COST Action
Final Achievement Report
(12/09/2019 to 11/03/2024)

CA18206: Glioma MR Imaging 2.0

The Action was approved by the Committee of Senior Officials (CSO) on 4-6-2019 and has the MoU reference COST 023/19.

This report was submitted on 08-04-2024 by the Action Chair on behalf of the Management Committee in fulfilment of the requirements of the rules for COST Action Management, Monitoring and Final Assessment.

COST Association AISBL
Avenue du Boulevard - Bolwerklaan 21, box 2 | 1210 Brussels, Belgium
T +32 (0)2 533 3800 | office@cost.eu | www.cost.eu

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Action leadership and participants

Leadership positions

Position	Name	Contact details	Country*
Chair	Dr Esther Warnert	e.warnert@erasmusmc.nl +31(0)107044124	Netherlands

Position	Name	Contact details	Country*
Action Vice-Chair	Prof Radim Jancalek	radim.jancalek@fnusa.cz 00420606670512	Czechia

Working groups

#	WG Title	# of participants	WG Leader	Country*
1	Advanced MRI biomarkers for glioma characterisation	139	Dr Gilbert Hangel gilbert.hangel@meduniwien.ac.at	Austria
2	Multi-site data integration	56	Dr Camille Maumet camille.maumet@inria.fr	France
3	Clinical translation	72	Dr Jan Petr j.petr@hzdr.de	Germany
4	Stakeholder Relations	21	Prof Marion Smits marion.smits@erasmusmc.nl	Netherlands
5	Dissemination	46	Ms Patricia Clement patricia.clement@ugent.be	Belgium

Other key leadership positions

Position	Name	Contact details	Country*
Science Communication Coordinator	Ms Patricia Clement	patricia.clement@ugent.be	Belgium
GH Scientific Representative	Esther Warnert	e.warnert@erasmusmc.nl	Netherlands

* The country displayed is:

- for the Action Chair, the country that nominated that person to the Management Committee before they were elected Action Chair;
- for the Action Vice-Chair the country that nominated the person as a Management Committee Member,
- for all other leadership positions, if the person is a MC Member the country displayed is the country of nomination, otherwise it is the country of the person's primary work affiliation.

Participants

COST members having accepted the MoU

AL	02/11/2021	**AM**	09/01/2023	**AT**	22/11/2019	**BE**	20/08/2019	**BA**	25/10/2019
BG	21/10/2019	**HR**	23/07/2019	**CY**	20/11/2019	**CZ**	01/08/2019	**DK**	03/07/2019
EE	03/09/2019	**FI**	02/11/2021	**FR**	25/06/2019	**GE**	12/04/2022	**DE**	02/07/2019
EL	30/09/2019	**HU**	02/11/2021	**IS**	02/11/2021	**IE**	19/07/2019	**IL**	02/11/2021
IT	23/07/2019	**LV**	02/11/2021	**LT**	02/11/2021	**LU**	02/11/2021	**MT**	27/06/2019
MD	02/11/2021	**ME**	02/11/2021	**NL**	12/07/2019	**MK**	02/12/2019	**NO**	05/07/2019
PL	24/06/2021	**PT**	28/06/2019	**RO**	18/07/2019	**RS**	23/04/2020	**SK**	16/12/2019
SI	02/11/2021	**ZA**	02/11/2021	**ES**	22/07/2019	**SE**	02/11/2021	**CH**	23/04/2020
TR	08/07/2019	**UA**	12/04/2022	**UK**	25/06/2019				

Other participants

Institution Name	Country

Summary

Main aim/ objective

build a pan-European network of experts in glioma research, patient organisations, data scientists, and MRI scientists by uniting the glioma imaging community within Europe and progressing development and application of advanced MRI for improved decision making in diagnosis, patient monitoring, and assessment of treatment response in clinical trials and practice

The Action addressed this as described below

In 2019, Glioma MR Imaging 2.0 (COST Action CA18026, https://glimr.eu/) started with building a pan-European and multidisciplinary network of international experts in glioma research, patient organisations, data scientists, and MR imaging scientists by uniting the glioma imaging community within Europe. We aimed at progressing the development and application of advanced MR imaging for improved decision making in the diagnosis and monitoring of patients diagnosed with glioma in clinical trials and clinical practice. Today, Glioma MR Imaging 2.0 (or short "GliMR) is a strong network with more than 300 members and recognized globally as a network of experts in the field of advanced MRI for glioma imaging. Our impact on the scientific community ranges from support and education for the individual researcher via personal grants and training schools, to being the hub for creating and strengthening international collaborations for new research projects, and finally impacting clinical research and practice worldwide through our publications about state-of-the-art MRI acquisition and analysis technology for glioma MRI diagnostics.

Although 50.000 Europeans are newly diagnosed with glioma each year, the number of patients treated within a single hospital is quite often too small for impactful developments in research about advanced MRI tools. In GliMR we therefore continue to promote safe sharing of medical data for research purposes, in compliance with current European Union regulations on data privacy. You could for instance have a look at our short information video for patients and their caregivers about sharing medical data for research. This video has been developed in collaboration with the International Brain Tumour Alliance and is available in 17 languages (https://glimr.eu/gdpr-video/).

Today, GliMR is looking forward to a bright future as a recently approved Working Group of the European Society for Magnetic Resonance in Medicine and Biology. In this capacity, we continue our work on development and application of advanced MRI for improved decision making in clinical care of patients diagnosed with glioma.

Action website

http://www.glimr.eu

Achievement of MoU objectives, deliverables and additional outputs/ achievements

MoU objectives

The Action reported the following achievement of its specific objectives.

MoU objective	Level of achievement	Further information (hyperlink or other)
Coordinate the identification and quantification of advanced MRI biomarkers for the application in the field of glioma, via harmonisation of imaging protocols and standardisation of open-access data analysis tools.	76 - 100%	The majority of networking events has brought GliMR members together in WG1 that has led to fruitful collaborations in terms of coordination of advanced MRI for glioma diagnostics. GliMR has successfully brought together experts in the field to formulate recommended MRI techniques for pre-diagnostics glioma characterization (https://doi.org/10.1002/jmri.28662, https://doi.org/10.1002/jmri.28663) and follow-up of high grade glioma (https://doi.org/10.3389/fonc.2022.810263, https://doi.org/10.3389/fonc.2021.811425). These papers are rapidly becoming highly cited indicating uptake in the neuro-oncological, international community. Additionally, the latest outcome of our WG1 is a review paper that focuses on all (open-access) data analysis tools for advanced MRI techniques that are included in the above mentioned reviews. This work is currently under review, as well as being submitted as a preprint. Finally, the work on advanced MRI for use in high grade glioma treatment monitoring is currently being transformed into specific guidelines to be distributed to the world-leading neuro-oncology associations.
Coordinate multi-site date integration and enable the creation of large datasets in glioma diagnostics by combining heterogeneous data sets from sites across Europe.	76 - 100%	Early into the network it became clear that the ambitions for this objective had to be adjusted into mostly coordinating multi-data site integration in stead of creating data sets from sites across Europe. This is largely due to the difficulties faced locally with sharing patient data in light of GDPR regulations. As a network, we have seen that the need to comply with GDPR regulations across Europe is quite often hampering the ease of data sharing, which occurs at varies levels across hospitals. As examples, in some hospitals it is already well regulated, with staff with expertise in GDPR-compliant data sharing and facilities (being) created to do so, while in others (even within the same country) there may be great reluctance because of missing expertise / fear of incompliance with GDPR. As such, as GliMR we have focused on coordinating efforts to aid and ease data sharing, as well as highlight success stories of data sharing and indicate where these databases can be found (online). Relevant output in this goal include: * Publication on open brain consent: https://doi.org/10.1002/hbm.25351 * Information video on data sharing for patients and caregivers (available in 17 languages): https://glimr.eu/gdpr-video/ * Review paper on data sharing practice and success stories for brain tumour imaging data sharing is in progress, expected publication in summer of 2024.
Disseminate the Action's goals and results in tailored manners to all relevant stakeholders, including the scientific and clinical communities, patient organisations,	76 - 100%	Throughout the Action we have linked with several relevant scientific and clinical communities, in particular to safeguard the existence of our network beyond the funding provided by COST. As such, we have now been incorporated as a Working Group of the European Society for Magnetic Resonance in Medicine and Biology, ensuring that we can host our annual meetings in conjunction with the annual meeting of the ESMRMB. Moreover, we continue to collaborate with scientific and clinical communities

industry, and the general public.		with the current works on reviewing current standards for data sharing (review WG2) and the continuous work on formulating guidelines for advanced MRI for high grade tumour assessement (WG3). These include international societies beyond Europe (American Society for Neuro-Radiology, Asian Oceanian Society of Radiology) and within Europe (European Association for Neuro-oncology, European organisation for research and treament of cancer). Through our fruitful connection with the International Brain Tumor Alliance (international patient organisation) we have been successful in generating the animation video for patients, as well as have invited speakers from the IBTA at our meetings which have led to successful results of incorporating the IBTA in grant proposal from our GliMR members for instance. We have not had a strong focus as a network on collaborating with industry partners. However, through our networking events, in particular our annual meetings, there have been connections formed between researchers and industry to explore new research projects on an individual project basis.
Foster cross-border information and knowledge exchange about past and current clinical trials and studies of glioma in order to develop multi-site, multidisciplinary, pan-European clinical studies while increasing the involvement of Inclusiveness Target Countries (ITCs).	76 - 100%	Our continuous efforts to increase the number of ITCs involved within our Action but also to promote active membership from our ITC members have paid off in terms of active membership from members within ITCs as well as some collaborations leading to fruitful, new research projects. Several new collaborations were initiated in terms of research as well as European/international grant applications of which some were successful. These include the PediTuMRI, a project that connects university hospitals in Prague (CZ) and Amsterdam (NL) to investigate advanced MRI in pediatric brain tumors as well as TACTIX, a Horizon-widera-2023-ACCESS-02-01-Twinning Bottom Up grant that focuses on Computational MRI technology and innovation excellence in Turkey accepted. This grant is led by GliMR members from Turkey, Germany and Amsterdam. We gave out 10 ITC conference grants for early career researchers to attend international conferences to present their work. We gave out 15 STSMs, all to early career researchers, to further their research careers. Moreover, the majority of attendees during our 4 annual meetings and 2 training schools were ECIs, with approximately one third of attendees coming from ITCs.
Act as a pan-European network for advancing glioma MRI and translating advanced MRI biomarkers from bench to bedside, bridging between MR imaging scientists and stakeholders from key international and multidisciplinary organisations on glioma research, industry collaborators, clinical practice and patient organisations.	76 - 100%	GliMR is now a well-known name in the field of neuro-oncological imaging. We have established ourselves as the international network to go to for brain tumour MRI and as such were able to become a working group of the ESMRMB to continue our efforts. We continue to receive invitations for members to join the network. In order to keep on providing the networking aspect of GliMR without COST funding, we are formulating a business plan on generating an online platform for networking, with the working title 'Glindr'. (For this purpose we have also submitted an COST Innovator Grant.) As can be seen in the output for our previous objectives, we have members across international scientific and clinical communities that are active on GliMRs behalf. Moreover, efforts are continuing to maintain momentum of GliMR in more formalized manners.

Deliverables

The Action reported the following deliverables:

Deliverable	Timing of deliverable	Further information (hyperlink or other)
Two open-access review papers on the existing and emerging techniques to obtain MRI biomarkers.	Delivered	https://doi.org/10.1002/jmri.28662
An open-source analysis pipeline for quantifying the advanced MRI biomarkers for glioma, and an accompanying methods paper about this pipeline.	Not delivered, but foreseen within 2 years	
A review of existing data and metadata standards and repositories for data exchange in glioma imaging research.	Not delivered, but foreseen within 2 years	
BIDS specifications to represent (1) advanced MRI datasets and their biomarkers and (2) patients' non-imaging metadata.	Not delivered, but foreseen within 2 years	
Sample consent forms that enable data sharing and comply with the European data protection regulation in as many European languages as possible.	Delivered	https://open-brain-consent.readthedocs.io/en/stable/
Overview of studies on glioma diagnostics and follow-up measurements from Action participating institutions.	Not delivered, but foreseen within 2 years	
Recommended glioma scan protocols for clinical application of advanced MRI, including novel and innovative techniques.	Delivered	https://doi.org/10.3389/fonc.2021.811425
Up-to-date statistics about representation in the Action and vice versa (where appropriate) from established international glioma research organisations and consortia, industry, clinical practice, and patient organisations.	Delivered	https://glimr.eu/about/stakeholders/
Action website and social media profiles (LinkedIn, Facebook, Twitter) for communication within and outside the Action (scientific, clinical and public). (Launched by Month 6 - but maintained throughout Action.)	Delivered	https://glimr.eu/
Multi-language recommendations for best clinical practice for both academic and general centres, based on the results and publications from the Action, published on the website.	Not delivered, but foreseen within 2 years	https://open-brain-consent.readthedocs.io/en/stable/

Additional outputs/ achievements

The following outputs/ achievements also resulted from the Action:

The Action reported 25 publications on the topic of the Action, co-authored by at least two Action participants from two countries participating in the Action, and for which the Action networking was necessary.

Co-authored Action publications - peer-reviewed

1. doi:10.1007/s40846-020-00582-z

Title	GliMR: Cross-Border Collaborations to Promote Advanced MRI Biomarkers for Glioma
Authors	Patricia Clement; Thomas Booth; Fran Borovečki; Kyrre E. Emblem; Patrícia Figueiredo; Lydiane Hirschler; Radim Jančálek; Vera C. Keil; Camille Maumet; Yelda Özsunar; Cyril Pernet; Jan Petr; Joana Pinto; Marion Smits; Esther A. H. Warnert
DOI	doi:10.1007/s40846-020-00582-z
Type	Journal article
Published in	Journal of Medical and Biological Engineering
Published by	Springer Science and Business Media LLC
ISSNs	1609-0985; 2199-4757
Subjects	Biomedical Engineering; General Medicine
Links	https://link.springer.com/content/pdf/10.1007/s40846-020-00582-z.pdf; https://link.springer.com/article/10.1007/s40846-020-00582-z/fulltext.html

2. doi:10.3389/fonc.2021.648528

Title	Effect of Applying Leakage Correction on rCBV Measurement Derived From DSC-MRI in Enhancing and Nonenhancing Glioma
Authors	Fatemeh Arzanforoosh; Paula L. Croal; Karin A. van Garderen; Marion Smits; Michael A. Chappell; Esther A. H. Warnert
DOI	doi:10.3389/fonc.2021.648528
Type	Journal article
Published in	Frontiers in Oncology
Published by	Frontiers Media SA
ISSN	2234-943X
Subjects	Cancer Research; Oncology
Link	https://www.frontiersin.org/articles/10.3389/fonc.2021.648528/full

3. doi:10.1002/jmri.28662

Title	Advanced MR Techniques for Preoperative Glioma Characterization: Part 1
Authors	Lydiane Hirschler; Nico Sollmann; Bárbara Schmitz□Abecassis; Joana Pinto; Fatemehsadat Arzanforoosh; Frederik Barkhof; Thomas Booth; Marta Calvo□Imirizaldu; Guilherme Cassia; Marek Chmelik; Patricia Clement; Ece Ercan; Maria A. Fernández□Seara; Julia Furtner; Elies Fuster□Garcia; Matthew Grech□Sollars; Nazmiye Tugay Guven; Gokce Hale Hatay; Golestan Karami; Vera C. Keil; Mina Kim; Johan A. F. Koekkoek; Simran Kukran; Laura Mancini; Ruben

	Emanuel Nechifor; Alpay Özcan; Esin Ozturk□Isik; Senol Piskin; Kathleen Schmainda; Siri F. Svensson; Chih□Hsien Tseng; Saritha Unnikrishnan; Frans Vos; Esther Warnert; Moss Y. Zhao; Radim Jancalek; Teresa Nunes; Kyrre E. Emblem; Marion Smits; Jan Petr; Gilbert Hangel
DOI	doi:10.1002/jmri.28662
Type	Journal article
Published in	Journal of Magnetic Resonance Imaging
Published by	Wiley
ISSNs	1053-1807; 1522-2586
Subject	Radiology, Nuclear Medicine and imaging
Links	https://onlinelibrary.wiley.com/doi/pdf/10.1002/jmri.28662; https://onlinelibrary.wiley.com/doi/full-xml/10.1002/jmri.28662

4. doi:10.1002/jmri.28663

Title	AdvancedMRTechniques for Preoperative Glioma Characterization: Part 2
Authors	Gilbert Hangel; Bárbara Schmitz□Abecassis; Nico Sollmann; Joana Pinto; Fatemehsadat Arzanforoosh; Frederik Barkhof; Thomas Booth; Marta Calvo□Imirizaldu; Guilherme Cassia; Marek Chmelik; Patricia Clement; Ece Ercan; Maria A. Fernández□Seara; Julia Furtner; Elies Fuster□Garcia; Matthew Grech□Sollars; N. Tugay Guven; Gokce Hale Hatay; Golestan Karami; Vera C. Keil; Mina Kim; Johan A. F. Koekkoek; Simran Kukran; Laura Mancini; Ruben Emanuel Nechifor; Alpay Özcan; Esin Ozturk□Isik; Senol Piskin; Kathleen M. Schmainda; Siri F. Svensson; Chih□Hsien Tseng; Saritha Unnikrishnan; Frans Vos; Esther Warnert; Moss Y. Zhao; Radim Jancalek; Teresa Nunes; Lydiane Hirschler; Marion Smits; Jan Petr; Kyrre E. Emblem
DOI	doi:10.1002/jmri.28663
Type	Journal article
Published in	Journal of Magnetic Resonance Imaging
Published by	Wiley
ISSNs	1053-1807; 1522-2586
Subject	Radiology, Nuclear Medicine and imaging
Links	https://onlinelibrary.wiley.com/doi/pdf/10.1002/jmri.28663; https://onlinelibrary.wiley.com/doi/full-xml/10.1002/jmri.28663

5. doi:10.3389/fonc.2022.810263

Title	High-Grade Glioma Treatment Response Monitoring Biomarkers: A Position Statement on the Evidence Supporting the Use of Advanced MRI Techniques in the Clinic, and the Latest Bench-to-Bedside Developments. Part 1: Perfusion and Diffusion Techniques
Authors	Otto M. Henriksen; María del Mar Álvarez-Torres; Patricia Figueiredo; Gilbert Hangel; Vera C. Keil;

	Ruben E. Nechifor; Frank Riemer; Kathleen M. Schmainda; Esther A. H. Warnert; Evita C. Wiegers; Thomas C. Booth
DOI	doi:10.3389/fonc.2022.810263
Type	Journal article
Published in	Frontiers in Oncology
Published by	Frontiers Media SA
ISSN	2234-943X
Subjects	Cancer Research; Oncology
Link	https://www.frontiersin.org/articles/10.3389/fonc.2022.810263/full

6. doi:10.3389/fonc.2021.811425

Title	High-Grade Glioma Treatment Response Monitoring Biomarkers: A Position Statement on the Evidence Supporting the Use of Advanced MRI Techniques in the Clinic, and the Latest Bench-to-Bedside Developments. Part 2: Spectroscopy, Chemical Exchange Saturation, Multiparametric Imaging, and Radiomics
Authors	Thomas C. Booth; Evita C. Wiegers; Esther A. H. Warnert; Kathleen M. Schmainda; Frank Riemer; Ruben E. Nechifor; Vera C. Keil; Gilbert Hangel; Patrícia Figueiredo; Maria Del Mar Álvarez-Torres; Otto M. Henriksen
DOI	doi:10.3389/fonc.2021.811425
Type	Journal article
Published in	Frontiers in Oncology
Published by	Frontiers Media SA
ISSN	2234-943X
Subjects	Cancer Research; Oncology
Link	https://www.frontiersin.org/articles/10.3389/fonc.2021.811425/full

7. doi:10.1007/s10334-021-00999-w

Title	Micro- to macroscale magnetic resonance imaging of glioma
Authors	Patricia Clement; Marion Smits; Matthias J. P. van Osch; Bruno M. Costa; Esther A. H. Warnert
DOI	doi:10.1007/s10334-021-00999-w
Type	Journal article
Published in	Magnetic Resonance Materials in Physics, Biology and Medicine
Published by	Springer Science and Business Media LLC
ISSNs	0968-5243; 1352-8661
Subjects	Radiology, Nuclear Medicine and imaging; Radiological and Ultrasound Technology; Biophysics
Links	https://link.springer.com/content/pdf/10.1007/s10334-021-00999-w.pdf; https://link.springer.com/article/10.1007/s10334-021-00999-w/fulltext.html

8. doi:10.1007/s10334-021-00978-1

Title	Detection of glioblastoma multiforme using quantitative molecular magnetic resonance imaging based on 5-aminolevulinic acid: in vitro and in vivo studies

Authors	Anita Ebrahimpour; Fatemeh Tirgar; Behnam Hajipour-Verdom; Ardeshir Abbasi; Mahmoudreza Hadjighassem; Parviz Abdolmaleki; Saereh Hosseindoost; Seyed Amir Hossein Javadi; Hassan Hashemi; Abbas Rahimi Foroushani; Nader Riyahi Alam; Mehdi Khoobi
DOI	doi:10.1007/s10334-021-00978-1
Type	Journal article
Published in	Magnetic Resonance Materials in Physics, Biology and Medicine
Published by	Springer Science and Business Media LLC
ISSNs	0968-5243; 1352-8661
Subjects	Radiology, Nuclear Medicine and imaging; Radiological and Ultrasound Technology; Biophysics
Links	https://link.springer.com/content/pdf/10.1007/s10334-021-00978-1.pdf; https://link.springer.com/article/10.1007/s10334-021-00978-1/fulltext.html

9. doi:10.1007/s10334-021-00987-0

Title	Feasibility of intravoxel incoherent motion in the assessment of tumor microvasculature and blood–brain barrier integrity: a case-based evaluation of gliomas
Authors	Andre Monteiro Paschoal; Maria Clara Zanon Zotin; Lucas Murilo da Costa; Antonio Carlos dos Santos; Renata Ferranti Leoni
DOI	doi:10.1007/s10334-021-00987-0
Type	Journal article
Published in	Magnetic Resonance Materials in Physics, Biology and Medicine
Published by	Springer Science and Business Media LLC
ISSNs	0968-5243; 1352-8661
Subjects	Radiology, Nuclear Medicine and imaging; Radiological and Ultrasound Technology; Biophysics
Links	https://link.springer.com/content/pdf/10.1007/s10334-021-00987-0.pdf; https://link.springer.com/article/10.1007/s10334-021-00987-0/fulltext.html

10. doi:10.1007/s10334-021-00980-7

Title	Feasibility of glioblastoma tissue response mapping with physiologic BOLD imaging using precise oxygen and carbon dioxide challenge
Authors	Vittorio Stumpo; Martina Sebök; Christiaan Hendrik Bas van Niftrik; Katharina Seystahl; Nicolin Hainc; Zsolt Kulcsar; Michael Weller; Luca Regli; Jorn Fierstra
DOI	doi:10.1007/s10334-021-00980-7
Type	Journal article
Published in	Magnetic Resonance Materials in Physics, Biology and Medicine
Published by	Springer Science and Business Media LLC
ISSNs	0968-5243; 1352-8661
Subjects	Radiology, Nuclear Medicine and imaging; Radiological and Ultrasound Technology;

	Biophysics
Links	https://link.springer.com/content/pdf/10.1007/s10334-021-00980-7.pdf; https://link.springer.com/article/10.1007/s10334-021-00980-7/fulltext.html

11. doi:10.1007/s10334-021-00989-y

Title	Diagnostic performance of edited 2HG MR spectroscopy of central glioma in the clinical environment
Authors	Dominik Juskanič; Jana Poláková Mištinová; Samuel Hollý; Monika Sekerešová; Kamil Koleják; Lukáš Pátrovič
DOI	doi:10.1007/s10334-021-00989-y
Type	Journal article
Published in	Magnetic Resonance Materials in Physics, Biology and Medicine
Published by	Springer Science and Business Media LLC
ISSNs	0968-5243; 1352-8661
Subjects	Radiology, Nuclear Medicine and imaging; Radiological and Ultrasound Technology; Biophysics
Links	https://link.springer.com/content/pdf/10.1007/s10334-021-00989-y.pdf; https://link.springer.com/article/10.1007/s10334-021-00989-y/fulltext.html

12. doi:10.1007/s10334-021-00911-6

Title	Mapping tumour heterogeneity with pulsed 3D CEST MRI in non-enhancing glioma at 3 T
Authors	Esther A. H. Warnert; Tobias C. Wood; Fatih Incekara; Gareth J. Barker; Arnaud J. P. Vincent; Joost Schouten; Johan M. Kros; Martin van den Bent; Marion Smits; Juan A. Hernandez Tamames
DOI	doi:10.1007/s10334-021-00911-6
Type	Journal article
Published in	Magnetic Resonance Materials in Physics, Biology and Medicine
Published by	Springer Science and Business Media LLC
ISSNs	0968-5243; 1352-8661
Subjects	Radiology, Nuclear Medicine and imaging; Radiological and Ultrasound Technology; Biophysics
Links	https://link.springer.com/content/pdf/10.1007/s10334-021-00911-6.pdf; https://link.springer.com/article/10.1007/s10334-021-00911-6/fulltext.html

13. doi:10.1007/s10334-021-00996-z

Title	3D APT and NOE CEST-MRI of healthy volunteers and patients with non-enhancing glioma at 3 T
Authors	Yulun Wu; Tobias C. Wood; Fatemeh Arzanforoosh; Juan A. Hernandez-Tamames; Gareth J. Barker; Marion Smits; Esther A. H. Warnert
DOI	doi:10.1007/s10334-021-00996-z

Type	Journal article
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Published by	Springer Science and Business Media LLC
ISSNs	0968-5243; 1352-8661
Subjects	Radiology, Nuclear Medicine and imaging; Radiological and Ultrasound Technology; Biophysics
Links	https://link.springer.com/content/pdf/10.1007/s10334-021-00996-z.pdf; https://link.springer.com/article/10.1007/s10334-021-00996-z/fulltext.html

14. doi:10.1007/s10334-021-00982-5

Title	GLINT: GlucoCEST in neoplastic tumors at 3 T—clinical results of GlucoCEST in gliomas
Authors	Benjamin Bender; Kai Herz; Anagha Deshmane; Vivien Richter; Ghazaleh Tabatabai; Jens Schittenhelm; Marco Skardelly; Klaus Scheffler; Ulrike Ernemann; Mina Kim; Xavier Golay; Moritz Zaiss; Tobias Lindig
DOI	doi:10.1007/s10334-021-00982-5
Type	Journal article
Published in	Magnetic Resonance Materials in Physics, Biology and Medicine
Published by	Springer Science and Business Media LLC
ISSNs	0968-5243; 1352-8661
Subjects	Radiology, Nuclear Medicine and imaging; Radiological and Ultrasound Technology; Biophysics
Links	https://link.springer.com/content/pdf/10.1007/s10334-021-00982-5.pdf; https://link.springer.com/article/10.1007/s10334-021-00982-5/fulltext.html

15. doi:10.1007/s10334-021-00994-1

Title	What do we know about dynamic glucose-enhanced (DGE) MRI and how close is it to the clinics? Horizon 2020 GLINT consortium report
Authors	Mina Kim; Afroditi Eleftheriou; Luca Ravotto; Bruno Weber; Michal Rivlin; Gil Navon; Martina Capozza; Annasofia Anemone; Dario Livio Longo; Silvio Aime; Moritz Zaiss; Kai Herz; Anagha Deshmane; Tobias Lindig; Benjamin Bender; Xavier Golay
DOI	doi:10.1007/s10334-021-00994-1
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ISSNs	0968-5243; 1352-8661
Subjects	Radiology, Nuclear Medicine and imaging; Radiological and Ultrasound Technology; Biophysics
Links	https://link.springer.com/content/pdf/10.1007/s10334-021-00994-1.pdf; https://link.springer.com/article/10.1007/s10334-021-00994-1/fulltext.html

16. doi:10.1007/s10334-021-00926-z

Title	Operator dependency of arterial input function in dynamic contrast-enhanced MRI
Authors	Magne Kleppestø; Atle Bjørnerud; Inge Rasmus Groote; Minjae Kim; Jonas Vardal; Christopher Larsson
DOI	doi:10.1007/s10334-021-00926-z
Type	Journal article
Published in	Magnetic Resonance Materials in Physics, Biology and Medicine
Published by	Springer Science and Business Media LLC
ISSNs	0968-5243; 1352-8661
Subjects	Radiology, Nuclear Medicine and imaging; Radiological and Ultrasound Technology; Biophysics
Links	https://link.springer.com/content/pdf/10.1007/s10334-021-00926-z.pdf; https://link.springer.com/article/10.1007/s10334-021-00926-z/fulltext.html

17. doi:10.1007/s10334-021-00975-4

Title	Repeatability of perfusion measurements in adult gliomas using pulsed and pseudo-continuous arterial spin labelling MRI
Authors	Amirah Faisal Alsaedi; David Lee Thomas; Enrico De Vita; Jasmina Panovska-Griffiths; Sotirios Bisdas; Xavier Golay
DOI	doi:10.1007/s10334-021-00975-4
Type	Journal article
Published in	Magnetic Resonance Materials in Physics, Biology and Medicine
Published by	Springer Science and Business Media LLC
ISSNs	0968-5243; 1352-8661
Subjects	Radiology, Nuclear Medicine and imaging; Radiological and Ultrasound Technology; Biophysics
Links	https://link.springer.com/content/pdf/10.1007/s10334-021-00975-4.pdf; https://link.springer.com/article/10.1007/s10334-021-00975-4/fulltext.html

18. doi:10.1007/s10334-021-00997-y

Title	The potential of advanced MR techniques for precision radiotherapy of glioblastoma
Authors	Patrick L. Y. Tang; Alejandra Méndez Romero; Jaap P. M. Jaspers; Esther A. H. Warnert
DOI	doi:10.1007/s10334-021-00997-y
Type	Journal article
Published in	Magnetic Resonance Materials in Physics, Biology and Medicine
Published by	Springer Science and Business Media LLC
ISSNs	0968-5243; 1352-8661
Subjects	Radiology, Nuclear Medicine and imaging; Radiological and Ultrasound Technology; Biophysics
Links	https://link.springer.com/content/pdf/10.1007/s10334-021-00997-y.pdf;

https://link.springer.com/article/10.1007/s10334-021-00997-y/fulltext.html

19. doi:10.1007/s10334-021-00922-3

Title	Overestimation of grey matter atrophy in glioblastoma patients following radio(chemo)therapy
Authors	A. Gommlich; F. Raschke; J. Petr; A. Seidlitz; C. Jentsch; I. Platzek; J. van den Hoff; J. Kotzerke; B. Beuthien-Baumann; M. Baumann; M. Krause; E. G. C. Troost
DOI	doi:10.1007/s10334-021-00922-3
Type	Journal article
Published in	Magnetic Resonance Materials in Physics, Biology and Medicine
Published by	Springer Science and Business Media LLC
ISSNs	0968-5243; 1352-8661
Subjects	Radiology, Nuclear Medicine and imaging; Radiological and Ultrasound Technology; Biophysics
Links	https://link.springer.com/content/pdf/10.1007/s10334-021-00922-3.pdf; https://link.springer.com/article/10.1007/s10334-021-00922-3/fulltext.html

20. doi:10.1007/s10334-021-00990-5

Title	Evaluation of normal-appearing white matter with perfusion and diffusion MRI in patients with treated glioblastoma
Authors	Sinan Şahin; Ersen Ertekin; Tuna Şahin; Yelda Özsunar
DOI	doi:10.1007/s10334-021-00990-5
Type	Journal article
Published in	Magnetic Resonance Materials in Physics, Biology and Medicine
Published by	Springer Science and Business Media LLC
ISSNs	0968-5243; 1352-8661
Subjects	Radiology, Nuclear Medicine and imaging; Radiological and Ultrasound Technology; Biophysics
Links	https://link.springer.com/content/pdf/10.1007/s10334-021-00990-5.pdf; https://link.springer.com/article/10.1007/s10334-021-00990-5/fulltext.html

21. doi:10.1007/s10334-021-00985-2

Title	A systematic review on the use of quantitative imaging to detect cancer therapy adverse effects in normal-appearing brain tissue
Authors	Jan Petr; Louise Hogeboom; Pavel Nikulin; Evita Wiegers; Gwen Schroyen; Jesper Kallehauge; Marek Chmelík; Patricia Clement; Ruben E. Nechifor; Liviu-Andrei Fodor; Philip C. De Witt Hamer; Frederik Barkhof; Cyril Pernet; Maarten Lequin; Sabine Deprez; Radim Jančálek; Henk J. M. M. Mutsaerts; Francesca B. Pizzini; Kyrre E. Emblem; Vera C. Keil
DOI	doi:10.1007/s10334-021-00985-2

Type	Journal article
Published in	Magnetic Resonance Materials in Physics, Biology and Medicine
Published by	Springer Science and Business Media LLC
ISSNs	0968-5243; 1352-8661
Subjects	Radiology, Nuclear Medicine and imaging; Radiological and Ultrasound Technology; Biophysics
Links	https://link.springer.com/content/pdf/10.1007/s10334-021-00985-2.pdf; https://link.springer.com/article/10.1007/s10334-021-00985-2/fulltext.html

22. doi:10.1148/radiol.230793

Title	Brain Tumor Imaging without Gadolinium-based Contrast Agents: Feasible or Fantasy?
Authors	Ivar J. H. G. Wamelink; Aynur Azizova; Thomas C. Booth; Henk J. M. M. Mutsaerts; Afolabi Ogunleye; Kshitij Mankad; Jan Petr; Frederik Barkhof; Vera C. Keil
DOI	doi:10.1148/radiol.230793
Type	Journal article
Published in	Radiology
Published by	Radiological Society of North America (RSNA)
ISSNs	0033-8419; 1527-1315
Subject	Radiology, Nuclear Medicine and imaging
Link	http://pubs.rsna.org/doi/pdf/10.1148/radiol.230793

23. doi:10.1002/jmri.28239

Title	Reproducibility of 3 T APT□CEST in Healthy Volunteers and Patients With Brain Glioma
Authors	Ivar J.H.G. Wamelink; Joost P.A. Kuijer; Beatriz E. Padrela; Yi Zhang; Frederik Barkhof; Henk J.M.M. Mutsaerts; Jan Petr; Elsmarieke van de Giessen; Vera C. Keil
DOI	doi:10.1002/jmri.28239
Type	Journal article
Published in	Journal of Magnetic Resonance Imaging
Published by	Wiley
ISSNs	1053-1807; 1522-2586
Subject	Radiology, Nuclear Medicine and imaging
Links	https://onlinelibrary.wiley.com/doi/pdf/10.1002/jmri.28239; https://onlinelibrary.wiley.com/doi/full-xml/10.1002/jmri.28239

24. doi:10.3389/fradi.2022.929533

Title	A Beginner's Guide to Arterial Spin Labeling (ASL) Image Processing
Authors	Patricia Clement; Jan Petr; Mathijs B. J. Dijsselhof; Beatriz Padrela; Maurice Pasternak; Sudipto Dolui; Lina Jarutyte; Nandor Pinter; Luis Hernandez-Garcia; Andrew Jahn; Joost P. A. Kuijer; Frederik Barkhof; Henk J. M. M. Mutsaerts; Vera C. Keil
DOI	doi:10.3389/fradi.2022.929533
Type	Journal article
Published in	Frontiers in Radiology

Published by	Frontiers Media SA
ISSN	2673-8740
Subject	General Medicine
Link	https://www.frontiersin.org/articles/10.3389/fradi.2022.929533/full

Co-authored Action publications - other

1. doi:10.1079/searchRxiv.2024.00471

   Advanced MRI processing for clinical glioma research.

Projects

The Action reported 3 project(s) and 2 proposal(s) resulting from the Action networking.

Key details of the projects are shown below:

1. PediTuMRI
   (National)
2. TACTIX - Twinning Approach for Computational MRI Technology and Innovation EXcellence in Türkiye
   (H2020 - Horizon Europe)
3. Mapping of glioma heterogeneity and infiltration extend by MR imaging biomarkers.
   (National)

Other outputs / achievements

The following other outputs/ achievements contributing to the COST mission resulted from the Action:

1. GliMR Animation Video for GDPR compliant data sharing

2. We send out regular newsletters with news about the action. This currently reaching approximately 200 people. https://glimr.eu/category/newsletters/

3. Special session at the ESMRMB annual (virtual) meetings of 2020, 2021, 2022, 2023.

4. Becoming an official Working Group of the ESMRMB.

5. Publication of Special Issue of MAGMA on advanced Glioma MR Imaging. This was done by GliMR members.

6. Active social media accounts. (https://www.facebook.com/glimr2.0 ;
   https://www.linkedin.com/in/glimr-cost-action-073046252/ ;
   https://www.youtube.com/channel/UCG4FyL6vywSwc8tInGfWyWw ;
   https://www.researchgate.net/project/Glioma-MR-Imaging-20-2 ;
   https://www.instagram.com/glimr2.0/)

7. Collaborative sessions during the annual meeting of the International Society for Magnetic Resonance in Medicine (e.g. Secret Session and invited talks). Annual meeting in London (UK), 2022.

Impacts

The Action reported the following impact(s):

Description of the impact, i.e. what will change, and for whom, as a result of what the Action achieved	Type of impact	Timing of impact
Our work in the Action generated several best practices on glioma MRI acquisition and analysis and share imaging data from patients diagnosed with glioma. In addition, the animation video made aids continues to raise awareness amongst patients across Europe and gives them information about safe and legal sharing of their clinical data. The combination of providing best practices as well as stimulating international data sharing has in the short-term led to more scientific advances trough novel or strengthened international collaborations, while in the long term provides improved diagnostics and decision-making in the treatment of patients diagnosed with glioma. The latter aids not only patients and their caregivers, but also their treating physicians.	• Scientific / Technological	Achieved
Our work in the Action generated several best practices on glioma MRI acquisition and analysis and share imaging data from patients diagnosed with glioma. In addition, the animation video made aids continues to raise awareness amongst patients across Europe and gives them information about safe and legal sharing of their clinical data. The combination of providing best practices as well as stimulating international data sharing has in the short-term led to more scientific advances trough novel or strengthened international collaborations, while in the long term provides improved diagnostics and decision-making in the treatment of patients diagnosed with glioma. The latter aids not only patients and their caregivers, but also their treating physicians.	• Societal	Foreseen five-to-ten years

Dissemination and exploitation of Action results

Dissemination and exploitation approach of the Action

The Action's dissemination and exploitation approach as well as all activities undertaken to ensure dissemination and exploitation of Action results and the outcomes of these activities are described below.

Our network has first and foremost had the aim to bring together clinical + scientific participants interested in advancing glioma MRI diagnostics. As such, we have focused on generating a strong and lasting network and less so on already disseminating and exploiting advances in MRI to commercial partners. However, what makes this strategy effective is that in having expert opinions and guidelines on best practices in advanced MRI techniques align, this stimulates the major MRI vendors to provide products that adhere to these best practices. In terms of post-processing software, we have always had a strong focus on open access data analysis approaches. This is something that inherently also makes commercialization difficult. However, at individual project level, there have been SMEs interested in generating CE-marked software for post-processing of advanced MRI techniques that have used GliMR's network to find clinical/research partners for further work.

Dissemination meetings funded by the Action (possible only until 31st October 2021)

The Action did not fund any Dissemination Meetings

Other dissemination activities

The Action also undertook the following dissemination activities:

Activity	Presentation of GliMR during the General Meeting of the brain tumour imaging group of the EORTC
Target	Clinicians and researchers involved in brain tumour research and clinical practice.
Outcome	GDPR officer was linked to GliMR. Additioinally presented to our audience during our GliMR session.
Link	https://www.eortc.org/event/btg-spring-2021/

Activity	Presentation of GliMR during annual meeting of the ISMRM in London (UK).
Target	Researchers and clinicians interested in collaborative MRI research from all over the world. (Annual meeting is visited by approximately 8000 attendees.)
Outcome	Raise awareness about GliMR, increased number of GliMR Members. Additionally it rose awareness about COST (and have had meetings since about organising COST Actions).
Link	https://www.ismrm.org/22m/

Exploitation activities

The Action undertook the following activities to ensure exploitation (use, in particular in a commercial context) of the Action's achievements:

Activity	Generating official guidelines for advanced MRI in high grade glioma treatment monitoring. It is currently being undertaken, does not have a commercial aspect to it.
Target	Clinicians treating patients with brain tumours. Policy makers for (general) hospital care.
Outcome	Results are expected in the coming 5-10 years, with formalizing (and maintaining) the guidelines.

Action Success(es)

The Action’s two most significant successes were the following:

- Establishing GliMR as a lasting, European network for brain tumour imaging, based on GliMRs work and output. We have recently become an official Working Group of the European Society for Magnetic Resonance in Medicine and Biology, which allows us to keep on connecting and strengthening our work within GliMR.
- The 4 review papers generated by the GliMR community on advanced MRI techniques for glioma characterisation and treatment follow-up are rapidly gaining traction. This includes influencing best practices for brain tumour MRI across the world. This will be further strengthened by formalizing the guidelines for treatment follow-up and having these endorsed by internationally renowned clinical societies.

Action Expenditure

The table below shows the budget allocated to the Action for each Grant Period:

#	Grant Period	Start Date	End Date	Budget allocated to Action (EUR)
1	AGA-CA18206-1	1-10-2019	30-4-2020	69,471.50 (EUR)
2	AGA-CA18206-2	1-5-2020	31-10-2021	114,705.60 (EUR)
3	AGA-CA18206-3	1-11-2021	31-10-2022	145,153.00 (EUR)
4	AGA-CA18206-4	1-11-2022	31-10-2023	153,180.00 (EUR)
5	AGA-CA18206-5	1-11-2023	11-3-2024	70,800.90 (EUR)