

Newsletter #8

iTOBOS

Intelligent Total Body
Scanner for Early
Detection of Melanoma



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iToBoS achievements and technological advances

The iToBoS project (developed from April 2021 to March 2025) represents a groundbreaking achievement in the field of dermatology. By focusing on early detection and personalized melanoma risk assessment, the project has successfully integrated advanced technologies, artificial intelligence, and multidisciplinary approaches to deliver an innovative diagnostic platform. This platform addresses critical challenges in melanoma detection with the aim of improving clinical outcomes and the overall experience for both patients and healthcare professionals.

The iToBoS project has successfully implemented a wide range of technological innovations that collectively improve the precision and efficiency of melanoma detection. Next, more relevant key achievements are presented.

Demonstration of the feasibility of using liquid lenses for non-contact dermatoscopic image acquisition

The use of liquid lenses in the total body scanner has been a pivotal innovation. These lenses enable the acquisition of high-resolution dermoscopic images without the need for physical contact. This technological advancement enables detailed visualization of skin lesions while ensuring a comfortable and non-invasive experience for patients.

Development of a total body scanner able to acquire non-contact dermoscopy

iToBoS project has developed an integrated total body scanning system designed to acquire high-resolution dermoscopic images without the need for direct contact with the patient's skin. The

system is equipped with advanced image processing and AI-driven analysis tools that enable automated detection and segmentation of skin lesions, streamlining the diagnostic workflow. This breakthrough in imaging technology marks a significant leap forward in early melanoma detection and has paved the way for more personalized and timely interventions.

Development of an AI cognitive assistant

A significant achievement has been the creation of a cognitive assistant powered by artificial intelligence. This tool can evaluate the specific malignancy risk of a skin lesion and providing a comprehensive assessment of the patient's overall risk. The assistant integrates multiple data sources, including skin images, skin phenotype, demographic information, clinical data, and the presence of genetic mutations. This multifaceted analysis supports healthcare professionals by offering actionable insights tailored to each patient.

Development of an intelligent human-machine interface

To enhance the usability and clinical adoption of the AI cognitive assistant, the iToBoS project has developed an intelligent human-machine interface designed specifically for dermatologists. This interface presents the results of the cognitive assistant in a clear, structured and intuitive manner, ensuring that healthcare professionals can easily interpret and act upon the AI-generated insights. By employing advanced visualization techniques, the system effectively highlights key risk factors,

lesion characteristics and patient-specific recommendations, facilitating a seamless integration into clinical workflows. This innovation bridges the gap between AI-driven analysis and medical decision-making, empowering dermatologists with a user-friendly tool that enhances diagnostic confidence and supports personalized patient care.

Integration of genomic data

The inclusion of genomic information, obtained through saliva samples, into the holistic risk score of a patient significantly enhances the predictive accuracy of melanoma risk assessments. By incorporating individual genetic markers, the project facilitates personalized risk stratification and enables early intervention strategies tailored to each patient's unique profile. This genomic integration complements clinical and phenotypic data, resulting in a comprehensive assessment that considers both intrinsic and environmental factors.

Advanced tools for anonymization

To address concerns regarding data privacy and security, the project has incorporated robust anonymization tools. These tools not only safeguard patient confidentiality but also enhance the extraction of clinically relevant features from skin lesions, ensuring that the AI models operate with optimized inputs.

Secure cross-continental data exchange

A significant milestone of the iToBoS project is the successful establishment of secure data exchange protocols between Europe and Australia. Even though Australia is not governed by GDPR, data exchange tools have been developed

while safeguarding patient data. This breakthrough not only preserves privacy and anonymity but also facilitates international collaboration by allowing researchers to integrate and analyse diverse datasets, ultimately enhancing melanoma detection and treatment strategies.

Contribution to advancing melanoma detection

The iToBoS project has made substantial contributions to improving the precision and personalization of melanoma diagnostics. By combining cutting-edge technologies and personalized approaches, the platform has transformed how melanoma risk is assessed and managed. Among the main contributions in the detection of melanoma, the following should be highlighted:

- The integration of high-resolution imaging, genomic data, and phenotypic factors has enabled earlier and more accurate detection of suspicious lesions. This comprehensive approach allows for the evaluation of both the malignancy risk of individual lesions and the patient's overall risk profile, ensuring a more holistic understanding of their condition.
- An initial patient questionnaire was implemented as part of the project to collect detailed information about their skin phenotype, sun exposure history, and activities related to ultraviolet radiation. This data provided essential context for understanding environmental and behavioural factors that contribute to melanoma risk.

iToBoS challenges workshop

iToBoS project addressed key challenges in skin cancer detection, such as monitoring lesion changes over time and ensuring accessibility in resource-constrained environments. iToBoS involved community engagement through two major machine learning (ML) challenges hosted on Kaggle: the ISIC 2024 Skin Cancer Detection Challenge and the iToBoS 2024 Skin Lesion Detection Challenge. These challenges encouraged the development of state-of-the-art ML models for classification and detection of skin lesions from clinical images, leveraging the extensive datasets provided by iToBoS.

The classification challenge, titled **ISIC 2024 Skin Cancer Detection with 3D-TBP**, focused on developing image-based algorithms to differentiate histologically-confirmed malignant skin lesions from benign lesions. Participants worked with lesion-centric crops extracted from 3D-TBP scans of several patients captured using the VECTRA WB360 scanner, accompanied by patient-level and image-level metadata. The challenge was launched on Kaggle in June 2024 and remained active until September 2024. It attracted remarkable global engagement, with 3,410 participants forming 2,739 teams and more than 79,000 submissions. The detection challenge, titled **iToBoS 2024 Skin Lesion Detection with 3D-TBP**, focused on developing machine learning models for detecting skin lesions across various regions of the body using 3D-TBP data. Participants were tasked to work

with wide-field images, which represent specific regions of the skin surface extracted from 3D-TBP scans and annotated with bounding boxes around all suspicious lesions. The dataset also included patient-level metadata, such as approximate age, anatomical region, and sun damage score, for each image. The challenge was launched in December 2024 and remained open for community participation until mid-February 2025.

Also, the University of Girona hosted the **iToBoS Workshop on Skin Lesion Detection with 3D-TBP** at the Politecnica-4 building, bringing together leading experts and practitioners in dermatology, medical imaging, machine learning, and artificial intelligence.

The event provided a comprehensive overview of the latest advancements in computer-aided dermatological diagnostics and served as a platform to analyse the results of the Lesion Detection Challenge organized by the iToBoS team.

The workshop served as a unique platform for knowledge exchange, featuring insightful discussions from distinguished researchers and industry professionals. Topics covered the integration of cutting-edge machine learning algorithms and the role of AI in enhancing diagnostic accuracy for skin lesions. Participants left the workshop with valuable insights and new professional connections, reinforcing the event's objective to promote collaborative efforts in dermatological research and technology development.

Guidance recommendations for the future implementation of AI in the medical context

The novel total body scanner and AI Cognitive Assistant developed in the iToBoS project can provide diagnostic advantages to clinicians and contribute to improved care and outcomes for melanoma patients. Given these potential benefits, the iToBoS solutions should continue to be developed and implemented beyond the project lifecycle. To ensure that any further development the iToBoS solutions is achieved in an ethically and socially responsible manner, it is crucial that accountability for the socio-cultural and ethical impacts of the iToBoS solutions continues to be a priority.

The examination of the socio-cultural and ethical impacts of the iToBoS solutions demonstrated that these impacts are interlinked, and that addressing issues will be an ongoing process which will require collaboration and cooperation across disciplines and perspectives.

Recommendations were made for the future development and use of the iToBoS solutions based on the exploration of five key socio-cultural and ethical considerations relevant to the project: privacy and data protection, autonomy, transparency, trust, and clinical effectiveness. Here a summary of the recommendations which are intended to guide stakeholders in the future development and implementation of the iToBoS solutions is presented.

Privacy and Data Protection

1. It is critical to keep a nuanced understanding of privacy in mind when engaging with stakeholders in

relation to the iToBoS solutions, especially when considering patient perspectives and how their views on privacy may impact their decision-making.

2. To respect the right of privacy when developing and implementing the iToBoS solutions, it is essential to maintain a strong regulatory environment, and guarantee compliance with data protection regulations. This must also be supported by allocating adequate resources to appropriately manage FAIR (Findable, Accessible, Interoperable, and Reusable) data requirements and promote RRI (Responsible Research and Innovation) culture.
3. In order to alleviate the concerns that patients may have about the use of their health data within the iToBoS solutions, deployers should maintain their commitment to preserving patient privacy and continue to provide up-to-date information to patients on how the iToBoS solutions are governed, how and where their data will be stored, and how their data will and will not be used.

Autonomy

4. Obtaining informed consent for the iToBoS solutions is not merely a box-ticking exercise, it is an important process which must prioritise patient autonomy and value the patient's perspective. The explanatory element of this process is critical and requires clearly and concisely communicating information in a manner that is culturally and socially sensitive, and consider factors such as language, age, ability or

education. Regarding the patient's perspective, a patient's decision-making process can be impacted by their views on privacy, their commitment to altruism, and their perception of risk and potential sense of desperation. Consideration must be given to any emotional distress a patient may be experiencing during this process, and psycho-social support should be made easily available to them.

5. Informed consent frameworks need to be adapted to meet the challenge of establishing a minimum standard of AI literacy for patients when they are being asked to consent to their health data being shared with AI systems. This should be considered in conjunction with the measures implemented and support provided to address basic literacy and health literacy issues.

Transparency

6. Explainable AI (XAI) must be defined in relation to the needs of the diverse, yet distinct, AI system stakeholders. It is necessary to develop tailored explainability strategies and techniques to communicate how AI solutions work and how decisions are reached. These strategies and techniques should be developed for the full lifecycle of the AI system's implementation, including understanding how to differentiate between successful results and failures. Groundwork for this should be incorporated into medical training and supported by technical design and security measures.
7. Co-creation engagement strategies should be leveraged between all parties, particularly the patients and clinicians, in order to understand their explainability needs, assess AI literacy levels, and take varying

perspectives into account. When designing explainability, the following question should be answered: 'What is being explained to me and why is it significant to me and my decision-making?'

Trust

8. It must be recognised that trust is a foundational principle in healthcare, and therefore there needs to be proactive engagement with patients and clinicians to build trust and demonstrate how ethics has been included throughout the design and implementation process of AI tools.
9. The iToBoS solutions should be treated as a decision-making tool and should continue to be developed, implemented, and deployed in compliance with relevant and up-to-date legislation, regulations, and guidelines.

Clinical Effectiveness

10. iToBoS solutions must be cautiously and efficiently implemented into existing care pathways to avoid exacerbating existing system inequalities and inefficiencies. This requires input and ongoing support from a variety of stakeholders, including patient advocacy groups, national governments, regulators, and insurers.
11. As AI tools become increasingly popular in healthcare, the position of clinicians and their concerns and obligations must be considered. Clinicians may need further guidance from their professional regulators, clarity from their clinical indemnifier, and further education and training to safely and efficiently engage with these technologies. In addition to supporting clinicians, these developments will provide guidance and assurance for patients and the general public.

Some project events and activities

In the eighth semester of the project iToBoS organized and participated in different events for communication, dissemination and outreach purposes. iToBoS representatives presented the project and shared experiences with a wide range of stakeholders, including relevant players from the fields of ICT, innovation, research, opto-electronics, healthcare, and business. The following events and activities are highlighted:

- London, 17-18/03/2025. AI UK 2025 event, hosted by the Alan Turing Institute.
- Barcelona & online, 3-6/03/2025. MWC Open Innovation Challenge.
- Girona & online, 4-5/03/2025. iToBoS 9th GA meeting and 8th PMB meeting.
- Girona, 17/02/2025. Innovative Approaches to Skin Lesion Detection with 3D-TBP at iToBoS Workshop.
- Girona & online, 30/12/2024-7/02/2025. iToBoS 2024 Challenge - Skin Lesion Detection with 3D-TBP.
- San Francisco, 25-30/01/2025. Photonics West.
- Online, 30/01/2025. Joint workshop of the stakeholders of the NEMECYS and iToBoS project.
- Montreux, 23-25/01/2025. 28th Annual Meeting of the European Dermatology Forum.
- Budapest & online, 28/11/2024. HUNREN Cloud Meet Up.
- Cartagena de Indias, 19-23/11/2024. XXIV Ibero-Latin American Dermatology Congress (CILAD).
- Barcelona, 5-12/11/2024. SC Open Innovation Challenge and Expo World Congress.
- Barcelona, 5/11/2024. Deep Tech Summit.
- Buenos Aires, 16-19/10/2024. 6th World Congress of Dermoscopy.
- Barcelona, 9-10/10/2024. AI & Big Data Congress.
- Marrakech, 6-10/10/2024. Medical Image Computing and Computer Assisted Intervention Congress 2024.
- Stuttgart, 8-10/10/2024. Vision Exhibition.
- Athens, 27/09/2024. European Researchers Night 2024.
- Amsterdam, 28/09/2024. European Academy of Dermatology and Venereology Congress 2024.
- Jena, 25-26/09/2024. W3+ Fair Convention and En-Tech Talks.



iToBoS team at the 9th GA meeting hosted by the University of Girona.

Work presented

During the eighth semester of the project the following deliverables have been produced and submitted:

Deliverable submitted	Month	Leader	Diss. level
D2.4 Report on transparency and interpretability of the iToBoS system.	46	TRI IE	PU
D2.5 Guidance recommendations for future implementation of AI in the medical context.	46	TRI IE	PU
D7.8 Software and methods for integrating XAI solutions into clinical and imaging-based quantitative AI-based risk assessment tools.	46	Fraunhofer	CO
D8.6 Report on methods, software and validation of the Cognitive Assistant.	46	NTUA	CO
D11.6 Final report on impact and learnings of patient involvement throughout iToBoS.	46	MPNEsupport	PU
D12.6 Proposals for new standardization initiatives.	46	FCRB	PU
D12.8 iToBoS challenges, execution of two open challenges.	46	FCRB	PU
D10.9 Report on the clinical data acquisition using the Bosch scanner.	47	FCRB	CO
D4.6 Final Data management plan aligned with FAIR principles and other initiatives including RDA and EOSC.	48	SZTAKI	PU
D7.2 Ground truth annotated dataset-Final release.	48	FCRB	CO
D7.3 Software and methods regarding XAI based dataset bias identification, documentation and prevention techniques.	48	Fraunhofer	CO
D9.4 Guidelines and plan for getting the certification of the system by international regulatory bodies.	48	CAN	CO
D10.6 A report on the image quality of Vectra and Bosch scanners compared to dermoscopic images generated in the clinical trial.	48	UQ	CO
D10.10 Report on status of posting results for the clinical feasibility study (250 new participants).	48	FCRB	PU
D12.3 Communication, Dissemination, Outreach and Engagement activities (Final release).	48	RICOH SPAIN	PU
D12.9 Global socioeconomic impact of project and final conclusions.	48	RICOH SPAIN	CO

Publications

During this eighth semester of the project the following scientific works have been published in the iToBoS context.

- "Going Smaller: Attention-based models for automated melanoma diagnosis". Computers in Biology and Medicine, 2025.
- "Skin 2.0: How cutaneous digital twins could reshape dermatology". Journal of Investigative Dermatology, 2025.
- "Green synthesis of gold nanoparticles: pros and cons of natural compounds". Nano Express, 2024.
- "Advancing dermoscopy through a synthetic hair benchmark dataset and deep learning-based hair removal". Journal of Biomedical Optics, 2024.
- "Tanorexia criteria for better understanding sun overexposure in one of the Italian leading towns for melanoma incidence". Italian Journal of Dermatology and Venereology, 2024.
- "Pruning by explaining revisited: Optimizing attribution methods to prune CNNs and transformers". European Conference on Computer Vision, 2024.
- "SPOT: Self-training with patch-order permutation for object-centric learning with autoregressive transformers". IEEE/CVF Conference on Computer Vision and Pattern Recognition, 2024.
- "Integrating generative AI with ABCDE rule analysis for enhanced skin cancer diagnosis, dermatologist training and patient education". Frontiers in Medicine, 2024.
- "A fresh look at sanity checks for saliency maps". World Conference on Explainable Artificial Intelligence, 2024.
- "Explainable concept mappings of MRI: Revealing the mechanisms underlying deep learning-based brain disease classification". World Conference on Explainable Artificial Intelligence, 2024.
- "PURE: turning polysemantic neurons into pure features by identifying relevant circuits". Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition Workshops, 2024.
- "Reactive model correction: Mitigating harm to task-relevant features via conditional bias suppression". Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition Workshops, 2024.
- "Understanding the (extra-)ordinary: validating deep model decisions with prototypical concept-based explanations". Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition Workshops, 2024.

In addition, different articles aimed at broader audiences have been developed and published on the project website, presenting the project from different perspectives, considering the different profiles of all the project partners.



iToBoS team

The consortium with 20 partner organizations is led by the University of Girona (Spain). This international consortium brings together **leading research / academic institutions** (5 research centres), **industries** (4 large companies and 7 SMEs) and **end-user entities** (3 hospitals and 1 patients' NPO).



The University of Queensland has received funding from the Australia's NHMRC under grant number APP2007014.



Let's stay in contact!

iToBoS has deployed some **digital channels to keep in touch with you and bring you the latest news** about the project. They are also a way to receive your ideas and comments as well as learn more about your needs.



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