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EXECUTIVE SUMMARY

In accordance with the Horizon Europe requirements, the GEMSTONE project includes a dedicated deliverable report (D1.3.) that is focused on data management. This report outlines strategies for the preservation of each dataset collected during the research activities, including details on metadata usage, data formats, and ethical considerations. Adherence to ethical standards set by Horizon Europe and national data privacy regulations is of critical importance, particularly during the collection and processing of personal data.

The Horizon Europe Programme requires that all beneficiaries maintain a structured and regularly updated data management plan (DMP). GEMSTONE's DMP provides a roadmap for enhancing data quality and aligning with the FAIR principles, which emphasise findability, accessibility, interoperability, and reusability of data. The DMP also addresses crucial aspects such as data security, resource allocation, and ethical concerns.

This executive summary outlines the project's approach to data management, software utilisation, and collaborative research practices. The data management within the GEMSTONE Project adheres to high standards, ensuring precision and security in the handling of research data. The project employs a systematic approach, whereby data generated from various software is regularly cleaned, categorised, and securely stored. Data is continually monitored and cleaned to maintain its relevance and accuracy. Classified data is stored on dedicated computers within the project's infrastructure and backed up monthly on external storage devices to prevent data loss and facilitate easy retrieval. In order to provide an additional layer of security and redundancy, backups are conducted on ACU servers.

The project also makes use of a number of advanced software solutions with the intention of enhancing research efficiency and output quality. These tools are of great importance to the project's operations, enabling sophisticated data analysis, real-time collaboration, and high-quality data visualisation. Collaboration is a cornerstone of the GEMSTONE Project, particularly with the ULUND team. Real-time data exchange is facilitated through software servers, ensuring that all team members have immediate access to the latest research data.

As a living document, the DMP will undergo periodic updates in order to remain in compliance with the evolving policies of the grant agreement. It is scheduled for a final version (D1.4) at the 36th month of the project.



1. Data Summary

The GEMSTONE Project, has developed a comprehensive Data Management Plan (DMP) that addresses the dual needs of managing both research and administrative data. Over the course of the project's implementation, particularly within Work Package 2 (WP2), a robust framework for generating and handling primary research data through laboratory or experimental research has been established. This initiative not only facilitates the generation of primary data but also promotes the transfer and exchange of cutting-edge experimental and theoretical techniques, thereby leveraging existing scientific data to enrich the project's scientific output.

In the context of the GEMSTONE Project, which forms part of the Horizon Europe framework, strict measures are implemented to ensure the responsible collection and processing of personal data. This adherence is in compliance with several key legislative frameworks that govern data protection within the EU and the specific nations involved in the project.

The project is in accordance with the ethical standards established by Horizon Europe, including adherence to EU Directive 2010/63/EU¹, which primarily concerns the protection of animals used for scientific purposes but also touches on broader ethical considerations relevant to research activities. Furthermore, the project adheres to the General Data Protection Regulation (GDPR, 2016/679)², a pivotal regulation within the EU that sets guidelines for the collection, processing, and storage of personal information.

Furthermore, the project adheres to national regulations, such as Turkey's Personal Data Protection Law (KVKK)³, which mirrors many of the principles found in the General Data Protection Regulation (GDPR). This ensures that personal data collected during the project's activities, including those related to twinning initiatives, communication and dissemination efforts, is handled with the utmost care. This encompasses the securing of informed consent from participants, the guarantee that data is used solely for its intended purpose, the implementation of adequate security measures to protect the data, and the assurance of individuals' rights to access, correct, or delete their personal data.

The project distinguishes between two main types of data: primary research data and administrative data. The latter category encompasses financial records, personnel data, data from dissemination activities, and data collected during administrative meetings and promotional events. Each category is managed with specific protocols designed to ensure the highest standards of efficiency, security, and compliance with regulatory standards.

A significant objective of the GEMSTONE Project is to enhance the reusability of the data

¹ **EU Directive 2010/63/**, EU, <https://eur-lex.europa.eu/eli/dir/2010/63/oj>.

² **General Data Protection Regulation (GDPR, 2016/679)**, <https://eur-lex.europa.eu/eli/reg/2016/679/oj>.

³ **Turkey's Personal Data Protection Law (KVKK)**, [https://www.kvkk.gov.tr/Icerik/6649/Personal-Data-ProtectionLaw#:~:text=ARTICLE%201%20%E2%80%93%20\(1\)%20The,persons%20who%20process%20personal%20data.](https://www.kvkk.gov.tr/Icerik/6649/Personal-Data-ProtectionLaw#:~:text=ARTICLE%201%20%E2%80%93%20(1)%20The,persons%20who%20process%20personal%20data.)



collected, particularly the capacity-building data from WP3, WP4, and WP5. This data is intended not only for internal project purposes but also to provide valuable insights that can extend beyond the life of the project. Tools such as the Best Practice Book, which will be made openly accessible, encapsulate methodologies and metadata that facilitate this broader use.

Comprehensive Data Management and Security Strategies

From the outset, the GEMSTONE Project has recognised the critical importance of systematic data management across different categories of data. These include research data in work packages and diverse administrative data, including financial, personnel, and event-related information. Key to these efforts has been the segregation and meticulous handling of data to ensure both integrity and compliance with data protection regulations such as the EU General Data Protection Regulation (GDPR).

Administrative Data Handling

The handling of administrative data has been categorised into several classes, including financial records, personnel data, and event-related data. For each category, rigorous protocols have been established. Financial records are handled with heightened confidentiality and are stored both physically in secure locations and digitally within secure IT infrastructures. Similarly, personnel data is carefully processed to comply with privacy regulations, ensuring that sensitive information is stored securely and is accessible only to authorised personnel.

Event Data Management

The project has also taken significant steps to manage data from various events. This is achieved through the use of videos, photographs, and attendance logs, which serve to document all activities in great detail. Furthermore, consent forms are utilised during events to comply with GDPR requirements. This ensures that all data collection is lawful and transparent. The meticulous documentation of these events helps to preserve the integrity and verifiability of the data collected.

Digital and Physical Data Security

The security of both digital and physical records has been a key concern. Digital data, including critical research and administrative information, is regularly backed up onto external hard disks that are managed exclusively by project management to avoid unauthorised access. The physical data is secured in restricted-access areas and is routinely digitised to prevent data loss due to physical degradation or disasters.

Enhancing Data Accessibility and Reusability

The Project's objective is to enhance data accessibility and reusability. This is achieved by storing data in the Acibadem University Open Access Repository, which allows for wide accessibility



while ensuring the data is managed under strict security measures. The repository employs persistent identifiers, making data easily retrievable and citable by other researchers, thereby facilitating broader scientific collaboration and data reuse. In order to further enhance the reusability of data, comprehensive documentation practices have been adopted. This includes detailed metadata, codebooks, and methodologies that are provided alongside the data. These documents are of critical importance for enabling other researchers to understand, replicate, and build upon the original research findings.

The GEMSTONE Project categorises its data into two principal types within its thematic framework. The first category comprises research data, which is primarily collected under Work Package 2 (WP2). The second category includes various types of administrative data. This administrative data is meticulously classified into several distinct categories: financial data, personnel data, data from dissemination activities, data from short-term visits, data from administrative meetings, and data used for promotional purposes.

1.1. Administrative and Capacity-Building Data

The administrative aspects of the project entail the documentation and storage of a multitude of data types. For instance, data pertaining to project management and coordination activities are meticulously collected and stored. This encompasses communication records with project partners, minutes from consortium meetings, and reports on project management activities. Furthermore, the project prioritises capacity-building activities under Work Packages 3, 4, and 5, where data is employed to drive dissemination and exploitation efforts.

Data from Events and Dissemination Activities

It is of the utmost importance to maintain comprehensive records of all activities conducted within the scope of the project. These records are created in the form of videos and photographs, which are subsequently used for the purposes of project promotion. In the event that GEMSTONE events are organised online, they are recorded and the information pertaining to the recording is shared with all participants. In the event that the event is organised in a physical, face-to-face manner, two forms are signed by all participants. The first of these forms is the consent form, which serves to inform the participants of the fact that the activity is being recorded and to obtain their consent.

In addition, a participation form is signed by all participants. This form contains the names, titles or academic positions, affiliated institutions and wet signatures of the participants. These lists are kept in a physical format. All digital and physical data are cleaned as a priority. All useless data are deleted without being classified. All data are classified and separated. Physically stored materials such as consent forms, participation lists, etc. are archived by the project manager. These records are stored in a room with restricted access. All physical materials are scanned and digitised. All consent forms, participant lists, videos and photos, digital data are stored on a computer allocated to project management. On the first Friday of each month, all data pertaining



to the project is transferred to an external hard disk, which is also allocated exclusively to project management. Backed-up administrative data is stored on servers allocated by ACU's IT department. Cloud technology is not employed to ensure data security in the storage of this data.

Data from Visual Materials

All materials used in the promotion of events are prepared in a digital environment in coordination with the ACU Corporate Communications department. These materials are prepared using Canva professional version. Canva is allocated to our project by ACU and is not covered from the project budget. Promotional materials are used both digitally and through online channels. In addition, all necessary materials are printed. The number of all printed materials is reported. Once a printed material has been used, it is archived by the project manager. All digital and physical data are cleaned as a priority. All useless data are deleted without being classified. All data are classified and separated. Physically stored materials such as consent forms, participation lists, etc. are archived by the project manager. These records are stored in a room with restricted access. The digital data obtained are stored on a computer allocated to the project management. On the first Friday of each month, all data pertaining to the project are transferred to an external hard disk, which is also allocated exclusively to the project management.

Data from Financial Records

Within the scope of the project, meticulous care is taken in the maintenance of financial data and the management of data obtained. Financial records are kept completely confidential and data security is ensured. All financial records of the project are kept by the project manager/project coordinator and the financial affairs department in coordination. All invoices of the project are available in ACU's E-Invoice system. A copy of the financial data is signed with a wet signature to guarantee that they have all been checked. Wet-signed copies of invoices and payment orders are physically stored by the ACU financial affairs department in their archives. Physical copies of these data are kept by the project manager. The physical copies are classified and archived. These copies are stored in a room allocated to project management, where entry and exit are prevented. All physical versions are also scanned and digitised. The scanned versions are classified and stored on a computer assigned to project management. On the first Friday of each month, all data pertaining to the project are transferred to an external hard disk, which is also assigned exclusively to the project management. All records are saved in Excel files in accordance with invoice numbers and dates. This allows for constant monitoring of the budget. No financial data belonging to the project is saved with cloud technology to ensure data security. In order to ensure the security of the project financial data, the external memory where the data is saved and the computer given to the project management are not permitted to be taken outside the ACU campus. Furthermore, no physical documents containing financial data are allowed to be taken outside the ACU campus. It is not saved on any USB memory.

Data from Meetings

The project entails the convening of meetings on a continuous basis. These meetings are held between the consortium partners and between the project researchers. Depending on the participants, these meetings are conducted either in person or online. Online meetings are conducted using a Zoom account belonging to ACU, with the associated costs covered by ACU. Meeting recordings are made with the consent of the participants. One week prior to the meeting, an agenda is sent to the participants. Decisions taken during the meeting are duly noted. The meeting notes are shared with the participants within seven days of the meeting. The following seven days are given to the participants to check them. At the end of the control period, the meeting notes are classified. These records are classified and stored on a computer assigned to the project management. On the first Friday of each month, all data pertaining to the project are transferred to an external memory, which is also allocated only to the project management. No records are taken during the physical meetings. A meeting agenda is sent to the participants one week prior to the meeting. During the meeting, a meeting attendance list is signed by the participants. This list includes the names, titles or academic positions, affiliated institutions and wet signatures of the participants. Decisions taken during the meeting are noted. Meeting notes are shared with the participants within seven days. These lists are physically stored. Physically stored materials are archived by the project manager. These records are stored in a room with restricted access. All physical materials are scanned and digitised. All digital data is stored on a computer allocated to project management. On the first Friday of each month, all data belonging to the project is transferred to an external hard disk, which is also allocated exclusively to project management. The administrative data that has been backed up is stored on servers that have been allocated by the ACU's IT department. Concurrently, digital copies are stored in a team account that has been designated for the project. This allows project partners to access the meeting minutes at any time.

Data from Personnel and Staff Management

All personnel data pertaining to the GEMSTONE project is collected on a regular basis. This data encompasses contracts, work sheets, wage data and CVs of employees. Given that GEMSTONE personnel data contains personal data, it is archived in accordance with the provisions of KVKK and all personnel data is protected in accordance with the relevant legislation. Furthermore, personal data is not shared with anyone. Information on the employment contracts and salary data of the project team is shared with the project management and stored by the ACU human resources unit. It is classified and stored in a special and restricted access room in the Human Resources unit. All payment information and employment contracts are digitally archived only by the Human Resources unit. The CVs of the project team and the work sheets showing the time spent on the project are classified and archived in a restricted access room by the Project Management team with wet signatures. Additionally, this data is recorded on a monthly basis in an Excel file. This file is stored on a computer that has been allocated to the project management team. On the first Friday of each month, all data pertaining to the project is transferred to an external memory device, which is also allocated solely to the

project management team. The use of cloud technology is not employed to store this data in order to ensure data security.

Data from Short-Term Visits

The GEMSTONE project encompasses two work packages (WP3 and WP4) that include short-term visit missions. To ensure the preservation of the knowledge gained during these visits, reports on the visits are prepared. Prior to each ACU researcher's visit, they are interviewed by Melike Şahiner, WP4 leader, about the purpose and expectations of their visit and asked to complete a questionnaire form. Following the conclusion of their visit, the researchers are once again interviewed and asked to complete a questionnaire form in order to ascertain whether their expectations have been fulfilled and to evaluate the information they have obtained. A visit report is requested from their supervisors regarding the short-term visits of ACU researchers. The researchers are required to write a scientific and administrative report about all their visits. All this data is evaluated by the WP4 Leader Ayşe Melike Şahiner and the Project Coordinator to ensure that the visits are improved and maximum efficiency is achieved. The data is then digitally classified and stored. The saved files are stored on a computer that has been allocated to the project management team. On the first Friday of each month, all data belonging to the project is transferred to an external hard disk, which is also allocated exclusively to the project management team.

1.2. Research Data

In the GEMSTONE project, under Work Package 2 (WP2), a comprehensive approach is employed to enhance the understanding of neurodevelopmental pathways that contribute to absence epilepsy and Parkinson's Disease. The project utilises genetically engineered models (GEMs) to facilitate this research, focusing on two primary types of data collection: EEG and brain imaging data. EEG data is collected and brain imaging studies are conducted on two specific animal models using chemogenetic and pharmacological techniques. The data collection utilises *Drd1a-Cre* mice and Genetic Absence Epilepsy Rats from Strasbourg (GAERS). The objective is to elucidate the functional roles of deep and superficial cortical neurons in the context of absence epilepsy. By analysing the activity and responses of these neurons, researchers aim to gain insights into the neuronal dynamics and circuitry involved in the disease's pathophysiology.

Creation of a Double Transgenic Model: The project also involves the development of a double transgenic model through Cre-loxP transgenesis. This part of the study focuses on the targeted deletion of the specific gene *SNCA* (alpha-synuclein), which is relevant to Parkinson's Disease. By manipulating this gene within the models, researchers intend to validate its role and effects in the progression of Parkinson's Disease, providing a clearer picture of genetic influences on the disease's development.



Data from Objective 2.1.: Examination of neurodevelopment and chemogenetic modulation of cortical layer 6 in absence epilepsy

The primary objective of WP2 is to examine the neurodevelopmental changes and chemogenetic modulation of cortical deep and superficial in absence epilepsy. This involves an in-depth study of the time domain changes in neuropeptide receptors within deep and superficial neurons of Genetic Absence Epilepsy Rats from Strasbourg (GAERS). By applying pharmacological techniques, the project aims to discern how different neuropeptide ligands—both agonists and antagonists—affect the generation of spontaneous absence seizures. This pharmacological approach is complemented by the collection of EEG data, which offers real-time insights into the effects of these manipulations on neural activity. Concurrently, the project undertakes extensive imaging studies to map the expression of neuropeptide receptors across various developmental stages, specifically at P21, and adult phases. These stages are critical for understanding the maturation and functional evolution of neural circuits involved in epilepsy. The imaging data, derived from immunohistochemical staining methods, provides a spatial characterisation of receptor distribution in both GAERS and control rats.

The project employs a further layer of complexity through the use of chemogenetic methods to modulate cortical deep and superficial activity using Designer Receptors Exclusively Activated by Designer Drugs (DREADDs) in *Drd1a-Cre* mice. This selective approach targets Cre-expression to specific subpopulations of deep and superficial neurons, facilitating precise control over neuronal activity. This segment of the research not only involves the collection of electroencephalogram (EEG) data but also includes electrophysiological studies using multi-electrode arrays and further imaging techniques to evaluate the impacts of neuronal modulation in deeper detail.

Data from Objective 2.2.: Investigation of the time course and distribution of α -syn expression in different brain regions in the conditional SNCA transgenic mouse model, examining α -synuclein pathophysiology of Parkinson's disease.

The second objective of WP2 is to investigate the pathophysiology of Parkinson's Disease by focusing on the time course and distribution of α -synuclein expression in various brain regions within a conditional SNCA transgenic mouse model. The project employs a Nestin-driver line for Cre-expression and generates mutant lines through Cre-loxP transgenesis with "floxed" SNCA mice in order to achieve the strategic objective. This model allows for targeted spatial and temporal control of gene expression, which is pivotal for tracing the progression of Parkinson's Disease.

To identify the specific neuronal populations that accumulate α -synuclein, the project conducts multichannel immunofluorescence experiments. These experiments are crucial for identifying the pathological spread and impact of α -synuclein within the brain. Further, brain tissues are collected at different neurodevelopmental stages for comprehensive biochemical and molecular analysis, including RNA and DNA evaluations. These analyses are essential for understanding

the molecular underpinnings of disease progression and for identifying potential therapeutic targets.

Data Format

In the GEMSTONE project, brain tissues from SCNA transgenic mice are collected at various neurodevelopmental stages in order to facilitate a thorough investigation into the genetic and molecular aspects of neurological disorders. This process involves the systematic sampling of brain tissue at critical developmental milestones, such as the neonatal, juvenile, and adult phases. Once collected, these tissues undergo detailed biochemical and molecular analyses, including RNA and DNA assessments. These analyses are of utmost importance for the identification of gene expression patterns, mutations, or any alterations in genetic material that could contribute to disease phenotypes. The molecular techniques applied, such as PCR, Western blotting, or sequencing, help elucidate the roles and impacts of specific genes, such as SNCA (synuclein alpha), in neurological conditions.

The EEG data collected in the GEMSTONE project is comprised of large-scale numerical measurements of electrical potential amplitudes. These are recorded with millisecond time resolution across multiple spatial locations, typically involving eight channel locations to capture a broad and detailed snapshot of brain activity. The data is stored as numerical arrays in the LabChart Data File format (.adicht), which is preferred for its compatibility and ease of conversion to other formats like MATLAB (.mat format). This flexibility is essential for ensuring that data can be easily accessed and analysed by researchers across different platforms. Furthermore, EEG data is also made available in the European Data Format (EDF), which is renowned for its ability to maintain the quality and integrity of raw data. The organisation of these data files is meticulous, with appropriate file headers and filenames that reflect the date, experimental condition, and animal ID, ensuring that data retrieval and correlation with experimental conditions are streamlined and error-free.

Imaging data is generated from immunohistochemistry (IHC) experiments designed to validate protein (such as neuropeptides) or viral (DREADD) expression. These experiments produce immunofluorescence images from coronal brain sections of GAERS rats and Drd1a-Cre mice, providing visual insights into the biological processes under study. The raw imaging data are saved in high-quality formats such as TIFF and .czi (used by ZEISS ZEN Microscopy Software), which support detailed analysis and are compatible with advanced imaging software. The processing of these images involves both general-purpose software such as Excel and specialized imaging software, which offers powerful tools for image analysis.

Both EEG and imaging data are organised in a logical manner, with the objective of facilitating easy access and robust data management practices. This organisation extends to the naming conventions used for files, which systematically include dates, experimental conditions, and specific identifiers for the subjects involved in the study. This approach not only aids in data management but also enhances the reliability and reproducibility of the research findings.



Software Use in Research Data

The GEMSTONE Project uses a variety of software tools to improve the efficiency and quality of our research activities. These tools are an integral part of our operations and consistently generate data that is essential to our analysis and decision-making processes. Supervisors regularly monitor this data to ensure its accuracy and relevance. The first step in managing this data is a thorough cleansing process to remove any irrelevant or redundant information. The data is then carefully categorised for ease of access and analysis. This categorised data is then securely stored on a dedicated computer to ensure it remains organised and easily accessible.

In order to safeguard this valuable data, a backup procedure is implemented that is both rigorous and comprehensive. On the last Friday of each month, the data is transferred to an external storage device that has been designated for the project. This practice not only protects the data from potential loss due to system failures but also ensures that we have a historical archive of all project activities for future reference. Additionally, the data is backed up on the ACU servers, providing an extra layer of security and redundancy. This configuration is of paramount importance for the maintenance of the integrity and continuity of our research data.

In order to facilitate efficient and direct data exchange with our collaborators, particularly the ULUND team, we utilise the dedicated servers of the software tools. This configuration allows for seamless collaboration, enabling both teams to access the latest data in real time, thereby enhancing the collaborative efforts and accelerating the research process.

Mosaic Vivarium

Mosaic Vivarium is an advanced laboratory animal management software designed to streamline the operational efficiency of research organisations that utilise laboratory animals. This software is particularly beneficial for managing the day-to-day complexities associated with animal research facilities, helping to ensure compliance, improving communication, and significantly reducing administrative overheads through digital transformation.

The software provides a comprehensive solution that includes tracking and invoicing, management of genetically modified animals, and support for a wide range of species. The software facilitates real-time data access, which is crucial for accurate decision-making and enhances the ability to manage laboratory animal resources effectively. Mosaic Vivarium integrates various operational aspects, including cage census and breeding management, compliance tracking, and protocol management. All of these features are accessible via a user-friendly web interface, which can be customized according to the specific needs of the facility.

The Mosaic Vivarium software is notable for its capacity to automate and streamline a range of critical tasks, including the procurement of animals, the maintenance of cage histories, and the management of tasks. It is compatible with barcode-based systems for the census of cages and has the capacity to utilise RFID tags, which further enhances its utility in managing complex laboratory environments. Additionally, it allows for the efficient management of data, enabling

users to record or import genotype results, manage breeding with full pedigree information, and track protocol or permit assignments.

The software used in the GEMSTONE Project organises and stores vast amounts of data generated during the production of transgenic animals. This data includes genetic profiles, breeding results and various other parameters essential for effective management of the animal production process. By systematically storing this data both in the programme's own archive and on dedicated computers, the project ensures that all information is easily accessible, well organised and securely maintained.

This data will be documented and stored using state-of-the-art systems that facilitate seamless data transfer between the collaborating institutions, Lund University and Acıbadem University. Once the data is securely stored, researchers at both institutions will conduct extensive analyses to identify any significant patterns or relationships between the variables. This stage is of great importance as it allows for the discovery of new insights and the validation of existing theories within their collaborative research efforts. Analysis aims to improve understanding of the research topic by using statistical tools and methods to examine the data for correlations, trends and causal relationships. This process can potentially lead to findings in their respective fields. The handling of this data is characterised by rigorous processes to ensure its quality, integrity and compliance with FAIR principles. The aim is to ensure that the data can be reused and accessed in the future.

GraphPad Prism

The GEMSTONE Project uses GraphPad Prism to handle complex data sets from neuroscience experiments. The software's robust analysis tools allow researchers to perform detailed analyses of EEG data, electrophysiological measurements and imaging results. By integrating Prism, the project will benefit from data processing, allowing the team to focus on the scientific questions at hand rather than the complexities of data management. GraphPad Prism is software designed specifically for scientific research, particularly in the fields of biology and medicine, combining biostatistics, curve fitting (nonlinear regression) and scientific graphing.

GraphPad Prism is not just a graphing tool; it integrates comprehensive analysis solutions with graphing capabilities to provide researchers with an efficient and effective way to work with their data. The software's primary strength lies in its ability to perform detailed statistical analysis without requiring users to have an extensive statistical background. Prism offers an extensive library of analyses, including t-tests, ANOVA, non-parametric comparisons and regression analysis. It helps users validate their assumptions and choose the right tests for their specific data sets. Prism's graphing capabilities are robust and highly customisable. Users can easily create a variety of graph types, from common bar and line graphs to more complex scatter plots and survival curves. Prism allows automation of repetitive tasks, which not only saves time, but also ensures that methods are repeatable. This is particularly useful in research where consistency across datasets or experiments is critical.



BioRender

For the GEMSTONE Project, BioRender serves as a critical tool for visual data representation, particularly in the production and analysis of transgenic animals. The software's ability to create detailed, accurate biological illustrations helps to effectively share and communicate research findings with the project team, ensuring that researchers can accurately depict biological processes, cellular structures and more. BioRender facilitates the creation of scientific figures up to 50 times faster than traditional methods. This efficiency is a significant benefit for researchers looking to streamline the preparation of grant applications, posters, publications and presentations.

Adobe Photoshop

Within the GEMSTONE Project, Adobe Photoshop is used primarily for its robust image processing capabilities. The software plays a role in the analysis and presentation of data from the project's research activities. From adjusting the clarity of images taken during experiments to creating figures that clearly communicate complex scientific results, Photoshop's advanced tools ensure that visuals are not only scientifically accurate, but also publication-ready. These tools allow detailed manipulation of photos, including enhancing and correcting colours, adjusting brightness and contrast, cropping and resizing images, and more. For scientific purposes, such precision is essential to ensure that images accurately represent experimental data without introducing artefacts or distortions that could mislead interpretations.

LabChart

The GEMSTONE Project uses LabChart as a key tool for the acquisition and analysis of EEG data. LabChart is employed to collect EEG recording data from models such as the GAERS rats and *Drd1a-Cre* mice. This data is of great importance for the study of neurodevelopmental changes associated with epilepsy. In conjunction with other imaging technologies, LabChart facilitates the processing and analysis of EEG imaging data obtained from various stages of neurodevelopment in research models. LabChart also enables the real-time sharing of data with collaborators, such as the team from ULUND, thereby enhancing collaborative efforts and speeding up the research process. In accordance with the project's data management policies, data collected and analysed with LabChart is regularly stored on dedicated project computers and backed up on external storage devices and ACU servers. This is done in order to ensure data integrity and security.

Research Data Processing

In the GEMSTONE Project, data management practices are employed to ensure the integrity and security of research data. The process involves several critical steps:



Data Classification and Cleaning

The initial stage of data classification and cleaning is of paramount importance. It involves the classification and cleaning of the collected data, with the objective of removing any irrelevant or redundant information. This stage is crucial for maintaining the focus on data that is valuable for analysis, as well as for organising the data logically, thus making subsequent processes more efficient.

Data Archiving and Quality Checks

Once the data has been cleaned, it is archived in a systematic manner. The process of archiving involves not only the storage of the data in an organised manner, but also the assurance of its accessibility for future research and analysis. The quality of the archived data is rigorously checked by a supervisor, ensuring that all stored information meets the high standards required for scientific research.

Local and Remote Data Storage

Once the data has been cleaned and verified, it is saved on a dedicated computer within the research laboratory. This local storage serves as the primary repository from which data can be accessed for immediate research needs.

Monthly Backup on External Memory

In order to prevent data loss due to hardware failure or other unforeseen events, the data is regularly backed up. Each month, a comprehensive backup of the data is made onto an external hard disk specifically allocated for the project. This practice provides a portable and secure copy of the data that can be stored offsite if necessary.

Cloud Storage and Sharing

In addition to local backups, the data is also saved using cloud technology. This approach facilitates easy sharing with collaborative teams, such as the ULUND Team, allowing seamless access to the data across different geographic locations. Cloud storage offers the dual benefits of redundancy and accessibility, which are crucial for collaborative international research projects.

Server-Based Storage Solutions

Finally, the data is also stored on servers provided by the ACU Information Technology department. These servers are likely to have robust security measures in place, providing a secure and reliable storage solution that ensures data integrity and protection against cyber threats.

2. FAIR Data

The GEMSTONE Project has been dedicated to the implementation of a comprehensive data



management plan (DMP) that adheres to the FAIR principles—ensuring the findability, accessibility, interoperability, and reusability of data. Over the past 18 months since the project's inception, considerable progress has been made in refining the processes and systems that handle the project's data, ensuring that they not only meet current standards but also set a benchmark for future research endeavours.

From its inception, the GEMSTONE project was designed to foster an environment where data is not only generated but also meticulously managed in order to ensure its findability, accessibility, interoperability, and reusability. The initial framework outlined specific strategies, including the implementation of robust metadata practices, the establishment of a structured repository, and the assurance that data is handled in compliance with the EU's GDPR. Metadata management was a particular focus, with clear versioning and the use of standardised naming conventions. These have been instrumental in enhancing the discoverability and utility of the data collected.

2.1. *Making Data Findable, Including Provisions for Metadata*

The GEMSTONE project has emphasised the creation of a structured approach to ensure that all data generated is easily findable. Central to this initiative is the strategic use of metadata, which has been meticulously designed to include all essential information such as version numbers and keywords. This ensures that data not only adheres to but also exemplifies the FAIR principles. An automated process integrated within the Acibadem University Open Access Repository ensures that this metadata is consistently updated and maintained. This guarantees that data remains findable both during and after the completion of the project. Furthermore, the use of persistent identifiers via the Handle System enhances this by providing unique and permanent web addresses for each dataset. This simplifies the retrieval and citation of research data.

The project's initial objective was to enhance the discoverability of data through the strategic use of metadata. This involved the development of a detailed metadata schema, which includes clear version numbers, relevant keywords, and standard naming conventions. These elements are crucial for the discoverability of data, as they facilitate the accurate and efficient cataloguing of information in the Acibadem University Open Access Repository. This repository, which integrates the Handle System, provides persistent identifiers that ensure each piece of data is easily and uniquely identifiable, thus significantly boosting its findability.

The project acknowledges the need to consider data privacy requirements, particularly the protection of personal data, in compliance with the EU General Data Protection Regulation 2016/679. In terms of accessibility, the GEMSTONE project has taken rigorous steps to delineate which data sets are openly available and which are restricted due to various constraints, such as privacy concerns or intellectual property rights. This categorisation is clearly documented, providing transparency and easing access for users who can view the data that is available for public use. The repository's integration with OpenAire further enhances this accessibility, allowing for a broader dissemination of the project's outputs. Data obtained up to the 18th month



are shared because the publication processes are not yet complete. Following the publication of academic articles and conference proceedings, the relevant data will be made open access in part.

The project team has prioritised the development of interoperability, ensuring that data formats and standards align with international norms. This facilitates the exchange and reuse of data across different platforms and among various research entities, which is crucial for collaborative research efforts that extend beyond geographical and institutional boundaries. The emphasis on reusability is evident in the project's strategy to make capacity-building data from Work Packages 4 and 5 will be available through the project website, free from any restrictions. This approach not only facilitates the sharing and utilisation of data within the scientific community but also supports the development of research capacities across various institutions. As of April 2024, these data will be used in a scientific study and then published on the project website.

The GEMSTONE project has exercised judicious management of the resources allocated for data management, ensuring that all activities related to data collection, storage, and dissemination are covered under the grant agreement. This strategic resource allocation supports the sustainability of data management practices throughout the lifecycle of the project. The roles and responsibilities defined for the partners and data authors have fostered a culture of accountability, which is crucial for the success of the data management strategy.

As the project progresses, the DMP will continue to evolve in order to incorporate new insights and address emerging challenges. The ongoing commitment to the FAIR principles and the adaptive nature of the project's data management practices ensure not only compliance with the current standards but also a readiness to embrace future advancements in data management technology and methodology.

2.2. Making Data Accessible

Accessibility is a fundamental aspect of the GEMSTONE project's data management strategy. The project delineates clear pathways for data access through the establishment of the Acibadem University Open Access Repository, which serves as the primary portal for external researchers to access the data generated by the project. This repository is backed by robust security measures enforced by the Information Technologies Directorate of Acibadem University, ensuring that the integrity and accessibility of data are uncompromised. In the event that data cannot be openly shared due to legal, ethical, or contractual restrictions, the project provides detailed documentation explaining these restrictions. This ensures transparency and adherence to the ethical standards mandated by Horizon Europe.

The enhancement of the Acibadem University Open Access Repository has been a central tenet of our data storage and accessibility strategy. The repository is managed by the Information Technologies Directorate of Acibadem University, which ensures the highest standards of data security and regular backups, thus maintaining the integrity and availability of data. In response to evolving needs and ongoing assessments, various other repositories were evaluated to expand



our data storage capabilities and ensure compliance with GDPR and FAIR principles. The repository ensures that all data, regardless of its nature, is assigned persistent identifiers through the Handle System, thus facilitating easy access and traceability. **The data pertaining to GEMSTONE may be and will be accessed via the link provided below:**

<https://openaccess.acibadem.edu.tr/communities/4dfda96b-b948-49b1-b5aa-83f94c38ddb>

It is our policy to make all non-sensitive research data as openly available as possible, barring any legal, contractual, or ethical restrictions. These data will be made open access after being used in academic publications. In the event that data sharing is restricted, these limitations will be clearly documented, detailing the reasons and the nature of the restrictions, in accordance with the transparency requirements of Horizon Europe.

The ethical management of data, particularly personal data involved in capacity-building aspects of the project, remains a priority. Rigorous standards are adhered to in order to protect privacy and confidentiality, with the objective of ensuring that all data handling practices promote responsible data management. In order to enhance interoperability, universal data formats and standards have been adopted which facilitate the seamless exchange and reuse of data across our partners. Furthermore, any data that does not include restricted personal data is systematically shared with our project partners via cloud technology.

In order to enhance the findability and usability of our data, we have implemented comprehensive metadata strategies. All metadata associated with the project's data will be openly available and licensed under the public domain dedication CC0, with the intention of facilitating unrestricted use and reusability. This metadata provides essential information that enables users to locate, access, and effectively use the data stored in our repository. Furthermore, in order to facilitate the interpretation and reuse of the data, we will provide detailed documentation on the necessary software and tools required to access and analyse the data, including open-source code when applicable.

It is the objective of this research project to refine the strategies employed in order to ensure the security, accessibility and compliance of the data with all regulatory requirements. Furthermore, the intention is to enhance the impact of the data through the dissemination of the data and the usability of the data. The future revisions of the DMP will reflect updates in the data handling practices, incorporating new insights and adapting to emerging challenges in data management.

2.3. Making Data Interoperable

The GEMSTONE Project prioritises the interoperability of its data, with the objective of facilitating seamless exchange and reuse across various platforms and institutions. This is achieved by adopting standard data formats and vocabularies, which ensure that the data can be easily integrated with other datasets and software tools. The European Data Format (EDF) for storing and processing electrophysiological data, for example, is used to ensure that datasets from neurodevelopmental studies on epilepsy can be easily shared and understood by researchers

worldwide. The project's approach to data organisation, with consistent file headers and naming conventions, enhances the potential for its datasets to be utilised in a broad range of scientific inquiries.

The GEMSTONE Project has concentrated on the establishment of a robust framework for data interoperability, which is of great importance for the exchange and enhancement of research findings across different scientific communities. The project has made use of the European Data Format (EDF) for the storage and processing of electrophysiological data from studies involving Genetic Absence Epilepsy Rats from Strasbourg (GAERS). The data set includes comprehensive recordings of neurodevelopmental changes, which are essential for the project's research on epilepsy. The selection of the EDF and other standardised data formats ensures that data collected by the GEMSTONE project will be readily integrated and utilised by researchers worldwide who may be utilising different systems and technologies.

The GEMSTONE project will store all its data in the Acıbadem University Open Access Repository. This repository is backed by robust IT infrastructure and security protocols to ensure that data is not only preserved over the long term but is also readily accessible to authorised users. To further enhance accessibility, the project has implemented persistent identifiers in the form of Digital Object Identifiers (DOIs), which simplify the citation and tracking of datasets within the academic community.

2.4. Increase Data Re-Use

In order to facilitate the re-use of the data generated, the GEMSTONE Project has implemented a number of strategies designed to render the data as accessible and useful as possible to other researchers and stakeholders. This includes the creation of detailed documentation, such as README files, metadata, and codebooks, which provide all of the necessary information about the data, including methodologies, variable definitions, and units of measurement. Such documentation is essential for validating the data's use in further research and ensuring its long-term utility. Furthermore, by licensing the data under open licenses such as the Creative Commons Attribution License (CC BY), the project will encourage and facilitate wider use and dissemination of the data, thereby ensuring that it will contribute to advancing scientific knowledge and discovery.

The GEMSTONE Project's enhancement of data reusability is evident in the strategic development and implementation of robust documentation practices. The project has recognised the importance of documentation for data analysis and has created detailed readme files complete with metadata, methodologies, codebooks, and information about data cleaning and analyses. These documents are structured to provide clarity on variable definitions, units of measurement, and other essential data attributes, ensuring that anyone accessing the data can understand and utilise it effectively.

Quality assurance represents a fundamental aspect of the project's data management practices. A



comprehensive range of processes has been implemented to encompass all stages of the data lifecycle, from collection and storage to processing, analysis, and dissemination. These processes include rigorous data cleaning, validation, and verification procedures, which are complemented by the utilisation of statistical methods designed to detect and correct errors. Furthermore, the GEMSTONE project places a strong emphasis on the ethical aspects of data management. This includes the implementation of data security measures to protect data from unauthorised access and potential loss, as well as the meticulous adherence to data protection and privacy laws to ensure the ethical handling of sensitive information.

In the future, the GEMSTONE Project will strive to guarantee the long-term sustainability and accessibility of its data. This will entail not only maintaining the data in a reliable repository but also continuously updating and preserving the associated metadata and documentation. Such efforts are crucial for facilitating the long-term reuse of the data.

3. Other Research Outputs

There is no other research output except what we identified previously in this document.

4. Allocation of Resources

The new version of the Data Management Plan (DMP) for the GEMSTONE project, which was based on the first version of the DMP and detailed the budget allocation and publication strategy for Open Access (OA) scientific outputs, incorporates significant progress and adherence to the Open Science criteria mandated by Horizon Europe.

The GEMSTONE project allocated €18,000 to publish six scientific articles in open-access formats, including 'gold' open-access in high-impact journals and EC-supported repositories, which are free of usage charges. This budget allocation was created to cover article processing charges (APCs), page charges, and other relevant publication fees. Although the initial allocation was intended to fund six publications, we aim to use the entire €18,000 budget and exceed the publication target. Ensuring that all publications not only disseminate research openly, but also meet the highest standards of accessibility and impact under the Horizon Europe Criteria.

During the project, we followed the open science criteria set by Horizon Europe. With the help of the ACU Library and its Electronic Resources Unit, we seamlessly integrated these standards into our publication processes. We also organized 3 seminars and trainings to improve the understanding and implementation of open access publishing standards among the GEMSTONE team members. The educational initiatives have increased understanding and dedication to the open-access framework throughout the consortium.

To support sustainable research practices, we plan to store all data associated with project for five years. ACU is responsible for managing the data and ensuring its longevity and accessibility in trusted repositories that comply with open-access policies. The Project Coordinator and

Project Manager play a lead role in data management, working under the close supervision of ACU's Electronic Resources Directorate. The infrastructure of ACU's Library and Electronic Resources Unit is a cornerstone of our strategy to ensure the long-term preservation of research data. This approach not only leverages existing resources, but also enhances the reliability and sustainability of the data management framework. This approach improves the reliability and sustainability of the data management framework by leveraging existing resources.

5. Data Security

The new version of DMP reflects both the progress made and the continued focus on data security and its standards. The updated sections have been synthesized into a cohesive update. Throughout its various activities, including meetings, seminars, and workshops, the GEMSTONE consortium has diligently collected data in diverse formats such as physical records, photographs, videos, and electronic documents. Each partner has independently stored this data, adhering strictly to organizational rules and the project's DMP (D1.1), ensuring its security and compliance with European Union data protection laws.

The personal information collected, in particular, has been kept confidential and stored only with the explicit and informed consent of the subjects, in accordance with the procedures of the consortium agreement. The project has maintained its commitment to national and international legal and ethical standards, including those of Turkey, Sweden, and Italy, as well as Horizon Europe's ethical guidelines and the General Data Protection Regulation 2016/679. All activities related to data collection, processing, and dissemination were conducted with utmost integrity.

Reflecting on the implemented measures, it is apparent that the GEMSTONE Project has not only adhered to its First DMP, but has also improved its data management practices in response to evolving project needs and external regulations. The organization of data storage, both physical and digital, and the stringent controls over access and updates reflect the project's data security and ethical compliance.

To enhance data security, the project implemented four robust methods:

Departmental Data Storage: Data storage was meticulously organized by department relevance, ensuring specialized handling and confidentiality.

Archiving and Access Control: Physical records were systematically numbered, filed, and stored in a secure archive room, safeguarding against unauthorized access.

Digital Record Keeping and Backup: A dual approach was taken for digital data, with records maintained on a project computer and backup on a hard disk within ACU's high-security network.

Regular Updates and Access Restriction: Designating specific times for data updates and restricting digital data access to authorized personnel only, thereby preventing data breaches.



As the project progresses, this document will serve as a dynamic tool, guiding the consortium's data management practices towards even higher standards of excellence and compliance.

6. Ethics

Since the beginning of the GEMSTONE Project, significant progress has been made in ensuring the ethical integrity of the research, particularly in relation to the use of animal models. All research activities that require animal models have consistently obtained the necessary ethical approvals from authorised bodies as originally planned. To ensure continuous ethical evaluation, Professor Janet Mifsud has been appointed as an Ethics Advisor to our Independent Advisory Board. Her expertise in clinical pharmacology and therapeutics has been instrumental in guiding the ethical conduct of our research activities. Ethical approval was obtained for all research activities in accordance with the highest national and international standards, including EU Directive 2010/63/EU and the UK Animals (Scientific Procedures) Act 1986. Approval details are provided below:

- Project's Initial Ethical Approval was granted on 10/10/2022 by Acıbadem University Ethics Committee under Document No. ACU-HADYEK-2022/82.
- The Chemogenetic Modulation and Validation Course Ethical Approval was granted on 20/12/2023 by Acıbadem University Ethics Committee under Document No. ACU-HADYEK-2023/79.
- Permission to import has been obtained from the Ministry of Agriculture and Forestry of the Republic of Turkey (Permission Number: E-90461321-407-12031364) on 14/11/2023.

The Drd-1a Colony, Nestin-Cre, and SNCA flox lines were imported from ULUND and Jackson Laboratory on December 15th, 2023 and January 9th, 2024, respectively. They were successfully integrated into ACU DEHAM following quarantine protocols and breeding plans that followed ethical standards.

7. Other issues

We do not have other national/funder/sectorial/departmental procedures for data management.

