teledermatology platform account, and 2) responded to a teledermatology consultation between 01-10-2019 and 30-09-2021. The questionnaire consisted of questions from the validated SAF-TSUQ questionnaire, and new questions regarding; demographics of teledermatologists, the use of teledermatology during the COVID-19 pandemic, the performance of teledermatology by general practitioners (GP), and the role of dermatologists in the teledermatology process. The open-ended questions were analysed by a grounded theory approach guided by a sociotechnical model and complemented by a complex adaptive system perspective. A panel discussion with three dermatologists was performed to provide additional insight into the responses to the questionnaire.

Results: We obtained responses from 25 out of the 249 invited dermatologists (10%). Overall, dermatologists had a positive experience with teledermatology. Interestingly, the frequency of teledermatology use was unaffected by the COVID-19 pandemic. However, the insufficient quality and incompleteness of the clinical content (photos and anamneses information) of the teledermatology consultation were experienced as critical factors impacting the efficiency of the teledermatology workflow. Dermatologists expressed the need to improve these aspects to avoid a time-consuming process or the need to request physical referrals of patients. Questionnaire responses were confirmed and enriched during the panel discussion and potential solutions to enforce more complete anamnesis information (e.g. mandatory fields) were suggested.

Conclusions: Dermatologists see teledermatology as a valuable tool to provide access to dermatology care. However, the quality and completeness of the provided photos and anamnesis information need to be improved to guarantee the effectiveness and efficiency of the complex teledermatology system. This could increase both the dermatologists' satisfaction and the quality of teledermatology services. Implementing teledermatology requires management of trade-offs such as time investments (workload) of practitioners in taking images versus image quality. Teledermatology implementation should be assessed from a complexity perspective to under trade-offs as a means of preventing unintended consequences.

(JMIR Preprints 23/02/2024:56723)

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DOI: https://doi.org/10.2196/preprints.56723

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Original Manuscript

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Authors' Contributions:

FvS conceptualized the study, was responsible for the data acquisition and wrote the manuscript from the first version onward. FvS and LWP were involved in the study design, the analysis, and interpretation of data. CK and MWJ were further involved in critical revision of the manuscript. All authors approved the final version of the manuscript.

Acknowledgments:

The authors would like to thank the dermatologist involved in the questionnaire review and all dermatologists who responded to the questionnaire, and Ksyos for sending the questionnaire to dermatologists. The authors also would like to thank Esmée Tensen for contributing to the preparation and distribution of the questionnaire, Bibiche Groenhuijzen for contributing to the data analysis, Miranda Roskam-Mul for the LimeSurvey support, and dr. Job P. van der Heijden for reviewing the manuscript.

Keywords:

teledermatology, teledermoscopy, provider satisfaction, dermatologist, dermatology, telemedicine, e-health, COVID-19, telehealth, general practitioner, quality, sociotechnical model

Conflicts of Interest:

FvS is a PhD researcher at the Amsterdam University Medical Center (UMC) and is employed by Ksyos and the Amsterdam UMC. The remaining authors state no conflicts of interest.

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Abstract

Introduction: Despite the global upscale of teledermatology during the COVID-19 pandemic, persistent barriers, such as the poor anamnesis and photo quality, hinder its effective use in practice. Understanding Dutch dermatologists' experiences and satisfaction with using the teledermatology system in the Dutch healthcare system is needed. A holistic evaluation may provide valuable insight to understand how barriers interrelate which is deemed necessary for the innovation of teledermatology in practice.

Methods: An online questionnaire was sent in December 2021 to Dutch dermatologists who 1) had an active teledermatology platform account, and 2) responded to a teledermatology consultation between 01-10-2019 and 30-09-2021. The questionnaire consisted of the validated SAF-TSUQ questionnaire, and new questions regarding; demographics of teledermatologists, the use of teledermatology during the COVID-19 pandemic, the performance of teledermatology by general practitioners (GP), and the role of dermatologists in the teledermatology process. The open-ended questions were analysed by a grounded theory approach guided by a sociotechnical model and complemented by a complex adaptive system perspective. A panel discussion with three dermatologists was performed to provide additional insight into the responses to the questionnaire.

Results: We obtained responses from 25 out of the 249 invited dermatologists (10%). Overall, dermatologists had a positive experience with teledermatology. Interestingly, teledermatology use frequency remained unaffected by the COVID-19 pandemic. However, the insufficient quality and incompleteness of the clinical content (photos and anamneses information) of the teledermatology consultation impacted the efficiency of the teledermatology workflow. Dermatologists expressed the need for improvement to avoid time-consuming processes or physical referrals. The panel discussion enriched and confirmed the responses, suggesting solutions like mandatory fields for the GPs for a complete anamnesis.

Conclusion: Dutch Dermatologists view teledermatology as a valuable tool to provide access to dermatology care. However, improvements regarding the quality and completeness of the provided clinical content are necessary for the effectiveness and efficiency of the complex teledermatology system in Dutch healthcare. This could increase both the dermatologists' satisfaction and the quality of teledermatology services. Managing trade-offs, such as time investments versus image quality, is crucial for teledermatology implementation and should be assessed from a complexity perspective to understand trade-offs and prevent unintended consequences.

Introduction

Telemedicine is a method to deliver healthcare remotely by use of digital technologies and is applied in several medical disciplines such as in the dermatology field [1,2]. Through teledermatology, photos and anamnesis information of different types of skin disorders of patients are digitally submitted by a primary care provider and reviewed by a remote dermatologist [3,4]. In the Dutch healthcare system, this facilitates the guidance of a general practitioner (GP) in primary care by a remote dermatologist from secondary care on the management of the skin disorder. GPs play a central role in the Dutch healthcare system in coordinating the patients' healthcare needs, including referrals to secondary care. Teledermatology has been used since 1995 [5], but challenges still exist worldwide [6,7], including the inability of dermatologists to conduct a full body skin check and palpation of the lesion. Consequently, dermatologists rely on the information provided by the GP for a diagnosis, emphasizing the need for high-quality photos and anamnesis details. This is illustrated by the Danish studies of Vestergaard et al. In these studies, 9.5-10% of the images were deemed of poor quality, assessed as 'useless' due to issues such as out-of-focus images or missing dermoscopic/ overview images [4,8]. Another known barrier are reimbursement issues, such as in the United States where patients and dermatologists are not always reimbursed for requesting or providing a teledermatology consultation, respectively [9,10].

An increase of dermatology referrals to secondary care in the Netherlands [11,12], underscores the growing demand for effective utilization of teledermatology. This surge is partly driven by the ageing Dutch population and increasing skin cancer incidence [13,¹⁴]. Within the next decade, incidences of basal cell carcinoma are expected to increase up to 30.4% [¹⁵], potentially leading to a heightened demand for referrals to secondary dermatological care. Despite these barriers, studies demonstrate the potential of teledermatology for general practice in the Netherlands, particularly in preventing unnecessary referrals end minimizing environmental impact [3,16-18].

The COVID-19 pandemic [19] had a massive impact on dermatology practice, as face-to-face care delivery became limited [20]. This led to a global, sudden upscale of teledermatology use to ensure that dermatologists could continue to provide essential dermatology care while still adhering to public health guidelines [21–25]. This required a steep learning curve from some dermatologists as they had to use teledermatology without adequate training or implementation of the service into their practice. These issues have led to increased support requests from dermatologists to the teledermatology provider [23–25]. Despite progress being made, known barriers to effective teledermatology use and implementation still existed after COVID-19 restrictions were stopped. How dermatologists experienced this need and delivery of training, support communication,

interaction and usage of a Dutch teledermatology platform by service providers and whether the COVID-19 pandemic impacted these perceptions positively or negatively is yet unknown. A holistic evaluation may provide valuable insight to understand how barriers interrelate which is deemed necessary for the innovation of teledermatology in practice and to inform strategies to optimize teledermatology services.

Guided by a complex adaptive system perspective, this study aims to understand Dutch dermatologists' experience and satisfaction with their training, support communication, interaction and usage of a teledermatology platform of a Dutch digital hospital during the COVID-19 pandemic, uncovering insights to improve teledermatology services for the future [26,27].

Methods

The Questionnaire

The Store-and-Forward Telemedicine Service User-satisfaction Questionnaire (SAF-TSUQ) [28], a Dutch validated questionnaire, consists of 29 closed-ended questions within the following themes: Training (e.g. offered training to work with teledermatology), Support Communication (e.g. preferred way to communicate with Ksyos), Interaction (e.g. teledermatology is easy to use) and Use (e.g. teledermatology improves access to dermatology care) with the telemedicine platform (Appendix). The responses are rated on a 5-point Likert scale (1= strongly disagree – 5= strongly agree) with two additional options "I do not know" and "not applicable". On basis of this questionnaire, the teledermatology service of Ksyos was evaluated [29]. Ksyos is a digital hospital and the largest teledermatology provider in the Netherlands [29].

We added 21 closed- and six open-ended questions to tailor the generic SAF-TSUQ questionnaire to specifically address the nuances of teledermatology use. These additional questions were added for the following themes; demographic information of dermatologists, the use of teledermatology (during the COVID-19 pandemic) (e.g. experience and frequency of use before/during the COVID-19 pandemic), the use of teledermatology by GPs (e.g. photo quality), and to evaluate teledermatology as experienced by the dermatologists (e.g. not able to perform a full body skin check) (Appendix). All questions were mandatory, except the optional free text fields at the end of each theme. These new questions were discussed in a focus group with teledermatology experts of Ksyos and reviewed by a dermatologist via email.

Participants

The supplemented questionnaire was sent by email to dermatologists who 1) had an active teledermatology platform account at the moment of sending the questionnaire, and 2) responded to a teledermatology consultation between 01-10-2019 and 30-09-2021.

The questionnaire was sent out in December 2021. Dermatologists gained access to the questionnaire via a unique link in the email. The link became inactive after the questionnaire was filled in so the questionnaire could only be filled in once. This link only allowed tracking if a questionnaire was filled in , thus the individual responses were not visible for the researchers. We sent reminders once to non-responders one week after sending the questionnaire. Informed consent was requested in the questionnaire for the use of their responses for research purposes.

Participation was voluntary and anonymous. Four gift cards were raffled among respondents who

completed the questionnaire in a larger study. The LimeSurvey questionnaire tool was used to store the questionnaire and its responses. The Medical Ethical Committee of the Amsterdam University Medical Center (location AMC) provided a waiver.

Analysis of the responses

The responses to the closed-ended questions of the SAF-TSUQ questionnaire were analysed descriptively per questionnaire theme with Rstudio.

The Sittig and Singh sociotechnical model was used for the analysis of the open-ended questions [30]. This sociotechnical model has previously been used to understand sociotechnical barriers and facilitators of digital health use after its implementation [31–34], and exists of eight interrelated dimensions; 1) hardware and software, 2) clinical content, 3) human-computer interface, 4) people, 5) workflow and communication, 6) internal organizational policies, procedures and culture, 7) external rules, regulations, and pressures, and 8) system measurement and monitoring (Table 1).

The open-ended questionnaire responses were analysed by combining an inductive and a deductive approach. First, during a content analysis with an inductive approach, two researchers (LWP, BG) systematically and independently reviewed the open-ended questionnaire responses to identify patterns and themes using a grounded theory approach [35]. Secondly, a deductive approach was applied to map the identified themes onto the sociotechnical model. The combined deductive and inductive approach allowed for the potential extension of the Sittig and Singh model.

During the content analysis, the data was ordered into discrete responses during the open coding phase. Responses consisting of multiple sentences were split into smaller units of meaning, if necessary. An inductive coding approach was applied by one researcher (LWP) and one coder (BG), meaning that the first codes emerged from the prior content analysis. This is an iterative approach whereby the data is reread and the first codes are refined and if required, new codes can be created. These refined and new codes were (re-)applied to the data until saturation of codes was reached and all responses were coded. This final set of codes is referred to as our set of 'subcodes'. The subcode 'not applicable' was assigned to responses that could not be interpreted by the researchers, and those responses were therefore assigned with the maincode 'not able to code' and were not assigned to a dimension. The subcodes represented the rich details of the responses. Patterns emerged from these subcodes from which maincodes were formulated. The maincodes represented higher-level categories of the data compared to the subcodes. During axial coding [36,37], sets of subcodes were grouped by one maincode. The open and inductive coding phase resulted in a codebook of sub- and maincodes (Appendix Table 1 and 2). The coders (BG, FvS) independently assigned sub- and maincodes and were blinded to each other's codes. Continuous discussion meetings took place

between the two coders (BG, FvS) and a researcher (LWP) to discuss the content of the responses and to refine the sub- and maincodes. In addition, the dimensions of the sociotechnical model were discussed. Small adaptations to the definition of the dimensions were made to fit them to the teledermatology evaluation. This was done during the inductive phase of coding [30], since at this moment, we got insights into the meaning and application of the dimensions (Table 1).

Finally with a deductive approach, one of the eight interrelated dimensions of the sociotechnical model [30] was independently assigned by the two coders to a response. There was a discussion meeting (BG, FvS) until consensus was reached regarding the assigned sub- and maincodes and dimensions. A third researcher (LWP) was involved in the discussion meeting if no consensus was reached.

Table 1. Definition of the dimensions adapted to the teledermatology situation [30]

Dimension	Definition
Hardware and software	All technical remarks on hardware and the software used on the (teledermatology) consultation platform, e.g., (the ease of use of) the photo equipment, (the ease of) uploading photos, and interoperability issues.
Clinical content	All remarks on the (un)structured, textual or numeric data; information, and knowledge that are stored on the (teledermatology) consultation platform. Also remarks on the (feedback of dermatologist on) quality of the photos provided by GP in the consultation.
Human computer interface	All remarks on the software interaction with the user, e.g., on the system layout or front-end features.
People	All remarks on individuals that interact with the system or remarks related to training and learnability.
Workflow and communication	All remarks on how teledermatology is used in the workflow, the impact on workload, and the tasks required to provide appropriate care, and communication with the telemedicine provider.
Organizational policies and procedures	All remarks on structures, policies, financials, and procedures of the telemedicine organization that influence technology management.
External rules, regulations, and pressures	All remarks on external factors outside the telemedicine organization that facilitate or impede efforts to design, implement, use, and evaluate technology, as well as remarks indicating that the use of teledermatology by healthcare providers has changed due to the COVID-19 pandemic.
System measurement and monitoring	All remarks including system availability, its use by stakeholders, its effectiveness, and associated (un)intended consequences (by the COVID-19 pandemic).
Not able to code	All remarks that were insufficiently specific or not comprehensive to be assigned to a dimension. This dimension also includes remarks about the questionnaire itself.

As part of our comprehensive evaluation, we will discuss teledermatology as a complex adaptive system (CAS) [26,27], characterized by several components that interact with each other as part of achieving broader system outcomes. Tenets of a CAS include emergent behaviour (system interactions may result in an outcome that is unpredictable) and non-linearity (a small change in one part of the system may lead to a large change in another part of the system) [38,39]. The components must be meaningfully integrated to achieve desired outcomes such as accurate diagnostic outcomes, improved patient care, and user satisfaction [9,40]. Teledermatology exhibits characteristics of a CAS where users (e.g. patients, GPs, dermatologists) are separated by system concepts (e.g. time and

space), and different technologies (e.g. digital systems and photography equipment). A CAS guided evaluation allows us to understand how various system sub-components interact within system operations, supplementing the sociotechnical approach by elucidating the relationship between multiple interacting components in a system.

Dermatologist Panel Discussion

After the questionnaire study, there was an open, unstructured panel discussion with three dermatologists (10, 12, and 13 year experience with Ksyos teledermatology platform) where one researcher (FvS) presented the questionnaire outcomes. The interpretation and perspectives of the dermatologists on the questionnaire results, and their experience with teledermatology was discussed. The remarks of the dermatologists were noted and directly mapped onto the adapted dimensions (Table 1).

Results

Demographics respondents

Twenty-five dermatologists (10%) completed the questionnaire, including informed consent (Table 2). We received three hard bouncers, six out-of-office emails (for an extended period of time), and two dermatologists who indicated that they did not want to receive the questionnaire and reminders. The median time to fill in the questionnaire was 11.50 minutes (average 16.49 minutes).

Table 2. Demographics Respondents

	Dermatologists n
	(%)
Gender	
Male	13 (52)
Female	12 (48)
Age	
25 - 34 years	2(8)
35 - 44 years	7 (28)
45 - 54 years	6 (24)
55 - 64 years	9 (36)
65 years or older	1(4)
Computer skills	
Excellent	7 (28)
Good	13 (52)
Sufficient	5 (20)
Bad	0(0)
Technical knowledge	
I am an innovator who is eager to try out new technology	0(0)
I am a pioneer and one of the first to experiment with new technology	6 (24)
I am a frontrunner; if others are adopting new technology, I want to do the same	16 (64)
I am a laggard and usually one of the last to try out new technology	3 (12)
How many times using the Ksyos platform	
Daily	12 (48)
Weekly	3 (12)
Monthly	8 (32)
A few times per year	2(8)
How long using the Ksyos platform	
6-12 months	1(4)
1-3 years	1(4)
3-5 years	4(16)
5-10 years	6 (24)
More than 10 years	13 (52)
	- ()

SAF-TSUQ Question Analysis

Overall, dermatologists found that the training, support communication and information provided by Ksyos was sufficient to work with the platform. However, they were more critical that teledermatology care is not considered the same as providing physical care (Figure 1).

Dermatologists were satisfied with performing the teledermatology tasks. They knew how to contact Ksyos, and if support communication with Ksyos was needed, they preferred to do this via email.

While they found that performing teledermatology didn't help them to increase their dermatology knowledge, dermatologists expressed that the platform is easy to use and understandable. Despite this positive feedback, one-third of the dermatologists mentioned that the platform did yet not contain all functionalities to provide teledermatology care (e.g. they expressed their preference to provide a diagnosis in a free text field).

The majority of dermatologists acknowledged that teledermatology serves as a valuable medium to provide the GP with advice, recommended the platform and stated that they would use it again.



Teledermatology during COVID-19

Some dermatologists reported that teledermatology use slightly increased during the first COVID- 19 wave, compared to pre-pandemic levels (Table 3). During this time, they noted that sufficient support from Ksyos on how to use teledermatology was received. Dermatologists observed that the type of questions asked by GPs in the teledermatology consultation did not change. They reported difficulties in evaluating teledermatology consultations with poor photo quality and anamnesis information.

Table 3. Responses COVID-19 questions

	Dermatologists n (%)
How often used the platform in first COVID-19 wave vs. before COVID-19	
More often used	7 (28)
Used about as often	17 (68)
Used less often	0(0)
Not applicable	1(4)
How often do you use the platform at this moment	
More frequently than before the COVID-19 pandemic	6 (24)
About the same as before the COVID-19 pandemic	16 (64)
Less frequently than before the COVID-19 pandemic	2(8)
Not applicable	1(4)
Did you receive enough support to perform teledermatology during the COVID-19 pa	andemic
Yes	22 (88)
No	3 (12)

The sociotechnical analysis

A codebook consisting of 13 maincodes and 113 subcodes was developed (Appendix table 1 and 2). Two coders (FvS, BG) had a 65.5% and 71.4% agreement after coding the responses with the suband maincodes, respectively. Out of the 247 responses that were coded, the two coders were not able to code 35 responses. We were able to map all responses on an existing dimension of the Sittig and Sing model (Figure 2).

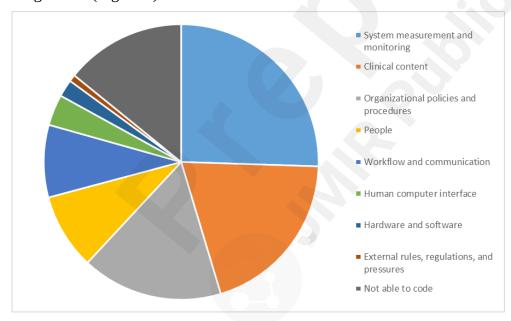


Figure 2. Distribution of coded responses on the dimensions

Table 4. Dimensions with related maincodes and exemplary quotes (Q)

Dimension, maincode	#	Exemplary Quotes
System measurement and monitoring	63	
Conditions for use	2	Teledermatology is only suitable for lesions that are on body parts that can be (easily) photographed.
Effect on care	3	Q1 – The patient doesn't need to visit the hospital and has therefore less risk of a COVID-19 infection.
General	8	Teledermatology is mostly going fine.
Learnability	3	I did not learn anything new.

Need for	3	Teledermatology should be applied on a larger scale.
Quality of care	22	Q3 - The overall picture of the skin is always important when assessing atypical lesions. Q4 - It's about the assessment of only this lesion. I cannot look at other lesions.
System use	19	Q2 - It's difficult to obtain a diagnosis based on only photos. I miss information about the skin condition and the story of the patient.
User-friendliness	1	The system is not very user-friendly, although it has improved a bit
Workload	2	Teledermatology is time-consuming
Clinical content	49	
Photo quality	35	Q5 – The photo quality is insufficient and the specific location of the lesion on the body is sometimes unclear from the photos.
Quality of care	11	It happens often that a teledermatology consultation contains insufficient information about the patient
System failure/improvement	2	It would be great if more photos per teledermatology consultation can be added
Workload	1	It increases my workload if the teledermatology consultation contains photos of insufficient quality
Organizational policies and	41	
procedures Effect on care	1	There are no restrictions (e.g. certain diagnosis) on when a GP can or
System use	41	cannot send a teledermatology consultation. $\mathbf{Q6} - I$ prefer not to use teledermoscopy, but it is useful for patients
		for whom it is difficult to visit the hospital
People	22	
Conditions for use	2	Teledermatology should only be used by specialized GPs
General	1	The GP is responsible for performing a full-body skin check
Learnability	2	Q7 – The GP can learn from the teledermatology consultations because for me it's only sharing my knowledge
Photo quality	1	We should not accept that patients take their own photos due to the low quality
System use	4	The use of teledermatology during the COVID-19 pandemic did not change
Training	11	Q8 – I provide tips for future consultations. That's one of my tasks as a specialist; inform the GP what you need to be able to obtain a diagnosis. Q9 – GPs should be taught what is needed to make high-quality photographs.
User-friendliness	1	It is difficult for a lot of patients to upload photos
Workflow and communication	21	
Conditions for use	2	Certain processes should be faster and more efficient
Need for	1	Teledermatology is essential
Quality of care	6	A photo or video cannot replace a physical consultation
System failure/improvement	1	I use a lot of different platforms which all have different credentials. This should be replaced by one system for digital care.
System use	7	Sometimes, the patient hasn't even visited the GP, and thus photos are sent by the GP that the patient has taken themselves.
Workload	3	Teledermatology requires a lot of time compared to a physical consultation
Human computer interface	9	
System failure/improvement	4	There are too many fixed, mandatory fields
System use	2	The new layout of the platform has improved
User-friendliness	3	The platform should be more user-friendly
Hardware and software	5	
System failure/improvement	5	There should be an app so that I can respond quickly to the GP
External rules, regulations, and pressures	2	

System use	2	GPs started using teledermatology due to the urgency during the COVID-19 pandemic
Not able to code	35	
Total	247	

System measurement and monitoring

Most dermatologists had a positive experience with teledermatology, especially during the COVID-19 pandemic where they could continue to provide care without seeing the patient at the hospital (Table 4. Q1).

Dermatologists (56%) noted that GPs generally provided complete information in the teledermatology consultations with the required types of photos and anamnesis. However, they were more critical regarding the use of teledermoscopy for diagnosing potential malignant skin lesions. The inability to perform a full body skin check of the patient is a barrier (Table 4. Q2). This underscores the need to receive (overview) pictures of the skin lesion, along with the patient anamnesis information. Dermatologists emphasized the importance of accurately selecting lesions for evaluation, given the ability of GPs to perform a full-body skin check (*quality of care*) (Table 4. Q3, Q4).

Clinical content

Dermatologists (44%) expressed their concerns about the low-quality of the photos taken by the GP, these are often blurry and assessment (*photo quality*). Also, overview and dermoscopic photos are mostly lacking (*quality of care*), hindering the assessment of the skin type and number of lesions. Consequently, most dermatologists (76%) advice physical referrals (Table 4. Q5).

Organizational policies and procedures

The accurate assessment of potential malignant skin lesions relies heavily on high-quality (dermoscopic) photos [41]. Seven dermatologists considered that teledermoscopy is unsuitable for this purpose, and prefer live dermoscopy for a clearer view of the skin (*system use*). Twelve dermatologists find teledermoscopy suitable and five dermatologists preferred not to use teledermoscopy, (Table 4. Q6) indicating different viewpoints for diagnostic suitability for different lesions (*system use*).

People

Several dermatologists indicate the importance of training GPs in providing high-quality photos and complete patient information (*training*, Table 4. Q9). They believe such training will help GPs

understand which information is required for accurate assessment by dermatologists. Dermatologists assert that they feel adequately trained in using teledermatology due to provided instructions, and emphasize that teledermatology doesn't enhance their dermatological knowledge but assists GPs in diagnosing skin lesions. (Table 4. Q7, Q8).

Workflow and communication

Three dermatologists find teledermatology more time-consuming than a physical consultation (*workload*), especially with poor-quality photos (*quality of care*). For these reasons, dermatologists prefer a physical consultation as they can't replace the full body skin check (*quality of care*). Dermatologists believe that teledermatology is therefore only useful for dermatologists who have sufficient time. Other dermatologists indicate that teledermatology is indispensable, for example to monitor patients with a known diagnosis and to supervise the GP.

Human-computer interface

Dermatologists differ in their viewpoint about the usability of the platform. While some believe that improvements have been made in the last years (*system use*), others mention that there are too many fixed, mandatory fields in the teledermatology consultation form which decreases their possibility to enter free text (*System failure/improvement*).

Hardware and Software

Dermatologists provide suggestions for system improvements, for example that the photography equipment of the GP should automatically focus to yield better photos, or a mobile app to respond to teledermatology consultations (*System failure/improvement*).

External rules, regulations, and pressures

Three dermatologists observed that that GPs used teledermatology more often during the COVID-19 pandemic than before, driven by the urgency to be able to provide dermatological care.

Dermatologist Panel Discussion

Comments of the dermatologists mostly matched the questionnaire responses (Table 5). We obtained additional insight into the experiences of dermatologists with teledermatology, since also new findings compared to the questionnaire responses were mentioned. Dermatologists gave possible explanations for critical responses on the use of teledermoscopy provided by dermatologists in the questionnaire (*Organizational policies and procedures*, *External rules*, *regulations*, *and pressures*).

There were no comments made regarding the dimension 'System measurement and monitoring'.

Table 5. Comments panel discussion mapped on the adapted dimensions and compared to questionnaire results.

Table 5. Comments pa	inel discussion mapped on the adapted dimensions and compared to questionnaire re	esults.	
Dimension	Comments panel discussion	Compared questionnain results	to re
Hardware and software	Preference for dedicated fields related to the question and suspected diagnosis of the GP, instead of one set of fixed, generic questions in the teledermatology consultation.	Known questionnair	from
Clinical content	The photo quality must be improved.	Known questionnair	from e
Human computer interface	More fields regarding the anamnesis should be mandatory so that the GP will provide more anamnesis information. The provided information by filling in those fields is necessary to be able to diagnose the lesion of the teledermatology consultation.	New result	
	Dermatologists prefer a free text entry field to fill in the diagnosis, instead of a field where a diagnosis is filled in based on a thesaurus. This is too restrictive.	Known questionnair	from e
People	GPs must be instructed on the importance of anamnesis information as well as how to obtain high-quality images that dermatologists will require to diagnose the lesion.	Known questionnair	from e
Workflow and	An option for GPs to request an urgent consultation.	New result	
communication	Currently, GPs can react to the dermatologists' response to the teledermatology consultation. GPs mostly use this to thank dermatologists, which is confusing for dermatologists because they expect additional questions.	New result	
Organizational policies and procedures	The use of teledermoscopy is discouraged, because the Dutch GP guidelines ("Nederlands Huisartsen Genootschap") advice to physically refer patients with suspicious lesions.	New result	
External rules, regulations, and pressures	The Dutch Board of Dermatologists ("Nederlandse Vereniging voor Dermatologie en Venereologie") is cautious regarding the application of teledermoscopy for the diagnosis of potential malignant skin lesions, since they believe that there is yet insufficient evidence regarding the diagnostic accuracy of teledermoscopy. As a result, there are different viewpoints on the use of teledermoscopy which discourages the use.	New result	
System measurement and monitoring	No comments	NA	

Discussion

Main findings

Dermatologists showed overall satisfaction with the teledermatology service, and considered it a valuable addition to dermatology care, rather than a replacement of face-to-face consultations. Dermatologists find supervising GPs in patient and lesion management especially valuable. Teledermatology facilitates efficient triage, aiding in prioritizing appointments in secondary care and thus streamlines the referral assessment process for dermatologists, ultimately saving time in dermatology practice. Despite reported preferences for face-to-face consultations, dermatologists consistently reported high satisfaction rates with teledermatology [3,42,43]. Teledermatology provides appropriate low-complex diagnostic care at the right place, although acknowledging limitations. The current healthcare landscape is marked by challenges, including rising healthcare costs and long hospital waiting times. Teledermatology emerges as a solution to enhance efficient dermatology care [44]. However, barriers were also identified through qualitative analysis of the

open-ended responses. Further, this discussion also explores factors that intricately influenced the dermatologists' experience and satisfaction with the use of teledermatology.

First, dermatologists reported that incomplete anamnesis information or low-quality (dermoscopic) photos (e.g. blurry, bad lightning), from GPs hinders an accurate diagnosis, as they heavily rely on this, due to the inability to conduct a full body skin check (*System measurement and monitoring* [45,46]. From the study's holistic perspective, the trade-off between the convenience of teledermatology (saving patient travel time and less unnecessary physical referrals) and the dermatologists' preference for physical consultations (depending on lesion complexity) is influenced by the quality of the provided clinical content.

The suboptimal quality of photos and anamnesis information may lead to more time-consuming teledermatology assessments (*Workflow and communication*), emphasizing the need for adequate clinical content quality. However, this illustrates a trade-off in teledermatology use, namely the balance between the photo quality and the time a GP spent on taking photos. High-quality photos this will likely increase the workload of the GP, but will save dermatologists' time during assessment and improve the dermatologists' confidence and diagnostic performance [47,48]. In contrast, a consultation with low quality images will likely be considered ineligible for assessment by the dermatologists [3,49]. These barriers were acknowledged during the panel discussion. The poor image quality barrier was already identified in 2011 in the United States [9], making it remarkable that this continues to exist in 2020 in Denmark [4] and in our study. Despite the time-efficiency of teledermatology [3], this study did not assess how quality of the clinical content affects the time needed for assessment by dermatologists.

Teledermatology was already widely implemented in Dutch general practice prior to the pandemic, leading to a more gradual uptake compared to other countries [20]. Dermatologists did not observe a massive increase in the number of teledermatology consultations during or after the pandemic which indicates its well-established use in the Netherlands. Despite the global forced uptake of teledermatology during the COVID-19 pandemic, both patients and their treating practitioners viewed the experience positively [50].

Our findings demonstrated how barriers impacted different aspects of care delivery. Exclusively analysing the closed-ended questions of the SAF-TSUQ questionnaire would not have unveiled these findings, as those specifically focussed only on the platform usage and omitted other aspects of teledermatology (e.g. workload, clinical content). Applying a user-centred approach by surveying the dermatologists gave a better understanding of the dermatologists experiences and satisfaction with using teledermatology. This emphasizes the need for improvements to ensure that teledermatology

remains of added value, facilitating its acceptance and implementation in general healthcare, rather than viewing it solely as a separate digital system [51].

From a sociotechnical CAS perspective we aimed to understand the impact of interacting system components (e.g. photo quality versus workload). While acknowledging that this study is limited in identifying all complex relationships of teledermatology use, nor that poor photo quality is a new result, we provide a different perspective on how to think about those barriers and how it presents trade-offs to manage those issues. The interrelated nature of digital health implementation means that we cannot view barriers as isolated entities but rather we must think of them as an interrelated system [30]. Our integrated sociotechnical-CAS perspective can be used to study digital health in other settings.

Future research

Future research could address the refinement of training methods for GPs to optimize their dermatology knowledge and use of the advanced photography equipment (*People*). The training should be time-efficient and flexible, given the high workload of GPs. We suggest that accreditation would be a nice incentive for participation. Second, automatic focus of camera equipment (*Hardware and software*), and artificial intelligence (AI) assisted (image) analysis tools to improve the quality of the provided clinical content should be investigated. The critical attitude of dermatologists towards teledermatology should be investigated. Despite advancements of photography equipment over the past decade and the widespread utilization of teledermatology, dermatologists remain critical. However, caution is needed when making aforementioned changes in teledermatology systems, since the barriers resulting from this study cannot be evaluated as an isolated entity. Changes could result in unintended consequences on various parts of the system. This underscores the complexity of teledermatology innovation. By looking through a complex system perspective, we could only identify the barriers, but also to support the investigation of the consequential impacts on various aspects when modifying one simple factor to a CAS [26,27].

Strengths and Limitations

We achieved an acceptable response rate of 10%, considering the fact that the questionnaire was distributed during a lockdown. A comparable response rate (13%) was achieved in the study of Kennedy et al [52]. The panel discussion enriched perspectives, thereby balancing diverse viewpoints. This study is part of a larger investigation into teledermatology, wherein also the experiences of GPs were investigated [53]. Through the additional open-ended questions and panel discussion, we were able to provide in-depth insight into the responses of closed-ended questions of

the SAF-TSUQ questionnaire. We thus believe that we obtained valid responses. This study was the first step to investigate the experiences of dermatologists with the use of teledermatology in the Netherlands. Follow-up research among a larger group of dermatologists is needed, to enrich our results.

Secondly, we used a sociotechnical model as a theoretical framework to thematically analyse the responses on the questionnaire, ensuring a consistency and reliability across the data evaluation process. Through structured coding, we were able to systematically explore the responses, revealing interconnected themes such as that 'workload', which could be related to 'Clinical content' (poor photo quality), 'Workflow and communication' (time-consuming), and 'System measurement and monitoring' (unable to conduct a full body skin check). More information could be gathered from research in practice in addition to the questionnaire responses (e.g. observing and interviewing how dermatologists and GPs use the teledermatology service). While various frameworks exists, such as Rogers' diffusion of innovations theory [54] and Reason's Swiss Cheese Model [55], they may have a limited scope for the evaluation of complex systems. In this study, we chose the sociotechnical model of Sittig and Singh [30] that integrates technological and sociotechnical (e.g. people, processes) factors. This sociotechnical model helped us to examine the experiences of dermatologists with teledermatology services in a systematic manner [56]. Given the fact that this teledermatology service is implemented since 1995 [5], this sociotechnical model accounts for long term perspectives, allowing for a thorough analysis of the open responses per dimensions of the model.

We experienced the expected limitations of a questionnaire study. Some incomplete responses were excluded. Since this study was the first step in understanding the dermatologists' experiences with teledermatology, we believe that a questionnaire combined with a panel discussion was an appropriate method. Follow-up research among a larger group of dermatologists within focus groups could provide a deeper understanding of the experiences. Using a sociotechnical model supported a consistent approach, but the sentiment of responses might be lost [57,58]. However, steps were taken to mitigate this through blinded coding and researcher discussions (FvS, LWP, BG).

Another limitation included the focus on a single teledermatology service which may restrict the generalizability of our findings. It was unknown if the dermatologists also had experiences with other teledermatology services, and avoided this in the questionnaire for clarity purposes. It should be addressed in follow-up research if the experiences of Dutch dermatologists with the Ksyos teledermatology service are shared across different teledermatology services. This could be achieved by investigating a broader range of teledermatology services across different countries through surveying dermatologists or conducting panel discussions, with a similar methodology employed in

our study. We acknowledge that the teledermatology system in the unique Dutch healthcare setting, including our results, may not be generalizable to other healthcare systems. Additionally, only experienced dermatologists responded to the questionnaire, thus a selection bias may exist. Including dermatologists who use teledermatology less frequent in follow-up research, could reveal broader perceptions. Finally, the questionnaire did not address reimbursement and legal aspects, which are important considerations for teledermatology adoption [9,10,56].

Conclusion

Our study sheds light on the use of teledermatology in the Dutch healthcare system. Dermatologists generally view teledermatology as a valuable tool to provide access to dermatology care as alternative or decision making prior to a physical consultation. However, their feedback highlights its challenges in providing effective and convenient care via teledermatology. Currently, trade-offs exist between the convenience of saving patient travel time and the preference for a physical consultation, and the need for high-quality photos versus the time spent by GPs on taking pictures. Improving the photo quality and the completeness of the anamnesis information is crucial. Innovative solutions such as AI assisted analysis tools, and not only GP training, are deemed necessary. Complete teledermatology consultations are a prerequisite for dermatologists to provide added value to the GPs and patients. Addressing barriers and implementing solutions will facilitate the continuous use of teledermatology, however we emphasize the need to address this from a complexity perspective to understand trade-offs as a means of preventing unintended consequences.

Appendix Questionnaire

* Question is mandatory

General questions Wat is uw leeftijd?* Kies één van de volgende mogelijkheden: 18 t/m 24 jaar 25 t/m 34 jaar 35 t/m 44 jaar 45 t/m 54 jaar 55 t/m 64 jaar 65 jaar of ouder	What is your age?* Choose one of the following options: 18-24 years 25-34 years 35-44 years 45-54 years 55-64 years ≥ 65 years
Wat is uw geslacht?* Kies één van de volgende mogelijkheden: Man Vrouw Overig Wil ik niet delen	What is your sex?* Choose one of the following options: Male Female Other Prefer not to say
In welke rol/functie bent u betrokken bij [telemedicine organization]?* Meerdere antwoorden mogelijk. Selecteer alle mogelijkheden: Cardioloog Dermatoloog Doktersassistent Huisarts Longarts Oogarts Optometrist POH(-GGZ/somatiek) Psychiater (GZ-)psycholoog of psychotherapeut Somnoloog Specialist ouderengeneeskunde Verpleeghuisarts Verslavingsarts Verpleegkundig specialist Zorgmanager Anders, namelijk:	In which role/function are you involved in at [telemedicine organization]?* Multiple answers possible. Select all that apply: Cardiologist Dermatologist Physician's assistant General Practitioner Pulmonologist Ophthalmologist Optometrist Nurse Practitioner (mental health/somatic) Psychiatrist (GZ-)Psychologist or psychotherapist Somnologist Specialist geriatric medicine Nursing home physician Addiction specialist Nurse specialist Care manager Other,
Hoe schat u uw computervaardigheden in?* Kies één van de volgende mogelijkheden: Slecht Voldoende Goed Uitstekend	How do you rate your computer skills?* Choose one of the following options: Poor Sufficient Good Excellent

 Hoe zou u uzelf het beste omschrijven?* Kies één van de volgende mogelijkheden: Ik ben een innovator en de eerste die nieuwe technologie wil uitproberen Ik ben een pionier en één van de eersten die nieuwe technologie uitprobeert Ik ben een voorloper, als anderen nieuwe technologie gebruiken, wil ik het ook gaan gebruiken Ik ben een achterloper en meestal één van de laatsten die nieuwe technologie uitprobeert Ik ben een achterblijver en de laatste die nieuwe technologie uitprobeert 	 How would you describe yourself?* Choose one of the following options: I am an innovator and the first to try out new technology I am an early adopter and am one of the first to try out new technology I am a part of the early majority. If others use a new technology, I want to start using it as well. I am a part of the late majority and am usually one of the last to try out new technology I am a laggard and am the last to try out new technology
Maakt u gebruik van het [telemedicine platform] in de praktijk?* Meerdere antwoorden mogelijk. Selecteer alle mogelijkheden: Ja, ik verstuur aanvragen en/of consulten en/of onderzoeken naar een specialist Ja, ik beoordeel consulten en/of onderzoeken Ja, ik ontvang alleen medische uitslagen van [telemedicine organization] in het Huisarts Informatie Systeem (HIS) Ja, ik log in om uitslagen te bekijken Ja, ik verstuur online behandelmodules en/of vragenlijsten naar de patiënt Nee Weet ik niet Ja, anders	Do you use the [telemedicine platform] in practice?* Multiple answers possible. Select all that apply: Yes, I send requests and/or consultations and/or examinations to a specialist Yes, I assess consultations and/or examinations Yes, I only receive medical results from [telemedicine organization] in the GP information system Yes, I log in to view medical results Yes, I send web-based treatment modules and/or questionnaires to the patient Nee I do not know Yes, other
Welke dienst(en) gebruikt u van [telemedicine organization]?* Meerdere antwoorden mogelijk. Selecteer alle mogelijkheden: Cardiologie Dermatologie GGZ Laboratorium aanvragen Oogheelkunde Pulmonologie Slaap Geen van bovenstaande Weet ik niet Which service(s) do you use from [telemedicine organization]?*	Multiple answers possible. Select all that apply: Cardiology Dermatology Mental health Laboratory requests Ophthalmology Pulmonology Sleep None of the above I do not know
Hoe vaak gebruikt u het [telemedicine platform] in de praktijk?* Kies één van de volgende mogelijkheden: Dagelijks Wekelijks Maandelijks Een aantal keer per jaar Nooit	How often do you use the [telemedicine platform] in practice? * Choose one of the following options: O Daily O Weekly O Monthly O A few times in a year O Never
Hoe lang werkt u al met het [telemedicine platform]?* Kies één van de volgende mogelijkheden: Minder dan een half jaar 6-12 maanden 1-3 jaar 3-5 jaar 5-10 jaar Meer dan 10 jaar	How long have you been working with the [telemedicine platform]?* Choose one of the following options: <6 months 6-12 months 1-3 years 3-5 years 5-10 years >10 years
Overige opmerkingen	

Preprints		van Sinde
ther comments		

The following questions are related to digital care during the

corona pandemic. We define the first corona pandemic as the

COI	/ID-19	panden	nic
\sim	עב-עני	panaci	-

De volgende vragen hebben betrekking op de digitale zorg gedurende de corona pandemie. De eerste corona golf definiëren we als de start van corona (periode maart – mei 2020).

start of corona (period March – May 2020). 2020). Hoe vaak heeft u het [telemedicine platform] gebruikt in de How often have you used the [telemedicine platform] during eerste corona golf vergeleken met de periode voor de corona the first corona wave compared with the period before the pandemie?* corona pandemic?* Kies één van de volgende mogelijkheden: Choose one of the following options: Minder vaak gebruikt Less often 0 Ongeveer even vaak gebruikt Approximately as often 0 Vaker gebruikt 0 More often Niet van toepassing Not applicable How often do you use the [telemedicine platform] currently?* Hoe vaak gebruikt u het [telemedicine platform] nu?* Kies één van de volgende mogelijkheden: Choose one of the following options: Minder vaak dan voor de corona pandemie Less often than before the corona pandemic 0 Ongeveer even vaak als voor de corona pandemie Approximately as often as before the corona pandemic 0 Vaker dan voor de corona pandemie More often than before the corona pandemic Niet van toepassing *Not applicable* Did you receive sufficient support for carrying out digital care Ontving u voldoende ondersteuning voor het uitvoeren van digitale zorg tijdens de corona pandemie?* during the corona pandemic?* Kies één van de volgende mogelijkheden: Choose one of the following options: Yes Ja No 0 Nee 0 Indien "Nee": If "No": Wat zou volgens u aan de ondersteuning verbeterd kunnen What do you think could be improved about support in the worden bij een volgende golf en/of pandemie?* another and/or pandemic?* wave Wat heeft u geleerd tijdens de corona pandemie over de What have you learned during the corona pandemic about the toepassing van digitale zorg?* application of digital care?* Overige opmerkingen Other comments

Training

Training							
	Helemaal	Oneens	Neutraal	Eens	Helemaal	Weet ik	Niet van
	oneens				eens	niet	toepassing
De training en uitleg die door [telemedicine organization] wordt aangeboden zijn voldoende om het [telemedicine platform] te kunnen gebruiken in mijn	0	0	0	0	0	0	0

JMIR Preprints van Sinderen et al werkzaamheden* Ik ben tevreden met de mogelijkheden voor bij- en/of nascholing die door [telemedicine 0 0 0 0 0 0 0 organization] worden aangeboden* Ik ben tevreden met de taken die ik uitvoer binnen mijn functie in het [telemedicine 0 0 0 0 0 0 0 platform]* Door het [telemedicine platform] te gebruiken ben ik in staat om mijn kennis en 0 0 0 0 0 0 \circ vaardigheden genoeg te ontwikkelen* Ik ben van mening dat het [telemedicine platform] aan mijn wensen en 0 0 0 0 0 0 0 verwachtingen voor digitale zorgverlening voldoet* Met taken wordt bedoeld het versturen van aanvragen en/of consulten en/of onderzoeken naar een specialist, het beoordelen van consulten/onderzoeken, het ontvangen of bekijken van medische uitslagen, het versturen van online behandelmodules en/of vragenlijsten naar de patiënt, etc. Met "kennis en vaardigheden ontwikkelen" wordt bedoeld in hoeverre u digitale en medische kennis verkrijgt door te werken met het telemedicine platform. Strongly Disagree Neutral Agree Strongly I do not Not <u>applicable</u> disagree agree know The training and explanation offered by [telemedicine organization] are sufficient to 0 0 0 0 0 0 \bigcirc be able to use the [telemedicine platform] in my work* I am satisfied with the possibilities for additional and/or continuing education 0 0 0 0 0 0 0 offered by [telemedicine organization]* I am satisfied with the tasks I perform within my profession in the [telemedicine 0 0 0 0 0 \bigcirc \bigcirc platform]* By using the [telemedicine platform] I am able to develop my knowledge and skills 0 0 0 0 0 0 0 I believe that [telemedicine platform] meets 0 my wishes and expectations for 0 0 0 0 0 telemedicine* 'Tasks' refers to sending requests and/or consultations and/or examinations to a specialist, assessing consultations and/or examinations, receiving or viewing medical results, sending web-based treatment modules and/or questionnaires to the patient, etc. 'Developing knowledge and skills' refers to the extent to which you acquire digital medical knowledge by working with the [telemedicine platform]. Overige opmerkingen Other comments Twitter Facebook Support Communication Website Op welke manier(en) communiceert u het liefst met In het [telemedicine platform] direct na het inloggen platform]?* [telemedicine Ik wil niet op de hoogte gehouden worden Meerdere antwoorden mogelijk. Selecteer alle mogelijkheden: Anders, namelijk... E-mail Telefoon Via een accountmanager Via een chatfunctie Anders, namelijk... Hoe wilt u op de hoogte gehouden worden over [telemedicine platform]?* Meerdere antwoorden mogelijk. Selecteer alle mogelijkheden:

E-mail LinkedIn

	which way(s) do you prefer to communicate with emedicine platform]?* <i>Multiple answers possible. Select</i>
all t	hat apply:
	E-mail
	Phone
	Via an accountmanager
	Via a chat function
	Other,
	would you like to stay informed about [telemedicine form]?* <i>Multiple answers possible. Select all that apply:</i>
	form]?* <i>Multiple answers possible. Select all that apply:</i> E-mail
	form]?* Multiple answers possible. Select all that apply: E-mail LinkedIn
plat	form]?* Multiple answers possible. Select all that apply: E-mail LinkedIn Twitter
plat	form]?* Multiple answers possible. Select all that apply: E-mail LinkedIn Twitter Facebook
plat	form]?* Multiple answers possible. Select all that apply: E-mail LinkedIn Twitter Facebook Website
plat	form]?* Multiple answers possible. Select all that apply: E-mail LinkedIn Twitter Facebook Website In [telemedicine platform] directly after logging in
plat	form]?* Multiple answers possible. Select all that apply: E-mail LinkedIn Twitter Facebook Website

	Helemaal oneens	Oneens	Neutraal	Eens	Helemaal eens	Weet ik niet	Niet van toepassing
De informatie en handleidingen die vanuit [telemedicine organization] aan mij worden verstrekt en de instructies die ik heb ontvangen om mijn werk uit te voeren zijn voldoende*	0	0	0	0	0	0	0
Ik ontvang voldoende relevante informatie met betrekking tot de besluiten, projecten en activiteiten van [telemedicine organization] die invloed op mij kunnen hebben*	0	0	0	0	0	0	0
Ik weet op welke manier ik contact kan opnemen met [telemedicine organization] indien ik vragen heb over mijn werk voor [telemedicine organization]*	0	0	0	0	0	0	0
Er zijn genoeg informatie kanalen voor suggesties of klachten bij [telemedicine organization]*	0	0	0	0	0	0	0

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	I do not know	Not applicable
The information and manuals that are provided to me by [telemedicine organization] and the instructions given to perform my work are sufficient*	0	0 (0	0	0	0	0
I receive sufficient relevant information regarding any decisions, projects and activities of [telemedicine organization] that may affect me*	0	0	0	0	0	0	0
I know how to contact [telemedicine organization] if I have questions about my work for [telemedicine organization]*	0	0	0	0	0	0	0
There are sufficient information channels for suggestions or complaints at [telemedicine organization]*	0	0	0	0	0	0	0

Overige opmerkingen	Other comments
	>

Interaction telemedicine platform

•	Helemaal oneens	Oneens	Neutraal	Eens	Helemaal eens	Weet ik niet	Niet van toepassing
Ik heb genoeg en de juiste middelen (zoals computers, holterkastjes, gebruiksvoorwerpen, etc.) om mijn (dagelijkse) werk voor [telemedicine organization] uit te kunnen voeren*	0	0	0	0	0	0	0
Het is gemakkelijk om het [telemedicine platform] te gebruiken*	0	0	0	0	0	0	0
Ik vind het prettig om het [telemedicine platform] te gebruiken*	0	0	0	0	0	0	0
Het [telemedicine platform] is simpel en gemakkelijk te begrijpen*	0	0	0	0	0	0	0
Het [telemedicine platform] bevat alle functionaliteiten die ik zou verwachten*	0	0	0	0	0	0	0
Wanneer ik binnen het [telemedicine platform] een fout maak kan ik deze gemakkelijk en snel herstellen*	0	0	0	0	0	0	0
Het [telemedicine platform] geeft foutmeldingen die duidelijk vermelden hoe ik problemen kan oplossen*	0	0	0	0	0	0	0

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	I do not know	Not applicable
I have sufficient and appropriate resources (such as computers, holterdevices, equipment, etc.) to perform my (daily) work for [telemedicine organization]*	0	0	0	0	0	0	0
It is easy to use the [telemedicine platform]*	0	0	0	0	0	0	0
I like using the [telemedicine platform]*	0	0	0	0	0	0	0
The [telemedicine platform] is simple and easy to understand*	0	0	0	0	0	0	0
The [telemedicine platform] includes all functionalities I would expect*	0	0	0	0	0	0	0
Whenever I make a mistake within the [telemedicine platform] I can easily and quickly fix it*	0	0	0	0	0	0	0
The [telemedicine platform] provides error messages that clearly state how I can fix problems*	0	0	0	0	0	0	0

Overige opmerkingen	Other comments

Use of telemedicine platform

⁺Hiermee bedoelen we vindt u dat een digitaal consult een regulier consult kan vervangen?

	Strongly	Disagree	Neutral	Agree	Strongly	I do not	Not
	Helemaal	Oneens	Neutraal	Eens	Helemaal	Weet ik	Nietvahle
The [telemedicine platform] improves	oneens	0	0	0	eens	niet	toepassing
Het ftelemedicine platformf verbetert de toegang tot de gezondheidszorgers me			$\overline{}$				
toegang tot de gezondheidszorgers me	8	8	8	8	8	8	8
Her telemedicine pratform breat mij wat	0	\cap	\cap	\cap	0	$\overline{}$	$\overline{}$
ik nodig heb om betere zorg te leveren						ŏ	
TK Werd snel productief door het werken ** Het het grennedichte platosing*re	0	0	0	0	0	0	0
ik ben van mening dat de dermatologie	$\overline{}$	$\overline{}$	$\overline{}$			$\overline{}$	
platform lis the same as an in-person 1						0	
wordt geleverd hetzelfde is als een regulier		O	0	O	O	0	0
wordt geleverd hetzelfde is als een regulier Consult use the [telemedicine platform]	0	0	0	0			0
Ik ben van plan het [telemedicine							
platform rhogmans the gebruiker icine			8	8	8	8	\square
nk zou het [telemedicine platform]	0	0	0	0	0	0	
_aanraden aan een collega*				<u> </u>			9

^{*}We mean do you think that a digital consultation can replace a regular consultation?

Overige opmerkingen	
	Other comments

The experience of the dermatologists during the teledermatology process

In onderstaande vragen wordt met "digitale dermatologie consultatie" het reguliere en dermatoscopie consult bedoeld. Wat zijn uw ervaringen met het gebruik van het digitale dermatologie consult (regulier, dermatoscopie) tijdens de corona pandemie?* Kies één van de volgende mogelijkheden:

- o Heel negatief
- o Negatief
- o Neutraal
- o Positie
- Heel positief

Licht uw ervaring toe

Wat heeft u geleerd van het gebruik van het digitale dermatologie consult (regulier, dermatoscopie) tijdens de corona pandemie?*

Zetten de verwijzers volgens u het reguliere digitale dermatologie of dermatoscopie consult correct in voor de verschillende soorten huidafwijkingen?* Bijvoorbeeld: een huisarts stuurt een gepigmenteerde laesie in middels een algemeen consult/zonder dermatoscopische foto's, of een huisarts stuurt een eczeem in middels een dermatoscopie consult/met dermatoscopische foto's

- o Ja
- o Nee

Licht toe waarom de verwijzers het volgens u wel/niet correct inzetten

Wat doet u in het algemeen bij twijfel van uw diagnose na beoordeling van de foto('s) van een digitaal dermatologie of dermatoscopie consult?* *Kies één van de volgende* mogelijkheden:

- O Ik twijfel nooit
- o Ik geef geen diagnose
- O Ik adviseer de huisarts de patiënt te verwijzen
- o Anders, namelijk....

Heeft u een training gehad over het beoordelen van digitale (dermatoscopische) foto's?* *Meerdere antwoorden mogelijk. Selecteer alle mogelijkheden:*

☐ Ja, ik heb dit geleerd tijdens mijn opleiding tot dermatoloog
 ☐ Ja, ik heb een (aanvullende) cursus gevolgd
 O Welke (aanvullende) cursus heeft u gevolgd?*
 ☐ Ja, ik heb dit geleerd door het opdoen van praktijkervaring
 ☐ Nee

"Digital dermatology consultation" refers to both regular and dermatoscopy digital consultations.

What are your experiences with the use of the digital dermatology consultation (regular, dermatoscopy) during the corona pandemic?* *Choose one of the following options:*

- o Very negative
- o Negative
- o Neutral
- o Positive
- Very positive

Explain your experience

What have you learned from the use of digital dermatology consultations (regular, dermatoscopy) during the COVID-19 pandemic?*

Do you believe referring physicians correctly utilize regular digital dermatology or dermatoscopy consultations for different types of skin conditions?* For example, a general practitioner sends in a pigmented lesion through a regular consultation/without dermatoscopic photos, or a general practitioner sends in eczema through a dermatoscopy consultation/with dermatoscopic photos.

o Yes

o No

Please explain why you think referring physicians do or do not use it correctly.

What do you generally do when you have doubts about your diagnosis after reviewing the photo(s) from a digital dermatology or dermatoscopy consultation?* *Choose one of the following options:*

- o I never have doubts
- o I do not provide a diagnosis
- o I advise the general practitioner to refer the patient
- o Other,...

Have	you	received	training	on	assessing	digital
(derm	atoscop	ic) photos?	* Multiple	answ	ers possible	. Select
all op	tions th	at apply:				
	Yes, I lea	arned this du	iring my d	ermato	ologist traini	ng
	Yes, I ha	ve taken an	(additiona	l) cour	se	
	0	Which (ad	ditional) c	ourse (did you take	?*
	Yes, I lea	arned this th	rough prac	tical e	xperience	
	No		0 1		•	

Vindt u over het algemeen dat de kwaliteit van ingestuurde (dermatoscopische) foto's voldoende is?* Kies één van de volgende mogelijkheden:

- o Ja
- o Nee

Licht toe waarom u dit wel/niet voldoende vindt

Digitale <u>dermatoscopie</u> consultatie is geschikt voor ... Denk aan patiënt populatie, type laesies* [open vraag] Digitale <u>dermatoscopie</u> consultatie is niet/minder geschikt voor Denk aan patiënt populatie, type laesies* [open vraag] In hoeverre gaat u ervan uit dat er een totale lichaamsinspectie heeft plaats gevonden bij de huisarts voor aanvang van het digitale dermatoscopie consult?*

Kies één van de volgende mogelijkheden:

- O Ik ga ervan uit dat dit altijd is gebeurd
- O Ik ga ervan uit dat dit soms is gebeurd
- O Ik ga ervan uit dat dit niet altijd is gebeurd

Vindt u het zelf niet kunnen uitvoeren van een totale lichaamsinspectie een drempel van het digitale dermatoscopie consult?* *Kies één van de volgende mogelijkheden:*

- o Ja
- o Nee
- O Licht toe waarom u dit wel/niet een drempel vindt

Welke dermatoscopische techniek heeft uw voorkeur bij gebruik van digitale dermatoscopie consulten?* *Kies één van de volgende mogelijkheden:*

- o Contact-dermatoscopie
- o Gepolariseerde dermatoscopie
- o Beide

Waar ziet u verbetermogelijkheden om een digitaal dermatologie consult optimaal te kunnen beoordelen?*

Overige opmerkingen	

Do you generally find the quality of the submitted (dermatoscopic) photos to be sufficient?* *Choose one of the following options:*

o Yes

o No

Please explain why you find this sufficient or insufficient

Digital dermatoscopy consultation is suitable for... Think about patient population, types of lesions*

Digital dermatoscopy consultation is not/less suitable for...

Think about patient population, types of lesions*

To what extent do you assume that a full-body inspection has been performed by the general practitioner before starting the digital dermatoscopy consultation?* *Choose one of the following options*:

- o I assume this has always been done
- o I assume this has sometimes been done
- o I assume this has not always been done

Do you consider the inability to perform a full-body inspection yourself a barrier for the digital dermatoscopy consultation?* *Choose one of the following options:*

- o Yes
- o No
- o Please explain why you consider this a barrier or not

What is your preferred dermatoscopic technique when using digital dermatoscopy consultations?* *Choose one of the following options:*

- o Contact dermatoscopy
- o Polarized dermatoscopy
- o Both

Where do you see opportunities for improvement in order to optimally assess a digital dermatology consultation?*

Other comments

Appendix Table 1. Codebook consisting of maincodes and subcodes

Maincode	Subcode
General	DH+, Checking responsibility GP
Conditions for use	Choose patient, DC unnecessary, DC useful under C, DDS unsuitable, DH + for small group, DH difficult for C, DH limited in HC, Digital capable, enough pictures, P do not want DC, specialized GP
Effect on care	DC + effect on health, DC time efficient, Dh ensures less spread, DH limited contacts, DH no effect on health, do not use DH often, Less p to 2nd line
Userfriendliness	DC with other system, DH difficult for P, DH user unfriendly, DH userfriendly
Need for	DH + addition to HC, DH available for team, DH essential, DH good alternative, DH more applicable
Photo quality	Bad lightening picture, DDS Photo quality -, Improvement photo quality, No details on picture, No improvement photo quality, No picture by P, Photo quality -, Photo quality +, Photo quality other, Photo quality P -, Photo quality P +, Pictures blurry, Pictures sharp, To few pictures
Quality of care	Consultation with insufficient Information, Calling & pictures > DC, DC for short time, DC not replaces PC, DC partially replaces PC, DC replaces PC, Dermatoscopy risky, M assessment difficult, Missing dermatoscopy, Missing melanoma, Not always PC, Only 1 skin abnormality, P helped faster with DH, PC is needed, Photo quality > QoC
Training	Getting used to DH, No support needed, No support received, No useful support Ksyos, Online support DH, Picture/DH instruction, Support colleague, Visit for explanation
Workload	DC no effect WL, DC not lower WL
Learnability	Digital capable, learned DC, learning effect, no learning effect
System use System failure/improvement	Back to normal after C19, C with insufficient Inf, Clear referral criteria, DC P sends pictures, DDC correct use, DDS final option, DDS for cancer, DDS for chronic patient, DDS for eldery people, DDS for pigmented laesi, DDS for rough estimate, DDS not for atypical naevi, DDS not for cancer, DDS not for complex cases, DDS not for inflammatory, DDS not for pigmented L, DDS unsuitable, Direct refer P to Derm, Just as often/Same DH, More DH due to C19, New layout +, No improvements DDC, Not more DC due to C19, Refer P to dermatologist, Suspicion malignancy, Suspicion melanoma, Urgent problems Dh user unfriendly, Functionalities not in DH, Improving upload photo, Layout app
	outdated, Less change HCI, Linking DS -, Linking/Feedback report HIS -, New layout -, New phone/attachments, Problem request R, Response time -, To few pictures, Update questionnaire DC, Warning quality
Communication Ksyos	Financial agreement, do not know all options
Not applicable	no response, not applicable

Appendix Table 2. Dimensions with corresponding maincodes and subcodes.

	#
System measurement and monitoring	63
Conditions for use	2
DDS unsuitable	1
DH difficult for C	1
Effect on care	3
DC +effect on health	1
DH ensures less spread	1
Do not use DH often	1
General	8
Checking Resp GP	1
DH+	7
Learnability	3
No Learningeffect - Covid	3
Need for	3

DH good alternative	1
DH more applicable	1
DH no added value	1
Quality of care	22
DC not replaces PC	1
DC partially replaces PC	1
Dermatoscopy risky	3
Missing melanoma	2
Only 1 skin abnormality	15
System use	19
DDS final option	1
DDS not for cancer	1
DDS not for pigmented L	3
DDS unsuitable	7
Just as often/Same DH	4
No improvements DDC	3
Userfriendliness	1
DC with other system	1
Workload	2
DC not lower WL	2
Clinical content	49
Photo quality	35
C with insufficient Inf	1
DDS Photo quality -	3
DDS Photo quality - Improvement photo quality	1
Improvement photo quality	1
Improvement photo quality No details on picture	1
Improvement photo quality No details on picture Photo quality -	1 1 3
Improvement photo quality No details on picture Photo quality - Photo quality +	1 1 3 3
Improvement photo quality No details on picture Photo quality - Photo quality + Photo quality other	1 1 3 3 4
Improvement photo quality No details on picture Photo quality - Photo quality + Photo quality other Photo quality P -	1 1 3 3 4 3
Improvement photo quality No details on picture Photo quality - Photo quality + Photo quality other Photo quality P - Pictures blurry	1 1 3 3 4 3 14
Improvement photo quality No details on picture Photo quality - Photo quality + Photo quality other Photo quality P - Pictures blurry Pictures sharp	1 1 3 3 4 3 14
Improvement photo quality No details on picture Photo quality - Photo quality + Photo quality other Photo quality P - Pictures blurry Pictures sharp Too few pictures	1 1 3 3 4 3 14 1
Improvement photo quality No details on picture Photo quality - Photo quality + Photo quality other Photo quality P - Pictures blurry Pictures sharp Too few pictures Quality of care	1 1 3 3 4 3 14 1 1
Improvement photo quality No details on picture Photo quality - Photo quality + Photo quality other Photo quality P - Pictures blurry Pictures sharp Too few pictures Quality of care C with insufficient Inf	1 1 3 3 4 3 14 1 1 1 7
Improvement photo quality No details on picture Photo quality - Photo quality + Photo quality other Photo quality P - Pictures blurry Pictures sharp Too few pictures Quality of care C with insufficient Inf DC not replaces PC	1 1 3 3 4 3 14 1 1 11 7
Improvement photo quality No details on picture Photo quality - Photo quality + Photo quality other Photo quality P - Pictures blurry Pictures sharp Too few pictures Quality of care C with insufficient Inf DC not replaces PC Missing dermatoscopy	1 1 3 3 4 3 14 1 1 11 7 1
Improvement photo quality No details on picture Photo quality - Photo quality + Photo quality other Photo quality P - Pictures blurry Pictures sharp Too few pictures Quality of care C with insufficient Inf DC not replaces PC Missing dermatoscopy Photo quality > QoC	1 1 3 3 4 3 14 1 1 1 1 1 2 1
Improvement photo quality No details on picture Photo quality - Photo quality + Photo quality other Photo quality P - Pictures blurry Pictures sharp Too few pictures Quality of care C with insufficient Inf DC not replaces PC Missing dermatoscopy Photo quality > QoC System failure/improvement	1 1 3 3 4 3 14 1 1 11 7 1 2 1
Improvement photo quality No details on picture Photo quality - Photo quality + Photo quality other Photo quality P - Pictures blurry Pictures sharp Too few pictures Quality of care C with insufficient Inf DC not replaces PC Missing dermatoscopy Photo quality > QoC System failure/improvement Too few pictures	1 1 3 3 4 3 14 1 11 7 1 2 1 2 2
Improvement photo quality No details on picture Photo quality - Photo quality + Photo quality other Photo quality P - Pictures blurry Pictures sharp Too few pictures Quality of care C with insufficient Inf DC not replaces PC Missing dermatoscopy Photo quality > QoC System failure/improvement Too few pictures Workload	1 1 3 3 4 3 14 1 1 11 7 1 2 1 2 2
Improvement photo quality No details on picture Photo quality - Photo quality + Photo quality other Photo quality P - Pictures blurry Pictures sharp Too few pictures Quality of care C with insufficient Inf DC not replaces PC Missing dermatoscopy Photo quality > QoC System failure/improvement Too few pictures Workload DC not lower WL	1 1 3 3 4 3 14 1 11 7 1 2 1 2 1 2 1
Improvement photo quality No details on picture Photo quality - Photo quality + Photo quality other Photo quality P - Pictures blurry Pictures sharp Too few pictures Quality of care C with insufficient Inf DC not replaces PC Missing dermatoscopy Photo quality > QoC System failure/improvement Too few pictures Workload DC not lower WL Organizational policies and procedures	1 1 3 3 4 3 14 1 1 11 7 1 2 1 2 1 41

DDS for cancer	1
DDS for chronic patient	2
DDS for pigmented laesi	10
DDS not for atypical naevi	3
DDS not for cancer	4
DDS not for complex casus	1
DDS not for inflammatory	3
DDS not for pigmented L	7
DDS unsuitable	9
Quality of care	1
Not applicable	1
People	22
Conditions for use	2
Digital capable	1
Specialized GP	1
General	1
Checking Resp GP	1
Learnability	2
No Learningeffect	2
Photo quality	1
No picture by P	1
System use	4
DDS for eldery people	3
Just as often/Same DH	1
Training	11
Picture/DH instruction	11
Userfriendliness	1
DH difficult for P	1
Workflow and communication	21
Conditions for use	2
DH + for small group	1
DH difficult for C	1
Training	1
No support received	1
Need for	1
DH essential	1
Quality of care	6
DC not replaces PC	4
DC partially replaces PC	1
M assessment difficult	1
System failure/improvement	1
Functionalities not in DH	1
System use	7
DDS for rough estimate	1
DDS not for atypical naevi	1
DDS not for cancer	2

DDS not for pigmented L	1
Direct refer P to Derm	1
Not applicable	1
Workload	3
DC not lower WL	3
Human computer interface	9
System failure/improvement	4
DH user unfriendly	1
Functionalities not in DH	1
New layout -	2
System use	2
New layout +	2
Userfriendliness	3
DH user unfriendly	2
New layout -	1
Hardware and software	5
System failure/improvement	5
DH user unfriendly	1
Functionalities not in DH	3
New phone/attachments	1
External rules, regulations, and pressures	2
System use	2
Back to normal after C19	1
More DH due to C19	1
Not able to code	35
NA	32
C with insufficient Information	1
No response	26
Not applicable	7
Total	247

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Supplementary Files

Figures

Responses on the SAF-TSUQ regarding the themes Training, Interaction, Support Communication, Usage. TD = teledermatology * Additional explanation in the questionnaire: we meant that a digital consultation could replace a regular consultation.



Distribution of coded responses on the dimensions.

