The next_AIM project
(INFN CSN5, 2022-2024)
https://www.pi.infn.it/aim/

Kickoff meeting, February 17 2022
https://agenda.infn.it/event/30287/

Alessandra Retico
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Sezione di Pisa

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The AIM (Artificial Intelligence in Medicine) project – 2019-2021

Resp. Naz.: A. Retico

11 Research Units:

- Pisa (M.E. Fantacci)
- Bari (S. Tangaro)
- Bologna (D. Remondini)
- Cagliari (P. Oliva)
- Catania (M. Marrale)
- Firenze (C. Talamonti)
- Genova (A. Chincarini)
- Lab. Naz. Sud (G. Russo)
- Milano (C. Lenardi)
- Napoli (G. Mettivier)
- Pavia (A. Lascialfari)

Artificial Intelligence to become the next revolution in **medical diagnostics** and **therapy**.

- New image processing and data analysis strategies, including radiomics approaches, need to be developed and extensively validated.

Objectives	Methods	Applications	
AIM1: Multicenter data harmonization	image processing; data filtering; feature extraction; feature classification; data harmonization; image classification; pattern recognition; radiomics; complex network analysis; network models; machine learning; deep learning	Reliability of multicenter studies in neuroimaging and in mammography.	MRI, RX, PET
AIM2: Quantification		Quantification of radiotracer uptake in PET. Quantitative MRI methods.	MRI, PET, omics
AIM3: Predictive models		Radiomics and dosiomics in oncology. ML and DL for disease diagnosis	MRI, RX, RT dose, CT, omics

Analysis of lung CT in Covid-19

Long-standing collaboration with Italian & European centers (hospitals / IRCCS) and with international consortia for data sharing

AIM' s collaborations with clinical centers and consortia

Several researchers from INFN divisions and University Departments collaborate with Radiologists, Clinicians and Medical Physicists in Clinical Centers to develop innovative solutions based on data mining and artificial intelligence.

Clinical partners

- IRCCS S. Martino (GE)
- IRCCS Stella Maris (PI)
- IRCCS Gaslini (GE)
- IRCCS Centro S. G. di Dio (BS)
- IRCCS G.Paolo II (BA)
- IRCCS Mondino (PV)
- IRCCS SDN (NA)
- IMAGO7
- AOUP (PI)
- Policlinico (BA)
- Policlinico (PA)
- Osp. Pediatrico Meyer (FI)
- Policlinico San Matteo (PV)

EU / consortia

- EADC (EU)
- ADNI (US)
- ABIDE (EU/US)
- ENIGMA (WW)

Azienda Ospedaliera Universitaria Policlinico Paolo Giaccone di Palermo

Provincia Lombardo-Veneta
Ordine Ospedaliero di S. Giovanni di Dio - Fatebenefratelli
CENTRO S. GIOVANNI DI DIO - FATEBENEFRATELLI
ISTITUTO DI RICOVERO E CURA A CARATTERE SCIENTIFICO
25125 BRESCIA - Via Pilastroni, 4
Telefono 030 35011 - Telefax 030 348255

Welcome to the EADC web site
European Alzheimer's Disease Consortium

Servizio Sanitario della Toscana

IRCCS Azienda Ospedaliera Universitaria San Martino – IST
Istituto Nazionale per la Ricerca sul Cancro

IRCCS FONDAZIONE STELLA MARIA

Gaslini

ABIDE

ENIGMA

ADNI Alzheimer's Disease Neuroimaging Initiative

next AIM: 2022-2024

Artificial Intelligence in Medicine (AIM): *next steps*

focus on *n*o-so-big data and *ex*plainable *t*echniques

next_AIM
Resp. Nazionale: A. Retico
Resp. Locali:
- Bari (S. Tangaro)
- Bologna (D. Remondini)
- Cagliari (P. Oliva)
- Catania (M. Marrale)
- Ferrara (G. Paternò)
- Firenze (C. Talamonti)
- Genova (A. Chincarini)
- Lab. Naz. Sud (G. Russo)
- Milano (C. Lenardi)
- Napoli (G. Mettivier)
- Pavia (A. Lascialfari)
- Pisa (M.E. Fantacci)

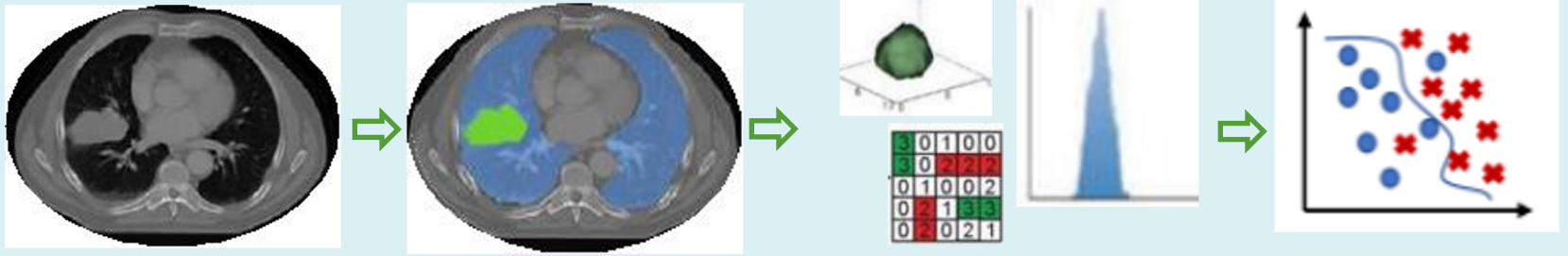
next **AIM** goal: *take steps towards developing robust and explainable AI algorithms and validating them on realistic use cases in the medical field*

A large variety of AI-based algorithms have already been developed to analyse medical images and data.
Their potential to improve clinical workflows has not yet been fully exploited due to:
- the lack of model robustness or generalizability
- the lack of transparency

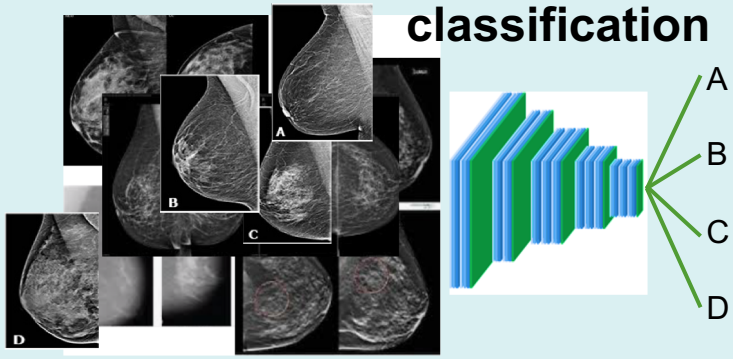
next AIM: research topics, challenges and implementation

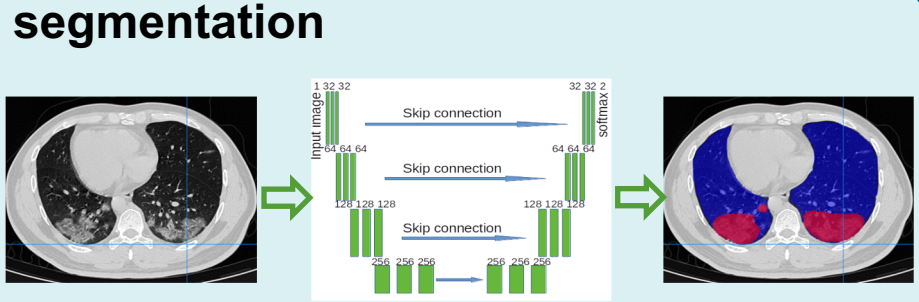
Typical AI-based analysis approaches used on medical data

a) Radiomics + Machine Learnin



b) Deep Learning





next AIM: research topics, challenges and implementation

WP1 **Challenge I: no-so-big data**

Strategies for efficient learning with limited data samples.

Evaluation of robustness and reliability of trained models.

WP2 **Challenge II: explainable AI (XAI)**

Make AI results understandable to humans.

Which image/data features were relevant to make a decision?

a) Radiomics + Machine Learning

b) Deep Learning

WP3 **Applications to real-world data samples**

Practical medical data analysis use cases on available samples (public data, private collections, integration of both), where the analysis approaches a, b or both are implemented, and the challenges I, II or both are encountered.

Implementation, test and validation in collaboration with colleagues working in Clinical context

next AIM: research topics, challenges and implementation

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WP4

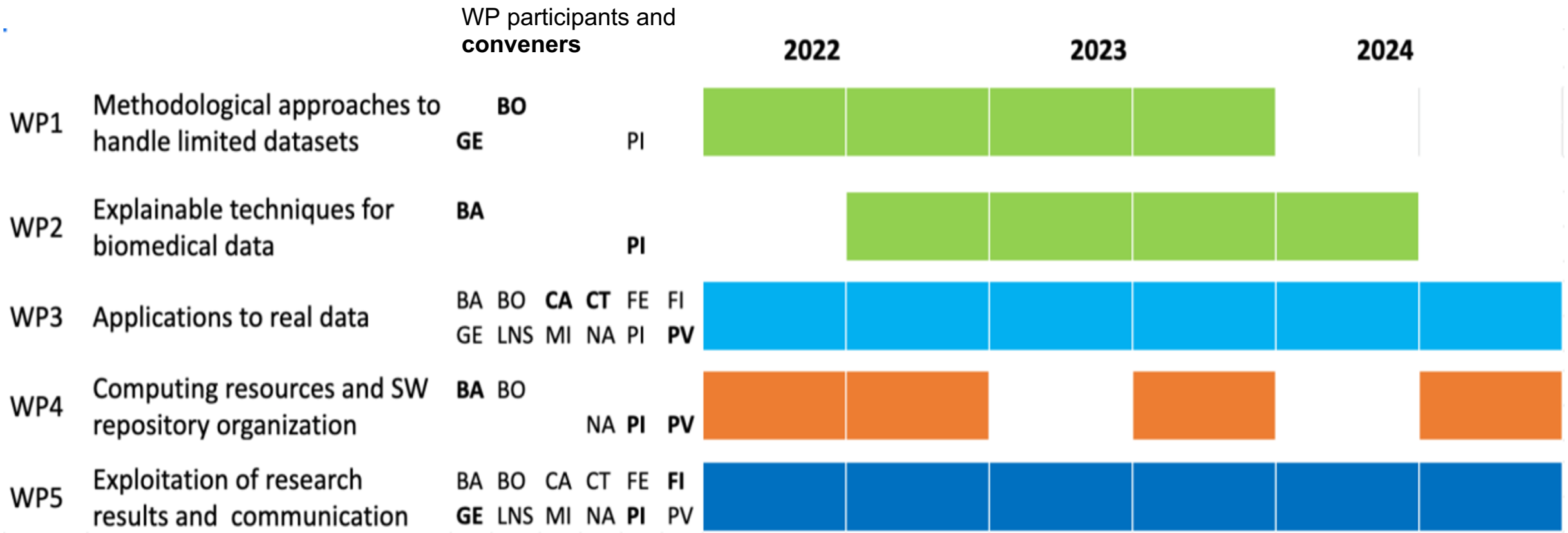
Computing resources and SW repository organization
(ReCaS, IBiSCo, INFN-Cloud + risorse HW locali)

WP5

Exploitation of research results and communication
(connection with AIFM, conferences, publications)

==> **https://agenda.infn.it/event/30287/**

timeline


WP participants and
conveners
2022
2023
2024
WP1
Methodological approaches to handle limited datasets
BO
GE
PI
WP2
Explainable techniques for biomedical data
BA
PI
WP3
Applications to real data
BA BO CA CT FE FI
GE LNS MI NA PI PV
WP4
Computing resources and SW repository organization
BA BO
NA PI PV
WP5
Exploitation of research results and communication
BA BO CA CT FE FI
GE LNS MI NA PI PV

People: 28.2 FTE (82 persone)

BARI						
1	Amoroso Nicola	Associato	Ricercatore	CSN V	30	
2	Bellantuono Loredana	Associato	Assegnista	CSN V	30	
3	Bellotti Roberto	Associato	Prof. Ordina	CSN V	20	
4	La Forgia Daniele	Associato	Altro	CSN V	10	
5	Lombardi Angela	Associato	Ricercatore	CSN V	50	
6	Maggipinto Tommaso	Associato	Prof. Assoc	CSN V	20	
7	Monaco Alfonso	Dipendente	Tecnologo	CSN V	35	
8	Pantaleo Ester	Associato	Assegnista	CSN V	30	
9	Tangaro Sabina	Associato	Prof. Assoc	CSN V	40	
10	Diacono Domenico	Dipendente	Tecnologo	CSN III	10	
					275	
BOLOGNA						
1	Brizi Leonardo	Associato	Ricercatore	CSN V	80	
2	Castellani Gastone	Associato	Prof. Ordina	CSN V	50	
3	Curti Nico	Associato	Assegnista	CSN V	30	
4	Giampieri Enrico	Associato	Ricercatore	CSN V	20	
5	Matteuzzi Tommaso	Associato	Assegnista	CSN V	50	
6	Remondini Daniel	Associato	Prof. Ordina	CSN V	70	
7	Sala Claudia	Associato	Ricercatore	CSN V	20	
8	Testa Claudia	Associato	Prof. Assoc	CSN V	80	
9	Vistoli Maria Cristina	Dipendente	Dirigente Tecnologo		10	
					410	
CAGLIARI						
1	Fanti Alessandro	Associato	Ricercatore	CSN V	30	
2	Golosio Bruno	Associato	Prof. Assoc	CSN V	30	
3	Oliva Piernicola	Associato	Prof. Assoc	CSN V	40	
4	Tiddia Gianmarco	Associato	Dottorando	CSN V	30	
5	Mazzarella Giuseppe	Associato	Prof. Ordina	CSN II	10	
					140	
CATANIA						
1	Bartolotta Antonio	Associato	Prof. Ordina	CSN V	50	
2	Borgese Riccardo	Associato	Specializza	CSN V	70	
3	Collura Giorgio	Associato	Assegnista	CSN V	70	
4	D'Oca Maria Cristina	Associato	Ricercatore	CSN V	50	
5	Marrale Maurizio	Associato	Prof. Assoc	CSN V	50	
6	Tomarchio Elio Angelo	Associato	Prof. Assoc	CSN V	50	
					340	

FERRARA						
1	Cardarelli Paolo	Dipendente	Ricercatore	CSN V	30	
2	Giganti Melchiorre	Associato	Prof. Ordina	CSN V	50	
3	Longo Lorenzo	Associato	Dottorando	CSN V	50	
4	Paternò Gianfranco	Associato	Ricercatore	CSN V	40	
5	Taibi Angelo	Associato	Prof. Assoc	CSN V	40	
					210	
FIRENZE						
1	Calusi Silvia	Associato	Ricercatore	CSN V	50	
2	Pallotta Stefania	Associato	Prof. Assoc	CSN V	20	
3	Piffer Stefano	Associato	Dottorando	CSN V	50	
4	Talamonti Cinzia	Associato	Prof. Assoc	CSN V	20	
					140	
GENOVA						
1	Alchera Nicola	Associato	Dottorando	CSN V	30	
2	Chincarini Andrea	Dipendente	Ricercatore	CSN II	30	
3	Gianeri Ruben	Associato	Assegnista	CSN V	100	
4	Peira Enrico	Associato	Dottorando	CSN V	100	
5	Sensi Francesco	Dipendente	Assegno di	CSN V	0	
					260	
LNS						
1	Russo Giorgio	Associato	Ricercatore	CSN V	50	
2	Stefano Alessandro	Associato	Ricercatore	Confermat	30	
3	Comelli Albert				100	
					180	
MILANO						
1	Arosio Paolo	Associato	Ricercatore	CSN V	30	
2	Carrazza Stefano	Associato	Ricercatore	CSN IV	20	
3	Groppi Flavia Maria	Associato	Prof. Assoc	CSN V	10	
4	Lenardi Cristina	Associato	Prof. Ordina	CSN V	20	
5	Manenti Simone	Associato	Assegnista	CSN V	10	
6	Veronese Ivan	Associato	Prof. Assoc	CSN V	10	
7	Orsini Francesco	Associato	Tecnico Ca	CSN V	10	
					110	

NAPOLI					
1	Mettivier Giovanni	Associato	Prof. Assoc	CSN V	25
2	Russo Paolo	Associato	Prof. Ordina	CSN V	25
3	Staffa MC				20
4	Acampora G				20
5	Landoni C				20
6	Masi M				20
					130
PISA					
1	Barca Patrizio	Associato	Specializzando		40
2	Biagi Laura	Associato	Ricercatore	CSN V	10
3	Bosco Paolo	Associato	Ricercatore	CSN V	20
4	Fantacci Maria Evelina	Associato	Prof. Assoc	CSN V	50
5	Lamastra Rocco	Associato	Specializzando		50
6	Laruina Francesco	Associato	Borsa Ente	CSN V	50
7	Lizzi Francesca	Associato	Dottorando		100
8	Retico Alessandra	Dipendente	Primo Ricer	CSN V	70
9	Tosetti Michela	Associato	Primo Ricercatore		10
10	Arezzini Silvia	Dipendente	Primo Tecn	CSN I	10
11	Ciampa Alberto	Dipendente	Primo Tecn	CSN I	10
12	Mazzoni Enrico	Dipendente	Tecnologo	CSN I	5
					425
PAVIA					
1	Cicolari Davide	Associato	Dottorando	CSN V	30
2	Lascialfari Alessandro	Associato	Prof. Ordina	CSN V	30
3	Mariani Manuel	Associato	Ricercatore	CSN V	20
4	Negri Andrea	Associato	Prof. Assoc	CSN I	10
5	Postuma Ian	Dipendente	Borse laure	CSN V	10
6	Protti Nicoletta	Associato	Ricercatore	CSN V	20
7	Rinaldi Lisa	Associato	Dottorando	CSN V	30
8	Figini Silvia	Associato	Prof. Ordina	CSN V	20
9	Filibian Marta	Associato	Tecnico Ca	CSN V	10
10	Pichiecchio Anna	Associato	Prof. Assoc	CSN V	20
					200

12 Sezioni
80 persone - 28 FTE

Financial requests

Piano finanziario globale di spesa

Anno	Missioni	Consumo	Altri_cons	Trasporti	Manutenzione	Inventario	Licenze-SW	Apparati	Spservizi	Totale
2022	*45.50*	*22.50*	*13.50*		*3.00*	*6.50*	*1.00*			**92.00**
2023	40.00	20.00	15.00		3.00	20.00	1.00			**99.00**
2024	40.00	20.00	15.00		3.00		1.00			**79.00**
Totali	**125.50**	**62.50**	**43.50**		**9.00**	**26.50**	**3.00**			***270.00***

2022

Sez. & Suf.	MISS				CON				ALTRICONS				SEM				TRA				PUB				MAN				INV				LIC-SW				APP				SPSERVIZI				TOTALE			
		Sj	Dot.	Ant.		Sj	Dot.	Ant.	Sj	Dot.	Ant.		Sj	Dot.	Ant.		Sj	Dot.	Ant.		Sj	Dot.	Ant.		Sj	Dot.	Ant.		Sj	Dot.	Ant.		Sj	Dot.	Ant.		Sj	Dot.	Ant.		Sj	Dot.	Ant.		Sj	Dot.	Ant.
BA	3.5				1.0				1.5																																		4.5	1.5		
	1.0				1.0				0.0																																		2.0			
BO	4.0				1.5				1.5																																		5.5	1.5		
	1.0				1.0				0.0																																		2.0			
CA	4.0				2.0																																				6			
	1.0				1.0																																				2.0			
CT	4.0				2.0				1.5																																6	1.5		
	1.0				1.0				0.0																																2.0			
FE	3.0				2.0				1.5																																5	1.5		
	1.0				1.0				0.0																																2.0			
FI	3.0				3.5				1.5																																6.5	1.5		
	1.0				3.0				0.0																																4.0			
GE	2.0	6			1.5				1.5																3.0								1.0										7.5	7.5		
	1.0	2.0			1.0				1.5																1.5								1.0										4.5	3.5		
LNS	2.0				2.0																																				4			
	1.0				1.0																																				2.0			
MI	1.0				4.0																																				5			
	0.5				2.5																																				3.0			
NA	4.5				1.0				1.5																				1.5														7	1.5		
	2.5				0.5				0.0																				1.0														4.0			
PI	6.0				2.0				1.5																																		8	1.5		
	2.0				1.5				1.5																																		3.5	1.5		
PV	4.0								1.5																				5.0								1.0						10	1.5		
	2.0								0.0																				4.0								1.0						7.0			
TOTALE	41	6			22.5				0	13.5															3				6.5				1								1				75	19.5		
	47				22.5				13.5				0				0				0				3				6.5				1				0				1				94.5			
	15	2	0	0	14.5		0	0	0	3	0	0													1.5	0	0		5	0	0		1	0	0						1	0	0		38	5.0	0.0	0.0
	17.0				14.5				3.0				0.0				0.0				0.0				1.5				5.0				1.0				0.0				1.0				43.0			

Milestones

2022		
31 Dec	M1.1	Identification of methodological pitfalls in case of small datasets
31 Dec	M2.1	Identification of explainability requirements for medical applications
31 Dec	M3.1	Identification of data samples for practical use cases and fist tests
30 Jun	M4.1a	Identification of available resources and usage instructions
31 Dec	M4.1b	SW package release instructions
31 Dec	M5.1	Workshop organization: "AI methods and applications in Medical Physics"
2023		
31 Dec	M1.2	Definition of robust pipelines for efficient model training on small datasets
31 Dec	M2.2	Customization of explainability pipelines to AI models for medical imaging
31 Dec	M3.2	Implementation of robust pipelines and explainability algorithms in at least three different use cases
31 Dec	M4.2	Integration of at least 1 application per site in **next**AIM SW package repository
31 Dec	M5.2	Workshop organization: "The right to explanation"
2024		
30 Jun	M2.3	Definition of optimal explainability methodology for medical problems
31 Dec	M3.3	Result evaluation for the practical use case and reporting
31 Dec	M4.3	Integration of all analysis pipelines trained for the use cases of WP3 in the **next**AIM SW package repository
31 Dec	M5.3	Submission of at least 1 scientific publication per use case