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ДИАГНОСТИКА И МАРШРУТИЗАЦИЯ ПАЦИЕНТОВ С ПОДОЗРЕНИЕМ НА ЗЛОКАЧЕСТВЕННЫЕ НОВООБРАЗОВАНИЯ КОЖИ В УСЛОВИЯХ ПЕРВИЧНОГО ЗВЕНА ЗДРАВООХРАНЕНИЯ: ПРОБЕЛЫ И ПЕРСПЕКТИВЫ

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Diagnosis and Routing of Patients with Suspected Skin Cancer in Primary Care Settings: Gaps and Perspectives

Резюме

Ранняя диагностика злокачественных опухолей кожи остается актуальной проблемой здравоохранения во всем мире. В первичном звене здравоохранения заподозрить у пациента злокачественное новообразование (ЗНО) кожи можно на основании данных анамнеза, осмотра, физикального обследования. Для исключения или подтверждения онкологического процесса необходимо провести дерматоскопическое исследование, которое выполняет врач-дерматовенеролог. Далее, если онкологический процесс исключить нельзя, пациента направляют к онкологу. Четко организованная маршрутизация выявленных пациентов улучшает благоприятный прогноз. Однако, для снижения показателей высокой запущенности по злокачественным образованиям кожи и оптимизации маршрутизации пациентов после обращения к врачу первичного звена здравоохранения необходимо обратить внимание на следующие моменты: обязательное прохождение периодического профилактического осмотра, особенно в возрасте старше 40 лет; полное физикальное обследование с тщательным сбором анамнеза и полный осмотр кожи терапевтом в рамках диспансеризации на приёме в первичном звене здравоохранения; применение обязательного дерматоскопического исследования для ранней диагностики ЗНО кожи врачом-дерматовенерологом, а при возможности — динамическое картирование кожи с анализом искусственным интеллектом; повышение профессиональной и коммуникативной подготовки медицинского персонала при общении с пациентом, особенно с впервые диагностированным ЗНО кожи, поскольку психосоциальные факторы влияют на отношение пациента к собственному здоровью; поддержание преемственности в работе врачей-терапевтов и врачей-дерматовенерологов для повышения качества и ускорения оказания квалифицированной медицинской помощи; создание в поликлиниках школ «Здоровая кожа» для повышение медицинской грамотности населения с обязательным информирование об опасности для здоровья и жизни ЗНО кожи, обучением навыков самообследования кожи; привлечение технологий электронного здравоохранения в качестве дополнительного источника информации.

Ключевые слова: *рак кожи, меланома, диагностика, первичное звено здравоохранения, профилактика, дерматоскопия, дерматоскопическое исследование, злокачественные новообразования кожи, маршрутизация пациентов*

Конфликт интересов

Авторы заявляют, что данная работа, её тема, предмет и содержание не затрагивают конкурирующих интересов

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Abstract

Early accurate detection of skin cancer is a growing global problem of health's services throughout the world. Malignant skin formation can be suspected by using an anamnesis, visual inspection of the skin, and diffrent types of investigations in primary care settings. The dermatoscopic examination is necessary for exclusion or confirmation skin cancer, which is performed by a dermatovenerologist. The patient is referred futher to an oncologist in case the cancer cannot be excluded. Well-organized identification of patients with suspected skin cancer is accociated with favorable prognosis. However, in order to reduce the rates of high neglect for malignant skin tumors and optimize the routing of patients after visiting a primary care phisician, it is worth to pay attention to the following points: annual medical check-up examinations, especially among people of age is over than 40 years; a complete physical examination, including thorough history and full body skin examination by general practition as part of a clinical examination in a primary care settings; the use of mandatory dermoscopic examination by a dermatovenerologist for early diagnosis of skin cancer, and, if possible, dynamic skin mapping with artificial intelligence analysis; increasing the professional and communicative skills, especially needed in managing newly diagnosed skin cancer, since psychosocial factors influence the patient's attitude towards his/her own health; maintaining continuity between general practitioners and dermatovenerologists to improve the quality of medical care; creation of "Healthy Skin" schools in clinics to increase the medical literacy of the population concerning the education regarding the danger of skin cancer, training in skin self-examination skills; using e-health technologies as an additional source of information.

Key words: *cancer, melanoma, diagnosis, primary care settings, prevention, dermatoscopy, dermatoscopic examination, malignant neoplasms of the skin, patient routing*

Conflict of interests

The authors declare no conflict of interests

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Conformity with the principles of ethics

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MA — malignancy, SBHI — State Budget Healthcare Institution, US — ultrasound, MSPCDC — Moscow Scientific and Practical Center of Dermatovenereology and Cosmetology, OCCC — Outpatient Cancer Care Center, CME — continuous medical education, UVR — ultraviolet radiation, FSAEI HE RSRMU n.a. N.I. Pirogov, Ministry of Health of Russia — Federal State Autonomous Educational Institution of Higher Education Russian State Research Medical University named after N.I. Pirogov, Ministry of Health of the Russian Federation, HLS — healthy lifestyle, FSBEI HE PRMU — Federal State Budget Educational Institution of Higher Education Privolzhsky Research Medical University, CNN — Convolutional Neural Network

Introduction

Despite advancements in the diagnosis of skin malignancies (MA) in Russia within the latest decade, the high prevalence of visually located advanced tumors are preserved.Skin melanoma is not the most prevalent tumor; however, mortality reported within a year since the diagnosis of melanoma in 2022 was 7.5 % [1]

The comparative analysis of MA-associated mortality in Moscow (2019-2021) demonstrated that skin melanoma is a leading pathology among skin MAs regarding the contribution to deaths among the total number of people died [2].

In 2022, the diagnosis of Stage III skin melanoma in Russia was established in 11.3 % of all first detected

cases, Stage IV — in 7.9 %[1]. The advanced melanoma parameter in 2022 was 19.2 % [1]. The number of multiple primary MAs, including those of skin, increases annually [3]. In 2002, 68,165 multiple primary tumors were diagnosed in Russia, i.e. 10.9 % of all first detected Mas [1].

One of the leading issues of increased skin disease prevalence is low awareness of the population about risk factors and lifestyle features that can lead to skin pathologies, including MAs. Prophylactic and awareness-raising procedures have an especially important value in adolescence — a period when behavior stereotypes are still formed [4].

Global actual healthcare issues still include the analysis of factors affecting the advanced state of skin MAs and the search for new solutions for improving the quality of early diagnosis and prevention. These article objectives include the review of possible causes of high advanced skin MA prevalence, including melanoma, search for approaches to perfecting the patient routing after visiting the primary care physician, and the possibility of skin MA prevention in primary care.

Methodology of literature search

The search for open-access full-text publications in Russian and English published in 2016-2024 were conducted in Elibrary and National Library of Medicine databases using the following keywords and their combinations: skin malignancies, melanoma, diagnosis, health literacy, primary healthcare, prevention. 51 publications concerning the issue analyzed were included into the final analysis.

Skin malignancies

The skin is the largest organ of the human body, with a total weight up to 3.6 kg and area of approximately 2 m^2 in adults [5]. The skin is composed of three layers: epidermis (consisting of keratinocytes (95 %) and several other cell lineages (melanocytes, Merkel cells, Langerhans cells); derma, consisting of collagen, elastic fibers, blood vessels, nerve fibers, glands; hypoderma, using which derma interacts with underlying tissues [5, 6].

Skin diseases affect millions of people globally in all age groups and include various pathologies, including acute and chronic diseases, benign and malignant disorders of the skin and its appendages [7, 8].

Neoplastic changes of the skin and its appendages are very variable and may emerge in all layers and cells. Depending on the histogenesis, skin MAs are divided into epithelial (basal cell carcinoma, squamous cell carcinoma, skin appendage cancer) and non-epithelial (melanoma, sarcoma, fibrosarcoma, leiomyosarcoma, angiosarcoma, sarcoma of unknown origin) [9]. When compiling reports about the condition of cancer care and analysis of statistical parameters, all MAs of the skin and its appendages are divided into melanoma and non-melanoma tumors, accounting for high mortality rates in melanoma within a year since the moment of diagnosis.

Melanoma is a rather dangerous tumor developing as a result of malignant transformation and uncontrollable proliferation of melanocytes. Melanoma is characterized by aggressive growth, enhanced tendency to quick lymphogenous and hematogenous metastasizing, unfavorable prognosis with the untimely treatment onset. Four clinical cutaneous melanoma forms exist: superficially spreading, nodular, malignant lentigo-melanoma, and acral-lentiginous melanoma [10]. Approximately 70 % of all cutaneous melanomas are superficially spreading and characterized by two growth phases: radial and vertical [10]. The 5-year survival of patients with the superficially spreading melanoma in the radial phase with the timely treatment is 95 %; if the radial phase transforms to the vertical one, the survival decreases to 40-60 % [11, 12]. As melanocytes are also located in the hair follicle bulbs, retina, internal ear, central nervous system, non-cutaneous melanoma forms may develop — these are characterized by progressive growth and unfavorable course [13-18].

Arnold M. et al. conducted a population epidemiological study, analyzing statistical data for 2020, and concluded that melanoma incidence is mainly reported in highly developed countries predominantly populated with fair-skinned people and, thus, a higher risk and a higher susceptibility to carcinogenic solar radiation effects. Researchers detected significant geographical differences in morbidity and mortality parameters by countries and global regions; with that, the highest cutaneous melanoma incidence was observed among the fair-skinned population in Australia, New Zealand, Western and Northern European countries (Denmark, Norway, the Netherlands), and North America. On the other hand, cutaneous melanoma remained rare in the majority of African, South and Central American, Asian countries. The largest melanoma-related mortality was reported in New Zealand: 5 cases per 100,000 patient-years. Nevertheless, the global proportion of deaths relative to the sick people remained disproportionately high in Asia and Africa compared to other world regions [19].

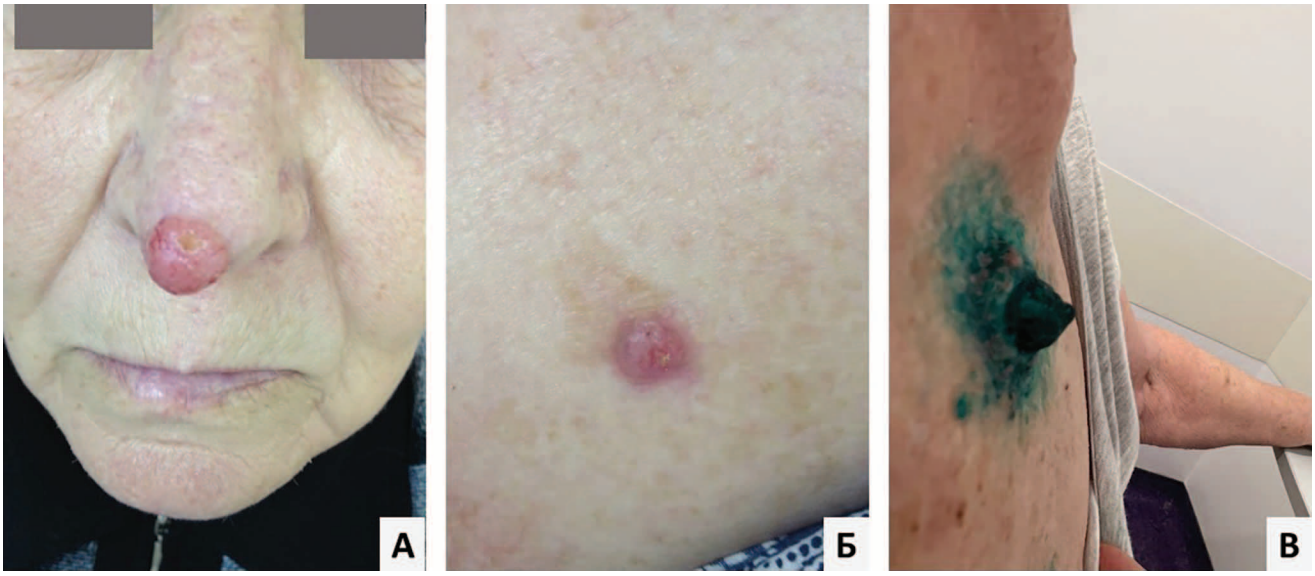

Figure 1. *A — Macro photograph: basal cell carcinoma of the nasal skin, nodular form, pT1N0M0, II art.; B — Macro photograph: basal cell carcinoma of the skin of the abdomen, nodular form pT1N0M0, I art.; C — Macro photograph: squamous cell carcinoma of the skin of the anterior chest wall, pT2N0M0, II art*

Based on authors' data, in 2020 melanoma was globally diagnosed in 325,000 people (174,000 males, 151,000 females), and almost 57,000 people (32,000 males, 25,000 females) died from this disease. Out of all newly diagnosed cases in 2020, 259,000 (79.7 %) people were over 50 years of age, while out of all deaths in 2020, 50,000 people (87.7 %) were over 50 years of age. According to Arnold M. et al., by 2040 the number of newly diagnosed cases of melanoma will have increased by more than 50 % — up to 510,000. Similarly, based on estimates, melanoma-related mortality will increase approximately by 68 % — from 57,000 in 2020 to 96,000 in 2040 — provided 2020 parameters remain stable. These predictions were calculated exclusively assuming changes in the world population count and age structure, but they did not account for possible changes in the age-related global or country-specific mortality. Global morbidity and mortality decrease should exceed 2 % to guarantee that the number of melanoma cases in 2040 will be less than that in 2020.

The most common non-melanoma skin MAs include basal cell carcinoma and squamous cell carcinoma, which are characterized by variable clinical signs (Figure 1).

At the end of 2021, the amount of Russian patients on constant follow-up with non-melanoma skin MAs was 10.8 %, being second after breast MAs, while first in the total morbidity structure for both sexes (12.7 %) [1]. Early diagnosis of non-melanoma cutaneous MAs significantly improves the prognosis and quality of life of patients [20].

Modern possibilities of skin MA diagnosis in primary care conditions

Visually located tumors, primarily skin tumors, are possibly diagnosed in a patient already upon visiting the primary care physician [21]. Simple and comprehensible (for primary care physicians) symptoms exist that provide timely cancer suspicion. Thus, the "ugly duckling" symptom may be detected upon the general examination of the patient's skin without using a special equipment (Figure 2).

Upon timely control routing from the primary healthcare to the cancer service, diagnosis and further treatment can be done for the patient before the emergence of metastases and life-threatening conditions.

Without significant clinical signs of the malignant process in the skin, cutaneous MAs may be suspected based on history, complete physical examination, including lymph node palpation, dermatoscopy.

When collecting history, it is necessary to determine whether the patient is in the risk group for cutaneous MAs. This conclusion can be made based on the following questions: Did you or your relatives have skin MAs? How long do you stay in the active sun annually? Do you have any occupational hazards? Have you developed any new skin lesions over the past 6 monts? How have your existing nevi changed lately? Do you attend tanning salons? Do you take immunosuppressive therapy? Postoperative scars on the skin require thorough

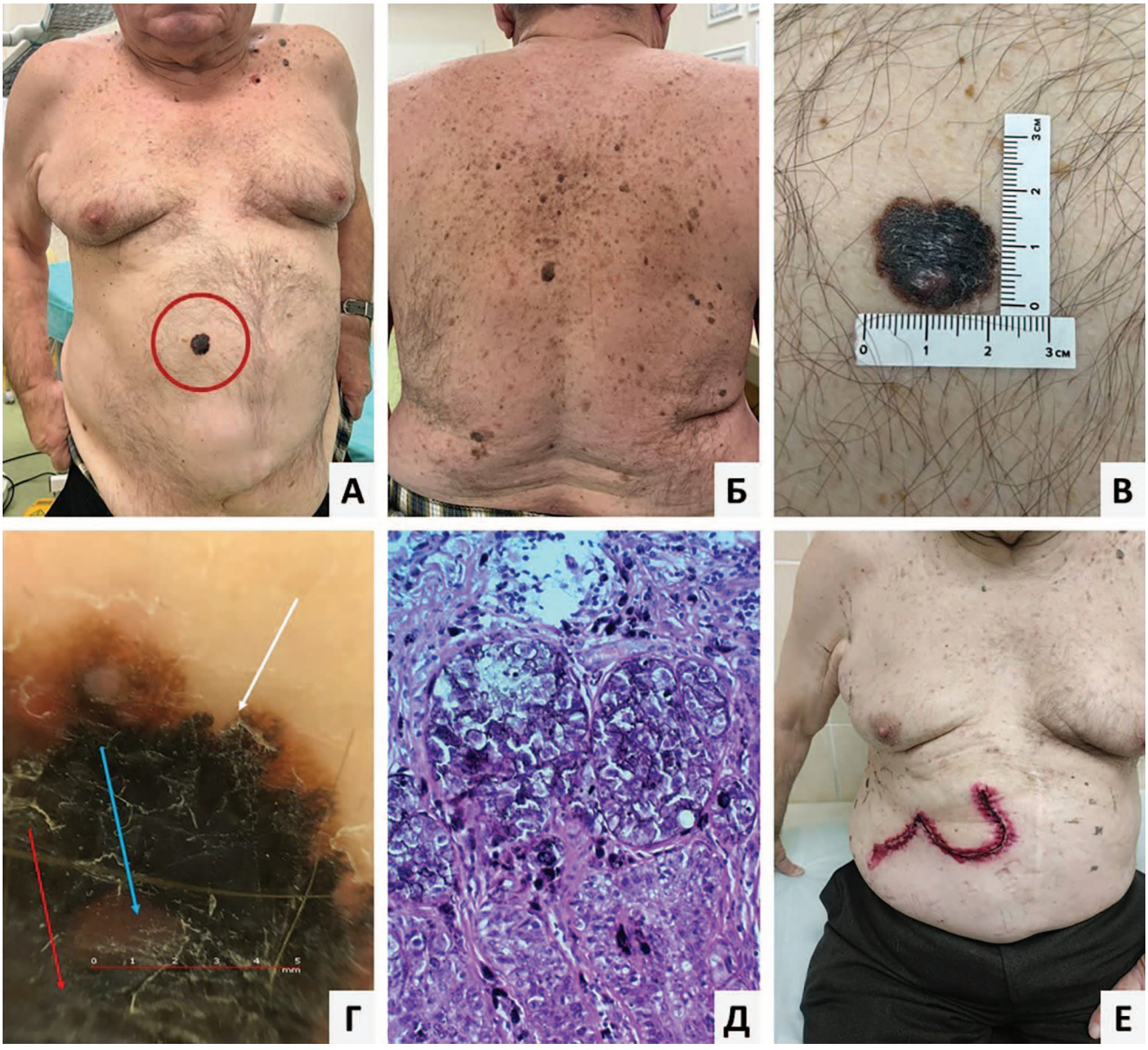

Figure 2. *A — Overview macro photograph of the patient's abdominal skin.*

Note. A bright brown spot is marked on the skin of the abdomen with a red circle, which differs significantly from other skin formations. The symptom of the "ugly duckling". Postoperative scar on the skin of the abdomen (mature cell lymphoma of the spleen in 2015, splenectomy); Б — Overview macro-image of the skin of the patient's back. There are multiple formations of different diameters on the skin of the back, of the same type in their structure; В — A macro photograph of melanoma of the skin on the patient's abdomen, C43.5, TxNxM0; Г — A dermoscopic image of melanoma of the skin on the abdomen, magnification × 20. A white arrow marks the uneven edge of the formation; a red arrow indicates a blue-white veil; a blue arrow indicates polychromy; Д — Histological examination of the removed material: nests of atypical melanocytes with uneven pigmentation, some cells without pigment, in others the pigment accumulates in the form of granules in the cytoplasm. Magnification x 200; Е — Overview macro-image of the patient's abdominal skin after surgical wide excision of skin melanoma with repair of the defect with a musculoskeletal flap on the vascular pedicle

interrogation concerning the history of malignancies, as the number of multiple primary MAs steadily increases, and cancer alertness concerning patients that underwent cancer surgeries should be increased [3] (Figures 2, 3).

When examining the skin in primary healthcare, the clinical diagnosis of melanoma may be suspected based on the combination of results of three pigmented lesion analyses: visual analysis of each separate lesion — examination with a naked eye (ABCDE mnemonic); intraindividual comparative analysis — search for the pigmented neoplasm not similar to others in the same patient ("ugly duckling", "Little Red Riding Hood" sign); chronological analysis of changes — search for quick and recent changes of this pigmented lesion, which can be confirmed by the patient or documentally, compared to prior photographs [22].

Dermatoscopy should be arranged if the cutaneous MA is suspected. According to the Order of the Ministry of Health of Russia dated November 15, 2012 No. 924n, On Approving the Procedure for Providing Medical Care in Dermatovenerology to the Population, dermatoscopy is conducted by the dermatovenerologist as part of primary specialized medical care; the dermatoscope

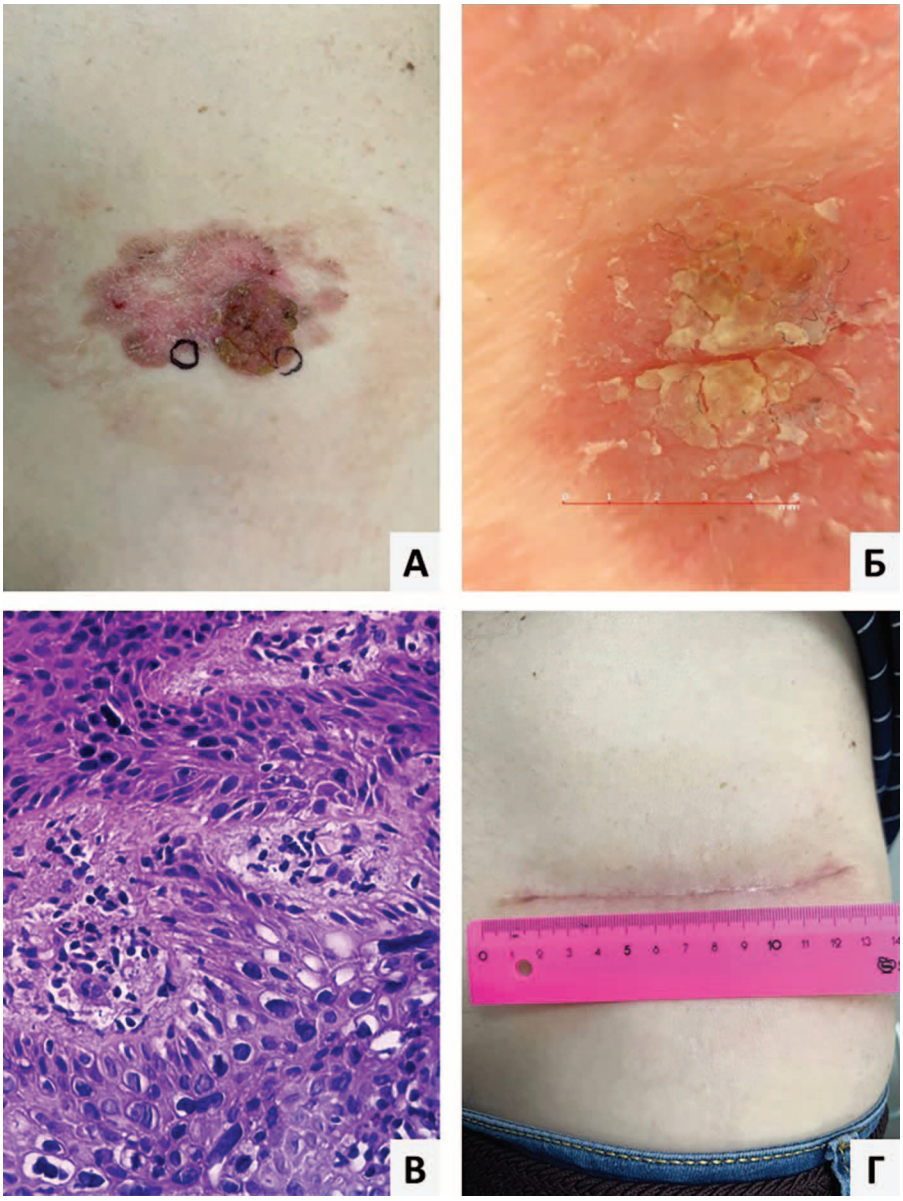

Figure 3. *A — Macro-image of abdominal skin formation in a patient undergoing surgical treatment for rectal carcinoma in 2021.*

Note. The black line encircles the places where the punch biopsy was taken; Б — Dermatoscopic image of the formation of the abdominal skin, magnification × 20; В — Histological examination of the punch biopsy material: skin fragments with invasive growth of squamous cell carcinoma G2 with focal keratinization; Г — A macrograph of the abdominal skin after surgical treatment. Postoperative scar

is included into the equipping standard of the consulting-diagnostic department of the dermatovenerology dispensary [23]. Patients from primary care are routed to the dermatovenerologist (Figure 4).

The targeted dermatoscopy of skin lesions suspicious of malignancies requires deep knowledge and professional experience from the dermatovenerologist — it is most effective for the early diagnosis of superficially spreading melanomas. Dermatovenerologists do not belong to primary care, and so the general practitioner arranges dermatoscopy in the outpatient setting, which can decrease the diagnostic significance due to incorrect interpretation of the data obtained. Besides, significant time is required for dermatoscopy of the whole skin with description and photography of the images obtained — it takes from 20 minutes to 2 hours per one patient, depending on the number of lesions. The issue of dermatoscopic image photography and storage of images obtained in the patient's medical chart is not solved in primary care. Herath H.M.M.T.B. et al. (2018) arranged a survey of general practitioners working in the National Hospital of Sri Lanka and obtained data that over 95.2 % of physicians did not consider dermatoscopy mandatory in routine practice at primary visits. It was demonstrated that only 10 % of primary care physicians conducted the complete

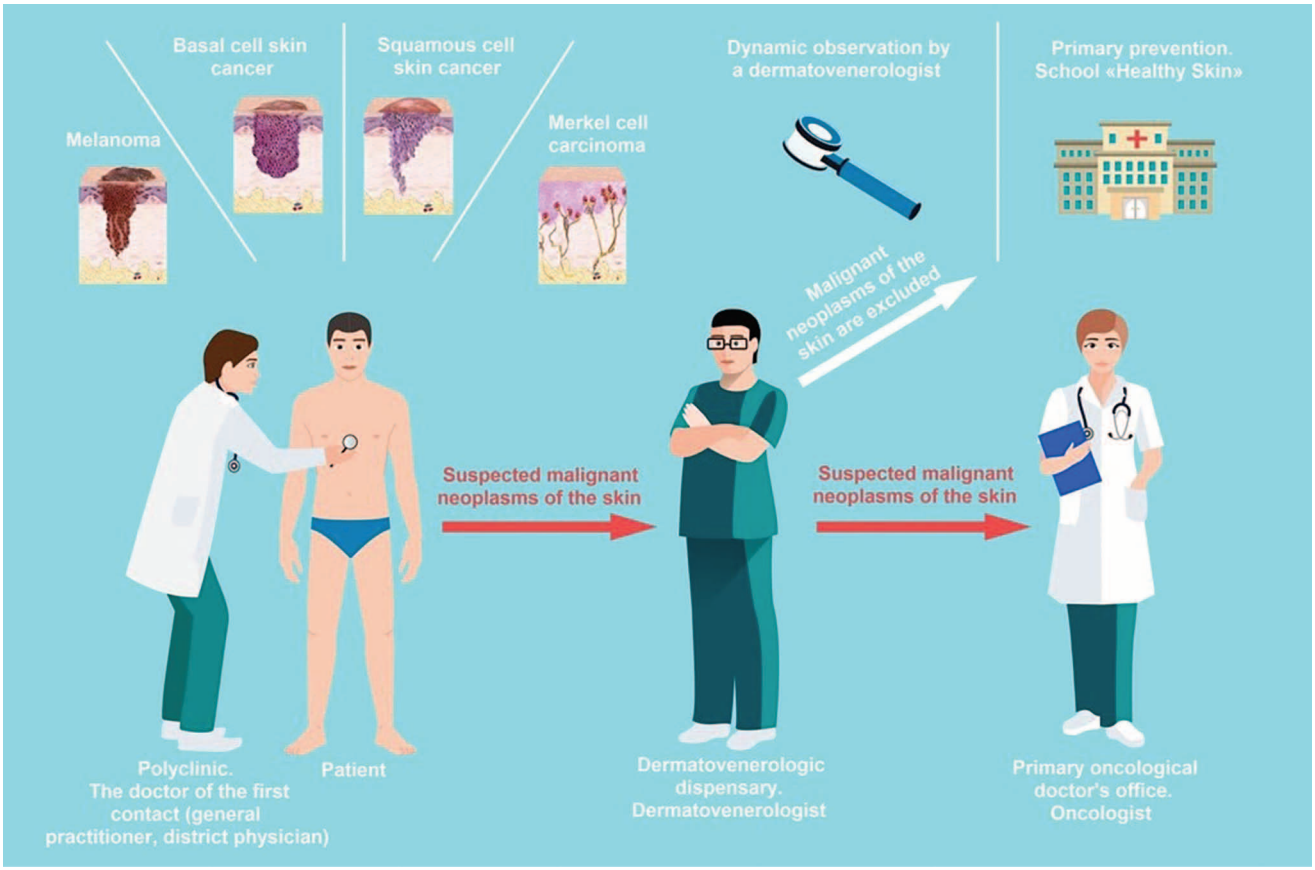

Figure 4. *Patient routing algorithm in case of suspected malignant neoplasms of the skin*

examination of the whole skin, and only 18 % of physicians arrange awareness procedures, informing patients about the risk of excessive solar exposure without corresponding protection [24].

The example of early cutaneous MA diagnosis efficacy with the help of dermatoscopy arranged by the dermatovenerologist was provided by the colleagues from the oncodermatology department of SBHI Center of Specialized Medical Care named after V.P. Avaev (Tver, Russia). According to the retrospective analysis of medical charts from 500 outpatient patients aged 16 to 85 years that visited the dermatovenerologist, the leading reason for visits was the prophylactic examination [25]. Using dermatoscopy with subsequent histological confirmation of the diagnosis, skin MAs were detected in 9.8 % of patients. Out of them, cutaneous melanoma was diagnosed in 18.3 % cases, basal cell carcinoma — in 75.5 % cases, squamous cell carcinoma — in 6.2 % cases. The majority of patients (96 %) with skin MAs were over 40 years of age. The results of the study conducted confirm the feasibility of using dermatoscopy for early cutaneous neoplasm diagnosis and the necessity of mandatory periodic prophylactic examinations, especially in persons over 40 years of age.

One of the legislative acts regulating the organization of oncology medical care in state medical organizations on primary care (in particular, in the Moscow healthcare system) is the Order of the Department of Healthcare of Moscow City dated January 15, 2020 No. 16, On Providing Medical Care in Oncology in Medical Organizations of the Moscow City State Healthcare System. The document approves the list of examinations (Table 1) for the patient with complaints or signs typical for cutaneous MAs, periods of examination and counseling of the oncologist when confirming the preliminary diagnosis of MA. For skin MAs, this period is 6 days.

If any complaint/sign of MA is present, patients are routed according to the algorithm stated in the table (Table 2).

To increase the quality of medical care with the purpose of early diagnosis and effective treatment of cancers, the project “Personal Assistant” providing patient assistance in the period from diagnosis in the primary care until dispensary follow-up by the oncologist has been developed.

To diagnose cutaneous MAs, primary care physicians of the Moscow healthcare use available clinical examination methods (“naked eye” examination) and weakly

Table 1. List of complaints/signs of malignant neoplasm of the skin requiring immediate examination of the patient

№	Complaint/objective examination data
1.	Pigmented formation with rapid growth
2.	Pigmented formation with a change in the configuration of the boundaries
3.	Pigment formation with different shades of color within a given formation
4.	Itching in the area of pigment formation
5.	Burning sensation in the area of pigment formation
6.	Long-term non-healing skin ulcer
7.	Painful and bleeding ulcers, seals, crusts on the surface of the skin (especially the scalp, neck)
8.	Sealing of the local area of the skin
9.	A red border around any volumetric formation

Table 2. List of examination / consultations in the presence of any complaint / sign of malignant neoplasm of the skin

N	Destination	Mandatory examination	Additional examination
1.	Polyclinic	Doctor's examination	Dermatoscopy
2.	MSPCDC Branch	Doctor's examination Dermatoscopy	Fluorescent diagnostics
3.	MSPCDC	Doctor's examination Dermatoscopy	Videodermatoscopy Fluorescent diagnostics Ultrasound of the skin
4.	OCCC	Doctor's examination	

Note: MSPCDC — Moscow Scientific and Practical Center of Dermatovenereology and Cosmetology, OCCC — Outpatient Cancer Care Center

magnifying optical systems (magnifying glass) that are included into the mandatory list of general practitioner devices. Dermatoscopy is conducted as part of complex patient examination in "Healthy Moscow" pavilions and medical prophylaxis rooms.

Possible approaches to advancements in the routing of patients after visiting the primary care physician

Patients not visiting the dermatovenerologist and/or oncologist after visiting the primary care physician is a significant issue in the routing of patients with suspected cutaneous MAs. Some patients, even with the correct diagnosis of melanoma established by the primary care physician or dermatovenerologist, prefers not to visit the oncologist due to subjective reasons: fear, no free time for prolonged treatment, unwillingness to present their diagnosis to relatives and colleagues, other diseases considered primary based on the patient's opinion, limited mobility, anosognosia, etc. Finally, these patients still visit the oncologist, but when malignancy is advanced, and the possible care is significantly limited. The probability of unfavorable prognosis increases if the period between the moment of diagnosis and the surgical intervention exceeds two months [26]. When visiting commercial clinics and cosmetologists, the physician does not usually have a possibility to route the patient using the Form No. 057/u to the primary oncologist, only recommending to visit the oncologist orally. Further responsibility for timely oncologist attendance lies on the patient him/herself. From their part, patients may postpone further examinations and treatment, which is significantly more efficient with timely visits, due to various reasons [27].

The study of O'Shea S.J. et al. (2017) [28] was devoted to the identification of factors associated with late physician visits. The study authors accentuated the attention on the necessity to inform wide population strata about the existence of cutaneous MAs and the possible transformation of existing nevi, mainly changes in the diameter (D)

to ≥ 6 mm and evolution (E). 159 patients (47 % males) aged 24 to 90 years (mean 62 years) answered the questionnair. In 15 % of them, melanoma was located in the head and neck area, in 30 % — on the torso, in 24 % — on upper extremities, and in 28 % — on lower extremities. The location was not defined in 5 patients. 40 (27 %) patients noted late physician visit (3 months later). The most common sign of melanoma reported by the interviewed people was increased nevus diameter. Over half of respondents (55 %) reported factors that precluded them from attending the physician: confidence of low disease risk for them, absence of general malaise, unwillingness to disturb the physician. With that, patients aged ≥65 years had a higher incidence of timely physician visits, and they rarely delayed the treatment compared to persons aged below 40 years.

Currently, psychosocial factors (work responsibilities, child care) are discussed as possible obstacles for timely physician visits among younger persons. Thus, a more balanced approach to the evaluation of the psychosocial patient's well-being may increase the efficacy of communication with the patient, persuading him/her to attend the physician timely [29].

Barinova A.N. et al. (2023) conducted a study of awareness of physicians belonging to different specialties and persons without higher medical education concerning the risk factors of cutaneous MAs, procedure of patient routing, and preventive measures. 463 people aged 20 to 72 years (81 % females) participated in the survey. Correct answers were reported in 72.7 % cases, however correct answers to all questions were provided by only 0.9 % respondents. The worst (incorrect) answers concerned prophylactic examinations [30]. In authors' opinion, it is necessary to arrange additional education of the medical staff, including in the CME (continuous medical education) system, differential diagnosis of cutaneous MAs, procedure for routing detected patients, and preventive measures.

Besides, a wider implementation of educational online-courses based on principles of early cutaneous MA diagnosis may also additionally contribute to the improvement of the epidemiological situation [31].

Approaches to cutaneous MA prevention

The issue of cutaneous MA prevention is global. Euromelanoma Pan-European Organization has developed primary prevention aimed at stimulating and awarding the correct behavior of persons exposed to ultraviolet radiation (UVR). To unite and increase the efficacy of work of specialists in the analysis, prevention, treatment, and rehabilitation of patients with the diagnosis of melanoma, the Russian Association of Melanoma Specialists "Melanoma PRO" has been working since 2016 [3]. The "Melanoma Day" is arranged annually in many Russian medical institutions, as part of which all willing persons can undergo early diagnosis of cutaneous MAs for free. The example of this event is the "Melanoma Day" arranged at FSAEI HE RSRMU n.a. N.I. Pirogov, Ministry of Health of Russia (Federal State Autonomous Educational Institution of Higher Education Russian State Research Medical University named after N.I. Pirogov, Ministry of Health of the Russian Federation), which is conducted by the Department of Dermatovenerology named after Academician Yu.K. Skripkin of the Medical Faculty. The experience of foreign colleagues from Australia can be presented as an example of preventive work — in that country commercial tanning salons have been banned on the legislative level since 2015, which, in conjunction with other preventive measures, has led to the decreased invasive melanoma mortality in persons below 40 years of age [32, 33].

The prevention of cutaneous MAs presumes a complex of various measures aimed at preserving and strengthening the human health. The inseparable prevention components include following healthy lifestyle (HL) principles, prophylaxis of potentially hazardous risk factors, elimination of exposure of negative environmental factors on the human health. The priority preventive measures should include the complex of measures providing the HL promotion, sanitary & anti-epidemic measures, periodic prophylactic examinations, dispensary follow-up. Prophylactic events are usually arranged individually with each person separately or in a group of patients in the medical organization, while at the population level these spread among the whole population, including adolescents. In general, such approaches form the basis of preserving the public health [34].

The awareness raising with patients in the risk group for melanoma presumes the active implementation of primary, secondary, and tertiary prophylaxis methods (Figure 5) [35-37].

The general main objective of primary cutaneous MA prevention is the limited skin exposure to the ultraviolet radiation (UVR) [38]. The secondary prevention objectives include dispensary follow-up and prophylactic examinations, periodic follow-up of suspicious cutaneous neoplasms, dermatovenerologist examinations with the purpose of early diagnosis. The tertiary prevention objectives include the prevention of cutaneous MA relapses, decreased risk factor exposure, increasing

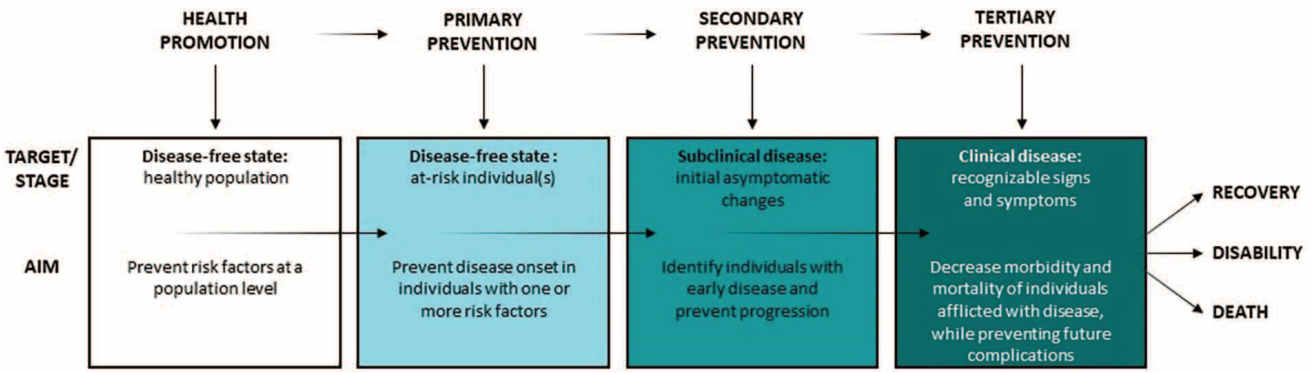

Figure 5. *Methods of primary, secondary and tertiary prevention. Adapted from Perez M., Abisaad J.A., Rojas K.D. et al. Skin cancer: Primary, secondary, and tertiary prevention. Part I. J Am Acad Dermatol. 2022;87(2):255-268. doi: 10.1016/j.jaad.2021.12.066*

patient's quality of life, compliance with HL principles, regular visits and compliance with dermatovenerologist, oncologist recommendations.

The formation of a correct concept of responsibility towards the proper health (i.e. compliance with HL, physician recommendations on the examination and treatment) is an important moment in the prevention of cutaneous MAs. A more attentive attitude of the patient to his/her health will help to change the negative attitude to the physician recommendations, being more responsible regarding the prescriptions and recommendations, in particular routing after cutaneous MA detection [39].

Undoubtedly, mortality can be decreased after elimination the possible causes of cutaneous MAs, due to which increased population awareness of health issues is one of the priority objectives in the tactics of patient management in primary healthcare [40].

Sufficient time for the patient contact (asking targeted questions, demonstration of skin self-inspection and lymph node examination methods) is also a very important condition for prophylaxis and increased medical literacy. Skin self-inspection as an efficient behavior strategy is considered a potentially beneficial instrument to decrease the risk of relapse and serious melanoma complications, i.e. patients can detect suspicious nevi, skin lesions or changes themselves. It has been proven that patients with melanoma that detected melanoma relapses themselves had better survival than patients in whom relapse was diagnosed by the physician [41].

Medical literacy skills represent a degree in which people can obtain, process, and understand the main medical information necessary for the corresponding decisions concerning the proper health preservation and strengthening. The active and constant familiarization of physicians (especially in primary healthcare) and wide population strata with signs and criteria of cutaneous MAs in early development stages: pamphlets with melanoma images and photographs in the radial growth stage in various body areas on the physician's worktable, publication of articles in scientific-practical journals for general practitioners and therapeutic physicians on principles and possibilities of the early cutaneous melanoma detection, available and correct information in the official websites, educational webinars organized by independent healthcare experts and attended by physicians — can serve an effective method of increasing awareness of cutaneous MAs [42].

Patients with the newly diagnosed cutaneous MAs should be provided with the complete and comprehensive information about the disease, compulsory treatment, and compliance with the attending physician recommendations. Stege H. et al. (2022) had the objective of retrospective medical chart analysis among 714 patients (40.9 % females) with cutaneous MAs aged 18 to 89 years (mean age 61.8 years) and analyzing the health information sources. Malignant melanoma was diagnosed in the majority of patients (76.9 %). Regardless of age, patients obtained the main information about the disease from the oncologist (n=526) and the general practitioner (n=374). 301 people obtained the information from the Internet, however the rate of using Internet resources decreased with age (p=0.052). And on the other hand, persons aged over 65 years obtained the information more often from the general practitioner rather than younger participants (p=0.043). Thus, younger patients are more prepared to search the information about health in the Internet. Besides, more educated participants significantly improved the understanding of health-related information. Electronic healthcare technologies become more

and more represented as the main source of information; due to this, it is really important to educate patients with cutaneous MAs, including in the electronic healthcare sphere, to make independent, justified decisions and to obtain larger confidence in life with their disease [43].

Another important aspect is to analyze the association of medical literacy skills and the level of perception of negative information about the health condition by patients with cutaneous MAs. It has been demonstrated that medical literacy skills affect the cognitive perception of information about the disease (OR 0.75, 95 % CI 0.58, 0.96), while persons with higher education think about genetic test results less frequently (β=-0.66) and are less prone to stresses (β=-1.15). The association ($p < 0.001$) has been detected between the medical literacy and the risk of melanoma affecting the frequency of thoughts about test results [44].

Thus, prophylactic measures may delay the cutaneous MA progression, while the increased medical literacy of the population in the complex of measures on decreasing cutaneous MA advancement requires further enhancement and detailed review of this issue.

Prospects of improving early skin MA diagnosis

Modern innovative methods of early cutaneous MA diagnosis are currently developed and implemented in Russia. However, to decrease the indicator of high advanced cutaneous MA incidence, one should improve the work in primary healthcare concerning the control routing of patients with suspected cutaneous MAs to the specialized oncology institution, as well as increase the occupational and communicative preparation of medical staff along with increasing the medical literacy of the population.

Foreign colleagues also note several aspects that should be enhanced in primary healthcare to increase the quality of early cutaneous MA diagnosis, including:

1. prevention (regular prophylactic examination in melanoma high risk groups, monitoring patients with skin lesions from UVR exposure and/or occupational risk factors);
2. early diagnosis (increased quality of dermatoscopy interpretation, regular skin mapping in risk groups);
3. routing (decreased delay between the primary physician counseling and biopsy, biopsy sending and diagnosis, diagnosis presentation to the patient, decreased referral time to the oncologist and treatment onset);
4. process of interpersonal physician/patient relations (patient communication aspects) [45].

The self-inspection skill is a significant factor for early skin MA detection. New IT-products with neural networks and the newest software (including for smartphones) are currently actively developed — these allow users to conduct the remote screening of skin lesions independently, also helping to decide upon the necessity of an off-line physician visit. The example of such mobile application may be the «Pro Rodinki» application developed at the Department of Skin and Venereal Diseases of FSBEI HE Privolzhsky Research Medical University (PRMU). As a rule, non-congenital melanocytic nevi emerge in childhood, grow in the early adult years, and then stop growing; their diameter is usually less than 5 mm. The evolution of existing skin nevi is interpreted ambiguously by patients. On the one hand, some patients suffer from cancerophobia; on the other hand, some patients ignore even significant changes (transformations of the shape, borders; size increase), not paying attention to them. Some nevi located on the skin of the scalp, back, genitals, are difficult to be examined during the self-inspection by the patient, and the continuous changes may be left unnoticed for a long time. The «Healthy Skin» schools in polyclinics managed by the dermatovenerologist are considered progressive; these are intended for awareness raising among wide population strata.

The most efficient diagnostic method for early cutaneous MAs, including those of rare locations, is still the prophylactic examination of the patient by the dermatovenerologist using dermatoscopy [46]. The digital dermatoscopy has been implemented recently into the clinical practice of dermatovenerologists — it is characterized by high sensitivity and specificity, and also enhanced by the artificial intelligence, which helps to decide during prophylactic examinations and further routing of patients with suspicious cutaneous neoplasms [21, 47-49]. To evaluate the transformation of melanocytic nevi and to determine *de novo* cutaneous neoplasms, skin mapping with the photography of dermatoscopic images is applied [50]. The skin mapping is more efficient in patients with multiple (≥ 50) cutaneous nevi due to several reasons: routine dermatoscopy of each nevus requires a lot of time, it is rather difficult to describe the accurate location of nevi, the photography of changes is difficult. Currently the skin mapping procedure is the most convenient one, although it requires rather costly equipment.

Artificial neural networks have found their use in many spheres of human life, including the medical care system. The mathematical model of an artificial neural network and remote medical technologies provide early

cutaneous MA diagnosis in digital images among wide population strata. High-precision artificial neural networks (Convolutional Neural Network, CNN) have demonstrated high potential in the automatic diagnosis of cutaneous MAs thanks to the analysis of images with a spatial structure [22, 47, 50, 51].

After visiting the primary care physician, mandatory informing about suspicious MAs and persuading the patient about the necessity of complying with all physician recommendations and mandatory feedback preservation seems prospective.

Conclusion

The high incidence of advanced cutaneous MAs, including melanoma, is a complex medical & social issue, including insufficient medical staff preparation; inadequate patient informing about the importance of prophylactic examinations and disease seriousness; gaps in routing patients detected in primary healthcare to the specialized oncology institution; absence of skin self-inspection skills in patients; absence of a "Healthy Skin" school for wide population strata.

To decrease the high rate of advanced cutaneous MAs, including melanoma, and the optimization of patient routing after visiting the primary care physician, the following is definitely required:

1. mandatory periodic prophylactic examinations, especially in people over 40 years of age;
2. complete physical examination with thorough history collection and complete skin examination during regular checkups in primary healthcare;
3. using mandatory dermatoscopy for early cutaneous MA diagnosis by the dermatovenerologist, if possible — repeated skin mapping with the artificial intelligence analysis;
4. enhanced professional and communicative medical staff training for patient communication, especially with those with a newly diagnosed cutaneous MA, as psychosocial factors affect the patient's attitude towards their health;
5. maintaining succession in the work of therapeutic physicians and dermatovenerologists to increase the quality and to accelerate specialized medical care;
6. creation of "Healthy Skin" schools in polyclinics to enhance the medical literacy of the population with mandatory informing about the danger of cutaneous MAs for health and life, training patients in skin self-inspection skills;
7. applying electronic healthcare technologies as an additional information source.

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