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ORIGINAL ARTICLE

Which medical disciplines diagnose and treat melanoma in Europe in 2019? A survey of experts from melanoma centres in 27 European countries

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Abstract

Background and objectives The incidence of melanoma is increasing. This places significant burden on societies to provide efficient cancer care. The European Cancer Organisation recently published the essential requirements for quality melanoma care. The present study is aimed for the first time to roughly estimate the extent to which these requirements have been met in Europe.

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Materials and methods A web-based survey of experts from melanoma centres in 27 European countries was conducted from 1 February to 1 August 2019. Data on diagnostic techniques, surgical and medical treatment, organization of cancer care and education were collected and correlated with national health and economic indicators and mortality-to-incidence ratio (MIR) as a surrogate for survival. Univariate linear regression analysis was performed to evaluate the correlations. SPSS software was used. Statistical significance was set at $P < 0.05$.

Results The MIR was lower in countries with a high health expenditure per capita and with a higher numbers of general practitioners (GPs) and surgeons (SURG) per million inhabitants. In these countries, GPs and dermatologists (DER) were involved in melanoma detection; high percentage of DER used dermatoscopy and were involved in the follow-up of all melanoma stages; both medical oncologists (ONC) and dermato-oncologists administered systemic treatments; and patients had better access to sentinel lymph node biopsy and were treated within multidisciplinary tumour boards.

Conclusion Based on these first estimates, the greater involvement of GPs in melanoma detection; the greater involvement of highly trained DER in dermatoscopy, dermatosurgery, follow-up and the systemic treatment of melanoma; and the provision of ongoing dermato-oncology training for pathologists, SURG, DER and ONC are necessary to provide an optimal melanoma care pathway. A comprehensive analysis of the melanoma care pathway based on clinical melanoma registries will be needed to more accurately evaluate these first insights.

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Conflicts of interest

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Introduction

In a world with an ageing population and inadequate primary prevention strategies for UV protection, the incidence of melanoma and non-melanoma skin cancer is increasing. This has placed a significant burden on societies and presented challenges for healthcare systems to provide efficient care for skin

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cancer patients and their families.[1–6] In cooperation with several professional organizations, including the European Association for Dermato-Oncology, the European Society of Medical Oncology and the European Society of Surgical Oncology,[7] the European Cancer Organisation (ECCO) recently published the essential requirements for quality melanoma care. They include the establishment of cancer care pathways that cover the entire patient journey. Also indicated are treatment by multidisciplinary teams in dedicated melanoma centres with patient-centred approaches, audits and quality assurance assessments of outcomes, the education of healthcare professionals and the availability of a high-quality cancer registration system.[7] Melanoma care pathways, similar to those described by ECCO, have been developed in the United Kingdom (UK) and Australia.[8,9]

The data on the organization of melanoma care in Europe were obtained from previous studies on melanoma and skin cancer care. In 2012, Trakatelli et al. analysed the patient care pathways in 10 countries. Their focus was dermatologist availability, time to dermatologic consultation and follow-up.[10] A 2013 European Dermatology Health Care Survey evaluated the dermatology workforce and health care in 33 European countries.[11] The Eurodermoscopy study of the International Dermoscopy Society provided a comprehensive analysis of the availability and clinical use of dermatoscopy in 32 European countries.[12,13] A recent study analysed the global oncology workforce.[14] These studies found a relationship between the provision of skin cancer care and disease outcomes.[5,6] Furthermore, a recent article documented a lack of access to medicines for metastatic melanoma that could exacerbate the survival disparities.[15]

The present study gathered comprehensive data on skin cancer diagnosis and treatment practices in Europe to assess compliance with the essential requirements and to highlight the barriers to improving melanoma care.

Materials and methods

A web-based survey of 32 experts from melanoma centres (23 dermato-oncologists [i.e. dermatologists (DER) with a specialty in oncology], 8 medical oncologists (ONC) and 1 oncological surgeon) in 27 European countries was conducted from 1 February to 1 August 2019. The participants were identified through their publications and leadership positions in national and European scientific organizations. A small proportion (15–25%) of the data were retrieved from the available national databases and scientific organizations, and a majority (75–85%) were estimations from current practice. The survey questionnaire collected data on melanoma care pathways (Table S1). This was supplemented with and examined against the physician workforce data from other sources (number of general practitioners (GPs) and surgeons (SURG), 2016 European Commission report; number of DER, DermaSurvey; and number of oncologists, the American Society of Clinical Oncology survey).[11,14,16,17–19] The data were further correlated with gross national income (GNI) per capita, health expenditure per capita (HEPC), universal health coverage service (UHC; retrieved from the World Bank 2018 database) and mortality-to-incidence ratio (MIR) as a surrogate for survival for 2018.[17–19] The estimated European standard mortality and incidence rates for 2018 were retrieved from the European Cancer Information System.[18] The countries were classified as Northern, Western, Southern and Eastern Europe on the basis of the United Nations geoscheme.

The correlations between the variables were estimated with Spearman's, point–biserial or rank–biserial correlation coefficients. The correlations between the dependent variables and the potential predictors were analysed with univariate linear regression in SPSS software. A *P*-value less than 0.05 was considered significant. Multivariate analysis was not performed because of the unfavourable ratio of potential predictors to outcomes.

Results

Medical specialties and diagnostic techniques regarding melanoma detection

The survey respondents indicated that the detection of melanoma and skin cancer was done mainly by DER in 18 (67%) European countries (Table 1). In three countries (Denmark, UK and Hungary [HUN]), GPs also played a significant role. In Belarus (BLR), mainly oncologists were involved in skin cancer detection. In Montenegro and Poland (POL), SURG were mainly involved (Table 1).

The respondents in every country indicated that dermatoscopy was used for melanoma and skin cancer detection. However, the percentage of DER using this technique varied from 10% in BLR to nearly 100% in Germany (DEU), the Netherlands and Spain. There was a statistical difference in the use of dermatoscopy in Northern and Western Europe (NWE) and Southern and Eastern Europe (SEE; 98% vs. 77%, $P < 0.05$).

According to the respondents, computerized digital dermatoscopy (CDD) was available in 20 (74%) countries. In NWE, CDD was available in university centres (60%) and private practice settings (25%). In SEE, it was used mainly in private practice (48%) and less commonly in university centres (32%). Reflectance confocal microscopy (RCM) was available in 15 countries (7/11 in NWE and 8/15 in SEE, $P > 0.05$), and optical coherence tomography (OCT) was available in 5 countries in university centres only.

Melanoma surgery and histopathology

According to the respondents, excisions with primary closure and excisions with skin flaps for melanoma and skin cancer were performed by DER, plastic, ENT/maxillofacial and oncological surgeons (OS) in 25 (92.5%) and 17 (63%) countries, respectively (Table 2). Surgical procedures with skin grafts were performed by plastic and ENT/maxillofacial surgeons (MFS) in every country and also by DER in 13 (48%) countries.

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Table 1 Medical specialties involved and diagnostic techniques used in clinical diagnosis of melanoma in Europe

Country	Medical specialty involved (%)*				Dermatologist using dermatoscopy (%)	Availability of diagnostic techniques		
	DER	GP	SURG	ONC		CDD	RCM	OCT
Northern Europe								
Denmark	45	45	5	5	92	No	No	No
Estonia	70	10	20	0	-	No	No	No
Latvia	75	10	1	10	80	Yes	Yes	No
Lithuania	60	0	30	10	51	Yes	No	No
Sweden	80	20	0	0	100	No	No	No
UK	50	30	15	5	99	Yes	Yes	Yes
Western Europe								
Austria	80	15	5	0	97	Yes	Yes	No
Belgium	100	0	0	0	90	Yes	Yes	No
France	90	5	5	0	65	Yes	Yes	No
Germany	80	20	0	0	100	Yes	Yes	Yes
The Netherlands	70	30	0	0	100	Yes	Yes	Yes
Switzerland	70	20	10	0	99	No	No	No
Southern Europe								
Albania	50	10	30	10	96	Yes	Yes	Yes
Bosnia and Herzegovina	98	2	0	0	60	No	No	No
Croatia	80	10	5	2	69	Yes	No	No
Greece	70	5	20	5	75	Yes	Yes	No
Italy	70	5	10	5	80	Yes	Yes	Yes
Montenegro	30	10	40	20	25	No	No	No
Portugal	80	15	4	1	90	Yes	Yes	No
Serbia	65	5	20	10	70	No	No	No
Slovenia	80	20	0	0	90	Yes	No	No
Spain	100		0	0	80	Yes	Yes	No
Eastern Europe								
Belarus	5	5	5	80	10	Yes	No	No
Czech Republic	90	2	6	2	80	Yes	No	No
Hungary	60	25	10	5	90	Yes	Yes	No
Poland	50	5	5	10	60	Yes	Yes	No
Romania	80	5	10	0	-	Yes	Yes	No
Median/total (%)	73	10	10	5	80	20 (74%)	15 (55.5%)	5 (18.5%)

CDD, computerised digital dermoscopy; DER, dermatologists; GP, general practitioners; OCT, optical coherence tomography; ONC, medical oncologists; RCM, reflectance confocal microscopy; SURG, surgeons.
*Estimated involvement of different medical specialties in clinical diagnosis of skin cancer, i.e. estimated percentage of patients that are coming for skin examination with a suspicion for skin cancer.

Microscopically controlled surgery (Mohs micrographic surgery, surgery with 3D histology) was unavailable or not used in melanoma treatment in 9 (33%) countries. According to the respondents, this procedure was performed by DER in 13 (48%) countries, plastic surgeons (PS) in 12 (44%) countries, MFS in 3 (11%) countries and OS in POL. Sentinel lymph node biopsy (SLNB) was performed by OS in 20 (74%) countries, PS in 16 (59%), MFS in 12 (44%) and DER in 6 (22%) countries. In POL and BLR, there were medical specialty-related restrictions on skin cancer surgery.

Histopathology for skin cancer diagnosis was performed by dermatopathologists and pathologists (P) in 9 (33%) countries. In 17 (63%) countries, DER were not involved in the histopathological diagnosis of skin cancer because only P were allowed to sign histopathological reports.

Systemic treatment of metastatic melanoma

Metastatic melanoma patients were treated by ONC in all European countries and by dermato-oncologists in 11 (40%). The systemic treatment of stage III and IV melanoma was administered (for ≥70% patients) mainly by ONC in 21 countries and by dermato-oncologists in Austria, France, DEU, the Czech Republic and HUN (Table 3). Intralesional treatment was administered by dermato-oncologists in 13 countries,

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Table 2 Melanoma surgery in Europe

Country	Type of surgery					SLNB availability* (%)
	Surgery with primary closure	Surgery with skin flaps	Surgery with skin grafts	Microscope. controlled surgery	SLNB	
Northern Europe						
Denmark	D, PS, GS	PS	PS	Not used	PS	98
Estonia	D, PS, MFS/ENT, OS	PS, MFS/ENT, GS, OS	MFS/ENT, OS, PS	Not used	MFS/ENT, OS	95
Latvia	D, PS, MFS/ENT, OS, GS	D, MFS/ENT	PS, MFS	Not available	OS	75
Lithuania	D, PS, MFS/ENT, OS	PS, MFS/ENT, OS, GS	PS, OS, MFS/ENT	PS	PS, OS	60
Sweden	D, PS, MFS/ENT, GS	D, PS, MFS/ENT, GS	D, PS, MFS/ENT	D	MFS/ENT, GS	90
UK	D, PS, MFS/ENT, GS	D, PS, MFS/ENT	D, PS, MFS/ENT, OS	D, PS	PS	80
Western Europe						
Austria	D, PS, GS	D, PS, GS	D, PS, GS	D, PS	D, PS	95
Belgium	D, PS, MFS/ENT, OS	D, PS, MFS/ENT	D, PS, MFS/ENT	D, PS	OS	85
France	D, PS, MFS/ENT, GS	D, PS, MFS/ENT	PS, MFS/ENT, OS	PS, MFS/ENT, OS	PS, MFS/ENT, OS	90
Germany	D, PS, MFS/ENT, OS	D, PS, MFS/ENT, GS	D, PS, MFS/ENT, GS	D, PS, MFS/ENT	D, MFS/ENT	90
The Netherlands	D, PS, MFS/ENT	D, PS, MFS/ENT	D, PS, MFS/ENT, OS, GS	D	MFS/ENT, OS	90
Switzerland	D, PS, MFS/ENT, GS	D, PS, MFS/ENT	D, PS, MFS/ENT	D, PS	PS, MFS/ENT	80
Southern Europe						
Albania	D, PS, MFS/ENT, OS, GS	PS, OS, GS	PS, OS	PS	OS	20
Bosnia and Herzegovina	D, PS, MFS/ENT, OS, GS	PS, MFS/ENT, OS, GS	PS, MFS/ENT	Not available	PS	95
Croatia	D, PS, MFS/ENT, OS, GS	D, PS, MFS/ENT, OS, GS	PS, MFS/ENT, OS	Not available	PS, MFS/ENT, OS	95
Greece	D, PS, MFS/ENT, OS, GS	D, PS, OS, GS	D, PS, OS	Not available	PS, OS	95
Italy	D, PS, MFS/ENT, OS, GS	D, PS, MFS/ENT, OS, GS	PS, MFS/ENT, OS, GS	D, PS, MFS/ENT	D, PS, MFS/ENT, OS, GS	50
Montenegro	PS, GS	PS	PS	Not available	PS	90
Portugal	D, PS, MFS/ENT, OS, GS	D, PS, MFS/ENT, OS, GS	D, PS, MFS/ENT, OS	D	D, PS, OS	90
Serbia	D, PS, MFS/ENT, OS, GS	PS, MFS/ENT, OS	PS, MFS/ENT, OS	D†	PS, MFS/ENT, OS	40
Slovenia	D, PS, MFS/ENT, OS, GS	PS, MFS/ENT, OS, GS	PS, MFS/ENT, OS	Not available	OS	95
Spain	D, PS, MFS/ENT, GS	D, PS	D, PS	D	D, PS, MFS/ENT, GS	95
Eastern Europe						
Belarus	MFS/ENT, OS, GS	PS, MFS/ENT, OS	PS, MFS/ENT, OS	Not available	OS	20
Czech Republic	D, PS, MFS/ENT, GS	D, PS, MFS/ENT, GS	D, PS, MFS/ENT	D	D, PS, MFS/ENT, OS, GS	95
Hungary	D, PS, MFS/ENT, OS, GS	D, PS, MFS/ENT	D, PS, MFS/ENT	PS	PS, MFS/ENT, OS, GS	70
Poland	D, PS, OS, GS	PS, OS	PS, OS	PS, OS	OS	90
Romania	D, PS, MFS/ENT, OS, GS	D, PS, MFS/ENT, OS, GS	D, PS, OS, GS, MFS/ENT	D†, PS†	OS	30

D, dermatologists; GS, general surgeons; MFS/ENT, maxillofacial and/or ear, nose and throat surgeons; OS, oncological surgeons; PS, plastic surgeons; SLNB, sentinel lymph node biopsy.
*Percentage of patients in whom SLNB is indicated and performed.
†Available only in private practice, not reimbursed.

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Table 3 Medical specialities in systemic treatment of melanoma and non-melanoma skin cancer in Europe

Country	Adjuvant*		Intralesional*			Systemic for unresectable stage III and stage IV melanoma*	
	Medical oncologists	Dermato-oncologist	Medical oncologists	Dermato-oncologist	Surgical oncologist	Medical oncologists	Dermato-oncologist
Northern Europe							
Denmark	100	0	100	0	0	100	0
Estonia	100	0	0	0	0	100	0
Lithuania	100	0	0	0	0	100	0
Latvia	100	0	0	0	0	95	5
Sweden	100	0	50	0	50	100	0
UK	100	0	100	0	0	100	0
Western Europe							
Austria	5	95	0	100	0	5	95
Belgium	100	0	100	0	0	100	0
France	10	90	0	90	10	10	90
Germany	20	80	0	95	5	20	80
The Netherlands	100	0	0		0	100	0
Switzerland	50	50	20	80	0	60	40
Southern Europe							
Albania	100	0	10	60	30	100	0
Bosnia and Herzegovina	100	0	0	100	0	100	0
Croatia	100	0	0		0	100	0
Greece	100	0	70	30	0	100	0
Italy	70	30	100	0	0	50	50
Montenegro	100	0	0	0	0	100	0
Portugal	95	5	50	50	0	95	5
Serbia	70	25	0	15	85	75	25
Slovenia	100	0	100	0	0	100	0
Spain	80	20	0	100	0	80	20
Eastern Europe							
Belarus	100	0	0	0	100	100	0
Czech Republic	20	80	50	50	0	30	70
Hungary	20	80	0	100	0	20	80
Poland	100	0	100	0	0	100	0
Romania	100	0	5	80	10	100	0

*Estimated percentage of patients treated by different medical disciplines.

ONC in 13 and surgical oncologists in 7 countries. In 15 countries, there were legislative and/or reimbursement restrictions on the prescription of systemic melanoma treatment by specialists other than ONC. Clinical trials were performed by specialists who were already involved in the systemic treatment of melanoma.

Organization of melanoma care

In this survey, melanoma care units (i.e. pigment lesion clinics, urgent access melanoma specialty care clinics) were defined as clinics in which patients with suspected melanoma had fast access to and priority status for surgical treatment and diagnostic work-up on the basis of primary care (GPs, primary care DER). It was estimated that quick access upon primary care referrals was available in 19 (70%) countries: all the countries in NWE and 8 (53%) in SEE (Table 4).

The follow-up for low-risk melanoma was organized mainly in general hospitals in 15 countries, in tertiary and comprehensive cancer centres in 10 countries and mainly in private practice settings in 2 countries (Table 5). Dermatologists were primarily responsible for the follow-up of low-risk melanoma (83% of countries of NWE, 67% of countries in SEE). For localized high-risk melanoma, DER were responsible for follow-up in 9/12 (75%) of NWE countries, and 7/15 (47%) countries of SEE. Medical oncologists and SURG were also involved in follow-up in 5/15 (33%) and 3/15 (20%) countries, respectively. In Portugal, GPs were reportedly responsible for follow-up of all localized melanoma cases. Patients with stage III melanoma were

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Table 4 Organization of melanoma care in Europe

Country	Melanoma care units	Accreditation of oncology centres	Quality control process of oncology centres	Multidisciplinary tumour board	Core specialties in MTB	Molecular oncology tumour board
Northern Europe						
Denmark	Yes	No	No	Yes	MO†, PS, P, R, RT	No
Estonia	Yes	Yes	No	Yes	D, MO†, OS, P, R, RT	Yes
Latvia	Yes	No	No	No	MO†, OS†	No
Lithuania	No	No	No	Yes	D, MO†, OS, PS, P, R, RT	No
Sweden	Yes	No	No	Yes	D†, MO†, OS†, PS, P, R, RT	No
UK	Yes	Yes	Yes	Yes	D, MO, OS, PS, P, R, RT	
Western Europe						
Austria	Yes	Yes	Yes	Yes	D†, MO, OS, PS, P, R, RT	No
Belgium	Yes	Yes	Yes	Yes	D†, MO, OS, PS, P, R, RT	No
France	Yes	Yes	Yes	Yes	D†, MO, OS, PS, P, R, RT	Yes
Germany	Yes	Yes	Yes	Yes	D†, MO, OS, PS, R, RT	Yes
The Netherlands	Yes	Yes	Yes	Yes	D†, MO†, OS, PS, R, RT, P	No
Switzerland	Yes	Yes	Yes	Yes	D†, MO, PS, P, R, RT	Yes
Southern Europe						
Albania	No	No	No	Yes	D, MO†, OS, PS, P, R, RT	No
Bosnia and Herzegovina	No	No	No	Yes	D, MO†, PS, P, RT	No
Croatia	Yes	Yes	Yes	Yes	D†, MO†, OS, PS, P, R, RT	No
Greece	No	No	No	Yes	D, MO†, OS, PS, RT	No
Italy	Yes	Yes	Yes	Yes	D, MO†, OS, PS, P, R, RT	Yes
Montenegro	Yes	No	Yes	Yes	D, MO, PS†, RT	No
Portugal	No	Yes	No	Yes	D†, MO, OS, PS, P, R, RT	Yes
Serbia	No	No	No	Yes	D†, MO†, OS†, PS, P, R, RT	No
Slovenia	No	Yes	Yes	Yes	D, MO†, OS†, P, R, RT	Yes
Spain	Yes	No	No	Yes	D†, MO†, PS, P, R, RT	No
Eastern Europe						
Belarus	Yes	Yes	Yes	Yes	MO†, OS†, P, R, RT	Yes
Czech Republic	Yes	No	No	Yes	D†, MO, OS, PS, P, RT	No
Hungary	Yes	Yes	Yes	Yes	D†, MO, OS, PS, P, R, RT	Yes
Poland	Yes	Yes	No	Yes	MO, OS†, P, R, RT	Yes
Romania	No	Yes	Yes	Yes	D, MO†, OS, P, R	No

MO, medical oncologists; OS, oncologic surgeon; P, pathologist; PS, plastic surgeon; R, radiologist; RT, radiotherapist.
*Melanoma care units - clinics in which patients with suspected melanoma had fast access to surgical treatment and diagnostic work-up on the basis of primary care referral (i.e. pigment lesion clinic).
†Organisation of multidisciplinary tumor board (MTB).

referred mainly to tertiary or comprehensive cancer centres. Oncologists were responsible for follow-up in 13 countries, DER in 10 and SURG in 6 countries.

Quality assurance, auditing and the accreditation of oncology centres are also essential to the establishment and maintenance of high-quality cancer care. The process of accreditation differs between countries. Any type of accreditation process for oncology centres was found to be established in 16 countries (67% in NWE, 53% in SEE). Fourteen of these countries had quality control processes (58% in NWE, 47% in SEE). MTBs were organized by ONC in 11 countries, DER in 8 and by both in 5 countries, while SURG were also involved in 6 countries (Table 4).

The survey data indicated that melanoma patients had access to multidisciplinary tumour boards (MTBs) in 23/27 (85%) countries and the following core medical specialties: ONC (27-countries), SURG (27 countries), DER (23 countries), radiotherapists (24 countries), P (22 countries) and radiologists (22 countries). Molecular oncology tumour boards were available in 10 countries (4/12 in NWE and 6/15 in SEE; Table 4).

Melanoma registries in Europe

Table 6 presents the availability of melanoma registries in Europe. National population cancer registries were established in 17/24 (71%) countries (90% in NWE, 50% in SEE), and

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Table 5 Follow-up of melanoma in Europe

Country	Melanoma stage					
	Low-risk localized (IA)		Intermediate and high-risk localized (IB-IIC)		Metastatic stage III	
	Medical specialty*	Institution†	Medical specialty*	Institution†	Medical specialty*	Institution†
Northern Europe						
Denmark	GP	SGH	S	TOC	S	TOC
Estonia	D	CCC	D	CCC	MO	CCC
Latvia	GP	TOC	GP	TOC	MO	TOC
Lithuania	D	TOC	MO	TOC	MO	TOC
Sweden	D	DGH	D	TOC	S	TOC
UK	D	TOC	D	CCC	MO	CCC
Western Europe						
Austria	D	DGH	D	GH	D	GH
Belgium	D	SGH	D	TOC	MO	TOC
France	D	PP	D	TOC	D	TOC
Germany	D	DGH	D	CCC	D	CCC
The Netherlands	D	DGH	D	DGH	D, MO, S	TOC
Switzerland	D	PP	D	CCC	D	CCC
Southern Europe						
Albania	S	DGH	MO	CCC	MO	CCC
Bosnia and Herzegovina	D	TOC	MO	TOC	MO	TOC
Croatia	D	DGH	D	CCC	MO	CCC
Greece	D	Dermatology hospitals	MO	TOC	MO	TOC
Italy	D	DGH	D	CCC	D	CCC
Montenegro	S	CCC	MO	CCC	MO	CCC
Portugal	GP	DGH	GP	TOC	GP	TOC
Slovenia	S	CCC	S	CCC	S	CCC
Serbia	D, S	TOC	D, S	TOC	D, S	TOC
Spain	D	DGH	D	GH	D	GH
Eastern Europe						
Belarus	MO	TOC	MO	CCC	MO	CCC
Czech Republic	D	DGH	D	TOC	D	TOC
Hungary	D	DGH	D	CCC	D	CCC
Poland	D	TOC	S	CCC	S	CCC
Romania	D	DGH	D	TOC	MO	TOC

CCC, comprehensive cancer center; D, dermatologists; DGH, dermatological unit in general hospital; GH, general hospital; GP, general practitioners; MO, medical oncologist; PP, private practice; S, surgeons; SGH, surgical units in general hospitals; TOC, tertiary oncology center.
*Medical specialty mainly involved in follow-up of the patients.
†Institution where majority of the patients are referred for follow-up.

melanoma clinical registries were available in 13/24 (54%) countries (50% in NWE, 57% in SEE).

Education

Skin cancer detection educational programmes for GPs were organized in 17 countries (73% in NWE, 60% in SEE). Dermatoscopy training was an official aspect of dermatology residency programmes in 20 (74%) countries (Table 7). However, it was also provided in other countries through dermatoscopy courses and mentorship during residency (Table 7). Dermatosurgery training during dermatology residency was available in 22 countries (92% in NWE, 73% in SEE), and dermato-oncology training was available in 22 countries (75% in NWE, 87% in SEE). In 11 countries (50% in NWE, 33% in SEE), a dermatopathology subspecialty was available to DER and P, and in 2 countries, it was available to P, only. In the 11 countries in which this was not available, DER faced legislative hurdles to perform histopathological analyses of skin cancer. Subspecialty

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Table 6 Melanoma registries in Europe

Country	Melanoma registry		
	National cancer registry	Clinical registry	Stage of melanoma recorded
Northern Europe			
Denmark	Yes	Yes	Stages I-IV
Estonia	Yes	No	Stages I-IV
Lithuania	Yes	No	
Sweden	Yes	Yes	Stages I-IV
UK	Yes	No	
Western Europe			
Austria	Yes	No	
Belgium	Yes	No	Stages I-IV
France	No*	Yes	Stages I-IV
Germany	Yes	Yes	Stages I-IV
The Netherlands	Yes	Yes	Stages I-IV
Switzerland	Yes	Yes	Stages I-IV
Southern Europe			
Albania	No	No	
Bosnia and Herzegovina	No*	No	
Croatia	Yes	Yes	Stages I-IV
Greece	No*	No	
Italy	No*	No	
Montenegro	Yes	No	
Portugal	Yes	Yes	Stages I-IV
Serbia	No*	Yes	Stages I-IV
Slovenia	Yes	Yes	Stages I-IV
Spain	Yes	Yes	
Eastern Europe			
Belarus	Yes	Yes	Stages I-IV
Czech Republic	Yes	Yes	Stages I-IV
Poland	Yes	Yes	Stages I-IV
Romania	No*	No	

*Regional registries exist.

training in dermatosurgery was available in 8 countries (5 in NWE, 3 in SEE), and subspecialty training in oncology was available for DER in 8 countries (33% in NWE, 27% in SEE; Table 7).

Correlation of economic and healthcare organization variables with melanoma mortality-to-incidence ratio

The MIR was calculated from data obtained from the European Cancer Information System.[18,20] It was correlated with the data on 1-year, 5-year and conditional 5-year survival from the EUROCARE-5 study of 18 countries for the same year.[5] A highly significant correlation was found, thus supporting the effectiveness of the MIR as a surrogate marker for survival in the absence of population-based survival data (Table S2). A higher MIR was associated with lower survival rates (Table 8).

The MIR was found to be significantly lower in countries with a higher GNI per capita, HEPC and UHC ($P < 0.001$) and in those with a higher number of GPs and SURG per million inhabitants, higher number of GPs involvement in skin cancer detection and higher percentage of DER using dermatoscopy. In the countries where SURG and oncologists were also involved in the clinical diagnosis of melanoma, the MIR was higher (Fig. 1). The percentage of melanoma patients who underwent SLND (if indicated) was higher in countries with a lower MIR. In the countries where surgical procedures with skin flaps and skin grafts were performed by DER and the histopathology of skin cancer was performed by P and dermatopathologists, the MIR was significantly lower. The MIR was also lower in countries where DER were involved in the follow-up of stage IB–IIC patients and DER and oncologists were responsible for the follow-up and systemic treatment of stage III and IV patients. In countries where only ONC were responsible for the follow-up of stage III patients, the MIR was significantly higher. The limitations in the prescription of systemic melanoma therapy and restrictions on reimbursement seemed to be correlated with a higher MIR (Table 8). Access to MTBs was significantly associated with a lower MIR, particularly in countries in which they were organized by DER.

Because the economic parameters were significantly correlated with the MIR, further analysis was done to explore the effects of the relationship between HEPC and various aspects of the healthcare system on the melanoma care pathway (Table S3). In countries with a higher HEPC, the GPs and/or DER were educated in the early detection of skin cancer; a higher percentage of DER used dermatoscopy; a higher percentage had a higher level of education in dermatologic surgery, dermatopathology and the systemic treatment of melanoma; and they had a greater involvement in the follow-up and systemic treatment of stage IB–III cancer. In countries with a lower HEPC, oncologists or SURG were responsible for skin cancer detection. In contrast, the workforce (number of DER, P, SURG and oncologists) and the estimated access to CDD and sentinel lymph node dissection were not correlated with the HEPC ($P > 0.05$).

Discussion

Melanoma was the seventh most frequently diagnosed cancer in the European Union in 2012. The highest incidence and mortality rates were recorded in the Nordic countries, and the lowest, in Southern Europe.[1–4,21,22] However, when the MIR was used as a proxy for the fatality rate, the highest MIR was in Central and Eastern Europe, and the lowest was in Western Europe.[6] In addition, the recorded survival rates ranged from <50% in Eastern and Southeast Europe to >90% in the Nordic countries.[5,22] Recent data from DEU indicated that the mortality rates were stabilizing, and even decreasing, in the Northwest countries.[22,23] This was attributed to nationwide screening campaigns and the widespread use of effective systemic treatments for metastatic disease.[24] In most of Eastern Europe, the first prevention campaigns were introduced in 2008; less effective melanoma care

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Table 7 Education of physicians in skin cancer diagnosis and treatment in Europe

Country	Educational programmes for GPs	Training in dermatoscopy as official part of dermatology residency	Training in dermato-surgery during dermatology residency	Training in dermato-oncology during dermatology residency	Subspecialty training in dermato-pathology	Subspecialty training in dermatologic surgery	Subspecialty training in oncology for dermatologists (DER)
Northern Europe							
Denmark	Yes	Yes		No	No	No	No
Estonia	No	No	Yes	Yes	No	No	No
Latvia	No	No	No	Yes	No	No	No
Lithuania	Yes	Yes	Yes	Yes	No	No	No
Sweden	Yes	Yes	Yes	Yes	No	No	No
UK	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Western Europe							
Austria	Yes	Yes	Yes	Yes	Yes	No	No
Belgium	Yes	No	Yes	No	No	Yes	No
France	Yes	No	Yes	Yes	Yes	Yes	Yes
Germany	Yes	Yes	Yes	Yes	Yes	Yes	Yes
The Netherlands	No*	Yes	Yes	Yes	Yes	Yes	Yes
Switzerland	Yes	Yes	Yes	Yes	Yes	No	No
Southern Europe							
Albania	No	Yes	No	Yes	No	No	No
Bosnia and Herzegovina	No	Yes	No	Yes	Yes	No	Yes
Croatia	Yes	Yes	Yes	Yes	No	No	Yes
Greece	No	Yes	Yes	Yes	No	No	No
Italy	No	Yes	Yes	Yes	Yes	Yes	Yes
Montenegro	Yes	No	Yes	Yes	No	No	No
Portugal	Yes	Yes	Yes	Yes	Yes	No	No
Serbia	Yes	Yes	Yes	Yes	No	No	Yes
Slovenia	Yes	Yes	Yes	No	No	No	No
Spain	Yes	No	Yes	Yes	No	No	No
Eastern Europe							
Belarus	Yes	No	No	Yes	No	No	No
Czech Republic	No	Yes	Yes	Yes	Yes	Yes	No
Hungary	No	Yes	Yes	Yes	Yes	No	No
Poland	Yes	Yes	Yes	Yes	No	No	No
Romania	Yes	Yes	Yes	No	No	Yes	No
Total (yes/no + yes), %	**18/27, 66%**	**20 (74%)**	**23 (85%)**	**23 (85%)**	**11 (40%)**	**8 (30%)**	**8 (30%)**

*Percentage of patients in whom SLNB is indicated and performed.

and significant delays in access to effective systemic treatments led to lower survival rates.[15,23,25]

The ECCO recently developed essential requirements for an optimal melanoma care pathway. However, the current survey found significant differences in the extent to which the countries had met these requirements.[7] In the countries where GPs and DER were educated and actively involved in clinical diagnosis of skin cancer and a higher percentage of DER were using dermatoscopy, the MIR seemed to be lower (Fig. 1, Table 7). On the contrary, the countries in which SURG and oncologists were also involved in clinical diagnosis of skin cancer had the highest MIR. This highlights the need for patients to have broader access to medical professionals who are skilled in the detection of skin cancer, with DER trained in dermatoscopy being the leaders in the field. These results confirm those of recent studies in the United States where a lower MIR was found to be correlated with dermatologist and primary care provider density.[26,27] The active collaboration of DER and GPs in the early diagnosis of skin cancer is crucial to preventing dermatology offices from being overloaded with unselected patients, thereby making access for patients with skin cancer very difficult.[28–30] In this regard, education of GPs in skin cancer detection and DER in dermatosurgery and dermatopathology is very important. In the current survey, advanced education in dermatosurgery and

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Table 8 Correlation of economic parameters and various components of melanoma care pathway to melanoma mortality-to-incidence ratio as a surrogate of survival

Variable	Correlation mortality-to-incidence ratio (MIR) in European countries*		
	B	95% CI	*P*-value
Economic variables			
Gross national income per capita*	−0.001	−0,001 to <0,001	<0.001
Universal healthcare coverage*	−1.295	−1.728 to −0.862	<0.001
Health expenditure per capita*	−0.005	−0.006 to −0.004	<0.001
Physicians workforce (number per 1 million inhabitants)			
General practitioners	<0.001	<0.001 to <0.001	0.079
Surgeons	<0.001	<0.001 to <0.001	0.091
Pathologist	−0.004	−0.024 to 0.017	0.703
Dermatologists	−0.182	−0.405 to 0.042	0.105
Oncologists	−0.003	−0.009 to 0.004	0.378
Medical specialties involved and diagnostic techniques used in clinical diagnosis of melanoma			
General practitioners	−0.451	−0.829 to −0.073	0.021
GPs access to educational programmes for skin cancer detection	−3.188	−12.866 to 6.491	0.503
Dermatologists	−0.156	−0.363 to 0.051	0.132
Percentage of DER using dermatoscopy	−0.273	−0.444 to −0.103	0.003
Surgeons	0.577	0.234 to 0.920	0.002
Oncologists	0.187	−0.085 to 0.46	0.169
Access to CDD	0.987	−9.003 to 10.977	0.840
Access to reflectance confocal microscopy (RCM)	−1.750	−10.909 to 7.409	0.697
Melanoma surgery			
Access to microscopically controlled surgery	6.296	−3.36 to 15.952	0.191
Access to SLND (% of patients with performed SLND when indicated)	−0.186	−0.372 to −0.001	0.049
Dermatologists performing surgical procedures with skin flaps	−11.047	−19.334 to −2.760	0.011
Dermatologists performing surgical procedures with skin grafts	−13.729	−21.305 to −6.154	0.001
Histopathology			
Histopathology performed by both dermatopathologists and pathologists (P)	−8.333	−17.389 to 0.722	0.070
Follow-up of melanoma patients			
Dermatologists responsible for follow-up of stage IA_	−7.767	−17.785 to 2.251	0.123
Dermatologists responsible for follow-up of stage IB-IIC	−11.436	−19.579 to −3.293	0.008
Dermatologists responsible for follow-up of stage stage IIIA	−12.294	−20.644 to −3.944	0.006
Oncologists responsible for follow-up of stage stage IIIA	11.536	3.517 to 19.555	0.007
Systemic treatment for metastatic melanoma			
Adjuvant treatment prescribed by both dermato-oncologists and medical oncologists (ONC)	−0.140	−0.265 to −0.014	0.031
Adjuvant treatment prescribed only by ONC	2.176	−2.682 to 7.034	0.364
Systemic treatment prescribed by both dermato-oncologists and ONC	−0.141	−0.269 to −0.012	0.033
Systemic treatment prescribed only by ONC	0.145	0.013 to 0.276	0.032
Legislative restrictions to prescribe systemic melanoma therapy based on medical specialty	8.533	−0.146 to 17.213	0.054
Limitations to reimbursement of systemic melanoma therapy based on medical specialty	10.889	2.143 to 19.635	0.017
Organization of melanoma care			
Melanoma care units with fast access from primary care	−6.921	−16.941 to 3.098	0.167
Accreditation process of oncology centres	−6.079	−15.187 to 3.03	0.181
Access to multidisciplinary tumour boards	−14.464	−28.038 to −0.889	0.038
Dermatologists responsible for organization of multidisciplinary tumour boards	−11.214	−19.314 to −3.115	0.009
Medical oncologists' responsible for organization of multidisciplinary tumour boards	2.526	−7.24 to 12.292	0.598
Education of DER			
Availability of subspecialization in oncology	−4.549	−14.912 to 5.814	0.374
Availability of subspecialization in dermatologic surgery	−9.868	−19.003 to −0.734	0.035
Availability of subspecialization in dermatopathology	−10.261	−18.536 to −1.987	0.017

*Estimated percentage of patients treated by different medical disciplines.

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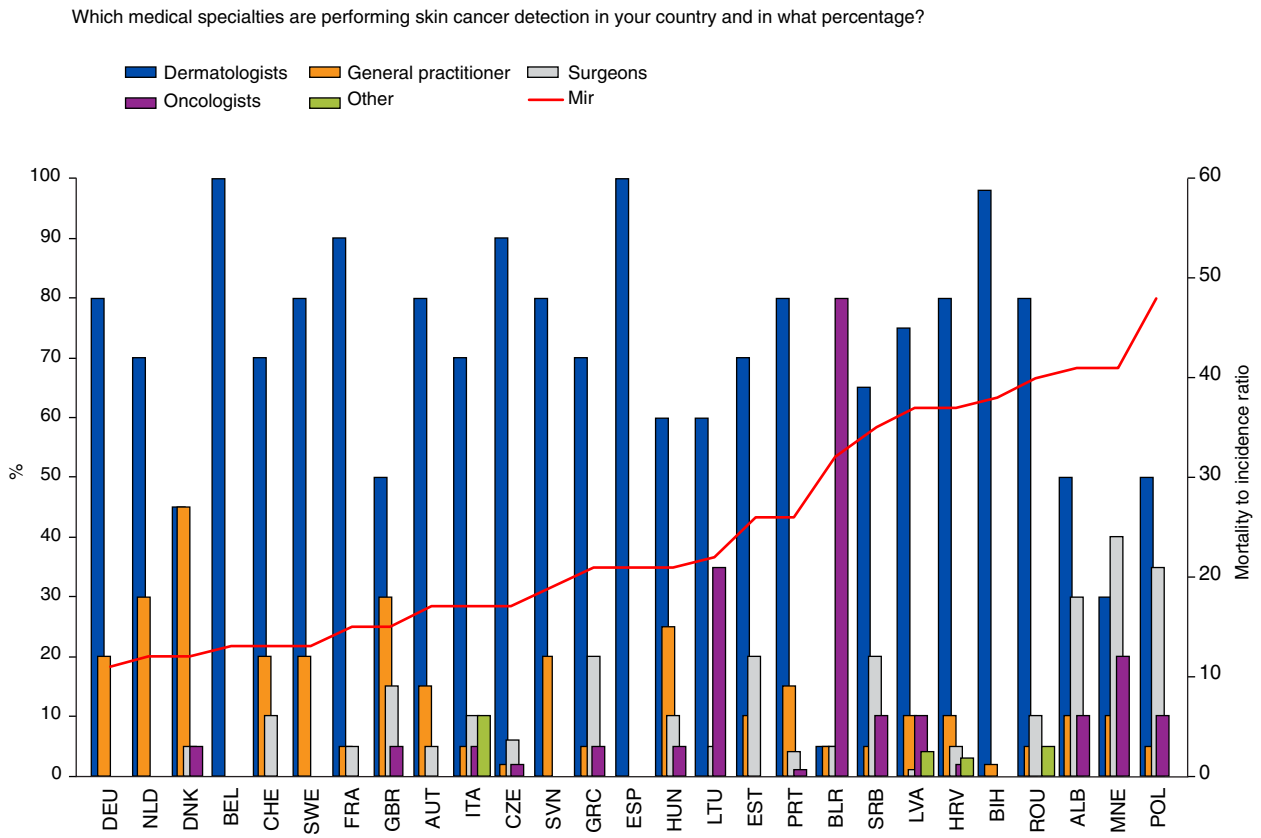

Figure 1 Medical disciplines involved in skin cancer detection and melanoma mortality-to-incidence ratio. ALB, Albania; AUT, Austria; BLR, Belarus; BEL, Belgium; BIH, Bosnia and Herzegovina; HRV, Croatia; CZE, Czech Republic; DNK, Denmark; EST, Estonia; FRA, France; DEU, Germany; GRC, Greece; HUN, Hungary; ITA, Italy; LVA, Latvia; LTU, Lithuania; MNE, Montenegro; NLD, the Netherlands; POL, Poland; PRT, Portugal; ROU, Romania; SRB, Serbia; SVN, Slovenia; ESP, Spain; SWE, Sweden; CHE, Switzerland; GBR, United Kingdom.

dermatopathology was found to be available in countries with a lower MIR. Also, skin cancer educational programmes for GPs were estimated to be available in 73% of the countries in NWE and 60% of those in SEE. Detailed analysis of dermato-oncology education in Europe was outside of the scope of this article and is planned for future studies.

A recent study found that not only late diagnosis but also less effective melanoma care can explain the persistent mortality disparities in Europe.[31] In previous studies, quick access to pigmented lesion clinics was associated with higher rates and the earlier detection of melanoma.[32–36] The current study found that melanoma care units with fast access upon primary care referrals (i.e. pigment lesion clinics) were established in approximately 92% of the countries in NWE and 53% of those in SEE. In previous studies, the presence of active MTBs led to better outcomes for cancer patients.[37] The current study found that the existence of MTBs was also significantly correlated with a lower MIR, particularly in countries where DER were responsible for their organization. In addition, the MIR was lower in countries in which there was better access to diagnostic SLND, DER were involved in the follow-up of stage IB–IIC patients and DER and oncologists were responsible for the follow-up and systemic treatment of stage III and IV melanoma patients. Limitations in the prescription of systemic melanoma therapy or medical specialty-related restrictions in reimbursement seemed to be correlated with a higher MIR (Table 7). This highlights the need for integrated melanoma patient care from diagnosis through follow-up and treatment in centres of excellence where dermatology services could play the primary role, as indicated in the ECCO's essential requirements.[7]

Melanoma clinical registries, which are essential for the monitoring and quality control of diagnostic and treatment processes, were available in 54% of the countries (50% in NWE and 57% in SEE). This was consistent with the population-based registry data generated from more comprehensive analyses.[18,38,39] In recent decades, significant improvements have been made in

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registration, particularly with the establishment of the European Cancer Information System. However, there is still a need for the further development of population and melanoma clinical registries to improve quality control in melanoma care.[18,38,39]

A limitation of the current study is that it is an expert survey. A small proportion of the data were retrieved from the available national databases and national associations. The majority of the information was estimations from the current clinical practice of DER, ONC and SURG. However, these estimates correspond to the findings of previous studies.[11,14] They can therefore be considered relevant, especially for the countries in which clinical data registries and healthcare audit data were not available.

The use of MIR as a proxy for fatality rates is not ideal. Indeed, the best-organized health systems tend to collect more accurate incidence data, while most of the countries do collect mortality data; thus, artificially higher ratios were found in the less organized health systems. Nevertheless, the MIR was found to be well correlated with the survival rates documented in the EUROCARE-5 study (Table S2). In the present study, many interacting variables were examined; thus, statistical reliability could not be achieved. However, some interesting trends were identified, and care was taken to avoid interpreting systematic associations and correlations as causal relationships.

The intention of the study was to provide an overview of the diagnosis and treatment of melanoma and skin cancer by the various medical specialties throughout Europe. In addition, the study aimed to estimate the extent to which the ECCO-recommended ideal melanoma care pathway had been implemented and to find exemplars that could guide improvements in the pathways in the various countries. In future studies, melanoma care pathways can be analysed on the basis of individual cases; however, national registries and/or European melanoma registry would need to be fully established in a majority of the countries to provide reliable data.

Conclusions

The incidence of skin cancer has been increasing throughout Europe; thus, healthcare systems should strive to fulfil the essential requirements for optimal care. The first estimates from this study suggest that skin cancer patients need integrated care that involves DER and GPs skilled in skin cancer detection, as well as SURG (e.g. dermatosurgeons, PS, ENT/MFS and surgical oncologists) in the initial surgical treatment. For lower-risk patients, optimal care also includes referrals to dermatologists for follow-up, and for patients with metastatic disease, it includes referrals to DER and oncologists for follow-up and treatment. The involvement of a higher number of professionals in patient care could contribute to lower mortality rates. It seems, that the greater involvement of DER who are highly trained in dermatoscopy, dermatosurgery and follow-up and treatment of melanoma may secure an optimal melanoma care pathway for patients. To confirm these estimates, melanoma care pathways can be analysed on the basis of individual cases and this should be explored in future studies.

List of abbreviations:

ECCO, European Cancer Organisation; EADO, European Association of Dermato-Oncology; NICE, UK National Institute for health and care excellence; GP, general practitioner; GNI, gross national income; HEPC, health expenditure per capita; UHC, universal health coverage; NWE, Northern and Western Europe; CEE, Central and Eastern Europe; SEE, Southern and Eastern Europe; MIR, mortality to incidence ratio; SLND, sentinel lymph node biopsy; DER, dermatologists; SURG, surgeons; ONC, medical oncologists; CDD, computerised digital dermatoscopy; RCM, reflectance confocal microscopy; OCT, optical coherence tomography; D, dermatologists; PS, plastic surgeons; MFS, maxillofacial surgeons; OS, oncological surgeons; GS, general surgeons; P, pathologist; R, radiologist; RT, radiotherapist; SLND, sentinel lymph node dissection; MTB, multidisciplinary tumor board; ALB, Albania; AUT, Austria; BLR, Belarus; BEL, Belgium; BIH, Bosnia and Herzegovina; HRV, Croatia; CZE, Czech Republic; DNK, Denmark; EST, Estonia; FRA, France; DEU, Germany; GRC, Greece; HUN, Hungary; ITA, Italy; LVA, Latvia; LTU, Lithuania; MNE, Montenegro; NLD, the Netherlands; POL, Poland; PRT, Portugal; ROU, Romania; SRB, Serbia; SVN, Slovenia; ESP, Spain; SWE, Sweden; CHE, Switzerland; GBR, United Kingdom.

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Supporting information

Additional Supporting Information may be found in the online version of this article:

Table S1 Questionnaire used in the study.
Table S2 Correlation of mortality-to-incidence ratio with 1-year and 5-year survival.
Table S3 Correlation of health expenditure per capita to melanoma care pathway components.

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