COMMON CANCER DATABASE

1 Background

Cancer continues to pose one of the most significant global health challenges, with millions of new cases diagnosed annually around the world [1]. Despite remarkable advances in medical science, the complex nature of cancer, characterized by its diverse molecular signatures and varied patient responses to treatments, necessitates continuous innovation and research. Traditional cancer therapies often follow a one-size-fits-all approach, which fails to consider the genetic diversity and individual complexities of tumors. This oversight often results in suboptimal treatment outcomes and highlights the urgent need for a more tailored approach.

Precision medicine represents a transformative approach in healthcare, offering treatments tailored to the genetic and molecular profiles of individuals. However, accessing large, diverse, multi-institutional, and global databases remains a major bottleneck, limiting the widespread adoption of precision medicine and slowing innovation and discovery in the field [2]. To fully harness its potential, it is important to establish an extensive infrastructure capable of integrating and analyzing large-scale datasets from diverse populations globally. This necessitates the development of a unified global database, a centralized repository that systematically consolidates cancer research data, including demographic information, genetic markers, treatment outcomes, and other pertinent data. Such integration is essential for advancing personalized treatment strategies and enhancing our understanding of disease mechanisms across different populations.

This editorial, rooted in discussions from the Worldwide Innovative Network (WIN) Consortium Common Database Committee meetings, represents a collective effort to address the urgent need for a global, integrated approach to cancer treatment data. By examining the current landscape, challenges, collaborative initiatives, and strategic solutions, it aims to chart a path toward a more unified and effective global framework for cancer care. The WIN Consortium is a global collaborative network of researchers, clinicians, and institutions across continents focused on advancing personalized cancer medicine through innovative research and clinical trials [3]. Establishing a global database would revolutionize cancer treatment by increasing research efficiency, enabling rapid hypothesis generation and testing, and facilitating the development of more effective personalized treatments. Moreover, this initiative would democratize access to the latest research and innovations, ensuring that breakthroughs are shared and beneficial treatments are accessible worldwide, regardless of geographical or economic barriers. The underrepresentation of diverse populations in genomic studies directly affects cancer treatment. Eligibility criteria for precision cancer drugs often rely on genetic mutations identified predominantly in European populations. Consequently, minority patients may have reduced access to these therapies, limiting the benefits of advancements in precision oncology. Establishing a global genomic database that includes data from underrepresented and vulnerable groups is important to addressing these disparities. Such a repository would facilitate the development of cancer treatments tailored to diverse genetic backgrounds, ensuring equitable healthcare outcomes. The World Economic Forum has called for increased diversity in genomic medicine, emphasizing the need for inclusive research to prevent widening health inequities [4].

2 The Need for a Common Cancer Database

Cancer's genetic diversity is clearly evident when viewed across different populations and individual patients, creating an undeniable imperative for integrating global data. Genetic mutations associated with cancer are not uniformly distributed. They vary significantly among different ethnicities and geographies, influencing both the progression of the disease and the efficacy of treatments. For instance, mutations in the BRCA1 and BRCA2 genes, which increase the risk of breast and ovarian cancers, exhibit different prevalence rates and patterns across ethnic groups, directly affecting the outcomes of targeted therapies[5]. Moreover, a significant challenge in this field is the underrepresentation of diverse populations in genomic research, leading to disparities in treatment outcomes. A 2018 study highlighted that

genomic databases predominantly consist of data from individuals of European descent, with African, Latin American, and Asian populations significantly underrepresented. This lack of diversity limits the generalizability of genomic findings and hinders the equitable application of precision medicine [6]. Similarly, a 2025 report emphasized that 95% of participants in genome-wide association studies are of European descent. This Eurocentric bias can lead to less accurate diagnostics and treatments for non-European populations, potentially exacerbating health disparities [7].

2.1 Benefits of a Global Database

A unified global database for cancer research offers several major advantages that could greatly advance the field of oncology. Researchers and clinicians can identify patterns and correlations by integrating datasets from diverse populations that smaller and localized datasets cannot reveal. This broader scope is particularly valuable for studying rare cancers and specific subpopulations, where larger sample sizes are necessary for statistical significance. Such an approach would foster more robust and generalizable findings, improving our understanding of cancer biology and treatment responses. Additionally, access to a globally integrated database would enable pharmaceutical companies to develop more effective therapies by considering the full spectrum of cancer related genetic variations across populations. This data-driven approach facilitates the design of targeted treatments for specific genetic anomalies and enhances the efficiency of clinical trials, optimizing the precision and efficacy of new therapeutic interventions.

Sharing and integrating data globally would also reduce redundancy in research efforts, promoting the efficient utilization of resources. Researchers could leverage previously collected data, avoiding duplicating studies and instead focusing on innovative investigations pushing cancer treatment boundaries. This streamlined approach would accelerate scientific progress and optimize funding allocation. Further more, incorporating patient history data into the global cancer treatment database is essential for a comprehensive understanding of each patient's care journey. These histories provide critical insights into treatment efficacy, side effects, and long-term health outcomes, enriching genetic and clinical trial data. By encompassing this holistic view, the database enhances predictive analytics and supports the development of personalized treatment strategies that improve patient quality of life.

Ultimately, the greatest beneficiaries of a global cancer database would be the patients. By providing clinicians access to a vast repository of analyzed and structured data, personalized treatment strategies could be developed more accurately. This would enable the selection of therapies tailored to individual genetic profiles, improving treatment efficacy while minimizing adverse effects.

2.2 Challenges to Integration

Creating a unified global database to enable precision medicine presents several major challenges. One of the primary obstacles is data standardization, as the diverse formats and structures of data used across different institutions can create significant barriers. Data collected by various research centers, hospitals, and pharmaceutical companies often exist in incompatible systems, employing different data collection standards that span genomic sequences, clinical outcomes, and detailed patient demographics. This technical complexity requires the development of uniform standards to enable seamless integration and comparison of data from multiple sources.

Legal and ethical barriers also play an important role in creating a global cancer database. Privacy laws vary significantly across countries, with each having its regulations governing medical data sharing. For example, the European Union's (EU) general data protection regulation sets strict standards for data privacy. It limits the transfer of personal data outside the EU, which can hinder the free flow of vital information for global research efforts. Alongside privacy concerns, ethical challenges arise, particularly in obtaining patient consent and safeguarding sensitive information. Ensuring a balance between using data for medical advancements and protecting individual privacy is essential. Addressing these concerns requires establishing clear, transparent consent procedures and implementing robust data protection methods to ensure patient anonymity.

Technological barriers also present a significant challenge in building and maintaining a global cancer research database. The infrastructure required to support such a system must be capable of handling vast amounts of data efficiently and securely. This includes developing sophisticated data management systems that can accommodate the integration, storage, and analysis of large datasets from various sources. Moreover, advanced analytical tools, such as artificial intelligence algorithms, are necessary to process and extract meaningful insights from complex datasets, helping to identify patterns and predictive markers that might be missed using traditional methods. Establishing and maintaining the infrastructure for this database demands considerable financial and human resources. Securing funding for technology upgrades, staff training, and ongoing maintenance can be especially difficult for institutions in resource-limited settings. Additionally, ensuring the privacy and security of the data is crucial. Stakeholders, including patients, may hesitate to share their information due to concerns about security risks. To build trust and encourage broader participation, robust security protocols and transparent practices must be implemented to protect shared data.

2.3 Addressing the Challenges

To overcome these obstacles, stakeholders across the healthcare, technology, legal, and policy-making sectors must work together. Collaborative initiatives can foster the development of shared goals and standards, while international treaties and agreements can help harmonize legal and ethical practices across countries. Furthermore, investments in cutting-edge technology and infrastructure are necessary to build and maintain a robust database that meets the needs of the global research community. Strong international collaborations play an important role in this effort, as demonstrated by organizations such as the WIN and the Global Alliance for Genomics and Health (GA4GH). These consortia work to harmonize research efforts and enhance data utility across borders, promoting best practices and methodologies that accommodate diverse regulatory and operational frameworks.

One of the main obstacles to establishing a unified database is ensuring that international consortia create effective frameworks and protocols to maintain the compatibility and high quality of data contributions from various countries and institutions. Establishing an environment of trust and mutual benefit is essential, as it encourages open data sharing, enriches global datasets, and accelerates advancements in cancer research and treatment. Without clearly defined structures for data integration, discrepancies in collection methods and reporting standards can undermine the potential benefits of a global database.

Another significant challenge lies in standardizing data collection across institutions and countries. Discrepancies in data formats and classification systems hinder seamless integration, making standardization efforts a priority. Encouraging the adoption of international data models such as the Observational Medical Outcomes Partnership (OMOP) and the Observational Health Data Sciences and Informatics (OHDSI) would provide a structured approach to organizing medical data, ensuring compatibility and comparability. These frameworks help standardize clinical terminology and data structures, ultimately improving the quality and usability of integrated datasets. However, successful implementation depends on ongoing collaboration among researchers, healthcare providers, and IT professionals to ensure these standards evolve alongside technological advancements and shifts in medical practice.

By addressing these obstacles through international partnerships, data standardization efforts, and sustained investment in infrastructure, the global research community can take significant steps toward realizing a unified cancer database that enhances research, improves treatment outcomes, and makes precision medicine accessible to patients worldwide.

2.4 Proposed Implementation Strategies

A comprehensive strategy involving policy changes, technological investments, and continuous stakeholder engagement is necessary to implement these solutions effectively.

One key strategy is the development of flexible data-sharing agreements that facilitate international collaboration while safeguarding patient privacy. Establishing legal frameworks that can adapt to different regulatory landscapes is crucial for ensuring smooth data exchange across borders. Engaging legal experts in the drafting and reviewing of these agreements helps navigate the complexities of international regulations, ensuring compliance with existing laws while anticipating potential legal shifts. Transparency in data-sharing policies is equally important in building trust among participants, allowing all stakeholders to understand the benefits and protections associated with data contributions. Although rapid data sharing can accelerate research and treatment advancements, it also presents patient privacy and security risks. Striking a balance between open data access and robust protection measures is essential to maintaining confidentiality while enabling meaningful scientific progress. Developing standardized contract templates that clearly define terms of use, responsibilities, and safeguards ensures that agreements remain relevant as legal and technological landscapes evolve.

Funding and resource allocation are critical in supporting the infrastructure necessary for a global cancer research database. Securing financial backing from government agencies, philanthropic organizations, and private sector stakeholders is essential for sustaining data management systems, security measures, and compliance protocols. International cooperation on funding initiatives can help ensure that resource allocation extends to developing countries, promoting equitable participation in global research efforts and preventing disparities in access to cutting-edge treatments.

Enhancing partnerships with pharmaceutical companies, academic institutions, and healthcare organizations further strengthens the foundation of a unified cancer treatment database. These collaborations facilitate access to extensive clinical trial data, offering insights into patient care trajectories and clinical outcomes. By bringing together diverse expertise and resources, such partnerships accelerate the development of clinical trials, improve data-sharing practices, and foster innovation in cancer research and treatment.

By leveraging these collaborative efforts and technological solutions, the global research community can overcome the challenges of establishing a unified cancer treatment database. This cooperative approach can potentially transform cancer care, making precision medicine accessible to patients worldwide.

2.5 Technological Consideration for Data Integration

Advancements in technology provide powerful tools to overcome the logistical and technical challenges associated with establishing a global cancer database. Cloud technologies offer scalable and cost-effective solutions for storing and managing large datasets, facilitating real-time access and collaboration across the globe without the need for extensive local infrastructure. However, as it may violate the privacy laws of some countries, alternatively, a decentralized database would overcome this issue. Distributed algorithms allow for the decentralized analysis of data, where each institution can process its own data locally while sharing only the results or insights, thereby maintaining data privacy and security. However, each infinitude needs to have some technical capacities to provide this service.

AI and machine learning algorithms can analyze vast amounts of data efficiently, identifying patterns and correlations that may not be apparent through traditional research methods. These technologies can accelerate the discovery of new treatment options and refine existing therapies based on real-world data. Such a database would increase the chance of using large and data-hungry machine learning models to find these patterns. Furthermore, it is necessary to identify gaps in the data required for AI algorithms before starting data gathering on a large scale.

For example, the Jewish General Hospital has implemented automated scripts to extract patient records from multiple systems as part of the Personalize My Treatment (PMT) project. This process consolidates data from electronic medical records, lab results, and imaging repositories into a single structured database, reducing manual entry errors and administrative overhead. Further, machine learning algorithms remove personally identifiable information from the extracted data to maintain patient confidentiality. Participating institutions can more rapidly build large-scale, high-quality datasets suitable for global research by applying similar approaches.

2.6 Similar Efforts

Numerous large-scale or multi-institutional cancer genomics initiatives have attempted to create multi-center databases. They provide valuable insights into how data can be collected, harmonized, and shared across varied healthcare systems. However, none of them covered a global population. In this section, we review some of these efforts.

The Cancer Genome Atlas (TCGA) [8] is one of the most used datasets for cancer studies. It provides comprehensive multi-omic genomic profiles for over 11,000 tumors spanning 33 cancer types. Although this dataset covered various tumors, the cohort primarily comprises US-based patient samples. Genomics England—100,000 Genomes Project [9] is a UK initiative primarily focused on rare diseases and cancer. It integrates whole-genome sequencing data with detailed clinical records for participants recruited through the National Health Service (NHS). This project places considerable emphasis on nationwide coverage across England. The Asian Clinical Trials Network for Cancers Project (ATLAS) [10] is another notable initiative aiming to unify oncology research efforts across multiple Asian countries. By coordinating clinical trials, sharing genomic profiles, and aligning treatment protocols, it strives to address regional disparities in care and outcomes. With a network of medical centers in countries such as Japan, South Korea, Singapore, and Thailand, this project enhances cross-border collaboration and aims to improve the representation of Asian populations in large-scale cancer studies.

On the other hand, ICGC-ARGO (Accelerating Research in Genomic Oncology) [11] is a next-generation international initiative building upon the original International Cancer Genome Consortium (ICGC). It represents a global effort involving multinational partnerships designed to integrate extensive genomic data with detailed clinical annotations, aiming to enhance precision oncology. ICGC-ARGO combines newly generated prospective genomic data with existing datasets from ICGC to facilitate large-scale cross-cohort analyses. Supported by numerous countries, ICGC-ARGO aims to characterize tens of thousands of patient genomes, enhancing diversity and global representation to address cancer heterogeneity and ultimately advance precision medicine worldwide. Although ICGC-ARGO aims for global representation, most contributing institutions are from high-income countries. Populations from lower and middle-income countries and underrepresented ethnicities remain comparatively less represented, potentially limiting the generalizability of findings.

Despite these regional-specific registries, low-income countries face fundamental barriers to contributing robust data on cancer or general medical imaging. Resource constraints, infrastructure challenges, and limited expertise often hamper efforts to collect and share high-quality data. The Consortium for Advancement of MRI Education and Research in Africa (CAMERA) [12] illustrates how targeted programs can help, notably through the Sprint Artificial Intelligence Training for African Medical Imaging Knowledge Translation (SPARK) Academy. By promoting AI training and

case-based learning, SPARK builds local capacity and alleviates resource constraints in underrepresented regions, ultimately paving the way for more inclusive datasets.

Meanwhile, these examples overall underscore the need for a more global, unified database. Some projects are heavily US-based, while others span multiple continents, yet regions across Africa, Asia, and Latin America remain underrepresented. Fragmented data structures, strict consent procedures, and varied local regulations further hinder multi-national integration. As a result, substantial gaps persist in the world's diverse cancer data, underlining the urgency of a more comprehensive repository that captures global genetic and clinical variability.

2.7 Current WIN Datasets and their Vision

In the effort to create global, large-scale datasets, the WIN Consortium unites diverse institutions worldwide, each maintaining its own repositories of genomic, clinical, and pharmacogenomic data. During committee discussions, it became clear that many members rely on different testing platforms, ranging from in-house gene panels to commercial providers to varied data structures and interoperability challenges. Some institutions gather extensive genomic and clinical annotations for certain patient cohorts, whereas others collect only basic demographic or treatment information. Longitudinal data on outcomes and adverse events often remains partial or manually tracked. Furthermore, each jurisdiction enforces its own privacy regulations, adding complexity to cross-border data exchange.

This paper has discussed several of these obstacles and outlined potential solutions. WIN members offer a demographically diverse patient base across continents such as the USA, Canada, Spain, and Australia, suggesting the network's potential to become one of the most inclusive global cancer data resources. Although it focuses predominantly on high-income countries, it underlines a strong need to recruit more institutions and resources from other parts of the globe to ensure that underrepresented populations are better captured. By filling these gaps, WIN can move closer to achieving a genuinely comprehensive worldwide cancer dataset. Table 1 shows currently available data from participants in the WIN consortium.

Table 1: Overview of WIN Member Databases

Institution / Participant	Data
Avera Cancer Institute (USA)	Uses commercial partners (Foundation, Tempus, etc.) and can access raw data from some. Conducts in-house testing (small panels, pharmacogenetics). Maintains curated data (treatments, sequencing, AEs, outcomes) on patients in MTB program over ~ 10 years. Mining EMRs is ongoing but challenging. Operates an in-house platform for data management.
University of Arizona (USA)	Received "All of Us" funding for genomic profiling of 1M patients in the US. Recommends OMOP/OHDSI for standardized data submission; Uses an EMR structure with $\sim 10K$ tables; aims to migrate to OMOP.
Brown University (USA)	Focuses on molecular modeling (proteins, cancer-related pathways) and AI-based approaches. Requires trajectory/confirmational data and potential integration with genomic data.
VHIO (Spain)	Also part of AACR GENIE; passed GDPR approvals for data sharing. Uses in-house panels (up to 500 genes) plus liquid biopsy assays (~ 1000 samples). Maintains deep curation of medical records (via REDCap). Data modeled in OMOP format for improved interoperability. Seeks to expand patient consent for broader data sharing.
Jewish General Hospital/Exactis (Canada)	Developed "Personalize My Treatment" (PMT) for clinical trial matching, covering $\sim 10K$ patients at 50 hospitals. PMT includes longitudinal data on solid tumors.
ProCan Children's Medical Research Institute (Australia)	Partners with ~ 100 groups globally to add proteomic data to retrospective cohorts (clinical trials or real-world). Over $20K$ samples with deep proteomic profiling; some normal tissue samples included. Maintains an in-house unified database with clinical and proteomics data for cross-cohort queries.
Catalan Institute of Oncology (Spain)	Primarily holds genomic data ($\sim 10K$ germline NGS samples, 1K somatic 500-gene panel). In-house developed database for storing data from Illumina-based assays.
Wake Forest University (USA)	Profiles most patients with third-party vendors (Tempus, Caris, etc.); raw data available from some vendors, but not all. Tracks $\sim 18K$ cases in Southeastern US, adding 8K more in the Midwest. Works to integrate demographic, treatment, and genomic information.

3 Conclusion

Establishing a global cancer treatment database represents a transformative advancement in precision oncology. Integrating longitudinal multimodal data, including genomic, diagnostic images, reports, and clinical data from conventional treatments and clinical trials from diverse global populations in a unified database would significantly increase the precision and effectiveness of cancer treatments. It would accelerate the pace of medical research by providing researchers with access to a vast, diverse, and rich dataset that transcends geographical and institutional boundaries. Most importantly, access to this global cancer database enables clinicians to improve patient outcomes through the delivery of personalized treatment plans based on comprehensive and accurate data.

However, the creation of such a global and diverse dataset presents its own set of challenges. These include standardized data formats, overcoming legal and ethical barriers to data sharing, and addressing the technological demands of managing a large-scale, global database. Solutions such as adopting international data standards such as OMOP and OHDSI, developing flexible data-sharing agreements, and leveraging advanced technologies like AI and distributed algorithms are essential to overcoming these obstacles.

Public and private healthcare systems and industries should commit to open data initiatives and invest in developing robust data management and analysis tools that can handle the complexities of a global database. Policymakers should support international collaboration by facilitating and funding research partnerships to integrate and utilize cancer treatment data. Academic and research Communities need to engage in multidisciplinary research to enhance the analytical capabilities of cancer data and promote the standardization and sharing of data across borders. And finally, we need to advocate for policies that support data sharing and participate actively in discussions about data governance to ensure that patient interests are protected.

Hence, we call to unite across sectors, disciplines, and borders to turn the vision of a global cancer treatment database into a reality. This concerted effort will revolutionize cancer research and treatment and pave the way for a new era in medical science where precision medicine is the norm, not the exception.

References

[1] IARC. Global cancer burden growing, amidst mounting need for services. `https://www.who.int/news/item/01-02-2024-global-cancer-burden-growing--amidst-mounting-need-for-services`. Accessed: 2025-03-18.

[2] Joshua C. Denny and Francis S. Collins. Precision medicine in 2030—seven ways to transform healthcare. *Cell*, 184(6):1415–1419, 2021.

[3] Wafik S El-Deiry, Catherine Bresson, Fanny Wunder, Benedito A Carneiro, Don S Dizon, Jeremy L Warner, Stephanie L Graff, Christopher G Azzoli, Eric T Wong, Liang Cheng, Sendurai A Mani, Howard P Safran, Casey Williams, Tobias Meissner, Benjamin Solomon, Eitan Rubin, Angel Porgador, Guy Berchem, Pierre Saintigny, Amir Onn, Jair Bar, Raanan Berger, Manon Gantenbein, Zhen Chen, Cristiano de Pádua Souza, Rui Manuel Vieira Reis, Marina Sekacheva, Andrés Cervantes, William L Dahut, Christina M Annunziata, Kerri Gober, Khaled M Musallam, Humaid O Al-Shamsi, Ibrahim Abu-Gheida, Ramon Salazar, Sewanti Limaye, Adel T Aref, Roger R Reddel, Mohammed Ussama Al Homsi, Abdul Rouf, Said Dermime, Jassim Al Suwaidi, Catalin Vlad, Rares Buiga, Amal Al Omari, Hikmat Abdel-Razeq, Luis F Oñate-Ocaña, Finn Cilius Nielsen, Leah Graham, Jens Rueter, Anthony M Joshua, Eugenia Girda, Steven Libutti, Gregory Riedlinger, Mohammed E Salem, Carol J Farhangfar, Ruben A Mesa, Bishoy M Faltas, Olivier Elemento, CS Pramesh, Manju Sengar, Satoru Aoyama, Sadakatsu Ikeda, Ioana Berindan-Neagoe, Himabindu Gaddipati, Mandar Kulkarni, Elisabeth Auzias, Maria Gerogianni, Nicolas Wolikow, Simon Istolainen, Pessie Schlafrig, Naftali Z Frankel, Amanda R Ferraro, Jim Palma, Alejandro Piris Gimenez, Alberto Hernando-Calvo, Enriqueta Felip, Apostolia M Tsimberidou, Roy S Herbst, Josep Tabernero, Richard L Schilsky, Jia Liu, Yves Lussier, Jacques Raynaud, Gerald Batist, Shai Magidi, and Razelle Kurzrock. Worldwide innovative network (win) consortium in personalized cancer medicine: Bringing next-generation precision oncology to patients. *Oncotarget*, 16(1):140–162, 2025.

[4] Amanda Russo. Global call to boost diversity of genomic medicine. `https://www.weforum.org/press/2020/07/global-call-to-boost-diversity-of-genomic-medicine/`. Accessed: 2025-03-12.

[5] Nancie Petrucelli, Mary B. Daly, and Gerald L. Feldman. Hereditary breast and ovarian cancer due to mutations in brca1 and brca2. *Genetics in Medicine*, 12(5):245–259, 2010.

[6] Latrice G. Landry, Nadya Ali, David R. Williams, Heidi L. Rehm, and Vence L. Bonham. Lack of diversity in genomic databases is a barrier to translating precision medicine research into practice. *Health Affairs*, 37(5):780–785, 2018. PMID: 29733732.

[7] Kanak Gupta. Are people of colour being left behind in the advancing field of genomics? https://imsmagazine.com/2025/01/27/are-people-of-colour-being-left-behind-in-the-advancing-field-of-genomics/. Accessed: 2025-03-12.

[8] National Cancer Institute. The cancer genome atlas program. https://www.cancer.gov/tcga. Accessed: 2025-03-18.

[9] Genomics England. 100,000 genomes project. https://www.genomicsengland.co.uk/initiatives/100000-genomes-project. Accessed: 2025-03-18.

[10] Mitsumi Terada, Kenichi Nakamura, Tomohiro Matsuda, Hitomi Okuma, Kazuki Sudo, Akhmal Yusof, Marcelo Imasa, Ekaphop Sirachainan, Pham Anh, Yasuhiro Fujiwara, Noboru Yamamoto, Pei Voon, Kulkanya Chokephaibulkit, Tatsuhiro Shibata, Manami Inoue, Hiroyuki Mano, Tatsunori Shimoi, Virote Sriuranpong, Kan Yonemori, and Kazuaki Shimada. A new era of the asian clinical research network: a report from the atlas international symposium. *Japanese journal of clinical oncology*, 53, 04 2023.

[11] The International Cancer Genome Consortium. Icgc argo data platform. https://platform.icgc-argo.org/. Accessed: 2025-03-18.

[12] Udunna C Anazodo, Jinggang J Ng, Boaz Ehiogu, Johnes Obungoloch, Abiodun Fatade, Henk JMM Mutsaerts, Mario Forjaz Secca, Mamadou Diop, Abayomi Opadele, Daniel C Alexander, et al. A framework for advancing sustainable magnetic resonance imaging access in africa. *NMR in Biomedicine*, 36(3):e4846, 2023.