2022-2023

CDG & Allies

Activity Report
&
Workplan

CDG & Allies – PPAIN

CDG & Allies - Professionals and Patient Associations International Network

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Team Leaders' Inspirational Message

> If you want to go fast go alone. If you want to go far go together.

– African Proverb

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CDG & Allies – PPAIN

40 Collaborators

12 Working Packages

The CDG & Allies research group is a collaborative effort among scientists, clinicians, and patients who are dedicated to improve the diagnosis, treatment, and care of individuals affected by Congenital Disorders of Glycosylation (CDG).

ACTIVITY REPORT 2022

CDG & Allies – PPAIN
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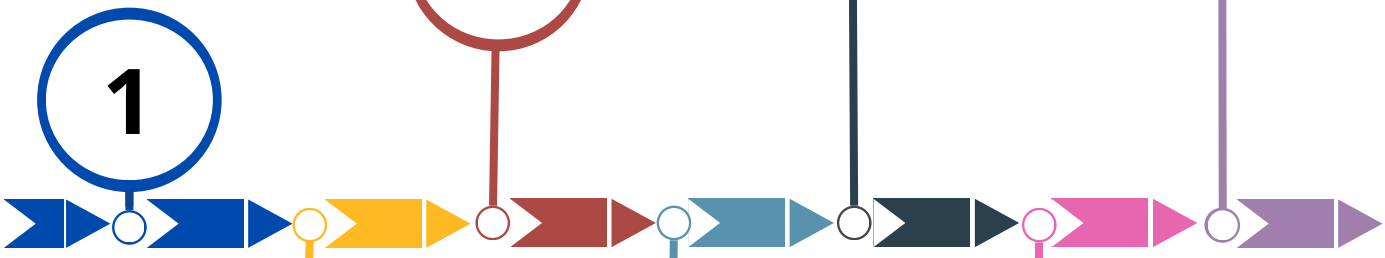
Activity Report 2022



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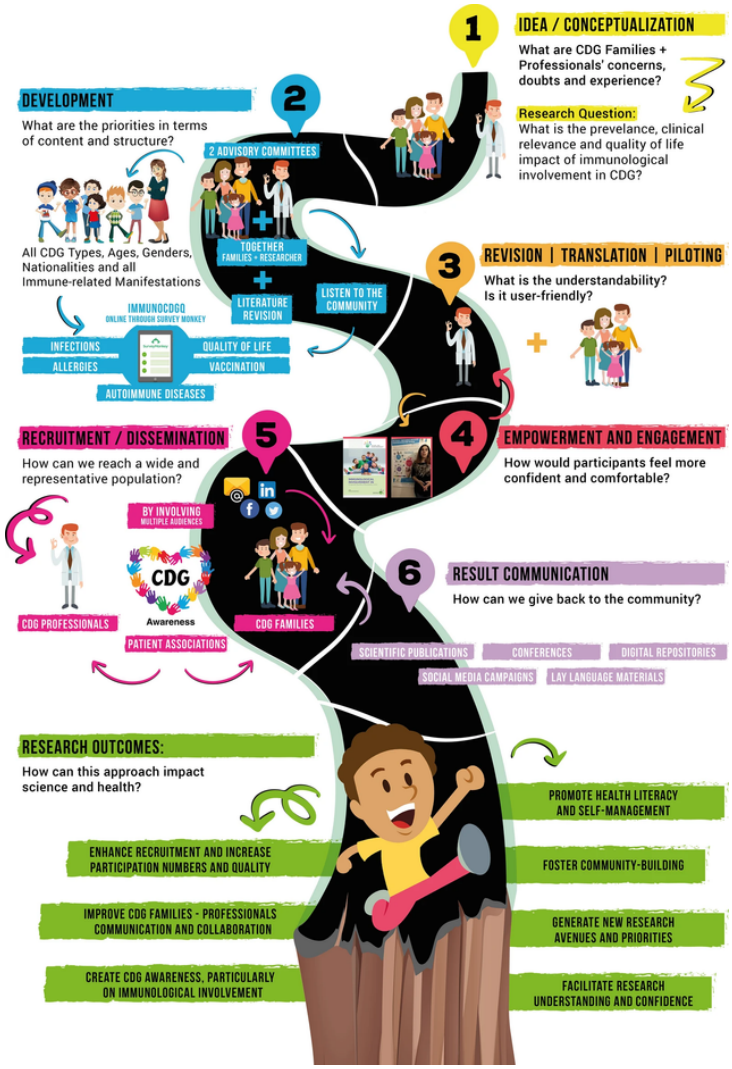
1

The road to successful people-centric research in RDs

Scientific Article Available HERE

Gathering robust clinical data on CDG have several challenges. Electronic web-based platforms offer significant opportunities to retrieve data and participant recruitment. The main goal of this work was to explore this paradigm using the immunology and CDG electronic (e-) questionnaire (ImmunoCDGQ), compare it with the literature and make recommendations.

A multistakeholder people-centric approach was initiated to develop and distribute the ImmunoCDGQ, to collect immune-related data directly from patients and family caregivers. As a control, we developed the Immuno-HealthyQ to be distributed among the general "healthy" population.



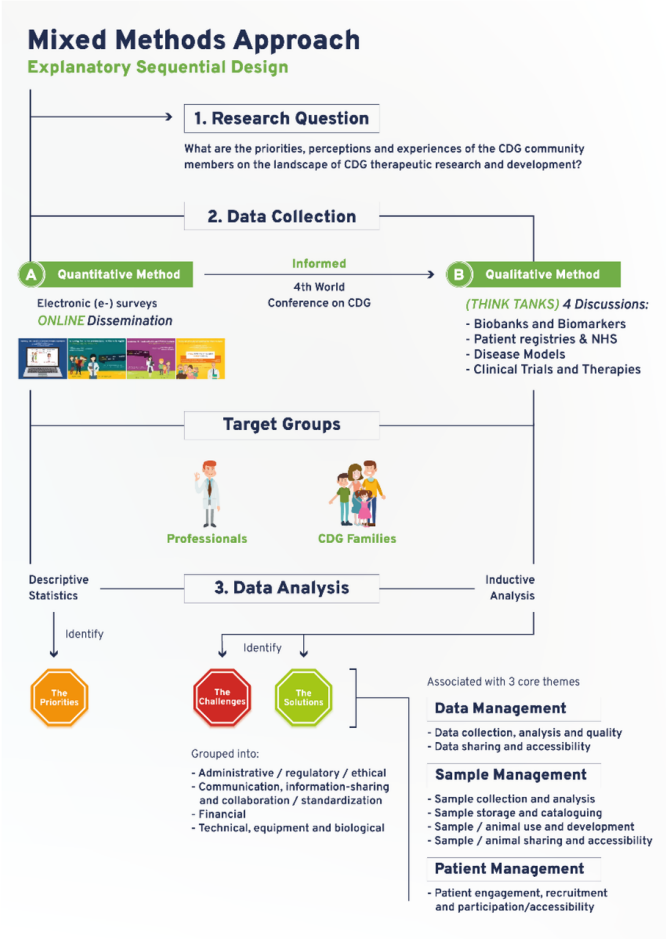
The rate of ImmunoCDGQ participation was high (94.6%, 209 out of 221). Multi-channel recruitment created sustained engagement, with Facebook being the most efficient social media channel for recruitment. In addition, 50.7% (106 out of 209) of ImmunoCDGQ questionnaires were responded to in the first month after the launch of this project. Literature analysis showed that most e-questionnaire-based studies in rare diseases are author-built (56.8%, 25 out of 44), simultaneously addressing medical and health-related quality of life (HRQoL) and information needs (79.5%, 35 out of 44). We conclude that both the ImmunoCDGQ methodology and CDG Community served as valuable tools for successfully developing a people-centric approach in biomedical research.

2

A Community-Led Approach as a Guide to Overcome Challenges for Therapy Research in CDG

Scientific Article Available HERE

The 4th World Conference on CDG for Families and Professionals served as a stage to develop a community-led mixed methods approach, to understand and analyze ongoing research, and to guide future research and development (R&D). In the first stage, we used electronic e-surveys, and in the second-one community-driven think tanks to prioritize the discussion and identify the main challenges and solutions associated with six therapeutic R&D tools, namely biobanks, registries, biomarkers, disease models, natural history studies, and clinical trials. The main challenges related to therapy R&D were administrative/regulatory, communication, financial, technical, and biological issues.



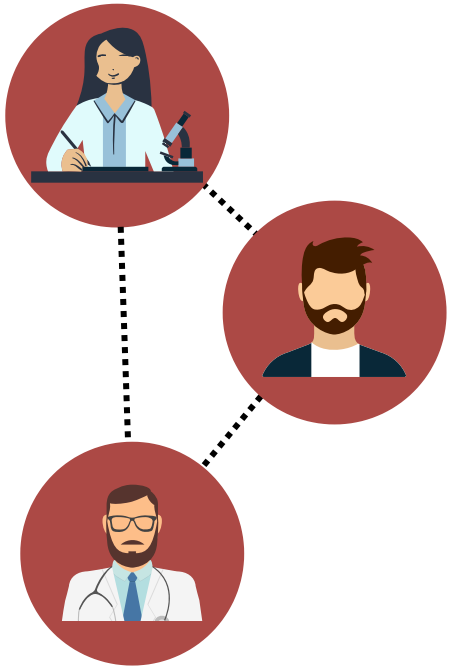
The prioritized tools were found to be interdependent, with diagnosis and treatments serving as the bidirectional triggers for these interactions. We concluded that this pioneer community-led methodology allowed the discovery of R&D gaps for CDG treatment and other rare diseases. However, the strong, forward-thinking approach to research, built on global alliances and including all CDG community members, sets the direction to improve future therapeutic R&D.

3

Stakeholders' views on drug development: the CDG community perspective

Scientific Article Available HERE

Researchers and clinicians have not been able to find effective therapeutics for most CDG, despite their efforts. To address this, a study was conducted to gather opinions and experiences of the CDG community (professionals and families) through an electronic survey. The goal of the study was to understand and guide future CDG drug development initiatives. 128 respondents, mainly from Europe and the USA (46 CDG professionals and 82 family members), participated in this study. As expected, most professionals were familiar with drug development (95%), while CDG families revealed a low familiarity. Nevertheless, both groups believed they could contribute significantly to the drug development cycle.



Concerning their experience with biobanks, disease models, patient registries, natural history studies (NHS), and clinical trials (CT), the CDG community stakeholders described low use and participation and variable familiarity. For example, CDG families revealed low involvement in CT design (25%) and information (60%), compared with professionals (60% and 85%, respectively). In addition, the CDG community (67% of professionals and 54% of families) reported an optimistic vision of artificial intelligence as a beneficial drug development tool. We conclude that the development of community-centric studies paves the way for CDG drug development and approval by identifying the main gaps and opportunities.

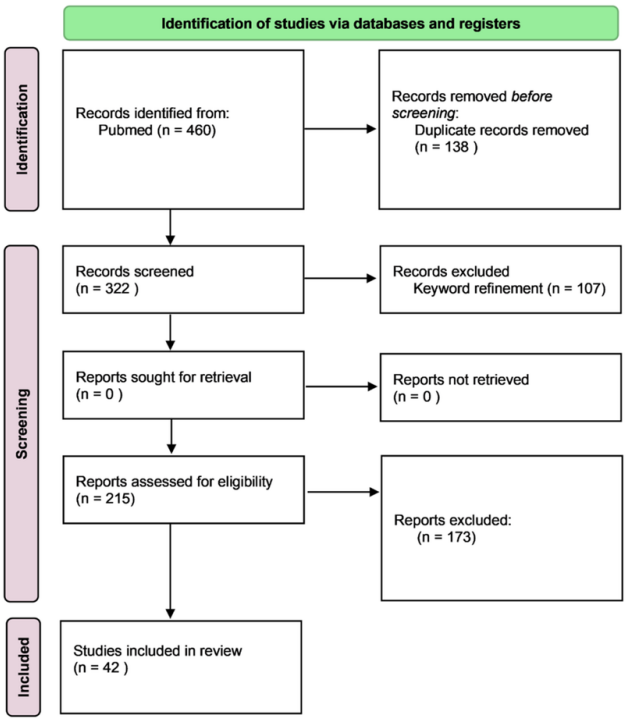
4

Systematic Review: Drug Repositioning for CDG

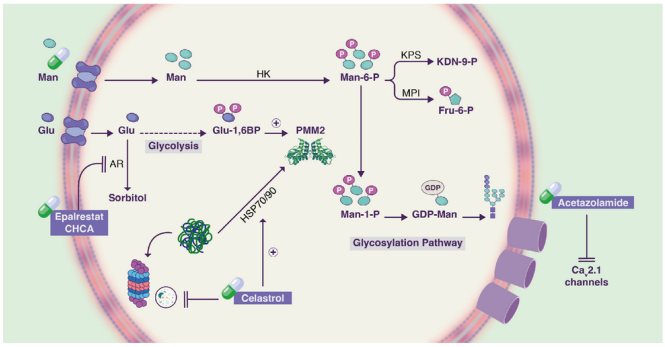
Scientific Article Available HERE

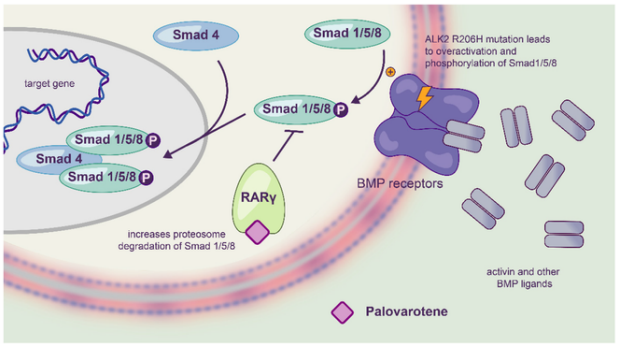
Recent advances in research and therapy development in CDG have made this review necessary. The focus of the review is on the current availability of adequate biomarkers and reliable *in vivo* and *in vitro* disease models, which are crucial for drug research and development (R&D), particularly in rare and heterogeneous diseases like CDG.

In addition, the article explores the concept of drug repositioning, a hot topic in drug R&D that involves (re)using known drugs for new medical purposes.



This approach is becoming increasingly popular for both common and rare disorders, especially when combined with artificial intelligence (AI) strategies. Compared to traditional methods, AI has been shown to accelerate the drug discovery process while also reducing costs, which is particularly important for underrepresented and underfunded rare diseases.





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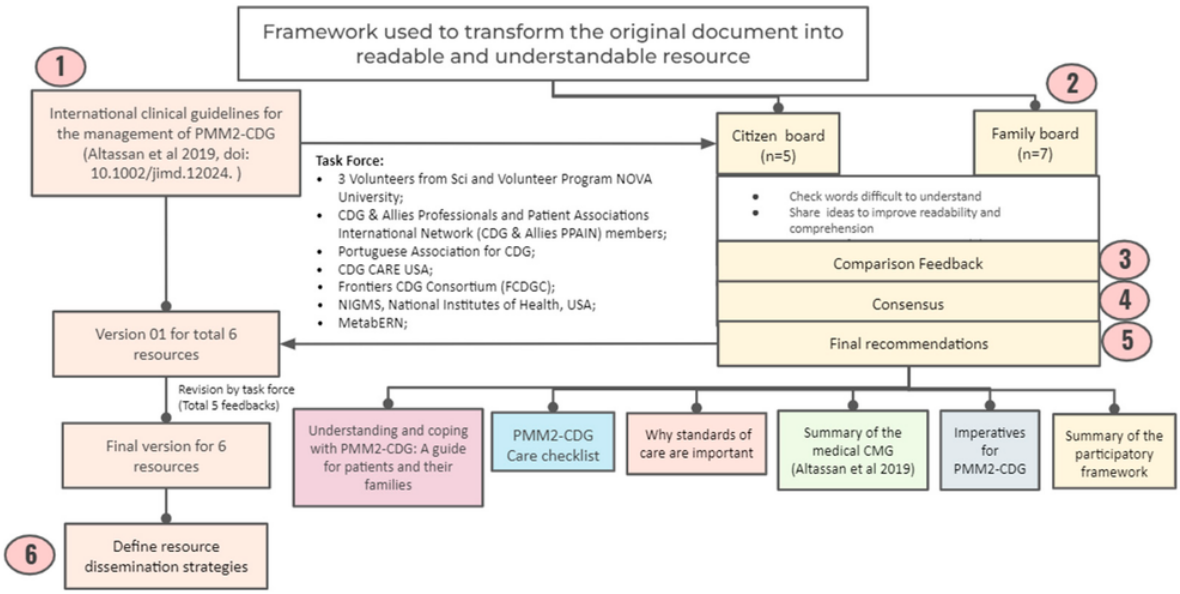
A Participatory Framework for Plain Language Clinical Management Guideline Development

Scientific Article Available HERE

Clinical management guidelines (CMGs) are evidence-based clinical recommendations used by professionals, patients, and family caregivers to support patient care in diagnosis and treatment. Clinical professionals have created numerous CMGs, but their technical terminology prevents non-medical stakeholders from understanding them. In addition, the opinions of patients and their families are frequently excluded from treatment guidelines. To overcome these challenges, we developed a proper methodology that addressed the CDG community's (patients, families, and professionals) preferences and needs. This pilot study was tested in the phosphomannomutase 2 (PMM2)-CDG community. Eighty-nine PMM2-CDG families and 35 professional stakeholders answered an e-questionnaire related to their CMGs preferences. Most families and professionals assessed CMGs as valuable (84.3% and 94.3%, respectively) and relevant (86.5% and 94.3%, respectively) in CDG care. Families identified the lack of CMGs awareness (50.6%) as the main challenge, suggesting their involvement in CMGs' development. On the other hand, professionals highlighted the lack of plain language (39.3%) as the main challenge, proposing adapting CMGs using plain language. Based on these findings, we developed a collaborative framework based on health literacy concepts aiming to enhance CMGs accessibility and comprehension, improving the quality of life of individuals living with a rare disease like CDG.



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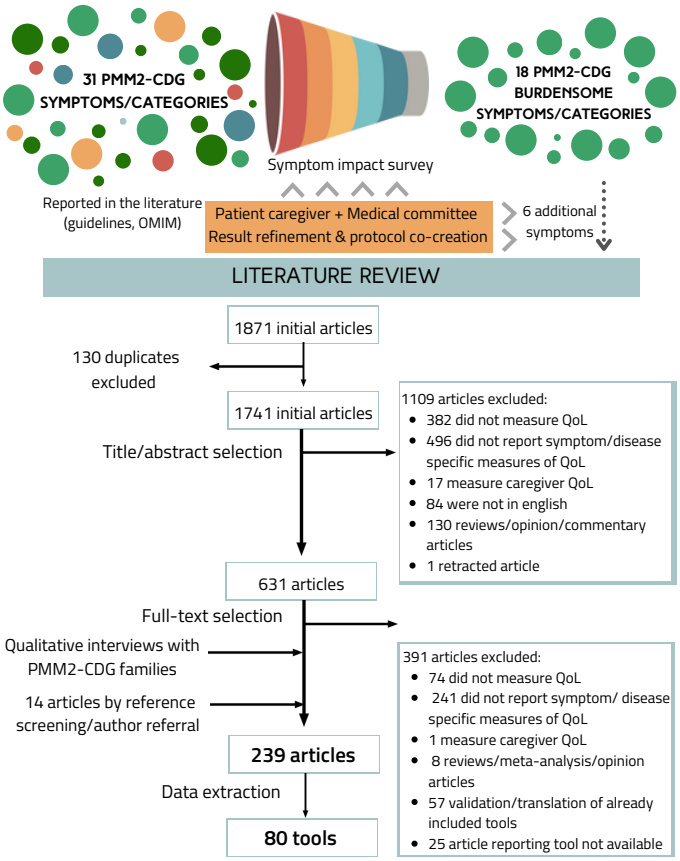
Patient Reported Outcomes for PMM2-CDG: listening to what matters for the patients and health professionals

Scientific Article Available HERE

Health-related Quality of Life (HrQoL) is a multidimensional measure, which has gained both clinical and social relevance. Implementation of a patient-centered approach to both clinical research and care settings, has increased the recognition of patient and/or observer reported outcome measures (PROMs or ObsROMs) as informative and reliable tools for the assessment of HrQoL. Inherited Metabolic Diseases (IMDs) are a group of heterogeneous conditions (like CDG) with phenotypes ranging from mild to severe and mostly lacking effective therapies. Consequently, evaluating patients' HrQoL is particularly relevant.



In this review, from the 1954 studies identified, 131 addressed HrQoL of IMDs' patients using PROMs and/or ObsROMs, both in observational or interventional studies. In total, we identified 32 HrQoL patient and/or caregiver-reported HrQoL instruments used among IMDs destined to self- or proxy-completion; only 2% were disease-specific. Multiple tools proved to be responsive to changes in HrQoL; the SF-36 and PedsQL questionnaires were the most frequently used in adult and pediatric populations, respectively. Furthermore, proxy data (obtained by a caregiver) demonstrated to be a reliable approach complementing self-reported scores. Numerous limitations were identified especially due to the rarity of these diseases.

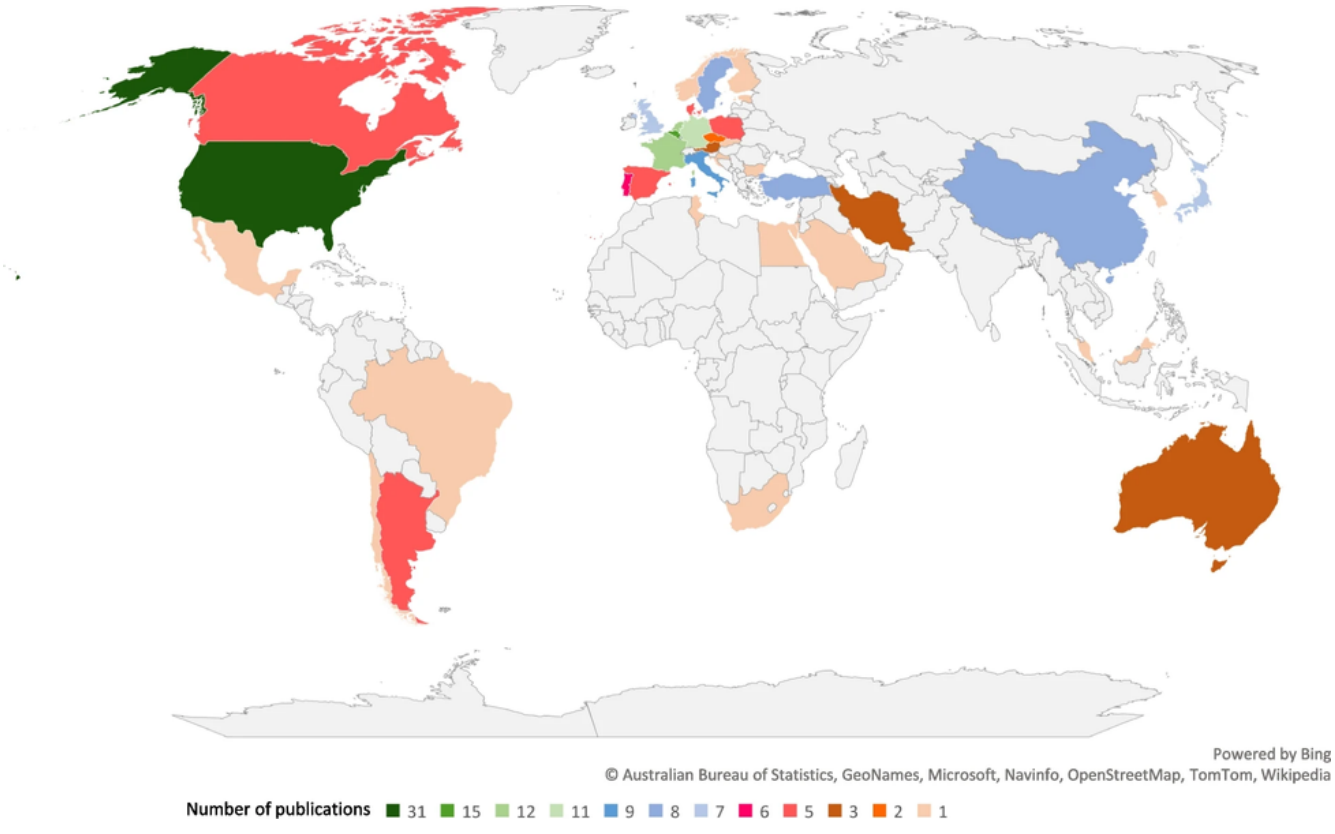
Even though HrQoL is still not frequently assessed in IMDs, our results show examples of the use of patient-reported HrQoL instruments in the field. The importance of HrQoL for clinical research and therapy approval incites further research in HrQoL PROMs' and ObsROMs' creation and validation in IMDs.

7

Epidemiology of CDG— overview and perspectives

Scientific Article Available HERE

The aim of this study was to compile and review information on the epidemiology (how often diseases occur in different groups of people and why) of CDG. In this review, we found 165 articles that covered CDG epidemiology and gathered data related to 93 CDG. The majority of studies discussed the frequency of symptoms in CDG patients followed by cohort studies, pathogenic variant allelic frequency, and the prevalence of the disorder in populations. The most reported CDG was phosphomannomutase-2 deficiency (PMM2-CDG) followed by FKTN-CDG, EXT1/EXT2-CDG, ALG6-CDG, and PIGA-CDG. We also discussed the challenges of reviewing epidemiological data concerning CDG due to the lack of centralized record registries. We concluded that collecting epidemiological data on CDG is crucial to support public health decision-making and target research for the development of therapeutics.



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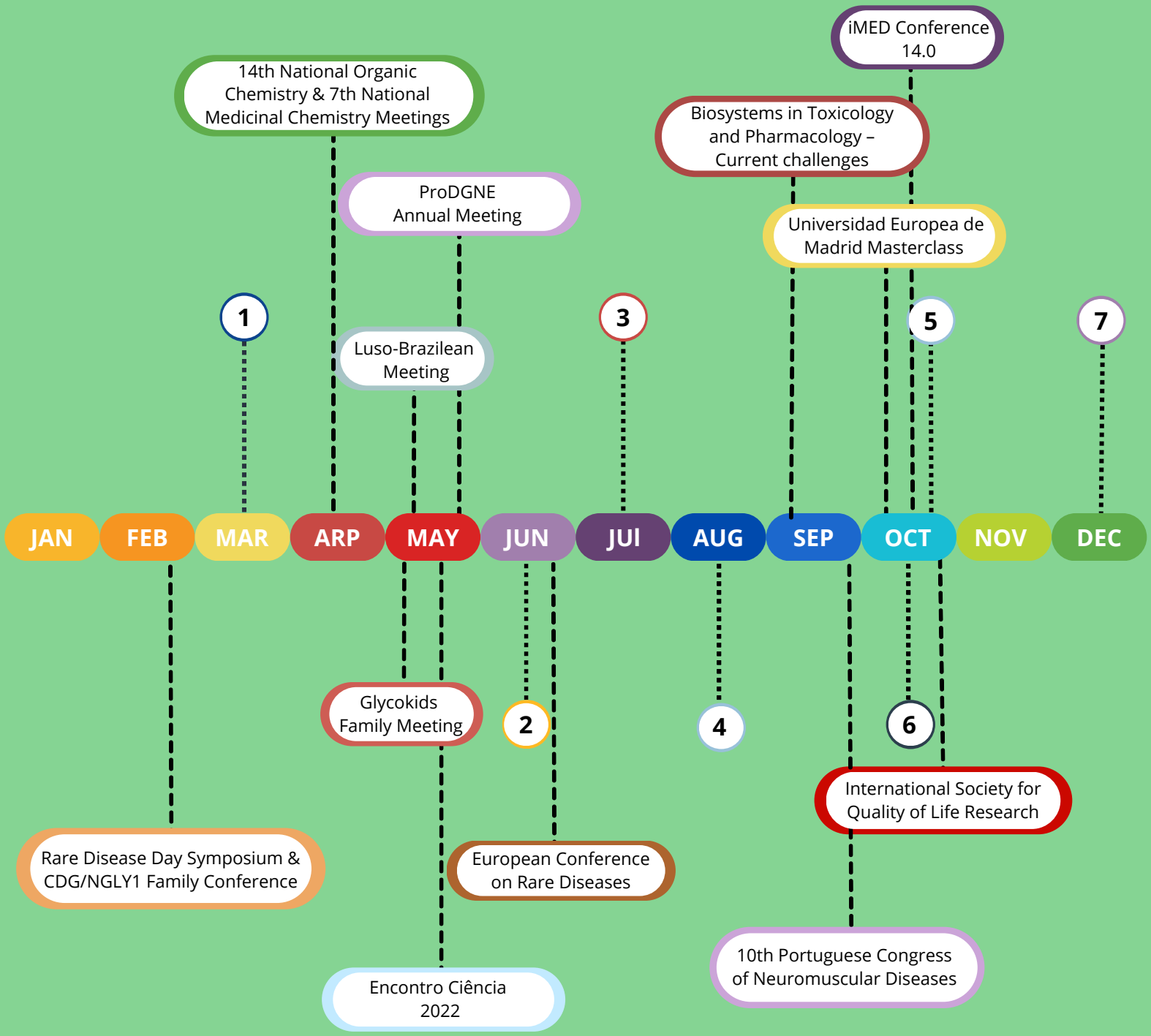

Legend

- Oral and/or Poster presentation
- Published Scientific Article (the numbers correspond to the project number mentioned above)

WORKPLAN
2023

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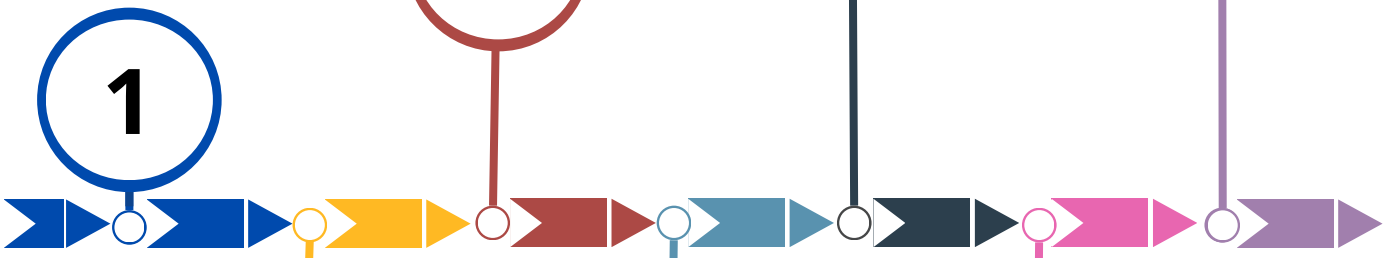
WORKPLAN 2023



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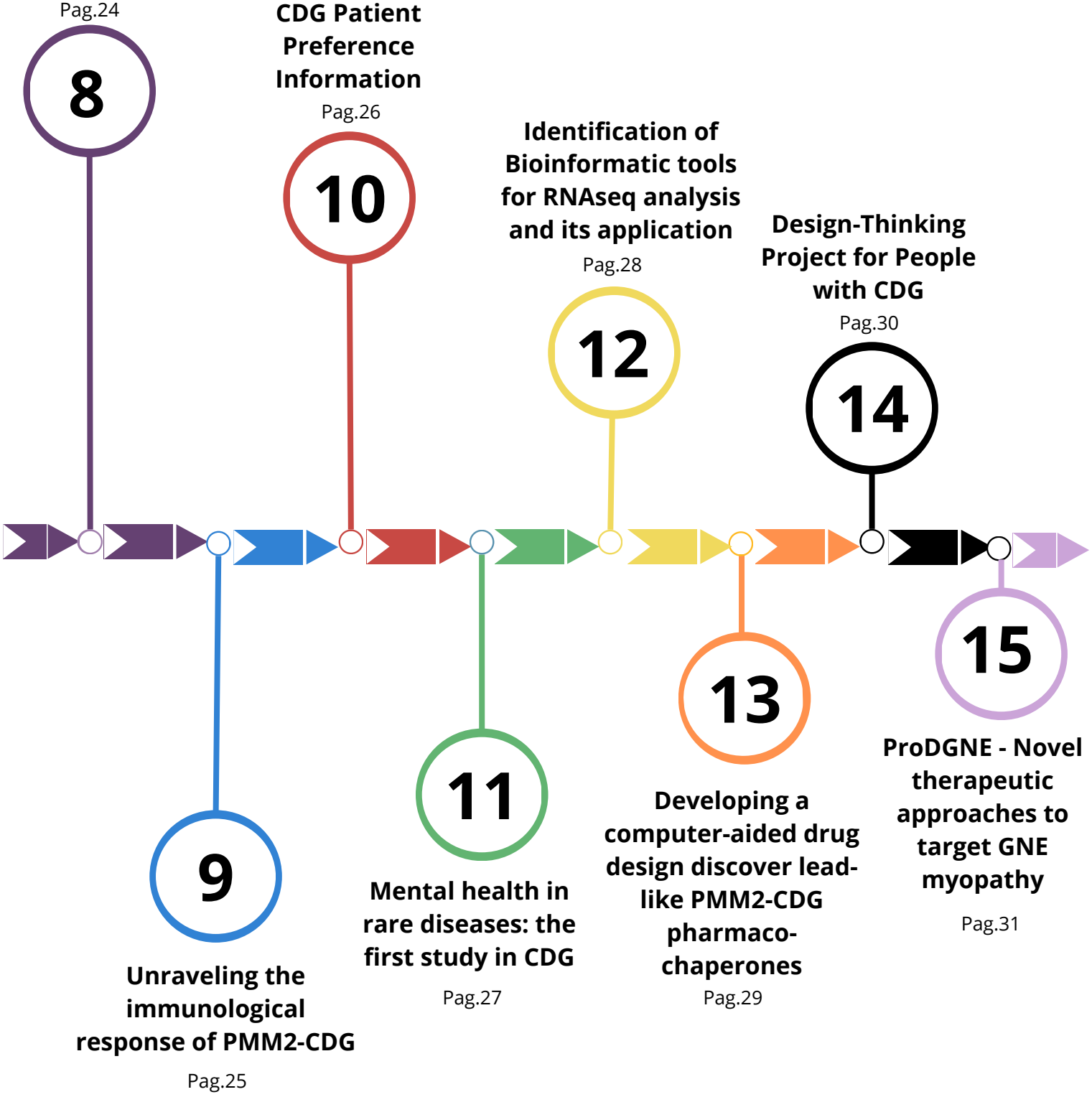
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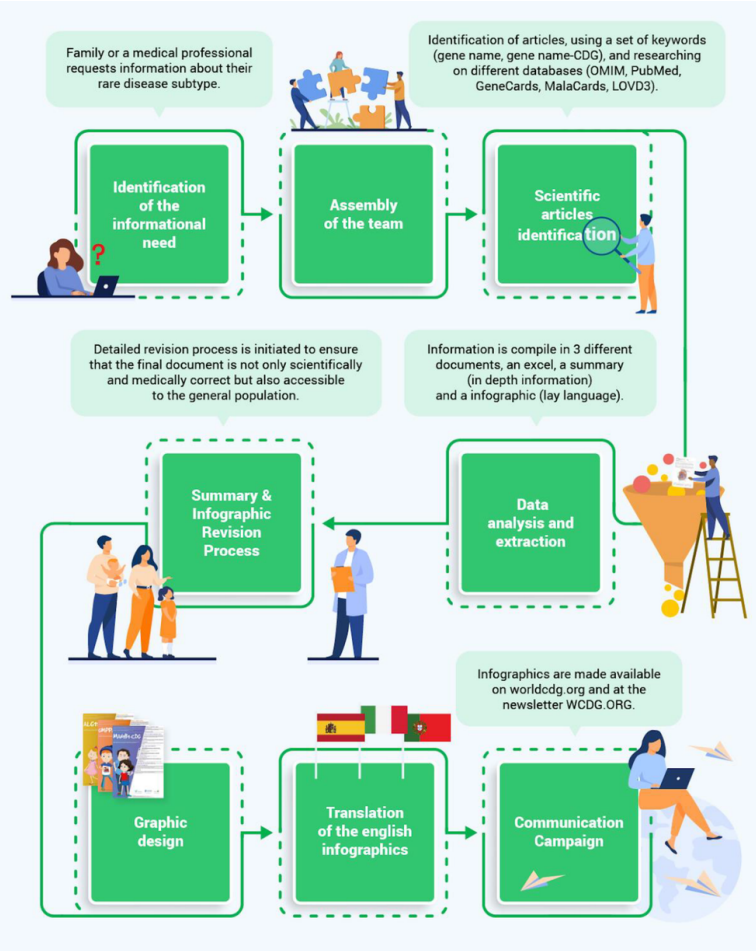
1

A Community-Based Participatory Framework to Co-Develop Patient Education Materials (PEMs) for Rare Diseases: A Model Transferable across Diseases

Scientific Article Available HERE

Around 50% of patients with chronic diseases do not adhere to their care plans, leading to lower health outcomes and increased medical costs. One way to address this issue is by providing Patient Education Materials (PEMs) to individuals living with a disease. PEMs can be especially helpful for people with rare or multisystem diseases, such as CDG, where a clear and simple explanation of complex information is needed. However, there is a lack of standardized approaches in developing PEMs for rare diseases, and community involvement in designing PEMs is crucial for diseases that are underserved.



This paper introduces a community-based participatory framework for co-creating PEMs for CDG, which can be adapted for other diseases. The framework was developed with input from CDG families, and aims to increase health literacy and empower families. The lack of standardized approaches for developing PEMs for rare diseases is highlighted by the limited number of articles found in the literature review, which underlines the importance of the framework presented in this paper. The PEMs created through this framework will be delivered in plain language and multiple languages to close the gap in resources available for CDG patients and their families.

2

CDG: state of the art in 2022

Scientific Article submitted for publication

CDG are characterized by defects in protein and lipid glycosylation, preventing the normal function of protein and lipid remodeling and assembly. These defects can cause, in the majority of cases, multisystem diseases involving the impairment of multiple organs simultaneously, being the central nervous system the most affected. Despite intensive research over the last years and the discovery of new methodologies, diagnosis techniques and biomarkers, targeted therapies' discovery and approval are the most evident unmet needs. We reviewed the state of the art of CDG until 2022, including genetic phenotypes, inheritance patterns, biochemical pathways, clinical features, biomarkers, diseases models, available treatments, and dates of first reports.

In addition, we highlight one of the most critical gaps in CDG - the lack of a clear and universal nomenclature and classification guidelines. This can create dualities in classification among professionals leading to confusion and misguidance and affecting the patients and their families. Therefore, with this review, we aim to i) provide information about clinical features of all CDG discovered so far to be consulted by the CDG community (physicians, researchers, patients, families, advocates, and caregivers), and ii) raise awareness among CDG leaders for the urgent need to set up guidelines to define the CDG already discovered and CDG yet to be identified.

3

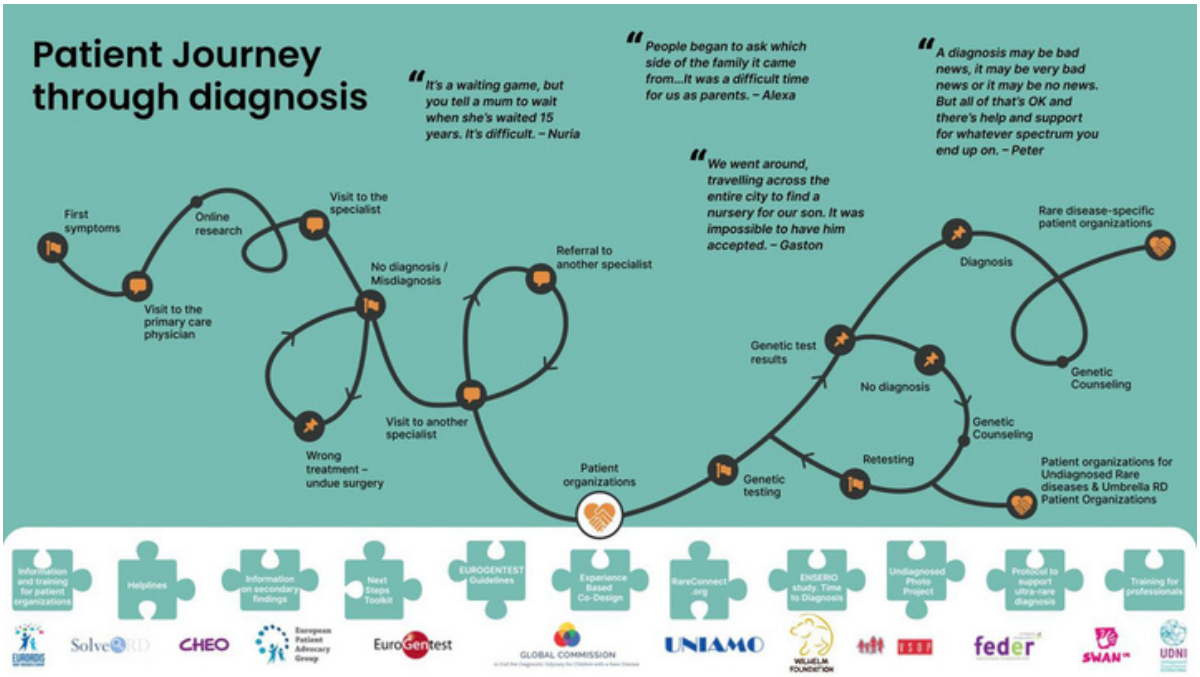
CDG Journey Mapping

CDG diagnosis is challenging due to the large number of potentially affected genes and associated clinical phenotypes, resulting in many cases remaining underdiagnosed and undertreated. Hence, there is a need to identify the current gaps in the patient's journey, from symptoms onset to definitive diagnosis and following that. To address this, the CDG Journey Mapping questionnaire was developed and completed by 160 families and 35 professionals.

From the family group, PMM2-CDG was the most common CDG (n = 89; 55.6 %). Therefore, due to underrepresentation of other CDGs, two groups were formed - PMM2-CDG and Non-PMM2-CDG - with the goal to gain a thorough understanding of their journey.

Some signs and symptoms can be recognized as unique clinical features in one group and not the other, namely strabismus for PMM2-CDG and seizures for the non-PMM2-CDG group. Concerning families' informational needs 65.6% (n=105) of individuals who were diagnosed received the information orally, highlighting the need for more diverse methods of conveying information related to their diagnosis.

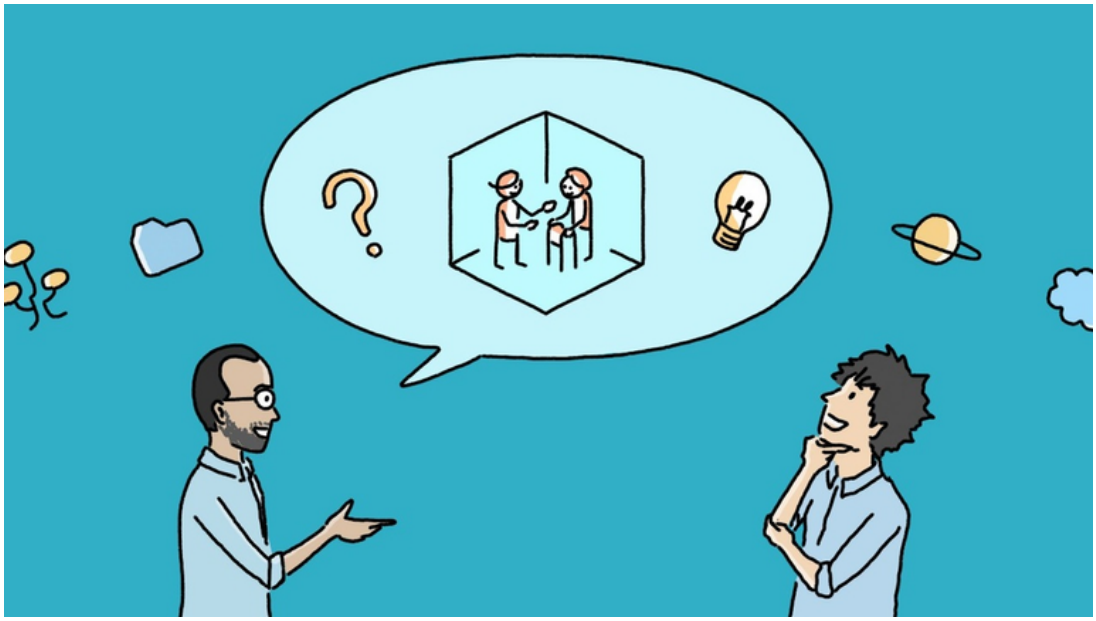
Understanding the CDG patient journey will enable stakeholders to address the needs of the community. CDG professionals and families may contribute towards improving standarts of care and mitigating current needs.



4

The use of Metaphors in CDG

The use of metaphors to describe a particular contextual situation has been proved to reflect the speaker's vision and the way they interact with the world. Therefore, utilizing metaphors to describe the impact that CDG has on the families' lives can help to perceive their reality and to highlight their perspective on dealing with the disease. Potentially, this can help the patient community coping with CDG by promoting motivation and behavioural changes. In the context of the CDG Journey Mapping project, 62 metaphors were provided by both CDG family members/caregivers and healthcare professionals. With the purpose of analyzing these metaphors, who follow the type "CDG is X", a systematic and statistically reliable coding manual was created. Three different tiers were evaluated: presence of motion event, type of motion event (source, path and goal) and locus control. The data indicated that about half of the metaphors were related to the JOURNEY metaphor. Additionally, it was observed that there are particular differences between healthcare professionals and family members in terms of conceptualizing their future with the disease (GOAL) as well as how much control they might have over it (LoC). Due to the small sample and reduced information on the participants' journey, this study is only preliminary, but potentially it can be expandable to studies with bigger samples or from other rare diseases.



5

Resilience in CDG

In recent years, mental health has been recognized as playing a crucial role in patients and family caregivers living with a chronic or rare disease, which is translated into vulnerability, decreased quality of life (QoL) and family functioning. Healthcare professionals have realized that managing symptoms or delaying disease progression is not enough if patients feel emotionally or psychologically distressed. Depression and anxiety significantly impacts patients' QoL and lead to poor health outcomes. Family caregivers are implicated in long-term healthcare management, including in the involvement of social, financial and emotional challenges, resulting in mental health issues.

Mental health conditions can be effectively treated at a relatively low cost, including developing coping strategies for patients and family caregivers with low resiliency. However, studies on mental health in people living with rare diseases, particularly those with moderate-severe neurological impairment, have been largely neglected.

To fill this gap, CDG and Allies developed a questionnaire and used the Brief Resilience Coping Scale as instrument to assess the levels of resilience in CDG patients and family caregivers, identifying those with lower resiliency and creating specific coping strategies. The simplicity of this scale is advantageous as it allows clinicians to identify individuals with low resilience levels in daily practice, favoring early intervention. This work is essential in addressing mental health in rare disease patients and caregivers, contributing to improving their QoL and patients` health outcomes.

6

World CDG Conference as a research and drug development platform

With this work, we aim to share the model that was developed and implemented for the 5th World Conference on CDG as a reliable, highly adaptable patient participation model that fosters community, disseminates understandable information, and serves as a borderless platform for CDG drug research and development.

Six in ten people who registered were patients or family members, with the rest being professionals (clinicians and pharmaceutical representatives). The conference covered nine different topics, including CDG research, drug development and diagnosis, patient and researcher well-being, new technologies in CDG research, patient care and management, key challenges and solutions for improving the CDG community, and the impact of COVID-19 on CDG. Three think tanks were held, and the results included a list of opportunities and solutions for maximizing CDG research and drug development, coping strategies for families, and Clinical Assessment Outcomes.

The 5th World CDG Conference accomplished its primary goal of assisting patients and families in engaging more effectively and actively in their healthcare decisions, through a variety of activities such as sharing patient and family stories with the rest of the community and participating in roundtable discussions, while also fostering an environment in which families feel comfortable and less discouraged to express their concerns and share their opinions with the rest of the community.

7

New Insights into the Oral Microbiome of CDG patients

The oral microbiome is the collection of microorganisms that live in the mouth, and has been found to play a role in a number of rare diseases. When we study the oral microbiome we can gain insights into disease pathogenesis and identify potential targets for prevention and treatment.

Moreover, by studying the oral microbiome, researchers may be able to identify biomarkers that could be used for early detection and diagnosis as well as researchers can better understand the impact of these conditions on overall health and identify strategies for improving quality of life.

The oral microbiome can influence both the local and systemic immune response, and changes in the oral microbiome have been linked to the development and progression of several rare diseases, such as Behçet's disease, Sjögren's syndrome, cystic fibrosis or Sickle cell disease.

Knowing the potential that the oral microbiome has to gain insights into different aspects of research and drug development and that the specific composition of the oral microbiome in CDG is poorly understood, we will compare the overall composition of oral bacteria between CDG and matched controls. This project will be launched during the in-person 6th World Conference on CDG 2023. Stay tuned!

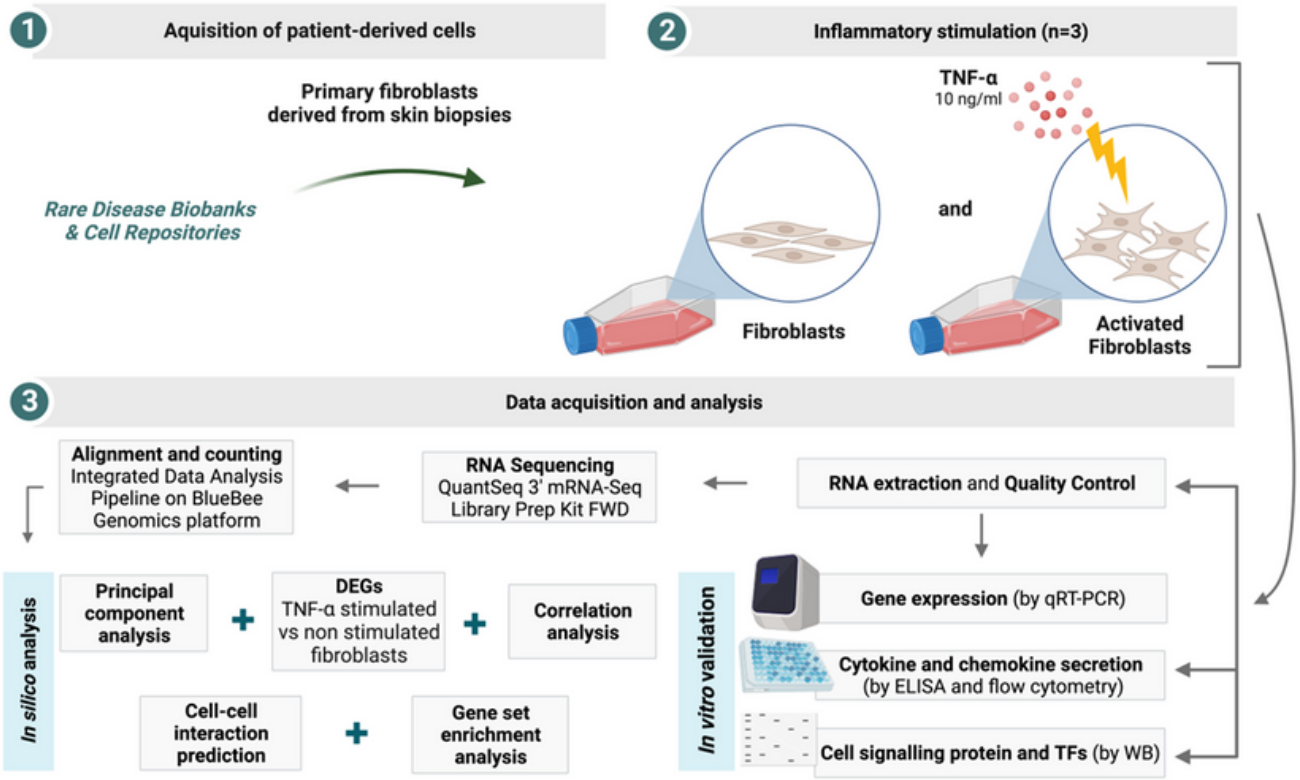
8

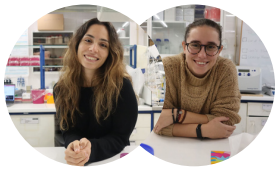
Fibroblasts' immune response: When rare diseases give you lemons, make lemonade

Researching rare diseases is difficult because how hard it is to get adequate and enough samples to study. Biobanks are places where scientists store samples that can be used in research. However, these biobanks often only limited types of samples available, like skin cells. One type of skin cells is the fibroblasts which scientists use to study many cell processes and pathologies, including immune-related diseases.

We did a study to see how fibroblasts respond to inflammation caused by a protein called TNF-α. We found that fibroblasts respond to TNF-α by increasing their metabolic activity and changing the way certain genes are expressed. These changes are related to the immune system and include processes like attracting white blood cells to the site of inflammation and producing certain proteins that are important for to trigger a correct immune response.

By understanding how fibroblasts respond to inflammation, we can use them to study immune-related conditions, including CDG that have immune problems. This study helps the immune research in CDG, mainly when it is difficult to obtain blood samples, by suggesting fibroblasts as an immune model.





9

Unraveling the immunological response of PMM2-CDG

CDG happen because of problems in the way our bodies make certain sugars. Some people with CDG have problems with their immune system, which often results in illness. In PMM2-CDG, recurrent and severe infections account for ~20% of child mortality. We aimed to understand why people with PMM2-CDG have immune system problems.

Therefore, we looked at cells (skin fibroblasts) from people with PMM2-CDG and compared them to cells from healthy people. We exposed the cells to a protein called TNF-α, which is involved in inflammation and immune system responses. We looked at the genes that were turned on (upregulated) or off (downregulated) in response to TNF-α and compared them between the PMM2-CDG and healthy individuals.

We found that the cells from people with PMM2-CDG had problems with some of the cell communication pathways that are activated by TNF-α and direct the immune system response. Specifically, they had lower levels of a protein called IL-6 and a protein called JNK-2. We think that these problems with the immune system pathways might partially explain why people with PMM2-CDG get infections.

To complement this finding we are also analyzing the patients' cell to bacterial and infectious stimuli.

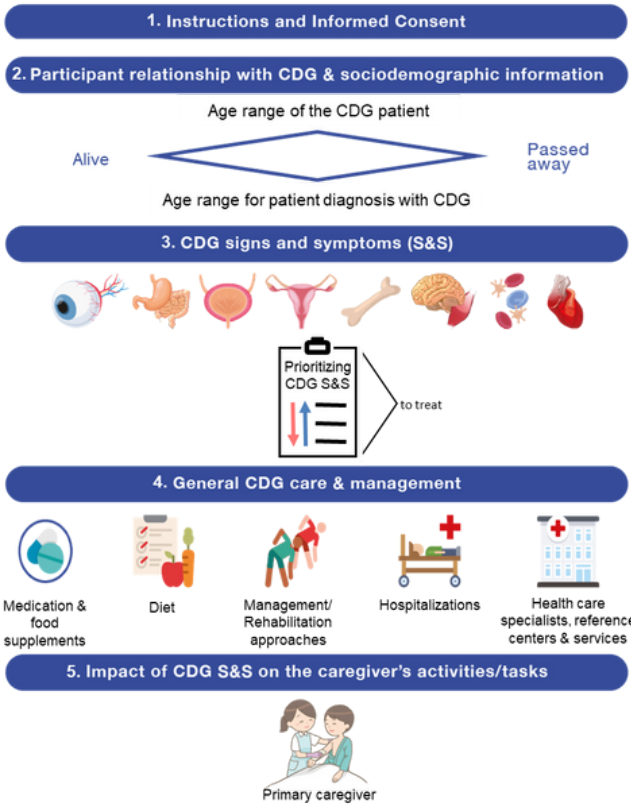
This study shows us that there might be potential ways to help people with PMM2-CDG with their immune issues by targeting these immune system pathways.

10

CDG Patient Preference Information

Last year, the CDG & Allies PPAIN, in collaboration with the World CDG Organization, launched a project aimed at determining the symptoms that families prioritize to be treated in CDG patients. This project took shape as an anonymous survey that was translated into seven different languages: English, Spanish, Portuguese, French, Dutch, German, and Italian.

The survey included glossaries to help families understand clinical jargon, making it easier for them to understand the questions and respond accurately.



This is the first Patient Preference Information study undertaken for CDG and it is crucial to gather information on the priorities and current management of CDG symptoms to support research and therapeutic development. Along with determining which symptoms are a priority to treat, the project will also address the impact of these symptoms on the quality of life of CDG patients and their caregivers, the best management and rehabilitation therapies available, the impact of hospitalizations, and the availability of healthcare specialists and services for CDG.

A small team has begun statistical analysis in order to augment the overall results that may emerge from this project. We'll have to wait until the 6th World Conference on CDG to see how this project turns out.

We continue to believe that a united and strong CDG community can make a difference for CDG children and adults. This project is yet again proof that joint forces of the CDG community can make a difference to those who live with CDG.

11

Mental health in rare diseases: the first study in CDG

Mental health is an important aspect of overall health and well-being, and it is particularly important in the context of rare diseases (RDs) like CDG. The UN Resolution: “Addressing the challenges of persons living with a RD and their families”, urges the implementation of “effective programes to promote mental health and psychosocial support” for persons living with a RD.

Living with a RD can not only be a challenging and isolating experience, but also people can experience anxiety, depression, frustration, and grief. These emotional responses can be triggered by factors such as the uncertainty of the disease's progression, social and financial burden. Keeping a healthy mind can be just as important as addressing the physical symptoms in a balanced approach to dealing with RDs. It is also important for healthcare providers to be aware of the mental health needs of individuals with RDs to provide them appropriate support and resources.

This study aims at exploring the impact on mental health of people living with CDG, and the experiences of health service support through an online survey, followed by a multistakeholder workshop (to be held during the in-person 6th World Conference on CDG). We want to (1) identify resources for coping with the emotional and psychological aspects of CDG; (2) identify best practices of mental health support and services transferable across RDs; (3) develop recommendations for better mental health support and services across countries for CDG and (4) develop tips and a toolkit to improve mental health.

Overall, our current research is aligned with the current EU policy agenda. We wish to contribute to the well-being of people living with CDG.

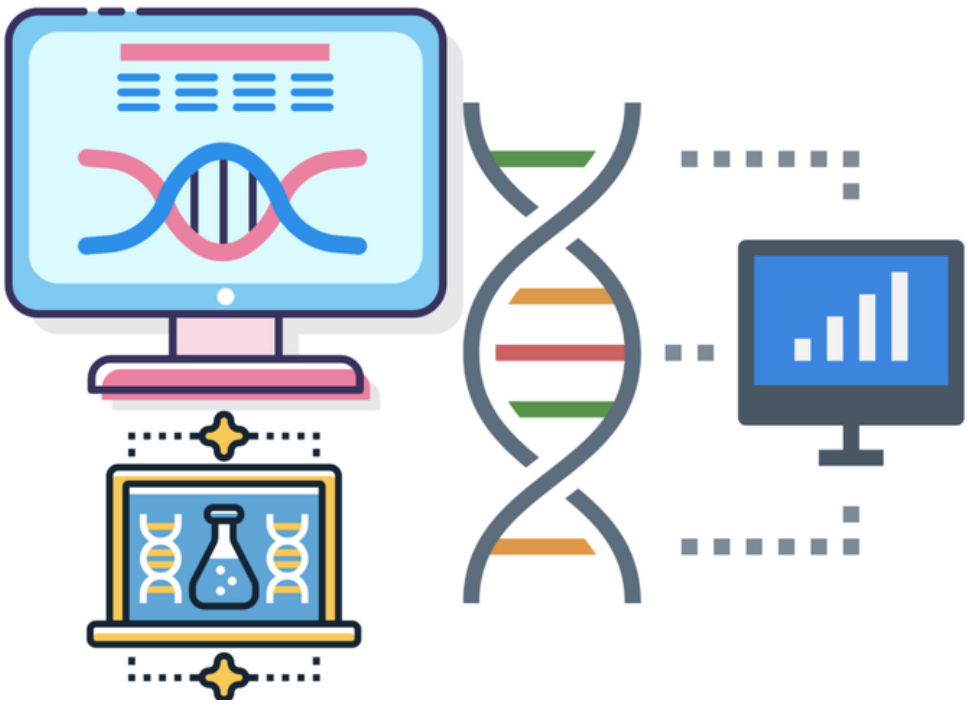
12

Identification of Bioinformatic tools for RNAseq analysis and its application

Bioinformatics is defined as the application of tools of computation and analysis to the capture and interpretation of biological data. Due to the ever increasing amount of data collected and needs in modern research, new bioinformatic tools are being constantly developed. Bioinformatics can be used not only to manage genome sequence data, but also for the analysis of gene variation and expression, analysis and prediction of gene and protein structure and function or to understand gene-disease interactions, for instance.

We seek to identify bioinformatic tools for RNA sequencing data (RNA-seq). This type of data is now commonly obtained due to their vast potential to uncover cellular mechanisms, for disease diagnosis, prognosis and therapeutic selection.

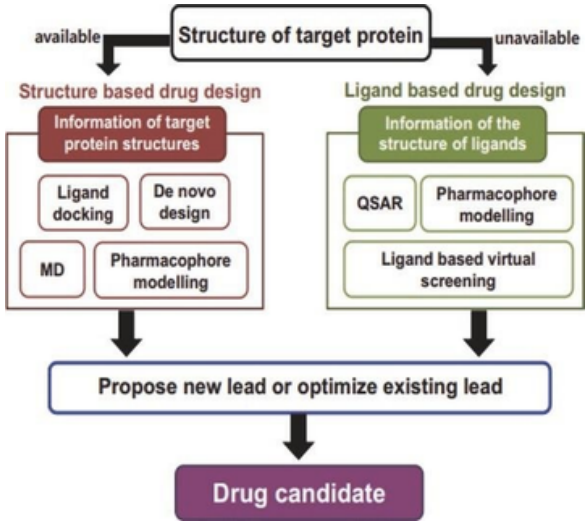
Using the identified tools we aim to analyze their potential for CDG and other rare genetic diseases. Moreover, we plan to perform comparative studies between tools highlighting advantages, disadvantages and limitations of their use. This project is developed under the Bioinformatics Master Program from Universidad Europea de Madrid.



13

Developing a computer-aided drug design discover lead-like PMM2-CDG pharmaco-chaperones

PMM2-CDG is characterized by genetic defects in phosphomannomutase 2 (PMM2), essential for N-glycosylation and for the proper function of several proteins and lipids. It is a multisystem disease with a variety of symptoms and phenotypes. No treatment is available for PMM2-CDG, although previous functional studies of patient-identified pathogenic mutations suggest the possibility of developing therapies with pharmaco-chaperones (PC) to rescue some deficiencies in the abnormal protein.

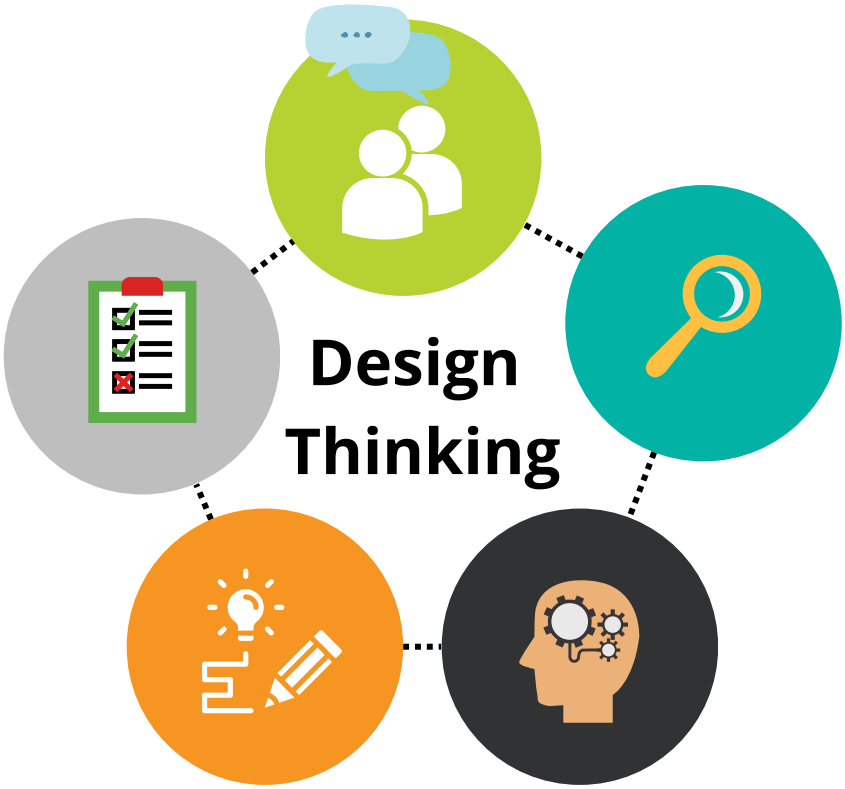


Computer-aided drug design (CADD) methods have emerged as a powerful tool in the development of therapeutically important small molecules. Therefore, we built quantitative structure-activity relationship (QSAR) classification and regression models to predict the interaction of molecules with PMM2. These models served as computational tools to perform a virtual drug screen to search and select molecules with the desired PC profile. Compounds with interesting results were then submitted to docking studies to further explore possible protein-ligand interactions. We found promising hits which we will now use to conduct experiments in patient-derived fibroblast to analyze their effect on the PMM2 activity and their glycosylation. This experimental work will allow us to elaborate on the therapeutic potential of selected hits and will provide proof-of-concept for the applied methodology. It will also define the predictive capabilities of our models for such complex structure-biological activity relationships.

14

Design-Thinking Project for People who have CDG

Many CDG families have been sharing about behavioral problems happening in their relatives living with CDG. Our aim is to study those behavioral issues in individuals with CDG using a patient-centered approach. This approach involves engaging patients, families, and healthcare professionals throughout the research process in a collaborative and interactive manner, with different stages. Initially, we will identify the behavioral issues experienced by people living with CDG through interviews and surveys. Subsequently, we will work on potential solutions to address these issues using design-thinking methodologies, with stakeholders being involved in every phase of the study. The solutions will be prototyped and tested in collaboration with patients, families, and healthcare professionals, with a focus on collecting feedback to refine and improve them.
As always, we want to give back to the community by sharing our findings with them. To achieve this, we plan to present our work to the families of those with CDG, attend scientific conferences, and publish a scientific article, among other possibilities.

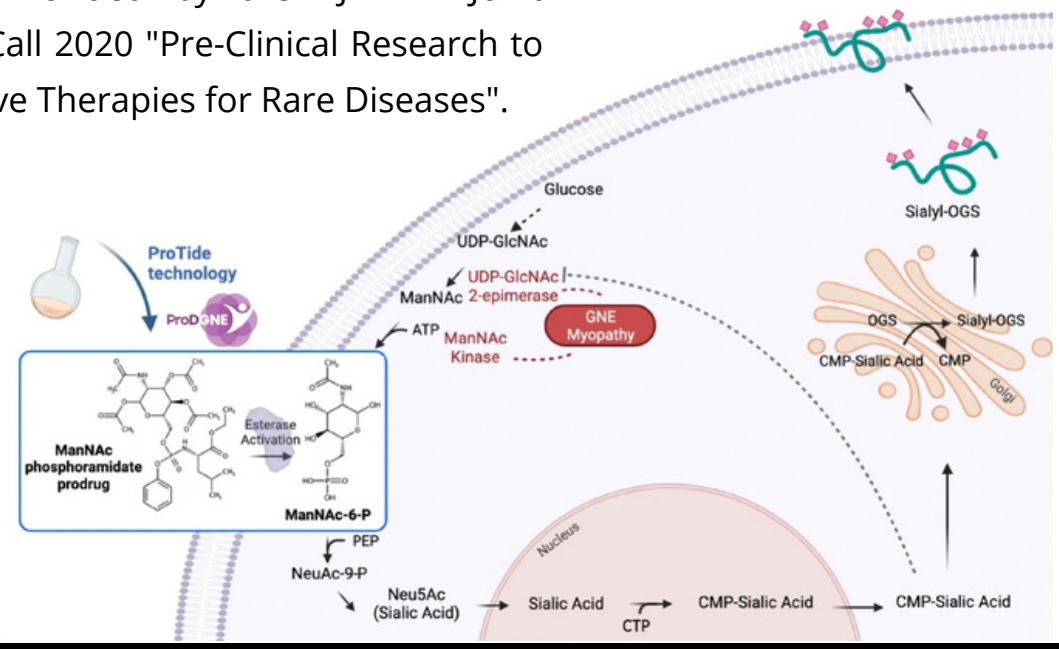


15

ProDGNE - Novel therapeutic approaches to target GNE myopathy

ProDGNE is a transnational pre-clinical research project which aims to develop an innovative therapeutic compound to treat GNE Myopathy (GNEM, also called GNE-CDG), an ultra-rare muscle disease affecting young adults. It represent and unique joint collaboration among patients, European and Canadian GNEM experts. It combines patient experience, synergist expertise in glycobiology, biochemistry, medicinal chemistry, clinical pharmacology, -omics, biomarker discovery, pharmaceutical technology and clinical expertise to develop novel attractive compounds to treat GNEM and bring them one step closer to patients.
The project fosters early stage development of an innovative class of drugs, called prodrugs, and improved delivery strategies to treat defects derived from GNE mutations. The prodrug is expected to become an active therapy when processed within cells, restoring glycosylation in patient cells, be more stable and have better bioavailability than drugs already tested clinically. When reaching a clinical phase, the benefits for patients include reduced toxicity and better absorption, making ProDGNE a potential effective and safer oral medicine. In addition, the identification of novel biomarkers will assist in the assessment of efficacy of this therapy in clinical trials.
The consortium works closely with clinical and patient partners and follows IRDiRC Guidelines to fill the knowledge gaps in GNEM, establish a target product profile addressing unmet medical needs, avoid delays in development, and expedite timeline of regulatory approval.

The project is funded by the EJP RD Joint Transnational Call 2020 "Pre-Clinical Research to Develop Effective Therapies for Rare Diseases".



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