



Continuous Monitoring and Prevention for Deep Vein Thrombosis

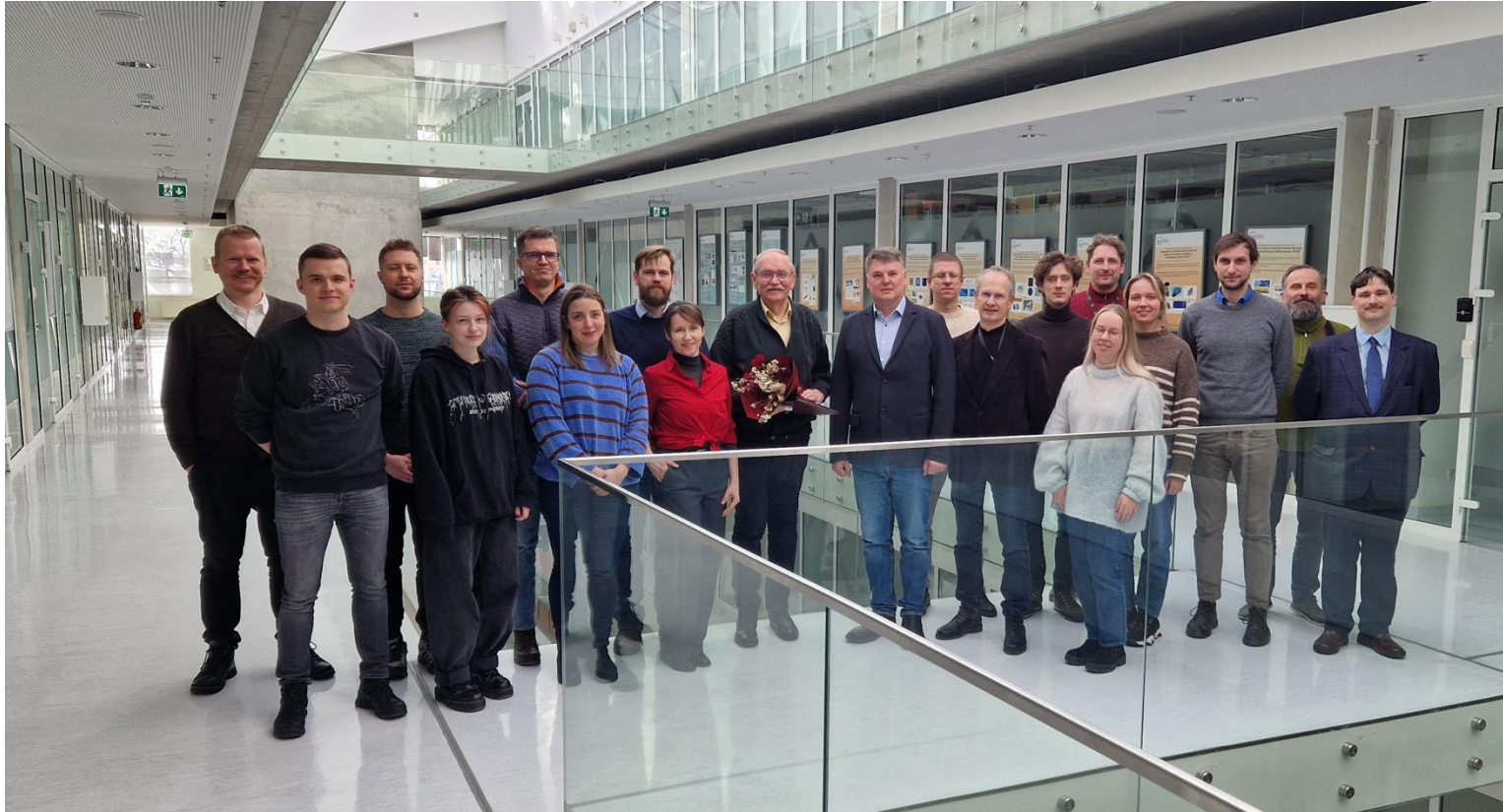
dr. Andrius Rapalis
Biomedical Engineering Institute
Kaunas University of Technology

Brussels, 4 June 2026



Horizon Innovation Action | Agreement No. 101137227
HORIZON-HLTH-2023-TOOL-05-05
Co-funded by the European Union

KTU Biomedical Engineering Institute



KTU Santaka Valley



KTU M-Lab



Case study: ThrombUS+ project



Call Identifier: HORIZON-HLTH-2023-TOOL-05-05

Call title: Harnessing the potential of real-time data analysis and secure Point-of-Care computing for the benefit of person-centred health and care delivery

Program: Horizon Europe, 4. Health, 2023-2024

Destination: 5. Unlocking the full potential of new tools, technologies and digital solutions for a healthy society

Proposal submitted: 13 April 2023

Wearable Continuous Point-of-Care Monitoring,
Risk Estimation and Prevention for Deep Vein Thrombosis

Project type: IA (Innovation Action)

Project Budget: 9,565,763.75 €

EU funding: 8,141,251.25 €

Duration: 42 months

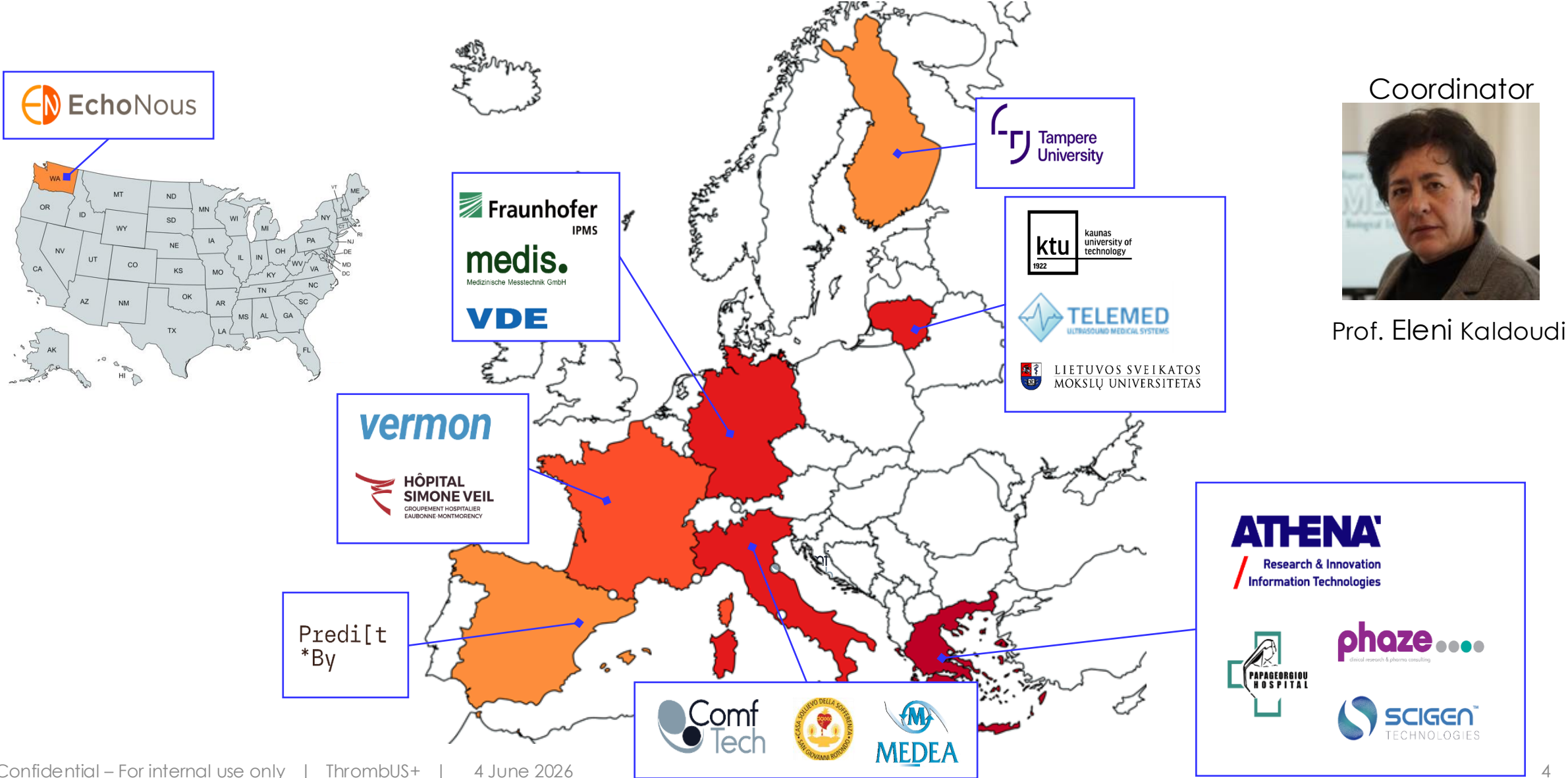
Start: 1 January 2024

End: 30 June 2027

Invited: 04 August 2023

Signed: 08 December 2023

The partners



Coordinator



Prof. Eleni Kaldoudi

The partners

Research - 5



Industry - 9

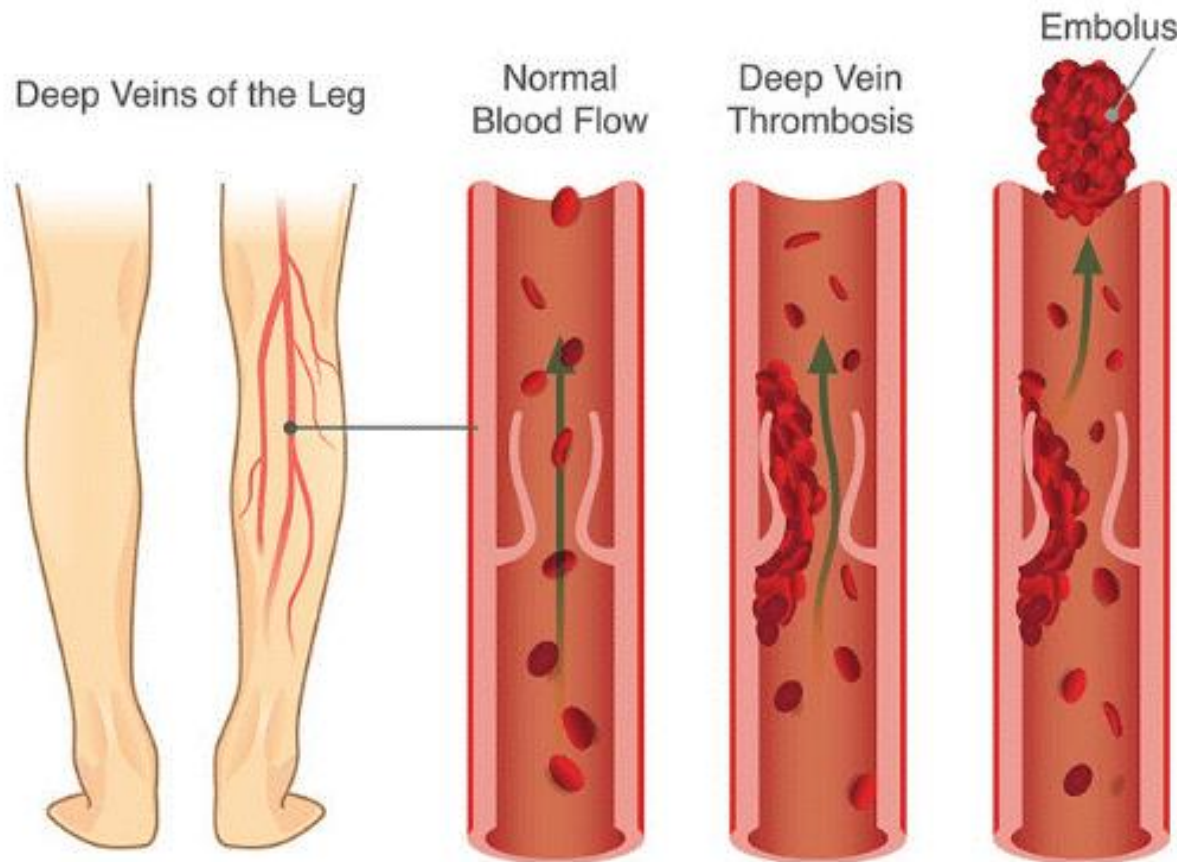


Hospitals - 5



Deep Vein Thrombosis

Deep Vein Thrombosis (DVT) is the clotting of blood in a deep vein of an extremity usually the calf or thigh.



- A clot is mainly composed of fibrin and red blood cells.
- A clot usually forms around the valves in the deep veins of the leg.
- The clot might be pushed via the heart to the lungs where it can block an artery, what is known as pulmonary embolism, an acute, life-threatening event.

DVT is a major preventable cause of morbidity and mortality worldwide:

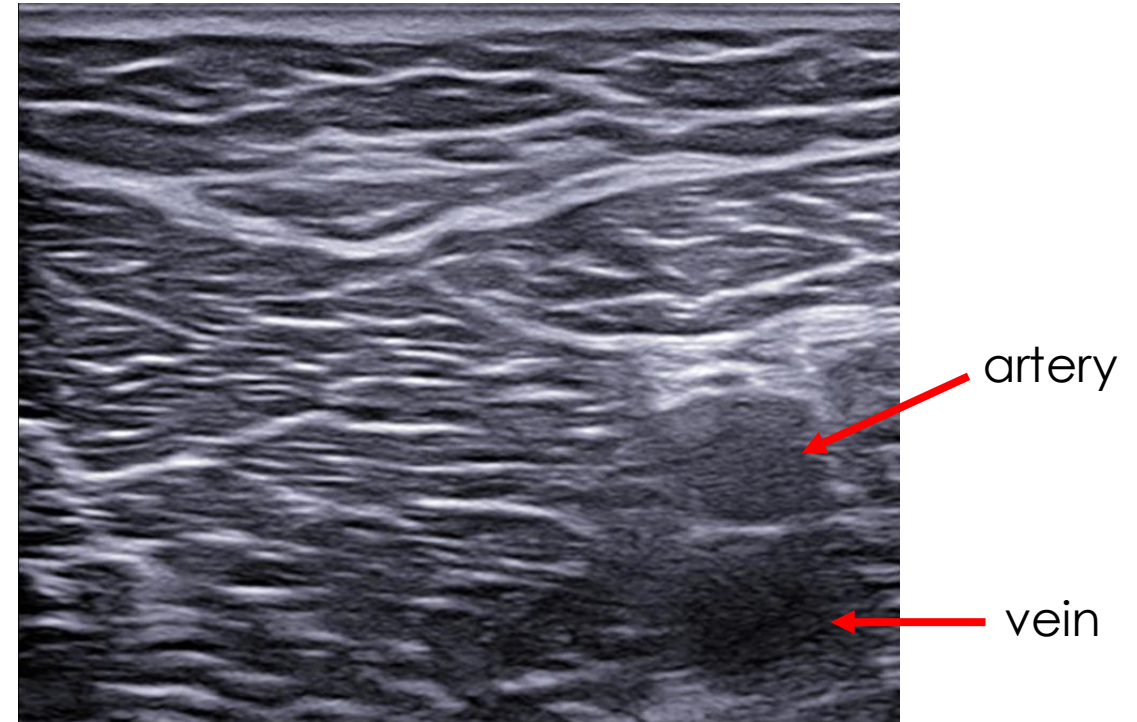
- 3rd most frequent vascular diagnosis after heart attack and stroke;
- Affects more than 1M Americans and more than 0.7M Europeans per year;
- Annual health expenditure related to DVT is €8.5 billion in EU.

Clinical standard for DVT detection

Currently, ultrasonography is the method of choice for DVT diagnosis:

- direct visualization of the thrombus;
- Doppler to assess venous flow;
- compression ultrasound.

Compression US



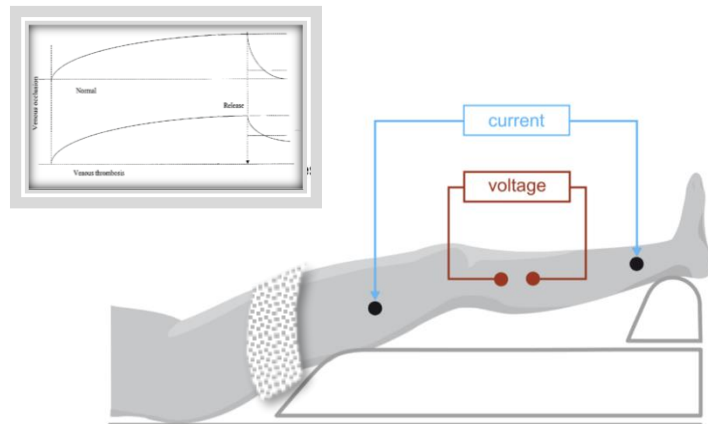
While compressing with the US probe till the artery starts to compress:

- when **normal**, the vein fully collapses.
- when **DVT is present**, vein does NOT collapse.

Alternative methods for DVT detection

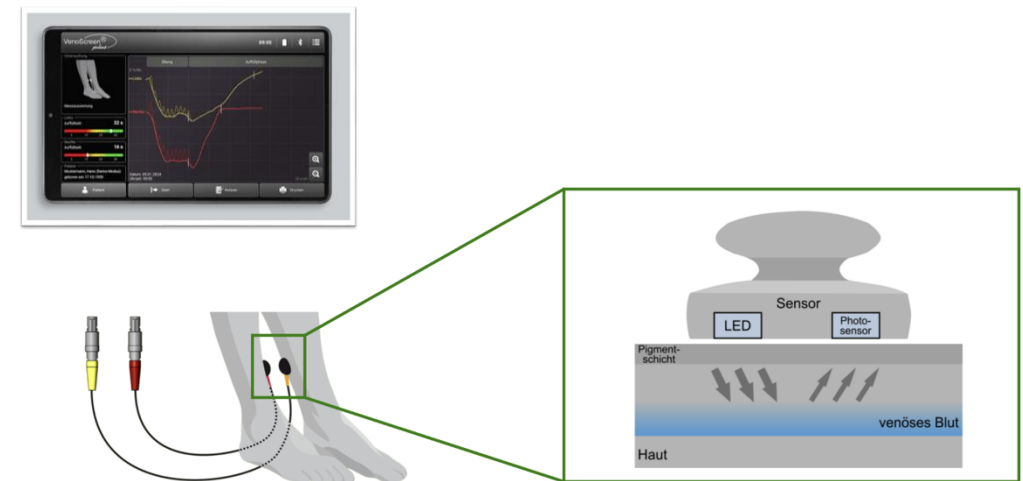
Venous Occlusion Plethysmography (VOP):

- measures blood volume changes in peripheral veins via electrical impedance changes



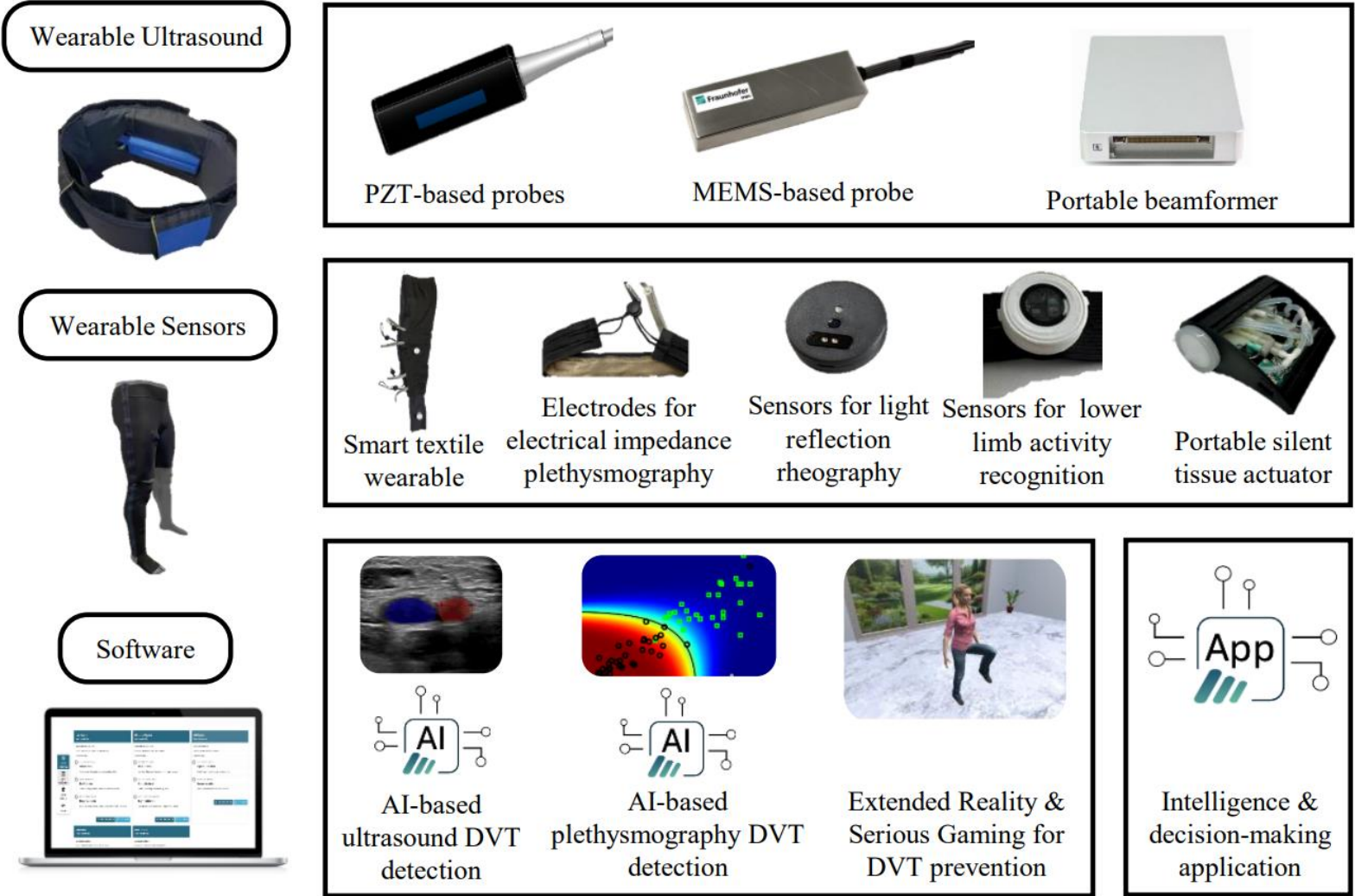
Light Reflection Rheography (LRR):

- measures blood volume changes in peripheral veins via reflection of light



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System modules & developed components

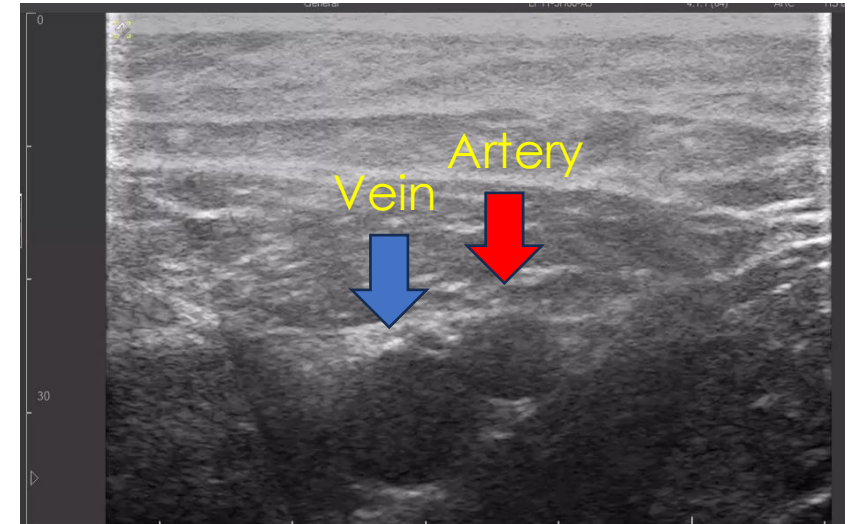


Compression Ultrasound Prototype

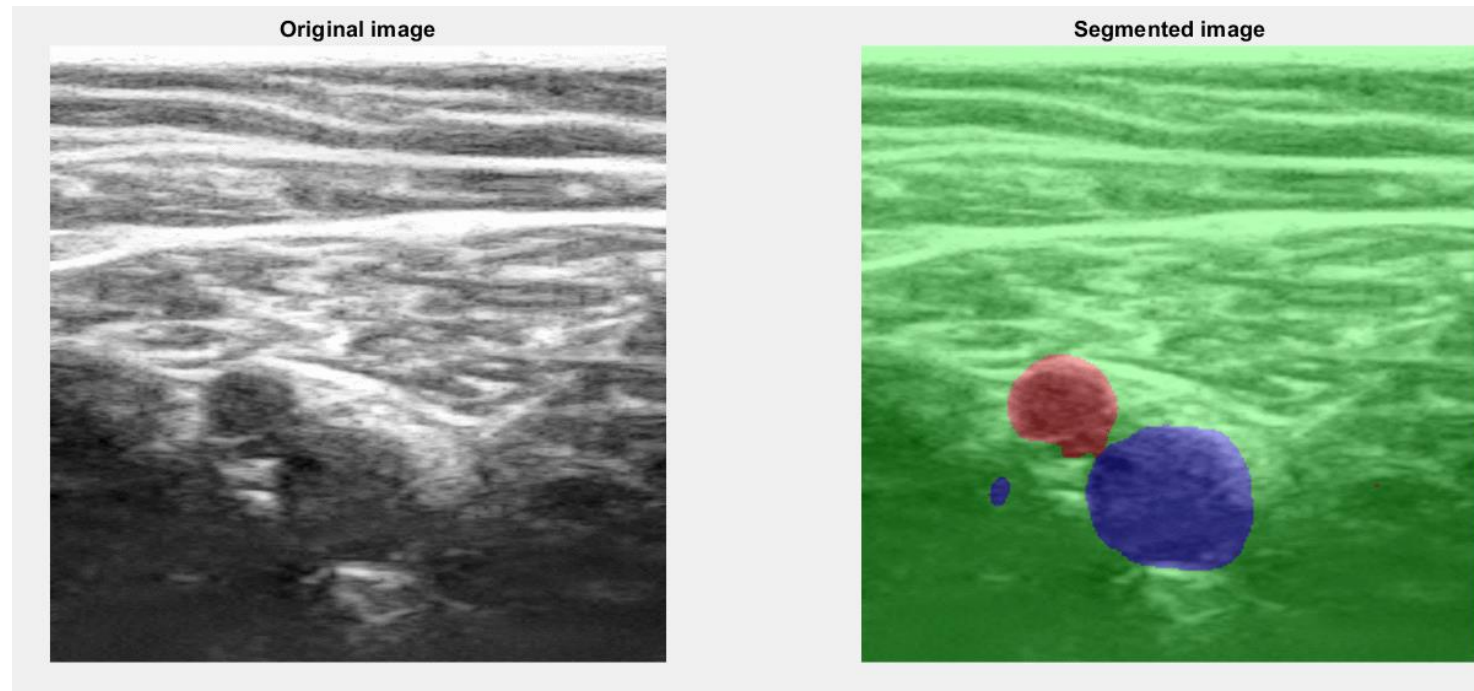
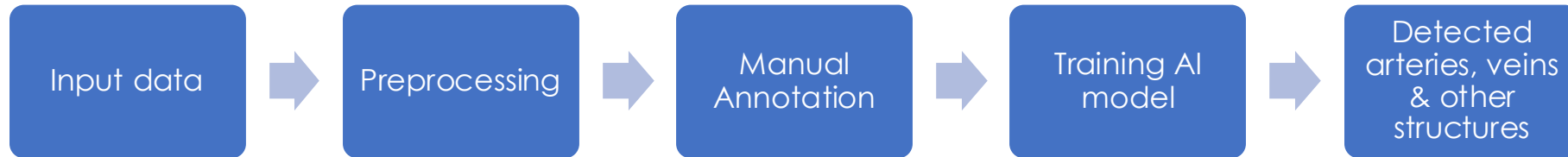
Tissue actuator with
US transducer



Telemed US
beamformer



AI / ML- based vessel segmentation



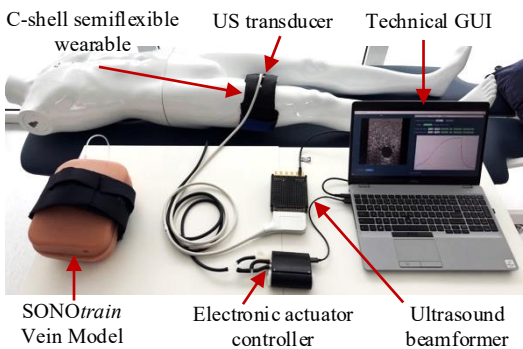
T6.3 Hardware integration



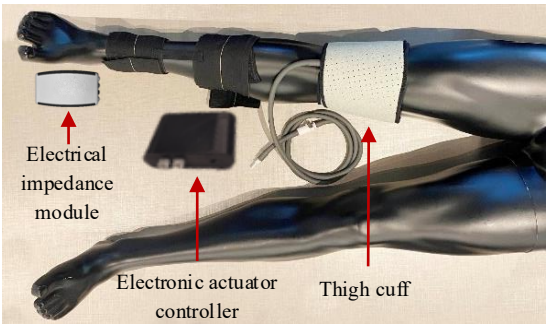
T6.5 Software and hardware integration



Compression ultrasound



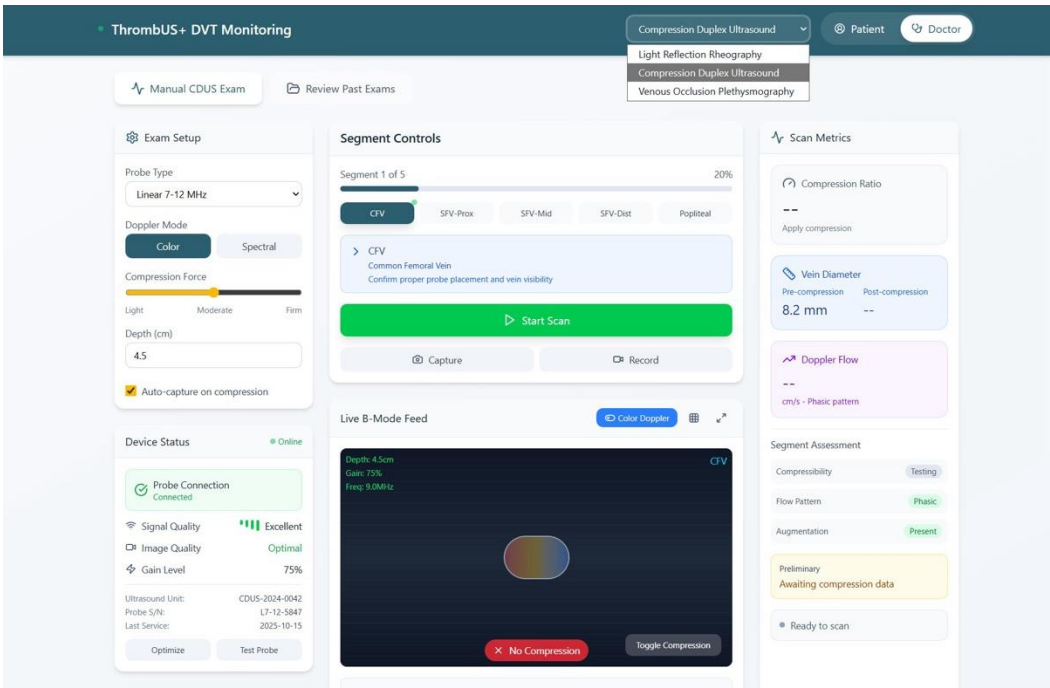
Venous Occlusion Plethysmography



Light Reflection Rheography



Central Hub & Intelligence



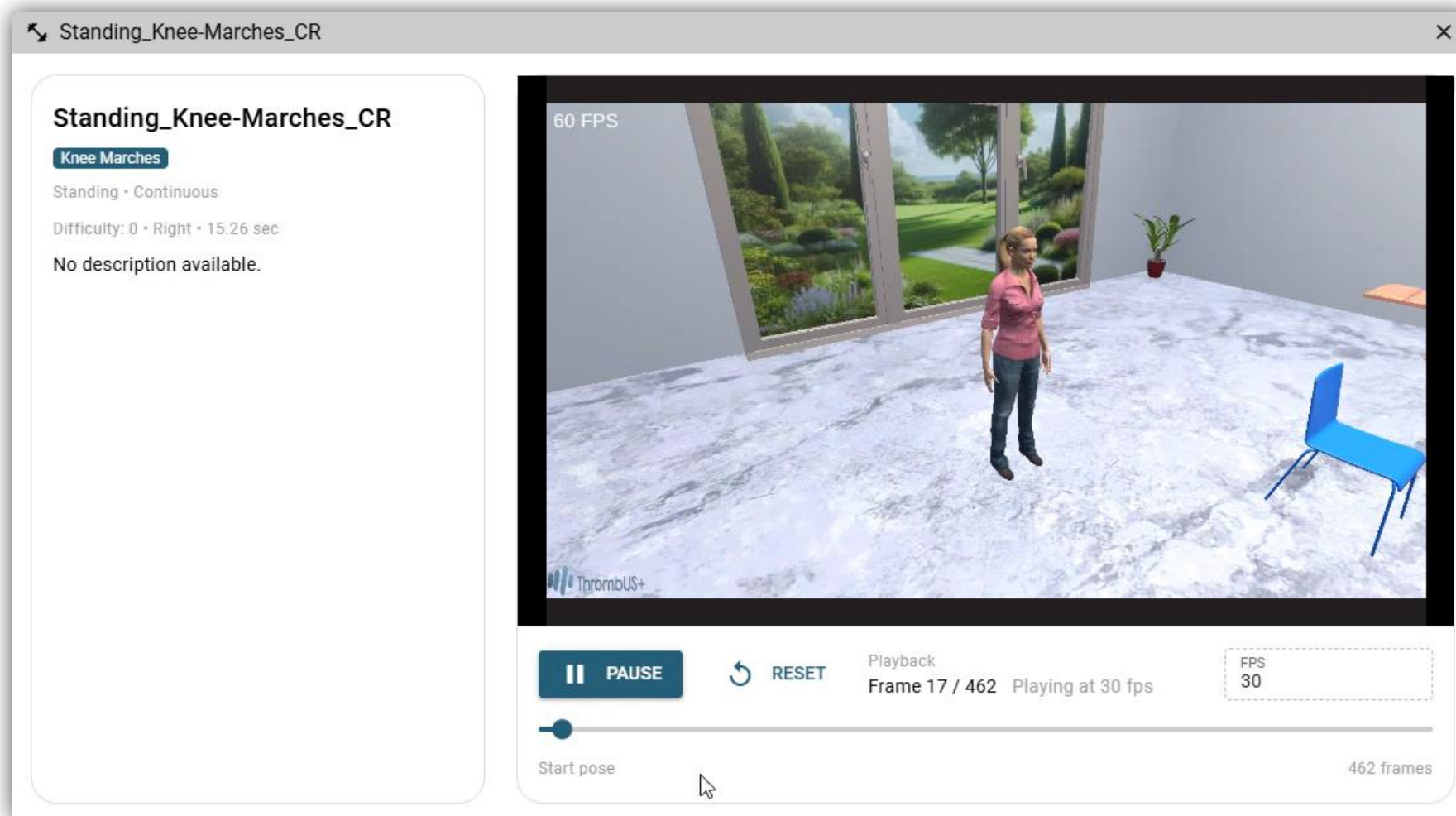
PREVENTION



Limb activity module



DVT Prevention: Exercise browsing and assignment editing



A Conventional ultrasound image set collection to create a training data set

Participants >3000

B1 Training data set collection using the prototype wearable ultrasound to fine tune the AI model

Participants >500

B2 Physiological signals, lower limb activity and plethysmography measurements via the ThrombUS+ prototype wearable sensor components from healthy volunteers

Participants >60

C1 Early feasibility study of the ThrombUS+ integrated prototype in patients in the postoperative ward

Participants 25-50

C2 Prospective, double-blinded, pilot study evaluating artificial intelligence driven automatic detection of deep vein thrombosis by the ThrombUS+ device compared to standard ultrasound imaging in patients suspected for deep vein thrombosis

Participants: 50-100

The deliverables

#	No	Lead	Type	Dissem	Month	Date
1	D8.1	SciGen	DEC	PU	1	Jan 2024
2	D1.1	ATHENA	DEC	SEN	1	Jan 2024
3	D10.1	ATHENA	ETHICS	SEN	1	Jan 2024
4	D1.2	ATHENA	R	SEN	3	Mar 2024
5	D1.3	MEDEA	R	SEN	3	Mar 2024
6	D8.2	SciGen	R	PU	3	Mar 2024
7	D9.1	VDE	R	PU	3	Mar 2024
8	D1.4	ATHENA	DMP	PU	4	Apr 2024
9	D7.1	PHAZE	R	PU	5	May 2024
10	D2.1	PBY	R	PU	6	Jun 2024
11	D2.2	VDE	R	PU	8	Aug 2024
12	D2.3	KTU	R	PU	10	Oct 2024
13	D2.4	ComfTech	R	SEN	12	Dec 2024
14	D3.1	VERMON	DEM	SEN	12	Dec 2024
15	D3.2	FRAUNHOFER	DEM	SEN	12	Dec 2024
16	D3.3	KTU	DEM	SEN	12	Dec 2024
17	D4.1	TAU	DEM	SEN	12	Dec 2024
18	D4.2	MEDIS	DEM	SEN	12	Dec 2024
19	D4.3	KTU	DEM	SEN	12	Dec 2024
20	D7.2	PHAZE	R	PU	12	Dec 2024
21	D7.3	PHAZE	R	PU	13	Jan 2025
22	D6.1	KTU	R	PU	14	Feb 2025
23	D3.4	TELEMED	DEM	SEN	15	Mar 2025
24	D7.4	PHAZE	R	PU	15	Mar 2025
25	D4.4	ComfTech	DEM	SEN	16	Apr 2025
26	D6.2	KTU	R	PU	18	Jun 2025
27	D3.5	KTU	R	PU	19	Jul 2025
28	D4.5	KTU	R	PU	19	Jul 2025

#	No	Lead	Type	Dissem	Month	Date
29	D7.5	PHAZE	R	PU	20	Aug 2025
30	D3.6	TELEMED	DEM	SEN	21	Sep 2025
31	D4.6	ComfTech	DEM	SEN	21	Sep 2025
32	D1.5	ATHENA	DMP	PU	24	Dec 2025
33	D7.6	PHAZE	R	PU	24	Dec 2024
34	D6.3	KTU	DEM	SEN	26	Feb 2026
35	D8.3	ATHENA	DATA	PU	26	Feb 2026
36	D5.1	EchoNous	DEM	SEN	28	Apr 2026
37	D5.2	TAU	DEM	SEN	28	Apr 2026
38	D5.3	ATHENA	DEM	SEN	28	Apr 2026
39	D5.4	ATHENA	DEM	SEN	28	Apr 2026
40	D5.5	ATHENA	DEM	SEN	28	Apr 2026
41	D6.4	ATHENA	DEM	SEN	28	Apr 2026
42	D7.7	PHAZE	R	PU	29	May 2026
43	D6.5	KTU	DEM	SEN	32	Aug 2026
44	D7.8	PHAZE	R	PU	36	Dec 2026
45	D1.6	ATHENA	R	SEN	42	Jun 2027
46	D1.7	MEDEA	R	SEN	42	Jun 2027
47	D7.9	PHAZE	R	PU	42	Jun 2027
48	D8.4	SciGen	R	PU	42	Jun 2027
49	D8.5	SciGen	R	PU	42	Jun 2027
50	D9.2	VDE	R	PU	42	Jun 2027
51	D9.3	PBY	R	PU	42	Jun 2027
52	D9.4	MEDEA	R	SEN	42	Jun 2027
53	D10.5	ATHENA	ETHICS	SEN	42	Jun 2027
54	D10.2	ATHENA	ETHICS	SEN	12	Dec 2024
55	D10.3	ATHENA	ETHICS	SEN	24	Dec 2025
56	D10.4	ATHENA	ETHICS	SEN	36	Dec 2026

52 +4
deliverables

**KTU responsibility
8 deliverables**

The latest paper about the ThrombUS+ project

The screenshot shows the journal's homepage with the article title prominently displayed. The header includes the journal name, a search bar, and navigation links. The article title is 'ThrombUS+ Project: Towards Wearable Continuous Point-of-Care Monitoring for Deep Vein Thrombosis of the Lower Limb'. Below the title, the authors are listed: Vaidotas Marozas, Stylianos Didaskalou, Rimvydas Eitminavičius, Rytis Jurkonis, Saulius Daukantas, Mantas Jucevičius, Andrius Rapalis, Nicolas Pousset, Mathieu Legros, and Eleni Kaldoudi. The article is marked as an 'INNOVATION REPORT' and has 28 authors. The journal cover image on the right features a DNA double helix and the journal title.

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INNOVATION REPORT

ThrombUS+ Project: Towards Wearable Continuous Point-of-Care Monitoring for Deep Vein Thrombosis of the Lower Limb

VAIDOTAS MAROZAS, STYLIANOS DIDASKALOU, RIMVYDAS EITMINAVIČIUS, RYTIS JURKONIS, SAULIUS DAUKANTAS, MANTAS JUCEVIČIUS, ANDRIUS RAPALIS, NICOLAS POUSSET, MATHIEU LEGROS, [...] , AND ELENI KALDOUDI +28 authors Authors Info & Affiliations

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ThrombUS+ Project: Towards Wearable Continuous Point-of-Care Monitoring for Deep Vein Thrombosis of the Lower Limb

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<https://spj.science.org/doi/10.34133/csbj.0082>

Project meetings

Greece, January 2024



Kaunas, May 2024



Italy, January 2025



Finland, June 2025



Spain, March 2026





Thank You

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Fraunhofer Institute for Photonic Microsystems



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