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Store-and-forward teledermatology for the most common skin neoplasms in Ukraine

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Abstract

Introduction: Among all malignancies in Ukraine in 2016, the group of non-melanoma skin cancers headed the list in men and made up 21.6%. This group was second in women and made up 17.6%. The diagnostics of skin tumors are becoming increasingly relevant.
Methods: The store-and-forward (SAF) method was used. The study included patients that were remotely diagnosed with melanocytic nevi, seborrheic keratoses, skin cancer, and skin melanoma. Patients signed up for remote diagnostics, were examined in person by dermatologists, and had tumors excised with a subsequent histological examination.
Results: Using telemedicine, 108 melanocytic nevi, 97 seborrheic keratoses, 62 skin cancers, and 47 skin melanomas were diagnosed and selected. The accuracy of teledermatological examination and teledermoscopy compared to clinical examination and dermoscopy was 90.3 to 100.0%. The accuracy of teledermatological examination and teledermoscopy compared to histopathological diagnoses was 85.1 to 98.9%.
Conclusion: Teledermatological diagnosis showed a high ability for detecting skin neoplasms in Ukraine.

Keywords: teledermatology, skin neoplasms, diagnosis, Ukraine

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Introduction

The availability and rapid provision of medical services remain the main issues in the healthcare system in Ukraine (1). This is especially important for the population in remote regions, as well as the urban population, which, due to a lack of time, is unable to make appointments with a physician (2). According to the National Cancer Registry of Ukraine, in 2016 the group of non-melanoma skin cancers was the most prevalent of all malignancies among men, constituting 21.6%. Among women it constituted 17.6% and was second most common after breast cancer (23.0%) (3). In 2014, 2,545 patients were registered with diagnosed skin melanoma. In 2015, there was a significant increase in the incidence of male mortality by 11.9%, and among women by 8.0% (4). Diagnostics of skin tumors have become increasingly relevant. The most common neoplasms doctors are facing in consultations are melanocytic nevi, seborrheic keratosis, skin cancer, and melanoma. These four categories comprise the majority of neoplasms.

Teledermatology is a field of dermatology that is widely used in practice. It is divided into real-time and store-and-forward (SAF) teledermatology. This study evaluates the capacity of SAF teledermatology for detecting skin neoplasms in Ukraine.

Methods

The SAF method was used (5–8). All patients were referred for distant diagnosis of skin neoplasms on Melanoma Day between 2013 and 2016. The patients did not meet the physician at the checkup. Administrators took macroscopic and dermoscopic pictures of neoplasms, collected general information (personal data, and exogenous and endogenous risk factors), and data related to neoplasms (persistence, color change, form change, and growth rate). Only one neoplasm had been examined in one patient. The patients themselves chose the tumors they wanted to check. Information about indicative symptoms was provided via the media a few months before Melanoma Day and by the administrators before the participants completed a questionnaire.

For the macroscopic photos, a ruler was placed close to the neoplasm, and the photo was taken with a Sony Cyber-Shot DSC-W560 camera from a distance of 15 to 20 cm. For the dermoscopic photos, the neoplasm was coated with oil as an immersion and a Dermlite 3Gen dermoscope was used, which was connected through an adapter with a Sony Cyber-Shot DSC-W560 camera. The dermoscope was then placed close to the neoplasm and the photo was taken. The administrators imported data and photos to the Telederm platform and sent them to an expert via the internet. The expert, who was working remotely, analyzed the pictures and data through the Telederm platform, and established the teledermatological diagnosis. To receive a conclusion with a teledermatological diagnoses and recommendations, patients had to come the day after the examination to meet administrators or receive it by e-mail or mail (Fig. 1). In addition to the teledermatological diagnosis, all of the patients were advised to have a face-to-face consultation with a dermatologist by appointment for a dermoscopic examination. Before the consultations, the administrators completed the patients' files, which contained personal data. The administrators then marked it as a telediagnostic consultation and localization of a neoplasm with no previous diagnosis. During the consultation, the doctor conducted a clinical examination of the neoplasm and dermoscopic examination with a Heine 20 dermoscope, and established a diagnosis and recommendations. For this study, patients with diagnosed melanocytic nevi, seborrheic keratosis, skin cancer, and melanoma were selected. Depending on the medical or cosmetic indications, patients were advised to have neoplasms excised with subsequent histological examination. During the diagnostic biopsy, the following methods were used:

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radiowave excision, combined approach (radiowave excision with cryodestruction of the basis), and surgery. The appointment card for the histology included the clinical diagnosis, but not the teledermatological diagnosis. After the patients completed these stages, all of the data were collected and compared.

Melanocytic nevi. Depending on the structure of the tumor with a previous diagnosis of melanocytic nevi, radiowave or surgical excision was recommended. The recommendations for radiowave excisions were given to patients with brown neoplasms with a typical teledermoscopic and dermoscopic structure (typical pigment net, globules, and vessels). In the presence of atypical structures (atypical pigmented network, globules, and vessels), homogeneous blue pigmentation, or signs of starburst, patients were advised to have neoplasms removed surgically.

Melanoma. After a face-to-face and dermoscopic examination of the neoplasms, patients were referred to an oncologist at the National Cancer Institute in Kyiv for consultation and treatment. Diagnostic biopsy of all tumors was performed with the surgical method, and only one histologist examined the histological specimen.

Seborrheic keratosis. All tumors telediagnosed as seborrheic keratosis were excised with the radiowave method with subsequent histological examination.

Skin cancer. All tumors were excised with the combined method (radiowave and cryodestruction of the basis) and sent for histological examination.

The results of the histological study were obtained in 2 to 3 weeks. Each histological specimen was obligatorily examined by two histopathologists independently (except melanoma). In cases of controversial diagnoses, a specimen was sent to a third histopathologist at the National Cancer Institute in Kyiv.

Surgical excisions of tumors with a preliminary diagnosis of skin melanoma were performed at the National Cancer Institute in Kyiv. The results of the histology were received within 7 to 10 days. In cases of confirmed diagnosis of melanoma, wide excision was used. The margins depended on Breslow-depth.

Statistical analysis was performed using the IBM SPSS 23.0 program using descriptive statistics (counts and percentage), accuracy, and 95% CI. Accuracy was calculated as (true positive + true negative) / (true positive + true negative + false positive + false negative) × 100. Confidence intervals for accuracy are "exact" Clopper–Pearson confidence intervals.

Results

In 4 years, 1,667 patients signed up for a remote consultation. Among these patients, 1,452 were advised to have their neoplasms excised. After receiving conclusions, 1,012 patients had a face-to-face consultation with a dermatologist. Eight hundred forty-six patients received recommendations to have tumors removed. Five hundred nineteen patients signed up for excision. For the study, 314 neoplasms were selected (melanocytic nevi, melanoma, seborrheic keratosis, and skin cancer; Fig. 2).

Using teledermatology and teledermoscopy, 108 melanocytic

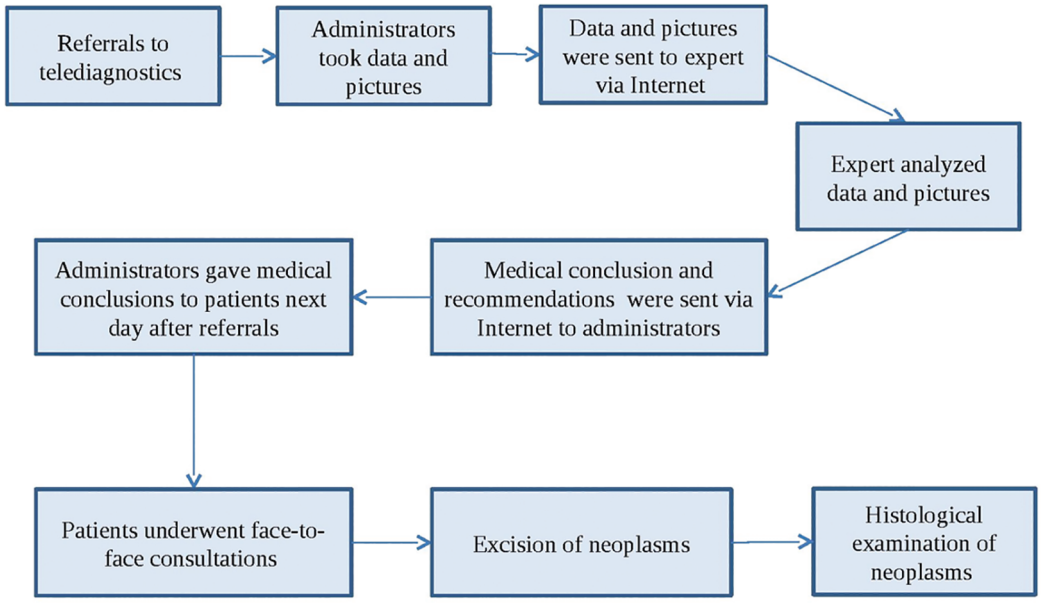

Figure 1 | Stages of the study.

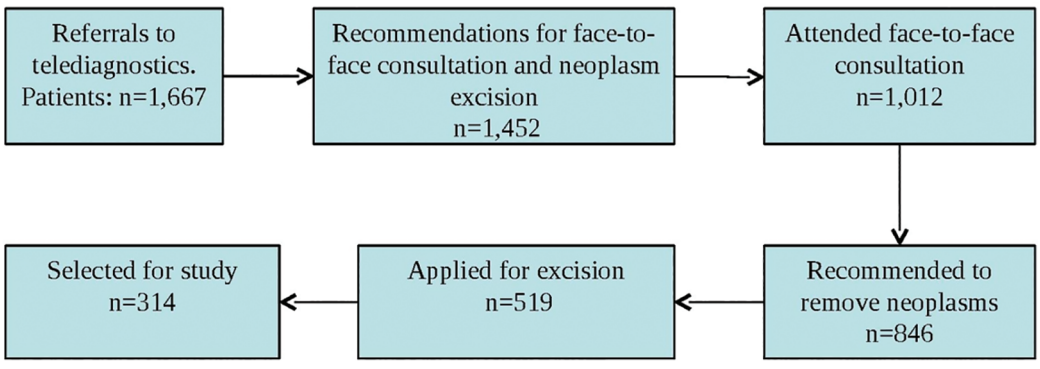

Figure 2 | Number of patients that participated in the study.

nevi, 97 seborrheic keratoses, 62 skin cancers, and 47 skin melanomas were diagnosed and selected.

Of 108 skin neoplasms with a telediagnosis of melanocytic nevi, 105 diagnoses were confirmed in face-to-face consultations using dermoscopy. Of 97 neoplasms with telediagnosis of seborrheic keratoses, 95 diagnoses were clinically and dermoscopically confirmed. Of 62 neoplasms with clinical and dermoscopic telediagnoses of skin cancer, 56 diagnoses were confirmed, and of 47 telediagnosis of melanoma, 47 neoplasms were clinically and dermoscopically confirmed. In other cases, benign skin neoplasms were diagnosed (Table 1). All of the neoplasms were grouped according to localization: the head, neck, trunk, or limbs (Table 2).

The radiowave method was used to excise 163 teledermatologically diagnosed skin neoplasms, of which 66 were melanocytic nevi and 97 were seborrheic keratoses. The combined method was used to excise of 62 teledermatologically diagnosed skin cancers. The surgical method was used to excise 89 teledermatologically diagnosed skin neoplasms, of which 42 were melanocytic nevi and 47 were melanoma.

According to the results of histological examinations of 108 skin neoplasms with telediagnoses of melanocytic nevi, this diagnosis was confirmed by both histologists in 105 cases. In three cases, there was a disagreement in opinions, among which two histopathologists had diagnosed other benign skin neoplasms. The third histopathologist determined two diagnoses of benign skin neoplasms and one diagnosis of melanoma (Table 3).

According to histological study results of 97 skin neoplasms with a telediagnosis of seborrheic keratoses, two histopathologists confirmed the diagnosis of seborrheic keratoses in 95 cases. In two cases, there was a disagreement in opinions, although all three histopathologists diagnosed benign skin neoplasms (Table 4).

According to the results of histological examinations of 47 skin neoplasms with a telediagnosis of melanoma, this diagnosis was confirmed in 40 cases. Histopathological diagnosis of dysplastic melanocytic nevi was diagnosed in seven cases (Table 5).

According to the results of a histological examination of 62 skin neoplasms with a telediagnosis of skin cancer, the first histopathologist identified 59 basal cell carcinomas (BCC) and three

Table 1 | **Teledermatological and clinical diagnosis of skin neoplasms.**

Teledermatological and teledermoscopic diagnoses	*n*	Clinical and dermoscopic diagnoses	*n*
Melanocytic nevi	108	Melanocytic nevi	105
		Seborrheic keratoses	1
		Trichofolliculoma	2
Seborrheic keratoses	97	Seborrheic keratoses	95
		Melanocytic nevi with hyperkeratosis	1
		Epidermal nevus	1
Skin cancer	62	Skin cancer	56
		Actinic keratoses	4
		Keratoacanthoma	2
Melanoma	47	Melanoma	47

Table 2 | **Distribution of skin neoplasms by localization.**

Localization	Melanocytic nevi		Melanoma		Seborrheic keratosis		Skin cancer	
	n	%	*n*	%	*n*	%	*n*	%
Head and neck	19	17.6	2	4.2	26	26.8	48	77.4
Trunk	81	75.0	31	66.0	66	68.0	10	16.1
Limbs	8	7.4	14	29.8	5	5.2	4	6.5
Total:	108	100	47	100	97	100	62	100

Table 3 | **Distribution of skin neoplasms by localization.**

Method and diagnoses				Histopathologist					
Teledermatological, teledermoscopic		Clinical, dermoscopic	Histopathological	1		2		3	
				n	%	*n*	%	*n*	%
MN	108 (100%)	MN 105 (97.2%)	MN	106	98.2	105	97.2	–	–
		SK 1 (0.9%)	SK	1	0.9	1	0.9	–	–
		TrF 2 (1.9%)	AV	1	0.9	–	–	1	0.9
			TrF	–	–	2	1.9	1	0.9
			MM	–	–	–	–	1	0.9
Total: 108 (100%)		108 (100%)		108	100	108	100	3	2.7
Accuracy in comparison to clinical and dermoscopic diagnoses, % (95% CI): 97.2% (92.1–99.4%)									
Accuracy in comparison to histopathological diagnoses, % (95% CI): 98.1% (93.4–99.7%)									

MN = melanocytic nevi, SK = seborrheic keratoses, TrF = trichofolliculoma, AV = acanthoma verrucosum, MM = melanoma.

Table 4 | **Results of histopathological study of skin neoplasms with a telediagnosis of seborrheic keratosis.**

Method and diagnoses				Histopathologist					
Teledermatological, teledermoscopic		Clinical, dermoscopic	Histopathological	1		2		3	
				n	%	*n*	%	*n*	%
SK	97 (100.0%)	SK 95 (98.0%)	SK	96	99.0	95	98.0		
		MN 1 (1.0%)	KA	1	1.0	–	–	1	1.0
			MN	–	–	1	1.0	–	–
			AV	–	–	–	–	1	1.0
		EN 1 (1.0%)	EN	–	–	1	1.0	–	–
Total: 97 (100.0%)		97 (100.0%)		97	100	97	100	2	2.0
Accuracy in comparison to clinical and dermoscopic diagnoses, % (95% CI): 97.9% (92.7–99.7%)									
Accuracy in comparison to histopathological diagnoses, % (95% CI): 98.9% (94.3–99.9%)									

SK = seborrheic keratoses, MN = melanocytic nevi, EN = epidermal nevus, KA = keratoacanthoma, AV = acanthoma verrucosum.

Table 5 | **Results of histopathological examination of skin neoplasms with a telediagnosis of melanoma by method.**

Teledermatological, teledermoscopic			Clinical, dermoscopic			Histopathological		
Diagnoses	*n*	%	Diagnoses	*n*	%	Diagnoses	*n*	%
Melanoma	47	100.0	Melanoma	47	100.0	Melanoma	40	85.1
						Dysplastic melanocytic nevus	7	14.9
Total:	47	100		47	100		47	100.0
Accuracy in comparison to clinical and dermoscopic diagnoses, % (95% CI): 100.0% (92.4–100.0%)								
Accuracy in comparison to histopathological diagnoses, % (95% CI): 85.1% (71.6–93.8%)								

squamous cell carcinomas (SCC). The second histopathologist determined 55 diagnoses of skin cancer and seven diagnoses of benign neoplasms. The third histopathologist identified four BCC among nine specimens examined, and provided two diagnoses of basal cell papilloma (BCP), two diagnoses of keratoacanthoma (KA), and one diagnosis of seborrheic keratoses (Table 6).

The accuracy of teledermatology and teledermoscopy for diagnosing melanocytic nevi, seborrheic keratosis, skin cancer, and melanoma was compared to clinical and dermoscopic diagnostic methods as well as histopathology (Table 7).

Discussion

We evaluated the SAF method for diagnosing the four most common nosologies: melanocytic nevi, seborrheic keratosis, skin cancer, and melanoma.

Many studies have shown that face-to-face consultations have greater accuracy than teledermatological consultations, particularly using the SAF method (9–14). However, this technique continues to be useful in skin neoplasm diagnostics. In this study, the accuracy of teledermatology compared to face-to-face consultation ranged from 90.3% to 100.0%, which is comparable to a previous study, in which the accuracy of teledermoscopy was defined as 91.0% compared to face-to-face consultations. Moreover, teledermatology and teledermoscopy correctly identified between 85.1% and 99.0% of histologically confirmed skin neoplasms, which is consistent with a previous study suggesting that the accuracy of the SAF ranges from 89.0% to 91.5% (15).

Of the 1,667 patients that were referred for teleconsultation, we recommended 1,452 neoplasm excisions. These were cases of atypical structure, periodic trauma, and cosmetic aspect. Confirmation through face-to-face consultation was obligatory. One-third of the patients did not have face-to-face consultations because they had no cancer diagnosis and no wish to excise the neoplasms. Of those that attended consultations (1,012 patients), 846 received confirmation for tumor excision. We were able to trace only 519 patients that had neoplasms excised. Others did not attend or may have had it done at another clinic; this could not be reliably confirmed. Of the 519 neoplasms, we selected 314 comprising the four most common nosologies (melanocytic nevi, seborrheic keratoses, skin cancer, and skin melanoma) for the study.

In one case of telediagnosis of melanocytic nevus, a diagnosis of seborrheic keratosis was made upon clinical and dermoscopic examination and confirmed by two histologists. This can be explained by the type of dermoscope used in the study. In seborrheic keratosis, milium-like cysts are histologically pseudocysts in the upper layers of the epidermis, and for polarized dermoscopes these falls into the "blind zone" and are imperceptible. Such structures can be viewed only with the help of standard dermoscopy. In cases of similar structures of melanocytic nevi and seborrheic keratoses, milium-like cysts can help establish the correct diagnosis (16). In one case, the teledermatological and teledermoscopic diagnosis of melanocytic nevi was not confirmed by clinical, dermoscopic, and histological diagnosis. The neoplasm was amelanotic and only a histological examination could establish the diagnosis (17).

In the group of teledermatologically and teledermoscopically diagnosed seborrheic keratoses, during clinical and histological examinations, one diagnosis of melanocytic nevus and one diagnosis of epidermal nevus were completed. This can be explained because keratosis is on the surface of neoplasms. Previous studies reported an association between melanocytic nevi and seborrheic keratoses (18, 19). When administrators took a dermoscopic picture of a neoplasm, keratosis was in the picture. During a clinical examination, the physician has an opportunity to view the volume of a neoplasm with a dermoscope. In the case of clinical and dermoscopic diagnosis of an epidermal nevus, the nevus can have keratosis on the surface and a small size, which makes the two neoplasms (seborrheic keratosis and epidermal nevus) indistinguishable.

In the melanoma group, all neoplasms had melanoma-specific structures and made it possible to suspect melanoma in all cases for both teledermoscopic and dermoscopic diagnoses. In doubtful cases, physicians preferred to establish a diagnosis of melanoma. Histology confirmed the diagnoses in 85.1% of the cases, resulting in 14.9% dysplastic nevi, which can also have melanoma-specific structures.

In the skin cancer group, clinical and dermoscopic examinations produced three diagnoses of actinic keratosis versus BCC upon teledermatological and teledermoscopic diagnoses and two diagnoses of keratoacanthoma versus SCC. These nosologies can have similar clinical and dermoscopic signs, and there is no need

Table 6 | **Results of histopathological study of skin neoplasms with a telediagnosis of skin cancer.**

Method and diagnoses					Histopathologist					
Teledermatological, teledermoscopic		Clinical, dermoscopic		Histopathological	1		2		3	
					n	%	*n*	%	*n*	%
BCC	59	BCC	53	BCC	59	95.2%	53	85.5%	4	6.5%
	95.2%		85.5%	AK	–	–	6	9.7%	–	–
		AK	4	BCP	–	–	–	–	2	3.2%
	3		6.5%	SCC	3	4.8%	2	3.2%	–	–
SCC		SCC	3	KA	–	–	1	1.6%	2	3.2%
	4.8%		4.8%	SK	–	–	–	–	1	1.6%
		KA	2							
			3.2%							
Total: 62 (100%)		62	100%		62	100%	62	100%	9	14.5%

BCC = basal cell carcinoma, SCC = squamous cell carcinoma, AK = actinic keratoses, KA = keratoacanthoma, BCP = basal cell papilloma, SK = seborrheic keratosis.

Table 7 | **Results of statistical analysis of teledermatological, teledermoscopic and clinical, dermoscopic, and histopathological diagnostic methods.**

Nosology	Teledermatological, teledermoscopic	Clinical, dermoscopic	Accuracy (95% CI)	Histopathological	Accuracy (95% CI)
Melanocytic nevi	108	105	97.2% (92.1–99.4%)	106	98.1% (93.4–99.7%)
Seborrheic keratoses	97	95	97.9% (92.7–99.7%)	96	98.9% (94.3–99.9%)
Skin cancer	62	56	90.3% (80.1–96.3%)	55	88.7% (78.1–95.3%)
Melanoma	47	47	100% (92.4–100.0%)	40	85.1% (71.6–93.8%)

to distinguish them (20).

The limitations of the study were that the dermatologists that examined patients face-to-face and using teledermatology had different lengths of experience in skin neoplasms (5 to 15 years). This could have increased the accuracy of teledermatological diagnoses because they were made by the doctors with the most experience. In addition, dermoscopes were non-polarized for dermoscopic examination and polarized for teledermoscopic ones. The crystalline structures specific to melanoma can be seen only with polarized dermoscopes, whereas the milium-like cysts specific to seborrheic keratosis are seen better with non-polarized dermoscopes. This could have influenced both teledermoscopic and dermoscopic diagnoses.

Conclusions

The teledermatological diagnosis was histologically confirmed in 85.1 to 99.0% of cases, depending on the nosology. It showed a high capacity for skin neoplasm diagnostics in Ukraine. Although face-to-face consultations are more reliable than the SAF method, the SAF method should not be discounted because it is a helpful method in skin neoplasm diagnostics.

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