**Bibliography on the Ethical, Legal, and Social Implications of** **Emerging Portable and Accessible Neuroimaging Technologies**

*Last updated: November 1, 2023*

**Introduction**

This bibliography contains resources related to the ethical, legal, and social implications (ELSI) of emerging portable and accessible neuroimaging technologies, as well as selected relevant publications from the scientific and medical literatures. The bibliography is focused specifically on the ELSI of portable and accessible neuroimaging, and does not include citations to broader literatures on ELSI of traditional fixed neuroimaging (e.g. the extensive literature on ELSI of incidental findings in MRI). The bibliography also does not include citations to literature on emerging neurotechnologies beyond brain imaging (e.g. neurostimulation). For more general resources on neuroethics, readers might view the [resources page of NIH BRAIN Neuroethics](about:blank) and the [resources page of the Global Neuroethics Summit](about:blank). The bibliography contains selected scientific publications related to emerging portable neuroimaging technologies, but is not exhaustive and generally excludes publications that are more technical in nature.

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The Bibliography is organized by topical area, with entries listed alphabetically within each category by last name of the first author. You can scroll down or click on each topical heading below to jump to a particular section:

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* [Portable Magnetic Resonance I](#PortableMRI)maging (MRI)
* [Portable Magnetoencephalography (MEG](#PortableMEG))
* [Portable Positron Emission Tomography (PET](#PortablePET))
* [Portable Functional Near-Infrared Spectroscopy (fNIRS](#PortablefNIRS))
* [Portable Electroencephalography (EEG](#PortableEEG))

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**Law and Ethics**

*Although there are established literatures on the ethics of traditional fixed neuroimaging, the literature specific to the ethical, legal, and social implications of highly portable and accessible neuroimaging is only beginning to emerge.*

Bannier, E., Barker, G., Borghesani, V., Broeckx, N., Clement, P., Emblem, K. E., Ghosh, S., Glerean, E., Gorgolewski, K. J., Havu, M., Halchenko, Y. O., Herholz, P., Hespel, A., Heunis, S., Hu, Y., Hu, C.-P., Huijser, D., de la Iglesia Vayá, M., Jancalek, R., … Zhu, H. (2021). The Open Brain Consent: Informing Research Participants and Obtaining Consent to Share Brain Imaging Data. *Human Brain Mapping*, *42*(7), 1945–1951. [https://doi.org/10.1002/hbm.25351](about:blank)

Beauvais, M. J. S., Knoppers, B. M. & Illes, J. (2021). A Marathon, Not a Sprint – Neuroimaging, Open Science and Ethics. *NeuroImage*, *236*, 118041. [https://doi.org/10.1016/j.neuroimage.2021.118041](about:blank) PMID: 33848622

Bianchi, D. W., Cooper, J. A., Gordon, J. A., Heemskerk, J., Hodes, R., Koob, G. F., Koroshetz, W. J., Shurtleff, D., Sieving, P. A., Volkow, N. D., Churchill, J. D. & Ramos, K. M. (2018). Neuroethics for the National Institutes of Health BRAIN Initiative. *Journal of Neuroscience*, *38*(50), 10583–10585. [https://doi.org/10.1523/JNEUROSCI.2091-18.2018](about:blank) PMID: 30541766

Clark, D. B., Fisher, C. B., Bookheimer, S., Brown, S. A., Evans, J. H., Hopfer, C., Hudziak, J., Montoya, I., Murray, M., Pfefferbaum, A. & Yurgelun-Todd, D. (2017). Biomedical Ethics and Clinical Oversight in Multisite Observational Neuroimaging Studies with Children and Adolescents: The ABCD Experience. *Developmental Cognitive Neuroscience*, *32*, 143–154. [https://doi.org/10.1016/j.dcn.2017.06.005](about:blank) PMID: 28716389

Greely, H. T., Grady, C., Ramos, K. M., Chiong, W., Eberwine, J., Farahany, N. A., Johnson, L. S. M., Hyman, B. T., Hyman, S. E., Rommelfanger, K. S. & Serrano, E. E. (2018). Neuroethics Guiding Principles for the NIH BRAIN Initiative. *Journal of Neuroscience*, *38*(50), 10586–10588. [https://doi.org/10.1523/JNEUROSCI.2077-18.2018](about:blank) PMID: 30541767

Gaudry, K. S., Ayaz, H., Bedows, A., Celnik, P., Eagleman, D., Grover, P., Illes, J., Rao, R. P. N., Robinson, J. T., Thyagarajan, K. & The Working Group on Brain-Interfacing Devices in 2040 (2021). Projections and the Potential Societal Impact of the Future of Neurotechnologies. *Frontiers in Neuroscience*, *15*, 658930. [https://doi.org/10.3389/fnins.2021.658930](about:blank) PMCID: PMC8634831

Goldfarb, M. G. & Brown, D. R. (2022). Diversifying Participation: The Rarity of Reporting Racial Demographics in Neuroimaging Research. *NeuroImage*, *254*, 119122. [https://doi.org/10.1016/j.neuroimage.2022.119122](about:blank) PMID: 35339685

Greely, H. T., Ramos, K. M. & Grady, C. (2016). Neuroethics in the Age of Brain Projects. *Neuron*, *92*(3), 637–641. [https://doi.org/10.1016/j.neuron.2016.10.048](about:blank) PMID: 27810008

Janssen, T. W. P., Grammer, J. K., Bleichner, M. G., Bulgarelli, C., Davidesco, I., Dikker, S., Jasińska, K. K., Siugzdaite, R., Vassena, E., Vatakis, A., Zion-Golumbic, E. & van Atteveldt, N. (2021). Opportunities and Limitations of Mobile Neuroimaging Technologies in Educational Neuroscience. *Mind, Brain and Education*, *15*(4), 354–370. [https://doi.org/10.1111/mbe.12302](about:blank) PMID: 35875415

Jones, D. T. & Kerber, K. A. (2022). Artificial Intelligence and the Practice of Neurology in 2035: The Neurology Future Forecasting Series. *Neurology*, *98*(6), 238–245. [https://doi.org/10.1212/WNL.0000000000013200](about:blank) PMID: 35131918

Jwa, A. S. & Poldrack, R. A. (2022). The Spectrum of Data Sharing Policies in Neuroimaging Data Repositories. *Human Brain Mapping*, 1–15. [https://doi.org/10.1002/hbm.25803](about:blank) PMID: 35142409

Krainak, D.M., Zeng, R., Li, N. et al. US regulatory considerations for low field magnetic resonance imaging systems. Magn Reson Mater Phy (2023). https://doi.org/10.1007/s10334-023-01083-1

Li, Y., Thompson, W. K., Reuter, C., Nillo, R., Jernigan, T., Dale, A., Sugrue, L. P. & ABCD Consortium. (2021). Rates of Incidental Findings in Brain Magnetic Resonance Imaging in Children. *JAMA Neurology*, *78*(5), 578–587. [https://doi.org/10.1001/jamaneurol.2021.0306](about:blank) PMID: 33749724

Palk, A., Illes, J., Thompson, P. M. & Stein, D. J. (2020). Ethical Issues in Global Neuroimaging Genetics Collaborations. *NeuroImage*, *221*, 117208. [https://doi.org/10.1016/j.neuroimage.2020.117208](about:blank) PMID: 32736000

Presidential Commission for the Study of Bioethical Issues (2015, March). *Gray Matters: Topics at the Intersection of Neuroscience, Ethics, and Society (Vol. 2)*. [https://bioethicsarchive.georgetown.edu/pcsbi/sites/default/files/GrayMatter\_V2\_508.pdf](about:blank)

Ramos, K. M., Grady, C., Greely, H. T., Chiong, W., Eberwine, J., Farahany, N. A., Johnson, L. S. M., Hyman, B. T., Hyman, S. E., Rommelfanger, K. S., Serrano, E. E., Churchill, J. D., Gordon, J. A. & Koroshetz, W. J. (2019). The NIH BRAIN Initiative: Integrating Neuroethics and Neuroscience. *Neuron*, *101*(3), 394–398. [https://doi.org/10.1016/j.neuron.2019.01.024](about:blank) PMID: 30731065

Ramos, K. M., Rommelfanger, K. S., Greely, H. T. & Koroshetz, W. J. (2018). Neuroethics and the NIH BRAIN Initiative. *Journal of Responsible Innovation*, *5*(1), 122–130. [https://doi.org/10.1080/23299460.2017.1319035](about:blank) PMID: 30854409

Robinson, J. T., Rommelfanger, K. S., Anikeeva, P. O., Etienne, A., French, J., Gelinas, J., Grover, P. & Picard, R. (2022). Building a Culture of Responsible Neurotech: Neuroethics as Socio-Technical Challenges. *Neuron, S0896-6273*(22), 2057–2062. [https://doi.org/10.1016/j.neuron.2022.05.005](about:blank) PMID: 35671759

Rommelfanger, K. S., Jeong, S.-J., Ema, A., Fukushi, T., Kasai, K., Ramos, K. M., Salles, A. & Singh, I. (2018). Neuroethics Questions to Guide Ethical Research in the International Brain Initiatives. *Neuron*, *100*(1), 19–36. [https://doi.org/10.1016/j.neuron.2018.09.021](about:blank) PMID: 30308169

Shen, F. X., Wolf, S. M., Bhavnani, S., Deoni, S., Elison, J. T., Fair, D., Garwood, M., Gee, M. S., Geethanath, S., Kay, K., Lim, K. O., Lockwood Estrin, G., Luciana, M., Peloquin, D., Rommelfanger, K., Schiess, N., Siddiqui, K., Torres, E. & Vaughan, J. T. (2021). Emerging Ethical Issues Raised by Highly Portable MRI Research in Remote and Resource-Limited International Settings. *NeuroImage*, *238*, 118210. [https://doi.org/10.1016/j.neuroimage.2021.118210](about:blank) PMCID: PMC8382487

Shen, F., Wolf, S., Garwood, M., Han, D., Illes, J., Kimberly, W., Klein, E., Rommelfanger, K., Rosen, M., Sheth, K., Torres, E., Tuite, P. & Vaughan, J. (2022). Challenges in Deploying Low-Field and Ultra-Low Field MRI in Research, Clinical Care, Population Screening, and Direct-to-Consumer Use (P15-7.001). *Neurology*, *98*(18 Supplement), 586. [https://n.neurology.org/content/98/18\_Supplement/586](about:blank)

Shen, F. X., Wolf, S. M., Gonzalez, R. G. & Garwood, M. (2020). Ethical Issues Posed by Field Research Using Highly Portable and Cloud-Enabled Neuroimaging. *Neuron*, *105*(5), 771–775. [https://doi.org/10.1016/j.neuron.2020.01.041](about:blank) PMID: 32135089

**Selected Guidelines**

*As neuroimaging research moves out of the lab and into the field, neuroimaging researchers will be confronted with novel ethical and technical challenges. The selected guidelines below provide high-level guidance for addressing those challenges.*

American College of Radiology Committee on MR Safety (2020). *ACR Manual on MR Safety*. [https://www.acr.org/-/media/ACR/Files/Radiology-Safety/MR-Safety/Manual-on-MR-Safety.pdf](about:blank)

Council for International Organizations of Medical Sciences (2016). *International Ethical Guidelines for Health-Related Research Involving Humans*. [https://cioms.ch/wp-content/uploads/2017/01/WEB-CIOMS-EthicalGuidelines.pdf](about:blank)

National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research (1979, April 18). *The Belmont Report: Ethical Principles and Guidelines for the Protection of Human Subjects of Research*. [https://www.hhs.gov/ohrp/sites/default/files/the-belmont-report-508c\_FINAL.pdf](about:blank)

Nuffield Council on Bioethics (2013). *Novel Neurotechnologies: Intervening in the Brain*. [https://www.nuffieldbioethics.org/wp-content/uploads/2013/06/Novel\_neurotechnologies\_report\_PDF\_web\_0.pdf](about:blank)

Participants in the 2006 Georgetown University Workshop on the Ancillary-Care Obligations of Medical Researchers Working in Developing Countries (2008). The Ancillary-Care Obligations of Medical Researchers Working in Developing Countries. *PLOS Med 5*(5), e90. [https://doi.org/10.1371/journal.pmed.0050090](about:blank) PMID: 18494553

Presidential Commission for the Study of Bioethical Issues (2010, December). *New Directions: The Ethics of Synthetic Biology and Emerging Technologies*. [https://bioethicsarchive.georgetown.edu/pcsbi/sites/default/files/PCSBI-Synthetic-Biology-Report-12.16.10\_0.pdf](about:blank)

TRUST Equitable Research Partnerships (2018). *Global Code of Conduct for Research in Resource-Poor Settings*. [https://www.globalcodeofconduct.org/wp-content/uploads/2018/05/Global-Code-of-Conduct-Brochure.pdf](about:blank)

World Health Organization (2011). *Standards and Operational Guidance for Ethics Review of Health-Related Research with Human Participants*. Retrieved September 12, 2021, from [https://www.who.int/publications/i/item/9789241502948](about:blank)

World Medical Association (2013, October). *Declaration of Helsinki: Ethical Principles for Medical Research Involving Human Subjects*. [https://www.wma.net/policies-post/wma-declaration-of-helsinki-ethical-principles-for-medical-research-involving-human-subjects/](about:blank)

Yeung, A. W. K., Singh, P. & Eickhoff, S. B. (2021). The Dissemination of Brain Imaging Guidelines and Recommendations. *IBRO Neuroscience Reports*, *12*, 20–24. [https://doi.org/10.1016/j.ibneur.2021.11.003](about:blank) PMID: 34918005

Yoo, S. H., Choi, K., Nam, S., Yoon, E. K., Sohn, J. W., Oh, B. M., Shim, J., & Choi, M. Y. (2023). Development of Korea Neuroethics Guidelines. Journal of Korean medical science, 38(25), e193. <https://doi.org/10.3346/jkms.2023.38.e193> PMID: 37365727

**Neuroimaging Research in Low-Resource Contexts**

*The increased portability and lower costs of new MRI technologies will allow researchers and clinicians to utilize MRI in low-resource contexts that previously did not have access to MRI. The citations below include articles in which MRI is being used in a wide range of research in low-resource contexts.*

Altaf, A., Baqai, M. W., Urooj, F., Alam, M. S., Aziz, H. F., Mubarak, F., Knopp, E. A., Siddiqui, K. M., & Enam, S. A. (2023). Utilization of an ultra-low-field, portable magnetic resonance imaging for Brain Tumor Assessment in lower middle-income countries. Surgical Neurology International, 14, 260. <https://doi.org/10.25259/sni_123_2023> PMID: 37560587

DesRoche, C. N., Johnson, A. P., Hore, E. B., Innes, E., Silver, I., Tampieri, D., Kwan, B. Y. M., Ortiz Jimenez, J., Boyd, J. G., & Islam, O. (2023). Feasibility and Cost Analysis of Portable MRI Implementation in a Remote Setting in Canada. The Canadian journal of neurological sciences. Le journal canadien des sciences neurologiques, 1–27. Advance online publication. <https://doi.org/10.1017/cjn.2023.250> PMID: 37434471

DeStigter, K., Pool, K. L., Leslie, A., Hussain, S., Tan, B. S., Donoso-Bach, L. & Andronikou, S. (2021). Optimizing Integrated Imaging Service Delivery by Tier in Low-Resource Health Systems. *Insights into Imaging*, *12*(1), 1–11. [https://doi.org/10.1186/s13244-021-01073-8](about:blank) PMCID: PMC8444174

Fuhrimann, S., Winkler, M. S., Staudacher, P., Weiss, F. T., Stamm, C., Eggen, R. I., Lindh, C. H., Menezes-Filho, J. A., Baker, J. M., Ramírez-Muñoz, F., Gutiérrez-Vargas, R. & Mora, A. M. (2019). Exposure to Pesticides and Health Effects on Farm Owners and Workers From Conventional and Organic Agricultural Farms in Costa Rica: Protocol for a Cross-Sectional Study. *JMIR Research Protocols*, *8*(1), e10914. [https://doi.org/10.2196/10914](about:blank) PMCID: PMC6367668

Harding, L., McFarlane, J., Honey, C. R., McDonald, P. J., & Illes, J. (2023). Mapping the Landscape of Equitable Access to Advanced Neurotechnologies in Canada. The Canadian journal of neurological sciences. Le journal canadien des sciences neurologiques, 50(s1), s17–s25. https://doi.org/10.1017/cjn.2023.18

Katus, L., Hayes, N. J., Mason, L., Blasi, A., McCann, S., Darboe, M. K., de Haan, M., Moore, S. E., Lloyd-Fox, S. & Elwell, C. E. (2019). Implementing Neuroimaging and Eye Tracking Methods to Assess Neurocognitive Development of Young Infants in Low- and Middle-Income Countries. *Gates Open Research*, *3*, 1113. [https://doi.org/10.12688/gatesopenres.12951.2](about:blank) PMCID: PMC6719506

Mateen, F. J. (2019). Multiple Sclerosis in Resource-Limited Settings: Research Opportunities in an Unequal World. *Neurology*, *93*(4), 176–180. [https://doi.org/10.1212/WNL.0000000000007837](about:blank) PMID: 31332086

Murali, S., Ding, H., Adedeji, F., Qin, C., Obungoloch, J., Asllani, I., Anazodo, U., Ntusi, N. A. B., Mammen, R., Niendorf, T., & Adeleke, S. (2023). Bringing MRI to low- and middle-income countries: Directions, challenges and potential solutions. NMR in biomedicine, e4992. Advance online publication. https://doi.org/10.1002/nbm.4992

Palzes, V. A., Sagiv, S. K., Baker, J. M., Rojas-Valverde, D., Gutiérrez-Vargas, R., Winkler, M. S., Fuhrimann, S., Staudacher, P., Menezes-Filho, J. A., Reiss, A. L., Eskenazi, B. & Mora, A. M. (2019). Manganese Exposure and Working Memory-Related Brain Activity in Smallholder Farmworkers in Costa Rica: Results from a Pilot Study. *Environmental Research*, *173*, 539–548. [https://doi.org/10.1016/j.envres.2019.04.006](about:blank) PMCID: PMC6581040

**Portable MRI**

*Multiple research teams are actively developing more portable and more accessible magnetic resonance imaging (MRI) technologies. These technologies include low-field MRI, ultra-low field MRI, and more portable high-field MRI. The citations below are selected publications describing these technological advances.*

Abbas, A., Hilal, K., Rasool, A. A., Zahidi, U., Shamim, M. S., & Abbas, Q. (2023). Low-field magnetic resonance imaging in a boy with intracranial bolt after severe traumatic brain injury: illustrative case, Journal of Neurosurgery: Case Lessons, 6(1), CASE23225. <https://doi.org/10.3171/CASE23225> PMID: 37392768

Aggarwal, P. P. K., Jimeno, M. M., & Geethanath, S. (2023). Repeatability of image quality in very low field MRI. arXiv preprint arXiv:2304.07267.

Altaf, A., Baqai, M. W. S., Urooj, F., Alam, M. S., Aziz, H. F., Mubarak, F., Knopp, E., Siddiqui, K., & Enam, S. A. (2023). Intraoperative use of ultra-low-field, portable magnetic resonance imaging - first report. Surgical neurology international, 14, 212. <https://doi.org/10.25259/SNI_124_2023> PMID: 37404510

Arnold, T. C., Tu, D., Okar, S. V., Nair, G., By, S., Kawatra, K. D., Robert-Fitzgerald, T. E., Desiderio, L. M., Schindler, M. K., Shinohara, R. T., Reich, D. S. & Stein, J. M. (2022). Sensitivity of Portable Low-Field Magnetic Resonance Imaging for Multiple Sclerosis Lesions. *NeuroImage: Clinical*, *35*, 103101. [https://doi.org/10.1016/j.nicl.2022.103101](about:blank) PMID: 35792417

Anoardo, E., & Rodriguez, G. G. (2022). New challenges and opportunities for low-field MRI. *Journal of Magnetic Resonance Open*, 100086. https://doi.org/10.1016/j.jmro.2022.100086

Ayde, R., Senft, T., Salameh, N. & Sarracanie, M. (2022). Deep Learning for Fast Low-Field MRI Acquisitions. *Scientific Reports*, *12*(1), 11394. [https://doi.org/10.1038/s41598-022-14039-7](about:blank) PMID: 35794175

Basser, P. (2022). Detection of Stroke by Portable, Low-Field MRI: A Milestone in Medical Imaging. *Science Advances*, *8*(16), eabp9307. [https://doi.org/10.1126/sciadv.abp9307](about:blank) PMID: 35442726

Beekman, R., Crawford, A., Mazurek, M. H., Prabhat, A. M., Chavva, I. R., Parasuram, N., Kim, N., Kim, J. A., Petersen, N., de Havenon, A., Khosla, A., Honiden, S., Elliott Miller, P., Wira, C., Daley, J., Payabvash, S., Greer, D. M., Gilmore, E. J., Taylor Kimberly, W. & Sheth, K. N. (2022). Bedside Monitoring of Hypoxic Ischemic Brain Injury Using Low-Field, Portable Brain Magnetic Resonance Imaging After Cardiac Arrest. *Resuscitation, S0300-9572*(22), 150­–4. [https://doi.org/10.1016/j.resuscitation.2022.05.002](about:blank)

Bossert, S., Unadkat, P., Sheth, K. N., Sze, G., & Schulder, M. (2023). A novel portable, mobile MRI: Comparison with an established low-field intraoperative MRI system. Asian Journal of Neurosurgery. https://doi.org/10.1055/s-0043-1760857

Chaban, Y. V., Vosshenrich, J., McKee, H., Gunasekaran, S., Brown, M. J., Atalay, M. K., Heye, T., Markl, M., Woolen, S. A., Simonetti, O. P., & Hanneman, K. (2023). Environmental sustainability and MRI: Challenges, opportunities, and a call for action. Journal of Magnetic Resonance Imaging. https://doi.org/10.1002/jmri.28994

Chetcuti, K., Chilingulo, C., Goyal, M. S., Vidal, L., O’Brien, N. F., Postels, D. G., Seydel, K. B. & Taylor, T. E. (2022). Implementation of a Low-Field Portable MRI Scanner in a Resource-Constrained Environment: Our Experience in Malawi. *American Journal of Neuroradiology, 43*(5), 670–674. [https://doi.org/10.3174/ajnr.A7494](about:blank) PMID: 35450856

Cho, S.-M., Wilcox, C., Keller, S., Acton, M., Rando, H., Etchill, E., Bush, E. L., Sair, H. I., Pitts, J., Kim, B. S., Whitman, G. & Giuliano, K. (2022). *Assessing the SAfety and FEasibility of Bedside Portable Low-Field Brain Magnetic Resonance Imaging in Patients on ECMO (SAFE-MRI ECMO study) – Study Protocol and First Case Series Experience* [Manuscript Submitted for Publication]. Johns Hopkins University School of Medicine. [https://doi.org/10.21203/rs.3.rs-1409569/v1](about:blank)

Cooley, C. Z., McDaniel, P. C., Stockmann, J. P., Srinivas, S. A., Cauley, S. F., Śliwiak, M., Sappo, C. R., Vaughn, C. F., Guerin, B., Rosen, M. S., Lev, M. H. & Wald, L. L. (2021). A Portable Scanner for Magnetic Resonance Imaging of the Brain. *Nature Biomedical Engineering*, *5*(3), 229–239. [https://doi.org/10.1038/s41551-020-00641-5](about:blank)

Cooley, C. Z., Stockmann, J. P., Witzel, T., LaPierre, C., Mareyam, A., Jia, F., Zaitsev, M., Wenhui, Y., Zheng, W., Stang, P., Scott, G., Adalsteinsson, E., White, J. K. & Wald, L. L. (2020). Design and Implementation of a Low-Cost, Tabletop MRI Scanner for Education and Research Prototyping. *Journal of Magnetic Resonance*, *310*, 106625. [https://doi.org/10.1016/j.jmr.2019.106625](about:blank)

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de Leeuw den Bouter, M. L., Ippolito, G., O’Reilly, T. P. A., Remis, R. F., van Gijzen, M. B. & Webb, A. G. (2022). Deep Learning-Based Single Image Super-Resolution for Low-Field MR Brain Images. *Scientific Reports*, *12*(1), 6362. [https://doi.org/10.1038/s41598-022-10298-6](about:blank) PMID: 35430586

Deoni, S. C. L., Bruchhage, M. M. K., Beauchemin, J., Volpe, A., D’Sa, V., Huentelman, M. & Williams, S. C. R. (2021). Accessible Pediatric Neuroimaging Using a Low Field Strength MRI Scanner. *NeuroImage*, *238*, 118273. [https://doi.org/10.1016/j.neuroimage.2021.118273](about:blank) PMID: 34146712

Deoni, S. C. L., Medeiros, P., Deoni, A. T., Burton, P., Beauchemin, J., D’Sa, V., Boskamp, E., By, S., McNulty, C., Mileski, W., Welch, B. E. & Huentelman, M. (2022). Development of a Mobile Low-Field MRI Scanner. *Scientific Reports*, *12*(1), 5690. [https://doi.org/10.1038/s41598-022-09760-2](about:blank) PMID: 35383255

Ezeala-Adikaibe, B. A., Oti, B., Ohaegbulam, S. C., Okwuonodulu, O. & Ndubuisi, C. (2022). 0.35 Tesla Magnetic Resonance Imaging Findings in a Cohort of 399 Seizure Patients. Experience From a Single Centre in Nigeria. *Annals of Clinical and Biomedical Research*, *3*(1), 188. [https://doi.org/10.4081/acbr.2022.188](about:blank)

Frija, G., Blažić, I., Frush, D. P., Hierath, M., Kawooya, M., Donoso-Bach, L. & Brkljačić, B. (2021). How to Improve Access to Medical Imaging in Low- and Middle-Income Countries? *EClinicalMedicine*, *38*. [https://doi.org/10.1016/j.eclinm.2021.101034](about:blank) PMCID: PMC8318869

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**Portable MEG**

*Magnetoencephalography (MEG) measures the magnetic waves created by the brain’s neural activity. Traditional MEG requires a large device, a big liquid helium cooling unit, and a motionless participant. But researchers are now developing portable MEG technology that relaxes those constraints. The citations below are selected publications describing new, portable MEG.*

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**Portable PET**

*Positron emission tomography (PET) is a method of indirectly measuring brain function by injecting a radioactive tracer into the bloodstream and then tracking how brain cells consume glucose. Traditional PET technology has required a large machine, with patients flat on their back. But new research is exploring the possibility of more portable and wearable PET technology. The citations below are selected publications describing these advances.*

Allison, J., Antkowiak, P., Bellam, N., Castro, F., Chen, L., Correia, P., Encarnação, P., Veloso, J., Mięsak, P., Morichi, M., Ren, Z., Simpura, S., Suhonen, E., Venturini, Y. & Watts, S. (n.d.). Wearable Positron Emission Tomography. *ATTRACT*. [https://phase1.attract-eu.com/wp-content/uploads/2019/05/WPET.pdf](about:blank)

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**Portable fNIRS**

*Functional near-infrared spectroscopy (fNIRS) utilizes sensers on the human scalp and optimal imaging to indirectly measure brain function by detecting changes in cerebral blood flow. fNIRS has always been more portable than fixed MRI, MEG, and PET, but new advances are allowing for even more portability at lower costs. The citations below present selected research utilizing portable fNIRS.*

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**Portable EEG**

*Electroencephalography (EEG) was invented in the 1920s and uses electrodes on the scalp to measure the brain’s electrical activity. Relative to the other technologies included in this bibliography, EEG is the most affordable and most portable. EEG is used in a variety of consumer-grade technologies, in technologies designed to monitor and enhance athletes’ performance, and in many field-based research projects. The citations below present a selection of this portable EEG research, but it should be noted that in the interests of space, much additional portable EEG research is not included here.*

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