

# Clinical practice guidelines for reporting nailfold videocapillaroscopy: a Delphi consensus on behalf of the Italian Society of Rheumatology study group on capillaroscopy

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on behalf of the Study Group on Capillaroscopy and Microcirculation in Rheumatic Diseases of the Italian Society of Rheumatology (CAPSIR)

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## Abstract

### Objective

*In clinical practice, standardised reporting of nailfold videocapillaroscopy (NVC) findings is lacking, making the interpretation and comparison of results difficult. We aimed to achieve a national consensus on how to describe NVC findings in routine clinical practice.*

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### Methods

*A web-based Delphi consensus study was conducted among members of the Study Group on Capillaroscopy and Microcirculation in Rheumatic Diseases of the Italian Society of Rheumatology (CAPSIR). The study was based on items derived from a previous systematic review and international consensus by the EULAR Study Group on Microcirculation in Rheumatic Diseases (SG\_MC/RD).*

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### Results

*A total of 40 items were proposed during the Delphi process, which was completed by 52 participants from different Italian regions. An agreement was reached on 23 items covering different aspects of the NVC examination: general aspects (2 items), description of the fingers examined (3 items), possible confounding factors (2 items), device description (2 items), image quality (1 item) and details of the NVC examination (13 items). Sixteen of these were considered mandatory for inclusion in the NVC practice report, and 7 were considered optional.*

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### Conclusion

*The proposed NVC checklist covers 23 relevant issues in clinical practice, including 16 mandatory items grouped into five categories. This national consensus will improve the reproducibility and generalisability of NVC reporting in daily clinical practice. Furthermore, the outcomes of this NVC consensus process will inform the next European web-based Delphi consensus study, to be conducted among the member countries of the EULAR SG\_MC/RD.*

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### Keyword

capillaroscopy, microcirculation, Raynaud's phenomenon, rheumatic diseases

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## Introduction

Nailfold videocapillaroscopy (NVC) is an easy-to-use, safe and non-invasive technique that has become an integral part of the imaging armamentarium in rheumatology research and clinical practice over the years (1, 2). Nowadays, rheumatologists are familiar with NVC, and the level of knowledge and availability of NVC is higher than other techniques for assessing microvascular involvement in systemic autoimmune rheumatic diseases (3-5).

Moreover, the role of NVC in the differential diagnosis of Raynaud's phenomenon (RP), early diagnosis and monitoring of systemic sclerosis (SSc), as well as scleroderma spectrum disorders is well established (6). As evidence of this, abnormal capillaroscopic findings were formally included in the 2013 ACR-EULAR classification criteria for SSc (7).

In the last ten years, the EULAR Study Group on Microcirculation in Rheumatic Diseases (SG\_MC/RD) has been active in standardising different phases of this technique, such as the nomenclature to be used in daily practice and research (8, 9), the items relevant for reporting in clinical research (10), and organizing several international face-to-face and online training courses.

Increased use in clinical practice has corresponded with major technical advances in image resolution and analysis. In addition, a patient infographic explaining the meaning and advantages of NVC has been developed in several languages, and it is available for free download from the ERN ReConnet (European Reference Network on Rare and Complex Connective Tissue and Musculoskeletal Diseases) website (11).

In Italy, the NVC training program is part of the curriculum for rheumatology trainees, and in 2020 the steering committee of the Italian Society of Rheumatology (SIR) approved the Study Group (SG) on Capillaroscopy and Microcirculation in Rheumatic Diseases (CAPSIR), which soon started its first project to obtain an overview of the use of NVC and identify potential unmet needs in Italian rheumatology centres (4).

Reporting methods were heterogeneous

among different centres, with the majority (74.2%) producing medical reports combined with capillaroscopic images. NVC images were described using either free text (71%) or with a pre-printed multiple-choice format produced by each centre (29%), which did not frequently adhere to the EULAR validated nomenclature (4).

Despite all these advances, there was no unanimous way of reporting in Italian centres, even though complete and accurate reporting is essential for comparing results. Based on these findings, in November 2024, CAPSIR\_SG members proposed a national Delphi consensus to develop an agreed NVC report.

## Methods

### Delphi process

The CAPSIR Steering Committee oversaw the management of the Delphi process. The study was exempt from Institutional Review Board (IRB) approval since there was no research involving patient samples or data.

The Delphi exercise was conducted online (Google Forms) from January to April 2025.

The national experts in the field of NVC were recruited among the members of the CAPSIR SG and invited to participate in this Delphi exercise. The experts were all members of the SIR. A total of 132 experts, included in the CAPSIR\_SG mailing list, were invited by e-mail to participate in this Delphi exercise. At least three reminders were sent. Experts who did not complete the first round were not invited to any of the subsequent Delphi rounds.

For all Delphi rounds, a deadline for submitting responses was set and communicated in the invitation. During this period, automated reminders were sent to participants who had not yet provided their ratings for each Delphi statement. Importantly, a glossary summarising NVC terminology in line with the EULAR nomenclature (8) has been included to summarise NVC terminology and to ensure standardisation of the final results (Table I). It should also be noted that when limb capillary dilations are present in NVC analyses, operators have to use the appropriate software to properly evaluate the diameters.

### Statistical analysis

The CAPSIR Steering Committee first reviewed the results of a systematic literature review (SLR) that had previously been conducted with the aim of identifying reporting items for NVC (10). In the previous SLR, references were retrieved using an initial search strategy in Medline via PubMed, Embase and Scopus (10). The objective of this strategy was to identify all studies in which NVC was performed on a population of adults and children with rheumatic musculoskeletal diseases (10). In this SLR (10), 319 studies were analysed, revealing three main topics: 1) patient preparation (21 items); 2) device technical description (6 items); and 3) examination details (19 items). The CAPSIR Steering Committee agreed on the three topic categories to be addressed: patient preparation, instrument description and capillaroscopic parameters. They also finalised the preliminary list of statements, comprising 11, 8 and 21 items respectively. In the first round, participants were asked to consider the items previously identified, to focus on new items that may have been omitted, and to clarify items that may be ambiguous. The second round was based on the results of the first round, and in the third-round, participants reviewed the responses to each item from the second round, including basic summary statistics for each question, and were asked to rate the items again. In each round, they were asked to rate the level of appropriateness of each item on a scale from 1 (extremely inappropriate) to 9 (extremely appropriate). To achieve agreement, the median of the responses for each item had to be  $\geq 7$ , and  $\frac{1}{3}$  or fewer of the participants had to be in the range 1-3 (12). Items on which no agreement was reached were excluded. The CAPSIR Steering Committee evaluated the results and comments from all the Delphi rounds, amending the newly proposed statements as necessary.

### Results

#### Delphi participants

Sixty-one experts responded to the invitation to participate, representing all Italian regions. There were more fe-

**Table I.** Glossary of NVC terminology (8, 9).

NVC parameters		
Terminology	Definition	
<b>Density</b>	The number of capillaries/mm of distal row	$\geq 7$ capillaries/mm: normal density <7 capillaries/mm: lowered density
<b>Dimension</b>	Diameter of the apical limb of the capillary	<20 $\mu\text{m}$ : normal diameter $\geq 20$ and $\leq 50$ $\mu\text{m}$ : dilated >50 $\mu\text{m}$ : giant capillary
<b>Morphology</b>	1) Normal: hairpin-shaped capillary 2) Non-specific variations: tortuous capillary (the limb bends but does not cross), or crossing (the limbs cross once or twice) 3) Abnormal shapes: bushy (capillary with small buds instead of branches capillary) and/or ramified capillary (capillary with branched limb) and/or crossed with more than 3 twisted, neoangiogenesis	
<b>Microhaemorrhages</b>	Pericapillary microhaemorrhages	
<b>Venous Plexus</b>	Visibility of the subpapillary venous plexus	
<b>Architecture</b>	Architecture of the capillary network	

**Table II.** Expert panel demographics.

	Round 1	Round 3
Experts invited, No.	132	52
Experts participated, No.	61	52
<b>Gender</b> (Female-Male)	39-22	33-19
<b>Italian region represented</b>		
- Northwest*	23 (37.7%)	20 (38.4%)
- Northeast <sup>o</sup>	8 (13.1%)	8 (15.4%)
- Centre <sup>s</sup>	14 (23%)	12 (23.1%)
- South and islands <sup>^</sup>	16 (26.2%)	12 (23.1%)
<b>Specialty</b>		
- Rheumatology	51 (83.6%)	44 (84.6%)
<b>Primary practice setting</b>		
- Public hospital	23 (37.7%)	20 (38.5%)
- University hospital	29 (47.6%)	25 (48.1%)
- IRCSS <sup>o</sup>	6 (9.8%)	5 (9.6%)
- Private practice	3 (4.9%)	2 (3.8%)
<b>NVC experience of respondents</b>		
- more than 10 years	40 (65.6%)	34 (65.4%)
- 5-10 years	15 (24.6%)	12 (23.1%)
- less than 5 years	6 (9.8%)	6 (11.5%)
- No experience	0	0

<sup>^</sup> Experts who completed the survey in full in the previous round were invited to subsequent rounds.

\*Valle d'Aosta, Liguria, Lombardy, Piedmont.

<sup>o</sup>Trentino-Alto Adige, Veneto, Friuli-Venezia Giulia, Emilia-Romagna.

<sup>s</sup>Tuscany, Umbria, Marche, Lazio.

<sup>^</sup>Abruzzo, Molise, Campania, Apulia, Basilicata, Calabria, Sicily.

<sup>o</sup>IRCSS: Institute of Hospitalisation and Scientific Care.

male (39, 64%) than male (22, 36%) panellists. Patient care settings were diverse, with 29 (47.6%) experts working in academic institutions and 23 (37.7%) in public hospitals. They were predominantly rheumatologists (51, 83.6%) who were familiar with NVC (65.6% reported using NVC in routine clinical practice for more than 10

years). In the second round, 52 of the 61 experts responded (response rate, 85.24%), and in the third round, all 52 participants responded (Table II).

#### Delphi results

The Delphi workflow is shown in Figure 1. After three rounds of voting, several items were rephrased, deleted

or merged. The process started with 40 items and resulted in a final list of 23. Based on participants' suggestions, items were grouped into five main categories (*i.e.*, general items, anatomical area, contextual factors, equipment, images and NVC parameters) rather than three (*i.e.*, patient preparation, device description and examination details). The results consisted of 16 mandatory (*i.e.*, essential to be reported in the NVC report) and 7 optional items (Fig. 2). The English and Italian versions of the final consensus report of the NVC are shown in Figure 2 and Supplementary Figure S1, respectively. In particular, in the first round, three items not explicitly related to NVC but to general good clinical practice were requested for inclusion in the reporting checklist: reason for request, indications for other tests and timing of NVC repetition (Table III).

Participants also agreed on the importance of clearly stating where NVC will be performed: on both hands, or which finger is excluded and why. Although some other aspects may be important to report in clinical research studies (10), there was no consensus on their relevance for inclusion in a medical report in routine practice (Supplementary Table S1).

Two contextual factors were considered important as potential confounders, namely the presence of nail polish (or artificial or gel nail polish) and the presence of periungual lesions for various reasons (finger trauma or nail biting, self-mutilation of cuticles, manicure, manual work or hobbies). Technical characteristics of the NVC instrument, such as model, brand and magnification, which may affect the accuracy of the NVC examination, have to be included in the report. As NVC is an imaging technique, it is important to report details of the image quality (*e.g.*, excellent, good, poor) and the possible reasons if the quality is not acceptable (fibrosis, local trauma, dirty, blurred, oedema).

Finally, capillary density, morphology and dimensions, all standardized NVC parameters useful in deriving the overall pattern, achieved the agreement reported in Table III. Participants also

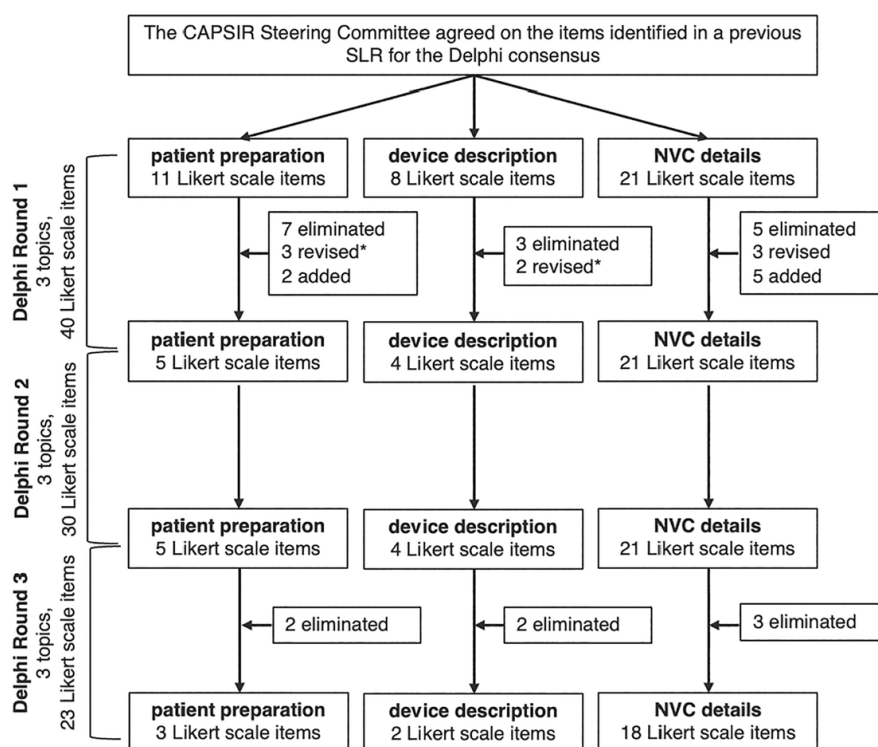


Fig. 1.

\*Two items have been merged.

agreed to include three further optional items, such as: capillary bed architecture, blood flow characteristics and venular plexus visibility. Full agreement was reached to report the overall pattern according to the standardized EULAR nomenclature as the conclusion of the report (Table III).

## Discussion

CAPSIR\_SG participants have produced the first national checklist focusing on the reporting findings of NVC in daily clinical practice. The target audience of this project is all Italian healthcare professionals who perform and report NVC in rheumatic diseases. This simple and practical checklist will ensure transparent and comprehensive NVC reporting and it is an attempt to standardise and homogenise NVC reporting.

The overarching principles of NVC examinations, as validated by the EULAR nomenclature, were accepted a priori, such as the number and fingers to be examined. Ideally, all 8 fingers (excluding the thumbs) should be examined to capture the heterogeneity in appearance that is common between and within the nailfolds (6, 8, 13).

As this format is intended to be used in a real-world scenario, two general items were requested to be added to the checklist, such as the reason for the request and indications for other tests and the timing of the repeat NVC. The majority of CAPSIR\_SG participants felt it was important to include these to emphasise the importance of NVC in the diagnosis and monitoring of scleroderma spectrum disorders.

In recent years, several NVC systems with different magnifications and performance have been introduced to the market (14-16). For this reason, the participants agreed to report device characteristics and magnification. By contrast, there was no consensus on items related to capillaroscopists' experience. This was primarily due to the lack of an agreed method for reporting and assessing such experience. However, the ongoing EULAR online courses on NVC and microcirculation will soon help participants report NVC findings correctly, culminating in a final examination to assess acquired competency. With clinicians concerned about increased administrative duties and cost-containment pressures, the importance of a time-



<b>General items</b>	Surname Name _____ Date _____	
	Reason for request _____	
<b>Anatomical area</b>	Right hand	2 3 4 5
	Left hand	2 3 4 5
	Reason for finger exclusion _____	
	Nail polish or artificial or gel nails	Yes No
	Periungual lesions	Yes No
<b>Equipment &amp; images</b>	Caused by	
	Finger trauma	Self-mutilation of cuticles
	Nail biting	Manicure
	Manual work or hobbies	
	Device model and brand _____	
<b>NVC parameters</b>	Magnification _____	
	Image quality	Excellent Good Poor
	If poor, potential reason	Fibrosis Oedema Dirty
		Local trauma Other
	No. of capillary/mm (median of both hands) _____	
<b>Final judgement</b>	Capillary characteristics <sup>§</sup>	
	Hairpin shaped capillaries	Absent Rare Frequent Very frequent
	Non-specific variations	Absent Rare Frequent Very frequent
	Abnormal shaped capillaries	Absent Rare Frequent Very frequent
	Dilated capillaries	Absent Rare Frequent Very frequent
	Giant capillaries	Absent Rare Frequent Very frequent
	No. of giant capillaries	Absent Rare Frequent Very frequent
	Other parameters <sup>§</sup>	
	Microhaemorrhages	Absent Rare Frequent Very frequent
	Types of microhaemorrhages	Traumatic Spontaneous
<b>Final judgement</b>	Blood flow characteristics*	Normal Slowed
	Venular plexus visibility*	Visible Not visible
	Nailfold architecture*	Normal Distorted
	Overall pattern	Normal Non-specific abnormalities
	Scleroderma pattern - early - active - late	Scleroderma-like pattern
Indications for other tests _____		
Repeat the capillaroscopy in _____		

**Fig. 2.** Summary of the items included in the checklist for reporting NVC in clinical practice.

<sup>§</sup>these parameters are classified according to a published scoring system (17) as absent: no changes (score=0); rare: less than 33% of capillary alterations/mm (score=1); frequent: 33–66% of capillary alterations /mm (score=2); very frequent: more than 66% of capillary alterations/mm (score=3).

\*Optional items.

consuming reporting checklist cannot be overstated. Furthermore, according to Italian legal guidelines, any clinical report must be easily understandable for patients and general practitioners

alike. Against this background, it was considered more practical and feasible in the first round to categorise non-specific capillary variations, abnormally shaped capillaries, and dilated

capillaries as absent, rare (less than 33% capillary alterations per mm), frequent (between 33% and 66% of capillary alterations per mm) or very frequent (more than 66% capillary alterations per mm) (17), rather than counting the number per mm (8).

Only for giant capillaries was there agreement to report both measures. For a capillary to be defined as 'giant', its apical diameter must exceed 50 micrometres. By definition, giant capillaries are absent in the 'late' pattern; they are merely dilations of neoangiogenic loops. Other parameters measured per mm were eliminated in the first Delphi round.

Since what we see during NVC is the column of red blood cells within the capillary walls, contextual factors that may influence capillary visibility (and thus alter the final NVC report) were considered (10). However, only factors directly disturbing the observation of the periungual area, such as recent manicure (18) or traumatic lesions, reached the consensus. On the contrary, there was no consensus on other issues such as environmental conditions, pre-test acclimatisation, hydration (19), avoidance of caffeine and nicotine (20).

Although a description of peripheral blood flow intensity was introduced as an optional item in the second round, this is a difficult parameter to evaluate without a proper automated system. Furthermore, the examination is operator-dependent and susceptible to short-term variations. The final checklist consists of 23 items (16 mandatory and 7 optional) grouped into 5 categories to provide standardized information about the NVC examination.

One of the most important factors is still capillary diameter, as progressive dilation of over 30 microns is considered an early sign of capillary damage. Over time, this may evolve into giant capillaries measuring over 50 microns in a large percentage of patients with RP and antinuclear antibodies. The latter is essential for making a differential diagnosis of RP secondary to connective tissue diseases (21, 22).

This reporting format is easy to use, comprehensive and appropriate, and

**Table III.** The results of the Delphi process on items to be reported in the NVC clinical practice were grouped into five main report categories (see definitions in Table I).

Items	Level of appropriateness			Median	Agreement
	1-3	4-6	7-9		
<b>General items</b>					
Reason for NVC request	0	5 (9.6%)	47 (90.4%)	9	Yes
Indications for other tests or when to repeat NVC	0	2 (3.8%)	50 (96.2%)	9	Yes
<b>Anatomical area</b>					
Indicate if NVC is performed on both hands	2 (3.8%)	4 (7.7%)	46 (88.5%)	9	Yes
Number of fingers examined	3 (5.8%)	7 (13.5%)	42 (80.7%)	8	Yes
Reason for finger exclusion	2 (3.8%)	3 (5.8%)	47 (90.4%)	9	Yes
<b>Contextual factors</b>					
Remove nail polish or artificial or gel nails	5 (8.2%)	10 (16.4%)	46 (75.4%)	7	Yes
Indicate the presence of periungual lesions and their causes ( <i>e.g.</i> , finger trauma, nail biting, self-mutilation of cuticles, manicure, manual work or hobbies)	0	2 (3.8%)	50 (96.2%)	9	Yes
<b>Equipment</b>					
Device model, brand	11 (21.1%)	11 (21.1%)	30 (57.8%)	7	Yes
Magnification	4 (7.7%)	4 (7.7%)	44 (84.6%)	9	Yes
<b>Images</b>					
Image quality (excellent, good, poor) and, if poor, possible reasons (fibrosis, local trauma, dirty, blurred, oedema).	0	1 (1.9%)	51 (98.1%)	9	Yes
<b>NVC parameters</b>					
No. of capillary/mm (median of both hands)	6 (11.5%)	7 (13.5%)	39 (75%)	8	Yes
Hairpin-shaped capillaries <sup>§</sup> (absent, rare, frequent, very frequent)	3 (5.8%)	5 (9.6%)	44 (84.6%)	9	Yes
Non-specific variations <sup>§</sup> (absent, rare, frequent, very frequent)	4 (7.7%)	4 (7.7%)	44 (84.6%)	9	Yes
Abnormal shaped <sup>§</sup> (absent, rare, frequent, very frequent)	0	1 (1.9%)	51 (98.1%)	9	Yes
Dilated capillaries <sup>§</sup> (absent, rare, frequent, very frequent)	0	0	52 (100%)	9	Yes
No. of giant capillaries/mm	2 (3.8%)	2 (3.8%)	48 (92.4%)	9	Yes
Giant capillaries <sup>§^</sup> (absent, rare, frequent, very frequent)	0	1 (1.9%)	51 (98.1%)	9	Yes
Microhaemorrhages <sup>§</sup> (absent, rare, frequent, very frequent)	0	1 (2%)	51 (98%)	9	Yes
Types of microhaemorrhages (traumatic, spontaneous)	2 (3.8%)	2 (3.8%)	48 (92.4%)	9	Yes
Nailfold architecture (normal, distorted)	0	1 (2%)	51 (98%)	9	Yes
Blood flow characteristics (normal, slowed)	2 (3.8%)	8 (15.4%)	42 (80.8%)	8	Yes
Venular plexus visibility (visible, not visible)	3 (5.8%)	9 (17.3%)	40 (76.9%)	8	Yes
Report the NVC pattern according to EULAR definitions (8)*	0	0	52 (100%)	9	Yes

<sup>§</sup>Using the Delphi method, participants voted on the appropriateness of reporting these parameters both per mm (according to the EULAR consensus) and as absent, rare, frequent, or very frequent (according to pragmatic daily practice). Only for giant capillaries was there agreement to report both measures. Other parameters were eliminated in the first round.

<sup>^</sup>To define a capillary dilation as 'giant' (*i.e.*, greater than 50 micrometres in diameter), the diameter at the apex must be measured and reported. By definition, giant capillaries are absent in the 'late' pattern; they are simply dilated neoangiogenic loops.

we believe it will be widely adopted in Italy, thereby improving the interpretability and reproducibility of NVC reporting.

The results of this current national NVC consensus will form the basis of the next European web-based Delphi consensus, which will be launched among the member countries of the EULAR Study Group on Microcirculation in Rheumatic Diseases and will be available in several languages.

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