HHS Public Access

Author manuscript

J Eur Acad Dermatol Venereol. Author manuscript; available in PMC 2021 November 01.

Published in final edited form as:

J Eur Acad Dermatol Venereol. 2020 November ; 34(11): 2659–2663. doi:10.1111/jdv.16855.

Human surface anatomy terminology for dermatology: a Delphi consensus from the International Skin Imaging Collaboration

C. Navarrete-Dechent[#1,2], **K. Liopyris**[#1,3], **M.A. Molenda**[4], **R. Braun**[5], **C. Curiel-Lewandrowski**[6], **S.W. Dusza**[1], **P. Guitera**[7], **R. Hofmann-Wellenhof**[8], **H. Kittler**[9], **A. Lallas**[10], **J. Malvehy**[11,12], **M.A. Marchetti**[1], **M. Oliviero**[13], **G. Pellacani**[14], **S. Puig**[11,12], **H.P. Soyer**[15], **T. Tejasvi**[16], **L. Thomas**[17], **P. Tschandl**[9], **A. Scope**[18], **A.A. Marghoob**[1], **A.C. Halpern**[1,*]

[1]Dermatology Service, Memorial Sloan Kettering Cancer Center, New York, NY, USA [2]Department of Dermatology, Escuela de Medicina, Pontificia Universidad Católica de Chile, Santiago, Chile [3]Andreas Syggros Hospital of Cutaneous & Venereal Diseases, University of Athens, Athens, Greece [4]Bravia Dermatology, Toledo, OH, USA [5]Department of Dermatology, University Hospital Zürich, Zurich, Switzerland [6]Department of Dermatology, The University of Arizona Cancer Center, University of Arizona, Tucson, AZ, USA [7]Melanoma Institute Australia, The University of Sydney, Sydney, NSW, Australia [8]Department of Dermatology, Medical University of Graz, Graz, Austria [9]Department of Dermatology, Medical University of Vienna, Vienna, Austria [10]First Department of Dermatology, Aristotle University, Thessaloniki, Greece [11]Melanoma Unit, Department of Dermatology, Hospital Clinic, Institut d'Investigacions Biomediques August Pi i Sunyer (IDIBAPS), Universitat de Barcelona, Barcelona, Spain [12]CIBER de Enfermedades Raras, Instituto de Salud Carlos III, Barcelona, Spain [13]Dermatology Associates, Plantation, FL, USA [14]Department of Dermatology, University of Modena and Reggio Emilia, Modena, Italy [15]Dermatology Research Center, The University of Queensland Diamantina Institute, The University of Queensland, Brisbane, Australia [16]Department of Dermatology, University of Michigan, Ann Arbor, MI, USA [17]Service de Dermatologie, Centre Hospitalier Lyon Sud, Lyon 1 University and Cancer Research Center of Lyons INSERM U1052 – CNRS UMR5286, Lyon, France [18]The Kittner Skin Cancer Screening and Research Institute, Sheba Medical Center, Sackler Faculty of Medicine, Tel Aviv University, Tel Aviv, Israel

[#] These authors contributed equally to this work.

Abstract

Background—There is no internationally vetted set of anatomic terms to describe human surface anatomy.

[*]**Correspondence:** A.C. Halpern. halperna@mskcc.org.

Consent for publication: The authors consent the publication of this submission (manuscript and figures).

Prior presentation: Preliminary data of this work were presented at the 2nd Transforming Dermatology in the Digital Era meeting held on 25 October 2018, in New York, NY.

Conflicts of interest
The authors have no conflict of interest to declare.

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

Objective—To establish expert consensus on a standardized set of terms that describe clinically relevant human surface anatomy.

Methods—We conducted a Delphi consensus on surface anatomy terminology between July 2017 and July 2019. The initial survey included 385 anatomic terms, organized in seven levels of hierarchy. If agreement exceeded the 75% established threshold, the term was considered 'accepted' and included in the final list. Terms added by the participants were passed on to the next round of consensus. Terms with <75% agreement were included in subsequent surveys along with alternative terms proposed by participants until agreement was reached on all terms.

Results—The Delphi included 21 participants. We found consensus (≥75% agreement) on 361/385 (93.8%) terms and eliminated one term in the first round. Of 49 new terms suggested by participants, 45 were added via consensus. To adjust for a recently published International Classification of Diseases-Surface Topography list of terms, a third survey including 111 discrepant terms was sent to participants. Finally, a total of 513 terms reached agreement via the Delphi method.

Conclusions—We have established a set of 513 clinically relevant terms for denoting human surface anatomy, towards the use of standardized terminology in dermatologic documentation.

Introduction

Skin surface anatomy landmarks are crucial for communication in dermatologic examination and surgery. At present, there is a lack of internationally accepted, consistently utilized set of terms for describing surface anatomy in dermatology. Existing surface anatomy terminologies tend to be incomplete, overlapping or ambiguous for use by clinical dermatologists.[1–5] This can create a practice gap with potentially detrimental implications, for example difficulty in identifying prior surgery site,[6] leading to wrong site of surgery and other complications.

Documentation in dermatology is becoming increasingly image-based. Photographic documentation may best depict the distribution of a skin rash or the specific anatomic location of a skin neoplasm. Consequently, we anticipate a constantly rising need for standards that allow communication across different imaging devices.[7–10] Skin imaging systems will require standardized anatomic landmarks, to allow consistent representation of the location of skin lesions on digital avatars. This can be exceedingly relevant when patients are referred between physicians (e.g. from a physician using system A to the Mohs surgeon using system B). In addition, artificial intelligence (AI) systems will need consistent metadata, including anatomic location records, for training and testing.[11] Finally, clinicians will likely expect imaging systems to generate text-based reports that reliably describe the anatomic location of a skin disease or surgery site.

To this end, the present study aimed to reach consensus, among an international group of experts in dermatological imaging, on a set of clinically relevant terms for denoting human surface anatomy in dermatology using the Delphi method.

Material and methods

This study was conducted from July 2017 to July 2019 under the framework of the International Skin Imaging Collaboration (ISIC). The collaboration is comprised of international leaders from academia and industry with expertise in dermatologic imaging (www.isic-archive.com). Seven core members of ISIC anatomy working group led the Delphi study; all other members of ISIC were invited to serve as participants.

Preliminary survey

Before the initiation of the consensus process, we distributed a survey among the study leaders, whose purpose was to define the methodology for attaining expert consensus. The survey was created by three core members (C.N-D, K.L and A.H.) and distributed via SurveyMonkey (San Mateo, CA, USA). It included nine questions with five levels of agreement from 'totally agree' to 'totally disagree'. Utilization of the Delphi method was endorsed ('totally agree' or 'agree') by all seven study leaders. The panel also agreed that (i) English will be used for the Delphi consensus; (ii) the threshold for acceptance of a term would be set at 75%; (iii) terms, for which agreement could not be achieved, would be sent for a subsequent survey round; and that (iv) modifying terms (e.g. lateral and medial) and definitions of specific anatomic boundaries were beyond the scope of the study.

The scope and format of the Delphi process were refined during a face-to-face ISIC working group meeting, held in New York City on 9 November 2017. We decided that the goal was to reach consensus on a hierarchical set of terms that was (i) sufficiently granular to address the majority of dermatology cases, yet (ii) sufficiently parsimonious to be practically used by clinicians, even if they had not incorporated electronic health records into their practice. We also decided to include oral and genital mucosa in addition to skin.

In preparation for the present study, Kenneweg *et al.*[5] conducted a formal comparison of available systems of surface anatomy including Systematized Nomenclature of Medicine, International Classification of Diseases (ICD)-10 and Foundational Model of Anatomy Ontology (FMA). This resulted in an initial hierarchical list of 385 anatomic sites, which was used as the Delphi starting list of terms. At the end of the Delphi process, the final list expanded to 513 discrete terms.[5]

Delphi process

First round—An invitation via email was sent to all 52 ISIC members, with the options 'to participate', 'not to participate' or 'to suggest a more appropriate colleague as substitute'. The group email was circulated twice, followed by personal emails to members who did not respond.

The first survey included 385 terms, organized in seven levels of hierarchy (e.g. upper extremity > arm; forearm; hand > palm > finger > proximal phalanx; distal phalanx). The respondents had the option to 'agree', 'disagree', 'propose a new term' or 'modify the term'. They also had the choice to 'add an additional term' to the same level of hierarchy or 'change the level of hierarchy'. Answers were recorded on an Excel spreadsheet (Microsoft Corp, Redmond, WA, USA). If agreement on a given term exceeded the 75% threshold, the

term was considered ‘accepted’. Added terms were vetted by a steering committee of four leaders (C.N-D, K.L, A.S. and A.H.) before being passed to the next Delphi round.

Subsequent rounds—Terms that achieved less than 75% agreement in the first survey were included in a second survey along with new terms alternatives based on responses from the first survey. New hierarchy levels and new terms suggested by the respondents were also included in the second survey. The consensus level of agreement threshold was set again at 75%. The same approach was used for the third survey to address terms that were not resolved by the second survey. All surveys sent via email used the ISIC server and presented a customized interface for ease of response.

Final round—During the conduct of this study, the newly proposed, ICD-11 classification was about to be published and included an additional setlist of terms not evaluated in the previous Delphi rounds. To enable consistency with this new classification scheme, an *ad hoc* Dermatologic Anatomy Terminology Working Group, consisting of members of ISIC and members of the ICD-11 Dermatology Topic Advisory Group, was formed. This working group advised to add granularity to the Delphi-derived terms, resulting in a final list of 519 terms. This additional list of terms, not included in previous Delphi rounds, was subjected to a final consensus round by the same Delphi participants. We used the same methodology and thresholds, as in prior Delphi rounds.[5]

Statistical analysis

Descriptive and relative frequencies were used to describe the survey respondents and the results of the consensus. Measures of central tendency were calculated. Data were recorded and organized in Microsoft Excel (Microsoft Corporation, Redmond, WA, USA). All analyses were performed between 1 November and 23 July 2019.

Results

Fifty-two members of ISIC were invited to participate in the Delphi process. Of them, 32 responded, with 21 agreeing to participate and 11 declining (lack of expertise [$n = 5$], time constraints [$n = 3$], no reason given [$n = 3$]). Demographic description of Delphi participants is shown in Table 1.

First survey

The first survey presented 385 terms to participants. Of these, 361 (93.8%) terms achieved consensus. Twenty-four terms lacked consensus (i.e. synonyms suggested or not achieving agreement); these included 10 terms describing the head region (‘frontal scalp margin’, ‘occipital scalp margin’, ‘parietal scalp margin’, ‘temporal scalp margin’, ‘vertex of scalp’, ‘external ear’, ‘tympanic membrane’, ‘lower eyelid margin’, ‘superior palpebral sulcus’ and ‘sill of nostril’) and 14 terms describing the torso and extremities [‘hypochondrium’, ‘inguinal region’, ‘trochanteric region’, ‘umbilical region’, ‘fingernails’ of each finger ($n = 5$) and each toenail ($n = 5$)]. In addition, participants added 49 terms [‘iris’, ‘nasolabial fold’, ‘inferior apex of lobule of pinna’, ‘iliac crest’, ‘infraumbilical line’, ‘flank’, ‘corona glans’, ‘sulcus of glans’, ‘lateral plantar area’, and, for each finger and toe – ‘nail matrix’ ($n = 10$),

'proximal nail fold' (n = 10), 'lateral nail fold' (n = 10) and 'hyponychium' (n = 10)]. There was only one change in level of hierarchy – 'nipple' was moved one hierarchical level down under 'areola'.

Second survey

During the second survey, we included the 24 terms that did not achieve consensus in the first survey, as well as the 49 newly added terms. Out of the 24 initial terms, consensus was achieved in 22 terms, while one term lacked consensus ('hypochondrium'), and one term was eliminated ('parietal scalp margin'). Of the 49 newly added terms, consensus was attained in 45 terms. Terms that did not achieve agreement included 'inferior apex of lobule of pinna', 'iliac crest', 'infraumbilical line' and 'flank'. By the end of the second round, 428 terms attained consensus.

Third survey

A third survey was sent to address the term 'hypochondrium'; participants reached consensus on the suggested alternative term 'hypochondrium/lateral upper quadrant' of the abdomen, with 83% agreement. By the end of the third round, 429 terms attained consensus.

Fourth survey and final list of terms

The newly proposed ICD-11 Surface Topography (ST) scheme encompassed 519 terms, and in comparison with the 429 Delphi-vetted terms, 111 discrepancies were found. A fourth survey was sent to address these 111 discrepancies between the Delphi and the ICD-ST terms.[1] Following this fourth round, 33 terms were added without modifiers. Six terms were added for multiple fingers and toes (total of 48 terms): eponychium (×10) and lunula (×10); interphalangeal toe joints (×9); finger/toenail (×10), metatarsophalangeal joints (×5); and finally, metatarsophalangeal head from second to fifth toe (×4). Three additional terms were added after a slight modification proposed by the Delphi participants (i.e. 'first metatarsal head/ball of foot', 'pharyngopalatine arch/fauces' and 'glossopalatine arch/fauces'). A total of 27 terms did not reach agreement and were excluded. This resulted in a total list of 513, Delphi-vetted, clinically relevant terms (Table S1, Supporting Information).

Delphi list of terms and comparison with ICD-ST

Compared to the ICD-ST, the final list of Delphi terms encompassed 144 differences (27.7% of all ICD-ST terms). There were 94 variations (e.g. limbus vs. limbus of cornea), 28 terms were eliminated, and 22 terms were added by the experts. The final list of terms compared with the ICD-ST[5] list of 519 terms is shown in Table S2 (Supporting Information). Examples of how terms can be mapped and used in daily clinical practice are available in Figs S1–S3 (Supporting Information).

Discussion

Herein, we report a Delphi consensus on clinically relevant skin surface anatomy terminology for dermatology that resulted in a list of 513 unique terms divided into 9 levels of hierarchy, inclusive of the oral and genital mucosa (Table S1, Supporting Information). We reasoned that a manageable set of terms (~500) would be practical for conducting the

Delphi process and for broad adoption by dermatologists, even if still using paper-based documentation. A more granular set of terms (i.e. in the thousands of terms) would probably require a completely digital user interface. We do believe that our proposed scheme provides a strong scaffold for designing more elaborate terminology schemes.

The presented terminology is comparable with the recently published ICD-ST list of terms.[5] However, the Delphi process identified 94 ICD-ST terms that were modified, 28 that were eliminated and 22 extra terms that were added by the experts in the different surveys. Notably, the 144 discrepancies between the Delphi and ICD-ST represent ~30% of all the ICD-ST published terms. Going forward, these discrepant terms (Table S2, Supporting Information) would be subject to scrutiny for clinical relevance and practical use.

The implementation of accurate and consistent anatomic mapping in dermatology has many potential advantages.[7,12–14] The current inconsistent anatomic terminology can lead to erroneous surgery site, particularly when multiple biopsies are concurrently done on a patient. In addition, communication on precise anatomic location is critical when a lesion is initially biopsied by a dermatologist and then referred elsewhere for definitive surgery.[6] While photographic documentation can expedite communication, it does not eliminate the need for consistent text-based communication. The rise of electronic medical records (EMRs) presents an opportunity for the rapid adoption and dissemination of reproducible terminology, particularly if the terms are presented in drop-down menus and/or associated with annotating anatomic maps. The reasonable correspondence of our proposed terms to ICD-11 scheme would allow for the generation of billing codes directly from the EMR.

A reproducibly applied set of anatomy terms would benefit dermatology research. In epidemiologic studies, consistent anatomic labelling would facilitate pooling of data from multiple sources.[15] This advantage is magnified when aggregating ‘big data’ to train AI algorithms. These systems can benefit from adding anatomic location as metadata point for calculating diagnosis and prognosis.[5,10,16–20]

Our study has strengths. The list of terms presented herein was vetted by a group of experts in which >70% have more than 10 years of experience evaluating and imaging skin lesions. Participants also practise in different parts of the globe, adding representation and generalizability to our terminology scheme.

Our study has limitations. First, an inherent limitation to expert consensus process in that it relies on a restricted group of participants. The terms should be endorsed and validated in daily practice by the broader dermatology community and other stakeholders. Second, our process and proposed terms were conducted in English, and translation to other languages would require additional feedback. Additionally, we did not address standardized modifier terms (e.g. left/right, inferior, lateral, medial). Finally, we did not perform agreement for the boundaries of each surface anatomy term as this was beyond the scope of our study. Future consensus should specifically address the anatomic boundaries for each term. We have created a web app (www.anatomymapper.com/delphi) that visually shows each term in a body map. Due to complexities, mucosa- and nail-specific terms have been omitted.

Conclusion

Through a Delphi process, we derived a hierarchical list of 513 clinically relevant terms that are consistent with ICD-11 and can be used as a starting point by the dermatology community to standardize documentation of anatomic sites. While the list is not exhaustive, we anticipate the set of terms to be adequate for most clinical situations. Adoption of a standardized anatomy lexicon can inform the process of setting Digital Communication in Medicine standards in dermatology.[21] These standards have the potential to improve clinical care and to harness the benefits of photographic documentation and machine learning in dermatology. A preliminary interactive body map is available at www.anatomymapper.com/Delphi. Formal validation of the lesion boundaries illustrated on anatomymapper.com is beyond the scope of the current paper, but we anticipate that this webapp will be a useful resource in the interim.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Funding sources

This research was funded in part by a grant from the National Cancer Institute/National Institutes of Health (P30-CA008748) made to the Memorial Sloan Kettering Cancer Center.

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Table 1

Delphi participants' characteristics (n = 21)

	Number (%)
Gender (male, %)	17 (80.9)
Age group (years)	
30–39	6 (28.6)
40–49	5 (23.8)
50–59	6 (28.6)
60–69	3 (14.3)
70–79	1 (4.8)
Country	
Australia	2 (9.5)
Austria	3 (14.3)
Chile	1 (4.8)
France	1 (4.8)
Greece	2 (9.5)
Israel	1 (4.8)
Italy	1 (4.8)
Switzerland	1 (4.8)
Spain	2 (9.5)
United States	7 (33.3)
Experience evaluating skin lesions (years)	
5–9	3 (14.3)
10–15	4 (19.0)
16–20	2 (9.5)
More than 20	12 (57.1)
Works at an academic institution	19 (90.5)